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## Evaluation of total quality management in library of Islamic Azad University in District 13

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**Abstract:** The main objective of this study is to evaluate the level of total quality management in libraries of Islamic Azad University at district 13 in managers' point of view in 2011. The research method was descriptive - survey and data collection tool was a questionnaire that researcher wrote with six components that included 42 items. After confirmation of their validity, reliability of the questionnaire was obtained through Cronbach's alpha for all the components above 0.75. The study population of 22 individuals was library managers of Islamic Azad University at district 13 and results obtained based on data from the questionnaire. This analysis has been done helping descriptive statistics using SPSS software and the results showed that all components of total quality management (commitment, customer orientation, training, realism, collaboration and continuous improvement) are quite desirable and results indicate that TQM has distance to achieve the desired condition.

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**Keywords:** Total Quality Management, Islamic Azad University District 13

### 1. Introduction

One of the largest and most important concerns of various organizations is improving the quality of products and services and providing the customer demands of these organizations. Academic libraries are one of the centers that play an important role in promoting and improving quality level in different areas. Developed countries owe their development to the development of libraries and information centers. Every society invests and pays attention to improve quality, has better and more fruitful future. Organizations intend to satisfy their customers with minimal costs and effort regard to customer satisfaction in order to provide desire and high-quality services. A smart action that does calm and steady in order to provide organization's goals and satisfy customers called total quality management.

Considering educational and cultural system in every society is important and improving its quality move society forward rapid development in all aspects. Therefore, it is necessary to develop the education and culture system, and its quality in every society. Besides social growth and development of nations, the place of libraries has also changed that these changes required revision the way to manage offices and organizations and applying scientific methods to manage them. Scientists believe that the goals of libraries have direct relation to the community's goals. In today's societies a broad and deep changes have developed in different areas and universities are not exempt from this. The libraries and information centers in universities have been undergoing many changes. Given the current circumstances, satisfaction of users, is a public primary and universal acceptance principle. The

satisfaction of users considered as one of the crucial indicators in improvement of service quality in academic libraries. Total quality is a principle which is then converted to utility. It means that at first, the idea of total quality should form in the minds of employees and after while mental concepts convert to actions and use as a tool to increase quality in organizations (Khadivi, 2002). Today, providing information services in college library for users has been developed and this development and provided information are one of measure of scientific progress so that in analysis of progress and development standards, development of academic library is considered as one of the major development indexes.

Baroofi (1996) believes that managing libraries often keep pace with modern principles and management theories have had a profound impact on library management. Therefore, a new approach of total quality management is used in managing libraries and information centers in order to improve the quality of provided services, users and employees' satisfaction, effective and efficient management, to develop libraries and finally to achieve the desired goals. In the current era of technological revolution, academic libraries are in charge of responding to needs of consumer groups, such as professors, staff, students, scholars, etc.

Quality of the library using common patterns in the field of quality management has not long history in Iran. To date, few studies have focused on this issue which will be mentioned later. Khorshidi (2000) studied total quality management in higher education institutions in Iran that the goal of education is to provide a framework for performance indicators of higher education system. The results

indicate that the lack of a coherent system of continuous evaluation is an important issue in education institutions. Tabande (2004) studied on comparing current and desire situation of libraries at the University of Shiraz in applying total quality management (TQM) from managers and experts' point of view. In this study, the reasons for this difference in attitude were identified that was lack of understanding of managers and experts about total quality management and ignorance about the philosophy of quality management. Noori (2005) studied on readiness of academic libraries of medical sciences in Tehran to implement Total Quality Management (TQM). The results of this study indicate that the average of total scores for all 9 concepts mentioned in University of Medical Sciences, Tehran University and Shahid Beheshti University was 7.5, 7.47 and 7.15 of the maximum 10 points respectively. Moreover, the concepts of "sense of belonging", "relationship status", "organizational culture", "considering education" and "considering continues improvement" were evaluated as appropriate and "leadership", "employees participation" and "considering customers were evaluated as moderate and finally "remuneration and promotion status" were evaluated as weak according to the scores obtained. Noori, according to this study concluded that TQM in libraries fundamental changes should be formed at first in the reward and promotion system and then in the categories of "considering customer", "employee participation" and "leadership". Akhshik (2007) studied on information technology management in libraries of Shahid Chamran University of Ahvaz and Jondi Shapour University according to EFQM<sup>1</sup> Excellence Model. The total score of these libraries was calculated 403 of 1000. The results indicate that overall, the quality of Information Technology Management at these universities is below average level. According to 9 criteria of the model, highest scores were related to customer results and the lowest scores were related to employees and society results. Barrionuevo, M. and Perez (2003) with the belief that university libraries in the 21st century has challenge of achieving excellence and based on the EFQM model and with the cooperation of a group of librarians of university libraries in Spain, wrote an epistle in order to evaluate services of academic libraries in the southern Spain. To prepare it, they evaluate different approaches to assessment and after implementing EFQM model in order to evaluate services of these libraries due to the comprehensive nature of this model, after applying changes on it, wrote an epistle in order to make it appropriate for evaluation of

library services. Melo and Sampaio (2003) studied some projects in a research called "Evaluation of performance quality of libraries" that ten years before that, they evaluated performance quality of services in academic libraries in Portugal and Brazil. They know evaluation of service quality of libraries as a concept that today has been accepted by all librarians and is a method to evaluate needs and user satisfaction and better performance of libraries. The main objective of this study is to evaluate the level of TQM in library of Islamic Azad Universities in district 13 that intend to develop libraries effectively by studying current situation of available libraries and analyzing their results. According to infrastructure scientific theories, variety of sciences have grown and flourished and scientific theories seem to be base of change and transformation in various aspects of human life. According to theories importance and development of different sciences in the shadow of emerging these theories, theoretical basics will be mentioned transiently. Quality is doing works correctly and continuously in all departments of an organization that means a factor that balances needs of customers and employees and financial objectives of the organization and also doing works correctly and continuously means providing needs of customers (Iranzadeh, 2001, 81). Quality is expressed or implied needs of customers (Iranzadeh, 2001, 255). Total quality management means to improve quality with low cost (Khadivi, 2002, 339). From Stephen Robbins' point of view, a comprehensive quality management has following features:

- 1- Too much considering to customers
- 2- Considering to continues improvement
- 3- Quality improvement in all tasks organization do
- 4- Accurate measurement or calculation
- 5- Giving authorities to employees

Akhshik (2007) studied on information technology management in libraries of Shahid Chamran University of Ahvaz and Jondi Shapour Medical Science University according to Excellence Model (EFQM). The total score of these libraries was calculated 403 of 1000. The results indicate that overall, the quality of Information Technology Management at these universities is below average level. According to 9 criteria of the model, highest scores were related to customer results and the lowest scores were related to employees and society results.

## 2. Materials and Methods

According to the research objectives, this study is a descriptive survey and researcher objective of this study is objective and real description of a situation. Statistical population of this study included all managers of libraries of Islamic Azad University in distinct 13 that were 22 people. All managers of

<sup>1</sup> European Foundation for Quality Management

libraries of Islamic Azad University in distinct 13 were chosen as sample.

The main tool for researcher in data collection is the questionnaire written by the researcher that is associated with TQM and its indicators and due to researcher literature and its parameter is related to commitment description, customer orientation, collaboration and cooperation, realistic, education and continuous improvement. Inferential statistics were used to analyze the findings. Data of received questionnaires were concluded and numbers and statistics were displayed at tables that are available in detail along with necessary descriptions in other section of the study.

### 3. Research findings

In this part of the statistical analysis, first, the distribution of statistical samples in terms of demographic variables such as education, gender, field of study and experience will be studied.

Table 1: Frequency distribution of respondents in term of managers' gender

| Gender          | Frequency | Frequency percent |
|-----------------|-----------|-------------------|
| Male managers   | 8         | 36.4              |
| Female managers | 14        | 63.6              |
| total           | 22        | 100               |

Table 1 shows that 63.6% of respondents in the statistical sample of this study are women managers with the highest frequency and others (36.4%) are male managers.

Table 2: Frequency distribution of respondents in term of field of study

| Field of study | Frequency | Frequency percent |
|----------------|-----------|-------------------|
| Librarianship  | 17        | 77.3              |
| other          | 5         | 22.7              |
| total          | 22        | 100               |

Table 2 shows that 63.6% of respondents in the statistical sample of this study with the highest frequency have librarianship degree and others (22.7%) are in irrelevant fields.

Table 3: Distribution of work history of sample managers in the study

|                    |       |
|--------------------|-------|
| Number             | 22    |
| mean               | 7.93  |
| Standard deviation | 3.23  |
| Variance           | 10.46 |
| Curvature          | 1.04  |
| Elongation         | 1.53  |
| Minimum            | 2     |
| Maximum            | 19    |

Based on data from Table 3, it is observed that mean is 7.93, standard deviation, 3.23, minimum, 2, maximum, 19, Curvature, SK=1.04 and Elongation is KU=1.53 that demonstrates that most individuals have a history of more than 10 years.

Table 4: Frequency distribution of respondents in term of education

| Field of study      | Frequency | Frequency percent |
|---------------------|-----------|-------------------|
| Assistant education | 4         | 18.2              |
| Bachelor            | 16        | 72.7              |
| Master              | 2         | 9.1               |

Table 4 shows that 72.7% of respondents in the statistical sample of this study with the highest frequency have bachelor degree and the lowest frequency (9.1%) is related to master. The diagram 4-2 is also confirmed it.

Now, in order to be informed of average performance of managers who have librarianship degree and distribution of their scores in each of the variables in this study, we tried to provide descriptive indicators of each of the variables in the table 5.

Table 5: Descriptive indicators of variables in term of gender and totally

| Indicators variables     |                       | Female managers    |         | Male managers      |         | Other field managers |         | Librarianship managers |         | total              |         |
|--------------------------|-----------------------|--------------------|---------|--------------------|---------|----------------------|---------|------------------------|---------|--------------------|---------|
|                          |                       | Standard deviation | average | Standard deviation | average | Standard deviation   | average | Standard deviation     | average | Standard deviation | average |
| Total quality management | commitment            | 46.29              | 6.71    | 48.38              | 7.11    | 47.21                | 7.22    | 50.55                  | 3.68    | 47.55              | 6.99    |
|                          | Customer orientation  | 38.00              | 10.78   | 46.51              | 11.40   | 42.66                | 11.50   | 45.10                  | 14.11   | 43.03              | 11.84   |
|                          | education             | 36.00              | 10.75   | 39.55              | 13.04   | 37.07                | 12.14   | 45.10                  | 11.03   | 16.38              | 12.24   |
|                          | realism               | 38.71              | 8.56    | 39.16              | 8.48    | 38.26                | 8.56    | 43.66                  | 6.28    | 39.00              | 8.46    |
|                          | participation         | 46.29              | 12.34   | 51.95              | 13.32   | 49.98                | 12.87   | 49.73                  | 15.60   | 49.94              | 13.18   |
|                          | Continues improvement | 34.58              | 10.81   | 33.14              | 13.61   | 32.98                | 12.21   | 37.45                  | 15.20   | 33.63              | 12.67   |
| Total quality management |                       | 246.73             | 41.30   | 273.68             | 50.42   | 258.98               | 47.39   | 284.89                 | 51.44   | 263                | 48.49   |

#### 4. Discussion

The results of data analysis show the average of scores by individuals who tested given to indicators considering by researcher to measure commitment component indicate that this component with weighing average 3.53 is partly desirable and findings indicate that there is a gap to reach the desired level. In explaining these findings, it can be said that library managers are loyal to their own organization and are satisfy to be in such organization and the reason is that employees are not intended to absenteeism. The results indicate that employees spend their extra time in libraries rarely.

The results of data analysis show the average of scores by individuals who tested given to indicators considering by researcher to measure customer orientation component indicate that this component with weighing average 2.84 is partly desirable and findings indicate that there is a gap to reach the desired level.

The results of data analysis show the average of scores by individuals who tested given to indicators considering by researcher to measure participation component indicate that this component with weighing average 3.23 is partly desirable and findings indicate that there is a gap to reach the desired level. In explaining these findings, it can be said that library managers in providing scientific and research journals in the library, encouraging and providing continuing education and training staff have done fairly good job and now there is smaller gap to reach desirable level.

The results of data analysis show the average of scores by individuals who tested given to indicators considering by researcher to measure realism component indicate that this component with weighing average 3.39 is partly desirable and findings indicate that there is a smaller gap to reach the desired level.

In explaining these findings, it can be said that managers are in desirable level in indicators of extracting statistics and information of accurate number of staff, books, journals and active members of libraries, extracting accurate percent of books and customers and extracting accurate statistics and information of equipments, technology and financial and construction resources available in the libraries. Decision making indicators also have been extracted based on accurate statistics and information and serious attempts have done to solve educational and financial problems.

The results of data analysis show the average of scores by individuals who tested given to indicators considering by researcher to measure continues improvement component indicate that this component with weighing average 2.90 is partly desirable and findings indicate that there is a gap to reach the

desired level. In explaining these findings, it can be said that managers have done fairly good job in all indicators of this component and there is gap to reach desirable level.

Importance of realism in TQM in studies have done by Khorshidi (2000), Noori (2005), Akhshik (2007) were confirmed.

The results of data analysis show the average of scores by individuals who tested given to indicators considering by researcher to total quality management components with weighing average 2.95 is partly desirable. The obtained average indicated that there is distance for total quality management components to reach desirable level. Therefore, it is necessary to library managers to attempt to reach the desired level in some components that their averages are in lower level that other components such as education, customer orientation and continuous improvement. Similarly, they should try to reach to desired level in other components of the total quality management using systematic and logical planning and try to stabilize them in desired level.

Tabande (1383) studied on comparing current and desire situation of libraries at the University of Shiraz in applying total quality management (TQM) from managers and experts' point of view and concluded that managers have better attitude to current situation of libraries in applying quality management and there is significant difference between managers and experts. In this study, the reasons for this difference in attitude, uninformed managers and experts of total quality management and their lack of understanding of the philosophy of quality management have been identified.

Noori (2005) studied on readiness of academic libraries of medical sciences in Tehran to implement Total Quality Management (TQM). The results of this study indicate that the average of total scores for all 9concepts mentioned in University of Medical Sciences, Tehran University and Shahid Beheshti University was 7.5, 7.47 and 7.15 of the maximum 10 points respectively. Moreover, the concepts of "sense of belonging", "relationship status", "organizational culture", "considering education" and "considering continues improvement" were evaluated as appropriate and "leadership", "employees participation" and "considering customers were evaluated as moderate and finally " remuneration and promotion status" were evaluated as weak according to the scores obtained. Noori, according to this study concluded that TQM in libraries fundamental changes should be formed at first in the reward and promotion system and then in the categories of "considering customer", "employee participation" and "leadership".

Akhshik (2007) studied on information technology management in libraries of Shahid

Chamran University of Ahvaz and Jondi Shapour University according to EFQM Excellence Model. The total score of these libraries was calculated 403 of 1000. The results indicate that overall, the quality of Information Technology Management at these universities is below average level. According to all criteria of the model, highest scores were related to customer results and the lowest scores were related to employees and society results.

Also, according to Lib Koval approach, Mir Ghafoori and Shafiei Roodposhti (2007) were measured level of service quality of Yazd University libraries including central library and educational institutions libraries in different dimensions of quality. The results showed that the quality of the library services is in desired level and there is a gap between users' expectations and understanding and this gap is deeper in dimensions of access to information and personal control.

Melo and Sampaio (2003) studied some projects in a research called "Evaluation of performance quality of libraries" that ten years before that, they evaluated performance quality of services in academic libraries in Portugal and Brazil. They know evaluation of service quality of libraries as a concept that today has been accepted by all librarians and is a method to evaluate needs and user satisfaction and better performance of libraries.

In one of the studies done, Serya and Ard (2006) evaluated library services (borrowing, reference services information services using computer) of Mahasarakham University in Thailand from users (bachelor students, faculty and library staff) point of view. The results showed that users believe that librarians responding and reliability of provided services are so important. Also, there is a relative difference between the available services and services that users expect. In other words, library should try to reach desired situation for users. Library of Castle Green (2005) in London has evaluated institution situation, services provided to users, space and building and budget and finally has compared them to standards of academic libraries. The results indicate that these libraries are standard in all areas with the exception of facilities.

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**Effect on Electronic City Electronic municipality (Case Study Zone 2 Tabriz)**Soltani Alireza<sup>1</sup>, Zeynali Azim Ali<sup>2</sup>, Zeynali Azim Mohammad<sup>3</sup>, Shahamfar Hadi<sup>4</sup>

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**Abstract:** This study examines the effect of electronic city on electronic municipality in second zone of Tabriz municipality. Main question is that whether creating electronic city impact on creating electronic municipality? This research method is descriptive and applied. Statistical population includes all employees of the Municipality of second zone of Tabriz that has been obtained through Morgan table and Likert spectrum technique is used to collect data. This study intends to provide a theoretical and intellectual infrastructure and transparent communication between the electronic city and electronic municipality in order to justify scientific reasons of this and creating electronic city in the developing world. According to studies and utilization of the results of other studies in this area was found that electronic city play an important role in creating electronic municipality and electronic city and electronic municipality are closely related to each other and every one requires the other.

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**Keywords:** Electronics City, Electronic Municipality, Electronic government, Electronic citizen, Tabriz City

**1. Introduction**

In current societies, some factors such as increasing poverty and social and economic injustice, population growth, increasing urbanization, have been made citizens and city manager facing many problems for city management. In addition, information and communication technology has made many changes in a wide range of societies today. It is more evident in cities and governments levels and includes electronic city, electronic government, electronic municipality, electronic citizen and electronic services and creating an electronic city can solve most of urban problems (Hadili and Zeynali Azim, 1389, p. 33-52). One of concepts has been studied widespread in advanced societies in recent decades and has been implemented successfully in some countries is electronic city and electronic municipality. In an electronic city not only citizens use virtual city, ministries and electronic organizations but also they do their routines such as daily purchases through network. It should be noticed that the electronic city is a real city has various citizens, offices, organizations and etc. In an electronic city that just certain communications and social interactions and provide a major part of their daily needs is done through the Internet. Most features of this informing network can be searched in the urban transport network and informing about disaster. When disaster occurs resorting to this system can manage occurred disaster as soon as possible. Electronics City is an undeniable need. Global approach was to be an informatics society and

today a more advanced society is which can generate and exchange information faster and have more features (Zeynali Azim et al., 2012).

**2. Electronic government**

Before the identification of electronic city, we should be familiar with the concept of electronic government because the electronic city is original base of forming electronic government. Information and communication technology and especially the Internet is the best tool to achieve electronic government (Magro, 2012, p. 148-161). Therefore, electronic government is a multidisciplinary and interdisciplinary concept that deals concepts of public administration, political science, communication and media studies, law, public policy, engineering and computer science, etc. There aren't correct studies and understanding of what is electronic government and the way it impacts on structure and managing of public institutions, information and public service delivery, relationships between individuals and organizations and those govern people (Gregory G. Curtin, 2007, p.1-14). Electronic government means government initiatives to help local officials in order to provide online and accessible services via the Internet and email to the citizens. (Abuali, et. al., 2010, p. 169-175) Information and communication technology is the only tool to achieve the goal. The aim is to provide better service to all stakeholders in the delivery of public services. Electronic city is a process of structural reform based on the polls as a strategic resource in all areas of government activity (Depest and Robben, 2003, p. 4-5). Electronic



government is an opportunity for better relations between the government and the public in on hand and between private organizations and institutions on the other hand. There are many advantages in implementing electronic government such as quick and easy sharing of data and information, citizens quick and direct access to the required information, saving energy, time, resources and costs, increase efficiency and productivity, positive environmental impacts, improving accountability to citizens, increase government transparency and reduce corruption activities, simplify the process and reduce the bureaucracy of government (Gupta & Jana, 2003, p. 365-387).

### 3-The concept of electronic city

Internet is passing of industrial society that urbanization was expanding on it day by day. Moreover, the urban population was rising increasingly. Parallel to these developments in human society, information society emerged that emergence context of it was began by electronic city (Kastelz, 1382). Today, it must be acknowledged that the world is changing dramatically. In the third millennium, information technology is as the main focus of change and development in the world (Behrouzian Nejad, 2011, p. 92-95). Electronic city development is a highly regarded subject around the world to expand opportunities for people living, working and fun. Creating electronic city has economic, social, cultural, and political influence on the city (Zangabadi et al, 2010). Electronic City is a city that has telecommunications and controls by department of and information and communication technologies to exchange information (Cohen et al., 2001). In an electronic city not only citizens use virtual city, ministries and electronic organizations but also they do their routines such as daily purchases through network. It should be noticed that the electronic city is a real city has various citizens, offices, organizations and etc. In an electronic city that just certain communications and social interactions and provide a major part of their daily needs is done through the Internet. Most features of this informing network can be searched in the urban transport network and informing about disaster. When disaster occurs resorting to this system can manage occurred disaster as soon as possible (Sarafrazi and Memarzadeh, 1386, p. 7). In fact, in an electronic city, citizens access the all update services of offices, organizations and inner city places and the services they need to perform their tasks directly, seven-twenty four, stable, secure, reliable and Confidential (Jalali, 1384). Thanks to electronic city, participation in local government, improvement of local service increase operational performance and official would be easier (Building an Information and

Technology Vision for Toronto, 2002, 2). Therefore, establishing electronic city causes reducing "population movement" in the real city. Separating city in two space (real space and virtual space), is kind of urban population movement management that tries to provide more peaceful and less expensive space and have urban and psychological security for citizens (Safari, Kanani Ahmad Begloo, 1386).

### 3-1- electronic city model

An electronic city has composed of different parts and components which have four parts.

- Electronic life
- Electronic organizations
- Electronic government
- Electronic infrastructure (Asgharizadeh et al., 2008)

1-Electronic life: lack of spending time for repetitive and useless activities, cost saving and pay attention to other issues such as family, culture, recreation and leisure times (Jalali, 1382)

2-Electronic organization: electronic organizations in the electronic city should interact with each other and with citizens and should also be compatible with the latest technology. Organizations that do not match themselves with the change, for doing continental business will not succeed. This field can include the following: (Asghiarzadeh et al, 2008) E-commerce, electronic procurement enterprise resource planning systems and customer relationship management.

3-Electronic government: The term electronic government was raised in political literature of U.S. for the first time in 1997 so that re-engineering of government does through information technology (Chen, 2003). Electronic government makes new opportunities to direct and easy access to government and public services provided to citizens, which is interpreted as a kind of direct democracy. These services include voting in an election or referendum, local government services to develop schools and non-profit organizations that all of them are practical decentralization tools of public services from high level to local levels (Howard, 2001, 8).

4-electronic infrastructure: electronic infrastructure is a platform for developing information technology including laws and regulations, human resources, culture and social conditions, and finally infrastructures of information and communication technology.

### 3-2- Urban spaces in relation to electronic city

Urban space is one of the elements of Spatial creating of city and forms and changes along with changing the history of nations during different eras (Tavasoli, 1387). In recent decades, the widespread use of information and communication technologies on urban interactions has led to the formation of

cyber space. Cyber means the boundary between human and machine, nature and culture, etc (Bel, 1383). ICT plays a major role in forming today's urban space and as a accelerate factor for the changes of economic, social and cultural life. We live in an era that rapid changes in information, knowledge and network society occurs. In the last twenty years, the technology has made remarkable progress and tools development and new applications are significant. On the other hand, city as a system has three subsystems include physical, functional and cognitive. Today, a new system called virtual space is also added that didn't change reality of city system but people's subjective perception of the city has changed in the system (Fistola, 2001, 359-363). Virtual urban space can be classified as follows.

- 1- Open, semi-closed and closed spaces
- 2- Public, semi-private and private spaces
- 3- Open, semi-closed and closed spaces
- 4- Reciprocity of filled and empty spaces (open and closed - mass and space) gives the physical nature to the system. What used as open and close or space and mass in city is equal to accessible inaccessible space on cybernetic space.
- 5- Public, semi-private and private spaces
- 6- Public and private spaces are characterized by space boundaries and realms based on property boundaries and physical barriers. But in cyberspace, the boundaries and realms are related to activity of each space and how to access it. For example, some of the sites are private and need special code to enter, some are semi-public need the invitation and code to enter and some are public and available to the public (Rabiee and Bemanian, 1388).

### 3-3- The necessity of creating electronic city in Tabriz

There are different factors related to creating electronic city in Tabriz that these are all due to technology advances and information and communication technologies and getting relations more in societies and all point to the necessary of electronic city in Tabriz and are:

- The close relationship between sustainable development and electronic city. Aspects of stable development have been created through the creation of electronic city such as reducing environment pollution, reducing traffic, increasing productivity and employment, improving urban stability, increasing citizen participation and etc that are features of electronic city (Hadili and Zeynali Azim, 1389, p. 33-55)

- Increasing cities population, electronic city is be able to create new and update specialties that can serve people long-distance and it is important for creating new jobs.
- Not creating mental sense of retardation among the people of the world
- Reduction of administrative procedures and bureaucracy that hurt people and the employees of its structural problems.
- Providing one-stop services to citizens and expedite service to the people
- Contribute to stable tourism development by proper advertising in virtual space and introduce attractions such as cultural, historical and natural attractions in our country that due to the potential that we have in this area, we can improve our country's economy by attracting tourists.
- Easy and public access to the necessary information and the appropriate distribution of urban services and the establishment of a fair and equal opportunity for the public.
- Aligning the investments with city needs and updating the traditional and efficient structures.
- Organizations and agencies better communication in order to reinforce integrated urban management.

Increasing population, vehicle and domestic migration, metropolises are having a lot of problems. Thus, reducing the time and space costs of everyday living helps to improving the quality of people life and reduces urban accidents and inter-city travels. Therefore, it is not in vain if we say electronic city approach is an opportunity to finish many urbanization concerns (Ketabchi, 1390, p.67-73)

### 3-4-Electronic citizen

A citizen is an active member of the community, with rights and duties granted by the society (Biasiotti and Nannucci, 269-280). Increasingly, citizens expect governments for quick access to public services and on 24 hours, 7 days a week, easily and reliable. The ability to access the service can be from home, work or any other location. They opposed any restrictions on how to access services, e.g. computer, TV, website, mobile phone or wireless devices. Electronic citizens can do their jobs through websites and emails instead of going to the cities to do their jobs, attend meetings and access to public information and formal and official documents (Reffat, 2006, 1-13). Electronic Citizen is a beautiful phrase, but where the minimum infrastructure issues such as mindset preparedness and culture is respected. In our country, some activities have been done in order to electronic societies and related issues that it shows the authorities have understood the importance of the issue. Police centers + 10 kinds of

credit cards, new banking services, Bon Hekmat cards, Bon cards, books, etc are examples. Supply and distribution of fuel cards are also a great move to make citizens familiar with electronic services (Karbasi, 1386). Below are some definitions of electronic citizen.

Electronic Citizen is someone who is familiar with information technology and can use electronic services of an electronic city in order to do daily activities such as recreation, education, communications and personal transactions. Electronic Citizen is a representative of the real citizen in electronic city who does not have his/her authority and just implement orders of real citizen. Electronic citizen identity is very important and to make an electronic citizen, a case can be created for him/her that electronic municipality can use user data (Kargari and Khademi Zare, 1384).

Electronic Citizens are able to use information technology in their daily affairs, and can receive their required services from related institutions and organizations by using electronic systems and devices (Singh, 2007, 477-490). Electronic citizen is someone who is familiar with information and communication technology, and knows culture of using electronic services of the city (Sahu, 2007, 477-490). Given these definitions, electronic citizen experiences new life versus traditional citizen. Saving time and costs according to doing many tasks without need to leave home or workplace and also reduce of urban and inter-urban traffic costs are the futures of an electronic citizen. Learning electronic citizen skills increases citizens ability to use modern information technology and therefore they will be ready to use electronic government services and facilities. (Layne, 2001 )

#### **4-Electronic municipality**

In fact, municipality is a set of mechanisms related to city and citizens whose goal is to provide spiritual and material needs (Ebrahimi and Irani, 589-611). One of the important tools that enable municipalities to provide services to the citizens of community is to access to new information technologies. This new technology enables municipalities to provide information and services effectively to their communities, and to increase participation in local organizations. Also, municipalities are able to support local organizations more widely in order to achieve better business. To achieve this goal, municipalities need to make collective decisions to choose a strategic direction. To do this, the best strategy is electronic municipality (local government) (Local Government New Zealand, 2003, 1-23). It was first introduced in England in 2000 (Centre for Urban and Regional Development Studies, 2003, 1-56). Thus, the

electronic municipality is an offers its services in the areas of municipal tasks to citizens using information technology quickly, available and securely (Layne and Lee, 2001). In such a system, citizens receive all services they need the best possible way and securely. Municipal also will control its and citizens' activities using information technology and focusing on services and information and will be ensured to quality and availability of services offered by them (Akman at el, 2005).

#### **4-1-Electronic municipality objectives**

Electronic municipality has three main objectives that are:

- Transforming services: Making them is easier, more responsive, more accessible and more affordable. This makes more service accessible for people with disabilities.
- Renewal of local democracy: Councils able to manage and lead their communities more open, accountable, inclusive and better. Electronic municipality (electronic local government) can give citizens the opportunity to talk with each other, participating with local councils and access to local services and increase communication with their political representatives.
- Promoting local economic vitality: Modern communication infrastructures, skilled workforce and promoting electronic business actively can help residents to improve and expand employment. Electronic city as a national strategy is an ambitious goal (Centre for Urban and Regional Development Studies, 2003, 1-56).

#### **4-2- Methodology for the formation and evolution of electronic municipality**

Electronic municipality generally has made up in four stages: emersion, promotion, interaction and integration.

Emersion stage:

The first action to create an electronic municipality is to provide strategic document based on field studies of facilities, current situation and comparative analysis of international experiences and activities in this field.

Promotion stage:

Many electronic municipalities around the world have started to work providing elementary services on the website and update infrastructure and teaching staff have done at this stage.

Interaction stage:

Next, websites and networks establish mutual communication and people can communicate with electronic municipalities easily.

Integration stage:

At this stage, some services such as urban database are available to citizens through Internet. In the integration stage, most services are provided by the website and citizens can access to most urban services using local network or through the Internet. This is the ground for holding electronic municipality. Most of the top electronic cities in the world like Toronto, Berlin and Boston are in the beginning of this stage. Creating virtual organizations and agencies and remote working system are future plans of electronic municipalities that by implementing them people going to offices will be minimized and employees can do their office works in every places (Sarafrazi and Memarzadeh, 1386).

### 5- Research methods and findings

Statistical community includes Tabriz municipality district 2 employees that are 210 individuals. The sample consisted of 100 Tabriz district 2 employees obtained from Morgan table. Sampling method is random and simple. Type of research is development- applied and main method is descriptive – analytical. This study, based on its

nature, collects necessary information on the following two methods:

1- Library and documental method in order to explain issues theoretically and collect information of official organizations and institutions

2- Field studies in order to identify the characteristics of the study area, including visits to the study area

In this study, information collects by observation, receipts, tables, databases, computer networks and etc. Data analysis was performed using SPSS statistical software.

### 5-1- Research findings

- Distribution of organizational strategy dispersion in district 2 municipality in order to develop electronic city

According to Table 4-1, enterprise strategy average is 48.88 and its standard deviation is 14.33 so that minimum value is 11.36 and maximum value is 75.

Table 5-1- Distribution of organizational strategy dispersion in district 2 municipality for electronic city development

| Variable            | number | Average | Standard deviation | Min value | Max value |
|---------------------|--------|---------|--------------------|-----------|-----------|
| enterprise strategy | 100    | 48.88   | 14.33              | 11.36     | 75        |

Figure 5-1- Distribution of organizational strategy dispersion in district 2 municipality for electronic city development

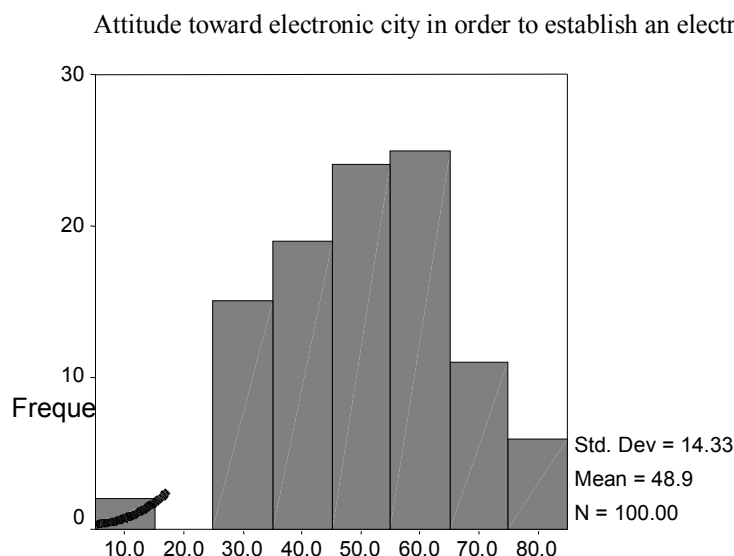
| Variable  | number | Average | Standard deviation |
|---|--------|---------|--------------------|
| Strategy along with strategic document and development policy to use ICT in city              | 100    | 3.28    | 0.86               |
| IT applications in the development of city  | 100    | 3.12    | 0.96               |
| A scientific model and specifying its implementation plan                                     | 100    | 3.10    | 0.90               |
| People welcoming to do usual affairs of virtual networks                                      | 100    | 3.07    | 1.04               |
| People are prepared to pay city service fees  | 100    | 3.06    | 0.88               |
| Culture and public awareness by municipal managers  | 100    | 3       | 0.63               |
| Prioritize urban and governmental services in city agenda                                     | 100    | 2.92    | 0.93               |
| Preparing experts to Infrastructure development in electronic city                            | 100    | 2.91    | 0.93               |
| Adequate experts in municipality to develop electronic services                               | 100    | 2.77    | 0.81               |
| An electronic signature to prevent citizens concern to access data and funds transfer service | 100    | 2.75    | 0.84               |
| City helps to re-engineering city structure to be coordinate with the Electronic city         | 100    | 2.47    | 0.72               |

- Distribution of attitude dispersion toward electronic city in order to establish an electronic city.

According to Table 5-1, average of attitude toward electronic city is 48.88 and its standard deviation is 14.33 so that minimum value is 11.36 and maximum value is 75.

Table 5-8-Distribution of attitude dispersion toward electronic city in order to establish an electronic city

| Variable   | number | Average | Standard deviation | Min value | Max value |
|--|--------|---------|--------------------|-----------|-----------|
| attitude toward electronic city in order to establish an electronic city | 100    | 48.88   | 14.33              | 11.36     | 75        |



Attitude toward electronic city in order to establish an electronic city

Figure 5-2- Distribution of attitude dispersion toward electronic city in order to establish an electronic city

| Variable   | number | Average | Standard deviation |
|--|--------|---------|--------------------|
| How much electronic networks development in municipality affects on promoting city attractions.                        | 100    | 4.20    | 0.90               |
| How much electronic networks development in municipality affects on organizing city traffics.                          | 100    | 4.19    | 0.96               |
| How much electronic networks development in municipality affects on reducing environment pollution.                    | 100    | 3.84    | 0.93               |
| How much electronic networks development in municipality affects on forming modern urban architecture.                 | 100    | 3.78    | 0.68               |
| How much electronic networks development in municipality affects on participating people in urban services.            | 100    | 3.75    | 0.80               |
| How much electronic networks development in municipality affects on promoting citizens' rights.                        | 100    | 3.74    | 1.02               |
| How much electronic networks development in municipality affects on eliminating false jobs in pathways.                | 100    | 3.73    | 0.95               |
| How much electronic networks development in municipality affects on managing urban integration.                        | 100    | 3.67    | 0.81               |
| How much electronic networks development in municipality affects on reconstructing time-worn buildings.                | 100    | 3.46    | 1.03               |
| How much electronic networks development in municipality affects on increasing modernization revenues.                 | 100    | 3.22    | 0.76               |
| How much electronic networks development in municipality affects on increasing revenues related to municipality taxes. | 100    | 3.20    | 0.66               |
| How much electronic networks development in municipality affects on reducing municipality dependency on density sale.  | 100    | 3.76    | 0.86               |

Providing electronic city model based on electronic city development in district 2 of municipality

In order to provide electronic city in terms of electronic city development weighted coefficients were used and determined that electronic city

development affects on following activities respectively.

Banking activities (coefficient = 70.33), Activities related to service providing (coefficient = 65.55), reducing bribery (coefficient = 58.8), reducing vehicle traffic and air pollution (coefficient =50.9), eliminating excess usage and developing green space (coefficient=43.2), official activities (coefficient=22.8) and getting information and news (coefficient=25.2) have most effects. Also, in this study, the minimum contribution is related to political and recreational activities.

| Variable  | Coefficient |
|---|-------------|
| Banking activities, such as paying bills, take money from the account, money transfer, etc.       | 70.33       |
| Activities related to providing services to citizens  | 65.55       |
| Reducing bribery in municipalities and organizations  | 58.8        |
| office activities, such as registering documents, passport application                            | 33.33       |
| Business activities, such as buying and selling goods, music, movies and food                     | 19.4        |
| Recreational activities, such as computer games, visiting museums                                 | 8           |
| Getting Information: news, newspapers, magazines, weather   | 25.2        |
| scientific activities: research about projects, finding essays, access to reliable sources        | 15          |
| Educational activities: school, university and other institutions                                 | 16.15       |
| Political activities: participating in elections, Announce to Parliament                          | 2.95        |
| Travel activities: booking travel tickets, booking hotels and renting car                         | 11.89       |
| Job search and job application: being aware of jobs opportunities, filling jobs application form  | 5.73        |
| Treatment activities: going to doctor, getting Safety instructions                                | 7.63        |
| Decision-making activities: the best and the least crowded route in city to reach the destination | 9.9         |
| reducing vehicle traffic and air pollution  | 50.9        |
| eliminating excess usage and developing green space   | 43.2        |

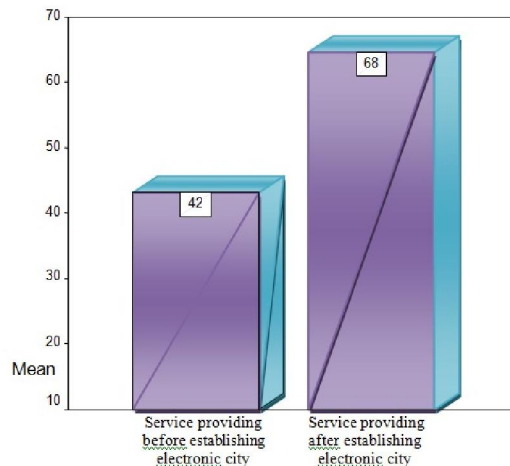


Figure 5-3- Providing electronic city model based on electronic city development in district 2 of municipality

## 6- Conclusions

In studying electronic city and electronic municipality and necessity of its development in developing community of Iran, and particularly in Tabriz, attention to four parts of electronic government include electronic city, electronic municipality and electronic citizen and education to overcome many of complex problems and to keep with global development is a need that there is no escape from it. Reducing air pollution and traffic as well as transparency of information and stages and doing services and rules and deal with bribery in municipality and avoid applying employees taste are of other advantages of electronic city. The aim of electronic city is to take advantages of electronic media and utilizing internet in order to facilitate citizens' affairs. Electronics city is one of the origins of urban managers and citizens to provide and utilize urban services. Electronic city is a city where citizens' affairs management include government and private organizations services do online, seven days a week, and 24 hours a day, with high quality, securely and using ICT tools and its usages. In other words, in an electronic city, all services citizens required provided through information network. This eliminates the need for physical movement of citizens to access government services and private institutions.

In this study, according to Table 5-1, enterprise strategy average is 48.88 and its standard deviation is 14.33 so that minimum value is 11.36 and maximum value is 75. It shows there is no enterprise strategy in district 2 of Tabriz.

Creating intelligent cities is one of the main goals of information technology. Creating such cities has many benefits.

In this study, according to Table 5-1, average of attitude toward electronic city is 48.88 and its standard deviation is 14.33 so that minimum value is 11.36 and maximum value is 75. It shows there is no attitude toward electronic city in district 2 of Tabriz.

Hence, it can be concluded that it's not possible to have appropriate services in electronic government system to create electronic city and municipality without creating platforms in computer systems and without integrated link between them. Organizing all computer systems and services and information provided shows that electronic government system is not just a website but also is all computer systems; information and services related to these systems so that these systems must be integrated with each other and be able to communicate with each other and provide information and services needed by users. Based on current study findings about studying electronic city effect on creating electronic municipality in electronic city of Tabriz (district 2) it can be concluded that creating electronic city of Tabriz is along with holding electronic city of Tabriz and these are close together.

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## Bee Honey Dose-dependently Ameliorates Lead Acetate- mediated Hepatorenal Toxicity in Rats

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**Abstract:** Lead poisoning is a serious condition caused by increased levels of the heavy metal lead in the body. Lead interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, liver as well as reproductive and nervous systems. The present study aimed to evaluate the ameliorative effect of bee honey against lead acetate toxicity. Honey was administered orally at doses of 0.2, 0.4 and 0.4 g/kg for one month. Lead treatment (200mg/kg, p.o) started 10 days before the honey treatment and continued with honey for one month. Positive control group were treated with lead acetate for 40 days. Lead intoxication caused a significant increase in serum malondialdehyde (MDA), decreased glutathione (GSH), increased uric acid, urea and creatinine. Moreover, lead administration increased bilirubin and the enzymatic activity of GOT, GPT and alkaline phosphatase. In addition, lead intoxication increased total cholesterol, HDL, LDL and triglycerides. Bee honey dose- dependently reversed the adverse effect of lead on liver and kidney function and decreased MDA level and normalized GSH level. In conclusion, induction of oxidative stress and disturbing lipid metabolism may be responsible for the adverse cellular effects of lead and that these cellular events may mediate the hepatotoxic and nephrotoxic manifestations in lead intoxication. Also, the beneficial effect of honey is likely- partially- due to its antioxidant property and its modulatory effect on the metabolic processes.

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**Key word:** Lead acetate- honey- liver- kidney

### 1. Introduction

Heavy metals including lead are naturally occurring elements that have a high atomic weight and a density at least five times greater than that of water and most of the heavy metal salts are soluble in water and form aqueous solutions and consequently cannot be separated by ordinary physical means of separation (El-Zahrani and El-Saied, 2012). Their multiple industrial, domestic, agricultural, medical, and technological applications have led to their wide distribution in the environment, raising concerns over their potential effects on human health and the environment (Tchounwou *et al.*, 2012). Their toxicity depends on several factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals (Vassallo *et al.*, 2011). During evolution, different organisms have developed diverse strategies to maintain an equilibrated relation with heavy metal ions present and available in the surrounding medium. Cells face two tasks, the first is to select those heavy metals essential for growth and exclude those that are not, and the second to keep essential ions at optimal intracellular concentrations (Cobbett and Goldsbrough, 2002; Perales-Vela *et al.*, 2006).

Lead is a persistent metal and commonly present in our living environment. Even at low doses of developmental stages, lead exposure resulted in embryonic toxicity, behavioral alteration, and adult

learning/memory deficit (Chen *et al.*, 2012). Consistently, Gargouri *et al.* (2012) studied the effect of lead acetate exposure in drinking water to mothers during gestation, from the 5th day of gestation to day 14 postpartum, revealing that caused lead deposition was found in the brain and cerebellum of newborns as well as cerebellum tissue damages and significant decrease in weight and protein content of these tissues. Oxidative stress and changes in antioxidant enzyme activities in brain tissues were also recorded (Gargouri *et al.*, 2012). Moreover, lead induced deficits in learning and memory through overactivation of hippocampal serine/threonine protein phosphatases PP1 and PP2A (Rahman *et al.*, 2012).

In addition, lead acetate disturbed biochemical and hematological indices and induced nephrotoxicity and hepatotoxicity through profound elevation of reactive oxygen species (ROS) production and oxidative stress, leading to increased lipid peroxidation level and depletion of intracellular reduced glutathione (GSH) level in kidney and liver (Ibrahim *et al.*, 2011, Wang *et al.*, 2011, Liu *et al.*, 2012). Consistently, lead acetate has been found to induce biochemical and histological abnormalities in blood, kidney, liver and brain tissues (Ozsoy *et al.*, 2011). Ademuyiwa *et al.* (2005) reported a significant positive correlation between blood lead and total cholesterol and LDL levels. Among studies of

inflammation, *in vitro* studies and a study of occupationally exposed workers found a relationship between lead and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), but not between lead and interleukin-6 (IL-6) (Valentino *et al.* 2007).

The health benefits of honey have long been realized by humans to treat a variety of ailments. Besides its sugar composition, honey consists of a number of bioactive compounds such as phenolic compounds, flavonoids, carotenoid-like derivatives, organic acids, Maillard reaction products, catalase, ascorbic acid, and other compounds which function as antioxidants (Bogdanov *et al.*, 2008). Several therapeutic and medicinal effects such as antibacterial, antimutagenic, antiproliferative, hepatoprotective, hypoglycemic, and antioxidant effects have been ascribed to honey through last years (Erejuwa *et al.*, 2010 a; Erejuwa *et al.*, 2010 b; Ghashm *et al.*, 2010).

The aim of the present study is to evaluate the protective effect of bee honey on lead-induced kidney and liver toxicity.

## 2. Materials and Methods:

Experimental animals: male adult Sprague Dawley rats (150-200 g) were kindly provided from our breeding center at NODCAR and kept for a week for acclimatization under normal conditions and constant temperature ( $25\pm 1^\circ\text{C}$ ) with *ad libitum* water and food until starting the experiment.

**Chemicals:** Lead acetate ( $\text{C}_4\text{H}_6\text{O}_4\text{Pb}\cdot\text{H}_2\text{O}$ ) was purchased from Sigma-Aldrich.

Bee honey was purchased from the Egyptian market.

A total number of 40 rats was divided into five equal groups, the first is the negative control group, the second group is the positive control group, which is treated with lead acetate (200mg/kg/day, p.o) for 40 days, the other three groups represent the combined treatment where the animals were treated with lead acetate (200mg/kg) for 40 days and bee honey was administered of three doses (0.2; 0.4 and 0.8g/kg, p.o) concurrently with lead at the last 30 days. At the end of treatments, animals were sacrificed. Blood samples were collected in clean and dry tubes and centrifuged at 3000 r.p.m for 10 min. for serum separation.

Determination of urea, creatinine, uric acid, bilirubin, total cholesterol, triglycerides, and high density lipoprotein (HDL) were analyzed colorimetrically using commercial available kits (STANBIO Lab. TX, USA). Low density lipoprotein was calculated mathematically by Friedwald's formula (1972). The activities of GOT, GPT and ALP were determined according to Reitman and Frankel (1957). Determination of reduced glutathione and malondialdehyde levels were determined by HPLC methods according to the Jayatilleke and Shaw (1993) and Karatepe (2004) respectively.

Statistical Analysis:

Data presented as means  $\pm$  SE. One-way ANOVA followed by LSD test were used to evaluate significant differences from the control and lead-treated group groups. Statistical processor system support (SPSS) for Windows software, release 10.0 (SPSS, Inc, Chicago, IL) was used.

## 3. Results:

Result in Table 1 depicted that lead treatment increased levels of uric acid, creatinine, urea and bilirubin compared to control group. Moreover, lead-treated animals exhibited high levels of total cholesterol, HDL, LDL and TAG (Table 2). Table 3 showed that lead acetate treatment significantly increased the enzymatic activities of GOT, GPT and ALP enzymes. Bee honey dose-dependently attenuated the elevating effect of lead on, kidney and liver function parameters and GOT, GPT and ALP enzyme activities and normalized kidney and liver function and lipid profile (Tables 1,2 and 3). Figures 1,2 and 3 represent the correlations between doses of honey and the tested parameters. Figure 4 showed that lead acetate significantly increased level of MDA and decreased the level of reduced glutathione in serum. Honey treatment antagonized the effect of lead acetate on both GSH and MDA levels in a dose-dependent manner. Figures 5 represent the correlations between doses of honey and the levels of glutathione (GSH) and malondialdehyde.

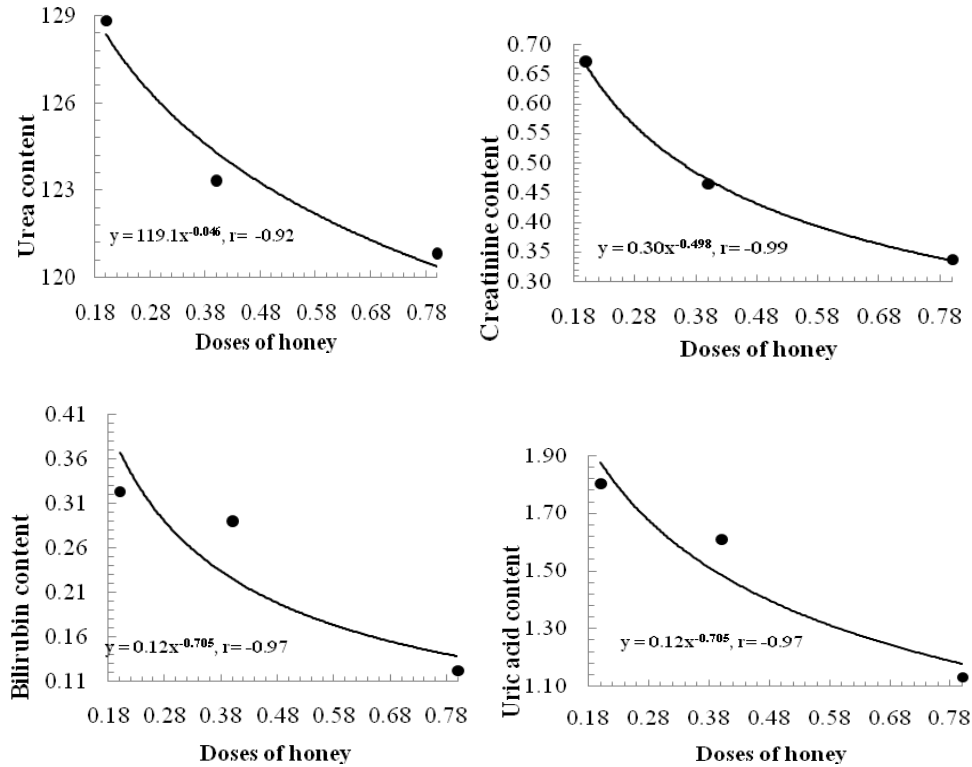


Figure 1: Relationship between the administered doses (0.2, 0.4, 0.8 g/kg b. wt.) of honey bee and the concentration of urea (mg/dl), creatinine (mg/dl), bilirubin (mg/dl) and uric acid (mg/dL) in serum of male albino rats. Each value is a mean of six rats.

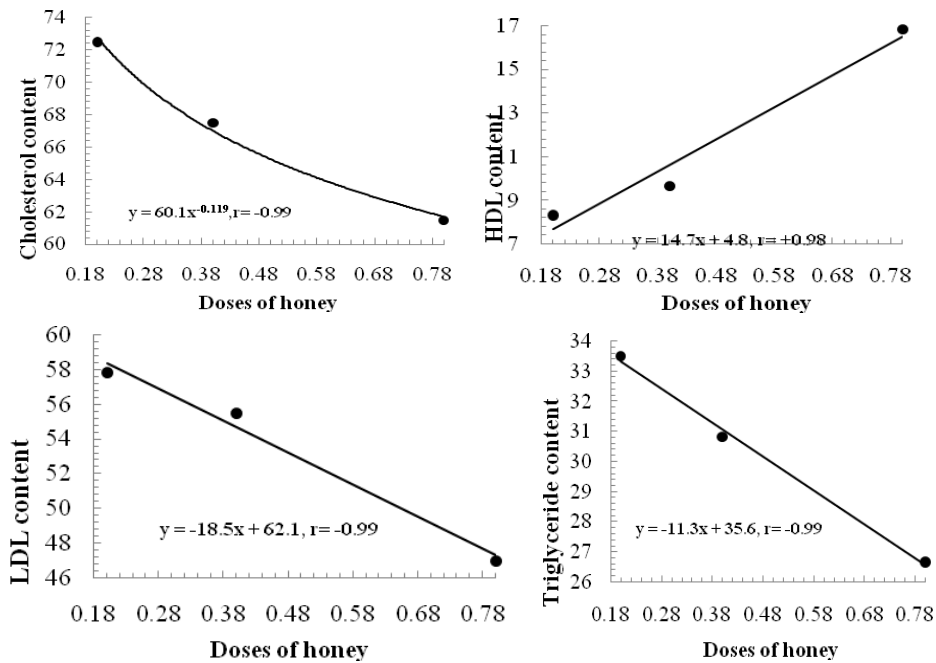


Figure 2: Relationship between the administered doses (0.2, 0.4, 0.8 g/kg b. wt.) of honey bee and the concentration of cholesterol (mg/dl), HDL (mg/dl), LDL (mg/dl) and triglyceride (mg/dl) in serum of male albino rats. Each value is a mean of six rats.

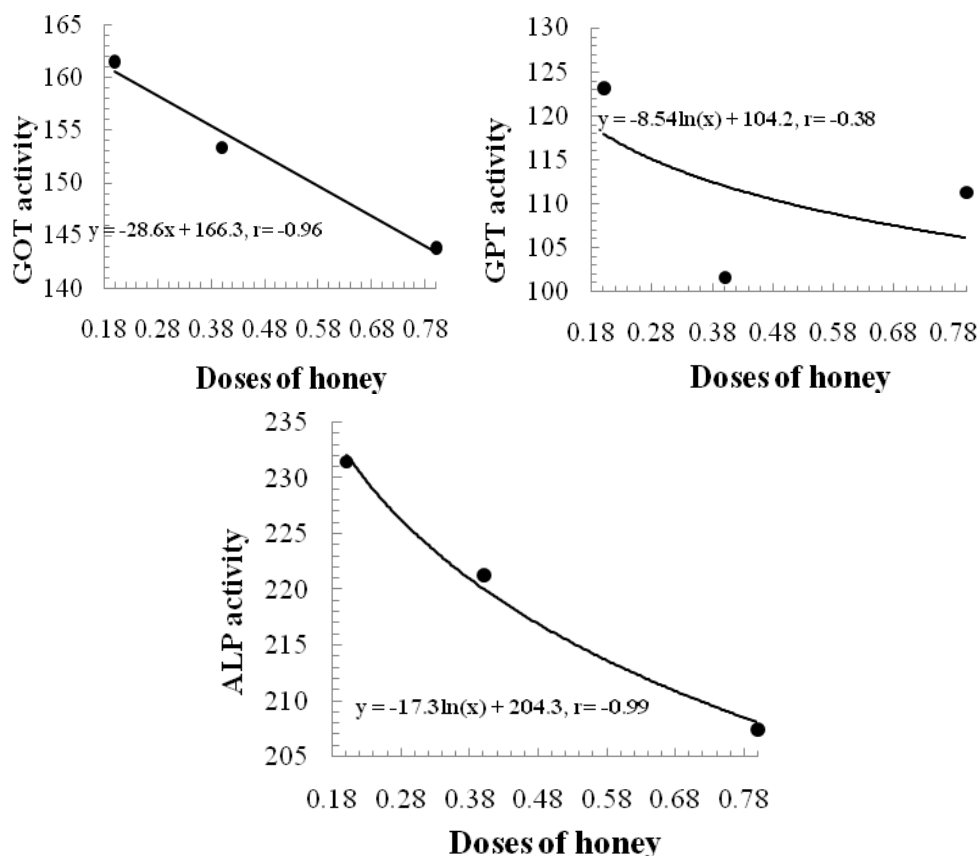


Figure 3: Relationship between the administered doses (0.2, 0.4, 0.8 g/kg b. wt.) of honey bee and the activities of GOT (U/l), GPT (U/l) and alkaline phosphatase ALP (U/l) in serum of male albino rats. Each value is a mean of six rats.

Table 1: Effect of Lead Acetate, Bee Honey (0.2, 0.4 and 0.8 g honey /kg b. Wt) alone or in combination on Levels of Urea, Uric Acid, Creatinine and Bilirubin in Serum of Male Albino Rats.

| Experimental groups           | Urea (mg/dl)                      | Uric acid (mg/dl)                | Creatinine (mg/dl)                | Bilirubin (mg/dl)                 |
|-------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|
| Control                       | 130.3 ± 0.687                     | 1.98 ± 0.049                     | 0.710 ± 0.052                     | 0.423 ± 0.017                     |
| Pb – administered rats        | 152.3 ± 1.14*                     | 2.73 ± 0.049*                    | 1.850 ± 0.043*                    | 0.783 ± 0.047*                    |
| Pb+H1 administered rats       | 128.8 ± 0.70                      | 1.80 ± 0.051                     | 0.672 ± 0.031                     | 0.323 ± 0.004                     |
| Pb+H2 administered rats       | 123.3 ± 0.49*                     | 1.61 ± 0.029*                    | 0.465 ± 0.021*                    | 0.290 ± 0.012*                    |
| Pb+H3 administered rats       | 120.8 ± 0.60*                     | 1.13 ± 0.204*                    | 0.337 ± 0.022*                    | 0.122 ± 0.005*                    |
| ANOVA (Doses of honey effect) | $F_{3,20} = 342$ ,<br>$P < 0.000$ | $F_{3,20} = 38$ ,<br>$P < 0.000$ | $F_{3,20} = 514$ ,<br>$P < 0.000$ | $F_{3,20} = 131$ ,<br>$P < 0.000$ |
| ▶ Correlation coefficient     | -0.82                             | -0.93                            | -0.81                             | -0.87                             |

Values are presented as mean ± standard error. (N=6)

$P < 0.000$ : significant effect of administered doses of honey at d.f. 3, 20 and  $\alpha = 0.0001$

▶ correlation coefficient between the administered doses of honey and the studied parameters.

\* significant difference in comparison with the corresponding controls at  $\alpha = 0.05$

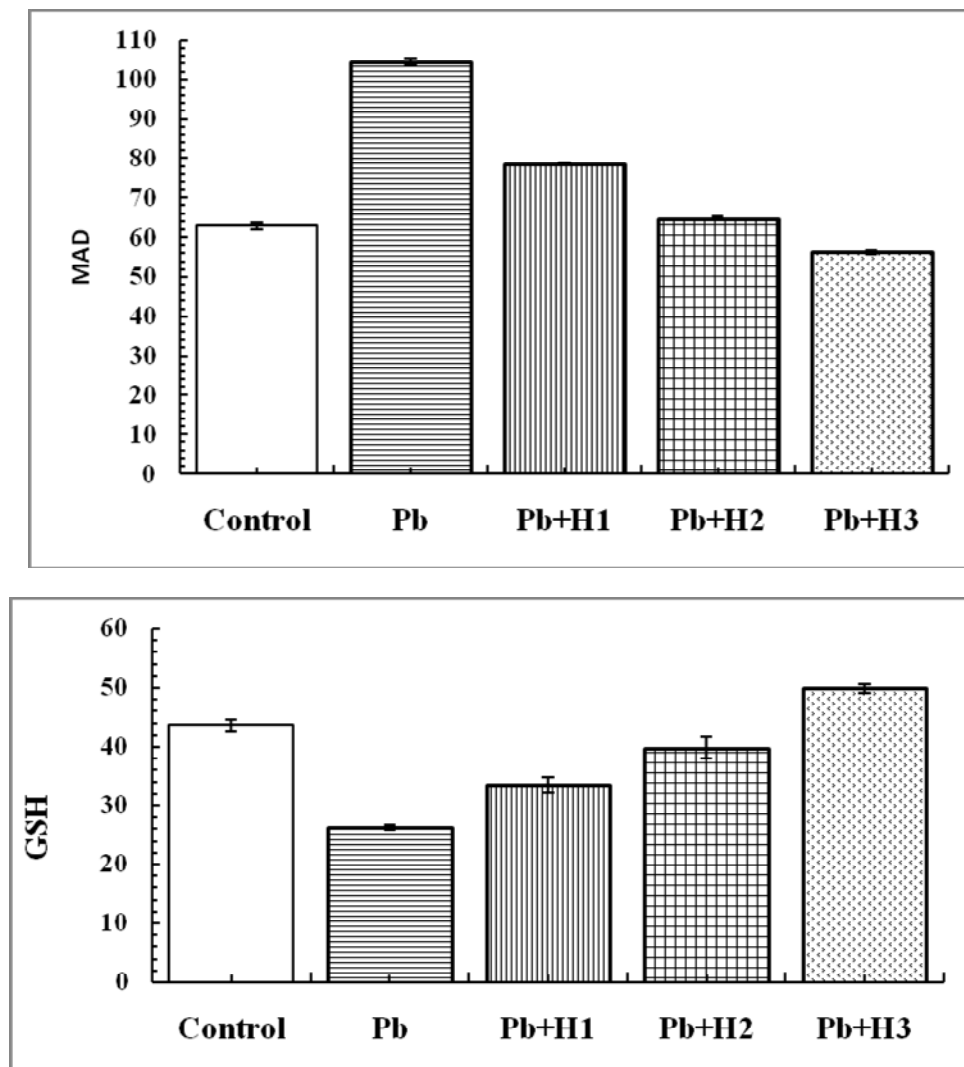


Figure 4. Effect of Lead Acetate, Bee Honey ( 0.2, 0.4 and 0.8 g/kg b.wt.) on the Levels of MAD and GSH in Serum of Male Albino Rats

Table 2: Table 1: Effect of Lead Acetate, Bee Honey (0.2, 0.4 and 0.8 g honey /kg b. Wt) alone/ or in Combination on Levels of Cholesterol, Triglycerides, HDL and LDL in Serum of Male Albino Rats.

| Experimental groups     | Cholesterol (mg/dl)            | Triglyceride (mg/dl)            | HDL (mg/dl)                    | LDL (mg/dl)                    |
|-------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|
| Control                 | 73.33±0.882                    | 34.50±0.764                     | 10.50± 0.764                   | 60.2±1.30                      |
| Pb – administered rats  | 78.50± 0.428*                  | 40.83±0.910*                    | 5.83± 0.307*                   | 65.2±0.70*                     |
| Pb+H1 administered rats | 72.50± 0.428                   | 33.50±0.563                     | 8.33± 0.422*                   | 57.8±0.60                      |
| Pb+H2 administered rats | 67.50± 0.764*                  | 30.83±0.307*                    | 9.67± 0.422                    | 55.5±0.43*                     |
| Pb+H3 administered rats | 61.50± 0.563*                  | 26.67±0.882*                    | 16.83± 0.477*                  | 47.0±0.73*                     |
| ANOVA (Honey Effect)    | $F_{3,20}= 165,$<br>$P <0.000$ | $F_{3,20}= 70, P$<br>$P <0.000$ | $F_{3,20}= 132,$<br>$P <0.000$ | $F_{3,20}= 143,$<br>$P <0.000$ |
| Correlation coefficient | -0.98                          | -0.95                           | +0.98                          | -0.98                          |

Values are presented as mean ± standard error. (N=6)

$P <0.000$ : significant effect of administered doses of honey at d.f. 3, 20 and  $\alpha = 0.0001$

▴ correlation coefficient between the administered doses of honey and the studied parameters.

\* significant difference in comparison with the corresponding controls at  $\alpha = 0.05$

Table 3: Effect of Lead Acetate, Bee Honey (0.2, 0.4 and 0.8 g honey /kg b. Wt) alone. or in Combination on Levels The enzymatic Activity of GOT, GPT and ALP in Serum Male Albino Rats

| Experimental groups     | GOT (U/l)                           | GPT (U/l)                           | ALP (U/l)                           |
|-------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Control                 | 160.5±0.76                          | 123.50± 0.764                       | 229.50± 0.764                       |
| Pb – administered rats  | 191.2±2.21*                         | 136.83± 1.014*                      | 261.50± 2.320*                      |
| Pb+H1 administered rats | 161.5±0.96                          | 123.17± 0.477                       | 231.50± 0.847                       |
| Pb+H2 administered rats | 153.3±0.67*                         | 101.67± 1.346*                      | 221.33± 0.558*                      |
| Pb+H3 administered rats | 143.8±2.50*                         | 111.33± 1.520*                      | 207.50± 3.344*                      |
| ANOVA (Honey Effect)    | F <sub>3,20</sub> = 135,<br>P<0.000 | F <sub>3,20</sub> = 111,<br>P<0.000 | F <sub>3,20</sub> = 119,<br>P<0.000 |
| Correlation coefficient | -0.89                               | -0.71                               | +0.93                               |

Values are presented as mean ± standard error. (N=6)

P<0.000: significant effect of administered doses of honey at d.f. 3, 20 and α= 0.0001

▶ correlation coefficient between the administered doses of honey and the studied parameters.

\* significant difference in comparison with the corresponding controls at α= 0.05

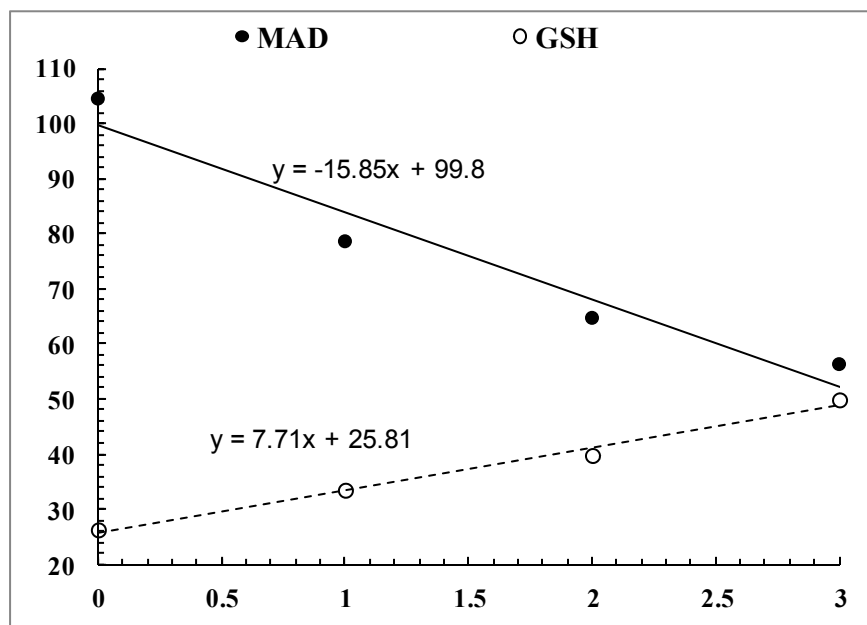


Figure 5. Relationship between the administered doses of honey and the concentrations of MAD and GSH in male albino rats, after 30 days of administration.

#### 4. Discussion:

The present study showed that lead increased urea, uric acid, creatinine and bilirubin levels, caused an elevation in the enzymatic activity of both GOT and GPT and disturbed lipid profile. This might indicate that lead exposure induced adverse effect upon liver and kidney function. Elevated liver enzymes may indicate inflammation or damage to liver cells. Inflamed or injured liver cells leak higher than normal amounts of certain chemicals, including liver enzymes, into the blood-stream, which can result in elevated liver enzymes on blood. Consequently, it is plausible that inflamed or injured liver cell resulted in disturbed lipid profile. In accordance, a recent

study indicated that oral administration of lead acetate increased the activity of blood enzymes: alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, lactate dehydrogenase and a decrease of creatinine level in rats (Ibrahim *et al.*, 2012). In addition, the present study indicated that lead exposure induced a significant increase in both total cholesterol, triglycerides, HDL and LDL levels. Similar findings have been reported for lead-exposure by Peters *et al.* (2012). whereas, Cocco *et al.* (1991) indicated that lead induced remarkable increase HDL but decreases in total cholesterol and LDL levels. However, another study of occupational lead exposure found a positive correlation between blood

lead and total cholesterol and LDL, but not between blood lead and HDL (Ademuyiwa *et al.* 2005). However, low doses of lead were associated with a decrease in total cholesterol and HDL and an increase in triglyceride levels (Skoczynska *et al.*, 1993).

The elevated MDA and decreased GSH levels might indicate increased lipid peroxidation and oxidative stress. This effect might be interpreted that lead may induce metabolic dysfunction through the enzymatic inhibition and/or disturbing the oxidant/antioxidant status. In good keeping to this interpretation, a recent study showed that lead decreased blood glutathione (GSH), GSH peroxidase, adenosine triphosphatase, and catalase but increased oxidized GSH, thiobarbituric acid reactive substance, and intracellular calcium in rat (Wang *et al.*, 2011 and Flora *et al.*, 2012).

Lead exposure induced metabolic disorders and biochemical changes in the liver (Lazarenko and Mel'nykova, 2012). Consistently, a previous study indicated that lead exposure caused changes in lipid metabolism which indicated that lead intoxication resulted in induction of phospholipidosis in the kidney and brain. (Ademuyiwa *et al.* , 2005). In accordance, several studies demonstrated normalizing effect of honey on lipid parameters and its potential benefits on risks of coronary heart disease (Münstedt *et al.*, 2009, Alagwu *et al.*, 2011 and Nemoiseck *et al.*, 2011).

It is worthy to note that the kidney is the first target organ of heavy metal toxicity because of its ability to reabsorb and accumulate divalent metals. The extent of renal damage by heavy metals depends on the nature, the dose, route and duration of exposure. In accordance, it has been reported that both acute and chronic intoxication cause nephropathies (Barbier *et al.*, 2005; Shelley *et al.*, 2012). In addition, a previous study revealed that lead inhibits the spontaneous refolding of chemically denatured proteins by forming high-affinity multidentate complexes with thiol and other functional groups and inhibited the chaperone-assisted refolding of chemically denatured and heat-denatured proteins (Sharma *et al.*, 2008).

From the obtained results, it is concluded that oral administration of honey bee dose-dependently showed significant suppression of lead-induced harmful effects on liver and kidney function and restored the normal lipid profile. Moreover, honey exhibited antioxidant potential against lead induced-oxidative stress. This effect might be due to the antioxidant and the lipid metabolism-enhancing effect of honey. In accordance to the present findings, a previous study indicated that honey exhibited a protective potential by improving the disrupted liver biochemical markers and alleviating the increase of

lipid peroxidation induced by Aluminum chloride (Shati and Alamri, 2010). In addition, a previous study indicated that honey has a remarkable total antioxidant capacity and radical scavenging activity (Oddo *et al.*, 2008, Cavuşoğlu *et al.*, 2009 and Küpeli *et al.*, 2010).

In conclusion, oxidative stress and to lesser extent abnormal lipid metabolism have been implicated in the hepatotoxicity of lead. Whereas, oxidative stress is the main culprit in the nephrotoxicity of lead intoxication. The beneficial effect of honey is due to its ability to counteract the oxidative damage and protect liver and kidney tissues and restore the normal metabolic processes.

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## Changes in socioeconomic status, community health and environmental conditions of fishermen by transmigration (*transmigrasi*) in Lampung Timur, Indonesia

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**Abstract:** Indonesia is characterized by an uneven population distribution, i.e., approximately 60 percent of the population is concentrated on Java Island (7 percent of Indonesia's land areas), and others live on the islands of Kalimantan, Sumatra, Sulawesi and Papua. In order to mitigate the overpopulation problem in Java, the Indonesian government created a transmigration program (*transmigrasi*) in the early 20th century to move people from densely populated areas (mainly Java) to more sparse areas. The Lampung Province in Sumatra has been one well-known destination of transmigration since the first migration in 1905. Focusing on the fishermen that migrated into the coastal area of Lampung Timur in the mid-1980s, this study aims described the transmigration-induced changes in their socioeconomic status (SES), community health, environmental conditions and quality of life. Focus group discussion with selected people and interviews with 179 heads of households (all are first generation) revealed that their SES and community health conditions generally improved after transmigration. However, certain kinds of environmental degradations happened after they settled in the area. In 1996 some people moved out to the elephant-conservation area to seek for more fish, but they were forced to come back to the transmigration area after having social conflicts with the government. The perception of community health and environmental conditions, and QOL score with social conflict experience was worse than without social conflict experience, and the desire for further migration was higher in the former. [Nugroho, AS., Fujimura, M., Inaoka, T. **Changes in socioeconomic status, community health and environmental conditions of fishermen by transmigration (*transmigrasi*) in Lampung Timur, Indonesia.** *Life Sci J* 2012;9(4):789-798] (ISSN:1097-8135). <http://www.lifesciencesite.com>. 124

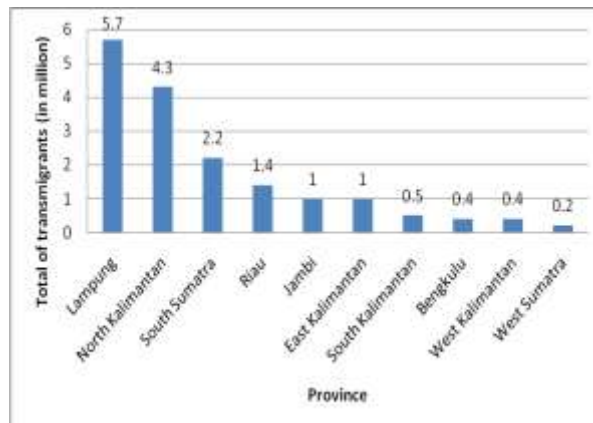
**Keywords:** Transmigration; fishermen; socioeconomic status (SES); community health; environmental conditions

### 1. Introduction

Human migration is natural, and academic papers have proposed several theories and models. A recent Human Development Report [1] stressed improvement in the quality of life (QOL), such as occupation, education, civil and political rights, and security and health care, but it is also true that immigrants have caused significant conflict with the indigenous population. Indonesia has a long history of migration programs (called *transmigrasi* in Indonesia) in the country. These programs were started during Dutch colonial rule in 1905 [2-4] to solve the overpopulation problem on Java Island (Java and Madura share only 7 percent of Indonesia's land, but they are inhabited by approximately 60 percent of Indonesia's population) as well as to reduce poverty in the country and to develop food production outside Java [5,6].

After independence in 1945, the Indonesian government continued the transmigration program [7], with various types of implementation. The transmigration in period (1945-1967) was understood as the displacement of families from an inner island (Java Island) to an outer island (Sumatra, Kalimantan, Sulawesi, Maluku and Papua Islands). After 1968, the Indonesian economy gradually developed under the New Order period (1968-1999), and many people participated in the program to fulfill their dreams. The

number of people participating in the transmigration program has decreased since 1999. In fact, the transmigration program stopped for a while in 2000. According to the 2010 census in Fig. 1, roughly 20 million people migrated from the inner islands to the outer islands [4,8,9], making Indonesia's transmigration program the largest voluntary land settlement scheme in the world [10].



**Fig. 1. Distribution of total migrants, families and descendants**

In Sumatra, including Lampung, the transmigrants' manpower was used on various kinds of plantations, and the provinces of South Sumatra and Lampung developed as food-production areas and North Sumatra developed as a plantation area [4,11,12]. However, the transmigration program has created problems such as the accelerated deforestation of sensitive rainforests from the overuse of natural resources and the overgrazing of land [4]. For example, the transmigration area in Central Kalimantan showed that the peat land was unacceptable for rice cultivation, crops were destroyed by rodents, drainage and irrigation systems did not work properly; and the groundwater was highly acidic and inappropriate for drinking [7]. Some transmigration programs fail to improve the living standard of migrants and their quality of life, and instead create unsuitable farming systems, environmental degradation and cultural conflict [13].

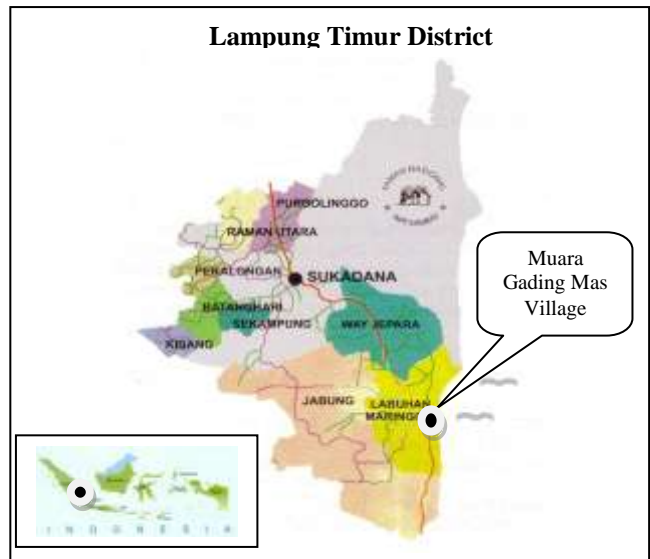
The transmigration program was devoted to farmers and to fishermen to keep the border area and to reduce the density of fishermen on Java Island. In the 1980s, it became difficult for fishermen on Java Island to catch fish; their income decreased and they participated in the transmigration program to fish the outer islands. Fishermen migrants can cause problems for local fishermen in the way of unfair competition for the fishing catch and environmental damage [14]. Fishermen migrants will encourage significant environmental changes and they are more likely to be found in villages with lower environmental quality [14]. The lower environment quality will affect income levels, especially for the small fishermen who depend on the environment [15]. Decreasing the economic level will reduce their quality of life. Lampung Timur is an interesting research area that can describe this condition.

This study aims to describe the changes in socioeconomic status, community health and environmental condition among the people who migrated in Lampung Timur from Java and Sulawesi as fishermen in 1984. People were asked about those conditions before migration (at their original village), immediately following their migration, and at the time of study. Then their perception of community health and environmental quality was compared to theirs and others responses. This study also aims to describe their quality of life (QOL) in the present condition

## 2. Material and Methods

Indonesia's Lampung Province has long history of transmigration from the first migration in 1905, and this province has accepted the most Indonesian migrants [4]. Lampung Timur has been the destination of the transmigration program since the 1970s; therefore it can demonstrate changes in socioeconomic status (SES), community health, and environmental

condition, and evaluate their quality of life (QOL). Research has been carried out in the transmigration area in Muara Mas Gading Village in the Lampung Timur district (Fig. 2). As many as 534 households (2,000 people) have migrated into this area from Java and Sulawesi since 1984. The most interesting thing is that the majority of migrants were fishermen.



**Fig. 2. Research area of Muara Gading Mas Village**

The social conflicts that have happened since then are also interesting. The fundamental conflict happened because the fishermen could not earn enough income fishing. In 1996 it became difficult to get fish around the transmigration area, and some migrants (84 households) moved again to the border of the Lampung National Zoo's conservation area (+10 km from their area), even though settlement was restricted [16]. Migrants had to fight with the forest police—the processes of conflict resolution started in late 2008, and the forest police ordered migrants to leave by the end of January 2009. Nevertheless, they refused to move out. After the negotiations on November 6, 2009, migrants agreed to return to the transmigration areas by November 26, 2009. More than half of the migrants have followed the agreement, but 40 households remain in the Lampung National Zoo's conservation area. The forest police burned their houses on July 15, 2010, and most of them returned to the migration area. Our research was carried out just after they returned to the migration area.

The focus group discussion (FGD) included the head of the village, village secretary and staff, indigenous stakeholders, the head of fishermen's group, midwives, and school principals to share general information about the transmigration history, public health, sanitation and environmental conditions

before migration (at original village), just after migration (1984) and at the time of the study (2010). Participatory research discussion started with a substantial amount of time spent on creative ways to explore the participants' experiences or situations [17]. Pictures, maps and diagrams were used to recall old information [18].

Questionnaires for household respondents were composed of three major questions about socioeconomic status (SES), community health and environmental conditions. The SES included household income, ethnic groups, and experience with social conflict, education history and occupation. Household income is the sum of income from all sources received by all members of the household each month. Income refers to wages, salaries, profits, rents, and any earnings received. Income can also come as unemployment or workers compensation, social security, pensions, interests, government support, and family financial assistance [19]. Free and serial recall was used to collect information. Free recall helped participants remember information with the list data [20], while serial recall helps participants remember events chronologically [21]. Specifically, the questionnaire above directed respondents to recall information before migration (in their original village), just after migration (1984) and at the time of study (2010).

Perception questions differ from other types of survey questions that measure perception because they ask respondents to provide information on how they perceive matters such as their health status, environmental conditions and the effectiveness of programs. The questionnaires mentioned satisfaction level measures of how people evaluate their life as a whole rather than their current feelings. Participants responded using a 5 Likert scale with a given statement. For these questionnaires, respondents only expressed their perceptions before migration and at the time of study (2010).

To determine the level of quality of life between migrants who have experienced conflict and those who have not, we retrieved data on quality of life using the method of WHOQOL-BREF in Indonesian (*Bahasa*) version [22]. WHOQOL-BREF is a multi-dimensional, multi-lingual, generic profile that is standardized for sick and well populations in diverse cultures [23]. It demonstrates psychometric properties of internal consistency, reliability, content validity, and discriminant validity [24] and it is now the best instrument for cross-cultural use [25]. The WHOQOL-BREF sheet is also very efficient and effective, consists of 26 items that keep respondents engaged. In this study, the WHOQOL-BREF questionnaires were used for the respondents to describe their QOL in the second point of study (2012).

In total, 179 people (household heads or representatives, 165 males and 14 females aged 41-91 years) were interviewed August-September 2010. The research used purposive sampling for experience with social conflict (25 from 84 households) because they were living together, as refugees tend to do. Snowball sampling was used for groups without experience with social conflict (154 from 450 households). However, snowball sampling can be vulnerable to sampling error or biases because the randomness of the selection may result in a sample that does not reflect the makeup of the population [26]. Only 45 people out of 179 were interviewed in the second research period in January 2012 because of limited time. We should choose the same sample in the first research period. The low sample number can affect the reliability and validity in QOL level. All the data were analyzed with SPSS version 17 [27].

### 3. Results

#### 3.1 Socioeconomic status of the migrants

As shown in Table 1, the migrants' average income (lowest column) before moving into Lampung was approximately 99,441 IDR/month, less than the minimum national standard at the time. Their income sharply increased after migration (259,776 IDR/month), since the government provided each migrant household a house (5 x 6 m<sup>2</sup>), 800 m<sup>2</sup> of land, a fishpond, food for one and one-half years at the beginning of resettlement in 1984, and agricultural and fishing equipment to every 20 households. Twenty-five years later, their average income increased to 554,469 IDR/month. The migrants' monthly household income average in IDR increased from year to year, but when compared to the currency exchange rate in USD, their income was classified below the standard of the national average income (GNP) [28,29].

When average income was classified by education, it was unexpectedly high among those without education in all three periods. However, this was because the fishermen followed their father's job without going to school. Most of them migrated into the area as fishermen, but their jobs have changed over 25 years. Eleven people who changed from fishermen to small industry owners had a higher average income than fishermen, although those migrants who became fishing port workers or transport service workers had a lower income.

Ethnic group was expected to affect their income level because fishing gear differs (therefore the catch amount varies) by ethnic groups. However, the difference in average income by ethnic group was minor. The difference in average income for those who experienced conflict and those with no experience with social conflict were small before and after transmigration. At present, the average income of

the group with social conflict experience is smaller than the group without social conflict experience, probably because social conflict made their economic situation difficult after coming back to the transmigration area.

or doctors (63.7 percent) before migration. Fishermen drunk traditional medicine or went to traditional birth attendants (TBA) when they had health problems. They preferred TBAs or traditional healers because they did not trust health centers (28.5 percent).

**Table 1. Monthly average income by socioeconomic status (SES) in each period**

|  | Average income per month |                   |                   |
|--|--------------------------|-------------------|-------------------|
|  | Before migration         | 1985              | 2010              |
| Education  |                          |                   |                   |
| Junior High School (2)                                   | 65,000 IDR               | 200,000 IDR       | 450,000 IDR       |
| Primary School (62)                                      | 78,064 IDR               | 237,903 IDR       | 530,645 IDR       |
| Illiterate (115)   | 111,565 IDR              | 270,260 IDR       | 569,130 IDR       |
| Occupation   |                          |                   |                   |
| -Jobless   | 25,102 IDR (42)          | -                 | 366,666 IDR (3)   |
| -Fishing port worker                                     | -                        | -                 | 487,500 IDR (8)   |
| -Small industry owners                                   | -                        | 200,000 IDR (1)   | 672,727 IDR (11)  |
| - Farmer   | 133,333 IDR (6)          | -                 | -                 |
| -Transport service worker                                | -                        | -                 | 475,000 IDR (4)   |
| -Fishermen   | 127,177 IDR (124)        | 258,595 IDR (178) | 555,228 IDR (153) |
| Ethnic   |                          |                   |                   |
| -Sundanese (56)  | 97,678 IDR               | 258,928 IDR       | 555,357 IDR       |
| -Bugis (69)  | 102,898 IDR              | 263,768 IDR       | 578,985 IDR       |
| -Javanese (54)   | 96,851 IDR               | 255,555 IDR       | 522,222 IDR       |
| With or without conflict                                 |                          |                   |                   |
| 1. With conflict (25)                                    | 109,600 IDR              | 284,000 IDR       | 526,000 IDR       |
| 2. Without conflict (154)                                | 97,792 IDR               | 255,844 IDR       | 559,090 IDR       |
| Average income   | 99,441 IDR               | 259,776 IDR       | 554,469 IDR       |
| International currency<br>(average in year) <sup>a</sup> | 1 USD = 1025 IDR         | 1 USD = 1110 IDR  | 1 USD = 8683 IDR  |
| GNP per capita   | 540 USD                  | 510 USD           | 2500 USD          |

Note: Figure in parenthesis indicates number of subjects in the category  
<sup>a</sup>Sources: Bank Indonesia, 2012 and The World Bank, 2012

### 3.2 Community health

The community health of the migrants can be seen through disease events and health seeking behavior. Disease event data was captured by asking the respondents cross-check questions about the disease events in their household. Respondents were given a checklist of disease events that have happened in their life. The disease event list in the questionnaires used data from the sub-district hospital in the Labuhan Maringgai (Puskesmas) from 2007–2009. As shown in Table 2, the communal pattern of disease events is similar in the three periods (before migration, just after migration and the study period). The most common disease events for transmigrants in 2010 were viral or infection fever (32.4%), common cold or influenza (25.8%), and pertussis (allergy, common cough, dry cough) (25.8%). Other disease events included diarrhea, asthma, scabies, etc.

In this research, health seeking behavior is described as the process from the recognition of symptoms to the use of particular health facilities. This method attempts to identify a logical sequence of steps and looks at social and cultural factors that affect this sequence. This is primarily an anthropological approach, with qualitative methods of investigation [30]. Table 3 shows that there were no health centers

They started going to health centers after migration (30.7 percent), when the government built new health centers in the transmigration area.

**Table 2. Disease events (percent of the people per year) in each period**

| Disease events              | Before migration | 1985  | 2010  |
|-----------------------------|------------------|-------|-------|
| 0. None                     | 25.4%            | 14.6% | 2.7%  |
| 1. Viral or infection fever | 29.5%            | 30.0% | 32.4% |
| 2. Pertussis                | 16.0%            | 18.6% | 25.8% |
| 3. Common cold or influenza | 16.0%            | 18.6% | 25.8% |
| 4. Diarrhea                 | 3.7%             | 6.4%  | 4.5%  |
| 5. Scabies                  | 3.7%             | 3.6%  | 3.0%  |
| 6. Asthma                   | 2.0%             | 2.9%  | 2.7%  |
| 7. Gastritis                | 1.2%             | 2.1%  | 2.4%  |
| 8. Malaria                  | 0.8%             | -     | 0.3%  |
| 9. Pregnancy disease        | 0.8%             | -     | 0.3%  |
| 10. Typhus                  | 0.8%             | 0.7%  | 1.2%  |
| 11. Eye diseases            | 0.4%             | 1.4%  | -     |
| 12. Kidney diseases         | 0.4%             | 0.4%  | -     |
| 13. Dengue                  | 0.4%             | -     | 0.3%  |
| 14. Hepatitis               | -                | 0.7%  | -     |
| 15. Diabetes                | -                | 2.1%  | 0.6%  |
| 16. Tuberculosis            | -                | -     | 0.9%  |

Note: Data calculation used multiple responses

In 1985, some people complained that they still found it difficult to go to health centers because they did not have enough money to pay for medical

treatment after migration (25.1 percent). Health insurance systems for the poor have been running since 2004, but they could not cover all medical expenses. The number of migrants who visited the health centers exceeded 58.7 percent, and the percentage that complained about the cost of medical treatment decreased in 2010.

**Table 3. Health seeking behavior**

| Reason  | Before migration |       |       |
|---|------------------|-------|-------|
|   | 1985             | 2010  |       |
| 1. No health center available                 | 63.7%            | 3.4%  | -     |
| 2. Don't trust health center                  | 28.5%            | 17.3% | 0.6%  |
| 3. Use traditional medicine                   | 4.5%             | 10.6% | 8.9%  |
| 4. No have medical treatment fee for hospital | 3.4%             | 25.1% | 19.6% |
| 5. Lazy to go to the hospital                 | -                | 5.6%  | 6.1%  |
| 6. Purchased medicine at local pharmacy       | -                | 7.3%  | 6.1%  |
| 7. Visited a health center                    | -                | 30.7% | 58.7% |

Note: Data calculation used multiple responses

### 3.3 Perception of community health

The perceptions of community health in the questionnaire were concerned with the level of access to health facilities and public health services before migration and at present. The data analyses were separated into groups of migrants with and without social conflict experience. The results of the t-test show that the variance and means of community health perception were significantly different in transmigrants (both groups) before and after migration ( $p < 0.05$ , Table 4).

**Table 4. Mean differences of community health perception of transmigrants (both groups with and without conflict experience) in before migration and present time (2010)**

| Community health perception of transmigrants (both groups) | Paired Differences      |                        |      |      |        |       |
|--|-------------------------|------------------------|------|------|--------|-------|
|  | Mean (Before migration) | Mean (After migration) | SD   | P    | 95% CI |       |
|  |                         |                        |      |      | Lower  | Upper |
| Time of before present study period                        | -.68                    | -.08                   | 1.07 | .00* | -.75   | -.43  |

\*Significant different if  $p < 0.05$

Note: Data calculation uses t-Test and N is 179. Likert scale: (-2) Very uncomfortable, (-1) uncomfortable, (0) not different, (1) comfortable, (2) very comfortable

The McNemar test of marginal homogeneity in Table 5 was carried out to examine the difference between the perceptions of the groups before and after migration. The left side of the table shows there was no difference proportion in the perception of community health in the group with social conflict experience before and after migration ( $p > 0.05$ ). The perception of community health in this group was better in the transmigration area. On the contrary, significant differences proportions in community health perception in the group without social conflict

experience before and after migration ( $p < 0.05$ ). The perception of community health in this group was better in the transmigration area.

**Table 5. Perception of community health before and after migration by the experience of social conflict**

| Community health perception | Those with experience of social conflicts |      |     |     | Those without experience of social conflicts |      |     |      |
|-----------------------------|---|------|-----|-----|--|------|-----|------|
|                             | N   | Mean | SD  | P   | N  | Mean | SD  | P    |
| Before migration            | 25  | -.24 | .92 | .06 | 154  | -.75 | .54 | .00* |
| After migration             | 25  | -.64 | .56 |     | 154  | .01  | .86 |      |

\*Significant different if  $p < 0.05$

Note: Data calculation used Mc Nemar test of marginal homogeneity and N is 179. Likert scale: (-2) Very uncomfortable, (-1) uncomfortable, (0) not different, (1) comfortable, (2) very comfortable

### 3.4 Environmental conditions

**Table 6. Claims for environmental condition (percent of the people per year)**

| Environmental degradation | Before migration | 1984 - 1995 | 2010  |
|---------------------------|------------------|-------------|-------|
| 0. None                   | 28.5%            | 8.3%        | 1.0%  |
| 1. Risk of tides rise.    | 28.5%            | 12.2%       | 4.3%  |
| 2. Nonproductive land.    | 1.0%             | -           | -     |
| 3. Soil sediment.         | 28.0%            | -           | -     |
| 4. Poor water quality     | 3.1%             | 1.5%        | 2.9%  |
| 5. Mangrove degradation.  | -                | 11.7%       | 1.4%  |
| 6. Household garbage.     | 4.7%             | 15.1%       | 28.0% |
| 7. Loss flora and fauna.  | -                | 2.9%        | 1.9%  |
| 8. Forest clearing.       | 2.6%             | 15.1%       | 0.5%  |
| 9. Abrasion               | 0.5%             | 14.1%       | 19.8% |
| 10. Water stagnation.     | -                | 19.1%       | 40.1% |
| 11. Productive land       | 3.1%             | -           | -     |

| Cause of environmental degradation |       |       |       |
|------------------------------------|-------|-------|-------|
| 0. None                            | 32.4% | 10.3% | 3.2%  |
| 1. Government policy.              | -     | 5.9%  | 10.2% |
| 2. Resettlement/Transmigration     | 24.0% | 22.1% | 3.8%  |
| 3. Fisheries activities.           | 1.1%  | -     | -     |
| 4. Deforestation.                  | 5.0%  | 6.9%  | 4.3%  |
| 5. Infrastructure                  | -     | 4.4%  | 7.0%  |
| 6. Population growth.              | 1.7%  | 9.3%  | 11.8% |
| 7. Abrasion.                       | -     | 4.9%  | 7.5%  |
| 8. Natural                         | 29.1% | 3.9%  | 3.2%  |
| 9. Harmful human activities        | 6.7%  | 31.4% | 41.4% |
| 10. Poverty problems               | -     | 1.0%  | 7.5%  |

Note: Data calculation used multiple responses

As shown in Table 6, the migrants settled in places with risks of tides rise (28.5 percent), and sediment (28.0 percent) before migration. The risk of tides rise would have happened due to the loss of mangroves trees, and river sedimentation could have been caused by natural sedimentation and resettlement. After migration, environmental problems such as water stagnation (19.1 percent) and deforestation (15.1 percent) became prominent because more mangrove trees were destroyed due to natural exhaustion and humans cutting them down for

firewood and fishing gear/anchors (31.4 percent). The loss of the mangrove trees was fatal because the transmigration area was close to the coast (50 m), and seawater could easily enter into the residential areas.

In 2010, more people claimed water stagnation (40.1 percent) and coastal abrasion (19.8 percent) due to floods and clogged canals, and the village administration built artificial embankments to prevent severe abrasion. In addition, the number of transmigrants throwing their household garbage (28.0 percent) in the canal, yards and public places increased, since there was no garbage disposal system and they did not care about the garbage. It is clear that household garbage can lead to a decline in water quality.

### 3.5 Perception of environmental conditions

The items regarding of environmental conditions in the questionnaire were concerned with the comfort level of environmental qualities before migration and at present. The results of the t-test (Table 7) show that the variance and means of environmental condition perception of transmigrants (both groups) were significantly different before migration and in the present study period ( $p < 0.05$ ).

**Table 7. Differences of environmental perception of transmigrants (both groups with and without conflict experience) in before migration and present time (2010)**

| Environmental perception of transmigrants (both groups) | Paired Differences      |                        |      |      |        |       |
|---|-------------------------|------------------------|------|------|--------|-------|
|   | Mean (Before migration) | Mean (After migration) | SD   | P    | 95% CI |       |
|   |                         |                        |      |      | Lower  | Upper |
| Time of before and present study period                 | -.68                    | .00                    | 1.30 | .00* | -.87   | -.48  |

\*Significant different if  $p < 0.05$

Note: Data calculation uses t-Test and N is 179. Likert scale: (-2) Very uncomfortable, (-1) uncomfortable, (0) not different, (1) comfortable, (2) very comfortable

The change of perception of environmental condition was examined in both groups (Table 8). The McNemar test of marginal homogeneity also applies to determine the differences in perception of environmental conditions before and after migration, similar to the perception of community health calculation. The right table shows significant differences between the present study period and before migration in the group with social conflict experience ( $p < 0.05$ ). The mean shows changes in the negative direction of the group with conflict experience. On the other hand, the perception of environmental conditions among those without social conflict experience (Table 8, right) was significantly different before migration and at present ( $p < 0.05$ ). The mean shows the positive direction of the group without experience with social conflict.

**Table 8. Perception of environmental condition before and after migration by the experience of social conflict**

| Environmental condition perception | Those with experience of social conflicts |      |     |      | Those without experience of social conflicts |      |     |      |
|------------------------------------|---|------|-----|------|--|------|-----|------|
|                                    | N   | Mean | SD  | P    | N  | Mean | SD  | P    |
| Before migration                   | 25  | .36  | .90 | .00* | 154  | -.85 | .58 | .00* |
| After migration                    | 25  | -.84 | .55 |      | 154  | .14  | .86 |      |

\*Significant different if  $p < 0.05$

Note: Data calculation used Mc Nemar test of marginal homogeneity and N is 179. Likert scale: (-2) Very uncomfortable, (-1) uncomfortable, (0) not different, (1) comfortable, (2) very comfortable

### 3.6 Impact of perception on the future desire

People without experience with social conflict seemed to live comfortably in the transmigration area. However, 101 out of 154 (65.6 percent) had thoughts of moving to another location if they could get support from the government, e.g., adequate housing and appropriate environmental capacity to support their livelihood as fishermen, while this percentage was a little less than 84 percent (21/25) for those with experience with social conflict (Table 9). They were willing to move again to find a comfortable place to live or to find a job or a place with a lot of fish stock resources, and to improve their living standard (Table 9).

**Table 9. The desire to move again to another place and their reasons**

|           | Those without experience of social conflicts |    |    |   | Those with experience of social conflicts |   |   |    |
|-----------|--|----|----|---|---|---|---|----|
|           | Reasons                                      |    |    |   | Reasons                                   |   |   |    |
|           | 0  | 1  | 2  | 3 | 0   | 1 | 2 | 3  |
| No        | 42   | 0  | 0  | 0 | No  | 4 | 0 | 0  |
| Yes       | 0  | 38 | 55 | 9 | Yes                                       | 0 | 5 | 15 |
| No answer | 10   | 0  | 0  | 0 | No answer                                 | 0 | 0 | 0  |

Note: Reasons are 0) No reasons, 1) To find a comfortable place, 2) To find a good job, 3) To improve living standard.

The logistic regression in Table 10 is intended to examine in more detail the factors that influence the migrants' desire to move, including their perception of environmental conditions and community health, SES and the presence of social conflict. The logistical regression showed only one factor—a job (2010)—that influenced their desire to move again to another area.

A factor that directly correlates is the difficulty of looking for a good job in the new area. Fishermen migrants have only small-capacity fishing gear in comparison to another newcomer, so the catch is also less than that of immigrant fishermen. Environmental factors and health no longer influence their desire to move, because only those who experience social conflict perceive the environmental degradation and health (25 respondents), while 154 respondents in the

non-conflict group had not been influenced by their perceptions of the environment and health.

Table 11 presents the results of the differences of means in each question and the reliability in four domains.

**Table 10. Logistic regressions of migrant’s desire to move with variables of perceptions at 1985 and 2010, their changes between 1985 and 2010, and SES at 1985 and 2010**

| Independent variables |  | B      | S.E.  | Wald  | df | Sig.  | Exp(B) |
|-----------------------|--|--------|-------|-------|----|-------|--------|
| Perception            | Environment condition (1985)           | -.136  | .483  | .079  | 1  | .779  | .873   |
|                       | Environment condition (2010)           | -.174  | .446  | .152  | 1  | .696  | .840   |
|                       | Environmental changes (2010 - 1985)    | .056   | .400  | .020  | 1  | .888  | 1.058  |
|                       | Community health condition (1985)      | -1.152 | 1.041 | 1.225 | 1  | .268  | .316   |
|                       | Community health condition (2010)      | 1.004  | 1.020 | .970  | 1  | .325  | 2.730  |
|                       | Community health changes (2010 – 1985) | -.823  | 1.014 | .660  | 1  | .417  | .439   |
| SES                   | Ethnic                                 | .208   | .221  | .890  | 1  | .345  | 1.231  |
|                       | Education                              | .159   | .128  | 1.537 | 1  | .215  | 1.172  |
|                       | Job (1985)                             | -.102  | .124  | .667  | 1  | .414  | .903   |
|                       | Job (2010)                             | -.155  | .075  | 4.261 | 1  | .039* | .857   |
|                       | Income (1985)                          | .000   | .000  | .164  | 1  | .685  | 1.000  |
|                       | Income (2010)                          | .000   | .000  | .345  | 1  | .557  | 1.000  |
| Social conflict       | Social conflict                        | -1.548 | .839  | 3.403 | 1  | .055  | .213   |
| Constant              |  | 1.890  | 1.176 | 2.582 | 1  | .108  | 6.622  |

\* Significantly different (p < 0.05)

Note: Variable in the Equation (logistic regression) and dependent is migrant’s desire move (no = 0, yes= 1)

**3.7 Comparison of QOL scores with and without social conflict experience**

Social conflicts should have affected the QOL of the migrants. In the second research period, households (21 with and 24 without social conflict experience) were interviewed to determine the differences in QOL between the two groups.

The highest means of the question items in both groups are at the level of body image and appearance (Q19) and spirituality (Q6). The reliability of the physical domain is below 0.6; therefore it is poor. The low reliability may be caused by a small number of respondents (<100 respondents).

**Table 11. Mean differences and reliability (Cronbrach’s alpha) between the with conflict and without conflict samples by four domains of the WHOQOL-BREF**

| Domains             | Questions items (Q)  | With experience of social conflicts |            |             | Without experience of social conflicts |            |            |
|---------------------|--|-------------------------------------|------------|-------------|--|------------|------------|
|                     |  | α                                   | Md         | Mean ± SD   | α                                      | Md         | Mean ± SD  |
| Physical            | Pain and discomfort (Q3)                                     |                                     | 2.00       | 1.86 ± .72  |  | 2.00       | 1.71 ± .75 |
|                     | Dependence on medication and treatments (Q4)                 |                                     | 1.00       | 1.52 ± .60  |  | 1.00       | 1.54 ± .72 |
|                     | Energy and fatigue (Q10)                                     |                                     | 2.00       | 2.10 ± .94  |  | 2.00       | 2.08 ± .65 |
|                     | Mobility (Q15)   | .41                                 | 3.00       | 3.14 ± .72  | .59                                    | 3.00       | 3.21 ± .65 |
|                     | Sleep and rest (Q16)   |                                     | 3.00       | 2.90 ± 1.04 |  | 3.00       | 2.96 ± .80 |
|                     | Activities of daily living (Q17)                             |                                     | 3.00       | 3.05 ± .80  |  | 3.00       | 2.92 ± .50 |
|                     | Working capacity (Q18)                                       |                                     | 3.00       | 2.90 ± .70  |  | 3.50       | 3.38 ± .71 |
| Physiological       | Positive feelings (Q5)                                       |                                     | 3.00       | 2.86 ± .65  |  | 3.00       | 3.38 ± .49 |
|                     | Spiritual/religion/personal beliefs (Q6)                     |                                     | 4.00       | 3.62 ± .80  |  | 4.00       | 3.96 ± .69 |
|                     | Thinking, learning, memory and concentration (Q7)            | .66                                 | 3.00       | 3.19 ± .40  | .66                                    | 3.00       | 3.38 ± .49 |
|                     | Body image and appearance (Q11)                              |                                     | 4.00       | 4.14 ± .94  |  | 5.00       | 4.46 ± .65 |
|                     | Self esteem (Q19)  |                                     | 3.00       | 3.38 ± .86  |  | 3.00       | 3.50 ± .72 |
|                     | Negative feelings (Q26)                                      |                                     | 2.00       | 2.38 ± .74  |  | 2.50       | 2.46 ± .58 |
| Social Relationship | Personal relationship (Q20)                                  |                                     | 3.00       | 2.76 ± .53  |  | 3.50       | 3.38 ± .71 |
|                     | Social support (Q22)   | .68                                 | 3.00       | 2.86 ± .65  | .66                                    | 3.00       | 3.38 ± .49 |
|                     | Sexual activity (Q21)  |                                     | 3.00       | 3.14 ± .65  |  | 3.00       | 3.33 ± .48 |
| Environmental       | Physical safety and security (Q8)                            |                                     | 3.00       | 3.05 ± .49  |  | 3.00       | 3.33 ± .48 |
|                     | Physical environment (infrastructures)(Q9)                   |                                     | 2.00       | 2.19 ± .75  |  | 3.00       | 2.71 ± .95 |
|                     | Financial resources (Q12)                                    |                                     | 2.00       | 2.00 ± .83  |  | 3.00       | 2.71 ± .69 |
|                     | Opportunities for acquiring new information and skills (Q13) | .78                                 | 2.00       | 2.00 ± .70  | .69                                    | 3.00       | 2.58 ± .58 |
|                     | Participation and opportunities for recreation (Q14)         |                                     | 1.00       | 1.43 ± .50  |  | 2.00       | 1.96 ± .62 |
|                     | Home environment (Q23)                                       |                                     | 2.00       | 2.19 ± .92  |  | 3.00       | 2.54 ± .77 |
|                     | Health and social care, availability and quality (Q24)       |                                     | 3.00       | 2.90 ± .62  |  | 3.00       | 2.79 ± .83 |
| Transport (Q25)     |  | 3.00                                | 2.57 ± .67 |             | 3.00                                   | 2.75 ± .94 |            |

Note: Md (median) and α (Cronbrach’s Alpha). Reliability (< 0.6 “poor”, 0.6 to < 0.8 “acceptable”, > 0.8 “good”)



Table 12 presents the results of the discriminant validity analysis by t-test. Significant mean differences were found between the group with and without experience with social conflict for the psychological, social and environmental domains.

**Table 12. Discriminant Validity of the WHOQOL-BREF Assessment**

| Domains            | With experience of social conflicts (Mean ± Sd) | Without experience of social conflicts (Mean ± Sd) | T value | Sig (2 tailed) |
|--------------------|---|--|---------|----------------|
| Physical Mean      | 38.00 ± 8.75                                    | 38.25 ± 9.54                                       | .248    | .807           |
| Psychological Mean | 50.76 ± 11.50                                   | 58.67 ± 10.87                                      | 1.944   | .046*          |
| Social Mean        | 46.95 ± 11.47                                   | 59.13 ± 10.62                                      | 4.025   | .001*          |
| Environment Mean   | 34.05 ± 10.75                                   | 43.67 ± 11.26                                      | 2.115   | .047*          |
| <b>Items</b>       |   |  |         |                |
| Overall QOL        | 2.71 ± .72                                      | 3.1 ± .13  | -.439   | .666           |
| General health     | 2.76 ± .89                                      | 2.79 ± .21   | 1.372   | .183           |

\*Significant difference between with and without social conflict experience ( $p < 0.05$ )  
Note: t-Test with Welch's method

The scores in the psychological, social, and environmental domains were influenced by the group with and without social conflict experience, but areas of the physical and general health and overall QOL were not affected. The physical domain and two items of QOL were not significantly different between the groups. On the other hand, the domains of psychological health, social relationships and environment were significantly lower in the group with social conflict experience than those in the group without social conflict experience. The average of each domain was below 60 (score 0-100), and the overall items of QOL and general health were below standard [31].

## 4. Discussions

### 4.1 Change of Transmigration Program in Indonesia

Millions of people have migrated from populous areas such as Java, Madura and Bali to the less populous areas of Sumatra, Kalimantan, Sulawesi, Maluku and Papua Islands [32-35]. Sumatra Island has turned into big cities, and many migrants, farmers especially, could increase their income by cultivating the land provided or by being employed by plantations in the new area. As for the fishermen, their income is essentially unstable, depending on their skills and the technology of fishing gear.

The transmigration process had potentially tremendous impacts on the areas of migration in terms of resource-use and social relationships. In fact, social conflicts (different types of social conflicts than used in this study) occurred in transmigration areas such as Aceh, Kalimantan, Maluku, Papua and Lampung in 2000-2005 [7]. In 2007, the government reorganized the transmigration program with local resettlement and developed an integrated city with comfortable transmigration areas that account for socio-economic

development and improvement of environmental quality and quality of life.

Fishermen transmigrants have different characteristics than farmer transmigrants that can influence their differences in SES, environment qualities, community health and QOL. Aspects of the environment qualities and community health cannot be separated from SES, which will ultimately determine the level of QOL. A correlation between fishermen in coastal areas and forest composition change, and they also observed interesting changes in the process of adaptation on the coast of East Sumatra [36].

### 4.2 Impact of transmigration on SES of fishermen

The migrants in Sumatra—including Lampung—could raise the quality of education, level of economy and welfare [11]. An improvement of QOL was achieved partly through government support in the transmigration area [12]. An improvement in SES, especially income, is very important because it is their major concern and motivation for migration. Furthermore, their income correlates with community health and the environmental quality of the transmigration area [37-39].

By the time of study in 2010, the income of the fishermen had increased constantly (that means the amount of fish catch increased), although it was still within the low-middle income level [40]. However, it is difficult for them to rapidly increase their while relying on small-scale fishing. Their parents fished as an occupation, and that is all they have done since they were children, so they had a little chance to get an education before they migrated. Low education made difficult for the fishermen that migrated to look for a new occupation, although some people became small business owners and earned more money than fishermen. Later, the government established primary and secondary schools in the transmigration area. However, 10 percent of the households moved into a new area near the border of the conservation area in the 1990s to get more fish. While ethnic difference did not have a significant effect on their income, the Bugis had bigger fishing gear to catch fish farther from the shoreline. The Bugis from Sulawesi have the skills to use static fishing gear, while the ethnic Sundanese and Javanese from the Java Islands use dynamic fishing gear.

### 4.3 Impact on transmigration on community health and environmental conditions

Health facilities and services improved in the transmigration area after migration. Today, a few migrants still find it difficult to go to the health center because of medical treatment fees, even though many migrants go there when they have health problems. However, for the group without experience with social conflicts, the perception of community health increased after migration in transmigration area. On

the contrary, the perception of community health of the group with experience with conflict did not increase after migration. Nevertheless, health seeking behavior in the migration area is better than those in the conservation area.

They realized that some environmental degradation such as water stagnation, abrasion and household garbage had become more serious, but they did not mention that these decreased their fish catch. Therefore, some people moved to the conservation area in 1996 not because of environmental degradation, but because of the will to get more fish. The perception of the environmental condition was also different between those with and without experience with social conflicts. The perception of environmental conditions of the group with experience with conflict did not increase after migration. These "bad feelings" about the environmental conditions in 2010 significantly attributed to the desire for another migration, although the rate of willingness to move again (as far as government supports are provided) did not markedly differ between the two groups.

The WHOQOL-BREF in both groups of transmigrants intended to give an overview of their QOL in the transmigration area. A limited number of respondents that took this test could not give the exact description of their QOL or if there was bias, but at least we can see the difference in the level of QOL between the groups with and without experience with social conflict. It is understood that except for physical domains, scores were by far lower in the group with experience with social conflicts than those without, while the generally low QOL score of each domain may reflect the characteristics of migrants such as low education level, low income and perception of environmental degradation.

## 5. Conclusion

This study subjected transmigrated fishermen, on whom little attention has been paid in the evaluation of transmigration program in Indonesia. In summary, SES of migrants, especially their income, improved by migration. The community health also improved with establishment of health seeking behavior in the transmigration area. While environmental degradations happened after settlement, however it was not the trigger for illegal migration to the conservation area. Perceptions of community health and environmental condition generally become better at present except for the groups with experience of social conflicts in the conservation area. This uncomfortable perception of environmental condition among those with experience of social conflicts was related to the desire for another migration, but it seemed difficult because government support is hardly obtained at present. As expected, QOL scores of

fishermen were generally low, especially among those experienced social conflicts.

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## Application of Genetic Algorithm (GA) Approach in the Formation of Manufacturing Cells for Group Technology

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**Abstract:** This paper is about minimizing intercellular movements of parts for the formation of manufacturing cells using GA approach. GA is a search technique based on the process of biological evolution and has been applied as an optimization method for the formation of manufacturing cells. Different GA operators and their importance in the optimization of cellular manufacturing have been discussed. A MAT LAB code has been developed for the calculation of different matrices and fitness values of chromosomes. The initial population of possible solutions (chromosomes) is generated randomly and the fitness value of each chromosome is calculated using code developed for the purpose. The next population is generated by the application of genetic operators process is repeated till stopping criteria is satisfied. Total ten populations are generated by the GA procedure and fitness values of different generations have compared graphically with detailed analysis. It is evident that using GA has minimized the intercellular movements of parts which indirectly improves productivity, profitability and provide competitive edge to the manufacturing enterprise in global environment.

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**Key Words:** Cellular Manufacturing (CM), Crossover, Group Technology (GT), Genetic Algorithm (GA), Production Flow Analysis (PFA), Mutation

### 1, Introduction

In Group Technology (GT), the manufacturing system is decomposed into manufacturing cells. Computer integrated manufacturing (CIM), flexible manufacturing systems (FMS) and many other automation programs have close association with GT. Group Technology is not only arrangement of machines into cells, but it also improves productivity of the organization by reducing movement of parts and work in process (WIP) Burbridge, John .L [2]. The reduction in response time to customer orders allows the companies to react quickly to changes in customer requirements and hence maintains a competitive edge in the rapid changes of market demands.

The design of a cellular manufacturing cell is a complex process with issues related to both system structure and operation. The structural issues include the formation of part families and machine groupings, selection of tools and fixtures, selection of material handling equipment and identification of equipment layout. Operational issues include detailed design of product, policies related to maintenance and inspection, procedures for production planning, modification of cost control and reward systems and

outline of procedures for interacting with manufacturing system. In this paper, focus is on structural issues, namely the identification of machine groupings and machines layout. Many criteria are used for the formation of manufacturing cells and significant is to minimize the intercellular movement of parts. Important to minimize intercellular movement in cell formation problem involves identification of families of parts and grouping of machines. Some approaches have been developed over the years however due to complex nature of the problem and variety of parameters; it still needs some approaches to find optimal solution. Methods to solve the problem can be classified into two parts, the design oriented approaches based on the design features of the parts and the production oriented approaches based on the routing information of parts. In this paper focus is on production oriented approaches. Some approach are Production Flow Analysis (PFA) Groover, M.P. [3]; Wemmerlov, U., and N.L. Hyer array based clustering Hierarchical clustering [4]; Non-Hierarchical clustering Apple, J.M [5]; Graph theoretic approach, Mathematical programming, Heuristics Offodile et.al[6]; and AI-based approaches Morad, N [7]. AI implementation

offers advantages over traditional cell formation methods applied to cellular manufacturing systems. The focus of this paper is to investigate the viability of using genetic based approaches for optimization problems associated with cellular manufacturing systems. One of such problems is formation of manufacturing cells with minimum intercellular movement by using genetic algorithms approach. The motivation to use this technique in manufacturing system is due to the robustness of the algorithms and its ability to find solution even for NP-complete problems which are common in manufacturing systems. GA are different from traditional optimization and search procedures as: they work with a coding of parameter rather than the actual parameter; search from a population of points, not a single point; application of GA operators causes information from the previous generation to be carried over to the next; use probabilistic transition rules, not deterministic rules Goldberg, D.E [1]. Genetic algorithms produce a set of solution and hence are flexible, able to incorporate constraints as well as multi-objective criteria into the algorithm. Although the standard genetic algorithm (SGA) which uses binary representation of chromosomes, most applications based on GA depart from the bit string representation. An attempt was made by some researchers to address the problem Hassan; AMS Zalzal, Norhashima Morad; Y.Yin, K.Yasuda and L.Hu; K.Yasuda, L.Hu and Y.Yin; Y.Yin and K.Yasuda; Albadawi, Z., Bashir, H., Chen, M; Selim, H.M., Askin, R.G., and Vakharia, A.J; Fraser, K., Harris, H., Luong, L [8-15], but focus was on layout design, batch scheduling, material flows, multi objective and development of mathematical models. Some suggested use of AI based tools from human factor perspective, cell penetration problems, industry specific cases and optimization of two stage models Johnson, D.J., Wemmerlov, U; Suresh, G; Chipperfield, A., Fleming, P, Polheim, H., Fonseca, C; Wemmerlov, U. and Johnson, D.J; Y.Yin, C.Xu and L.Hu; Yi Kou, Jianjun Yang [16-21]. The purpose of this work is to minimize the intercellular movement of parts for the formation of manufacturing cells at precise level. An optimized arrangement of machines can be formed to indirectly reduce material handling cost and improve productivity and to investigate the ability of GA in the optimization of cellular manufacturing systems in our environment and the benefits of using GA approach as compared to traditional optimization methods.

## 2. Research Methodology

Genetic algorithms are very efficient search algorithms based on the mechanics of natural selection process. They have been used very successfully to solve a wide range of complex optimization problems. As the formation of manufacturing cells in cellular manufacturing is a complex problem GAs are suited to this problem. Genetic algorithms are very effective and flexible optimization tools as they produce optimal or near-optimal solutions not a single solution like traditional optimization methods, hence GAs are flexible in nature. In the formation of manufacturing cells often we need to optimize more than one criterion thus optimization become very difficult and a lot of time would be required to solve problem in such cases. Traditional approaches are normally based on only one criterion to create machine cells and ignore other very important parameters such as processing time of parts and machine capacity. The processing time of parts, machine capacity and the number of parts required which should be known for the formation of manufacturing cells are totally ignored.

In order to overcome the shortcomings of traditional optimization methods and to achieve flexibility when solving complex optimization problems, a GA based fitness function is developed for the formation of manufacturing cells. The objective function used for the formation of manufacturing cells is to minimize the intercellular movement of parts shown in figure 1.

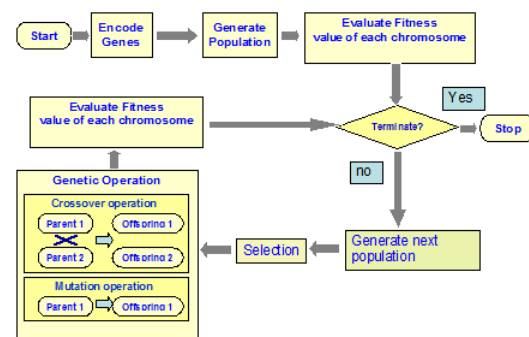


Figure 1 Genetic Operation Process

Different parts of project are being manufactured at shop floor. Manufacturing equipment includes turning machines, milling machines, drilling machines, rolling machine, shearing machine, hydraulic press and surface grinder. The machines are required to be arranged in manufacturing cells in such away that intercellular movement of parts is minimized to a certain level. At present the machines

are not arranged in manufacturing cells and different parts are processed on machines according to process plan sheets. As the production requirement of each part increases, there are problems regarding parts movements in machines and material handling. The routing information of each part from process plan sheet of the part is given in table 1.

Table 1 Routing Information of parts

|                 |    | Number of Machines |   |   |   |   |   |   |   |   |    |    |    |    |    |
|-----------------|----|--------------------|---|---|---|---|---|---|---|---|----|----|----|----|----|
|                 |    | →                  |   |   |   |   |   |   |   |   |    |    |    |    |    |
|                 |    | 1                  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Number of Parts | 1  |                    |   | 1 | 1 |   |   | 1 |   |   |    |    |    |    |    |
|                 | 2  |                    |   | 1 | 1 |   |   | 1 |   |   |    |    |    |    |    |
|                 | 3  |                    | 1 |   | 1 |   |   |   |   | 1 | 1  |    |    |    |    |
|                 | 4  | 1                  | 1 |   |   |   |   |   |   |   |    |    |    | 1  |    |
|                 | 5  |                    |   | 1 |   |   | 1 | 1 |   |   |    |    |    |    |    |
|                 | 6  |                    | 1 |   |   |   |   |   |   |   |    |    | 1  |    |    |
|                 | 7  |                    | 1 |   |   |   |   |   | 1 |   |    |    |    | 1  | 1  |
|                 | 8  |                    |   |   |   |   |   |   |   |   |    | 1  | 1  |    |    |
|                 | 9  |                    |   |   |   | 1 | 1 |   |   | 1 |    |    |    |    | 1  |
|                 | 10 |                    |   |   |   |   |   | 1 | 1 |   |    |    |    |    |    |
|                 | 11 |                    |   |   | 1 |   |   |   |   |   |    |    |    | 1  |    |
|                 | 12 |                    |   |   |   |   |   | 1 | 1 |   |    |    |    |    | 1  |
|                 | 13 |                    |   | 1 |   |   |   |   |   |   | 1  |    |    | 1  |    |
|                 | 14 |                    |   |   |   |   | 1 | 1 |   |   |    |    |    |    |    |
|                 | 15 |                    |   |   | 1 |   | 1 |   | 1 |   |    |    |    |    | 1  |
|                 | 16 |                    |   |   |   |   | 1 | 1 |   |   |    |    |    |    |    |
|                 | 17 |                    |   | 1 | 1 |   |   |   |   |   |    |    |    |    |    |
|                 | 18 |                    |   |   |   |   |   |   |   |   |    |    |    | 1  |    |
|                 | 19 |                    |   | 1 |   |   |   |   |   |   |    |    |    |    |    |
|                 | 20 |                    |   | 1 | 1 |   |   |   |   |   |    |    |    |    |    |
|                 | 21 |                    | 1 |   |   |   |   |   |   |   |    |    | 1  |    |    |
|                 | 22 |                    |   |   |   |   | 1 | 1 |   |   |    |    |    |    |    |
|                 | 23 |                    |   | 1 | 1 |   |   |   |   |   | 1  |    |    |    |    |
|                 | 24 |                    |   |   |   |   |   |   |   |   | 1  | 1  |    |    |    |
|                 | 25 |                    | 1 |   |   | 1 |   |   |   |   |    |    |    | 1  |    |
|                 | 26 | 1                  |   |   | 1 |   |   |   |   |   |    |    |    | 1  |    |
|                 | 27 |                    |   |   |   |   | 1 | 1 |   |   |    |    |    |    |    |
|                 | 28 | 1                  |   |   |   |   |   |   |   |   |    |    |    |    | 1  |
|                 | 29 |                    |   | 1 |   |   |   |   | 1 | 1 | 1  |    |    |    |    |
|                 | 30 |                    |   |   | 1 |   |   |   |   |   | 1  |    |    |    | 1  |

Since total number of parts = 30; total number of machines = 14; production requirement of each part = 5, this means that total 150 parts have to be manufactured. Based on the routing information of each part a part-machine incidence matrix  $E_{ji}$  is written as:

$$E_{ji} = \begin{bmatrix} 0011001000 & 0000 \\ 0011001000 & 0000 \\ 0101000011 & 0000 \\ 1100000000 & 0010 \\ 0010011000 & 0000 \\ 0100000000 & 0100 \\ 0100000100 & 0011 \\ 0000000000 & 1100 \\ 0000110010 & 0001 \\ 0000001100 & 0000 \\ 0000100000 & 0010 \\ 0000001100 & 0001 \\ 0001000001 & 0010 \\ 0000011000 & 0000 \\ 0000101010 & 0001 \\ 0000011000 & 0000 \\ 0011000000 & 0000 \\ 0000000000 & 0100 \\ 0010000000 & 0000 \\ 0011000000 & 0000 \\ 0100000000 & 1000 \\ 0000011000 & 0000 \\ 0011000001 & 0000 \\ 0000000001 & 1000 \\ 0100100000 & 0010 \\ 1001000000 & 0100 \\ 0000011000 & 0000 \\ 1000000000 & 0001 \\ 0010000110 & 1000 \\ 0000100001 & 0001 \end{bmatrix}$$

Where

$j$  = part number;  $i$  = machine number

$E_{ji}$  is a  $30 \times 14$  matrix which shows processing requirement of each part,  $i = 1$ ; if part is processed on machine and zero otherwise. The objective function is to minimize the intercellular movement of parts. The objective of fitness function is denoted as 'F'.

Intercellular movement of parts = (production requirement of each part) (number of movements of parts to each cell - 1)

Production requirement of each part is represented by a matrix  $N_j$ ,  $N_j$  is a  $1 \times n$  matrix.

$X_{il}$  is a machines\*cells matrix and

$$X_{il} = \left\{ \begin{array}{l} 1 \text{ if machine } i \text{ is in cell } l \\ 0 \text{ otherwise} \end{array} \right\}$$

$E_{ji}$  is an  $n*m$  matrix and

$$E_{ji} = \begin{cases} 1 & \text{if part } j \text{ is processed on machine } i \\ 0 & \text{otherwise} \end{cases}$$

$Y_{jl}$  is a parts\*cells matrix, and

$$Y_{jl} = \begin{cases} 1 & \text{if } \sum_{i=1}^m E_{ji} \times X_{il} > 0 \text{ means that part } j \text{ is produced in cell } l \\ 0 & \text{otherwise} \end{cases}$$

In other words matrix  $Y_{jl}$  shows cellular movement of parts.

If we represent intercellular movement of parts by  $F$  then combining the information given above in mathematical form [22]:

$$F = \sum_{j=1}^n N_j \left[ \sum_{l=1}^k Y_{jl} - 1 \right] \dots\dots\dots$$

Where

- $j$  = part number
- $i$  = machine number
- $n$  = total number of parts
- $l$  = cell number
- $m$  = total number of machines
- $k$  = total number of cells
- $N_j$  = production requirement

of each part

$Y_{jl}$  = parts \* cell matrix showing information whether the part is in manufacturing cell or not.

$Y_{jl} = 1$  if part in cell and zero otherwise.

**3. Parameter Settings and Method of Analysis**

For using Genetic Algorithm technique for the formation of manufacturing cells the parameters are set as: The initial population (chromosomes) is generated randomly; Integer based chromosome's representation is used which inform length of individual equal to total number of machines; crossover probability = 0.7; mutation probability = 0.07; the initial population size = 10; total no. of generations = 10; twenty percent elitism criteria are used i.e. 02 individuals with the best fitness values are automatically selected for next generation; the position of gene shows machine number and the

which is three in this problem; generation gap (GGAP) of 0.1 is used for individuals/ chromosomes which are the weakest in the process of evolution i.e. only one chromosome is replaced by new one. The above mentioned parameter setting can be illustrated by following chromosome:

[2 1 3 2 3 1 1 2 3 3 1 2 3 2]

There are fourteen digits in the chromosome showing 14 numbers of machines; manufacturing cell 1 (C1) has machines 2, 6, 7 & 11; manufacturing cell 2 (C2) has machines 1, 4,8,12 & 14, and manufacturing cell 3 (C3) has machines 3, 5,9,10 & 13 respectively shown in figure 2.

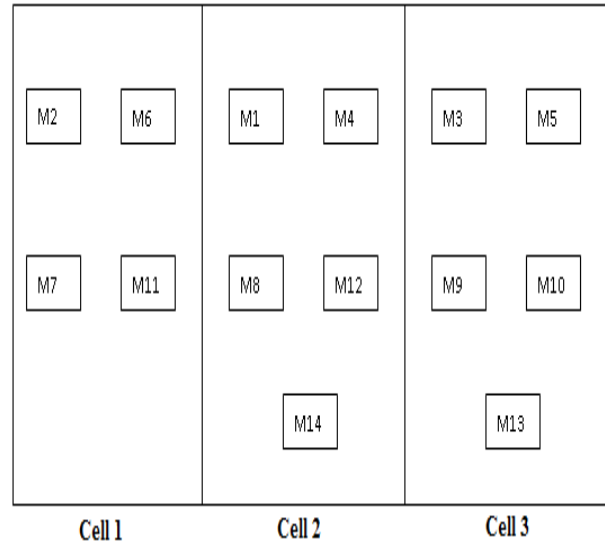


Figure 2 Machines in manufacturing cell

It is shown that part 1 is being processed at machines 3, 4 and 7. Now machine 3 is in cell 3, machine 4 is in cell 2 and machine 7 is in cell 1. So total number of cellular movements for part 1 is 3 and intercellular movements for part 1 are 2 respectively. Similarly intercellular movements for other parts can also be found e.g. Intercellular movements for parts 3, 7, 11, 15, 22, 26, and 30 are 2, 2, 0, 2, 0, 0, and 1 respectively.

**3.1 Calculation Methodology and Chromosome Representation**

For the chromosome [2 1 3 2 3 1 1 2 3 3 1 2 3 2], matrix  $X$  which shows information of different machines into manufacturing cells is written as:

$X_{il}$  is a machines\* cells matrix

$$X_{it} = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

$E_{ji}$  is a parts\*machines matrix; and  $A = E_{ji} * X_{it}$   
(parts\*machine matrix)\*(machine\*cell matrix)

Matrix A is a parts\*cells matrix showing number of parts movements to each manufacturing cell.

$Y_{ji}$  is 1 if part visits manufacturing cell and zero otherwise;

$B = Y_{ji}'$ ; matrix B is transpose of  $Y_{ji}$  matrix to calculate no. of cellular movements of each part.

Columns 1 through 13

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \end{bmatrix}$$

Columns 14 through 26

$$\begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

Columns 27 through 30

$$\begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

$C = \text{sum}(B)$

Matrix C shows number of cellular movements of each part.

Columns 1 through 13

$$[3 \ 3 \ 3 \ 3 \ 2 \ 2 \ 3 \ 2 \ 3 \ 2 \ 1 \ 2 \ 2]$$

Columns 14 through 26

$$[1 \ 3 \ 1 \ 2 \ 1 \ 1 \ 1 \ 2 \ 1 \ 1 \ 2 \ 2 \ 2 \ 1]$$

Columns 27 through 30

$$[1 \ 1 \ 3 \ 2]$$

$D = C-1$ ; matrix D shows number of inter cellular movements of each part

Columns 1 through 13

$$[2 \ 2 \ 2 \ 2 \ 1 \ 1 \ 2 \ 1 \ 2 \ 1 \ 0 \ 1 \ 1]$$

Columns 14 through 26

$$[0 \ 2 \ 0 \ 1 \ 0 \ 0 \ 1 \ 0 \ 0 \ 1 \ 1 \ 1 \ 0]$$

Columns 27 through 30

$$[0 \ 0 \ 2 \ 1]$$

$E = D'$ ; E is transpose of matrix D, transpose is taken so that it can be multiplied with matrix N

N = matrix N shows part demand for each part

Columns 1 through 13

$$N = [5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5]$$

Columns 14 through 26

$$[5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5]$$

Columns 27 through 30

$$[5 \ 5 \ 5 \ 5]$$

$$F = N * E = 140$$

For the chromosome mentioned above the total number of intercellular movements are 140 to manufacture thirty different parts of quantity five each. For easing the above mentioned calculation MAT LAB code has been developed and implemented.

Each population consists of ten chromosomes/individuals. Integer based chromosomes representation is used. Length of individual (LIND) = total number of machines:

$$[2 \ 1 \ 3 \ 2 \ 3 \ 1 \ 1 \ 2 \ 3 \ 3 \ 1 \ 2 \ 3 \ 2]$$

The chromosome shows that there are total 14 machines, and integers 1, 2, and 3 show numbers of manufacturing cells. Gene value varies from one to total number of manufacturing cells which is 3 in this case shows cell number. Further gene position shows the machine number and chromosome machines 2, 6, 7, and 11 are in cell 1, machines 1, 4, 8, 12, and 14 are in cell 2, and machines 3, 5, 9, 10, and 13 are in cell 3. The initial population is generated randomly. Initial population is denoted by P (0) and consists of 10 chromosomes.



$$P(0) = \begin{bmatrix} 23213123122313 \\ 13221321113223 \\ 11221332233133 \\ 23221132331132 \\ 13221321231133 \\ 11231233221312 \\ 13123112231233 \\ 13221321231331 \\ 32321311313122 \\ 23123212113221 \end{bmatrix}$$

**3.2 Evaluation and Generation**

**Evaluation of Generation 1**

Objective function values for the initial population (10 randomly generated chromosomes) are calculated by using code. The values are:

[155, 150, 120, 145, 130, 140, 120, 120, 170, 150]

Average value of fitness function = 140

The individuals in the current generation are used to create children that make up the next generation. Individuals in the current generation with the best fitness values are called elite children. Beside elite children genetic algorithm creates crossover children by selecting genes from a pair of individuals in the current generation and combines them to form children. the before and after crossovers are given below:

```

Parent 1  1 1 2 3 1 2 3 3 2 | 2 1 3 1 2
Parent 2  2 3 1 2 3 2 1 2 1 | 1 3 2 2 1
           Crossover point
After crossover

Child 1   1 1 2 3 1 2 3 3 2 1 3 2 2 1
Child 2   2 3 1 2 3 2 1 2 1 2 1 3 1 2
    
```

Crossover enables the algorithm to extract the best genes from different individuals and recombine them into superior children. Another important genetic algorithm operator is mutation. In mutation random changes are applied to a single individual in the current generation to create a child. For example

```

      ↓
Child 1  1 1 2 3 1 2 3 3 2 1 3 2 2 1  before mutation
      1 1 2 3 2 2 3 3 2 1 3 2 2 1  after mutation
      (Muted child)
    
```

Mutation increases the likelihood that algorithm will generate individuals with better fitness values otherwise algorithm could produce individuals whose genes were a subset of the combined genes in the initial population.

**Calculation for Second Generation**

Fitness function values from generation 1

[155, 150, 120, 145, 130, 140, 120, 170, 120, 150]

Average fitness function value = sum of the individual values/number of individual  
= 140

The steps to select individuals for 2<sup>nd</sup> generation in which 20% elitism criterion is used i.e. from 10 individuals in the generation 02 individuals with best fitness value will selected in 2<sup>nd</sup> generation. These are called elite children. The remaining 08 individuals are obtained by universal stochastic sampling and then new children for 2<sup>nd</sup> generation are created by crossover and mutation operations and shown in figure 2. Crossover probability of 0.7 is used which means that the number of crossover children will be 0.7\*8=5.6 rounded off to 06, and the remaining 02 children will be muted children.

Table 2 Fitness values and selection probability of chromosomes of initial population.

| Number of individuals | Fitness value | Selection probability = individual fitness value/ sum of individual values |
|-----------------------|---------------|--|
| 1                     | 155           | 0.110  |
| 2                     | 150           | 0.107  |
| 3                     | 120           | 0.085  |
| 4                     | 145           | 0.103  |
| 5                     | 130           | 0.092  |
| 6                     | 140           | 0.100  |
| 7                     | 120           | 0.085  |
| 8                     | 170           | 0.121  |
| 9                     | 120           | 0.085  |
| 10                    | 150           | 0.107  |

In stochastic sampling selection probability of each individual is calculated and represented on scale. To select 08 individuals so 08 pointers will be drawn according to the method: Say 1<sup>st</sup> pointer position is 0.1 as it should be in the range of [0, 1/8=0.125], Interval between pointers=total probability-position of 1<sup>st</sup> pointer/no. of pointers = 1.0-0.1/8 = 0.9/8=0.1125

So, 1<sup>st</sup> pointer is at 0.1, 2<sup>nd</sup> at 0.225 and so on.

0 0.110 0.217 0.302 0.405 0.497 0.597 0.682 0.803 0.888 1.0

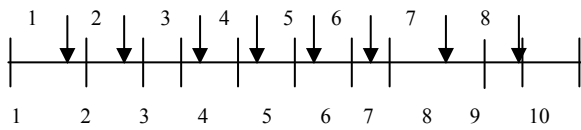
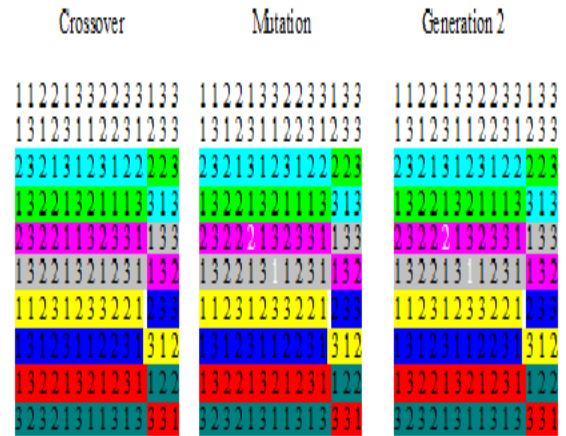


Figure 3 Stochastic Universal Sampling

By universal stochastic sampling individuals shown in figure 3, 10 are not selected and individuals 1, 2, 4, 5, 6, 7, 8, and 9 are selected to perform genetic operators (crossover and mutation) to generate next population (generation).

| Generation 1   | Fitness function Values | After universal stochastic sampling     |
|----------------|-------------------------|---|
| 23213123122313 | 155                     | 23213123122313                          |
| 13221321113223 | 150                     | 13221321113223                          |
| 11221332233133 | 120                     | Elite 1<br>not selected during sampling |
| 23221132331132 | 145                     | 23221132331132                          |
| 13221321231133 | 130                     | 13221321231133                          |
| 11231233221312 | 140                     | 11231233221312                          |
| 13123112231233 | 120                     | Elite 2<br>13123112231233               |
| 13221321231331 | 170                     | 13221321231331                          |
| 32321311313122 | 120                     | 32321311313122                          |
| 23123212113221 | 150                     | not selected during sampling            |
| 1              | 11221332233133          | Elite 1                                 |
| 2              | 13123112231233          | Elite 2                                 |
| 3              | 23213123122313          |   |
| 4              | 3221321113223           |   |
| 5              | 23221132331132          |   |
| 6              | 13221321231133          |   |
| 7              | 11231233221312          |   |
| 8              | 13123112231233          |   |
| 9              | 13221321231331          |   |
| 10             | 32321311313122          |   |

After crossover of chromosomes 3&4, 5&6, 7&8, and 9&10; and mutation of 5&6



Evaluation of Generation 2

Fitness function value of each chromosome in generation 2 is calculated by using MAT LAB and method given above. The fitness values are: [120, 120, 145, 125, 140, 140, 155, 140, 140, 155]

Average value of fitness function for generation 2 = 138 and comparison of generation 1 and 2 is shown in figure 4.

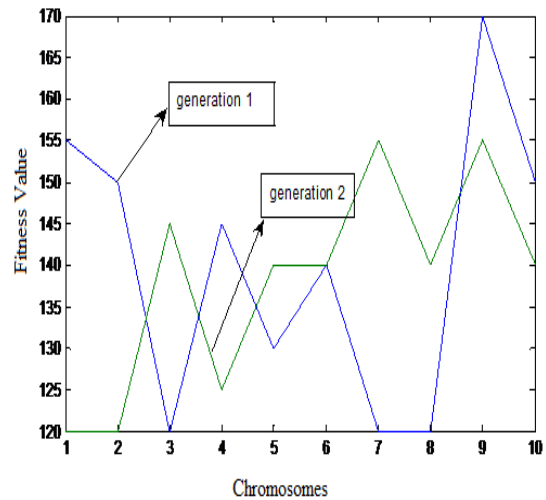


Figure 4 Comparison of fitness values of generation 1 and 2.

In the same way total 10 generations/populations are created by GA procedure and the fitness values are calculated for each chromosome in the generations. A generation gap (GGAP) of 0.1 is used

for generation number 6, 7, 9, and 10. This means that only 1 Chromosome is replaced by new chromosome in the selected individuals of generations 5, 6, 8, and 9 used to create generations 6, 7, 9, and 10. The particular chromosome that is being replaced having largest fitness value and objective is to minimize the intercellular movements of parts so chromosome with largest fitness value is replaced by new one.

#### 4. Analysis and Discussion

In the process of evolution from generation 1 to 10 by using genetic operators and code, there is a random variation in the values of fitness function of chromosomes. During this process the weakest individuals tend to die over the period of time i.e. in the next generations.

| Generation 1       | Generation 10      |
|--------------------|--------------------|
| 23213123122313 155 | 13332111233331 75  |
| 13221321113223 150 | 33222111223321 80  |
| 11221332233133 120 | 23222112231131 115 |
| 23221132331132 145 | 23222111123321 85  |
| 13221321231133 130 | 13213111233331 100 |
| 11231233221312 140 | 33222111223331 80  |
| 13123112231233 120 | 13122111223321 95  |
| 13221321231331 170 | 13223111223321 105 |
| 32321311313122 120 | 23331111233331 75  |
| 23123212113221 150 | 13222112231131 110 |

Figure 4 compares the fitness values of chromosomes of generations 1, 5 and 10. It is clear that in the process of evolution by using GA the fitness value i.e. the intercellular movement of parts is decreasing. The process of evolution from generation 1 to generation 10 the chromosomes with the best fitness values tend to survive and the chromosomes with which least fit are replaced by new chromosomes by using different genetic operators. The use of different genetic operators enables the population size (number of chromosomes) to remain constant from generation 1 to generation 10 and fitness values of different chromosomes can be compared as shown in figure 4. The areas of search space with better fitness values are identified. Generation 10 has chromosomes 1, 9 with fitness value 75, chromosomes 2, 6 have fitness value 80 and the chromosome 7 has fitness value 85. These close fitness values (minimum number of intercellular movements) are very encouraging in making decisions where the best solution cannot be implemented due to economic constraints. The figure

5 shows the effectiveness of GA in the formation of manufacturing cells.

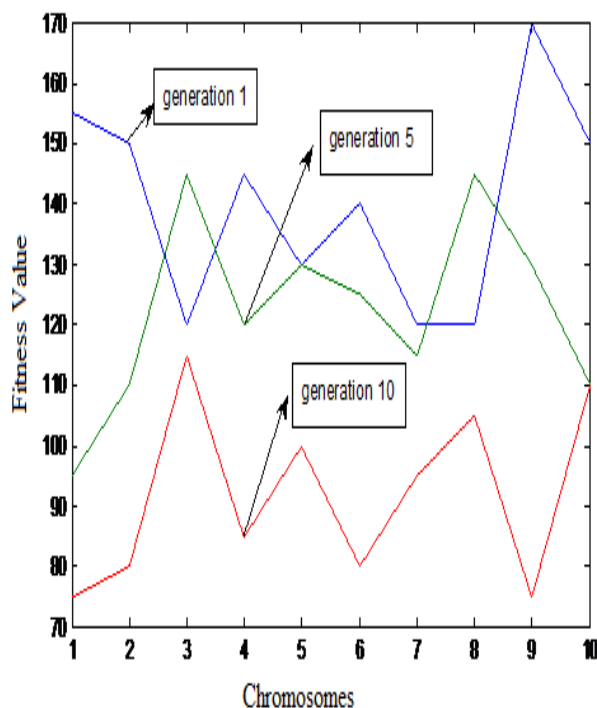


Figure 4 Comparison of fitness values of generations 1, 5 & 10.

Figure 5 shows the values of chromosome in each generation. It is evident from figure 5 that fitness values change randomly in the process of evolution. The figure 6 shows fitness values of elite chromosomes at each generation. As total number of generations are 10 and 20% elitism criteria has been used so figure 6 shows the fitness values of 20 elite chromosomes. For first two generations the fitness value of elite chromosomes is constant. Proceeding towards next generations in the evolutionary process there are random changes in the fitness values of chromosomes for generations 4, 5, and 6. For generations 7, 8, and 9 there are slight changes in fitness values of chromosomes with the fitness value decreasing all the time. Last generations 02 chromosomes with minimum fitness value is obtained.

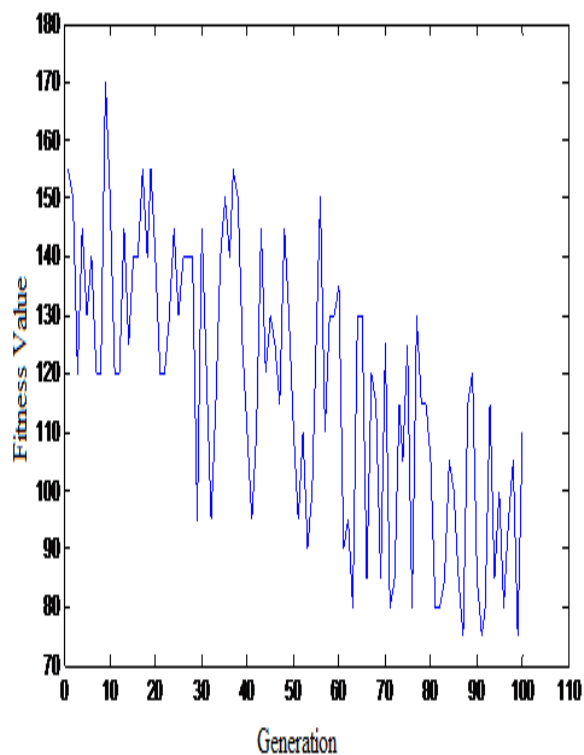


Figure 5 Fitness value of each chromosome in all generations.

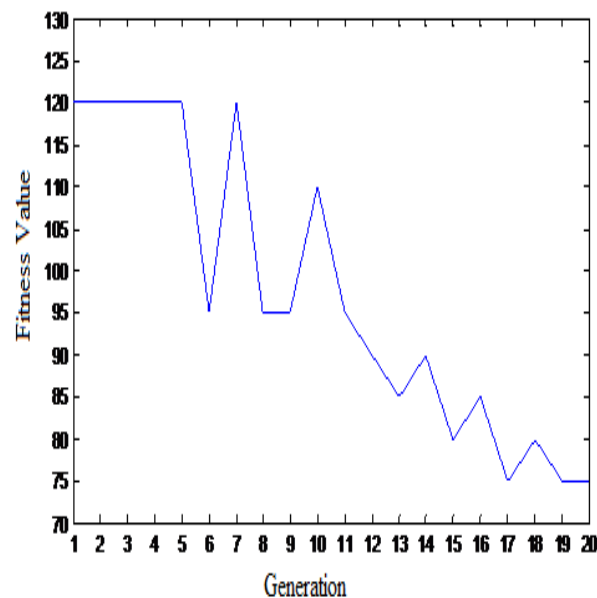


Figure 6 Fitness values of elite chromosomes at each generation.

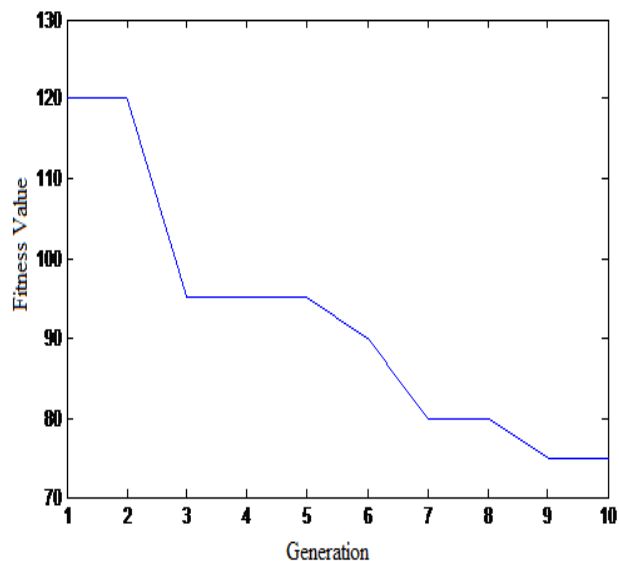


Figure 7 Lowest fitness values at each generation.

The figure 7 shows the lowest fitness value at each generation. For generation 1 the lowest value of fitness function is 120 and for last generation the lowest value is 75. Hence the value of fitness function i.e. the intercellular movement of parts is considerably reduced from generation 1 to 10.

The figure 8 shows the average fitness function value at each generation. The average value of fitness function for generation 1 is 140 and in the process of evolution it has minimized to 92 for generation 10. Hence it is found that intercellular movements of parts are minimized by genetic algorithm approach. The plotted results show slow move towards the optimized value (minimum value of intercellular movement of parts). Although the process towards optimization is slow but it is encouraging that GA can produce optimized results for complex problems faced in modern manufacturing systems.

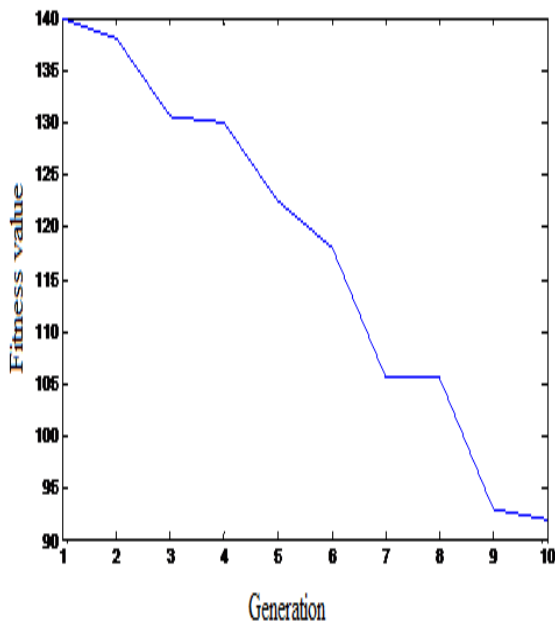


Figure 8 Average fitness values at each generation.

## 5. Conclusion

It is evident that genetic approach has minimized intercellular movements of parts i.e. for generation 1, the minimum value of intercellular movements is 120 and in the process of evolution in the next generations the value of intercellular has minimized continuously reaching the minimum value of 75 for generation 10. Minimization of the intercellular movements will result in material handling cost reduction which indirectly improve productivity, profitability and give competitive edge to the manufacturing enterprise. The set of solutions gives the flexibility required in manufacturing systems where certain things may happen which will not allow the best solution to be implemented due economic constraints and decision maker can choose other solutions which are not the best but good without having to run the program again. A small change in the value and position of gene in a chromosome causes significant reduction in intercellular movements of parts thus enabling us to make flexible decisions. Hence it is concluded that even changing the position of one machine in a cellular manufacturing system results in significant optimization results. The fitness value of elite chromosomes at first 02 generations is constant. In the evolutionary process for generations 3, 4, 5 and 6 there are random changes in the fitness values of elite chromosomes. There are slight changes in the fitness

values of elite chromosomes for generations 7, 8, and 9. This shows that the implementation of GA procedure in the formation of manufacturing cells gradually improves the search space until a minimum fitness value is achieved for last generation. The last generation has 02 elite chromosomes with the same fitness value. In this paper genetic algorithm approach has been used to minimize the intercellular movements of parts for the formation of manufacturing cells and the algorithm developed is for parts which are being processed on different machines. Development and modification of the algorithm to include alternative machines is a subject of further research. In this work fitness function is for one objective i.e. to minimize the intercellular movement of parts; a multi-objective genetic algorithm fitness function can be generated. By applying different genetic operators (different types of crossover, mutation, and reinsertion) and parameter settings in the evolutionary process, comparative effectiveness of the GA operators and algorithm can be checked and used for fine-tuning of solutions obtained from evolutionary process. Further research work is to minimize the backtracking movements of parts for the formation of manufacturing cells in cellular manufacturing systems.

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## A very short note on the best bounds in Sandor and Debnath's inequality

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**Abstract:** In this short note, we discuss the best bounds of the Sandor and Debnath's inequality and we obtain in simple proof that

$$\frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x-(2\gamma-1)}} < \Gamma(x) < \frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x-1/6}}, \quad x > 1$$

where  $\gamma$  is the Euler- Mascheroni constant.

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**Key Words:** Stirling's formula, Sandor and Debnath's inequality, gamma function, digamma function, factorial  $n$ , best bounds.

MSC 2010 classification : 33B15, 26D07, 40A25.

### 1 Introduction.

Stirling's formula for factorials in its simplest form is

$$n! \sim \sqrt{2\pi} n \left(\frac{n}{e}\right)^n \quad (1)$$

This approximation is used in many applications, especially in statistics and in the theory of probability to help estimate the value of  $n!$ , where  $\sim$  is used to indicate that the ratio of the two sides goes to 1 as  $n$  goes to  $\infty$ . In other words, we have

$$\lim_{n \rightarrow \infty} \frac{n!}{n^{n+1/2} e^{-n}} = \sqrt{2\pi}.$$

Stirling's formula was actually discovered by De Moivre (1667-1754) but James Stirling (1692-1770) improved it by finding the value of the constant  $\sqrt{2\pi}$ . A number of upper and lower bounds for  $n!$  have been obtained by various authors [4].

J. Sandor and L. Debnath [7] found the following double inequality

$$\frac{e^{-n}\sqrt{2\pi}n^{n+1}}{\sqrt{n}} < n! < \frac{e^{-n}\sqrt{2\pi}n^{n+1}}{\sqrt{n-1}} \quad n \geq 2 \quad (2)$$

After that, this formula and other similar estimations were established by Guo [3]. N. Batir [1] refined and extended the double inequality (2) to the form for  $n \geq 1$

$$\alpha_n = \frac{e^{-n}\sqrt{2\pi}n^{n+1}}{\sqrt{n-(1-2\pi e^{-2})}} < n! < \frac{e^{-n}\sqrt{2\pi}n^{n+1}}{\sqrt{n-1/6}} = \beta_n \quad (3)$$

which is better than the Burnside's formula for [2]

$$n! \sim \sqrt{2\pi} \left(\frac{n+1/2}{e}\right)^{n+1/2} \quad (4).$$

C. Mortici [5] discuss in the double inequality (2) and established an asymptotic expansion, leading to a new accurate approximation formula which provides all exact digits of  $n!$ , for every  $n \leq 28$ . Mortici's formula is stronger than the upper bound  $\beta_n$  in the double inequality (3).

In this short note, we will improve the lower bound of the double inequality (3) and we will prove its upper bound by different method. Throughout this work, the logarithmic derivative of the gamma function

$$\Gamma(x) = \int_0^{\infty} t^{x-1} e^{-t} dt,$$

denoted by

$$\psi(x) = \frac{\Gamma'(x)}{\Gamma(x)},$$

is called the psi or digamma function. One of the elementary properties of the gamma function is the functional equation  $\Gamma(x+1) = x\Gamma(x)$ , in particular  $n! = \Gamma(n+1)$ .

In order to prove our main result we need the following Theorem

### Theorem 1.

For  $x > 1$

$$\begin{aligned} \log x - \frac{1}{2x} - \frac{1}{12x^2} &< \psi(x) \\ &< \log x - \frac{1}{2x} - \frac{2\gamma - 1}{2x^2}, \end{aligned} \quad (5)$$

where  $\gamma$  is the Euler-Mascheroni constant.

**2 Main result**

Our main result is the following Theorem:

**Theorem 2.**

For  $x > 1$

$$\frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x - (2\gamma - 1)}} < \Gamma(x) < \frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x - 1/6}}, \quad (6)$$

where  $\gamma$  is the Euler-Mascheroni constant.

**Proof.**

Let the function

$$M_\theta(x) = \frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x - \theta}} \Gamma(x), \quad x > \theta > 0. \quad (7)$$

It is clear that

$$M_{\theta_1}(x) < M_{\theta_2}(x), \quad \forall \theta_1 < \theta_2, \quad (8)$$

which means that  $M_\theta(x)$  is increasing function w.r.t.  $\theta$ . Also,

$$\lim_{x \rightarrow \infty} M_\theta(x) = 1. \quad (9)$$

Now

$$\begin{aligned} \frac{d}{dx} M_\theta(x) = M_\theta(x) &\left( \frac{-1}{2(x - \theta)} + \log x \right. \\ &\left. - \psi(x) \right) \end{aligned} \quad (10)$$

There are two cases:

The first case if we take

$$\log x - \frac{1}{2x} - \frac{1}{12x^2} < \psi(x),$$

then we get for  $x > 1, \beta$  that

$$\begin{aligned} \frac{d}{dx} M_\beta(x) &< M_\beta(x) \left( \frac{-1}{2(x - \beta)} + \frac{1}{2x} + \frac{1}{12x^2} \right) \\ &< M_\beta(x) \left( \frac{x - (1 + 6x)\beta}{12x^2(x - \beta)} \right) \\ &< 0 \end{aligned}$$

if  $x - (1 + 6x)\beta \leq 0$ , which satisfies if  $\beta \geq 1/6$ . Then the function  $M_\beta(x)$  is decreasing function for  $\beta \geq 1/6$  and  $x > 1$ . But

$$\lim_{x \rightarrow \infty} M_\beta(x) = 1,$$

then we obtain

$$M_\beta(x) > 1, \quad \beta \geq \frac{1}{6}; \quad x > 1 \quad (11)$$

Also,  $M_\beta(x)$  is increasing function w.r.t.  $\beta$ , then

$$M_\beta(x) > M_{1/6}(x) > 1, \quad \beta > \frac{1}{6}; \quad x > 1$$

which give us the following best upper bound of Sandor and Debnath's inequality

$$\Gamma(x) < \frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x - 1/6}}, \quad x > 1. \quad (12)$$

The second case if we take

$$\psi(x) < \log x - \frac{1}{2x} - \frac{2\gamma - 1}{2x^2},$$

then we get for  $x > 1, \mu$  that

$$\begin{aligned} \frac{d}{dx} M_\mu(x) &> M_\mu(x) \left( \frac{-1}{2(x - \mu)} + \frac{1}{2x} + \frac{2\gamma - 1}{2x^2} \right) \\ &> M_\mu(x) \left( \frac{(x - \mu)(2\gamma - 1) - \mu x}{2x^2(x - \mu)} \right) \\ &> 0 \end{aligned}$$

if  $(x - \mu)(2\gamma - 1) - \mu x \geq 0$ , which equivalent

$$\mu \leq \frac{x}{1 + \frac{2\gamma - 1}{x}} \leq 2\gamma - 1 \quad \forall x > 1.$$

Then the function  $M_\mu(x)$  is increasing function

for  $\mu \leq 2\gamma - 1$  and  $x > 1$ . But  $\lim_{x \rightarrow \infty} M_\mu(x) = 1,$

then we obtain

$$M_\mu(x) < 1, \quad \mu \leq 2\gamma - 1; \quad x > 1. \quad (13)$$

Also,  $M_\mu(x)$  is increasing function w.r.t.  $\mu$ , then

$$M_\mu(x) \leq M_{2\gamma - 1}(x) < 1, \quad \mu \leq 2\gamma - 1; \quad x > 1$$

which give us the following best lower bound of Sandor and Debnath's inequality

$$\Gamma(x) > \frac{e^{-x}\sqrt{2\pi}x^x}{\sqrt{x - (2\gamma - 1)}}, \quad x > 1. \quad (14)$$

In particular, if we put  $x = 1$  in (6), we have for  $n > 1$

$$\begin{aligned} \mu_n &= \frac{e^{-n}\sqrt{2\pi}n^{n+1}}{\sqrt{n - (2\gamma - 1)}} < n! \\ &< \frac{e^{-n}\sqrt{2\pi}n^{n+1}}{\sqrt{n - 1/6}} = \beta_n \end{aligned} \quad (15)$$

It is clear that  $1 - 2\pi e^{-2} < 2\gamma - 1$ , which gives us that  $\alpha_n < \mu_n < n!$  for  $n > 1$ . Then the lower bound of (15) is better than the lower bound of (3).

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## Treatment of ipsilateral femoral neck and shaft fractures

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**Abstract: Background:** No consensus exists regarding the optimal treatment of ipsilateral femoral neck and shaft fractures. We report our experience of managing 13 patients with ipsilateral femoral neck and shaft fractures by using either cannulated screws or dynamic hip screws for the neck and retrograde femoral nail for the shaft.

The purpose of this study is to evaluate the function; outcome and healing of that complicated fractures. **Material and methods:** A consent was taken from thirteen patients who sustained ipsilateral femoral shaft and neck fractures from January 2007 and March 2011 in El Minoufiya University Hospital in Egypt. 10 patients with fracture neck femur had been treated with cannulated screws while 3 patients were treated by dynamic hip screw. all fractures shaft had been treated with retrograde femoral nail. The mean follow up period was 18 months with range from 12-36 months.

**Results:** There were 10 males and 3 females. The average age was 31 years old with range of 19-45years. The mean follow up period was 18 months with range from 12-36 months. The average healing period of femoral neck fracture was 14 weeks and all femoral neck fractures united. Average union time for femoral shaft fractures was 19 weeks (range, 16–36 weeks). Three femoral shaft fractures needed bone graft at six months. **Conclusions:** The treatment methods used in the present study achieved satisfactory functional outcome in these complex fractures. The femoral neck fracture should preferably be stabilized first.

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**Keywords:** Ipsilateral femoral neck and shaft fracture, retrograde femoral nail, cannulated screws.

### 1. Introduction

Ipsilateral fractures of the femoral neck and shaft were first reported in 1953<sup>(1)</sup>.

Combined fractures of neck femur and femoral shaft are the result of high energy trauma, such as motor vehicle accidents (MVA) and falls from heights. The fracture occurs when hip is axially loaded while leg is abducted.<sup>(2)</sup>

A number of issues increase the difficulty and complexity of managing a combined femoral neck–shaft injury as compared with addressing either fracture alone. The optimal timing of fixation, sequence of fracture fixation, and implant selection must be considered, yet little data exist regarding the optimal management of these fractures. It is clear, however, that excellent reduction of both fractures is the goal of treatment of this injury pattern.<sup>(3-9)</sup>

The ideal fixation strategy for high-energy ipsilateral femoral neck and shaft fractures remains controversial. Although a general consensus exists that early fixation of these injuries is appropriate, the prioritization of fractures and optimal implant selection in the operating room remain to be defined.

Many implant options exist to manage the combined neck–shaft injury. These include antegrade femoral nailing with cancellous screws placed around the nail for the neck fracture, cephalomedullary nailing using the proximal interlocking screws for neck fixation, plate fixation of the diaphyseal fracture with cancellous screw or sliding hip screw fixation of the neck fracture, and retrograde intramedullary

nailing for shaft fixation with cancellous screw or sliding hip screw fixation of the diaphyseal fracture. All these techniques have demonstrated varying degrees of success, with reported rates of femoral neck and shaft nonunions as high as 25% and 10%, respectively. No studies to date have conclusively demonstrated superiority of any particular devices on long term clinical outcomes.<sup>(10)</sup>

Currently, there is no biomechanical evidence in the literature to support a particular construct combination from the numerous available options for ipsilateral neck and femoral shaft fracture fixation.

### 2. Material and methods

Between January 2007 and March 2011 in El Minoufiya University Hospital in Egypt, 13 patients with ipsilateral fracture neck femur and femoral shaft fracture had been treated with either cannulated screws or dynamic hip screw for fracture neck femur and retrograde femoral nail for fracture shaft femur. Patients with neck and shaft fractures more than eighteen years of age were included. All peritrochanteric fracture, iatrogenic neck fractures and fracture proximal third femur were excluded. There were 10 males and 3 females. The mean age was 31 years old with range of 19-45years. 8 patients had non-displaced fracture neck femur (Garden I or II) while 5 patients were displaced (Garden III). All fractures shaft femur were displaced and 2 patients were open and had Gustilo-Anderson type I. Nine

patients had a femoral shaft fracture in the middle third and four in the distal third. According to the Winquist-Hansen classification, there were 2 patients type I, 7 patients type II, 4 patients type III. All fractures were treated emergently within 48 hours of the injuries. Two patients had associated injuries, one had ipsilateral fracture both bone leg which was treated by interlocking tibial nail while the second had fracture patella which was treated by tension band.

Surgery was performed with the patient in a supine position with fractured limb on sterile radiolucent table and knee flexed 90 degree. With this positioning, movement of the C arm is free in both AP and lateral position around the hip and thigh.

Fracture neck femur was fixed first, non-displaced fractures neck femur (Garden I or II) were fixed by three cannulated screws without manipulation. Displaced fractures neck femur (Garden III) was reduced by gentle manipulation except in one case where open reduction had been done.

A midline incision from the upper pole of the patella to tibial tubercle, then medial parapatellar approach is done to expose intercondylar notch. A wire was placed 1cm anterior to attachment of anterior cruciate ligament, in midline of the shaft in both AP

and lateral view. Guide wire is introduced and trial reduction is attempted by applying manual traction. In 10 cases closed reduction had succeeded while in 3 cases closed reduction had been failed, so open reduction had been done. All cases were fixed by retrograde interlocking nail femur.

Operations were performed within a mean of 48 hours following trauma

All patients received perioperative antibiotic prophylaxis in the injection form 1 h before surgery until the seventh postoperative day followed by oral antibiotic until removal of stitches. On the second postoperative day, range of movement exercises was started. Non touch weight bearing was allowed using crutches after stitches removal.

### 3. Results

The mean follow up period was 18 months with range from 12-36 months

Patients were followed at monthly intervals up to six months, then at three monthly intervals up to one year, and then every six months up to the last follow-up. The follow-up study included both clinical and radiological evaluations.

**Table I: The function assessment system adapted from Friedman and Wyman, 1986**

| Result | Activities of daily living | Pain             | Range of motion                          |
|--------|----------------------------|------------------|--|
| Good   | No limitation              | Nil              | Less than 20% loss of hip or knee        |
| Fair   | Mild limitation            | Mild to moderate | 20%–50% loss of hip or knee motion       |
| Poor   | Moderate limitation        | Severe           | More than 50% loss of hip or knee motion |

Nine cases were good, three cases were fair and only one case was poor.

The poor result was attributed to open reduction of the femoral neck and delayed union of the femoral shaft and the patient had more than 50% limitation of knee motion.

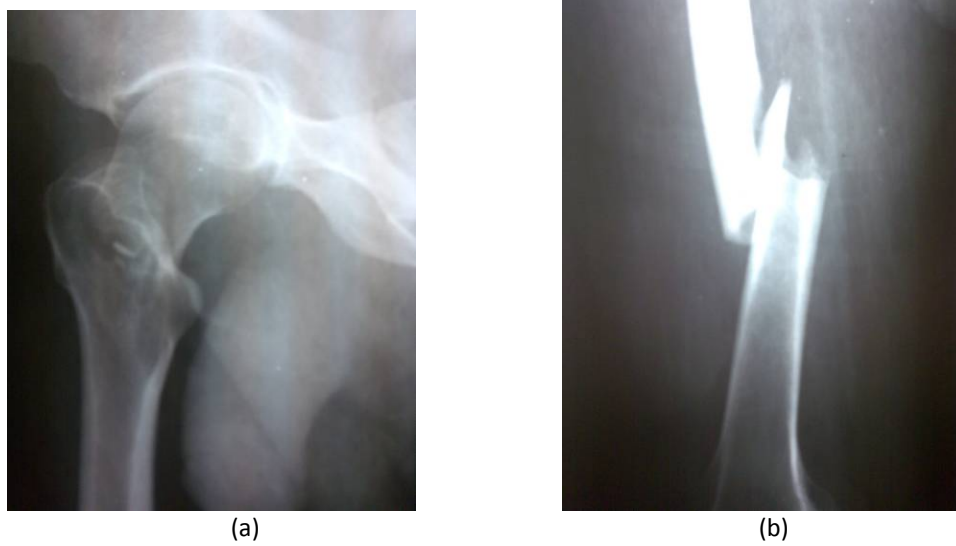
Progressive weight bearing was allowed after the appearance of callus on radiographs. Postoperative radiographs follow up were done for all cases to assess accuracy of fracture reduction, progression to union and early detection of femoral head osteonecrosis.

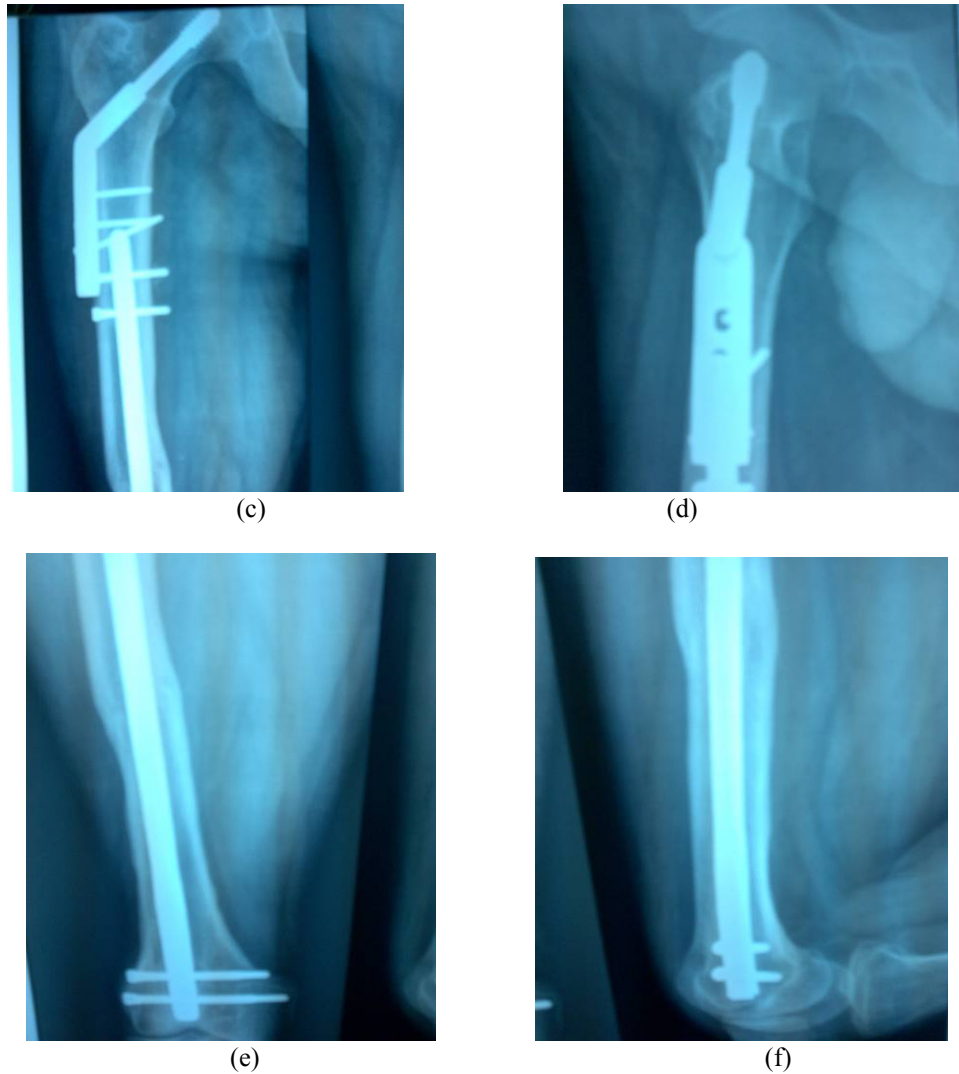
The average healing period of femoral neck fracture was 14 weeks and all femoral neck fractures united. Neither osteonecrosis of femoral head nor fracture neck femur nonunion was observed.

The shaft fracture is often highly comminuted, reflecting the high-energy nature of this injury. Average union time for femoral shaft fractures was 19 weeks (range, 16–36 weeks). Three femoral shaft fractures needed bone graft at six months and on 9 months follow up, those united without further interventions.



**Figure 1: (a) Preoperative radiograph of 25 years old male with RTA (b)and (c) Postoperative radiograph 6 months showing complete union at 6 months follow up.**





**Figure 2 (a) (b) Preoperative radiograph of 39 years old male with RTA  
(c) (d) (e) (f) Postoperative radiograph showing complete union at 9 months follow up.**

#### 4. Discussion

Ipsilateral fracture neck femur and fracture shaft femur represent complex fracture pattern so it is mandatory to do plain antero-posterior and lateral views of the hip to avoid miss diagnosis of fracture neck femur in each fracture shaft femur. The majority of the patients in the present series were young males with high-energy trauma, as also reported in the literature. Femoral neck fractures were most often basilar in the present series and in other series. <sup>(2)</sup>

Although evidence has been presented to support fracture fixation in either sequence, the most devastating potential sequelae involve the management of the femoral neck fracture. Delayed fixation of displaced neck fractures has been shown to be associated with an increased risk of a vascular necrosis. Due to the lack of successful salvage options for femoral head osteonecrosis in the young adult,

prioritization of formal reduction and internal fixation of the displaced neck fracture has been advocated

Though there is confusion regarding which fracture should be managed first, there appears to be a general consensus regarding the seriousness of the complications involving femoral neck fractures so we stabilized femoral neck fractures first in all patients.

There is still no consensus on the optimal treatment method for these complex fractures. In a meta-analysis of the reports published in the literature, the locked intramedullary nails or reconstruction nails yielded results that were superior to those for combinations of plates. The plate series was associated with more frequent infections and nonunion, while the nail fixations were complicated by rotatory malalignments and shortenings.

The choice of the implant was influenced by the surgeon's preference. Kao has found

reconstruction nailing to be technically demanding. It is difficult to achieve reductions in displaced femoral neck fractures in such complex injuries with reconstruction nailing, and varus nonunion or malunion can occur.<sup>(11)</sup>

In our series, fractures with neck fractures were managed effectively with 2 devices. In all cases, anatomic neck alignment was maintained; fixation of the femoral neck was performed in all cases with a screw, before nail passage, and we feel that this was an important factor in preventing displacement of the femoral neck fracture during shaft fixation.

Singh *et al.*, stated that the choice of the treatment method should be dictated primarily by the type of femoral neck fracture and the surgeons familiarity with the treatment method chosen. The femoral neck fracture should preferably be stabilized first, and a delay of 56 days does not affect the ultimate functional outcome.<sup>(1)</sup>

Watson and Moed also reported more femoral shaft non unions than expected in their series, requiring more revision procedures than femoral neck non unions to achieve union.<sup>(12)</sup>

Bedi *et al.*, stated that open reduction and internal fixation of a displaced femoral neck fracture followed by retrograde nailing of the femoral shaft allowed accurate reduction and uneventful union of both fractures in most patients. The use of a cephalomedullary device to address both fractures simultaneously led to a significantly higher rate of mal reduction of one of the fractures.<sup>(13)</sup>

## 5. Conclusion

Fracture neck femur in ipsilateral fracture neck femur and fracture shaft femur differ from isolated fracture neck femur in that most of energy is absorbed by the fracture shaft lead to non displaced or partially displaced fracture which reflect on the incidence of union and osteonecrosis; while in isolated neck fracture almost all energy is absorbed by fracture neck which may result in markedly displaced fracture. Uses of cannulated screws or dynamic hip screw for fixation of fracture neck femur and uses of retrograde interlocking nail for femoral shaft fracture achieved satisfactory functional outcome in these complex fractures.

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## Impact of Leptin Receptor Gene GLN223ARG Polymorphism on Obesity in Jeddah City

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**Abstract:** Obesity is a major global epidemic problem. Obesity results from the combined effects of genes, environment, lifestyle and the interactions of these factors. The leptin receptor gene plays a critical role in the regulation of body weight. Genetic variations of leptin receptor gene may play a role in the pathophysiology of human obesity. In this study, the association between the LepR gene polymorphism and obesity in Jeddah population was evaluated by determine the distribution of alleles frequency of the leptin receptor GLN223ARG polymorphism in 180 volunteers (94 males & 86 females). Each gender was divided into 2 groups: Children and Teenager (6-17 years old), and Adults (18-27 years old). As well as each group were divided into 2 sub-groups according to BMI obese and non obese (control). When comparison the obese and non obese groups, results demonstrated that no significant difference between genotype distribution and body mass index (BMI), weight, hip, waist and waist-hip ratio (WHR). In contrast, there was a significant increase in GG genotype (OR= 19.11, 95%CI: 0.95-384.95,  $P=0.01$ ) compared to AA genotype, and GG genotype (OR= 25.24, 95%CI: 1.25-509.46,  $P=0.006$ ) compared to AG genotype in males children and teenagers, which suggests that genetic polymorphisms (GLN223ARG) of leptin receptor gene may play a role in prevalence of obesity in children and teenagers males group.

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**Key word:** Obesity, Leptin receptor gene, Jeddah city, weight, waist.

### 1. Introduction

Obesity is a major global epidemic problem and it is a complex disorder resulting from a net imbalance between genetic, energy intake and expenditure. Obesity results from the combined effects of genes, environment, lifestyle and the interactions of these factors (**Bouchard, 1994** and **Mantzoros, 1999**). Obesity is the most common nutritional problem in the United States (**Devlin, 2002**) and increasing in Kingdom of Saudi Arabia (KSA) (**Al-Nozha et al., 2005**). Previous studies in KSA, conducted from 1990 to 1993, have shown an overall prevalence of obesity of 22.1% and approximately 53% of Saudi adults are either overweight or obese (**Al-Nozha et al., 2005**). Obesity rate in Saudi Arabia was much higher, especially among females (**Al-Othaimen et al., 2007**). This indicates that health authorities need to address the problem, for example with a campaign for nutrition education and physical activity for the general population.

Childhood obesity increases the risk of obesity in adulthood. **Whitaker et al., (1997)** found that obesity is an increasingly important predictor of adult obesity among older children. Moreover, overweight in adolescence predicts a broad range of adverse health effects (**Must et al., 1992**) Therefore, it is important to identify the cause of obesity, and to prevent obesity in childhood.

The name leptin was derived from the Greek word λεπτοσ: root leptos, meaning thin, because it

induces weight loss when injected in mice (**Mouzon et al., 2006**). This name was proposed by (**Halaas et al., 1995**) for the fat-regulating hormone Leptin is an adipose-derived cytokine present in the circulation in amounts proportional to fat mass (**Mergen et al., 2007**) encoded by the obese (Ob) gene localized on human and mouse 7 and 6 chromosomes, respectively. The Ob gene was first discovered in adipose tissue of the obese mouse through positional cloning. The full coding sequence contains 167 amino acids and represents a 21-amino-acid signal peptide and 146-amino-acid circulating bioactive hormone. In both human and mouse, the leptin gene is composed of three exons and two introns (**Bagchi and Preuss, 2007**).

The Ob gene is highly conserved among vertebrates. Mouse leptin shares 84% sequence identity to the product of the human Ob gene. When mutated Ob gene, the Ob gene is no longer deliver its appetite-suppressing message. The mice consequently develop a syndrome that resembles extreme obesity and type 2 diabetes in humans (**Munsch and Beglinger, 2005**).

Leptin circulates in blood as a 16 kDa monomeric protein, (**Munsch and Beglinger, 2005; Castracane and Henson, 2006; Mouzon et al., 2006**), which is mainly but not exclusively produced by white adipose tissue (WAT) as a negative feedback response to maintain body weight by regulating appetite and fat metabolism (**Ahima, 2006; Prieur et al., 2008**). Leptin acts as a signal to help the

body decide when it has eaten enough food to feel full. Leptin levels in WAT and plasma are related to energy stores, such that leptin increases in well fed state and decreases during fasting (Ahima, 2006). Leptin levels fits the criteria for a feedback signal from body energy stores to the brain as defined by Kennedy in 1953: leptin levels drop during starvation, when fat depots are depleted to support the organism's basic energy needs, and leptin levels rise during refeeding where fat depots are replenished (Kennedy 1953; Münzberg *et al.*, 2005).

The leptin receptor plays a critical role in the regulation of body weight, fat storage and energy homeostasis. In several studies it could be shown that LepR variations can lead to extreme obesity. The leptin receptor is encoded by the diabetes (db) gene (Matsuoka *et al.*, 1997). Were the first to isolate and describe the leptin receptor (LepR) in mice. The human LepR gene is found on chromosome 1p31, spans about 70 kb, and contains 20 exons (Thompson\* *et al.*, 1997). Leptin is predominantly produced by adipocytes, but leptin receptors are located in many tissues, in organs involved in energy storage, metabolism and digestion, such as skeletal muscle, adipose tissue, pancreas, stomach, small intestine, colon and liver. There are many peripheral tissues as sites of LepR, such as brain (the choroid plexus and hypothalamus), the lungs, kidneys, adrenals, ovaries, uterus and testes. LepR can be also found in tissue related to immunity, such as spleen, thymus, lymph nodes haematopoietic cells and T-cells (Frühbeck, 2001; Margetic *et al.*, 2002; Bjorbaek and Kahn, 2004; Bagchi and Preuss, 2007)

Single Nucleotide Polymorphisms (SNPs) are the most common genetic variants. SNPs are a single base substitution of one nucleotide with another throughout the human genome, in both coding and non-coding regions. This type of polymorphisms is the most common variations among individuals (Venter *et al.*, 2001). Several such polymorphisms exist in the leptin receptor gene including these at codons 109, 204, 223, 343, 492, 656, 976 and 1019. Were the first to identify a single nucleotide polymorphism in the coding region of the leptin receptor gene, GLN223ARG or Q223R. The GLN223ARG polymorphism, characterized by an adenine (A) to guanine (G) transition at position 668 of codon 223 in exon 6 in the extracellular domain of LepR, results in an amino acid substitution (a glutamine with an arginine) (CAG to CGG) (Gotoda *et al.*, 1997; Thompson *et al.*, 1997; Richert *et al.*, 2007).

The GLN223ARG mutation has shown greater consistency in their association with obesity in different population studies. It has been suggested that the change of amino acid glutamine (GLN or Q)

by an arginine (ARG or R) causes a change of electric charge from neutral to positive, which can affect the functional characteristics of the receptor and is thought to be associated with an impaired signaling capacity of the leptin receptor and with higher mean circulating levels of leptin. Numerous analyses of LepR SNPs have been published over the last decade. The SNP GLN223ARG (A>G) has been studied extensively in a wide range of populations, several studies have associated this variant with obesity but results were discordant (Matsuoka *et al.*, 1997; Yiannakouris *et al.*, 2001; Duarte *et al.*, 2006; Duarte *et al.*, 2007; Constantin *et al.*, 2010).

The GLN223ARG leptin receptor polymorphism investigated in this study results from the substitution of amino acid from glutamine (CAG) to arginine (CGG) in the extracellular domain of the receptor. This may results in altered leptin binding and therefore, receptor dimerization and signaling capacity of the leptin receptor. To investigate the frequency of the GLN223ARG alleles in Jeddah population, DNA extracted from blood samples, digestion of the PCR product with the restriction enzyme *MspI* for detection of the alleles of GLN223ARG and Statistical analysis.

## 2- Materials and Methods

### Human subjects:

This study was approved by the ethical Committee (unit of biomedical ethics) from King Abdulaziz University; all participants gave their written informed consent of their participation. The study included 180 participant (94 males and 86 females) randomly selected from Jeddah city population, aged 6 to 27 years. The blood samples of the subjects were collected from King Abdulaziz University Hospital in Jeddah. All the participants underwent complete physical examination. At the time of blood collection, information was recorded for all subjects, including height and weight (waist (WC), and hip circumferences (HC) only for females). All volunteers were asked to answer a questioner about family history of obesity and genetic diseases. Exclusion of pregnant women and people who use any treatment course in this study. Each gender was divided into two groups: from 6-17 years old (Children and Teenager), and from 19-27 years old (Adults). As well as each group were divided into two sub-groups according to BMI (Healthy "control" and obese). Classification of BMI for adults over the age of 20 years according to the World Health Organization (WHO) (Healthy BMI < 25 and Obese BMI ≥25), while the children and teens, BMI is age- and sex- specific which often referred to as BMI-for-age. We used the BMI-for-age growth charts (for girls & boys) from Centers for Disease Control and



Prevention (CD) and the American Academy of Pediatrics (AAP). After BMI is calculated, the BMI number is plotted on the BMI-for-age growth charts to obtain a percentile ranking (Healthy BMI < 85<sup>th</sup> percentile and Obese BMI ≥ 85<sup>th</sup> percentile). The practical works of this research were conducted at the Biology Graduate Studies laboratories, sixth building at King Abdulaziz University, Jeddah.

### Methodology:

#### Genetic Analysis:

Genomic DNA was extracted from whole blood which stored in EDTA coated tubes by using Qiagen-QIAamp DNA Blood Mini Kit. The concentration of genomic DNA was determined by the quantitative method, which is based on the optical density measurement. Was quantified using spectrophotometric analysis using 6800 UV/Vis Spectrophotometer (JENWAY, UK). The purity was determined by calculation the ratio of absorbance at 260 nm to absorbance at 280 nm ( $A_{260}/A_{280}$ ). Pure DNA should have an  $A_{260}/A_{280}$  ratio of 1.7 - 1.9.

#### Amplification for GLN223ARG gene:

Genotyping of the LepR polymorphism was carried out using the polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) assay with previously described primer pairs (Sorli Guerola, 2008). Forward primer: 5'- TCC TCT TTA AAA GCC TAT CCA GTA TTT-3', and Reverse primer: 5'- AGC TAG CAA ATA TTT TTG TAA GCA AT- 3'. PCR amplification products were obtained using (QIAGEN HotStarTaq Master Mix Kit) a final volume of 50µl and prepared as [2µl genomic DNA (2µg/µl), 25µl HotStar Taq Master Mix, 19µl RNase free water, 2 µl of each primer] in a Thermal cycler (mastercycle personal, Eppendorf, Germany). The amplification conditions were as follows: initial denaturation at 95°C for 15 min followed by 35 cycle of denaturation at 94°C for 1 min, annealing at 55°C for 1 min and extension at 72°C for 1 min, followed by final extension at 72°C for 10 min. The PCR product was purified by using the isolate PCR kit (Bioline Inc., USA). The DNA bands were Visualized under UV light and photographed using gel documentation (Molecular Imager<sup>®</sup> Gel Doc<sup>™</sup> XR + Systems with Image Lab<sup>™</sup> 2.0 Software, BioRad, USA). The ethidium bromide (fluorescent dye) intercalates between bases of DNA causing the visualization of the bands. The gel was then photographed.

#### Genotyping of rs1137101SNP in GLN223ARG gene:

The resulting DNA fragment was 368bp in length. The genotypes for this SNP were determined

by restriction fragment length polymorphism (RFLP) procedure. They were prepared as follows: in a labeled clean and dry Eppendorf tubes 10µl of PCR product, 16.3µl of sterile, deionized water, 0.2µl of 100X BSA, 2µl of 10X RE Buffer, and mixed by pipetting. Finally, 1µl of restriction enzyme (*MspI*) were added. The tubes were incubated for 4 hours at 37°C followed by heat inactivation for 15 minutes at 65°C. After that, the genotypes were resolved after running it on 2% (w/v) agarose gels electrophoresis.

#### Statistical Analysis:

Statistical analysis of the data was performed using the Statistical Package for Social Science (SPSS for windows, version 16) (SPSS Inc., Chicago, IL, U.S.A). Descriptive data were given as mean ± standard deviation (SD). Differences among groups were tested using t-test for unpaired data. The Fisher's exact test and Chi-square test were applied to test the association between genotypes and clinical groups. Contingency analysis was applied to calculate the odds ratio (OR) and 95% confidence interval (CI) to estimate the relative risk and strength of association for their various genotypes or their combinations. Statistical significance was defined as the probability of *P* value less than or equal 0.05 (Two-sided). Hardy-Weinberg Equilibrium was tested by goodness-of fit  $\chi^2$  test to compare the observed genotypes frequencies to the expected genotypes frequencies among the obese and non obese, chi-square test featuring one degree of freedom.

### 3- Results

Table 1 shows males' group data; there were a significant difference between the obese group and non-obese group in weight, BMI and waist ( $P < 0.05$ ). Table 2 shows females' group data, which represents a significant difference between the obese group and non-obese group, in weight, BMI, hip and waist ( $P < 0.05$ ).

Figure 1 shows the genotyping results of GLN223ARG leptin receptor polymorphism. A single band of 368 bp shows the presence of allele A (GLN/GLN), while the presence of 2 bands of 245 and 123 bp shows the presence of allele G (ARG/ARG). There are 2 bands for the G allele because this product contains a digestion site for the *MspI* enzyme, which is absent when A is present. Therefore, the PCR product containing the G allele is cleaved by *MspI* and produces 2 bands of low molecular weight.

Table 3 shows the distribution of genotype and allele frequencies for GLN223ARG polymorphism in males' children and teenagers group (6-17 years old). The obese group genotyping were 40.9 % (n=9) homozygous AA, 36.4 % (n= 8) heterozygous AG

and 22.7 % (n= 5) homozygous GG compared to the non-obese group (control) (45.7 % (n= 16) homozygous AA, 54.3 % (n=19) heterozygous AG, the GG homozygous genotype was undetected in this group. In obese group, the frequency of the A and G alleles were 59.1 and 40.9 respectively compared to control group (A and G alleles frequency were 72.9 and 27.1 respectively). In contrast, there were no significant differences in alleles frequencies between

obese and non-obese group in this age class ( $P=0.12$ ).

When comparing the obese and control groups results, the frequency of the homozygote GG were highly significant ( $P=0.006$ ) because there was no GG genotype in control group. There was an increased frequency of the A allele in control group (72.9) compared to obese group (59.1) and an increased frequency of the G allele in obese group (40.9) compared to control group (27.1).

**Table 1:** Descriptive of males group data (n = 94).

| Age class          | Variables                | BMI class   |             | P value |
|--------------------|--------------------------|-------------|-------------|---------|
|                    |                          | Non obese   | Obese       |         |
| 6-17 (y)<br>n= 57  | n                        | 35 (61.4%)  | 22(38.6%)   |         |
|                    | Age (Years)              | 12.9±3.31   | 13.52±2.80  | 0.46    |
|                    | Weight (Kg)              | 37.97±12.42 | 67.37±21.57 | 0.00*   |
|                    | Height (m)               | 1.47±0.18   | 1.53±0.14   | 0.18    |
|                    | BMI (Kg/m <sup>2</sup> ) | 17.02±2.59  | 28.25±7.03  | 0.00*   |
|                    | Waist (cm)               | 65±6.87     | 87.95±15.42 | 0.00*   |
| 18-27 (y)<br>n= 37 | n                        | 19 (51.4%)  | 18 (48.6%)  |         |
|                    | Age (Years)              | 20.21±1.61  | 20.94±2.5   | 0.29    |
|                    | Weight (Kg)              | 16±8.79     | 99.17±18.36 | 0.00*   |
|                    | Height (m)               | 1.71±0.05   | 1.73±0.05   | 0.45    |
|                    | BMI (Kg/m <sup>2</sup> ) | 20.75±2.59  | 33.29±6.24  | 0.00*   |
|                    | Waist (cm)               | 77.05±7.01  | 1.03±16.04  | 0.00*   |

\* Significance ( $P<0.05$ ) Values are expressed as mean ± standard deviation (SD), and were compared by t-test. BMI; Body mass index. n; No. of sample.

When comparing AA and AG genotype the odd ratio (OR) was (0.75), this indicated there were no effect and association. When comparing between AA and GG genotype ( $P=0.01$ ) the odd ratio was (19.11), which indicated that the odds of obese is about 19 times higher in GG genotype compared to control (RR=12.47, 95% CI: 0.75-207.2). When comparing between AG and GG genotype ( $P=0.006$ ) the odd ratio was (25.24), indicated that the odds of obese are about 25-fold higher in GG genotype than control (RR=15.71, 95% CI: 0.94-261.9).

Table 4 shows the distribution of genotype and allele frequencies of the obese males were 50% (n= 9) homozygous (AA), 50% (n= 9) heterozygous (AG) and the homozygous (GG) genotype was undetected, compared to the non obese males (control), the results were 47.4% (n= 9) homozygous (AA), 42.1% (n= 8) heterozygous (AG) and 10.5 (n= 2) homozygous (GG). In obese group, the frequency of the A and G alleles were 75 and 25 respectively; compared to control group, the frequency of the A

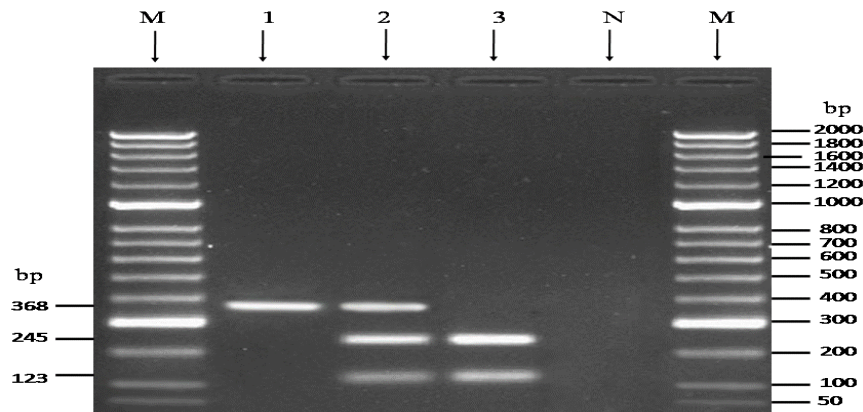
and G alleles were 68.4 and 31.6 respectively. In contrast, there were no significant differences in frequencies of alleles between obese and non-obese group in this age class ( $P=0.53$ ).

When comparing the obese and non-obese groups results, the frequency of the homozygous AA and heterozygous AG ( $P=0.86$ ), the homozygous AA and GG ( $P=0.47$ ), and heterozygous AG and homozygous GG ( $P=0.47$ ) were not significantly difference. Also, the frequency of dominant model AA and AG+GG genotype were not significantly difference ( $P=0.86$ ). There was an increased frequency of the A allele in the obese group (75) compared to non-obese group (68.4), and an increased frequency of the G allele in non-obese group (31.6) compared to obese group (25). When comparing AA and AG genotype the odd ratio was (1.13) and AA and GG genotype the odd ratio was (0.2), this indicates –nearly- non existence for the effect and association.

**Table 2:** Descriptive of females group data ( $n = 86$ ).

| Age class             | Variables                | BMI class   |             | P value |
|-----------------------|--------------------------|-------------|-------------|---------|
|                       |                          | Non obese   | Obese       |         |
| 6-17 (y)<br>$n = 50$  | $n$                      | 33 (66%)    | 17 (34%)    |         |
|                       | Age (Years)              | 13.05±2.61  | 12.24±3.23  | 0.34    |
|                       | Weight (Kg)              | 38.52±10.93 | 54.82±17.53 | 0.00*   |
|                       | Height (m)               | 1.46±0.13   | 1.44±0.12   | 0.51    |
|                       | BMI (Kg/m <sup>2</sup> ) | 17.68±2.89  | 25.10±5.55  | 0.00*   |
|                       | Hip (cm)                 | 79.69±10.09 | 93.71±11.83 | 0.00*   |
|                       | Waist (cm)               | 66.20±8.94  | 85.12±15.25 | 0.00*   |
|                       | WHR                      | 0.83±0.05   | 0.91±0.10   | 0.00*   |
| 18-27 (y)<br>$n = 36$ | $n$                      | 19 (52.8%)  | 17 (47.2%)  |         |
|                       | Age (Years)              | 21.37±2.73  | 21±1.93     | 0.64    |
|                       | Weight (Kg)              | 50.42±8.33  | 78.41±12.45 | 0.00*   |
|                       | Height (m)               | 1.58±0.04   | 1.59±0.05   | 0.63    |
|                       | BMI (Kg/m <sup>2</sup> ) | 20.24±3.24  | 31.14±4.26  | 0.00*   |
|                       | Hip (cm)                 | 93.24±6.86  | 116±9.62    | 0.00*   |
|                       | Waist (cm)               | 75.03±6.55  | 93.65±9.16  | 0.00*   |
|                       | WHR                      | 0.81±0.05   | 0.81±0.05   | 0.85    |

\* Significance ( $P < 0.05$ ). Values are expressed as mean  $\pm$  standard deviation (SD), and were compared by t-test. BMI; Body mass index. WHR; waist-hip ratio.  $n$ ; no. of sample.



**Figure 1:** Photograph of a 2% (w/v) agarose gel showing the digested PCR products for GLN223ARG leptin receptor polymorphism genotyping. Lane M: DNA marker. Lane 1: Homozygous AA (GLN/GLN); genotype produce one band of size 368 bp. Lane 2: Heterozygous AG (GLN/ARG); genotype produce three bands of size 368, 245 and 123 bp. Lane 3: Homozygous GG (ARG/ARG); genotype produce two bands of size 245 and 123 bp. Lane N: A negative control (- DNA).

Table 5 shows the distribution of genotype and allele frequencies for GLN223ARG polymorphism in children and teenagers females group (6-17 years old). The obese group genotyping were 47.1% ( $n = 8$ ) homozygous (AA), 35.3% ( $n = 6$ ) heterozygous (AG) and 17.6% ( $n = 3$ ) homozygous (GG) compared to the non obese group (control) which were 48.5% ( $n = 16$ ) homozygous (AA), 36.4% ( $n = 12$ ) heterozygous (AG) and 15.2% ( $n = 5$ ) homozygous (GG). In obese group, the frequency of the A and G alleles were 64.7 and 35.3 respectively, compared to control group the

frequency of the A and G alleles were 66.7 and 33.3 respectively. In contrast, there were no significant differences in frequencies of alleles between obese and non obese group in this age class ( $P = 0.84$ ).

When comparing the obese and control groups' results, the frequency of the homozygous AA and the heterozygous AG ( $P = 1$ ), or the homozygous AA and GG ( $P = 1$ ), and the heterozygous AG and the homozygous GG ( $P = 1$ ) were not significantly difference. Also, the frequency of dominant model AA and AG+GG genotype were not significantly

difference ( $P= 0.92$ ). The frequency of the G allele was increased in obese group (35.3) compared to control group (33.3), whereas the frequency of the A allele was increased in control group (66.7) compared to obese group (64.7). When comparing AA and AG genotype the odd ratio was 1 (95% CI: 0.27-3.66), AA and GG genotype the odd ratio was 1.2 (95% CI: 0.22-6.34), and AA and AG+GG genotype the odd ratio was 1.06 (95% CI: 0.33-3.42), this indicated there were no effect and association.

Table 6 shows the distribution of genotype and allele frequencies for GLN223ARG polymorphism in adults females group (18-27 years old). The obese group genotyping were 47.1% (n= 8) homozygous (AA), 41.2% (n= 7) heterozygous (AG) and 11.8% (n= 2) homozygous (GG), compared to the non-obese group (control) were 42.1% (n= 8) homozygous (AA), 47.4% (n= 9) heterozygous (AG) and 10.5% (n= 2) homozygous (GG). In obese group, the frequency of the A and G alleles were 67.6 and

32.4 respectively compared to control group, the frequency of the A and G alleles were 65.8 and 34.2 respectively. In contrast, there were no significant differences in frequencies of alleles between obese and non-obese group in this age class ( $P= 0.86$ ). When comparing the obese and non-obese groups' results, the frequency of the homozygous AA and heterozygous AG ( $P= 0.71$ ), or the homozygous AA and GG ( $P= 1$ ), and the homozygous GG and heterozygous AG ( $P= 1$ ) were not significantly difference. Also, the frequency of dominant model AA and AG+GG genotype were not significantly difference ( $P= 0.76$ ).

Table 7 shows the comparison results between all obese children and teenagers (males and females) and all obese adults (males and females). There was an increased frequency of the GG genotype in obese children and teenagers (4 times) than obese adults and an increased frequency of the AA and AG genotype in obese adults.

**Table 3:** Genotypes and Allele frequencies in males' children and teenagers

| Genotypes | Frequencies %     |               | P value            | OR (95% CI)         | RR (95% CI)        |
|-----------|-------------------|---------------|--------------------|---------------------|--------------------|
|           | Non obese (n= 35) | Obese (n= 22) |                    |                     |                    |
| AA        | 45.7 (n= 16)      | 40.9 (n= 9)   | Reference          |                     |                    |
| AG        | 54.3 (n= 19)      | 36.4 (n= 8)   | <sup>a</sup> 0.62  | 0.75 (0.23-2.39)    | 0.87 (0.48-1.56)   |
| GG        | 0                 | 22.7 (n= 5)   | <sup>b</sup> 0.01  | 19.11 (0.95-384.95) | 12.47 (0.75-207.2) |
| AG + GG   | 54.3 (n= 19)      | 59.1 (n= 13)  | <sup>c</sup> 0.006 | 25.24 (1.25-509.46) | 15.71 (0.94-261.9) |
| Alleles   |                   |               |                    |                     |                    |
| A         | 72.9 (n= 51)      | 59.1 (n= 26)  | Reference          |                     |                    |
| G         | 27.1 (n= 19)      | 40.9 (n= 18)  | 0.12               | 1.86 (0.84-4.13)    | 1.51 (0.89-2.54)   |

Data are presented as number of cases with frequency. OR: Odds Ratio. RR: Risk Ratio. CI: Confidence Intervals. <sup>a</sup>: AA vs. AG,  $P$ -value Person Chi-Square test. <sup>b</sup>: AA vs. GG,  $P$ -value Fisher Exact test. <sup>c</sup>: AG vs. GG,  $P$ -value Fisher Exact test. <sup>d</sup>: AA vs. AG+GG,  $P$ -value Person Chi-Square test.

**Table 4:** Genotypes and Allele frequencies in adults males group (18-27 Years old) (n= 37)

| Genotypes | Frequencies %     |               | P value           | OR (95% CI)      | RR (95% CI)      |
|-----------|-------------------|---------------|-------------------|------------------|------------------|
|           | Non obese (n= 19) | Obese (n= 18) |                   |                  |                  |
| AA        | 47.4 (n= 9)       | 50 (n= 9)     | Reference         |                  |                  |
| AG        | 42.1 (n= 8)       | 50 (n= 9)     | <sup>a</sup> 0.86 | 1.13 (0.3-4.24)  | 1.06 (0.54-2.11) |
| GG        | 10.5 (n= 2)       | 0             | <sup>b</sup> 0.47 | 0.2 (0.01-4.75)  | 0.24 (0.01-4.44) |
| AG + GG   | 52.6 (n= 10)      | 50 (n= 9)     | <sup>c</sup> 0.47 | 0.18 (0.01-4.28) | 0.22 (0.01-4.05) |
| Alleles   |                   |               |                   |                  |                  |
| A         | 68.4 (n= 26)      | 75 (n= 27)    | Reference         |                  |                  |
| G         | 31.6 (n= 12)      | 25 (n= 9)     | 0.53              | 0.72 (0.26-2)    | 0.79 (0.38-1.65) |

OR: Odds Ratio. RR: Risk Ratio. CI: Confidence Intervals. <sup>a</sup>: AA vs. AG,  $P$ -value Person Chi-Square test. AA vs. GG,  $P$ -value Fisher Exact test. <sup>c</sup>: AG vs. GG,  $P$ -value Fisher Exact test. <sup>d</sup>: AA vs. AG+GG,  $P$ -value Person Chi-Square test.

**Table 5 :** Genotypes and Allele frequencies in children and teenagers females group (6-17 Years old) (n= 50)

| Genotypes      | Non obese (n= 33) | Obese (n= 17) | P value           | OR (95% CI)      | RR (95% CI)      |
|----------------|-------------------|---------------|-------------------|------------------|------------------|
| AA             | 48.5 (n= 16)      | 47.1 (n= 8)   | Reference         |                  |                  |
| AG             | 36.4 (n= 12)      | 35.3 (n= 6)   | <sup>a</sup> 1    | 1 (0.27-3.66)    | 1 (0.48-2.1)     |
| GG             | 15.2 (n= 5)       | 17.6 (n= 3)   | <sup>b</sup> 1    | 1.2 (0.22-6.34)  | 1.15 (0.33-3.92) |
|                |                   |               | <sup>c</sup> 1    | 1.2 (0.21-6.8)   | 1.13 (0.35-3.69) |
| AG + GG        | 51.6 (n= 17)      | 52.9 (n= 9)   | <sup>d</sup> 0.92 | 1.06 (0.33-3.42) | 1.03 (0.59-1.79) |
| <b>Alleles</b> |                   |               |                   |                  |                  |
| A              | 66.7 (n= 44)      | 64.7 (n= 22)  | Reference         |                  |                  |
| G              | 33.3 (n= 22)      | 35.3 (n= 12)  | 0.84              | 1.09 (0.46-2.6)  | 1.06 (0.6-1.87)  |

OR: Odds Ratio. RR: Risk Ratio. CI: Confidence Intervals. <sup>a</sup>: AA vs. AG, P-value Person Chi-Square test. <sup>b</sup>: AA vs. GG, P-value Fisher Exact test. <sup>c</sup>: AG vs. GG, P-value Fisher Exact test. <sup>d</sup>: AA vs. AG+GG, P-value Person Chi-Square test.

**Table 6:** Genotypes and allele frequencies in adults females group (18-27 Years old) (n= 36)

| Genotypes      | Non obese (n= 19) | Obese (n= 17) | P value           | OR (95% CI)       | OR (95% CI)      |
|----------------|-------------------|---------------|-------------------|-------------------|------------------|
| AA             | 42.1 (n= 8)       | 47.1 (n= 8)   | Reference         |                   |                  |
| AG             | 47.4 (n= 9)       | 41.2 (n= 7)   | <sup>a</sup> 0.71 | 0.78 (0.19-3.13)  | 0.88 (0.44-1.78) |
| GG             | 10.5 (n= 2)       | 11.8 (n= 2)   | <sup>b</sup> 1    | 1 (0.11-8.95)     | 1 (0.17-5.77)    |
|                |                   |               | <sup>c</sup> 1    | 1.29 (0.14-11.54) | 1.22 (0.21-7.04) |
| AG + GG        | 57.9 (n= 11)      | 53 (n= 9)     | <sup>d</sup> 0.76 | 0.81 (0.22-3.06)  | 0.91 (0.51-1.65) |
| <b>Alleles</b> |                   |               |                   |                   |                  |
| A              | 65.8 (n= 25)      | 67.6 (n= 23)  | Reference         |                   |                  |
| G              | 34.2 (n= 13)      | 32.4 (n= 11)  | 0.86              | 0.92 (0.34-2.46)  | 0.95 (0.49-1.82) |

OR: Odds Ratio. RR: Risk Ratio. CI: Confidence Intervals. <sup>a</sup>: AA vs. AG, P-value Person Chi-Square test. <sup>b</sup>: AA vs. GG, P-value Fisher Exact test. <sup>c</sup>: AG vs. GG, P-value Fisher Exact test. <sup>d</sup>: AA vs. AG+GG, P-value Person Chi-Square test.

**Table 7:** Comparison genotypes between all obese children and teenagers and all obese adults.

| Genotypes | Children and teenager (n= 39) | Adults (n= 35) |
|-----------|-------------------------------|----------------|
| AA        | 43.6% (n= 17)                 | 48.6% (n= 17)  |
| AG        | 35.9% (n= 14)                 | 45.7% (n= 16)  |
| GG        | 20.5% (n= 8)                  | 5.7% (n= 2)    |

#### 4- Discussion

In this research, the distribution of alleles of the leptin receptor gene GLN223ARG polymorphism in obese subjects and compared this with those obtained from non-obese subjects was studied. The techniques used were PCR analysis of leptin receptor polymorphisms in DNA extracted from peripheral blood samples. PCR analysis was used for genotyping. The GLN223ARG leptin receptor polymorphism investigated in this study results in the substitution of amino acid from glutamine (CAG) to arginine (CGG) in the extracellular domain of the receptor. This may results in altered leptin binding and therefore, receptor dimerization and signaling capacity of the leptin receptor. However, such

mutations are extremely rare and are not likely to be responsible for the obesity, because there are many factors that involved and contribute to the appearance of obesity (Ben Ali, et al., 2009). Data in the literature concerning the association between the GLN223ARG polymorphism and obesity are controversial among different ethnic population.

In the current study, the results demonstrated that no significant differences with all parameters (weight, height, BMI, hip, waist and WHR) screened across genotypes in the obese group compared to non-obese group. Also, when the subject were divided into males and females, there was no significant differences in BMI and all parameters, which agree with two studies of obese males

(Echwald, *et al.*, 1997; Gotoda *et al.*, 1997), which detected no associations between GLN223ARG and BMI and leptin levels.

In contrast, a recent study in Tunisian population found that the obese men whom carrying the ARG allele had lower BMI than those whom homozygous for GLN allele (Ben Ali *et al.*, 2009). Also, our results disagree with Greek population study, which reported the presence of a weak association between GLN223ARG polymorphism and BMI (Yiannakouris *et al.*, 2001). In Caucasian women (Quinton, *et al.*, 2001) found that carriage of the A allele (AA and AG) was associated with a higher mean BMI than not carrying the A allele ( $P=0.009$ ). In Saudi obese women) demonstrate that, GG and AG genotype had higher BMI and leptin levels were increased significantly (Daghestani, *et al.*, 2009).

Childhood obesity increases the risk of obesity in adulthood. Whitaker *et al.*, (1997) found that obesity is an increasingly important predictor of adult obesity among older children. Moreover, overweight in adolescence predicts a broad range of adverse health effects (Must *et al.*, 1992). Therefore, it is important to identify the cause of obesity, and to prevent obesity in childhood.

In this study, the subjects were subdivided according to age class into two groups' children and teenagers group, and adults group. The males children and teenagers results showed a significant increased in GG genotype in obese, an increased in GG genotype in females children and teenagers but not significant compared to non obese groups. This suggests that there was an association between GLN223ARG polymorphism and obesity in male children and teenagers but not in females, because males children and teenagers had a higher weights from 36 kg to 115kg with mean ( $67.37\pm 21.57$ ) and high BMI with an average ( $28.25\pm 7.03$ ) compared to females whom weights from 29 kg to 85 kg with mean ( $54.82\pm 17.53$ ) and BMI with an average ( $26\pm 5.55$ ). Our results disagreement with previous study conducted on children females and males carried out in Mexican adolescents Guizar-Mendoza (2005), reported that no significant difference in genotypes frequencies for GLN223ARG polymorphism between obese and non obese children. Another study in Japanese school children Endo *et al.*, (2000), reported that the GLN223ARG polymorphism is not associated with obesity in Japanese school children because the difference between obese and non obese was not significant (). Also, Komşu-Ornek *et al.*, (2012) stated that there were no differences in the genotype frequencies or allele distribution for GLN223ARG polymorphism among obese, obese with metabolic syndrome and lean Turkish children,

which suggest that there was no association between GLN223ARG polymorphism and obesity in Turkish children. Same finding was reported by Pyrzak *et al.*, (2009) confirmed no association between GLN223ARG polymorphism and obesity in children

In the Kingdom of Saudi Arabia, several studies have been carried out and the numbers of obese individuals is rising in an alarming rate. In a national study on Saudi adults, 15.12% of the males and 23.97% of the females were found to be obese, while 32.82% and 29.09% respectively were overweight (EL-Hazmi and Warsy, 2002).

In this study, results obtained from adult males and females showed that there was an increased frequency of the AA and GG genotype in obese females and an increased frequency of the AG and AA genotype in obese males compared to control but not significant. In contrast, Gotoda *et al.*, (1997) reported that there was an increased frequency in AA and GG genotype on white British male population. Also, AG and AA genotype was an increased in overweight and obese Caucasian women (Wauters *et al.*, 2001). In Saudi women Daghestani *et al.*, (2009) found that GG homozygote and AG heterozygotes genotype had higher frequencies among obese subjects (Recent studies (Changnon *et al.*, 1999; Duarte *et al.*, 2006; Duarte *et al.*, 2007; Ben Ali *et al.*, 2009) demonstrated that there was an increased frequency of the AG genotype in obese compared to non obese. In contrast, (Yiannakouris *et al.*, 2001; Constantin *et al.*, 2010) reported an increased in GG genotype in obese compared to non obese.

This study showed no significant differences in genotypic distribution and allele frequencies of the GLN223ARG polymorphism between all adults obese and non obese subjects, which confirmed (Ben Ali *et al.*, 2009) study. In the other hand, Duarte *et al.*, (2006) conducted a study in Brazilian multiethnic subjects and found there was a significant differences in genotypic distribution in obese compared to lean or normal individuals in the co-dominant and dominant models, but not in the recessive model. Another study of Brazilian population conducted by Duarte *et al.*, (2007), confirmed that the association of the GLN223ARG polymorphism with obesity was related to the co-dominant and dominant model ( $P=0.05$ ) and ( $P=0.03$ ) respectively, but not with the recessive model ( $P=0.628$ ). Also, Yiannakouris *et al.*, (2001) reported a significant differences in genotype distribution of the GLN223ARG polymorphism which related to the co-dominant models ( $P=0.02$ ) and recessive model ( $P=0.01$ ) between normal weight and overweight-obese subjects in Greek population

## Conclusion

Based on the results of this study, there was no association between leptin receptor gene GLN223ARG polymorphisms and obesity in females children and teenager, and adults males and females groups; while appeared a significant association in males children and teenager groups with too high risks may be due to overweight and obesity in this groups compared to others age groups. Together these results suggest a possible role for leptin receptor gene GLN223ARG polymorphisms in obesity in males' children and teenager groups and **Recommended** to conduct further studies on females' children and teenager age class and males' adults to identify the impact of this gene in Saudi society obesity. Further studies in a large samples may be helpful to investigate a more subtle effect of this gene in this serious phenotype. Such studies should also consider possible interactions of this LepR variant with other genetic polymorphisms.

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## Saliva to Monitor Warfarin Therapy after Prosthetic Heart Valve Replacement

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**Abstract:** Patients with prosthetic heart valve are in need of anticoagulant therapy for protection against thromboembolic events. Warfarin therapy is monitored by Prothrombin time (PT) and International Normalized Ratio (INR). The clotting assays are invasive and may carry infection and prosthetic valve endocarditis. We try to use human saliva as noninvasive diagnostic fluid to access anticoagulant state. Our study was done in Cardiothoracic Department in Ain Shams University Hospital on 132 Patients had prosthetic valve (MVR, AVR or DVR) and under Warfarin therapy. We measure salivary TF activity by Quick one stage method; then calculate TF activity ratio and TF activity log to 10. The therapeutic value of salivary TF ratio ranges from (2.23 to 3.60) and salivary TF log to 10 ranges from (2.364 to 2.560). There is strong positive correlation between both salivary TF ratio and salivary TF log to 10 with INR (2.00 to 3.50). Salivary TF activity ratio has wider range than TF log to 10, and needs each laboratory to make its control under standardized conditions. Thus, the measurement of salivary TF activity ratio is a reliable test for follow up of patients on oral anticoagulant therapy.

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Key words: Prothrombin time (PT), INR, Saliva, Tissue factor (TF), Warfarin.

### 1. Introduction

Patients with prosthetic heart valve are in need of anticoagulant therapy. Warfarin is suitable for protection against thromboembolic events. Its activity has to be monitored by blood testing for Prothrombin time (PT) and International Normalized Ratio (INR). The target INR in patients with one or more mechanical heart valve ranges between (2.00- 3.50). Many medications and chemicals in certain foods may enhance or reduce Warfarin anticoagulant effect. Thus, close and repeated monitoring of the degree of anticoagulation is essential. In order to optimize the therapeutic effect without risking dangerous side-effect such as bleeding. (1, 2) The clotting assays have many drawbacks. First, they are invasive, requiring some blood from the patient. Secondly, to perform coagulation of blood in a vial, this requires delicate handling, accurate timing and citration of plasma. Thirdly, the assay depends on additional product (Thromboplastin) which differs from the reference substance of WHO. To ensure accuracy, we have to calculate complicated INR. Fourthly, multiple blood samples may carry infection and prosthetic valve endocarditis when antiseptic measurements not taken well. Finally, they indirectly reflect fibrinopeptides and fibrinogen degradation products. (3) We aim to use noninvasive diagnostic technique to measure the state of anticoagulant. The use of human saliva as a diagnostic fluid offers advantage of being collected non-invasively by individuals with modest training. (4, 5) Tissue factor (TF) is the key initiator of coagulation cascade. Tissue factor (TF) is a

lipoprotein that with factor VII makes a complex that initiates blood coagulation by the extrinsic pathway. (6) TF antigen is elevated in hypertensive subjects as compared with normotensive subjects. (7) Tumor derived tissue factor is associated with venous thromboembolic events in malignancy. (8) The circulating pool of TF in blood is associated with increased blood thrombogenicity in patients during cardiopulmonary bypass. (9) TF pathway is considered as the primary physiological mechanism initiating blood coagulation. Induction of Warfarin anticoagulation reduces TF activity with vitamin K dependent clotting factors. The plasma clotting assays of PT measure vitamin K dependent clotting factors by adding Thromboplastin neglecting the effect of TF. (10) Saliva is a unique body fluid being free of factors V and VII and has TF activity. Measurement of salivary TF activities by Quick one stage method can give a direct image of the anticoagulant state of the blood. (11)

#### Aim of the study:

Use saliva as a biological fluid for monitoring TF activity and anticoagulant status.

### 2. Patients & Methods:

A total of 132 Patients in cardiothoracic department after open heart surgery for valve replacement using prosthetic valve (MVR, AVR or DVR) in Ain Shams University Hospital and under oral anticoagulant (warfarin) treatment after explaining the test for them and get their agreement

with written consent. Compared to 20 volunteers (control group); received no medication with normal liver function tests and normal PT (INR: 0.96-1.05) to compare their level of TF in saliva with those patients on oral anticoagulant.

Citrated blood samples are taken for measurement of their routine follow up PT & INR. Samples were usually collected between the hours of 8 to 11 A.M. Salivary flow was stimulated by chewing of sterile cotton swan (under tongue) for at least 2 minutes. Mixed oral saliva was collected into 17X100 mm plastic tube by hugging swab with the cover about 2 cm from the bottom of the tube and centrifugation at 500g for 15 min. at room temperature.

**(Table 1): PT and TF in patient and control groups:**

|               | Patient group |              |                | Control group  |
|---------------|---------------|--------------|----------------|----------------|
|               | PT sec.       | INR          | TF sec.        | TF sec         |
| <b>Mean</b>   | <b>30.912</b> | <b>2.774</b> | <b>294.596</b> | <b>107.331</b> |
| <b>± (SD)</b> | <b>12.380</b> | <b>1.096</b> | <b>98.447</b>  | <b>11.932</b>  |

We calculate TF ratio by this equation:

**TF Ratio = TF activity of the patient / mean of TF activity of control group (in sec)**

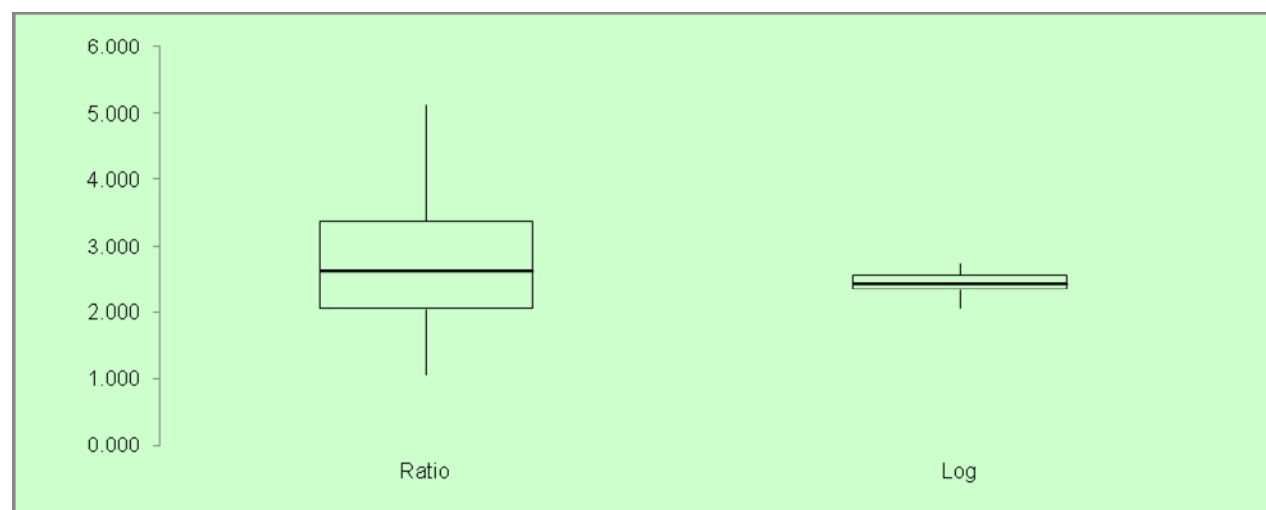
Then, calculate log to 10:

**Log to 10 of TF activity of patient in sec**

. (Table 2, Fig. 1)

**(Table 2): Comparison between TF ratio and TF log:**

|               | TF Ratio     | TF log       |
|---------------|--------------|--------------|
| <b>Mean</b>   | <b>2.745</b> | <b>2.444</b> |
| <b>± (SD)</b> | <b>0.917</b> | <b>0.153</b> |



**(Fig. 1) Comparison between TF ratio and TF log.**

There is positive significant correlation between INR and both TF ratio and TF log to 10. (Table 3)

TF was assayed by mixing 0.05 ml of saliva with 0.05 ml of 0.02 M. CaCl<sub>2</sub> at 37° C for at least 5 min. then add 0.05 ml normal plasma control using coagulometer (DADE BEHRING BFTII). The results of all TF assays represent the average of duplicate determinations.

### 3. Results:

In the 132 who are on oral anticoagulant we found that TF in second mean 294.6±98.45 and in the controlled group mean 107.3±11.93 and there is a highly significant different between patient group and control group ( $p < 0.001$ ). (Table 1)

**(Table 3): r test between INR and both TF ratio and TF log to 10.**

| R test between INR & TF | INR<br>r test | Significant (p)          |
|-------------------------|---------------|--------------------------|
| Ratio                   | 0.796         | $p < 0.001$ (highly sig) |
| Log to 10               | 0.728         | $p < 0.001$ (highly sig) |

Considering of therapeutic target of INR in patients after prosthetic heart valve were in between 2.00 and 3.50 (INR), sensitivity, specificity and efficacy of both TF ratio and TF log to 10 were done by doing ROC curve, revealed very high sensitivity, specificity and efficacy of both TF ratio and TF log to 10. (Table 4)

**(Table 4): Sensitivity & Specificity of Salivary Tissue Factor as control of oral anticoagulant therapy with target INR form 2.00 to 3.50**

|                     |                        | Cut off value | Sensitivity | Specificity | Efficacy |
|---------------------|------------------------|---------------|-------------|-------------|----------|
| TF ratio to control | Low (INR $\geq$ 2.00)  | 2.229         | 86.21 %     | 83.33 %     | 84.11 %  |
|                     | High (INR $\leq$ 3.50) | 3.600         | 86.36 %     | 97.44 %     | 95.00 %  |
| TF log to 10        | Low (INR $\geq$ 2.00)  | 2.364         | 84.62 %     | 82.76 %     | 84.11 %  |
|                     | High (INR $\leq$ 3.50) | 2.560         | 95.45 %     | 89.74 %     | 91.00 %  |

The cut off value of TF ratio (2.229-3.600) and TF log to 10(2.364-2.560) is used in monitoring the therapeutic dose of Warfarin. The cutoff value is indicator for the proper dose; the low cut off value is used in distinguishing under dose while the high cut off value is used for over dose. .

There is no significant difference between the sensitivity, specificity and efficacy of TF ratio and TF log to 10.

#### 4. Discussion:

Patients after prosthetic heart valve replacement need to be on long life oral anticoagulant to avoid valve thrombosis. These have variable presentations; asymptomatic thrombosis, emboli, angina, hemodynamic compromise or shock from an obstructed valve. The number of prosthetic valves implanted is about figure of 60,000 per year. (12). Patients with mechanical valves are in need of long life oral anticoagulant. Patients with bio-prostheses or mitral repair may have other indications for long life anticoagulation, such as, atrial fibrillation (AF), heart failure, and impaired left ventricular function (ejection fraction 30%) (12). The target INR is 2.00-3.00 for AVR, and 2.50-3.50 for MVR (13). The high variability of the INR is associated with reduced survival after valve replacement. (12-14)

So, accurate and reliable test as (PT, INR) is essential to evaluate these patients. It may be painful especially in children; also it may causes ecchymosis at the site of sample. Repeated tests may lead to loss of blood regularly especially if it was repeated at short interval. These drawbacks make patients reluctant to do test. If antiseptic measures are not probably taken during sampling, these may predispose endocarditis. Bettadapur *et al.* (13) found that 26% had poor compliance for treatment and follow up after open heart surgery for valve replacement. The risk of major bleeding begins to rise when the INR exceeds 4.5 and

rises steeply above an INR of 6.0 (12, 13). So search for other reliable test with less side effects may be helpful for those patients to avoid over or under anticoagulation therapy. The analysis of saliva for TF activity may predict diagnostic application of saliva for monitoring warfarin therapy(5). As a diagnostic fluid, saliva offers many advantages over plasma because it can be collected non-invasively. Furthermore, saliva may provide cost-effective approach for the screening of large population. Our study revealed that TF activity significantly reduced in patients on oral anticoagulant (294.6 $\pm$ 98.45) compared to TF activity of control group (107.3 $\pm$  11.93). T-test was highly significant, this result give us a hope for a promising reliable test to control oral anticoagulant therapy with the use of saliva (TF).

The therapeutic value of salivary TF ratio ranges from (2.23) to (3.60) and salivary TF log to 10 ranges from (2.364) to (2.56). There is strong positive correlation between salivary TF activity ratio and INR (2.00 to 3.50). Also, salivary TF log to 10 correlates significantly with INR.

So, measuring of tissue factor activity of saliva as a predictor test is highly specific (83.3%-97.4% for TF ratio) and (84.1%-95.0% for TF log to 10), with sensitivity (86.2%-86.4% for TF ratio) and (84.6%-95.5% for TF log to 10).The efficacy of salivary TF activity is (84.2%-95% for TF ratio) and (84.1%-91% for TF log to 10). We prefer to use TF activity ratio

because of its wider range than TF log to 10. Salivary TF ratio needs each laboratory to make its control under standardized conditions. Thus, the measurement of salivary TF activity ratio is a reliable test for follow up of patients on oral anticoagulant therapy. We hope to use the Nano technology in the future for making a strip to test salivary activity to be available for patients. This may be greatly helpful to save life for many patients die from valve thrombosis, thrombotic emboli or bleeding due to poor control of oral anticoagulant therapy.

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## Impact of Homeownership on Children's Academic Outcomes: A Critical Methodological Review of Literature

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**Abstract:** The primary goal of this paper is to provide a critical methodological review of literature on homeownership and child academic outcomes. It focuses on the strengths and weaknesses regarding causal inference of different research findings. We first build a conceptual framework on the relations between homeownership and child academic outcomes. In the body of the review, six empirical studies using different quasi-experimental techniques were critically analyzed and compared regarding their strengths and weaknesses of establishing causal inference. A final comment on the quality of literature and future directions are also discussed.

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**Keywords:** Homeownership, children's academic outcomes, instrumental variable estimation, regression discontinuity, difference-in-difference, fixed effect, differential effects

### 1. Introduction

Homeownership has been connected to wide-ranging benefits in the literature (Boehm & Schlottmann, 1999; Hepp, 2010). Enormous amounts of money from the public and private have been invested in increasing the homeownership rate as an important strategy to regenerate distressed urban communities (Harkness & Newman, 2003a). This includes the 2 trillion dollar "American Dream commitment" of Fannie Mae, multimillion-dollar homeownership programs of the Enterprise Foundation, and the millions of dollars of programs under the control of U.S. Department of Housing and Urban Development (HUD) (Harkness & Newman, 2003a) just to name a few.

However, as a result of the collapse of the subprime mortgage market in 2007, the widely believed benefits of homeownership and policies designed to encourage homeownership have come under great scrutiny. The perspective on promoting homeownership among low-income population as an unmitigated goal is no longer universally held (Lerman & McKernana, 2008). This paper thus focuses on the potential effects of homeownership on children's academic outcomes. Does homeownership influence children's educational outcomes? How big is the effect size? These questions are crucial in policy evaluation and future policy formulation.

Our primary goal is to provide a critical methodological review of literature on homeownership and child academic outcomes with focus on the strengths and weaknesses regarding causal inference. We first build a conceptual framework on the relations

between homeownership and child academic outcomes. In the body of the review, six empirical studies using different quasi-experimental techniques were critically analyzed and compared regarding their strengths and weaknesses of establishing causal inference. A final comment on the quality of literature and future directions are also discussed.

### 2. Conceptual Framework

#### 2.1 Links between homeownership (*T*) and children's academic outcomes (*Y*)

The treatment (*t*) in this paper refers to homeownership. One can either be in the treatment (i.e., is a home owner), or in the comparison (i.e., is not a home owner, they could be renters, staying with others, or homeless). Homeownership has been linked to many positive child outcomes including better health, fewer behavioral problems, greater academic achievement (e.g., in math and reading), lower high school dropout rates, are less likely to be teen parents, higher level of educational attainment by age 25, and are more likely to graduate from high school (Boehm and Schlottman 1999; Green and White, 1997; Haurin D., Parcel, & Haurin R., 2002)

Homeownership can exert control on child outcome through several pathways including parenting practices and assets (Harkness & Newman, 2003a). There is some evidence on improved parenting of homeowners due to either their greater investment in their properties or residential stability. Homeowning parents are found to provide a more stimulating and emotionally supportive environment, which improves children's cognitive abilities (Haurin, D., Parcel, &

Haurin, R., 2002).

Another explanation is that homeownership improves life satisfaction and/or self-esteem for adults, which in turn produces a more positive home environment for children (Balfour and Smith 1996). Assets theory also stipulates homeownership as an important type of assets that can generate psychological benefits for adults (Sherraden, 1991). Additional explanations include the improved personal and management skills associated with home-owning experiences which are then transferred to children (Green and White, 1997).

Homeownership can also have an impact on children's academic outcomes through the effects of assets. Housing is the primary asset held by most American families and assets can be leveraged during times of need to benefit children. For example, homeowners can apply for home equity loans to pay for their children's college education. Empirical evidence has linked net worth of equity to better child outcomes (e.g., college attendance) (Aaronson 2000; Boehm & Schlottman, 1999). Homeowners also enjoy some tax advantages, which could lead to better outcomes of their children. However, Harkness and Newman (2003a) argue that the effect of homeownership as a function of assets could have negative impact on children in poor families if the down payment and maintenance costs absorb resources that could have been invested on children.

## 2.2. *The existence of confounding covariates (Xs and Us)*

Despite the abundance of evidence in favor of the links between homeownership and child outcomes, estimating the true effect of homeownership is not an easy task due to its endogeneity. Homeownership is often associated with a collection of parental and neighborhood characteristics that are difficult to disentangle. Instead of benefiting from growing up in an owned house itself, children might benefit from the factors often accompanying homeownership.

Demographic characteristics are important parental and household characteristics that could influence homeownership and child academic outcomes. It does not require much education to figure out the direct link between family income and homeownership. Family with higher income and more savings are more likely to purchase houses simply because they can afford it. And there is substantial evidence linking family wealth to child academic outcome directly (Duncan & Brooks-Gunn, 1997; Shanks, 2007).

Parents' education level may also attribute to their decision of purchasing a house, an activity that involves certain financial skills. Highly educated parents, on the other hand, may provide a more

cognitively stimulating environment or have higher expectations, which in turn produce better academic outcomes of their children. There is also some evidence suggesting racial differences in home ownership and child outcomes (Coulson, 1999).

Behavioral and psychological characteristics of the parents such as saving behavior, nurturing abilities, propensity to invest, and goal attainment (Hepp, 2010) are other parental level covariates. It is reasonable to believe that certain characteristics of the parents may lead them to purchase housing property since a home purchase is a large financial commitment. For example, homeowners could be more responsible and/or have better financial management skills than renters considering the duties associated with home maintenance and mortgage payments. Responsible parents may pay more attention to monitor their children's behavior and bring up children with better outcomes. Or perhaps parents who are more involved with their children are also more likely to purchase a home. Unlike demographic characteristics, however, these personal traits of homeowners' characteristics are most often not measured in surveys.

Neighborhood characteristics are another constellation of confounding covariates. Homeowners are most often found in communities characterized by higher incomes, higher rates of homeownership, and greater residential stability (Harkness & Newman, 2003a). The available amenities such as a good school in a community might attract parents to permanently settle down and buy a house there. Going to a good school is also likely to produce better academic outcomes of children. Neighborhood safety is another potential factor that can influence the relationship between homeownership and child outcomes. High crime rates in a neighborhood could reduce the market value of its prosperities and thus discourage parents to purchase houses there. Living in an unsafe neighborhood and being exposed to crimes at an early age could greatly affect children's academic outcomes. In short, the observed and/or unobserved characteristics let it be parents or neighborhood, could lead to biased estimates of homeownership effects.

## 2.3 *Independent predictors of child academic outcomes (Ws)*

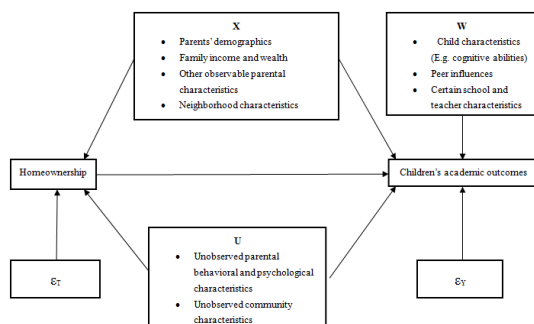
The existence of independent predictors—variables that influence child academic outcomes but are not associated with homeownership—can increase the precision of the treatment effect estimate. Since Ws are not associated with the treatment status, their existences will not bias the estimate of treatment effect. Some child characteristics that can arguably be Ws include child's gender, cognitive and intellectual ability, physical and mental health status, motivations and other unobserved

characteristics that influence its academic outcomes. Peer influence, certain teacher and school characteristics may also add the explanatory power to child academic outcomes. For example, nurturing or more experienced teachers may lead to better students' academic outcomes through adequate stimulation and proper teaching methods.

However, it is much less evident that experienced teachers could have somehow affect parents' decision of purchasing a house. Similarly, children who have positive peer networks at school (e.g., connected to pro-social peers, have little disruptions at school) may feel less distressed and thus function better academically. But it is much less obvious that their peer relations would affect parents buying a house or not (though in some rare cases, it might be true).

See Figure 1 for a graphic representation of the conceptual framework of the effects of homeownership and child academic outcomes.

**Figure 1.** Conceptual Framework of the effects of homeownership and child academic outcomes.



### 3. Methods

In this paper we present critical analyses of six empirical studies examining the causal relationship between homeownership and child academic outcomes. If multiple outcomes were examined in a single study, only child academic outcomes were reported in this paper. Techniques used in the selected studies ranges from statistical control in regression using longitudinal dataset, instrumental variable estimation, difference-in-difference, fixed effect, and differential effect. Studies using different methods were deliberately selected to provide a wide coverage and a comparison between methods.

### 4. Discussion

#### 4.1 "Statistical control" in multiple regressions

Study 1: Boehm & Schlottmann (1999)

This study uses the Panel Study of Income Dynamics (PSID) dataset, which collected data from a national representative sample of American families during the period between 1968 and 1992, to test whether homeownership by parents have an impact on

their child's highest educational attainment. The population of sample (POS) was restricted to children who left their parents' households between 1975 and 1982 to allow a 10-year interval in which to observe subsequent children's outcome after leaving their parent (n=911). In other words, the analysis tested the relationship between homeownership by parents and family situation during the 7 year prior to the year in which the children left their parents' home, and child highest education attained within the next 10 years period. Assuming correct function form, regression results should be able to be generalized to the whole POS.

In regression analysis, controlling for selection bias depends heavily on statistical control to partial out the influences of covariates. In their study, Boehm and Schlottmann (1999) controlled a set of different family covariates, including family size, parents' asset income and non-asset income, average house value, and parents' educational background. According to our literature review, these are indeed very important covariates that could greatly influence homeownership status and child education outcomes. To improve the precision of estimate, they also included four child characteristics (i.e., gender, race, veteran status, and time disabled). They found that after controlling for other covariates, the regression coefficient of homeownership remained significant.

This study has several strengths. It uses a national representative sample. More importantly, a clear time order was established for making any causal conclusions. In addition, the authors included some of the most important covariates into their model.

However, the list of family characteristics they "controlled for" is no way an exhaustive list of potential confounders. The presence of systematic differences between homeowners and non-homeowners in terms of expectations, sense of responsibility, and other psychological and behavioral characteristics could distort or explain away the significant impact of homeownership found in this study. Other techniques are in need in order to control the systematic differences (i.e., selection bias).

#### 4.2 Instrumental variable estimation (IVE)

Instrumental variable estimation represents one of such techniques. To put it simple, an instrument variable is a variable closely related to the treatment, but has no direct impact on the outcome variable (i.e., the only way for an instrument to exert control on the outcome is through the effect of the treatment). IVE approach carves out the influences of unobserved covariates (Us) on outcomes and is able to provide unbiased estimate of treatment effect, provided that the instrument is a valid one.



Study 2: Green & White (1997)— endogenous switching model

In this often cited paper, Green & White (1997) examined whether homeownership by parents predicts their 17 or 18-year-old child's schooling status. Three datasets including PSID, the Public Use Microsample of the 1980 Census of Population and Housing (PUMS), and High School and Beyond (HSB) were used to cross-validate homeownership estimates. Population of sample was restricted to children of PSID households who were 17 years old in any of the years 1980-1987; households that contained a 17 year old in 1980 in PUMS; and children of 18 years old in a follow-up survey in 1982 of the HSB data.

The authors first tested three probit models with the above-mentioned datasets respectively. The dependent variable for all three models was the same—a binary variable equaling one if a 17 or 18-year-old is still in school or have already graduated from high school and equaling zero if they have dropped out of school. A set of household characteristics and homeownership status were entered as the predictors, with slight variations across three datasets, depending on the availability of relevant information in each dataset.

More specifically, household explanatory variables (other than homeownership status) included race of the household head, family size, family income, household head's educational level, marital status, and employment history in PSID sample. In PUMS, the length of tenure (i.e., the number of years the household has lived in its present housing unite) and housing quality were also included other than the fore-mentioned predictors in the PSID sample. The inclusion of tenure length and housing quality could help reduce the omitted variable biases. With the HSB data, some additional variables included were youth disability status and language spoken in their household. Three models yielded similar results by supporting the hypothesis that home-owning by parents have a statistically significant impact on whether their children stay in school.

The authors were not completely satisfied with regression results and they were aware of the endogeneity of homeownership. In order to have a better control for selection bias, they estimated a bivariate probit (endogenous switching) model with PSID dataset, which explains both parents' tenure decision and children's stay-in-school decision. This procedure bears the spirit of instrumental variable estimation. The equations were shown below (copied from Barker & Miller, 2009).

$$I^* = \gamma'Z + \alpha P + \mu$$

$$J_0^* = \beta_0'X + \varepsilon_0 \text{ if } I = 0$$

$$J_1^* = \beta_1'X + \varepsilon_1 \text{ if } I = 1$$

$$I = \begin{cases} 1 & \text{if } I^* > 0 \\ 0 & \text{if } I^* \leq 0 \end{cases}$$

$$J_i = \begin{cases} 1 & \text{if } J_i^* > 0 \\ 0 & \text{if } J_i^* \leq 0, \end{cases}$$

$I^*$  is parents' propensity to purchase a house,  $Z$  is a vector affecting parents' tenure choice (other than the instrument),  $P$  is an instrument that captures the relative cost of owning versus renting, whereas  $J^*$  is child's propensity of staying at school. The instrument—relative housing cost should affect parents' propensity of home purchasing directly but not child education outcomes.

The idea was that if there were uncontrolled unobserved covariates ( $U$ s) in their original probit model, the residual terms  $\varepsilon$  and  $\mu$  should be correlated. And this would bias the homeownership effect estimates obtained in their earlier analysis. In order to rule out this selection bias, they estimate the  $\text{Corr}(\varepsilon_0, \mu)$  and  $\text{Corr}(\varepsilon_1, \mu)$  using full information maximum likelihood and found that the correlations were not statistical significant. Therefore, they concluded that selection bias is not a problem in their sample (i.e., that their regression estimates were most likely not biased).

However, their conclusion may not be valid after all because the particular instrument variable, which is the ratio of the average user cost of owner-occupied housing to the average rent on rental housing in the year of the household most recent move, may not capture the full picture of the economic cost of home-owning. Other economic determinates of home purchasing such as local property tax rate, expected house price, and interest rates may also influence home purchasing and will be reflected in the residual term  $\mu$ . Since these purely economic factors are uncorrelated to personal characteristics, the correlation estimate between  $\varepsilon$  and  $\mu$  will most likely be smaller. In other words, the insignificant correlation in their analysis might be caused by the inability to include relevant instruments rather than the absence of selection bias.

Instead of testing for the correlations between residuals, we could use regular IVE approach to first regress the treatment status on the instrument and covariates  $X$ s; and then regress the outcome on the predicted value of treatment along with  $X$ s and  $W$ s to obtain unbiased treatment effect estimate for the

compliers. This could address the problems identified above and strengthen the internal validity. However, it limits the population of causal inference (POCI) to compliers, whereas in Green & White's original paper, generalizability was not compromised (i.e., POCI is the virtually the same as POS). The question is whether to have a stronger internal validity with limited generalizability or have good external validity but to live with a strong assumption for internal validity.

Other weaknesses of the probit estimates are that family wealth, home environment or neighborhood effects were not controlled for, and that the same functional form was assumed for the whole POS when different sub-groups (e.g., low and high income family) might have different functional forms.

#### Study 3: Aaronson (2000) – Instrumental variable estimation

With a critical attitude toward the assumptions made in Green & White's work, Aaronson (2000) re-examined the PSID dataset utilizing instrumental variable approach. He expanded his sample to children who reached the age of 17 between 1975 and 1993 in the PSID dataset. The dependent variable, which measures whether the child graduated from high school by age 19, is also slightly different from Green & White's study. He further matched PSID data to geocode database to capture some residential mobility of the family and their neighbors and tested how residential mobility influenced homeownership effects.

Aaronson first estimated a probit regression including observable family characteristics (e.g., child's gender, race, parents' age, head's education, family size, etc.) on the outcome variable and obtained homeownership effect comparable to that in Green & White's study. He then added measures of residential mobility including frequency of residential moves, the duration of residential and neighborhood residence into the regression model, and found half of the homeownership effect obtained in previous model disappeared. This led him to question the distinctive contribution of homeownership. He suspected that the "effect" of homeownership could merely reflect its association with third factors such as residential mobility, home equity, or some other latent conditions, rather than its unique impact on the outcome.

To address the endogeneity problem of homeownership, Aaronson utilized an instrumental variable approach. He constructed two instrumental variables: one is group average homeownership rate (formed by taking state-year average homeownership rates by race and income quintile using the March CPS surveys) for homeownership; the other one is residential mobility (measured by family mobility rates prior to the child turning age 5). He argued that average homeownership rates could pick up regional variation

that is driven by housing costs, property tax rates and other secular trend in housing and would be unrelated to the error terms of child educational outcomes. As for residential mobility, he suspected pre-school moves would not influence child's school progress. Two sets of two-stage regressions, one that includes the homeownership instrument and one that includes both homeownership and residential mobility instruments were tested with five samples: the full, the low and high income neighborhood, and the low and high mobility neighborhood samples. As expected, the estimates were smaller than the probit model tested earlier and were statistically insignificant after controlling for residential mobility (with one exception for low mobility neighborhood sample). For low mobility neighborhood sample, homeownership effect remained significant.

Aaronson's study, compared to Green & White's article, has two major strengths. First, he utilized two instruments to control for the endogeneity of homeownership and residential mobility, which should be able to yield unbiased estimate provided the instruments were valid. The assumptions for the instrumental variable approach were comparatively weaker than that in Green & White's article. The second strength is that he did not impose the same functional form on the whole sample; instead, he estimated homeownership effects with different sub-groups respectively (i.e., high and low income group, high and low neighborhood mobility group). Again, this requires weaker assumptions as compared to Green & White's study in which they assumed a single function form for the whole sample.

The validity of the two instruments, however, can be challenged. An instrument is not supposed to be directly related to the outcomes. It is plausible that frequent pre-school movement could influence children's psychological wellbeing and cognitive ability, therefore disqualifies the residential mobility variable as a valid instrument. A good instrument should also be strongly related to the treatment. The partial  $R^2$  from the instruments ranges from .049 to .088, not exactly the strongest predictor of homeownership.

#### 4.3 Difference-in-difference

##### Study 4: Barker & Miller (2009)

Barker and Miller used a "difference in difference" method to estimate homeownership effect on children's reading and math test scores. They restricted their population of sample to families that changed from renters to owners or owners to renters. They argued that if an independent effect of homeownership exists, one would expect an improvement in test scores of children in families that move from renting to owning and a decline in test scores of children in families that

changed from owning to renting, holding other family characteristics constant.

The authors looked into the Early Childhood Longitudinal Study (ECLS) data. The identified families with changes of tenure during the times that the child was in first grade and third grade. Descriptive statistics showed that children of homeowners consistently scored higher than children of renters, and children who moved from rental to owner occupied housing improved more than children who moved in the other direction. They then regressed the improvement in test scores from first to third grade on dummy variables indicating whether the family stayed as owners for the whole time, whether it moved from renting to owning, whether it moved from owning to renting, and whether it stayed as renters (always renting is the reference group). No significant homeownership effect was found.

However, their findings should be interpreted with caution. First of all, the effective sample size was small because not so many families changed tenure within a three-years period (79% of the families were owners in 1st grade and 82% were owners in 3rd grade, exact numbers were not provided in the article). Moreover, the analysis was restricted to those who changed tenure within a three-year period, which may be too short to detect any long-term effect of homeownership.

The major problem with the DID estimate in this study is that the conditional independence assumption seems implausible. In the analysis, the effects of always-owners, owner-to-renter, and renter-to-owner were compared to the effect of always-renters. To get an unbiased DID estimate, there should be no unobserved covariates (Us) after differencing the effect of always-renters. This assumption may not hold. For example, families who switched from renting to owning could be more likely to move to a better neighborhood, they might decide to own because they were getting remarried or having another baby, or they might care more about their children and therefore they decided to purchase a house as the child gets older. Although the authors controlled several family changes during this period, it was unlikely that these change measures were exhaustive. In short, it takes a strong assumption to believe the observed homeownership effect is unbiased that it is not merely a reflection of its association with other covariates.

In addition, the authors imposed same functional form for those who moved from renting to owning and those who moved from owning to renting by putting them into the same regression model. This may not hold because families who switched from owning to renting and those who switched from renting to owning could have very different experiences. In other words, they could be systematic differences between these two types of families and the relationships between the

treatment, covariates, and the outcome for these families could be different.

#### 4.4 Fixed Effect

Study 5: Boyle, Georgiades, Mustard & Racine (2007)

An alternative method to control for family-specific and neighborhood-specific unobserved factors is fixed effect approach. Conditional fixed effect models allow identification of within-neighborhood and/or within-family variation in homeownership status. Utilizing fixed effect to control for family-specific factors requires sibling data and variation in tenure status within siblings. Such cases are difficult to identify. To our knowledge, no study has ever utilized fixed effect to control for family-specific unobserved factors to estimate homeownership effect on children's educational outcomes. Studies that estimated neighborhood fixed effect do exist. Though not an ideal case, here we present one study that estimated homeownership effect when controlling for neighborhood-specific fixed effect.

In this study, Boyle et al. (2007) examined a set of neighborhood and family characteristics on participants in 1983 (when they were between 4 and 16 years old) and their total years of education (excludes grades repetition) in 2001 when they were 22-34 years old from the Ontario Child Health Study (OCHS). They used three-level multilevel modeling since the data was nested (i.e., children nested within family, family nested within community). Homeownership (renting versus owning) was one of the several family characteristics included to predict child education attainment. Since homeownership was not their focal predictor and treated as a fixed factor at the family level, it was not possible to rule out family-specific unobserved characteristics for homeownership effect estimate. However, neighborhood-specific unobserved characteristics were controlled for provided that there were within community variation on tenure status. The results suggested that children living in renting families when they were young had lower educational attainment when they were young adults.

The major problem with the estimate is that family-specific unobserved characteristics were not controlled for. It is possible that parents who owned were systematically different from those who rented in the same neighborhood. Although several family demographic, physical, behavioral and psychological characteristics were included in the regression analysis, there is no guarantee that additional confounders do not exist.

#### 4.5 Differential Effects

Study 6: Harkness & Newman (2003b): IVE differential effects

A common weakness of the afore-evaluated

studies is that their findings were based on samples that included families from across the income spectrum (Harkness & Newman, 2003b). To test if the benefits of homeownership differ across income levels, Harkness and Newman utilized differential effects approach and estimated homeownership effects in low-income and high-income groups separately using IVE. The population of sample came from the PSID data. Individuals who were born between 1957 and 1973 and who had family data available for each year when they were between ages 11 and 15 in the PSID data were included into the analysis. The two groups included children from families with parental earnings less or more than 150% of the federal poverty threshold for at least three of the five years the children were between age 11 and 15. Children's educational outcomes were measured by whether they graduated from high school at age 20, years of education at age 20, and whether they had any post-secondary education at age 20.

For instruments for homeownership labeled as highway stock (annual change in state's per capital highway investment), cost ratio (ratio of owner to renter costs in census region), metropolitan area (ratio of median property value of median rent), and state homeownership rate were tested to compare their robustness. All four instruments significantly predicted homeownership in low-income group, but only two significantly predicted homeownership in high-income group. Two-stage regression results suggested significant homeownership effects for all three educational outcomes in low-income group; however, no significant effects were detected for high-income group after covariates and the instruments were included.

The major strength of this study is that it does not impose the same functional form on low-income and high-income groups. Instead, IVE approach was utilized on each sub-group and differential effects were detected. Another strength is that four different instruments were used to provide comparisons among instruments.

However, two instruments (highway stock and cost ratio) were not exactly valid instruments for high-income groups as they failed to predict homeownership within that group. Another weakness is that by operationalizing homeownership as years living in home-owning families, the authors assume the outcome changes as a linear function of homeownership. This might not be valid.

## 5.0 Conclusion

Based on our review, homeownership appears to have only small independent effect on children's educational outcomes. A significant proportion of homeownership effect observed in cross-sectional studies can be explained away once other important

covariates are included in the model. This is not surprising given the endogeneity of homeownership. In order to obtain an unbiased estimate of homeownership effect, future research should either adopt true experiment design or utilize appropriate quasi-experimental methods to deal with selection bias.

If plausible instrument(s) could be constructed, IVE appears to be the best choice because the assumptions required to make valid causal inference are relatively weaker compared to other methods. Besides, it does not require much on the specific nature of the data and/or the original research design. Because of its efficiency, IVE is the most popular quasi-experimental method in homeownership literature. However, future studies should take caution in selecting instruments. The validity of instruments should be explicitly evaluated theoretically and empirically. Using multiple measures to construct an instrument or using multiple instruments seem to be a good way to cross-validate the results of IVE.

When a plausible instrument does not exist, fixed effect may be a good choice when the data is nested. The ideal situation would be sibling data where one sibling lived with renting parents at one time and the other(s) lived with home-owning parents at another time. Theoretically, using fixed effect with sibling data should be able to eliminate the effects of unobserved family characteristics. However, the results should be interpreted with caution since other family changes over time that affect the educational outcomes of the siblings differently may be correlated with switches in homeownership. Family changes (e.g., divorce, being laid-off, etc) that could be related to change of tenure and children's educational outcomes should be controlled for when estimating homeownership effect.

Another quasi-method that could be utilized to estimate homeownership effect, though less commonly applied, is difference-in-difference (DID). The endogeneity of homeownership makes the conditional independence assumption in DID vulnerable to criticism. When a panel of people who switch their tenure voluntarily (i.e., without any policy incentives) is used to obtain DID estimate, important family changes should be controlled for. Another way to implement DID is to utilize existing policy changes.

When DID and fixed effect does not apply, propensity score matching (PSM) is another alternative to estimate homeownership effect. Compared to DID and fixed effect, PSM has little requirements on the data structure and can be easily implemented as long as a comparison group can be formed. To our knowledge, no study has ever utilized PSM to estimate homeownership effects on children's educational outcomes. The validity of PSM largely relies upon whether all the important covariates are included at the first step to predict homeownership status. If one can

make the case that important covariates are included, then PSM seems to be a convenient and efficient choice.

Evidence also suggests that homeownership effects differ across groups (e.g., low-income, high-income group). Future studies should take this into consideration and avoid imposing the same functional form for different groups of people.

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## Improving Young Indigenous Malaysian Children's Incidental Vocabulary Acquisition and Oral Narrative Skills through Shared-book Reading

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**Abstract:** This paper is based on a quasi-experimental study which investigated the impact of Shared-book Reading (SBR) on the development of vocabulary and oral narrative skills of young Indigenous Malaysian children learning Malay as a second language. Sixty three (63) Orang Asli children from two first-grade classrooms participated in the study. One of the classes was randomly assigned to implement SBR sessions while the other served as wait-listed control. Prior to the intervention, all students were assessed on a grade-appropriate literacy screening test (LINUS I), a Rapid-automatized naming task (RAN), and a Children's Nonword Repetition Test (CNRep). After a five-week intervention, all students were assessed on vocabulary and storytelling. Results showed that experiences of SBR accelerated Orang Asli children's oral Malay language production and increased their level of word-meaning knowledge. Specifically, the SBR group performed significantly better than the control group on the word-defining task. They also produced more coherent, higher quality narratives in a wordless picture story-telling task. They told the stories with greater verbal rate which contained significantly greater vocabulary diversity. These results altogether yield significant implications for the literacy instruction practices of Orang Asli children.

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**Keywords:** Indigenous peoples, achievement gap, emerging literacy, second language learning, shared-book reading, incidental vocabulary acquisition, oral narrative skills

### 1. Introduction

The purpose of this paper is to report findings of a study which investigated the effects of an approach to teaching reading in the classroom, Shared-book Reading (SBR), on the oral and vocabulary development of young Indigenous Malaysian (Orang Asli) children learning to read Malay as a second language. The Orang Asli children who typically come from low-income backgrounds rarely attain the same levels of achievement in literacy as their non-indigenous counterparts. Despite the importance of oral Malay proficiency for Malay language learners (MLLs), literacy instruction practices for MLLs too often feature individual seatwork and teacher-directed whole class instruction, depriving MLLs of rich experience in oral Malay Language. It is not surprising that having few chances for extended use of the language Orang Asli children show low academic engagement and lag behind in reading achievement.

In Malaysian public schools, language is treated as one of the core subjects with great emphasis on the attainment of phonics, vocabulary and grammar. Little opportunity is provided for interactive language that is comprehensible, interesting, and relevant to the students. Language teachers typically rely on simple tasks that require little opportunities for the students to respond using language that is authentic and purposeful.

Round-robin reading is extensively practiced in language classrooms using graded readers to try to improve Malay Language pronunciation and oral reading accuracy instead of opting for proactive literature circles where children can connect their background experiences with the information-rich texts they read.

The current language lessons are usually fast-paced and cognitively low-level. The question-answer routine between teacher and student limits students' opportunities to think and talk about the text, let alone to formulate and express their extended ideas to the class. The emphasis on phonics, spelling, accurate oral reading, proper Malay language pronunciation, vocabulary lists, grammar, and literal comprehension has probably been exacerbated by the perception of schools that these emphases are necessary to prepare students to pass high-stakes examinations (Assaf, 2006). There is a reason to fear that the regimen in today's schools inhibits the language development of Orang Asli children learning to read in Malay and may retard their cognitive development and undermine their motivation for school by taking the meaning and enjoyment out of learning (Gersten, 1996).

To address the inadequacy of conventional literacy instruction for Orang Asli children and some of the limitations of research for this group of MLLs,

Shared-book Reading (SBR), an approach that promotes relaxed, supportive atmosphere of shared reading was employed in the current study aiming to promote Orang Asli children's oral narrative and vocabulary development in the Malay language. Shared book reading can be defined as a practice that occurs between an adult and a child or children when reading or looking at a book. As such, it encompasses a range of methods that vary in complexity (Van Kleeck, Gillam, Hamilton, & McGrath, 1997; What Works Clearinghouse [WWC], 2006). Unlike traditional classroom instruction in which students spend 70% of their time passively watching and listening to the teacher (Simmons et. al, 1995), SBR is intended to allow children to experiment as they develop strategies for predicting and self-correcting (Anderson et. al, 2002).

SBR aligns itself well with the research by the Russian linguist, Lev Vygotsky which has shown that learning is most effective when it is collaborative. Shared reading enables children — especially second language children — to engage in genuine reading at a level beyond which they might not be able to do on their own (Hyland, 2005). While it has been clearly proven that social interactions play a role in shaping a child's development, the trick is to ensure that these contacts will also help to bring about positive effects on their learning.

The success of SBR in achieving that goal first came to light when researchers like Holdaway (1979) and Elley (1989) demonstrated that the intervention was capable of increasing phonological awareness and oral development amongst kindergarten children. Since then, studies have continued to demonstrate the power of SBR as a positive influence on learning to read among children. It has since shown to be a successful educational intervention that provides social opportunities, enabling the young second language learners gain confidence, share knowledge, self-correct and construct meaning cooperatively.

A large amount of research explores positive effects of SBR on the more privileged, language mainstream classrooms (e.g. Blewitt & Rump, 2009; Evans et. al., 2008; Hindman et. al., 2008; Horner, 2004; Pollard-Durodola et. al, 2011; Trivette & Dunst, 2007; and Ukraineitz et. al., 2000). Nonetheless, studies of SBR with the underprivileged groups have also shown similar positive effects of the approach in improving and facilitating literacy skills of emergent young readers. In Davie and Kemp's (2002) study, SBR facilitated more intelligible language of young children with mild to moderate disabilities in speech production. SBR also has shown to accelerate vocabulary development of Head Start (low-income) children in the United States (Hindman, Wasik & Erhart, 2010). In the study carried out by Mason et. al. (1990), SBR

increased print concept awareness, letter knowledge, writing and reading abilities of at-risk preschool children. SBR has also improved language-delayed children's expressive vocabulary (Whitehurst, 1994).

However, to date, it seems there have not been any studies conducted on the effects of SBR on Indigenous Malaysian children's second language learning. Although SBR is widely used in middle-class classrooms where teachers are familiar with the approach and teaching materials are widely available, it is probable that the effects of SBR can extend beyond regular mainstream classrooms and have significant implications for indigenous children's learning of the second language. By improving the approach in teaching reading and getting students engaged in the activities, it seems it would follow naturally that the atmosphere in the indigenous classroom would become more inviting and cooperative, lending itself to higher levels of student participation and achievement. The centerpiece of this educational intervention is a series of a simple and engaging reading instruction that entails the use of giant-sized storybooks carefully selected to suit the children's readability level as well as background knowledge where the teacher illustrates "skills in action" by directing attention to letters, word patterns, and conventions of print to the children (Hyland, 2005).

The goal of this quasi-experimental research was to document instructional practices that could give a large boost to children's capabilities of being active recipients of information and promotes them to be full participants in reading through questioning, labeling, elaborating and by joining in the reading as they wish (Hayden, 1986 in Hyland, 2005). The primary objective of the study was to measure the impact of shared-book reading in promoting emerging literacy skills of young Indigenous Malaysian children. The study was organized around the following research questions:

1. What differences in vocabulary and oral Malay language proficiency, if any, were there among students assigned to the treatment and control groups prior to the implementation of Shared-book Reading sessions?
2. What differences in vocabulary and oral Malay language proficiency, if any, were there among students that were engaged and those not engaged in Shared-book reading sessions and activities?

For the purpose of analysis, the research questions were posed as null hypotheses.

H<sub>01</sub>: There was no difference in vocabulary and oral Malay language proficiency of students assigned to treatment group and control group prior to the implementation of Shared-book Reading sessions.

Ho2: There was no difference in vocabulary and oral Malay language proficiency of students who were engaged in Shared-book Reading activities and those who did not participate in Shared-book Reading activities.

## 2.0 Methods

### 2.1 Research Design

This study employed the nonequivalent control group design where the level of significance ( $\alpha$ ) was set at 0.05. Pretests were administered to all participants prior to the treatment. The pretests were helpful in assessing students' literacy level prior to the intervention and also in testing initial comparability among groups. Posttests were administered to measure treatment effects. The total treatment lasted for 600 minutes over a span of 5 weeks. In order to avoid the problem of the students becoming "test-wise", the pretest and posttest were not parallel forms of the same test.

### 2.2 Participants

Two Malay Language teachers and their first grade classrooms with predominant enrollment of Orang Asli children (N=63) in Kuala Langat (southwest district of the state of Selangor) participated in the study. Of all 63 students, 57 (90.48%) were Orang Asli, 2 (3.17%) were Malays and 4 (6.35%) were Indians. Because this study specifically targeted Orang Asli children learning Malay as a second language (MLLs), only the 57 Orang Asli children were included for data analysis. There were 27 MLLs in the SBR group and 30 MLLs in the control group. There were 49.10% boys (SBR: 17.54%, Control: 31.56%) and 50.90% girls (SBR: 29.84%, Control: 21.06%). The mean age of the MLL sample was 6.7 years old. All students come from a household with per capita monthly household income of MYR 84.66 (USD 29.19).

### 2.3 Instruments

A national standardized literacy screening test (LINUS 1) was used to obtain all students' baseline literacy level prior to the intervention. Two other pretests, Children's Nonword Repetition Task (CNRep; Baddely & Gathercole 1996) and the Rapid Automatized Naming task (RAN; Snodgrass & Vanderwart, 1980) were administered to assess each student's working memory retrieval, lexical access and phonological encoding which are crucial components for successful language learning.

Ten (10) giant-sized storybooks were selected from an established reading series with a wide range of themes (e.g. animals, vehicles, sports, celebrations, culture, and fiction). The books were also carefully organized to have different ranges of age-appropriate readability level, where the stories become slightly challenging in terms of text structures, vocabulary, syntax and length as the intervention progresses across

time.

All students were assessed with two posttests by the end of the intervention. The oral vocabulary test (developed by the researchers) primarily aimed at assessing students' content-word transfer knowledge in which 40 words were cautiously selected from the 10 storybooks used in the intervention. The storytelling task using Mayer's (1965) well-established "Frog Where Are You?" story sought to elicit students' oral narrative skills.

### 2.4 Procedure

To determine the impact of SBR on promoting students' emerging literacy skills in L2, a non-equivalent control group quasi-experimental design was selected for this study. The quasi-experimental design (Campbell, Shadish, & Cook 2002) allows the authors to use intact groups with no random assignment to the treatment or the control.

The two identified MLL teachers received a one-day training of SBR to familiarize them with the approach and the materials. The two sample classes were then randomly assigned to either treatment or a waitlisted control after the training to guard against selection bias. To ensure fidelity of implementation to ensure the intervention was implemented as designed, the researchers were present in the treatment classrooms during each session from beginning until the end.

Except for LINUS 1 (which was administered by the schools), pretests were carried out for one week at both sites prior to the intervention where students were individually administered the CNRep (Badeley & Gathercole, 1996) and RAN (Snodgrass & Vanderwart, 1980) tasks. Students' responses were all audio-recorded.

After pretest data have been gathered, 10 SBR sessions were carried out one-hour per session, twice a week for five consecutive weeks, embedded within the Malay Language instruction period in the treatment classroom. Over the course of the treatment, the children were engaged in age-appropriate stories read by their Malay language teacher and involved in post-reading activities both in whole-class and small-group modes. Treatment students played a more active role in class participation by role-playing and retelling the stories. The waitlisted control group continued to receive regular Malay Language instruction during the period of data collection.

Posttests were administered after the 10 SBR sessions have been delivered. The posttests consisted of assessing students from both sites on their 1) oral vocabulary to test their knowledge transfer of content words from the storybooks read in SBR sessions, and 2) oral narrative skills based on a wordless picture story book. All students in both assigned conditions were administered and audio-recorded individually. The



waitlisted control group and their language teacher later received the teaching packet and materials after completion of data collection.

### 2.5 Analysis

A mixed method approach was employed in this study. Quantitative data gathered were organized, entered, and ultimately analyzed using the SPSS statistical analysis software. The study employed both descriptive and inferential statistical analyses. Multiple analyses of covariance (Mancova) were primarily employed in the quantitative analysis of this study. It was deemed appropriate for the study as it measures covariance between the pretests (as covariates) and posttests (as dependent variables) between the control and treatment classes. Alpha level of .05 was set as a priori in all related tests. Hierarchical regression analyses were also employed to determine the impact of SBR on students of differing levels of initial Malay Language proficiency.

Qualitative data gathered (storytelling) were transcribed in verbatim and later coded using the Systematic Analysis of Language Transcripts (SALT, 2010) conventions. Based on the generated coding, the qualitative data were later analyzed quantitatively using the same language software (SALT, 2010) to be included in the overall statistical analysis to seek for causal inferences.

The storytelling transcripts were also graded qualitatively. Two native Malay Language speakers blind reviewed the transcripts and employed holistic scoring using the Narrative Scoring Scheme (NSS), an assessment tool that provides an index to student's ability to produce a coherent story. The inter-rater reliability between the reviewers was 0.878. The NSS scores were also ultimately included as one of the dependent variables in the hierarchical regression analysis of this study.

## 3.0 Results and Discussion

### 3.1 Initial Malay Language Proficiency

Table 1 summarizes the descriptive statistics of children's performance on the three Malay Language proficiency pretests: LINUS 1, Rapid Automatized Naming (RAN, 1980) test and Children's Nonword Repetition (CNRep, 1996) as well as Cronbach's alpha reliability coefficients. Using the three pretest scores as dependent variables, a one-way MANOVA analysis found no significant main effect of the intervention condition,  $F(3, 53) = .386$ ,  $p = .764$ ,  $\eta_p^2 = .021$ , suggesting the initial Malay Language proficiency of the SBR and the control group was comparable. See figures 1 and 2 for a comparison of results for both waitlisted control and treatment groups on the RAN and CNRep.

Table 1. Means (SDs) of Performance on Pretests

| Pretests | Cronbach's $\alpha$ | SBR             | Control          |
|----------|---------------------|-----------------|------------------|
| LINUS 1  | NA                  | 1.85<br>(.77)   | 1.67<br>(.66)    |
| RAN      | .943                | 40.39<br>(9.08) | 41.35<br>(10.15) |
| CNRep    | .794                | 29.70<br>(4.79) | 28.47<br>(5.86)  |

### 3.2 Intervention Effects on Vocabulary

Table 2 displays students' performance on the Vocabulary test. The analysis of the score were divided into three components: 1) Vocabulary – Decoding, the proportion of words each student was able to decode correctly regardless of accuracy of meaning, 2) Vocabulary – Meaning, the proportion of words each student was able to define correctly regardless of ability to decode the words correctly, and 3) Vocabulary - Decoding + Meaning, the proportion of words each student was able to decode and define correctly. Using the pretest scores as covariates, a MANCOVA analysis was performed to seek for intervention effects on Vocabulary. Significant difference was found between the SBR and the control group on overall Vocabulary,  $F(3, 50) = 12.74$ ,  $p = .00$ ; Wilk's Lambda = .57,  $\eta_p^2 = .43$ . Out of the three pretests, only the LINUS 1 covariate was significantly related to the combined Vocabulary outcome measures,  $F(3, 50) = 33.26$ ,  $p = .00$ ; Wilk's Lambda .33;  $\eta_p^2 = .67$ .

Table 2. Means (SDs) of Performance on Vocabulary Decoding, Meaning, and Decoding+Meaning.

| Measures                        | SBR          | Control      |
|---------------------------------|--------------|--------------|
| Vocabulary – Decoding           | 26.37(20.35) | 19.37(17.41) |
| Vocabulary – Meaning            | 40.52(9.529) | 27.23(13.15) |
| Vocabulary – Decoding + Meaning | 25.81(19.89) | 18.50(16.56) |

Further analysis of each individual dependent variable, using a Bonferroni adjusted alpha level of .017, showed that there was no contribution toward Vocabulary – Decoding,  $F(1, 52) = 1.33$ ,  $p = .255$ ,  $\eta_p^2 = .025$  and Vocabulary Decoding + Meaning,  $F(1, 52) = 1.827$ ,  $p = .182$ ,  $\eta_p^2 = .034$ . There was treatment effect on Vocabulary – Meaning,  $F(1, 52) = 32.396$ ,  $p = .00$ ,  $\eta_p^2 = .384$ . The results suggest that SBR sessions have an impact on students' learning of word-meaning but did not help improve students' decoding skills.

Findings of this study adds to the previous research that engaging children in shared-book reading sessions improves students overall vocabulary with significant results in learning of word meanings. The

conversation and extra-textual questions that accompanies the shared-book reading sessions have facilitated the young children learning of unfamiliar words (Blewitt et al., 2009). Children with lower initial Malay proficiency seemed to benefit more from SBR in learning new word meanings than those with higher initial Malay proficiency. See *Figure 4*.

This result is unique in experimentally demonstrating children's vocabulary growth based on their language proficiency. Typically, children with higher initial language proficiency tend to learn more than children with lower initial language proficiency. This striking effect may be due to the fact that shared-book reading sessions call for the teacher to ask scaffolding questions facilitated children's deeper understanding of word meanings.

While there was a trend for the SBR students to read more new words, the difference was not significant, most probably because of the duration of the intervention was not long enough to obtain such results. However, the evidence that children's word-meaning knowledge increased over the course of treatment corroborates previous research demonstrations that young children learn vocabulary successfully from SBR (Ard & Beverly, 2004; Blewitt, Rump, & Coom, 2009; Biemiller & Boote, 2006; Elley, 1989; Ewers & Brownson, 1999; Hargrave & Senechal, 2000; Justice, 2002; Justice, Meier, & Walpole, 2005; Penno, Wilkinson, & Moore, 2002; Reese & Cox, 1999; Robbins & Ehri, 1994; Se'ne'chal, 1997; Se'ne'chal & Cornell, 1993; Se'ne'chal, Thomas, & Monker, 1995).

### 3.4 Intervention Effects on Storytelling

Table 3 displays the descriptive statistics of the language measures from the students' storytelling in five categories: story length (number of words), vocabulary diversity (number of different words), verbal rate (time length; words per minute), story quality rating (NSS) and mazes (percent of mazes over total words)<sup>1</sup>. MANCOVA analysis using pretest scores as covariates found a significant overall intervention effect,  $F(6, 47) = 10.843$ ,  $p = .00$ ; Wilk's Lambda = .42,  $\eta_p^2 = .58$ . However, out of the three pretests, only the LINUS 1 covariate was significantly related to the combined storytelling outcome measures,  $F(6, 47) = 3.38$ ,  $p = .01$ ; Wilk's Lambda = .70,  $\eta_p^2 = .30$ .

Further ANCOVA analyses using a Bonferroni adjusted alpha level of .01 found significant differences between the SBR and the control group on the story length, vocabulary diversity, verbal rate, and story quality rating,  $ps < .01$ . Compared to the control group, the SBR group took longer time to tell the stories, used more different words, produced more words per minute, and told better stories. Results for the total time of the storytelling and mazes produced were non-significant indicating that students' performance did not significantly differ by treatment condition. SBR

sessions helped improve young indigenous children's Malay speaking skills in terms of the production of higher quality of story structure in oral narratives. The narratives produced by the SBR group were more coherent in terms of hierarchical thematic structuring and global plot organization. Narratives produced by the SBR students contained more detailed descriptions of setting, character development, conflicts, and resolution essential for advancing the plot in a logical order. SBR students regardless of overall NSS scores also expressed more mental states of characters (e.g. the boy got angry) and used more clear referents. SBR students' ability to produce more coherent stories than their counterparts in the control classroom is no doubt because of active experience with the set of stories in SBR enabled them to obtain a better understanding of narrative structure.

Table 3. Means (SDs) of Language Measures of Storytelling

| Measures                          | SBR            | Control       |
|-----------------------------------|----------------|---------------|
| Number of Words                   | 199.07 (88.64) | 81.20 (27.43) |
| Number of different words         | 70.78 (16.14)  | 48.80 (17.65) |
| Time length                       | 2.66 (.39)     | 2.46 (.49)    |
| Words per minute                  | 74.16 (28.07)  | 34.34 (13.50) |
| NSS                               | 16.26 (3.17)   | 12.97 (2.83)  |
| Percent of mazes over total words | 7.07 (3.43)    | 8.63 (2.25)   |

Shared-book reading sessions may also have promoted young Indigenous Malaysian children's oral narrative skills because the acquisition in narrative competence is achieved through the combination of advancing language skills developed through sharing personal experiences, stories, and other text-level materials (Miller et al., 2006). In addition to the wide and deep reading experience, students have more opportunities to practice speaking in the Malay language in the shared-book reading sessions by sharing their understanding of the stories in the post-reading activities (e.g. role-playing, group work, and making personal connections) which should improve their skill at expressing oral narratives.

Shared-book reading not only improved children's performance at a global narrative structure level but also at lexical and syntactical level. Although students

in both conditions took considerably the same amount of time to tell the story, the number of words produced by the SBR students almost doubled up that produced by the control group. Vocabulary diversity also doubled up in the SBR classroom indicating that exposure to a wide variety of stories made students more comfortable and confident to use different types of words in their narratives.

### 3.5 Differentiated Treatment Effects with Varying Initial Language Proficiency

To investigate if SBR influences learning of word-meaning and oral narrative skills differently for children with varying levels of initial Malay Language proficiency, hierarchical regression analyses were conducted using the Vocabulary – Meaning and oral narrative scores (story length, vocabulary diversity, verbal rate, and mazes), as dependent variables, respectively. In each analysis, the LINUS 1 pretest score was entered first, followed by condition contrast: SBR vs. Control, and their interaction was entered last.

For the Vocabulary – Meaning, a significant trend toward an interaction between initial Malay Language Proficiency and the SBR vs. Control contrast was found,  $p = .01$ . Students with lower levels of initial Malay Language Proficiency benefitted more from the SBR sessions than did the students with higher levels of initial Malay Language Proficiency,  $\beta = -.55$ . See Figure 1.

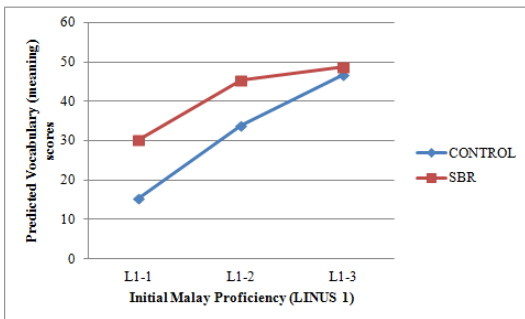


Figure 1. Vocabulary – Meaning as a function of initial Malay language proficiency.

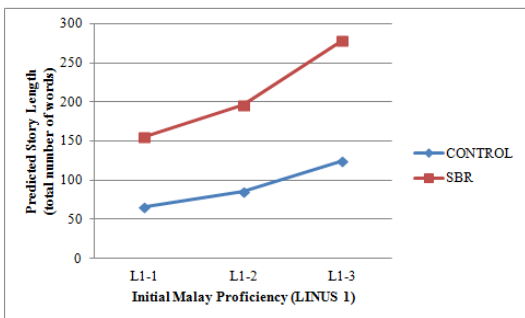


Figure 2. Story length as a function of initial Malay language proficiency.

For the oral narrative skills, result for the story length (total number of words) was consistent with the ANCOVA analysis where SBR vs. control contrast was significant,  $p = .00$ , but no significant interaction between initial Malay language proficiency and the SBR vs. Control contrast was found,  $p = .11$ . Figure 2 shows that students in the treatment condition produced stories that were longer suggesting significant SBR effects on story length.

In terms of vocabulary diversity (number of different words), consistent with the previous ANCOVA analysis, SBR vs. Control contrast was significant,  $p = .01$ . However, no significant interaction between initial Malay language proficiency and the SBR vs. Control contrast was found,  $p = .30$ . Figure 3 show that students in the treatment condition outperform students in the control group regardless of initial Malay proficiency.

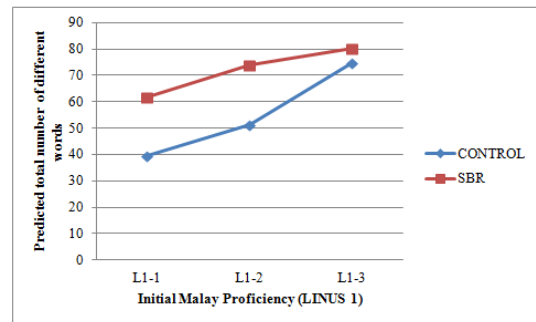


Figure 3. Vocabulary diversity as a function of initial Malay language proficiency.

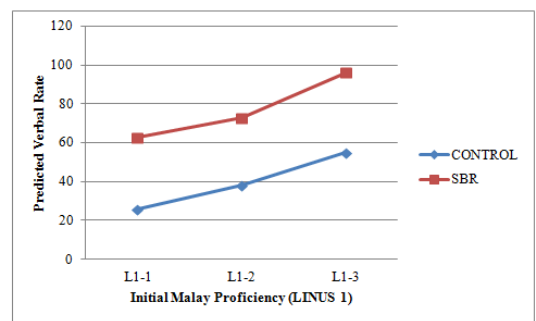


Figure 4. Verbal rate as a function of initial Malay language proficiency.

For the verbal rate (number of words per minute), consistent with the previous ANCOVA analysis, SBR vs. control contrast was significant,  $p = .00$  but no significant interaction between initial Malay language proficiency and the SBR vs. Control contrast was found,  $p = .76$ . Figure 4 shows that students with varying initial Malay language proficiency gained almost equally from SBR sessions.

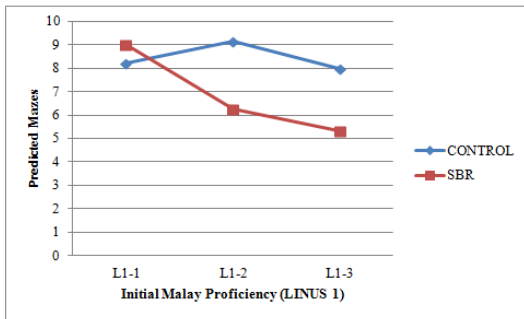


Figure 9. Mazes as a function of initial Malay language proficiency.

Result for the mazes (percent of mazes over total of words) was consistent with the ANCOVA analysis where the SBR vs. control contrast was non-significant,  $p = .07$  but the interaction between initial Malay language proficiency and the SBR vs. Control contrast was significant,  $p = .04$ . Figure 5 shows that students with lower initial Malay language proficiency (L1-1 and L1-2) produced more mazes than students with higher Malay language proficiency regardless of treatment condition,  $\beta = -.80$ .

In brief, SBR can effectively increase Orang Asli first graders' oral narrative skills and receptive vocabulary attainment.

#### 4.0 Conclusion

The current study has implications for effective literacy instruction for young Indigenous Malaysians learning a second language. The results offer evidence that providing extensive oral language development opportunities by engaging students in free-flowing reading sessions accelerates L2 learners' receptive and expressive language. The goal of listening, speaking, reading, and writing for authentic communication and self-expression is met in Shared-book Reading sessions.

Despite the short duration of the project, lasting only about 10 hours in total over one month and a half, engaging in close-knitted, reading aloud sessions significantly impacted Indigenous Malaysian L2 learners' oral language and vocabulary development. SBR filled a gap in the Indigenous Malaysian children's needs for opportunities to develop early literacy skills at par with their mainstream, non-Indigenous peers.

#### Note:

Mazes refer to revisions or repetitions in spoken language. Children typically produce more mazes in contexts that are linguistically demanding such as the production of oral narratives (as opposed to conversational speech).

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## Inter and intra professional collaboration in the implementation of Problem-Based Learning in nursing education: lesson for South Africa

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**Abstract: Purpose:** This review examines various examples of collaboration in PBL implementation, particularly between academic and practice entities. **Methods:** The updated integrative review (IR) approach according to Whitmore and Knalf (2005) was utilized to guide this search and understand the extent to which PBL is collaboratively implemented in nursing education for pre-registration programme. **Findings:** Collaboration emerged as a consistent theme – whether between academics and practitioners in the supervision and guidance of nursing students, between faculty members and real patients in facilitating PBL group tutorial sessions, between inter-professional students in PBL learning, or between nurses of different specialties in developing PBL scenarios. [Rakhudu M A; Amaize A; Useh U; & M Maselesele **Inter and intra professional collaboration in the implementation of Problem-Based Learning in nursing education: lesson for South Africa.** *Life Sci J* 2012;9(4):849-859] (ISSN:1097-8135). <http://www.lifesciencesite.com>. 132

**Key concepts:** Collaboration, implementation and problem based learning, inter-professional, intra-professional

### 1.Introduction

Nursing educators worldwide are charged with the task of preparing a nurse workforce that is responsive to dynamic population changes that are increasing in complexity. Problem-based learning (PBL) as a pedagogical approach that has been proposed as a solution to address the challenge of producing nurses that are critical thinkers, life-long learners, and more equipped to handle the challenges of their ailing communities (Rideout, 1994). The approach arose from critiques of predominantly lecture-based courses taught in medical schools in the 1950s and 1960s. It was argued that such methods of teaching lacked relevance to future physician practice in that it did not encourage teamwork, inquiry skills, problem-solving and critical thinking skills, nor was it effective in linking theory of practice (Tavakol & Reicherter, 2003). The World Health Organization echoed such concerns, especially from the standpoint of rapid technologic and information growth: “The explosion of scientific information makes traditional curricula increasingly irrelevant, because they are based on what is known today, to the exclusion of how to learn what will be known tomorrow” (Kantrowitz, et al., 1987; WHO, 1993 in Tavakol & Reicherter, 2003). The development of PBL began at medical schools at Case Western University in the United States in the 1950s and at McMaster University in Canada in 1965 (Tavakol & Reicherter, 2003).

While there are many variations to PBL implementation, there are shared elements and core components that work together to foster integration of knowledge from a variety of disciplines. Students are given a carefully crafted, ill-defined problem

scenario (much like the type that would be encountered in the practice setting), and engage in an analytic process of progressive inquiry by initiating and developing appropriate hypotheses (Biley & Smith, 1998). The teacher’s role shifts from that of a content expert to that of a facilitator of group learning process and provider of guidance in eliciting critical learning objectives. Working in groups, students integrate their previous knowledge and then explore the various aspects of the problem scenario using formal and informal resources (Biley & Smith, 1998). They subsequently bring their findings back to the larger group, which solidifies and stimulates further learning. As students become life-long learners, the process strengthens important skills such as: critical thinking, teamwork, self-direction, communication, and problem solving (Biley & Smith, 1998).

Nursing education literature is rich with case studies and evaluations of PBL implementation experiences, suggesting that this student-centered approach has increasingly established a strong place in nursing. The effective implementation of PBL is crucial to ensuring the successful integration of theory and practice for students. This depends on well-crafted problem scenarios, trained facilitators, supportive guidance, translation of classroom learning into the practice setting, and available resources (human, fiscal, informational, and infrastructural) to support all of these endeavors. When compared with traditional lecture-based approaches, PBL has been seen as a resource-intensive endeavor because it requires: a much lower teacher-to-student ratio, a strong capacity in crafting problem scenarios, adept facilitation skills, adequate infrastructural support for students’ self-directed

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learning process (including library resources, internet connectivity, and in some cases even simulation / skills labs or standardized patients), and appropriate student assessment methods.

At North West University's Mafikeng Campus (NWU-MC) in South Africa (a historically disadvantaged university), nurse educators have implemented PBL for third- and fourth-year nursing students since 2002. In a qualitative study conducted in 2008 exploring the experiences of nursing students regarding PBL (Rakhudu 2008) and Internal and External programme evaluation of PBL in 2008 (NWU 2008), NWU-MC students voiced their desire to have improved integration of PBL insights in the clinical practice setting. This has prompted an examination of the nursing education PBL literature around the topics of collaboration and better integration of theory and practice.

This literature review examines various examples of collaboration in PBL implementation, particularly between academic and practice entities.

#### **Framework.**

The updated integrative review (IR) approach according to Whitmore and Knalf (2005) was utilized to guide this search. Integrated review is described as a specific type of literature review that summarizes past theoretical and empirical literature to provide a more comprehensive understanding of a phenomenon (Whitmore and Knalf (2005). The overall goals of IR framework include defining of concepts, reviewing of theories, reviewing of evidence, and analyzing methodological issues. For this publication, the aim was to search for evidence for best practice in collaboration in implementing problem based learning in nursing education.

## **2. Methods**

This review focused broadly on exemplars of collaboration in PBL implementation in nursing. Articles included in the review adhered to the following inclusion criteria:

- 1) Problem-based learning (PBL) as a teaching method or central focus
- 2) The study demonstrated some level of collaboration between distinct entities
- 3) Participants were students, clinicians, and/or educators – all nursing-related
- 4) The study was published in the last 12 years (since 1999)
- 5) The study was available in English

Initially, a broad search of published studies was conducted using PUBMED, CINAHL, and MEDLINE. The following search words “problem-based learning”, “collaboration”, “nursing education” and related terms were used in this search. The searches identified 114 citations. Other papers were

located from the reference sections of these articles and by searching recent electronic or paper. These results were then scanned to eliminate articles that only described isolated PBL implementation experiences or that offered commentary or critique on methodology and research related to PBL. While initially the focus of the search was on the education of nursing students, it was decided that including other entities of collaboration might provide more insight on the topic. This process yielded a total of 19 articles spanning 1999 to 2010. These included 1 systematic review of PBL utilization in clinical teaching and 18 other articles describing collaborations of varying configurations and aims.

## **3. Results and Discussion**

### **1. PBL in the clinical setting.**

The only systematic review found in this search (Williams & Beatti, 2008) investigated the use of PBL by clinicians as a method of clinical teaching in undergraduate health professional programs. Authors sought to answer the following questions: 1) What is the clinician's understanding of the term PBL?; 2) Is PBL utilized or applied as a strategy for teaching in the clinical setting?; and 3) What facilitates or impedes the implementation of PBL in the clinical setting? (Williams & Beatti, 2008). Five qualitative studies spanning 7 years (1998-2005) were found to meet inclusion criteria, though only one of these studies focused exclusively on nursing education. This systematic review confirmed that PBL is indeed used as a teaching strategy in the clinical setting. Although the studies were heterogeneous in nature, a common theme was that application of PBL in the clinical setting was heavily influenced by clinician perceptions of PBL in relation to knowledge, preparation, and understanding of the teaching approach. Specifically, a lack of understanding of the basic PBL principles interfered with the teaching process, which led clinicians to revert to more traditional teacher-centered methods, thus undermining the more student-centered facilitation of critical thinking (Williams & Beatti, 2008). A number of barriers to PBL implementation in the clinical setting were noted, namely: poor understanding of PBL on the part of clinicians, irregular communication between clinicians and lecturers, unclear role perception, high staff turnover, lack of coordination between clinical experiences and PBL content, lack of PBL training/preparation for clinical teachers, lack of support of students in the clinical setting, time management, and competing demands of patient and clinical environment (Williams & Beatti, 2008). Authors also noted a number of proposed solutions to address some of these barriers, including: regular and focused

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communication between the lecturer and clinician; appointment of a clinical teaching associate to create a student/faculty/expert nurse triad in the clinical setting; matching clinical experiences and PBL tutorials; providing PBL training to all teachers and clinicians; and gravitating toward a process of “supported participation” rather than self-directed learning in the clinical setting to facilitate PBL (Williams & Beatti, 2008). They further concluded that more research is needed to identify best practices in PBL implementation in the clinical setting. O’Neill, Willis, and Jones (2002) investigated the student experience in linking PBL and clinical experiences at the University of Manchester in the United Kingdom. At this particular university, a PBL approach was introduced in 1994 through an integrated course throughout students’ clinical clerkships. Third- and fourth-year students were asked to respond to an open-ended question on the end-of-module course evaluation. Data from these questionnaires and from six focus groups were analyzed by theme. Authors found that students used a process of elaboration to link their learning from PBL into the clinical setting. This was accomplished through two main ways: encountering an appropriate patient (outside the PBL group), bringing their experiences back to the PBL group for discussion (inside the PBL group). The process was facilitated by the following factors: proper match between the clinical clerkship and the PBL case content, the role of the tutor in the facilitation process, and the self-directed initiatives of the student.

## **2. PBL collaboration for the clinical education of nursing students.**

Seven of the 19 articles in this review described exemplars of PBL collaboration with the aim of clinical education of pre-registration nursing students. Examples involved nursing institutions and health service organizations in Europe (Finland, Brussels, Sweden), Australia (New South Wales), the United States (Washington DC), and Canada (Ontario). Nursing students were at the center of all of these exemplars, and two articles described inter-professional collaborative learning with other health professions students (physiotherapy, medical and nursing students in Goelen et al., 2006; medicine, occupational therapy, physical therapy, social work, and nursing students in Solomon et al., 2003).

Ääri et al. (2008) describe a collaborative partnership between Turku University of Applied Sciences and Turku Health Care Department in Finland. At this institution, PBL had been implemented in nursing education since 2004, and it was necessary to enhance the students’ clinical learning. Authors decided to pilot an initiative where tutorial PBL small group sessions would be carried

out in the long-term care practice portion of the curriculum (this was the students’ first clinical experience). Clinical mentors of the nursing students were initially given a 20-hr mentor’s training which covered the basics of PBL and evidence-based nursing. One PBL cycle consisting of two 2-hr tutorial sessions (each group consisting of 8-9 students) was carried out during the four-week clinical practice and held near the practice wards.

During these sessions, clinical mentors (registered nurses) and university faculty worked together as tutors to promote student learning. A self-reported pre- and post-test questionnaire was administered to the students before and after the clinical practice experience. Results of the questionnaire showed that there were significant differences in PBL learning skills as well as in interactions with old patients before and after the intervention. Other notable results were a high level of student satisfaction and increases in both “own attitude towards long-term care” and “interest in work in long-term care.” Authors concluded that this intervention was a positive one for all parties involved and pointed to collaboration between teacher and clinical mentor as an important factor in creating the best possible clinical practice learning environment for nursing students. They also suggested a number of practical considerations for other seeking to implement PBL tutorials in clinical, namely that: 1) the scenario must be fruitful and current for both students’ learning goals and for clinical practice; 2) there must be adequate space for small group work and information-seeking activities (e.g. internet) near the ward; 3) the teacher must arrange the tutorial group work schedule in collaboration with the mentors; 4) the nurse administration of clinical practice must be involved and must see it as professional development for clinical nurses as well; 5) teacher and mentors of clinical practice must be capable of collaboration; and finally 6) the journal / notes of the tutorials that indicate the process and outcome of the small group work can be very informative to other nursing staff of the ward (Ääri et al., 2008).

Another collaborative teaching effort, described in Curtis (2007), took place in Australia and focused on mental health nursing. Mental health professionals in New South Wales, Australia were concerned that they were having difficulty recruiting newly-graduated nurses to their specialized area of nursing, citing the perceived lack of preparation by the tertiary sector, students’ prejudices and anxieties about mental illness, perceived lack of support during clinical placement, and the quality of the clinical placement itself. The need to address these issues brought about collaboration between academics at the



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University of Wollongong (UOW) and clinicians in the local Area Health Service. Collaborators decided to focus their efforts on the intensive clinical workshops designed to prepare 2<sup>nd</sup>- and 3<sup>rd</sup>-year bachelor of nursing students for entry into their 4-wk mental health clinical placements. Consultation with clinicians about student competency during mental health clinical placements revealed that students not only took too much time to adjust to the mental health clinical environment, but also that they needed more skill development prior to clinical placement. It was decided to adopt a combination PBL / role-play approach to these pre-clinical workshops, organized across a 2-wk period.

The 2-day workshops were co-facilitated by a mental health clinical nurse consultant working in an emergency department and an academic with a background in mental health, alcohol, and other drug nursing; both were experienced facilitators. In consultation with other mental health clinicians, the facilitators developed the problem scenarios and compiled supporting documentation that addressed a variety of mental health conditions as well as practice issues that come into play in the mental health setting (legal issues, ethical issues, dual diagnoses, etc.). The “consumers/clients/patients” in the role-plays were played by experienced clinicians and caregivers who were coached and debriefed by the facilitators. Students working in small groups were able to practice their interview skills in the first phase of the PBL process and were given feedback. In addition, they were given an introduction to their clinical placement sites and were able to ask any questions they had. When the clinicians left, the students were assigned to formulate and write up a mental status assessment based on the information obtained during the scenario.

They were also asked to identify gaps in their knowledge and learning objectives and then seek information overnight in order to formulate a nursing care plan for the next day. They were then asked to write an initial nursing report and present their consumer/client/patient to another group of students during a mock staff shift handover. Evaluations were collected from students at three time points: immediately after the workshop, after their mental health clinical placements, and for a selected number of students who were known to have chosen a career in mental health nursing upon graduation. The workshops were consistently rated highly, and were said to be very useful in increasing student confidence and knowledge preparation prior to the clinical placement. Responses after the clinical placements confirmed the usefulness of the workshop in preparing students for “what to expect.” Clinicians who were surveyed found the workshop experience

to be valuable because they allowed them to contribute to the students’ learning and showcase the mental health nursing field. The recent graduates who chose mental health nursing also corroborated the usefulness of the workshops in inspiring them to pursue mental health. The author concluded that this collaborative teaching approach was a successful intervention in bridging the gaps between institutes of learning and of professional practice, and pointed out that there was a 5-fold increase in new graduates choosing to begin their career in mental health in the two years since introducing the workshops.

Three other studies (Holaday & Buckley, 2008; Ehrenberg & Häggblom, 2007; Staun et al., 2009) described strategies that made use of PBL principles in the clinical learning environment as a way to bridge theoretical knowledge to the practice setting. All involved collaborations between academics and clinical nurse preceptors / supervisors in order to support student learning in accordance with the PBL principles of self-directed learning, reflection, and critical thinking.

In Holaday and Buckley (2008), nurse faculty at Trinity University in Washington DC, the Catholic University of America in Washington DC, and George Mason University in Fairfax, VA decided to work together to come up with an educational strategy that effectively addressed their challenges of faculty shortages, larger class sizes, competition for clinical sites, and limited educational resources. The model they developed has the following tenets: 1) students construct their own learning objectives for their clinical experiences based on individual learning needs and guidance from course objectives while clinical faculty help monitor their knowledge gained and modify the objectives as needed (through an ongoing clinical log); 2) the learning experience is completely embedded in the clinical setting where actual patient case situations encountered by students are used; and 3) guided by clinical preceptors, students choose an actual patient case encountered during their clinical experience, follow categorical guidelines, and develop written case situations that are then used for PBL tutorials. Clinical experience and tutorials occur concurrently, and students are assessed on their participation and progress in both domains. Although outcome data of this model is still forthcoming, authors note that it has been a rewarding and ongoing collaboration of nurse educators committed to teaching excellence.

Two examples from Sweden (Ehrenberg & Häggblom, 2007; Staun et al., 2009) highlight similar collaborative strategies in linking PBL with clinical education. In Staun et al. (2009), educators and clinicians employ the use of “patient-centered training in student-dedicated treatment rooms,”

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where the nursing student (alone or in pairs) take responsibility for patients placed in a student-dedicated room, performing all nursing care with the guidance and support of supervising clinical staff. The students followed the same patients for several days (rather than on their supervisors), and a logbook was kept to guide communication, assessment, and joint reflection between student, clinical supervisor, and lecturer. This approach was found to be highly satisfactory by most participants – both for staff and for students, with students feeling that their time in clinical education had been used efficiently. The process of supported student reflection was cited as an important strategy to bridge the theory-practice gap (Staun et al., 2009). Ehrenberg and Häggblom (2007) described a similar guided reflection strategy to enhance clinical education. This intervention had the objective of improving nursing students' integrated learning during clinical education, ability to actively search for knowledge, reflect critically, and improve the clinical learning environment. Central tenants in this intervention were: 1) PBL as an educational method; 2) guided reflection; and 3) a supervision model supporting nurse preceptors. Nurse preceptors were supported by training in PBL, reflection, and techniques for literature search in nursing research. Each student was assigned to a nurse who was his/her personal preceptor during the whole 11-week clinical placement. This nurse preceptor supervised the student in the clinical environment and supported his/her self-directed learning. An additional part of this intervention involved a head nurse preceptor who was responsible for a small group of students from different clinical units. In collaboration with the clinical lecturer, this head preceptor arranged weekly meetings with the group of students to discuss problems and issues from the clinical field. Every other week, students were to bring patient scenarios from their units, which formed the basis for integration of theoretical and practice knowledge. The clinical lecturer held a joint appointment at the university and at the hospital, supported the head preceptor, the personal preceptors, as well as the students through the entire process and oversaw assessment processes. Students and staff perceived the utilization of PBL principles in this supervisory model to be positive overall. Authors emphasized the need for strong collaboration between health care clinics and the university as well as adequate training and support of all parties involved, especially in the central tenants of PBL. They concluded that when integrated into the clinical setting, PBL can engage students in authentic situations and prepare them for their professional careers by training them to be life-long learners.

The two remaining articles that describe

exemplars of PBL collaboration with the aim of clinical education of pre-registration nursing students focus on inter-professional collaborative learning with other health professions students. Goelen et al. (2006) described inter-professional learning with undergraduate physiotherapy (3<sup>rd</sup> year), medical (2<sup>nd</sup> year), and nursing students (3<sup>rd</sup> year) in Brussels, Belgium, while Solomon et al. (2003) described inter-professional learning with undergraduate medicine, occupational therapy, physical therapy, social work, and nursing students in Ontario, Canada. Both used real patients to enhance the PBL process.

In Goelen et al. (2006), the educational module consisted of 5 2-hr seminars given at 2-wk intervals during 10 consecutive weeks, with a total of 177 students divided into control groups of 8 single-profession students and intervention groups of 8 students evenly distributed from 3 professions – nursing, medical and physiotherapy. The triggers for PBL were a stable Parkinson's patient interviewed by the students in the 2<sup>nd</sup> seminar, and a recent stroke patient interviewed in the 4<sup>th</sup> seminar. In the first seminar, was an introductory orientation seminar where students familiarized themselves with each other and prepared for the patient interview process in the next seminar. The 3<sup>rd</sup> and 5<sup>th</sup> seminars were dedicated to student presentations of their work on the educational goals derived from seminars 2 and 4. Pre- and post-module evaluations were conducted using the Luecht et al. (1990) Interdisciplinary Education Perception Scale (IEPS) to assess student attitudes toward inter-professional cooperation in relation to this particular intervention (Goelen et al., 2006). In the intervention groups, authors found a significant improvement in overall attitudes of male students, as well as in attitudes pertaining to competency and autonomy of individuals in one's own profession. No significant improvements were found in the control groups, and authors found no adverse effects of the use of real patients in the educational module – in fact the patients valued the opportunity to contribute to teaching and brought more complexity, empathy, and humanity to the educational experience for students. Authors concluded that the inter-professional PBL module using real patients had the potential to improve attitudes pertaining to inter-professional collaboration and could have important implications in their ultimate future practice in health care.

Solomon et al. (2003) describes a similar incorporation of real patients in inter-professional PBL education. In this initiative, 10 senior-level students representing 5 professions (medicine, occupational therapy, physical therapy, nursing, and social work) were recruited to participate in an 8-week course on rehabilitation issues in HIV at

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McMaster University. Two tutorial groups of 5 each met weekly for 2 hours per session. Two experienced tutors interested in HIV (one a physician and the other an occupational therapist) from the Faculty of Health Sciences at McMaster University were recruited to participate as facilitators. In addition, two persons with HIV-AIDS (PHAs) who were experienced educators were asked to participate as resource tutors and were given training in PBL and basic facilitation skills. Their role was to provide insight from the perspectives of a PHA and prompt students to consider various aspects of the problem. Students were required to keep a weekly journal and participated in semi-structured qualitative interviews within two weeks of the conclusion of the course. A broad theme that emerged from both the journals and the interviews was that students saw many benefits of the involvement of PHAs in the tutorial process – they provided a perspective on the lived experience and a context for learning, challenged assumptions and values, and acted as knowledge resources to guide students in their self-directed learning. Some students worried about offending the PHA tutors, but were able to work through these anxieties as the course progressed. Authors concluded that the involvement of PHAs in small-group PBL settings was perceived positively by students and created a more relevant learning text while addressing some of the issues of stigma in health professional students.

### **3. PBL collaboration for the training and professional development of clinical nurses.**

Another seven of the 19 articles in this review described exemplars of PBL collaboration with the aim of strengthening the capacity of clinical nurses. Price & Price (2002) uses examples from midwifery and gives an informative review of helpful frameworks that can be used in maximizing the clinical practice environment as a learning opportunity for students and clinical nursing staff alike. Celia & Gordon (2001) describe a PBL effort at a hospital in Philadelphia, USA used to train novice nurses as they enter the acute healthcare setting. Five other studies (Badeau 2010, Blackford & Street, 1999; Kim et al., 2007; Matthews-Smith et al., 2001; and Williams et al., 2002) describe examples of PBL being used for the training and professional development of clinical nurses in various settings around different topics (cardio-pulmonary, ethical decision-making, communication and cultural diversity, and geriatrics). All of these articles illustrate fruitful collaboration between academic institutions and practice institutions to further professional development of nurses.

Price & Price (2002) point out that PBL is traditionally implemented in the classroom setting, where issues of patient safety and competing

demands on time are not a primary concern. The previous section of this review examined a number of examples where these issues were circumvented through strong collaboration between academics and clinicians committed to enhancing nursing student learning.

They argued that in order for PBL to be implemented effectively in the clinical environment, the approach must be adapted to bridge the learning differences between the two contexts. For example, the clinical supervisor takes on a modified facilitator role and must be mindful of problems and learning issues that are thematic and apply to more than one client so that short patient stays does not disrupt learning.

Authors emphasize the difference between the clinical supervisor role and that of the classroom PBL facilitator. Because of the demands of the practice environment, the clinical supervisor cannot afford to adopt an entirely nondirective role. S/he must continually assess the practitioner / learner's comfort level and competence in the practice environment. When using patients as foci of learning, inquiries must be handled discretely so that patients do not perceive that the student learner is unprofessional or incompetent. As an example, casting the parent as an expert to his/her child's disease process is much more helpful than asking naïve questions about what the parent might assume the student nurse should already know about the child's care. Echoing other studies, Price & Price agree that the process of reflection (on the part of both the supervisor and the learner) is an invaluable tool in promoting learning in the clinical setting. They further conclude that having a structured experience, framework-guided training, an appropriately tailored clinical supervisor role, and consistent monitoring and evaluation of group process are keys to successful adaptation of PBL in the professional development of staff and student learners alike (Price & Price, 2002).

Celia & Gordon (2001) was the only study in this review that described a PBL experienced used to train and orient novice nurses to the acute setting. This initiative, which took place at the Hahneman University Hospital in Philadelphia, USA (an acute tertiary-care teaching facility), represented a collaboration between the hospital's Staff Education and Training Department, the Staff Development Instructor, and Director of Nurse Recruitment and Retention, as well as the Medical College of Pennsylvania / Hahnemann University School of Nursing (which offered the program for graduate credit) (Celia & Gordon, 2001). Funding for the program was provided in the form of salaries for the new nurses as well as a flat rate of pay to cover

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training and participation for the nurses serving as trainers. The curriculum was designed to give novice nurses a comprehensive overview of acute and chronic health problems and patient management issues, while developing expertise in resources-seeking, clinical reasoning, self-directed learning skills. Thirteen PBL cases were developed, and novice nurse groups (14 in the first class and 12 in the second class divided into 2 groups) met on 2 non-consecutive days over a 6-wk period. Instructors and clinical nurse specialists reviewed the PBL cases for accuracy, realism, and clinical relevance, and a PBL consultant helped with the actual construction of the cases. Each PBL case was completed over an 8hr period with a 3-4hr sessions devoted to researching learning issues. A summative assessment was used in which learners were given a similar PBL scenario to complete in a week's time, and evaluated orally in a 45-minute session on his/her ability to think critically. Orientation to the clinical unit, supervised clinical practice, as well as skills labs were incorporated as other aspects of this comprehensive orientation program. Post-course surveys showed that participants strongly agreed that the PBL format was useful as a learning tool for novice nurses transitioning into acute care. Novice nurses expressed the desire to have PBL as a regular part of their clinical education and would have preferred to have PBL in their undergraduate curricula. Nurses also noted that they could relate the PBL cases to patients they were seeing in the clinical units. Authors concluded that this PBL-based orientation program aimed at preparing novice nurses for tertiary care successfully supported novice nurses through the transition into acute care delivery. Preceptors and supervisors noted improved self-direction and critical thinking skills of program graduates (Celia & Gordon, 2001).

A number of other articles described PBL as a useful tool in nursing staff professional development. In Kim et al., (2007), a collaborative effort between nursing faculties in a university and clinical nursing leaders in an affiliated hospital in Seoul, Korea resulted in a pilot PBL program for continuing education of nurses. Two PBL packages in cardio-pulmonary nursing were developed and piloted in collaboration with nurse faculty after the need for PBL education was identified at a workshop involving the two stakeholders. The scenario development team consisted of 4 head nurses and 3 nurse faculty members who were experts in cardio-pulmonary nursing. The implementation consisted of 6 weekly 3-hr sessions with 45 nurses not previously exposed to PBL, divided into 5 groups according to their clinical backgrounds. Upon evaluation, participants noted a number of perceived advantages

of PBL, including: self-motivation, active attitude, enhanced self-confidence and presentation skills, comprehensive approach, use of evidence-based practice, cooperative learning, and self-reflection. They also noted the following disadvantages: time-consuming, lack of direction, different learning outputs depending on abilities of group members. Based on these findings, the authors concluded that PBL is strongly recommended as a continuing education approach if tailored to the learning needs of clinical nurses. Additionally, the collaborative development of the program with school researchers and hospital nurses was seen as a positive educational strategy for evidence-based research and practice (Kim et al., 2007).

Two other articles (Williams et al, 2002 and Badeau 2010) described similarly successful outcomes from using PBL as a strategy for professional development of nursing staff. Williams et al. (2002) described PBL at the New Mexico Veterans Administration (VA) Health Care System as a strategy to enhance the ethical decision-making of nursing staff. Eighteen primary care nursing staff (10 registered nurses, 5 licensed practical nurses, 1 nursing assistant and 2 health technicians) volunteered to participate in this pilot study, facilitated by a nurse manager. The PBL case used was adapted with permission from a case used in one of the nursing courses at the University of Phoenix. The pre- and post- test evaluations found that participants shared knowledge and demonstrated improved scores in decision-making and critical thinking skills. The authors further concluded that PBL is an appropriate learning and teaching strategy for ambulatory care nurses, and noted an increased awareness of ethical issues in the clinical environment (Williams, et al., 2002). In Badeau (2010), an initiative headed by the vice president of nursing and the director of innovation and knowledge at Joseph Brant Memorial Hospital (a Southern Ontario community hospital in Canada) and funded by the Nursing Secretariat (through the Ministry of Health and Long Term Care in Ontario) gave rise to a PBL professional development program for nurses. The program provided nurses the opportunity to spend time away from their regular responsibilities and further their education. The PBL program took place on site and occurred once every week during a regularly scheduled 11.25-hr day shift for a 6-wk period, with groups of no more than 8 participants. McMaster University School of Nursing was also requested to assist in the planning and development of the PBL opportunity for nurses and to serve as PBL group facilitators. The program planning committee consisted of a clinicians and educators who assessed organizational learning needs,

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identified desired outcomes, developed program objectives, developed participation criteria, selected program participants, assigned PBL groups, assigned facilitators, selected program topics, and developed problem scenarios, learning packages, and evaluation forms. Anecdotal evidence suggests positive outcomes related to the professional development of nurses, including: self-reported improvement in communication, conflict-management, research, and critical thinking skills. Authors further conclude that evidence-based nursing can be operationalized through PBL approaches to professional development of nursing practice (Badeau, 2010).

Two additional articles that used PBL in the professional development of nurses were guided by the assessment of specific nursing educational needs. In the case of Blackford & Street (1999), the PBL initiative arose out of an assessment of nursing issues in caring for children and families of non-English speaking background (NESB). The issues of communication and cultural differences were increasingly impacting nursing care at the Royal Children's Hospital in Melbourne, Australia. Twenty-six nurses from clinical areas with high NESB client intake participated in the initial research into nursing educational needs. Six of these nurses (2 clinical educators, 1 unit manager, and 3 experienced nurses, all from different units) participated in the follow-up collaborative effort to develop clinical-derived PBL packages that were subsequently piloted and incorporated into graduate nursing curricula, and into day-long / 2 half-day in-service education workshops in clinical areas. The nurses involved in this effort expressed enthusiasm of the PBL approach in the hospital setting in promoting learned across clinical areas, and their collaboration set the stage for further education on nursing units (Blackford & Street, 1999). In Matthews-Smith et al., (2001), collaboration between the Scotland National Board of Nursing, Midwifery, and Health Visiting and the University of Glasgow gave rise to a training and educational needs assessment around geriatric issues. Focus groups and individual interviews with nurses caring for older adults (22 hospital nurses, 15 nursing home nurses, 14 home care nurses), and group discussions with older adults formed the basis for the needs assessment. The assessment yielded rich information that formed the basis of a 9-scenario PBL module around various content, skills, and process areas deemed to enhance geriatric nursing care. The final educational module was embedded in the research findings from the needs analysis and consultation with the clinical areas. The authors offer this framework as an exemplary approach to: being attentive to diverse needs of nurse adult learners, promoting deeper approaches to learning, and

enhancing critical thinking skills (Matthews-Smith et al., 2001).

#### **4. Collaboration to enhance the PBL process.**

The final three articles in this review focus on studies that highlight examples of collaboration to enhance the PBL process itself. Niemer et al. (2010) outlines a collaborative process for PBL scenario, while Carrega & Byrne (2010) describes the use of PBL to teach clinical education skills, and Conway et al. (2002) highlights challenges of PBL implementation across nursing cultures.

It is often acknowledged that a fruitful PBL learning experience is highly dependent on the quality of the PBL scenario itself (Roberts & Ousey, 2004; Duch, n.d.; White, 2005). The effective PBL scenario must first engage students' interest, motivate further self-directed learning, and relate to the real world (Duch n.d. in Niemer et al., 2010). It must require students to make decisions or judgments based on facts, information, logic, or rationalization; further, it must be open-ended (not limited to one correct answer), connected to previously-learned knowledge, and embody controversial issues that will elicit diverse opinions (Duch n.d. in Niemer et al., 2010). Based on these principles, Niemer and colleagues put together a 10-member PBL scenario development team consisting of 2 pediatric, 2 obstetrics / newborn, 3 medical-surgical, 2 psychiatric, and 1 skills / simulation nurse faculty at Northern Kentucky University in Kentucky, USA. Through a series of 3 6-hour workshops, participants worked together to develop a set of PBL scenarios that were clinically relevant, amenable to theoretical analysis and problem-solving by nursing students. The first workshop focused on orienting participants to PBL and solicitation of appropriate actual patient care experiences. The second workshop took these patient care experiences to a theoretical level appropriate for students. The third and final workshop focused on peer review and finalization of the PBL scenarios. At the end of this time-consuming, yet creative process, 10 PBL scenarios and templates for implementation were developed. Authors noted positive evaluation from students in the eventual course that used these PBL scenarios.

Carrega & Byrne (2010) provide an example of PBL as a teaching strategy to enhance the skills of experienced nurses in a nursing education Master's program. At a Southeastern University in Georgia, USA, a PBL assignment was used to better prepare future nurse educators / clinical faculty. Masters level students were in the 2<sup>nd</sup> of a 4-semester program and were given an assignment involving PBL scenarios that described clinical learning situations of pre-registration nursing students. By having the graduate students create a teaching plan for each PBL

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scenario, the assignment provided a way to assess their creativity and problem-solving abilities in helping facilitate the learning of a hypothetical future student. Despite the need for further research into the effectiveness and long-term knowledge acquisition, the authors concluded that PBL can be used as a strategy to better prepare future nurse educators for clinical teaching, and perhaps in their guidance of students' self-directed learning and critical thinking skills in the clinical environment (Carrega & Byrne, 2010).

The final article in this literature review focuses on broader issues of cross-cultural implementation of PBL (Conway et al., 2002). This article explains a collaborative effort between the University of New South Wales, nursing faculty at the University of Newcastle, and the Australian Federal Government (AusAID) to help enhance nursing education in the Maldives at the Maldivian Institute of Health Sciences. The Australian PBL curriculum was delivered offshore with University of Newcastle faculty of nursing staff visiting the Maldives for 1- to 6-wk teaching visits. Through the PBL implementation process, it was very apparent that there were significant differences between the Australian and Maldivian understandings and practices in nursing. In addition, there were remarkable differences between beliefs and attitudes about illness and health care practices in the capital (Male) and in the smaller islands of the Maldives. There were religious, political, language, and cultural concerns that impacted on the PBL content. Authors cited that the implementation success was only possible because of close collaboration with the community of health-care providers in the Maldives, continuous communication, mutual understanding, sharing information reciprocally, and being creative, innovative, and flexible. Authors concluded that PBL has the potential to be a powerful tool for changing cultures and caution nurse educators to ensure that such program delivery is culturally relevant rather than conflicting with the cultural values and realities of nursing practice in the host culture. Programs must be designed in alignment with cultural and contextual circumstances so that learner capacity may be strengthened effectively (Conway et al., 2002).

#### **Collaboration as a common theme and lessons**

The present review has summarized 19 peer-reviewed articles that examine the uses of PBL as an approach to further nursing education. Collaboration emerged as a consistent theme – whether between academics and practitioners in the supervision and guidance of nursing students, between faculty members and real patients in facilitating PBL group tutorial sessions, between inter-professional students in PBL learning, or between nurses of different

specialties in developing PBL scenarios. In many of the studies, PBL was cited as an effective approach to bridging the gap between theory, practice, and research and enhancing important skills necessary for nurses to take better care of their patients – students were able to better integrate their classroom learning in the clinical setting through reflection, experienced nurses were able to enhance their practice through professional development opportunities, and PBL modules were seen as a way to respond to research-derived learning needs of professional nurses. Conway et al. (2002) emphasized a final lesson of being mindful of cultural and contextual relevance when implementing PBL.

#### **4. Conclusion, recommendations and Implications for the South African context**

These articles shed light on a number of implications for the resource-limited South African context (particularly at NWU-MC). It is clear from the literature that collaboration can take many forms, but a central aim unites all of efforts. The central aim or motivation for collaboration can range anywhere from the need to develop effective PBL scenarios (as in Niemer et al., 2010), to the need to transition novice nurses into practice in a tertiary care setting (as in Celia & Gordon, 2001), to the need to better prepare students for the mental health nursing clinical placement (as in Curtis, 2007), to the need to address learning needs of nurses caring for geriatric patients (Matthews-Smith et al., 2001), to the need to better integrate classroom learning and clinical learning for nursing students (as in Ääri et al., 2008; Holaday & Buckley, 2008; Ehrenberg & Häggblom, 2007; and Staun et al., 2009), to the need to enhance inter-professional attitudes (as in Goelen et al., 2006). In order for NWU-MC to develop an effective model for collaboration centered on PBL, it must decide on its central collaborative aim. This will drive whether or not NWU-MC decides to focus its efforts on nursing students, practicing clinical nurses, or on enhancing existing PBL processes. This central aim will depend on available financial and infrastructural resources, institutional priorities and mandates, availability and willingness of prospective stakeholders, and current human resource capacity.

As NWU-MC moves toward collaboration in PBL, it may be helpful to develop research efforts to identify important PBL stakeholders (especially those at the managerial level) as well as priority educational needs facing the nursing profession as a whole (similar to those undertaken in Matthews-Smith, 2001 and in Blackford & Street, 1999). As NWU-MC moves forward in collaboration, it must keep in mind the cross-cultural lessons from Conway et al. (2002) especially since the PBL approach is a

new system of teaching and learning for this rural context. Furthermore, NWU-MC must keep in mind the differences between classroom learning and clinical learning (as outlined in Price & Price, 2002). Ultimately, to ensure success, special attention must be paid to the training of all collaborating parties in PBL, piloting new interventions before scale-up, and careful evaluation of interventions.

The nursing education literature is rich with numerous examples of PBL implementation. The use of this pedagogical strategy in the clinical setting among collaborative partners is still relatively new because of inherent challenges of bridging the theory-practice-research gap and the demands that the clinical setting poses. This examination of the literature has provided a number of tangible exemplars for collaborative implementation of PBL involving nursing students, nursing educators, nurse managers, clinicians, and researchers. As NWU-MC in South Africa gravitates toward a more collaborative approach to the implementation of PBL, lessons learned from these exemplars can provide much guidance and insight.

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**Biosorption of Cd<sup>+2</sup> and Pb<sup>+2</sup> on *Cyperus laevigatus*: application of factorial design analysis****Khairia M.Al-Qahtani**Department of Chemistry, Faculty of Science, Princess Nora Bint Abdel-Rahman University, Saudi Arabia  
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**Abstract:** Heavy metals pollution has become one of the most serious problems today and the use of plant biomass for the detoxification of industrial effluents for environmental protection and recovery of valuable metals offers a potential alternative to existing treatment technologies. Considering the fact that *Cyperus laevigatus* is resistant to polluted environmental and has the capability to accumulate heavy metals in its body, plant biomass itself can also be used to remove heavy metals from contaminated water by harnessing its natural properties. In this research the experimental design technique was used to optimize the biosorption of cadmium and lead ions by *Cyperus laevigatus* biomass from aqueous solutions, simulating industrial effluents. The removal of Cd<sup>+2</sup> and Pb<sup>+2</sup> was studied, separately, using the factorial design 2<sup>3</sup>. The three factors screen were pH, temperature (T) and metal ion concentration (X) at two markedly different levels: pH (2.0 and 6.0) T (20 and 45 °C) and X (20 and 800 mg l<sup>-1</sup>). The most significant effect for Cd<sup>+2</sup> and Pb<sup>+2</sup> biosorption was ascribed to T. The interaction effect of X, pH and T.X also have a significant influence on the Pb<sup>+2</sup> efficiency. A normal distribution was observed between the predicted values (model) and the observed (experimental).

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**Keywords:** *Cyperus laevigatus*, Biosorption, Factorial experimental design.

**1. Introduction**

Water contamination by heavy metals, released into the environment as a result of different activities, is a very important problem in the current world. Considerable attention has been paid to methods for metal removal from industrial wastewaters because they pose serious environmental problem and are dangerous to human health [1]. Conventional techniques for removing dissolved heavy metals include chemical precipitation, carbon adsorption, ion exchange, evaporation and membrane processes [2]. However, these techniques have certain disadvantages such as incomplete metal removal, high reagent and energy requirement and generation of toxic sludge that require disposal [3].

Due to the high costs of commercial adsorbents, the search for alternate and innovative treatment techniques has focused attention on the use of biological materials for heavy metals removal and recovery technologies (Biosorption). This technique has gained important credibility during recent years due to its effectiveness in reducing the high concentration of heavy metal ions (from industrial wastewater) to very low levels. It is considered a potentially viable method on both technical and economic grounds, because of its low operating costs [7] and the decontamination efficiency for highly diluted effluents. Additionally, metal can be recovered from the biosorbent and reused. Different types of biomass have been investigated for the biosorption characteristics of Pb<sup>2+</sup> and Cd<sup>2+</sup> from aqueous solution [8]. The seaweed *Sargassum* sp was used [9] for removal of lead and cadmium ions from water.

Moreover, Vecchio et al. [10] studied the removal of Cu<sup>2+</sup>, Pb<sup>2+</sup> and Cd<sup>2+</sup> ions by biosorption on bacterial cells. Also, Srivastav et al. [11] used the aquatic plants for removal of lead and zinc ions from waste water. The adsorption of lead ions on nonliving *Penicillium chrysogenum* biomass was also investigated [12].

Among the biological materials, *Eichhornia crassipes* (Mart.) Solms (widely distributed aquatic macrophyte) has been reported to have high metal binding capacities and promising results with regard to metal removal from wastewater [13]. It was reported that the ability of *E. crassipes* to accumulate metal ions was found to be in the order of Pb<sup>2+</sup> > Cd<sup>2+</sup> > Cu<sup>2+</sup> = Zn<sup>2+</sup> [14]. The adsorption capacity of Pb<sup>2+</sup> affected by experimental parameters such as pH, contact time and concentration of Pb<sup>2+</sup> solution, on to *E. crassipes* plant biomass was studied [15]. They found that the uptake percent of Pb<sup>2+</sup> increased by increasing pH values.

However, some authors have evaluated removal efficiencies of heavy metals by this species as a function of one-factor-at-a-time. Few studies employed the factorial design method for evaluating the influence of the operation variables on biosorption processes. The biosorption of Cd<sup>2+</sup> and Pb<sup>2+</sup> was optimized using 2<sup>3</sup> factorial designs by Petemele et al. & Barros et al. [16,17]. The biosorption of Cr<sup>3+</sup> and Cr<sup>6+</sup> using 2<sup>3</sup> and 2<sup>4</sup> factorial designs, respectively was studied [18, 19]. Factorial design is employed to define the most important process variables affecting the metal removal efficiency [20]. It is also used to reduce the total number of experiments in order to achieve the best overall optimization of the system [21]. The factorial

experimental design methodology involves changing all variables from one experiment to the next. The design determines which factors have important effects on the response as well as how the effect of one factor varies with the level of the other factors. The determination of factor interactions could only be attained using statistical designs of experiments [21], since it cannot be shown when the system optimization is carried out by varying just one factor at the time and fixing the other.

The objective of this study was to establish how pH, temperature and initial concentration of lead and cadmium ions interacted and ultimately affected their removal efficiency from aqueous solutions by means of *Cyperus laevigatus* biomass. A factorial design  $2^3$  scheme was used to study the removal of  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$ , separately, for the benefit of both the remediation of heavy metal pollutants from aquatic environment and the management of *Cyperus laevigatus* harvested from wetlands.

## 2. Materials and Methods

### 2.1. Biomass preparation

A biomass of *Cyperus laevigatus* was used as biosorbent for the biosorption of  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$ . Samples of the biomass were collected from industrial zone in Riyadh City. They were washed several times using de-ionized water to remove soils, then dried in an oven at 60 °C for 48 hrs, chopped and sieved. The particles with an average of 0.5mm were used for the experiments.

### 2.2. Reagents and equipments

Doubly distilled water was throughout employed. Initial solutions with different concentration of  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  were prepared by proper dilution from stock standards (800 g L<sup>-1</sup>  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$ ). The pH adjustment of the solutions were made with aliquots of 1.0 mol l<sup>-1</sup> of  $\text{HNO}_3$  utilizing a pH/mV hand-held meter (Crison pH meter, PH 25)

### 2.3. Batch biosorption procedure

Batch experiments were carried out under the following conditions: 0.2 g of *Cyperus laevigatus* biomass, 30 ml of  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  solution, and an agitation speed of 200 rpm. The pH, temperature, and initial  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  concentration employed are shown in Table 1. The experiments were carried out with the values of pH (2, 6) that were not influenced by the metal precipitation, as metal hydroxide [22]. The maximum temperature employed in the present study was 45 °C, as the higher temperature damages the active sites in the biomass [23]. Samples were collected after 6 hours to reach equilibrium for the sorption system [18]. Control samples were made in absence of any metal. Aliquots for analysis were filtered using glass filter provided with Whatman filter paper, and the residual  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  concentration was measured by Varian ICP-AES.

Sixteen duplicate experiments were carried out: eight for  $\text{Cd}^{2+}$  and eight for  $\text{Pb}^{2+}$ . All possible combinations of variables, called factors in the jargon, were used, and a matrix was established according to their high and low levels, represented by  $\pm 1$ , respectively.

Table 1 : High and low levels of factors

| *Factor  | Element          |            |                  |            |
|----------|------------------|------------|------------------|------------|
|          | $\text{Cd}^{2+}$ |            | $\text{Pb}^{2+}$ |            |
|          | Low level        | High level | Low level        | High level |
| T (°C)   | 20.0             | 45.0       | 20.0             | 45.0       |
| X (mg/l) | 20.0             | 800.0      | 20.0             | 800.0      |
| pH       | 2.0              | 6.0        | 2.0              | 6.0        |

\*T: Temperature ; X : Initial concentration

The removal efficiency (R) of  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  from aqueous solution was defined as:

$$R = \frac{C - C_F}{C} \cdot 100 \quad (1)$$

Where: C and  $C_F$  are, the initial and final concentrations of  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$ , respectively.

### 2.4 Statistical design of experiments (full factorial design)

For studying the  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  biosorption on *Cyperus laevigatus* biomass, the removal efficiency (R) could depend on the acidity of the medium (pH), initial metallic ion concentration (X), and temperature (T). Other variables such as biosorbent concentration and speed of agitation were kept constant. A full  $2^3$  factorial design and results for removal efficiency are shown in Table 2. For treatment of data, the Minitab Statistical Software (release 14.1) was employed throughout in order to obtain the effects, coefficients, standard deviation of coefficients and other statistical parameters of the final model.

Table 2 : Experimental factorial design results for  $\text{Cd}^{2+}$  and  $\text{Pb}^{2+}$  biosorption

| Factor | Element                |         |                        |         |      |      |
|--------|------------------------|---------|------------------------|---------|------|------|
|        | $\text{Cd}^{2+}$       |         | $\text{Pb}^{2+}$       |         |      |      |
|        | Removal efficiency (%) | Average | Removal efficiency (%) | Average |      |      |
| T      | X                      | pH      |                        |         |      |      |
| 1      | 1                      | 1       | 69.2                   | 68.5    | 68.2 | 68.4 |
| 1      | 1                      | -1      | 68.8                   | 68.5    | 68.3 | 68.4 |
| 1      | -1                     | 1       | 85.7                   | 85.5    | 44.1 | 44.4 |
| -1     | -1                     | 1       | 85.6                   | 85.5    | 44.2 | 44.4 |
| 1      | -1                     | -1      | 72.8                   | 72.6    | 82.4 | 82.6 |
| 1      | -1                     | -1      | 72.7                   | 72.6    | 82.5 | 82.6 |
| 1      | 1                      | -1      | 45.8                   | 45.6    | 79.1 | 79.4 |
| -1     | 1                      | -1      | 45.7                   | 45.6    | 79.3 | 79.4 |
| -1     | 1                      | 1       | 21.3                   | 21.7    | 25.4 | 25.6 |
| 1      | 1                      | 1       | 21.5                   | 21.7    | 25.5 | 25.6 |
| -1     | -1                     | 1       | 10.2                   | 10.6    | 9.4  | 9.2  |
| -1     | -1                     | 1       | 10.4                   | 10.6    | 9.3  | 9.2  |
| -1     | -1                     | -1      | 34.4                   | 34.6    | 30.7 | 30.9 |
| 1      | -1                     | -1      | 34.5                   | 34.6    | 30.8 | 30.9 |
| -1     | -1                     | -1      | 21.1                   | 21.3    | 9.9  | 9.7  |
| -1     | -1                     | -1      | 21.2                   | 21.3    | 9.8  | 9.7  |

\*Experimental in duplicate

### 3. Results and Discussion

Metallic ion uptake by a biosorbent in a batch system usually depends on several factors, such as acidity of the medium (pH), initial metallic ion concentration, time of contact between the metallic ion and the biosorbent, speed of shaking, etc. The optimization of all those variables using the univariate procedure is very tedious and the best condition could not be attained, because the interactions among all the factors are neglected. Also, it is not known if the set of other fixed variables were kept at other levels, the results would lead to the same optimization. In addition, the total number of experiments to be carried out in the univariate procedure is much higher when compared with statistical design of experiments.

In this study, the factors screened were pH, initial metallic ion concentration (X), and temperature (T), for removal efficiency of Cd<sup>2+</sup> and Pb<sup>2+</sup> by *Cyperus laevigatus* biomass using a batch adsorption system. Main interaction effect, coefficients of the model, standard error of each coefficient and the probability for the full 2<sup>3</sup> factorial designs for Cd<sup>2+</sup> and Pb<sup>2+</sup> are presented in Tables 3 & 5, respectively.

The codified mathematical model employed for the 2<sup>3</sup> factor design is:

$$R = A_0 + A_1T + A_2X + A_3pH + A_4TX + A_5TpH + A_6XpH + A_7TXpH \quad (2)$$

Where: A<sub>0</sub> represents the global mean and A<sub>i</sub> the other regression coefficients.

Substituting the coefficients A<sub>i</sub> in Equation (2) by their values from Tables 3 & 5 we get the following equations:

$$RCd^{2+} = 43.713 + 24.86T - 6.88X + 8.06pH - 5.43TX - 1.23TpH + 2.01XpH + 0.39TXpH \quad (3)$$

$$RPb^{2+} = 45.05 + 23.15T + 1.52X + 4.32pH + 7.47TX - 1.77TpH - 5.75XpH + 0.07TXpH \quad (4)$$

The effects of the main factors (T, X, pH) represent deviations of the average between high and low levels for each one of them. In case of Cd<sup>2+</sup>, a change in pH and T values from low to high level results in 16.125 % and 49.725 % increase in the removal efficiency (Table 3). If a variation from high to low is made for X, increases of 13.775 % in the removal efficiency are observed, respectively. In case of Pb<sup>2+</sup>, T, X and pH exert an influence in their low levels, increasing removal efficiency by 46.3 %, 3.05 % and 8.65 %, respectively. It can be concluded that when the effect of a factor is positive an increase in the value of the removal efficiency is observed when the factor changes from low to high level. In contrast, if the effect is negative, a reduction in removal efficiency occurs for the high level of the same factor.

As can be seen from Tables (3&5), some main factors and their interactions were significant at 5% of probability level ( $p < 0.05$ ). On the other hand, some effects were discarded, because they did not exhibit any

statistical significance. As such, the resultant models can be represented by:

$$RCd^{2+} = 43.71 + 24.86T - 6.88X + 8.06pH - 5.43TX \quad (5)$$

$$RPb^{2+} = 45.05 + 23.15T + 7.47TX - 5.75XpH \quad (6)$$

In order to better evaluate each factor and its interaction in case of Cd<sup>2+</sup>, Fig.1A, presented the normal probability plot of standardized effects. The graph of Cd<sup>2+</sup> could be divided in two regions: the region with percent below 50%, where the factors and their interactions presented negative coefficients (TpH, T.X, X), and the region with percent above 50%, where the factors presented positive coefficients (T, pH, X.pH). All these factors and interactions which were represented as a square were significant figures while the effects represented by a circle were not significant (Fig.1A).

Fig. 1B presented the Pareto Chart of standardized effects at  $p = 0.05$ . All the standardized effects were in absolute values (to verify which were positives and negatives, see Fig. 1A). All the values that presented an absolute value higher than 1.000 ( $p = 0.05$ ), which were located at right of the line, were significant. The absolute standardized value of the effect of each factor and its interaction appeared at the right of each bar.

Analyzing the graphs of Fig. 1A and the values of Table 3, it can be inferred that the T was the most important variable of the overall biosorption procedure. The positive value of its coefficient meant that the Cd<sup>2+</sup> uptake by *Cyperus laevigatus* biomass was favored at high T values (T = 45.0). In order to avoid a disruption of the *Cyperus laevigatus* biomass at T lower than 45.0, this value was fixed for continuing the optimization of this work. The second important factor for overall optimization of the batch system was the pH. Only the achievement of this result emphasizes the merit of using the statistical design of experiments over the conventional univariate process of optimization of the system. This information would not be acquired in a univariate of optimization in biosorption system. The third important factor affect the overall optimization of the batch system was the metallic ion concentration (X). The negative coefficient value justifies that low metallic ion concentration led to high removal efficiency of Cd<sup>2+</sup> ions. The fourth important factor affect the overall optimization of the batch system was the interaction of two factors T.X which was more significant than the main factors X and pH.

In Table 4 is presented the analysis of variance for the factorial design 2<sup>3</sup> without the insignificant three-way interactions. As can be seen, the main factors and two-way interactions were significant at 5% of probability level ( $p < 0.05$ ), as discussed above.

(A)

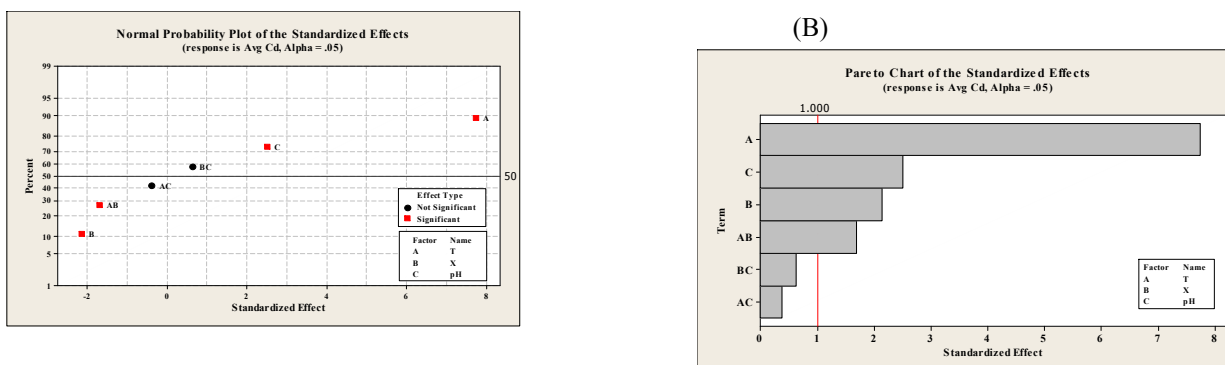


Fig. 1: (A) Cd Normal probability plot of standardized effect at  $p=0.05$ . The dotted line at 1.000 divides the negative effects from the positive one. (B) Pareto plot of standardized effect (absolute value) at  $p=0.05$

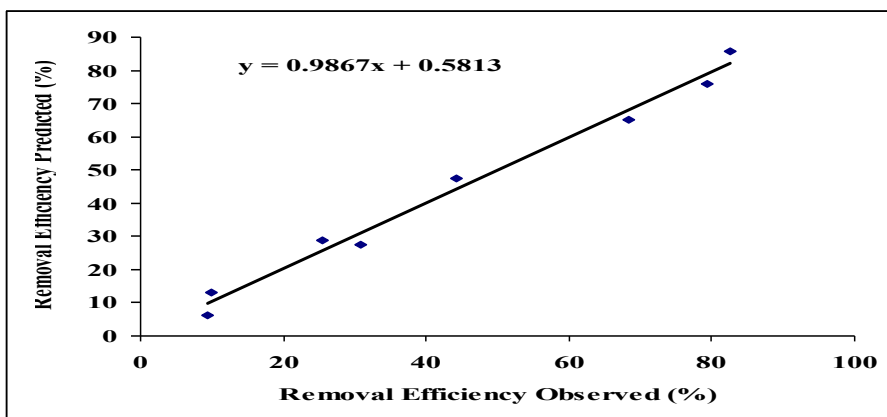


Fig. 2: Normal probability plot for the removal efficiency of  $Cd^{2+}$ .

Table 3: Statistical parameters for  $2^3$  design ( $Cd^{2+}$ ).

| Term                                | Effect  | Coefficient | S.E of coefficient | $p$    |
|-------------------------------------|---------|-------------|--------------------|--------|
| constant                            |         | 43.713      | 3.212              | 0.0047 |
| <b>Main factors</b>                 |         |             |                    |        |
| T                                   | 49.735  | 24.862      | 3.212              | 0.0082 |
| X                                   | -13.775 | -6.887      | 3.212              | 0.0278 |
| pH                                  | 16.125  | 8.063       | 3.212              | 0.0241 |
| <b>Interaction of two factors</b>   |         |             |                    |        |
| T.X                                 | -10.875 | -5.438      | 3.212              | 0.0340 |
| T.pH                                | -2.475  | -1.238      | 3.212              | 0.0766 |
| X.pH                                | 4.025   | 2.012       | 3.212              | 0.0644 |
| <b>Interaction of three factors</b> |         |             |                    |        |
| T.X.pH                              | 0.78    | 0.39        | 0.388              | 0.550  |

The effects and coefficients are given in coded units.  $P$ : probability and S.E.: standard error of coefficient.

Table 4: Analysis of variance for removal efficiency of  $Cd^{2+}$  - full  $2^3$  factorial design (coded units)

| Source             | d.f | Seq SS  | Adj SS  | Adj MS  | F     | $P$    |
|--------------------|-----|---------|---------|---------|-------|--------|
| Main effects       | 3   | 5844.68 | 5844.68 | 1948.23 | 23.60 | 0.0150 |
| 2-Way Interactions | 3   | 281.18  | 281.18  | 93.73   | 1.14  | 0.0583 |
| Residual Error     | 1   | 82.56   | 82.56   | 82.56   |       |        |
| Total              | 7   | 6208.43 |         |         |       |        |

d.f.: degree of freedom. Seq SS: sequential sum of squares, Adj.MS: adjusted sum of squares,  $F$ = factor F and  $p$ : probability.

Likewise, the results of  $Pb^{2+}$  biosorption (Table 5 and Fig. 3) demonstrated that the T was the most important variable. However, the positive value of its coefficient meant that the  $Pb^{2+}$  uptake by *Cyperus laevigatus* biomass was favored at high T values ( $T=45.0$ ). Accordingly, the T is proved to be a key condition affecting adsorption performance of the studied metals. This is in line with many authors [15, 24, 25, 26]. The second important factor for overall optimization of  $Pb^{2+}$  biosorption was the interaction of two factors T.X which was more significant than the main factors X and pH. The positive value of T.X coefficient meant that high metallic ion concentration with high T value would lead to an unexplained increase in the removal efficiency of  $Pb^{2+}$  that could not be explained using the univariate procedure of optimization of the system. The third important factor affect the overall optimization of the batch system was the X.pH. The negative value of its coefficient meant that the  $Pb^{2+}$  uptake by *Cyperus laevigatus* biomass was favored at low pH values (pH 2.0). In order to avoid a disruption of the *Cyperus laevigatus* biomass at pH higher than 2.0, this value was fixed for continuing the optimization of this work. In Fig 2 B, though the interaction of two factors X.pH was significant, it acquired the least effect on the removal efficiency of  $Pb^{2+}$  compared to others. The negative coefficient value of this interaction tells us that both factors should be decreased in order to achieve the highest response. The analysis of variance (Table 6) for the factorial design  $2^3$ , without the insignificant three-way interactions, indicated that the main factors and two-way interactions were significant at 5% of probability level ( $p < 0.05$ ).

Optimal conditions realized from the optimization experiment (observed values) were verified by comparing with calculated data from the model (predicted values). Figs. 2 and 4 present the normal probability plot of predicted removal efficiency for  $Cd^{2+}$  and  $Pb^{2+}$ , respectively. In both cases, it was observed how closely the set of observed values with the predicted ones, with correlation coefficients (R) of 0.98 and 0.96 for  $Cd^{2+}$  and  $Pb^{2+}$ , respectively.

Temperature has an influence on the biosorption of metal ions, but to a limited extent under a certain range of temperature, which indicates that ion exchange mechanism exists in biosorption to some extent [33]. In the present investigation, temperature has a significant effect on the biosorption efficiency of  $Cd^{2+}$  onto *Cyperus laevigatus* biomass. However it was found that temperature (5-40 °C) had minor effect on the sorption level of Cd, Cu or Co by *Saccharomyces cerevisiae* [34]. Moreover, higher removal efficiency of  $Pb^{2+}$  was detected at high temperature condition (45 °C). This revealed the endothermic nature of  $Pb^{2+}$  biosorption onto the studied plant biomass [35]. The adsorption of  $Cd^{2+}$  and  $Pb^{2+}$  onto carboxymethylated lignin from sugarcane bagasse and *Ulva lactuca* biomass, respectively, was studied [16, 33]. They reported contrary opinion for our results. They found that the decrease in the biosorption of both ions with the rise in temperature may be due to either the damage of active binding sites in the biomass [23] or increasing tendency to desorb metal ions from the interface to the solution [36].

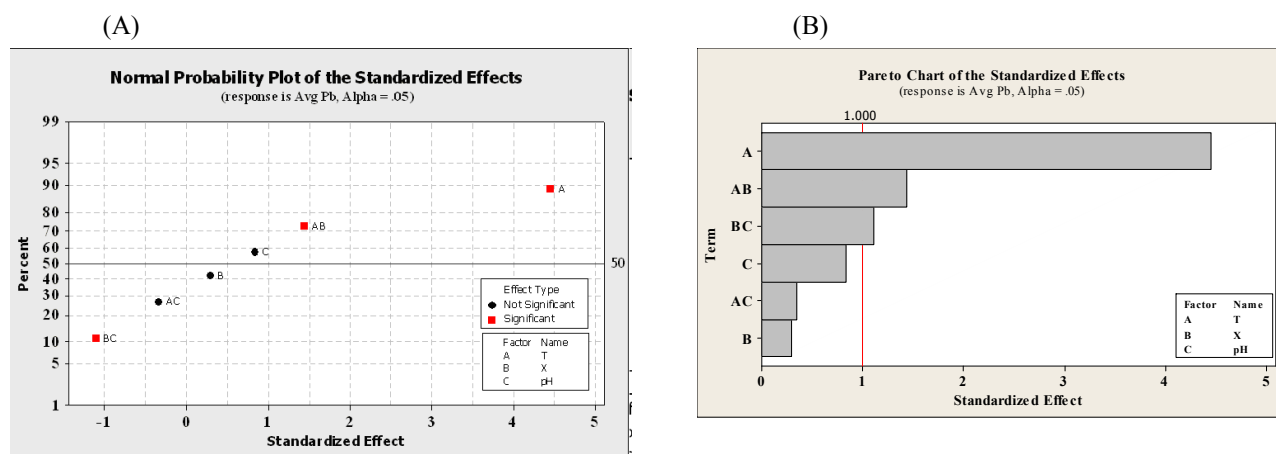


Fig. 3: (A) Pb Normal probability plot of standardized effect at  $p=0.05$ . The dotted line at 1.000 divides the negative effects from the positive one. (B) Pareto plot of standardized effect (absolute value) at  $p=0.05$

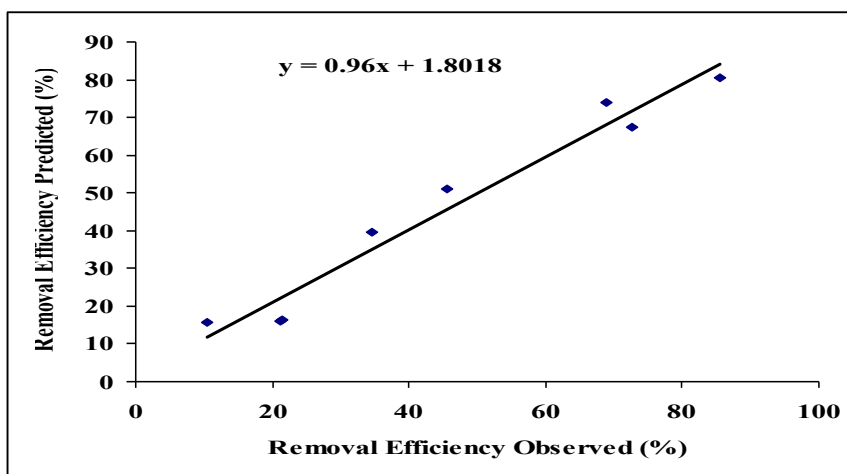


Fig.4: Normal probability plot for the removal efficiency of  $Pb^{+2}$ .

Table 5: Statistical parameters for  $2^3$  design ( $Pb^{+2}$ ).

| Term                                | Effect  | Coefficient S.E. of coefficient $p$ |       |        |
|-------------------------------------|---------|-------------------------------------|-------|--------|
|                                     |         |                                     |       |        |
| constant                            |         | 45.050                              | 5.200 | 0.0073 |
| <b>Main factors</b>                 |         |                                     |       |        |
| T                                   | 46.300  | 23.150                              | 5.200 | 0.0141 |
| X                                   | 3.050   | 1.525                               | 5.200 | 0.0818 |
| pH                                  | 8.650   | 4.325                               | 5.200 | 0.0558 |
| <b>Interaction of two factors</b>   |         |                                     |       |        |
| T.X                                 | 14.950  | 7.475                               | 5.200 | 0.0387 |
| T.pH                                | -3.550  | -1.775                              | 5.200 | 0.0791 |
| X.pH                                | -11.500 | -5.750                              | 5.200 | 0.0468 |
| <b>Interaction of three factors</b> |         |                                     |       |        |
| T.X.pH                              | 0.02    | 0.01                                | 0.001 | 0.932  |

The effects and coefficients are given in coded units.  $P$ : probability and S.E.: standard error of coefficient.

Table 6: Analysis of variance for removal efficiency of  $Pb^{+2}$  - full  $2^3$  factorial design (coded units)

| Source                    | d.f | Seq SS | Adj SS | Adj MS | F    | P      |
|---------------------------|-----|--------|--------|--------|------|--------|
| <b>Main effects</b>       | 3   | 4455.6 | 4455.6 | 1485.2 | 6.87 | 0.0272 |
| <b>2-Way Interactions</b> | 3   | 736.7  | 736.7  | 245.6  | 1.14 | 0.0583 |
| <b>Residual Error</b>     | 1   | 216.3  | 216.3  | 216.3  |      |        |
| <b>Total</b>              | 7   | 5408.7 |        |        |      |        |

d.f.: degree of freedom. Seq SS: sequential sum of squares, Adj.MS: adjusted sum of squares,  $F$ = factor F and  $p$ : probability.

Many studies concerning sorption of heavy metals by different biomaterials indicated that pH and temperature influence removal efficiency. It was found that the pH is one of the most important environmental factors in biosorption of heavy metal ions [27]. The pH value of solution strongly influences not only the site dissociation of the biomass ' surface, but also the solution chemistry of the heavy metals: hydrolysis,

complexation by organic and/or inorganic ligands, redox reactions, precipitation, the speciation and the biosorption availability of heavy metals. It was demonstrated that the suitable pH ranges for the various metal ions were slightly different [28]. The results of the present research indicated that the highest removal efficiency for  $Cd^{2+}$  were attended at the higher pH value (pH=6.0) and at lower pH value (pH=2.0) for

Pb<sup>2+</sup>. These results were concomitant with the findings of Southichak et al. [29]. They studied the effect of pH upon heavy metal adsorption by reed biomass in a wide range of pH and concluded that the maximum sorption was observed near neutral condition (pH = 6) for Cu<sup>2+</sup>, Ni<sup>2+</sup>, Cd<sup>2+</sup> and Zn<sup>2+</sup>, while that for Pb<sup>2+</sup> was from the acidic range (pH 2-4). The adsorption of Pb<sup>2+</sup> at lower pH was also observed in other biomaterials such as the biomass *Zoogloea ramiiger* [30] and fungus *Mucor rouxii* [31]. On the other hand, Abdel-Halim et al. [15] studied the adsorption capacity of Pb<sup>2+</sup>, affected by Experimental parameters such as pH, contact time and concentration of Pb<sup>2+</sup> solution, on to *Eichhornia speciosa* plant biomass. They found that the uptake percent of Pb<sup>2+</sup> increased by increasing pH values. Moreover, Sekhar et al. [24] reported that Pb<sup>2+</sup> removal by different organs of *Hemidmus indicus* was unaffected by pH change.

At lower pH, the adsorption of many heavy metals usually took place with low removal efficiency. This occurred because there was a high concentration of proton in the solution and this proton competed with the metal ions informing a bond with active sites on the surface the biomaterials. These bonded active sites thereafter became saturated and was inaccessible to other cations [32, 22]. The biosorption characteristics of Cd<sup>2+</sup> ions from aqueous solution using the green alga (*Ulva lactuca*) biomass were investigated as a function of pH, biomass dosage, contact time, and temperature [26]. They found that the maximum biosorption of Cd<sup>2+</sup> ions was found at pH 5, 20 °C, 60 min and 20 mg l<sup>-1</sup> of biosorbent.

In the present research, the metal ion concentration has no effect on the biosorption efficiency of Pb<sup>2+</sup> onto *Cyperus laevigatus* biomass. However, the results showed that the biosorption of Cd<sup>2+</sup> increased by decreasing its initial concentration in the solution (10 mg l<sup>-1</sup>). The sorption of Cd<sup>2+</sup>, Ni<sup>2+</sup> and Zn<sup>2+</sup> by Ca-treated *Sargassum* sp. biomass was compared under low and high ionic strength conditions and an exponential decrease in the removal efficiency of the sorption system with increasing metal concentration was reported [37].

Since there is no literature report on the adsorption of heavy metals by *Cyperus laevigatus* biomass using factorial design, the results obtained were compared with those of many different types of biomaterials. The effects of pH (4.0 and 5.5), initial metal concentration (5.0 and 10.0 g l<sup>-1</sup>) and biomass concentration (0.4 and 0.7 g l<sup>-1</sup>) on biosorption of Cd<sup>2+</sup> using *Aspergillus niger* was studied [17]. The biosorption process studied was modeled based on 2<sup>3</sup> factorial designs. The most important factor was the biomass concentration. An increase in the removal efficiency occurred with an increase in biomass concentration and pH. However, the removal efficiency decreased with an increase in initial metal

concentration. Although the biosorbent mass was constant in the present experiment, pH showed the same tendency in both cases. Moreover, the interaction effects X.pH have significant influence on Cd<sup>2+</sup> removal efficiency. The biosorption of Cd<sup>2+</sup> and pb<sup>2+</sup> onto sugarcane bagasse using 2<sup>3</sup> factorial designs was studied by Brasil et al. [19]. Three operating factors were analysed: temperature (30-50 °C), initial metal concentration (0.1 and 1.0 mol dm<sup>-3</sup>) and pH (5 and 6). The fixed parameters were time of exposition (8 h) and initial biosorbent concentration (0.2 g l<sup>-1</sup>). The authors concluded that temperature is the most important factor in the single system (pb<sup>2+</sup>), while initial metal concentration was the most important variable for the binary system (Cd<sup>2+</sup> and pb<sup>2+</sup>). In the single system the adsorption increases with increasing temperature and in the binary one the adsorption decreasing with increasing initial metal concentration. This is coincide with the results of the present study showed that temperature was the most important variable as it acquired significant influence on the adsorption of pb<sup>2+</sup> and Cd<sup>2+</sup>.

### Conclusion

The factorial experiment design method is undoubtedly good technique for studying the influence of major process parameters on response factors by significantly reducing the number of experiments and henceforth, saving time, energy and money. The use of factorial design offers good and fast screening procedure and mathematically computes the significance of several factors in one experiment that predicts where the optimum is likely to be located. Besides, it allows the identification of the most important parameters for biosorption of metallic ions under tested conditions. In the present research, the most significant effect for Cd<sup>2+</sup> and pb<sup>2+</sup> biosorption were ascribed to T. The interaction effects of T.X also has a significant influence on the Cd<sup>2+</sup> and pb<sup>2+</sup> removal efficiency.

The normal probability plot between the predicted values (model) and the observed (experimental) clearly demonstrate how closely the set of observed values with the predicted ones, with high correlation coefficients. In addition, the biosorption studies of Cd<sup>2+</sup> and pb<sup>2+</sup> onto *Cyperus laevigatus* biomass showed that this biosorbent was a powerful and low-cost biosorbent for these metallic ions removal from aqueous solution opening the possibility of this biosorbent to be employed in the treatment of industrial effluents and agricultural waste waters before being delivered into the environment. It is worthwhile to advise the metal industry sponsors to apply such experimental designs to maintain high efficiency and profit biosorption process.

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**Consequence of changes in the elderly people population: elderly women in Iran**Shirazikhah M.<sup>1</sup>, Mousavi M.T.<sup>2</sup>, Sahaf R.<sup>3</sup>, Sarmadi M.<sup>4</sup> (Corresponding author)

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**Abstract:** Goal and Purposes: Iranian older women population is growing and becoming older due to fertility decline and also success of health programs resulting in increases in life expectancy. As in the last two decades the population of elderly women increased from 3% to 4.1% and to 7 percent in recent census. It is expected that over the future decades this increasing trend continues due to the increasing number of elderly women worldwide and markedly increasing of life expectancy of women after 50 years, it is expected that women represent a larger number and proportion of Iran older people population. However, surprisingly, the statistics show that in 1976 to 2005 the population of the elderly women has declined in each decade. This situation occurred while life expectancy in men is usually less than women. Therefore in this paper we try to review the situation of Iranian elderly women in the Iranian population in terms of the elderly woman's health, education, family status, employment, quality of life, social isolation. Methods: This study is a review study that have been made with the views of experts by interview with experts, expert panel, group discussions and also extracting information from relevant books, and articles. Finally, the results were analyzed. Results: Considering the status of elderly women from various dimensions, including physical health, psychological, familial and social we find out that Iranian elderly women are not only vulnerable groups in term of their gender but also are in risk of different problems in elder years. This causes that this group threat double way in terms of quantity and quality of life. In this article we are going to evaluate Iranian older women from different dimensions aimed to attract focus of the politicians and decision makers to the elderly, especially elderly women. Future high quality national studies are required to be conducted in Iran to investigate physical, psychological and social aspects of Iranian older women.

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**Key words:** elderly women, health, social status, familial status

**Introduction:**

Elderly population is a part of development in many societies. Women now comprise more than half of the elderly population worldwide, mostly living in developing countries. This ratio is projected to increase sharply in the future, because about two thirds of women in 59-45 years of their age live longer than men (24).

Iran, the second largest country in the Middle East south of the Caspian Sea and north of the Persian Gulf. Iran has 5000 fascinating history. Iran has a population of around 78 million. The health status of Iranians has improved over the last two decades. In Iran, according to 2006 census, population of people more than 60 years is 7.3% of the total population and has increased more than doubled during the past 20 years. This increase was more than overall population growth during this period. In other words, country's elderly population has grown over 100% in the five censuses from 1976 to 2006 (1).

Statistics show that by reducing the fertility rate in Iran, the population of women follow the entire population trend of the elderly structure such as in two decades the population of elderly women ratio to the total female population increased from 3% to 4.1 percent and in the recent census increased to 7 percent and is expected that this increasing trend continues in the coming decades (3 and 1).

Currently at least in 35 countries in the world life expectancy of women has risen to more than 80 years. The lowest rates in developing countries are 50 years and in developing countries is 60-70 years. Therefore, the increased longevity of women over 50 years in all regions is observed. (24) However, greater longevity cannot be interpreted to be healthier life because of health and disease patterns in men and women are very different. Greater longevity of women caused them suffer from chronic diseases such as osteoporosis, diabetes, hypertension, urinary incontinence, and arthritis more than men (4 and 25).

For secure health of seniors and meet their physical and mental needs worldwide, plans and policies are on development and planning step and in this regard attention to the gender dimensions of the elderly and especially elderly women is essential. For three main reasons, more attention to the health of elderly women will require for health development in the future:

A: Increasing numbers of older women around the world

B: significant increase of lifetime of women after 50 years of age

C: positive attitude of communities towards health of older people as people who can be a source of effective services to families and society. (24)

Given the above, we also expect that most of Iranian elders be elderly women but surprisingly statistics form the years 1977-2005, show that the population of elderly women has declined in each decade. This happened while the life expectancy in men is usually less than women and it was anticipated that the number of women exceed men so more reflection on this subject is necessary (26).

Considering the above findings it seems essential that survey performed in all aspects including health (physical, psychological and social) and other factors affecting health such as economic and cultural problems. Obviously, with understanding the effective factors may we could undertake next steps to improve the status of this group with more understand.

#### Methods:

This study was a review study that use regulated opinions of experts, expert groups and data

extraction from published studies and ultimately results were analyzed.

Research community is written documentation related to the topic of study such as official web site and resources in libraries of related centers and documents of Seniors Office of the Ministry of Health and other health care resources. For recognition and enforcement of these resources we consulted with experts in executive branches and geriatrics and gerontologists.

Purposive sampling was based on dependence level and relation with the under study subjects and includes the key words among the available resources such as "elderly", "elderly women", "Senior Services", "healthy aging", "Elder Abuse" and "protection of the elderly".

For data collection, the views of experts, expert groups in the form of interviews, panel and group discussions and extract information from books, articles, and studies have been made and all of available library resources reviewed deeply and purposeful and finally, the results were analyzed.

#### Results:

##### Population of elderly women in Iran

According to latest estimates of Statistical Center of Iran, (Table 1) in 1358 shows that the number of people aged 60 years and over in Iran was 5,121,043 of which 2,654,833 (51.84%) were men and 2,466,210 were women (48.16%) respectively. These statistics reflect the high number of elderly men comparing to elderly women and looking closer we find this superiority in terms of the number until age of 90 and in oldest old women are more.

Table1: Population over 60 years by sex and age 2006

| Percent | Women   | Percent | Men     | Men&Women | Age      |
|---------|---------|---------|---------|-----------|----------|
| %50     | 738003  | %50     | 726449  | 1464452   | 60-64    |
| %48     | 575080  | %52     | 622470  | 1197550   | 65-96    |
| %47     | 521087  | %53     | 598231  | 1119318   | 70-74    |
| %46     | 321552  | %54     | 372570  | 694122    | 75-97    |
| %47     | 208080  | %53     | 236980  | 445060    | 80-84    |
| %49     | 63668   | %51     | 63992   | 127660    | 85-89    |
| %52     | 20586   | %48     | 18792   | 39378     | 90-94    |
| %54     | 8898    | %46     | 7754    | 16652     | 95-99    |
| %55     | 9256    | %45     | 7595    | 16851     | &more100 |
| %48     | 2466210 | % 52    | 2654833 | 5121043   | Total    |

Source: data processed by the Iranian Statistics Center data, 2006 General Population and Housing census.

The observed trend of sex ratio of seniors of 60 years and older showed that the ratio of seniors of 60 years and older in 1335 was that for every 100 women, there was 111 men, and this number, during 50 years and in 1385 has been reached to 108 (Table 2). Above statistics show the number of women was

never more than men in this age group while due to the higher increase in life expectancy in women (73 years in women and 68 years for men in 1384) it is expected that the ratio of women to men in elders be more (2).

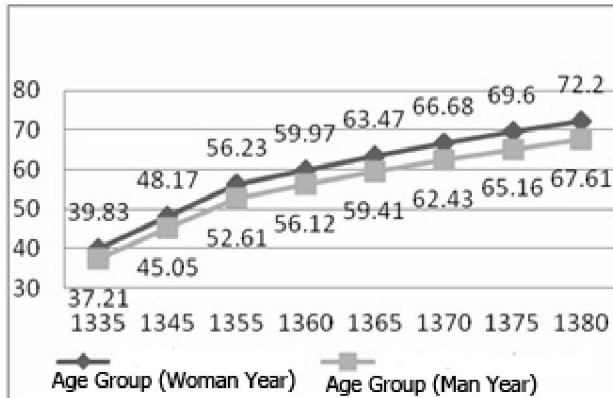
Table 2: Sex ratio of 60 years and more, 70 years and more, 80 years and more in Iran during the period 1976-2006

| 2006 | 1996 | 1986 | 1976 | 1966 | 1956 | Year Age |
|------|------|------|------|------|------|----------|
| 108  | 116  | 112  | 109  | 110  | 111  | 60&More  |
| 113  | 113  | 98   | 112  | 110  | 107  | 70&More  |
| 108  | 94   | 93   | 113  | 104  | 105  | 80&More  |

Source: data processed by the Iranian Statistics Center data, 1956-2006 General Population and Housing censuses.

### Women and life expectancy:

Graphs (1) the life expectancy of men and women in 1976-2006



Source: Management and Planning Organization - Statistics Center of Iran - 2003 According to Chart (1) life expectancy for women in Iran in 1956 was almost 40 years and the figure for men was 37 years and in 2001 is 72 years in women and 68 years in men.

Estimated rate of change in the next few years is such that life expectancy for women has been consistently higher than men. Given the higher population and increased life expectancy for women it is expected to be more elderly women than men in the population. But population age pyramid clearly shows otherwise. (2)

This is important because in proportion to increases in life expectancy should other components of health status be considered in conjunction with this society group. It seems that with studying this subject somewhat better judgments performed about the lack of conformity.

### Health status of elderly women:

Based on the health and illness status survey in Iran in 2001, the most common diseases among women of more than 40 years, is hypertension, neurological disorder, and duodenal ulcers, respectively. (6)

Hypertension in elderly women, both urban and rural areas is twice as higher in women than in men and the mean age of diagnosis time for women was more than men (62 and 67 years in rural and

urban women and 61 men and 63 in urban and rural) (27).

Now the risk of hypertension in women 70 years and older increased to more than twice and in this age group the second common illness is cataract. (6) in the field of visual impairment, elderly women more than men have blurred vision in both eyes and blurred vision generally is more in rural areas than city. (27)

In one research on heart disease in elderly men in Iran reported that, 17% and 25% of men and women have it and in hypertension 42% of elderly men 46% in women have been reported to have hypertension (19).

It seem that men more than women suffer from heart disease & stroke but with age increase, these diseases involve women too and should considered them a major cause of death and disability of women (6).

In another report announced that of the major reasons for hospitalization of women in cities is cardiovascular disease and in village is eye disease. Remember that the percentage of cardiovascular disease in the city is significantly higher than rural areas and is higher in women than men. The mean age at diagnosis time in rural and urban men is between 60-62 years and in women is between 63-66 years (27).

In the cause of death in 18 provinces in 2001, three major causes of death in women aged 50 years and more, regardless of death from old age, were cardiovascular diseases, cancer and incident and unintentional accidents. Ranked first is heart attack causes death from cardiovascular diseases and women have died more than men of these diseases (8).

In a study in Iran on 53.2 of elders there was Hyper triglyceridemia Prevalence (63.6% women, 42.6% males) and observed that this problem can be due to lack of nutrition and regular daily activities and prevalence of obesity in these people and due to this urban elderly women are more prone to obesity (21).

Osteoporosis results in Iran show that women in the age group of 60-69 years 56.3% of women and 16.7 percent of men had osteoporosis. Also in 2001 the incidence of fractures due to osteoporosis in women was as one of the most common complications of osteoporosis in the femur

with about 4337 cases, 917 cases was in spinal column and 1806 was on the arm (7).

Hip fracture (upper thigh), is one of the causes of disability and mortality among elderly people in the world. In a study that was conducted in 2001 among patients with upper femur fractures, prevalence rates of 67.7% of women (20).

The prevalence of large and small joint pain in women of 50 years and more have been reported nearly 6 times more than men in this group (6).

In another study it was shown that there is a clear relation between disability and gender such that Mean obtained scores in women, was in moderate disability, and in men, was in low levels of disability. (23).

Having regard to the use of aids such as eyeglasses, canes, crutches, walker or wheelchair, hearing aids and artificial teeth men significantly more than women and urban more than rural people have the necessary aids (27).

About drug use in elderly women aged 40-69 years shows that taking medication of women is nearly two times more than men in this age group. (In women 27% and in men 16 %)

And in aged 70 years and above shows that taking medication of women is 34.9% and in the men it is 25.4%. (6)

Research conducted by the Welfare Organization showed that in both physical problem (43.1% vs. 39.9%), mental and emotional problems (25.3% vs. 17.8%) were reported by older women more than men. In addition, it is also showed significantly higher regular medication dose-taker in women than men (46.5% vs. 43.2%).

Above study of elderly people shows lack of health insurance (59.1% for men and 58.2% for women). Note that more than half of our country is without health insurance coverage. (9).

According to a study by Jghtay and Asadi in 1992 there were only 43/3 percent of seniors with

Insurance and remain had no insurance and percentage of rural people was 74.9 percent.

On smoking in Iran, in a study of it were 39% of elders which 38.9% was male and 29/1% was women (21) as compared with 15% for men and 12 % for women have been reported for industrial communities (22). The above statistics show that smoking prevalence in the Iranian society has more relative frequency. The results showed that although tobacco use in women is less than men, but with age increase, especially hookah smoking increases and this increase is observed among rural women more than urban women (6 and 10).

#### Women and literacy:

The results of the health status of elderly in 1999 shows that the illiteracy rate among elderly women in Iran, especially rural women is significantly more than elderly men to as 79.1 percent of elderly women in urban and 95 percent of elderly women in rural areas were illiterate (10 ).

The recent census results also show that the literacy rate in men aged 60 to 64 years and 65 years were 20.6% and 16.3%, respectively while in the same year, the rate for women was 5% for 60-64 years and for 65 years and more was 3.5%. According to above statistics in 2006 the rate of literacy among men aged 60 to 64 years was 59.2% and in 65 years and more was 38.2%, i.e. about 3-fold. While rate of literacy among women aged 60 to 64 years was 28.5% and in 65 years and more was 16.1% or approximately 5.5 fold.

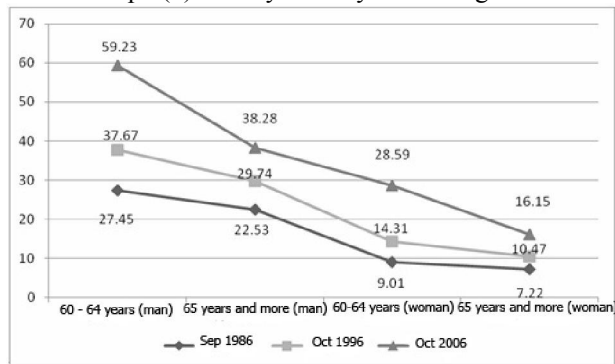
Illiteracy rate among women over 60 years of age, despite the relative decline in recent census was 80.15 percent in recent census and is significantly more than men in this age group (56%). This rate, is especially among elderly women in rural than urban elderly (95% vs. 17.9 percent) (3).

Table (3) literacy rates by sex and age (thousand)

| Nov2006       | Nov 1996      | Oct 1985      | Sex and age group |
|---------------|---------------|---------------|-------------------|
| Literacy rate | Literacy rate | Literacy rate | Total             |
| 43.78         | 27.11         | 19.16         | 60-64             |
| 27.81         | 20/73         | 15/5          | 65&More           |
| 88.74         | 84.66         | 71.02         | .Man              |
| 59.23         | 37.67         | 27.45         | 60-64             |
| 38.28         | 29/74         | 22/53         | 65&More           |
| 80.34         | 74.21         | 52.07         | ...Woman          |
| 28.59         | 14.31         | 9.01          | 60-64             |
| 16.15         | 10.47         | 7.22          | 65&More           |

Source: Iranian Statistical Center Site- Census 2006

Graph (2) literacy rates by sex and age



### Women and family status:

Census statistics in 1994 show that only 49.75 percent of elderly Iranian women are married and have spouse while in married aged men it was nearly twice (90.22 percent) of married elderly women. (3) In 1994 in Iran 68.1% of elderly living with their husband or wife and children. 22.9 percent lived with their children. The rate of elderly women was only 12.8 percent and in elderly men was only 2.5 percent. (11)

Study showed that women more than men going to rest home. (60.6% women vs. 39.4% of men) (17). 1373 data in Iran shows that 68.1% of elderly live with a spouse or spouse and children, 22.9 % are living only with children. The rate of alone elderly women was only 12.8% and of alone elderly men was only 2/5 percent. (9:10)

### Women and employment

In Iran the most difficult economic issues and problems related to old people is economic and money problems. In 2006 from the total population of 65 years and more than 33 percent were active economically. While in the 1996 census, 34.2% were active economically and of total active people, 93 percent employed in the private sector and 5% were public sector wage earners, and 2% not stated their jobs. Of this 95 percent and 5 percent of elderly men and women are employed, respectively. As you can see the economic activity in this group comparing to 10 years earlier reduced 1.5 percent and employment percentage of elderly men is much higher in older women. This factor and low literacy levels, caused the lack of independence and self reliance among the elderly women (Statistical Center of Iran, 2006).

Employment status of the elderly is not only different in two genders but also have significant difference in city and village such that in the city 43 percent of elderly men are employed, 36% are unemployed with incomes and 21% are unemployed with no income and in village 65 percent of elderly men are employed, 16% are unemployed with incomes and 19% are unemployed with no income. In the city 3 percent of elderly women are employed, 11

percent are unemployment with income, 15% unemployed with no income and 71 percent are housekeepers but among rural women, 10 percent of elderly women are employed, 7 percent are unemployment with income, 13% unemployed with no income and 70 percent are housekeepers (12).

In a study conducted in Tehran, 92.3% declared that they have a monthly pension and its frequency for men was 98.6% and for women was 87.6%. (18)

### Quality of Life

In Iran, a research on the elders of west of Tehran was carried out and showed that the average quality of life of elderly men (34/26 with SD of 8/375) was better than quality of life of women (31/06 with SD of 9/212), respectively. (16)

Orfila & et al examined in Spain difference between the quality of life in elderly men and elderly women. Based on research conducted in the country, health-related quality of life in women comparing to men was in a worse situation and this is associated with disability and chronic diseases in women. (15) Based on the researches in different areas, there are significant differences in quality of life of elderly men and women. These differences are from men's more wealth, allowing them to remarry following the loss of a spouse, more social respect, and likewise. These opportunities are waiting for men more than for women. (18)

### Discussion:

According to the census in 2006 in Iran, the population of people over 60 years was more than 5 million and women, were 48.1 percent of this age group. With respect to the fact that female life expectancy is longer than male it is expected that population of women in this age group are more than men in this age group. But according to the last census (1335-1385) women has never been more than men in this age group and this needs to be investigated (3, 4 and 5)

In most countries, life expectancy at 60 years of age in both men and women is increasing (2). According to estimates, women reach 60 years of age have life expectancy of averagely about 20 years and this rate for men is 17 years. It is expected that this amount increased two years by 2020 (2) but the increase in life expectancy and the age length doesn't means life is better and more healthy (1) an resultant of increase in life expectancy among elderly women is increased risk of physical and mental diseases in them. (11)

Generally, the problems and threats of the health of elderly women can be divided into three categories:

#### 1. Physical problems

Increased risk of chronic diseases like hypertension, diabetes, osteoporosis, rheumatoid arthritis, dementia, and cardiovascular disease, as well as visual and hearing loss and other disabilities due to aging and menopause in older women.

Research conducted by the Welfare Organization showed that physical problems (43.1% vs. 39.9%) were reported in elderly women more than men (9)

Since the probability of disability increases with age (6), so this is not surprising that statistics show the number of women with disabilities among the elderly population is growing. Results of research in different countries, including developed and developing countries illustrating that women generally spend more of their life with motor limitations than men. (24). on disability rates among elderly Iranian women also statistics show that disability increases with age. (6)

High prevalence of chronic diseases in elderly women deal with their loss of abilities so they need long-term care. In addition to impact of these diseases on increasing of mortality rate among elderly women, serious consequences on health status and life quality expected. These outcomes are in relation to issues such as menopause, osteoporosis, arthritis, urinary incontinence and cognitive impairment is sensory, and the prevalence of these problems increased with age and has extreme importance for old women. (31)

Smoking in women is one of risk factors of the most common causes of death in women such as cardiovascular disease and cancer. Smoking prevalence in elderly women is less than elderly men. Tobacco use among elderly women is with increased risk of respiratory problems, drug use, unhappiness and dissatisfaction with social relationships. Even after a lifetime of smoking, the withdrawal of it benefits for elderly women as the risks of coronary events and mortality from smoking-related cancers, and chronic respiratory decreased immediately and over time will be removed. (24)

So awareness of this stratum of society is necessary to prevent its consequences. Generally, aging is a biological, continuous, and irreversible process in humans, but can be postponed with care and appropriate methods in order to take advantage of long life with appropriate quality. Although most research focus on the dimensions of diseases and disabilities of this period but new studies go to healthy and successful aging and changing attitudes toward stereotypes of aging as a time for disease have senility.

World Health Organization has emphasized the increasing longevity alone, without improving the quality of life in the last years of healthy life is not

the final word and healthy life is more important than life expectancy. The term "healthy life expectancy" means the number of years a person can expect, to live with good health. The definition of "health" in aging ages and in various communities may be difficult, but at least provide health for older people so that they can provide acceptable quality of life, is essential (28). So the number of years women live after 60 years of age may be associated with health or with disability. Collecting statistics in developed countries shows that the number of years with health increased and years of living with disability is declining. (29)

## 2. Mental - Psychological

The obtained data show that depression and obsessive-compulsive in women is more than men and other disorders in elderly men is more than in women. (30). of psychological problems, depression, anxiety, sleep disturbances, dementia, and emotional problems in elderly women is prevail (4).

Researches in Iran demonstrate the psychological problems of women at 25.3% vs. 17.8% in men. Mirabzadeh research in Razi hospital in 2001 showed that 75% of elderly men and 60% of aged women live with their families without psychiatric disorder. (31)

In Mohammadi and colleagues research, findings show that the prevalence of mental disorders is higher in women than men. And ratio of these disorders in women is 44.1% and 35.1% in men. Probably the lack of income, unemployment stressor, restriction of social relationships, and uniformity of life are among factors of increased incidence of mental disorder. (32)

Given that the elderly suffer from physical activity and the ability to take care himself, physical and mental problems often result in hospital admissions for elderly. This admission can have a heavy cost for the elderly and ultimately for the health care system. (33)

## 3. Social

Social problems including poverty, isolation, lack of support from family, lack the necessary social support such as literacy, the enjoyment of rights and social security and pension insurance.

Another important point is that older women, just when they most need support and help is coping with the hazards. Protection and support of elderly women in developing countries often performed by families and normally done by family women. But in more developed countries the percentage of elderly women lives alone is more, but there are more supportive social systems for them. (11)

According to studies there are significant differences based on the quality of life in elderly men

and women can be seen. These differences are from wealth of man, allowing them to remarry following the loss of a spouse, more social respect, and likewise. These opportunities waiting for men more than for women. (18)

Social isolation is more problematic for women. Because their life expectancy is generally higher than their husbands, and it makes them vulnerable in different fields. In such circumstances, women are more prone to trauma and dementia. (18) Older women typically have more diverse diseases and functional disabilities. Elderly, who are mainly women, not only are more vulnerable to the disease but also because often they lost their supportive relatives they could have lost the appropriate support of the support networks. The majority of the elderly population which are deposited in a nursing home are elderly women comprise 75 years and more.

Likelihood of being widowed elderly women than elderly men in most parts of the world is higher. And continuing widowed elderly women in Iranian culture as a natural fact of life is accepted, while the choice of a spouse's pension for elderly widow men is regarded as a natural fact. This fact is very serious effects on physical health, race - emotional, and social needs. The negative consequences of that is more than economic and social consequences but to put them in more vulnerable situations in term of access to health services provider and Additional costs would be imposed on individuals and health systems.

Older people who live alone, especially if they suffer disability, for meet material needs for themselves and their affairs have much difficulty and will have to rely more on their children and relatives. Life problems in urban communities and uncontrolled immigration in rural areas has led children to visit their elderly parents less and less every day and create a feeling of loneliness in the elderly increasingly. (5)

Fewer women than men are prepared for independent living. Education trends and women's entry into the community in past years has led many elderly women without a spouse could not manage their financing needs, Transportation needs, and Provision of housing needs. (3)

Women go to the nursing home because it is likely that older men are looking to remarry while widowed elderly women often remain widows. Widowed women more often playing more role of caring of other family members such as children, grandchildren or patients and generally elderly women are an important source of care in the family, while their activities are not often taken into account. (1)

**4. Other influential factors**, including economic factors, political, and cultural factors also influences on women and have consequences on quality of life as well as health and increase costs of health care system. For example, poverty in old ages often reflects the economic situation was limited in the previous periods of the life and is a determinant health factor. Developed countries that have more accurate data on poverty are shows that older women are poorer than men but these statistics are not available in developing countries. Poverty is associated with inadequate access to food, and nutrition and health of elderly women usually reflect that their nutritional status is poor. For example for years, fertility and sacrifice their food to other family members can lead to chronic anemia in the elderly women.

Another important factor is the education level and literacy among elderly women that is very low in developing countries and this has many effects on their health and their families.

Studies in Iran show that mostly, elderly women relief through the maintenance of child care. Percent of employment in elderly women is very less than elderly men. The greatest source of economic support in the Iranian elderly women is economic help and support of their children. (9)

With regard to relationship between education and employment opportunities and social status we can guess that the vast majority of elderly women are among the vulnerable groups of our country in terms of socio – economic manners and Consideration of their status should be the priority of aging issues (5)

UN General Assembly on December 8, 1989 noted that gender stereotypes associated with age discrimination causes the social and economic problems of elderly women became more acute every day. (13)

In addition, the General Assembly meeting of December 23, 1994, was seriously called for various forms of activities of older women who usually do not endorsed by the government on its economic value should be considered and properly be evaluated. (14)

Different manifestations of poverty are: lack of sufficient income and resources for sustainable livelihoods, hunger and malnourishment, inadequate hygiene, absence or lack of access to education and other basic services, increased virulence and deaths from disease, homelessness and lack of affordable housing, unsafe environments, and finally discrimination and social expulsion. Moreover, the lack of participation in decision making and participation in civic life, social and cultural manifestations of poverty are some manifests of



poverty. Poverty in its various forms is obstacle of access to services and poor individuals with lower social status, have fewer social opportunities (participation in many social activities such as travel or pay the entry fee is required to pay by money) less choice (in the case of services or products), less control over their lives. In summary poverty is not to meet basic needs including food, clothing, housing is health.

The following causes of poverty among elderly women are more common:

1 - Working at home is financially invalid. That means that disabled housewives are without insurance coverage but only in the dependence on their wives.

2 - Many of the women due to pregnancy and lactation periods lost Years that they could be in the labor market and in fact, being a mother and be punished.

3 - Early retirement by women leads to a reduction in pension in remaining of life.

4 - Discrimination based on gender causes women to have fewer job opportunities.

The above situation is caused not only our country but worldwide economic status of elderly women is lower than their male counterparts. (5) And elderly men and women overall have not been in similar situations. Before and after the elderly life women have difficulty compared with men so in formulating programs and performing necessary measures for their needs we cannot be indifferent to the gender discrimination. (35)

What is certain is that old age alone is not problematic, but the degree of dependence in this age is of special importance and need for further investigations. Reasons that depend on older people include: 1- Disease 2- Failure 3 - mental and cognitive impairment 4- Spouse die 5- Poverty. Unfortunately, as noted above in all cases the situation is worse in elderly women than men.

Overall, above findings implies that we pay attention to Problems for older women will. If we consider that women in the past few decades, in addition to their labor force participation continued their traditional role – i.e., housekeeping and child rearing - and also have continued steadfastly in the double task patiently we certainly ensured that the community is obliged to provide their health and welfare without hesitate. (5)

#### **Suggestions:**

1- Assessment of services needed by the elderly, according to sex and designing comprehensive and codified programs in providing comprehensive health services, to meet their needs

2 - Awareness and sensitiveness of women about common problems associated with them and educate

women about healthy lifestyles in the ages before the elderly

3 - Considering the comprehensive insurance coverage (social security and health) for the elderly population, especially housekeeper women are very important.

4 - Policies to support the elderly in small towns and villages and prevent their migration

5 - Create a needed platform for elderly employment for their empowerment

6 – Create platform to maintain traditional values, to strengthen family bonds, love and unity among family members and generations

7- The awareness about the consequences and risks of aging in pre-old age and old age and providing the cultural context for this community group to provide opportunities for their marriage.

8 - Providing opportunities to volunteer in elderly people, especially elderly women, in order to prevent their isolation.

9 - Special protection of household caretaker women and developing insurance covers in this group.

10 - Passed laws protecting the health of older women and support their families

11 - Continuous assessment of health status of elderly women and the effectiveness of providing services to them to improve requirement health care and services.

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8/8/2012

***In Vitro* Shoot Organogenesis and Plant Regeneration of *Cymbalaria muralis***Aye Aye Thwe<sup>1</sup>, Sun Kyung Yeo<sup>1</sup>, Soo Cheon Chae<sup>2,\*</sup>, and Sang Un Park<sup>1,\*</sup><sup>1</sup>Department of Crop Science, Chungnam National University, 99 Daehangno, Yuseong-Gu, Daejeon, 305-764, Korea<sup>2</sup>Department of Horticultural Science, College of Industrial Sciences, Kongju National University, 1 Daehoe-ri, Yesan-kun, Chungnam, 340-720, Korea  
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**Abstract:** We developed an efficient protocol for *in vitro* shoot organogenesis and plant regeneration from *Cymbalaria muralis* leaf explant cultures. Leaf explants were cultured in media containing different concentrations of cytokinins. After determining the most effective cytokinin and cytokinin concentration, we tested the effects of various auxins at different concentrations on the regeneration efficiency and growth of shoots from excised leaf segments. Among the cytokinins tested, zeatin supplementation resulted in the highest shoot initiation efficiency, largest number of shoots per explant, and longest shoots after 6 weeks of culture. In this study, zeatin in combination with an auxin, naphthalene acetic acid, was highly effective for inducing shoot regeneration. Among the cytokinin/auxin combinations tested, supplementation of the culture medium with 1 mg/L zeatin and 0.1 mg/L naphthalene acetic acid resulted in the greatest number of shoots per explant (8.3), highest regeneration efficiency (93%), and longest shoot length (27 mm). Zeatin with 0.5 mg/L naphthalene acetic acid supplementation resulted in the second-highest values for each of these measures. The combined application of cytokinin and auxin might play a vital role in shoot organogenesis of *C. muralis*.

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**Keywords:** *Cymbalaria muralis*, organogenesis, cytokinin, auxin, *in vitro*, leaf explant

**1. Introduction**

*Cymbalaria muralis* is an herbaceous perennial plant that belongs to the Figwort family, Scrophulariaceae. It is a small flowering herb that is native to the Mediterranean, widely naturalized in several temperate regions of the world, and typically grows on moist rocks and walls. It can be found in the cracks of old walls and is capable of climbing garden fences, reaching a height of over 3 feet. The flowers of *C. muralis* are hermaphroditic and are self-fertile. There are 2 subspecies, of *C. muralis*: *C. muralis muralis* and *C. muralis pilosa* (Vis.) Degen. *C. muralis* contains the following iridoids: antirrhinoside, linarioside, antirrhidine, linaride, 8-epiloganic acid, macfadienoside and muralioside (Bianco et al., 1997). Iridoids are responsible for pharmaceutical activities such as neuroprotective, anti-inflammatory and immunomodulator, hepatoprotective and cardioprotective effects and occur widespread in nature, mainly in dicotyledonous plant families like Scrophulariaceae (Tundis et al., 2008).

While most plants normally reproduce sexually, some species can propagate vegetatively. Vegetative propagation may require any one of several techniques, depending on the plant species. However, regeneration systems based on tissue culture have been recently developed for economically important plants (Chandra et al., 2010;

Debnath et al., 2006). *In vitro* techniques can improve these systems considerably through the application of nutritional and hormonal components under aseptic conditions. Plant proliferation using *in vitro* techniques is referred to as micropropagation because miniature shoots or plantlets are derived in the initial phase of the technique (Ekiert, 2000; Honda et al., 2001).

Many methods for the regeneration of whole plants from excised plant tissue are available. Organogenesis is a developmental system in which shoots or roots (organs) are induced to differentiate from a single cell (or a group of cells). Plant regeneration by organogenesis typically involves induction and development of a shoot from explant tissue, followed by transfer to a different medium, induction of root formation, and plant development (Boudaoud, 2010; Fleming, 2006). The propagation of *C. muralis* is currently achieved either by stem cutting or by planting of seeds. Propagation from seed is difficult and takes time because the seeds are very small and have a low rate of germination. An efficient method for the regeneration of intact plants from tissue culture is essential for establishing a multiple micropropagation system and for use of such a system as a tool for genetic transformation. We therefore developed a method of plant regeneration and micropropagation from *C. muralis* leaf explant cultures.

## 2. Material and Methods

### Seed Sterilization and Germination

Seeds of *C. muralis* were surface-sterilized with 70% (v/v) ethanol for 30 s and 2% (v/v) sodium hypochlorite (Sigma, St. Louis, Mo. USA) solution for 10 min, then rinsed 3 times in sterilized water. Ten seeds were placed on 25 mL of agar-solidified culture medium in petri dishes (100 × 15 mm). The basal medium consisted of MS (Murashige and Skoog, 1962) salt and vitamins (Sigma, St. Louis, Mo. USA) solidified with 0.7% (w/v) agar. The pH of the medium was adjusted to 5.8 before the addition of agar, and then sterilized by autoclaving at 121 °C for 20 min. Seeds germinated after 2 weeks of culture in a growth chamber kept at about 70–80% humidity and at 25 °C under standard cool white fluorescent tubes with a flux rate of 35  $\mu\text{mol s}^{-1}\cdot\text{m}^{-2}$  and a 16-h photoperiod.

### In vitro Plant Regeneration

Leaf explants of *C. muralis* grown *in vitro* were aseptically cut into pieces that were approximately 0.7 × 0.7 cm. The basal medium consisted of MS medium solidified with 0.7% (w/v) plant agar. The medium was sterilized by autoclaving before use. To determine the optimal cytokinin concentration for shoot regeneration from leaf explants, the MS medium was supplemented with 0, 0.1, 0.5, 1, and 2 mg/L 6-benzylaminopurine (BAP), kinetin (N6-furfuryladenine), 1-phenyl-3-(1,2,3-thiadiazol-5-yl)-urea (TDZ), and zeatin. To improve shoot regeneration, the culture medium was optimized by testing the effect of different concentrations (0, 0.1, 0.5 and 1.0 mg/L) of indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), and naphthalene acetic acid (NAA) on shoot formation and growth. Cultures were maintained at 25 ± 1 °C in a growth chamber with a 16-h photoperiod under standard cool white fluorescent tubes (35  $\mu\text{mol s}^{-1}\cdot\text{m}^{-2}$ ) for 6 weeks.

### Rooting of Regenerated Shoots

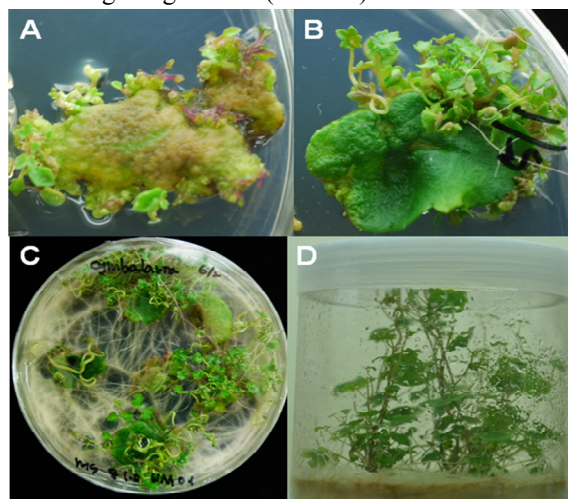
Regenerated shoots (~30 mm in length) were transferred to 1/2 MS medium in a Magenta box. The medium was solidified with 8 g/L plant agar and 50 mL was placed in each culture vessel. Four shoots were cultured in each culture vessel. Regenerated shoots were incubated at 25 ± 1 °C in a growth chamber with a 16-h photoperiod under standard cool white fluorescent tubes (35  $\mu\text{mol s}^{-1}\cdot\text{m}^{-2}$ ) for 4 weeks. After 4 weeks, the rooted plants were washed with water to remove agar, transferred to pots containing autoclaved vermiculite, and covered with polyethylene bags for 1 week to maintain high humidity. The plants were then transferred to soil and maintained in a growth chamber with a 16-h photoperiod and a day/night temperature of 18/20 °C

for 2 weeks. These hardened plants were then transferred to the greenhouse for further use.

## 3. Results and Discussion

### Effect of Cytokinins on shoot organogenesis

A simple and effective protocol was developed for the *in vitro* plant regeneration and micropropagation of *C. muralis*. Cytokinins play an important role in plant organ initiation (Shani et al., 2006; Perilli et al., 2010). In this study, we investigated the effect of different cytokinins on the efficiency of shoot organogenesis. Shoot development from leaf explants was successful only in media containing zeatin, TDZ, and the medium containing 1 mg/L BAP (Table 1).



**Figure 1.** *In vitro* shoot organogenesis and plant regeneration of *Cymbalaria muralis*. (A) Shoot primordia emerging from a leaf explant after 3 weeks of cultivation on MS solid media supplemented with 1.0 mg/L zeatin. (B) After 5 weeks of culture, fully developed shoots were produced from the leaf explant culture. (C) After 6 weeks of culture, shoot regeneration from the leaf explant culture (D) Plantlets were regenerated on 1/2 MS solid medium after 4 weeks in culture. Magnification A-B X5.

The number of shoots and regeneration rate increased with increasing concentrations of TDZ (0.5–2.0 mg/L) and zeatin (0.1–1.0 mg/L). Among the media tested, the medium that contained 1.0 mg/L of the cytokinin zeatin produced the largest number of shoots from each explant (5.4), resulted in the maximum shoot length (13 mm) and had the highest regeneration efficiency (89%). As concentrations of zeatin increased above 1.0 mg/L, the number of shoots, shoot length, and regeneration efficiency decreased. No shoot regeneration was observed in media containing kinetin (N6-furfuryladenine) at any concentration. The regeneration efficiency was only 20% in the medium containing 1.0 mg/L BAP (6-benzylaminopurine), and there were very few shoots

per explant. After 3 weeks of culture on the medium supplemented with zeatin, formation of shoot primordia and small elongated shoots adjacent to the cut surface were observed (**Figure 1A**). Cells of the epidermis proliferated to produce shoots directly (direct shoot organogenesis) without an intervening

callus phase. Regenerated shoots developed from shoot primordia within 5–6 weeks. After 6 weeks of culture, fully developed shoots were produced from leaf explants (**Figure 1B**). The addition of 1 mg/L zeatin resulted in the most robust shoot initiation.

**Table 1.** Effect of cytokinins on shoot regeneration and growth from *Cymbalaria muralis* leaf explants after 6 weeks of culture on MS medium

| Cytokinin (mg/L) | Regeneration %* | No. of shoots per explant* | Shoot length* (mm) |
|------------------|-----------------|----------------------------|--------------------|
| Control          | 0               | --                         | --                 |
| BAP              | 0.1             | --                         | --                 |
|                  | 0.5             | --                         | --                 |
|                  | 1               | 20                         | 2.0 ± 0.2          |
|                  | 2               | --                         | --                 |
| Kinetin          | 0.1             | --                         | --                 |
|                  | 0.5             | --                         | --                 |
|                  | 1               | --                         | --                 |
|                  | 2               | --                         | --                 |
| TDZ              | 0.1             | --                         | --                 |
|                  | 0.5             | 33                         | 3.2 ± 0.3          |
|                  | 1               | 40                         | 3.8 ± 0.2          |
|                  | 2               | 65                         | 4.0 ± 0.2          |
| Zeatin           | 0.1             | 67                         | 3.5 ± 0.4          |
|                  | 0.5             | 74                         | 4.2 ± 0.3          |
|                  | 1               | 89                         | 5.4 ± 0.1          |
|                  | 2               | 83                         | 4.8 ± 0.2          |

Regeneration frequency (%) = (No. of explants with root differentiation/all explants) × 100

-- No response

\* Values represent the mean ± standard deviation of 50 shoots

### Combined Effects of Cytokinins and Different Concentrations of Auxins

To enhance shoot organogenesis, young leaf explants from *in vitro*-grown *C. muralis* plants were cultured for 6 weeks in media containing 1 mg/L of zeatin and various concentrations of one of the following auxins: IAA, IBA, or NAA. The combination of zeatin and 0.1 mg/L NAA resulted in a higher regeneration rate (93%), more shoots from explants (8.3), and longer shoot length (27 mm) than zeatin alone (**Table 2**). These results agree with those of Lainé and David (1994) who observed shoot formation from *Eucalyptus grandis* leaf explants cultured on medium containing a combination of zeatin and NAA. In the present study, zeatin combined with NAA also resulted in the development of numerous adventitious roots. *C. muralis* appears to have a very prompt response to auxin that may be associated with its creeping habit. This results in profuse adventitious root development together with shoot organogenesis (**Figure 1C**). Shoot regeneration capacity decreased with increasing NAA concentration (0.1 to 2.0 mg/L).

At high concentrations of NAA, numerous root proliferations developed from the excised leaf segments, but no shoots were developed (data not shown). *C. muralis* cultured in media containing with the range tested of IAA and the medium containing 0.1 mg/L IBA produced fewer and shorter shoots than explants cultured in zeatin alone. However, there was no regeneration response in media with IBA concentrations of 0.5 mg/L and 1 mg/L. Overall, the optimum combination of cytokinin and auxin for shoot regeneration in *C. muralis* was 1.0 mg/L of zeatin supplemented with 0.1 mg/L of NAA.

### Plant Micropropagation

*In vitro* organogenesis is one of the key techniques associated with genetic transformation, as it permits the successful regeneration of transgenic plants after co-cultivation with bacteria. Therefore, the development of efficient regeneration protocols is the most critical step in genetic transformation experiments (Degenhardt-Goldbach et al., 2011). The regenerated plantlets were obtained after 4 weeks of culture on hormone free ½ MS solid medium in Magenta box (**Figure 1D**).

**Table 2.** Effect of MS medium supplementation with 1 mg/L zeatin and different concentrations of auxins on shoot regeneration and growth from *Cymbalaria muralis* leaf explants after 6 weeks of culture

| Auxin   | (mg/L) | Regeneration % | No. shoots per explant * | Shoot length* (mm) |
|---------|--------|----------------|--------------------------|--------------------|
| Control | 0      | 89             | 5.4 ± 0.1                | 13.0 ± 0.07        |
| IAA     | 0.1    | 67             | 2.7 ± 0.4                | 20.0 ± 0.08        |
|         | 0.5    | 50             | 3.5 ± 0.1                | 18.0 ± 0.05        |
|         | 1      | 33             | 2.3 ± 0.3                | 12.0 ± 0.08        |
| IBA     | 0.1    | 50             | 1.5 ± 0.2                | 19.0 ± 0.11        |
|         | 0.5    | --             | --                       | --                 |
|         | 1      | --             | --                       | --                 |
| NAA     | 0.1    | 93             | 8.3 ± 0.2                | 27.0 ± 0.12        |
|         | 0.5    | 75             | 7.7 ± 0.1                | 24.0 ± 0.09        |
|         | 1      | 45             | 2.0 ± 0.1                | 14.0 ± 0.08        |

Regeneration frequency (%) = (No. of explants with root differentiation/all explants) × 100

-- No response

\* Values represent the mean ± standard deviation of 50 shoots

In the present study, we optimized a rapid protocol for efficient shoot organogenesis and normal plant regeneration from leaf explant cultures of *C. muralis*. The plants regenerated by this method can be multiplied by vegetative multiplication (*in vivo*) for further use in landscaping, ground cover, or as medicinal plants.

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9/6/2012

**Shoot Organogenesis and Plant Regeneration from Leaf Culture of *Rehmannia elata* L.**Thanh Mai Nguyen Thi<sup>1</sup>, Aye Aye Thwe<sup>2</sup>, Pham Anh Tuan<sup>2</sup>, Soo Cheon Chae<sup>3,\*</sup>, Sang Un Park<sup>2,\*</sup><sup>1</sup> Faculty of Agriculture-Forestry-Fishery, Vinh University, Nghean, Vietnam.<sup>2</sup> Department of Crop Science, Chungnam National University, 99 Daehangno, Yuseong-Gu, Daejeon, 305-764, Korea<sup>3</sup> Department of Horticultural Science, College of Industrial Sciences, Kongju National University, Daehoe-ri, Yesan-kun, Chungnam, 340-720, Korea  
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**Abstract:** For the regeneration of shoots, leaf segments of *Rehmannia elata* were cultured on Murashige and Skoog (MS) medium supplemented with various concentrations of 6-benzylaminopurine (BAP) (1, 2, or 4 mg L<sup>-1</sup>) with or without 1-naphthalene acetic acid (NAA) used at 0.1 or 0.5 mg L<sup>-1</sup>. Regenerated shoots were obtained from the leaf cultures at all BAP concentrations with or without both concentrations of NAA. However, the highest shoot regeneration frequency (92.23%) and shoot number per explant (4.03 shoots) were obtained on MS medium supplemented with BAP (4 mg L<sup>-1</sup>) and NAA (0.1 mg L<sup>-1</sup>) solidified with Gelrite (4 g L<sup>-1</sup>). The survival rate was ~70% when the rooted plants were hardened and transferred to soil. The continuous production of *R. elata*-regenerated plants from leaf explants under these conditions could be used as a possible micropropagation system for this species.

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**Keywords:** *Rehmannia elata*, shoot organogenesis, plant regeneration, leaf explant, *in-vitro* culture

**1. Introduction**

Plant tissue culture is a useful tool that allows the rapid and large-scale production of new and true-to-type (i.e., genetically identical) plants using only a relatively small amount of space and supplies. Many plant species have been successfully cultured *in vitro*, such as *Tagetes erecta* L. (Vanegas et al., 2002), *Torenia fournieri* L. (Kanchanapoom et al., 2009) and *Kalanchoe blossfeldiana* Poelln. (Castelblanque et al., 2010) and they are suggesting the broad applicability and potential for plant tissue culture in plant propagation.

The genus *Rehmannia* of the family Scrophulariaceae contains 6 species of flowering plants that were originally discovered in China but that are also distributed in Japan and Korea. The root of this genus is particularly valued because of its medicinal properties. In particular, the root of *Rehmannia* contains a number of constituents, including beta-sitosterol; calcium; copper; glucose; glucosamine; histidine; mannitol; zinc; amino acids; and vitamins A, B, C, and D. Moreover, the root of *Rehmannia* has become popular for its usefulness in regulating deficient blood patterns (e.g., anemia), replenishing vitality, and strengthening the liver, kidney, and heart (Liang et al., 2009; Wang et al., 2009). In addition, this herbal root is effective for the treatment of a variety of ailments such as diabetes, constipation, urinary tract problems, and dizziness and for body temperature regulation. It has also been

regarded as an effective fertility enhancer.

*Rehmannia* plants can be propagated from seeds or tuberous roots. However, propagation from seed is not an efficient method because the seeds show poor viability and are slow to germinate (15~30 days), consequently delaying the root harvesting time (Park et al., 2009). A few studies have reported on *in vitro* plant regeneration and micropropagation in several species of the *Rehmannia* genus (Zhang et al., 2008; Park et al., 2009). However, more studies are needed for an efficient plant propagation system for the production of beneficial medicinal compounds from plants in this genus.

*Rehmannia elata*, commonly known as Chinese Foxglove, possesses large flowers that provide a nice accent in the host. Hence, in addition to the medicinal root, *R. elata* has commercial value as an ornamental or cut flower. However, to date, no report has been published on the shoot regeneration from leaf explants of *R. elata*. The present investigation was undertaken with the objective of developing an efficient protocol for the regeneration of *R. elata* from *in vitro* leaf culture.

**2. Material and Methods**  
**Shoot Organogenesis**

The plant materials for this study were obtained from *R. elata* plants maintained in the greenhouse. The leaves were thoroughly washed under tap water and surface sterilized with 70% (v/v)

ethanol for 30 s. Afterwards, the leaves were further disinfected with a 1% sodium hypochlorite solution or Clorox for 15 min. Next, the leaf explants were rinsed with sterilized distilled water to remove the residual Clorox. The explants were then cut aseptically into pieces approximately  $7 \times 7 \text{ mm}^2$  in size, and 7 explants were placed on medium in a petri dish ( $100 \times 25 \text{ mm}$ ) containing 25 mL of Murashige and Skoog (MS) basal medium (1962). The MS basal medium contained mineral salts and vitamins and was supplemented with 3% (w/v) sucrose as a carbon source and 0.8% (w/v) Phytagar (Gibco) as a solidifying agent. The pH of the medium was adjusted to 5.7~5.8 before adding the Phytagar and was sterilized by autoclaving it at  $121^\circ\text{C}$  for 20 min.

### Shoot Regeneration Procedure

The culture medium for testing the efficiency of plant hormones in shoot induction and growth consisted of MS salts (Murashige and Skoog, 1962) with 3% sucrose (w/v) and different combinations of 2 plant hormones at various concentrations. The first set of media contained 6-benzylaminopurine (BAP) alone in 3 different concentrations (1, 2, or  $4 \text{ mg L}^{-1}$ ); the second set of media contained BAP (1, 2, or  $4 \text{ mg L}^{-1}$ ) in combination with NAA ( $0.1$  or  $0.5 \text{ mg L}^{-1}$ ). Moreover, different concentrations of several gelling agents (6, 7, 8, or  $9 \text{ g/L}$  of Phytagar or 2, 3, 4, or  $5 \text{ g/L}$  of Gelrite) were examined to evaluate the effect on shoot regeneration and growth. Cultures were maintained at  $25^\circ\text{C} \pm 1^\circ\text{C}$  in a growth chamber with a 16-h photoperiod, under standard cool white fluorescent tubes ( $35 \text{ mmol s}^{-1} \text{ m}^{-2}$ ) for 6 weeks. The cultures were transferred to new medium every 3 weeks.

### Rooting of Regenerated Shoots

Regenerated shoots ~ 2 cm in length were transferred to a Magenta box containing 50 mL of MS medium solidified with  $4 \text{ g L}^{-1}$  Gelrite. The culture boxes were maintained in a growth chamber under controlled conditions for rooting. After 8 weeks, the rooted plants were washed with water to remove the Gelrite, transferred to pots containing autoclaved vermiculite soil, and covered with polyethylene bags for 1 week to maintain high humidity. These hardened plants were then transferred to the greenhouse for further use.

## 3. Results and Discussion

### Enhancement of Shoot Organogenesis by Plant Growth Regulators

The ratio of auxin to cytokinin plays an important role in plant organogenesis and growth. In

this study, we investigated the influence of various concentrations of BAP used alone or in combination with NAA and the effect of different gelling agents on the efficiency of shoot organogenesis. Regenerated shoots were observed from leaf cultures on MS medium containing BAP with or without NAA.

The shoot regeneration rate increased with increasing BAP concentrations. However, a decline in shoot regeneration was observed when the BAP concentration increased to  $4 \text{ mg/L}$  (Table 1). The highest regeneration rate (69.17%), number of shoots per explant (2.17), and shoot length (1.43 cm) were achieved with BAP at  $2 \text{ mg L}^{-1}$  (Table 1).

**Table 2.** Effect of Different Concentrations of BAP and NAA on Shoot Regeneration and growth from Leaf Explants of *Rehmannia elata* after 6 Weeks of Culture on MS medium

| Plant hormone*            |                           | Regeneration rate** (%) | No. of shoots per explant** | Shoot length <sup>a</sup> (cm) |
|---------------------------|---------------------------|-------------------------|-----------------------------|--------------------------------|
| NAA (mg L <sup>-1</sup> ) | BAP (mg L <sup>-1</sup> ) |                         |                             |                                |
| 0.1                       | 1                         | 76.63± 4.1              | 2.77± 0.3                   | 1.33±0.1                       |
|                           | 2                         | 82.53± 5.2              | 3.27± 0.3                   | 1.50±0.2                       |
|                           | 4                         | 86.40± 3.4              | 3.77± 0.2                   | 1.73±0.2                       |
| 0.5                       | 1                         | 75.00± 4.8              | 2.72± 0.1                   | 1.20±0.3                       |
|                           | 2                         | 81.10± 2.8              | 2.83± 0.3                   | 1.47±0.3                       |
|                           | 4                         | 82.67± 4.2              | 3.03± 0.2                   | 1.57±0.2                       |

-- No response

\* Basal medium consisted of MS salts and vitamins and  $30 \text{ g/L}$  sucrose solidified with  $8 \text{ g/L}$  Phytagar.

\*\* Based on 100 leaf explants per experimental condition.

<sup>a</sup> Values represent the mean ± standard deviation of 50 shoots.

No shoot organogenesis was observed in BAP-depleted MS medium, indicating that BAP is important for shoot organogenesis in *R. elata*. Eckardt (2003) reported that cytokinin deficiency results in a major reduction in shoot development, thereby leading to dwarfism, late flowering, plants, enhanced root growth, and alterations in reproductive development. Furthermore, cytokinins are required in plant tissue to maintain both cell division and leaf primordium formation. Shoot organogenesis and regeneration capacity increased significantly when BAP was used in combination with NAA (Table 2).



**Table 1.** Effect of Different BAP Concentrations on Shoot Regeneration from Leaf Explant of *R. alata* after 6 Weeks of Culture on MS medium.

| BAP concentration<br>(mg L <sup>-1</sup> )* | Regeneration rate**<br>(%) | No. of shoot/explant<br>(shoots)** | Shoot length <sup>a</sup><br>(cm) |
|---|----------------------------|------------------------------------|-----------------------------------|
| 0   | --                         | --                                 | --                                |
| 1   | 57.47 ± 4.6                | 1.57 ± 0.2                         | 1.10 ± 0.1                        |
| 2   | 69.17 ± 3.4                | 2.17 ± 0.3                         | 1.43 ± 0.3                        |
| 4   | 55.23 ± 4.9                | 1.83 ± 0.4                         | 1.27 ± 0.2                        |

\* Basal medium consisted of MS salts and vitamins and 30 g/L sucrose solidified with 8 g/L Phytagar.

\*\* Based on 100 leaf explants per experimental condition.

<sup>a</sup> Values represent the mean ± standard deviation of 50 shoots.

A high concentration of BAP combined with a low concentration of NAA resulted in the best conditions for maximum shoot organogenesis and regeneration. The highest regeneration rate (86.4%), number of shoots per explants (3.7) and greatest shoot length (1.73 cm) were obtained with BAP at 4 mg/L combined with NAA at 0.1 mg/L, so that using a combination of cytokinin and auxin was better than cytokinin alone. According to Skoog and Miller (1957), interactions between cytokinin and auxin play a crucial role in the control of plant morphogenesis. Generally, in organogenesis protocols, a high cytokinin-to-auxin ratio induces shoots, whereas a high auxin-to-cytokinin ratio produces roots. Meanwhile, equal or nearly equal concentrations of

these phytohormones are found to cause callus proliferation.

#### Promoting Shoot Organogenesis by Gelling Agents

For investigating the effects of different concentration of gelling agents on the shoot regeneration of *R. elata*, leaf explants were grown for 6 weeks in MS basal medium containing mineral salts and vitamins, 30 g L<sup>-1</sup> sucrose, 4 mg L<sup>-1</sup> BAP, 0.1 mg L<sup>-1</sup> NAA, and various concentrations of Phytagar or Gelrite (Table 3). The number of shoots per leaf explant and the shoot growth were ~10% and ~8% greater in media with Gelrite at 4 g/L than in that with Phytagar at 8 g/L.

**Table 3.** Effect of Different Gelling Agents on Shoot Regeneration and Growth from Leaf Explants of *R. elata* after 6 Weeks of Culture.

| Gelling agent* | Concentration<br>(g L <sup>-1</sup> ) | Regeneration rate**<br>(%) | No. of shoots per explant** | Shoot length <sup>a</sup> (cm) |
|----------------|---------------------------------------|----------------------------|-----------------------------|--------------------------------|
| Phytagar       | 6                                     | 54.27 ± 6.0                | 2.30 ± 0.2                  | 1.23 ± 0.1                     |
|                | 7                                     | 78.57 ± 5.4                | 3.17 ± 0.3                  | 1.50 ± 0.2                     |
|                | 8                                     | 84.33 ± 3.3                | 3.53 ± 0.2                  | 1.77 ± 0.2                     |
|                | 9                                     | 81.67 ± 3.5                | 3.47 ± 0.2                  | 1.63 ± 0.2                     |
|                | 10                                    | 77.83 ± 4.2                | 2.63 ± 0.2                  | 1.33 ± 0.1                     |
| Gelrite        | 2                                     | 65.70 ± 4.5                | 3.34 ± 0.2                  | 1.60 ± 0.2                     |
|                | 3                                     | 87.50 ± 3.2                | 3.60 ± 0.4                  | 1.78 ± 0.3                     |
|                | 4                                     | 92.23 ± 2.9                | 4.03 ± 0.3                  | 1.96 ± 0.2                     |
|                | 5                                     | 85.33 ± 3.1                | 3.74 ± 0.4                  | 1.50 ± 0.2                     |

\* Basal medium consisted of MS salts and vitamins and 30 g/L sucrose.

\*\* Based on 100 leaf explants per experimental condition.

<sup>a</sup> Values represent the mean ± standard deviation of 50 shoots.

This result is in agreement with a previous study by Park et al., (2009) who demonstrated that shoot organogenesis in *R. glutinosa* was more efficient on 3 g/L of Gelrite than on Phytagar 8 g/L used at the same concentration. In addition, a significant amount of research has shown that the use of Gelrite results in more efficient shoot organogenesis in *Bacopa monnieri* (L.) Pennell than the use of Phytagar (Shrivastava and Rajani, 1999). Moreover, Saito and Suzuki (1999) and Shrivastava and Rajani (1999) have reported the superiority of Gelrite over agar for the purposes of shoot regeneration in apples.

In this study, we were able to optimize the shoot regeneration medium in *R. elata* by using MS salts and vitamins, 30 g L<sup>-1</sup> sucrose, 4 mg L<sup>-1</sup> BAP, 0.1 mg L<sup>-1</sup> NAA, and 4 g L<sup>-1</sup> of Gelrite as a gelling agent. This protocol can be useful for efficient shoot regeneration and micropropagation not only in plant tissue culture but also in other plant transformation approaches, even though further studies are still necessary for in vitro shoot organogenesis in *R. elata*.

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**Ranking effective factors of training in basis of sustainable agriculture promotion using TOPSIS method**Ali Dadaras Moghadam<sup>1</sup>, Nona Ghanaat<sup>2</sup>, Adel Ranji\*<sup>3</sup>, Babak Mohammadi Sharafshade<sup>4</sup><sup>1</sup> Department of Extension and education agricultural, Birjand Branch, Islamic Azad University, Birjand, Iran<sup>2</sup> Department of Mechanics of Agricultural machinery, Science and Research Branch, Islamic Azad University, Zahedan, IRAN<sup>3</sup> Young researchers club, Takestan Branch, Islamic Azad University, Takestan, Iran<sup>4</sup> Irrigation Engineering Shahrood University of Technology Student[planing.researcher@yahoo.com](mailto:planing.researcher@yahoo.com)

**Abstract:** This paper presents how the TOPSIS method is used in ranking the training methods that are used for sustainable agriculture. Sustainable agriculture is the adoption of eco friendly methods of agriculture that will aid in preserving the environment for future generations. This research is looking into how effective the factors of training for sustainable agriculture are in promoting it. The objective of this research is to find out which method is factor is more effective when it comes to the driving factor of the training on sustainable agriculture. Since this is a problem with multi decisions for the solution, the TOPSIS method is the best to use as it supports the evaluation of multi decision criteria. The TOPSIS method will be used side by side with the AHP method, this is because the weights of criteria will be gotten using the AHP method. The research will give both the qualitative and quantitative aspects of the research. The most important part of the assessment is to understand the TOPSIS method and criteria in order to analyze the effectiveness of the training that sustainable agriculture uses. The finding of the research was that the most effective factor that influences the training of sustainable agriculture is increase in crop yield. This is because the increase in crop yield will automatically lead to the other factors; for example, increase in crop yield will lead to improved economic status of the region and its people. The conclusion of the research is based on the most effective factor and the benefits it gives to the regions that decide to adopt sustainable agriculture.

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**Keywords:** TOPSIS, AHP, effective factors on training, sustainable agriculture

**1. Introduction**

Sustainable agriculture is an integrated system of plant and animal production practices that depend on the principles of ecology that is the study of organisms and the environment around them (Miguel, 2006). This type of agriculture is a form of environmental awareness. Some of the farming methods used has long-term negative effects on the environment, thus the need to promote sustainable agriculture (Hodgson, 2011). For example, tillage will eventually cause soil erosion while irrigation without having proper drainage will damage the soil. Farmers who venture into sustainable agriculture have to be trained on how to use this method of farming. Lack of awareness at both the ground level and at the higher level translates that there is need for training for both the farmers and the people.

The statement of the problem here is how effective the training basis of sustainable agriculture is. Is it effective enough to influence a farmer to decide to practice sustainable agriculture? The assessment of this question will be done using the TOPSIS method to analyze the effectiveness of the training factors. Using the TOPSIS and AHP methods, the result was that an increase in crop yield was the most effective factor in the training basis of sustainable agriculture promotion.

The main challenge that was faced is the discovery that TOPSIS has to be used hand in hand with the AHP method. In other words, TOPSIS method is interdependent to the AHP method. In conclusion, the research proved that the superior factor was increased crop yield as this will automatically lead to the other benefiting factors that are a result of sustainable agriculture.

**1.1 Theoretical framework**

Sustainable agriculture can be used to enhance the economic status of a region and at the same time preserve the ecosystem as well as the environment. Most farmers see sustainable agriculture as a way to improve crop yield, increase their income and increase the diversity in the crops they grow (Cauwenbergh, 2007). For the promotion of sustainable agriculture, there has to be training for both individuals and groups on methods that they can use to successfully adapt to sustainable agriculture. Sustainable agriculture should improve the quality of life; this is environmentally and in the approach of farming as the old methods that farmers are used to have long-term damage to the soil (Rosing, 2005). This way, the resources can be maintained for future generations to use. Training for

both the farmers and concerned government departments is important in the promotion of sustainable farming as this is what will determine whether to practice sustainable agriculture or not as they would have all the knowledge they need to make the decision.

There are factors that drive the decision to train trainees on particular things concerning sustainable agriculture. It is important for the government, especially the agricultural department, and farmers to have the required training for sustainable agriculture. It is important to train as this will give people the knowledge, skill, attitude and understanding required for sustainable agriculture. Environmental impact assessment and planning are the most important things that they should be trained about as this would help them to manage the natural resources. The driving factor that creates the need for training is the fact that there are no skilled people to implement environmental legislation and economic instruments that are appropriate enough to ensure sustainable development and protection of the natural resources.

The other form of training is done through field trips. This is done for the trainees to see the actual impact of sustainable agriculture as well as the practical part of the training. Through the field trips, the trainees are taught ways and what to use in the farms. For example, if the trainees are taken to a farm, they can see how pesticides and chemicals are used. Here, they can learn how to use the chemicals and pesticides in the right quantity to avoid damages to the environment. Through the field trips, most trainees would understand what they did not understand verbally.

## 2. Material and Methods

The methods that will be used in this research are the TOPSIS method and the AHP method. The AHP method has to be used as the TOPSIS cannot be used on its own unless the weight of criteria has been provided for the research. The TOPSIS method is usually used when one has multi-decisions to make from many or different alternatives to consider before reaching the final decision. The TOPSIS method considers three criteria to the decision (Lichtfouse, 2009). These include qualitative benefits criteria; cost attributes criteria and the quantitative benefits criteria. This method also considers two estimated alternatives when coming up with the ideal solution; the ideal alternative, which is the option that has the best of all the benefits considered and the negative ideal alternative which has the worst attributes values of the decision (Zhang, 2010). The final solution that will be decided upon when using the TOPSIS method should lie in between the ideal alternative and the negative ideal alternative.

The AHP is an effective tool in the modeling and structuring of a multi-criteria problem. The method develops priorities for goals in order to get the different alternatives that are available (Kahraman, 2007). This value is achieved using pairwise comparison as it gives quantitative information that will be considered in the decision making stage. The pairwise comparison also offers the best basis for making an analysis on the present and the anticipated situation expansively (Grovera, 2005). The pairwise comparison uses all the alternatives available and compares them on the positive and negative attributes they have. The strategy selection is based on the qualitative criteria of each strategy. The numerical qualitative strategy has to be altered to numerical values to come up with the right decision or alternative options. There are steps that have to be followed to implement AHP successfully. Firstly, one has to identify the problem. In this step, one defines what the problem is and comes up with a goal to solve it. The second step is creating a hierarchy model for the problem at hand. The model should have the goals that one has set as well as the alternative goals and criteria. The criteria goals should always relate to the alternative goals (Bernroider, 2008). The AHP method should always have a hierarchy diagram that resembles a family tree. At the very top of the tree arrangement is the overall goal. It is then followed by criteria in the middle and finally the alternative goals at the bottom (Nguyen, 2005).

The third step is to create a pairwise comparison matrix for each of the lower levels ( $n \times n$ ) using a relative scale of measurements. The pairwise comparison scale should range between 1-9 scale (Gafsi, 2006). It is done in terms of which element dictates the other. The final step of the AHP method is a summary of all the steps above, that is the pairwise comparison and having determined the consistency, one comes up with the equation that will help calculate the weights of criteria as well as develop a matrix judgment

$$CI = (\lambda \max - n) \div (n - 1)$$

$$CR = CI \div RI \text{ (Taskin, 2007).}$$

### 2.1 Input to TOPSIS method

The method usually considers that there are (m) alternatives and (n) attributes each having a score with respect to the relevant criteria of both (m) and (n). When the option is (i) and criterion is (j), the score of option in respect to the criterion is  $x_{ij}$ ; then we have a matrix  $x = (x_{ij})$   $m \times n$  matrix, considering that j is the better set of attributes and j' is the less adequate set of attributes (Kulak, 2005).

## 2.2 The steps of TOPSIS

There are steps that one has to follow in order to come up with the best decision. The steps are as follows (Kulak, 2005): The first step of the TOPSIS methods is to come up with a normalized decision matrix. This step transforms the various attributes dimensions to non-dimensional attributes which will allow comparison across the criteria (Wang, 2005). The normalized data is:

$$R_{ij} = x_{ij} / (3 \times 2^{ij}) \quad i=1, \dots, m; \quad j= 1, \dots, n$$

The second step is to come up with a weighted normalized decision matrix. Assume that we have a set of weights for each criterion,  $w_j$  for  $j= 1, \dots, n$ . Multiply each column of the normalized decision matrix with its associated weight and the new matrix will be  $v_{ij} = w_j r_{ij}$ .

The third step of the TOPSIS method is to determine the ideal and the negative ideal solutions. The ideal solution is:  $A^* = \{V_1^*, \dots, V_n^*\}$ , where  $V_j^* = \{\max(v_{ij}) \text{ if } j \in J; \min(v_{ij}) \text{ if } j \in J'\}$

The negative ideal solution is:

$$A' = \{v_1', \dots, v_n'\}, \text{ where} \\ V' = \{\min(v_{ij}) \text{ if } j \in J; \max(v_{ij}) \text{ if } j \in J'\}$$

The fourth step of the TOPSIS is to calculate the separation measures for each of the alternatives. The separation from the ideal alternative is (Fish, 2008):

$$S_i^* = [\sum_j (V_j^* - V_{ij})^2]^{1/2} \quad i=1, \dots, m$$

The separation from the negative ideal alternative is:

$$S'_i = [\sum_j (V'_j - V_{ij})^2]^{1/2} \quad i= 1, \dots, m$$

The fifth step is to calculate the closeness to the ideal solution,  $C_i^*$

$C_i^* = S'_i / (S_i^* + S'_i)$ ,  $0 < C_i^* < 1$  then select the option of  $C_i^*$  that is closest to 1.

### Case Study

The TOPSIS method is applied to the problem at hand. The effective factors of training in the basis of sustainable agriculture promotion as well as factors that determine the training for the promotion of sustainable agriculture is what we will consider for the case study. There are three main factors that influence a nation to consider sustainable agriculture. These factors are improving the general economic status of the region; this is both the nation or state and the farmer's economic status, to preserve the ecosystem for the future generations to use and finally to increase the region's crop yield and diversity of the crops they

produce (Shavali, 2005). The main objective is to rank the factor that is most effective for a nation to decide to train on sustainable farming. The second objective is deciding which method and criteria for the decision-making criteria would give the best ranked factor. This factor has to consider negative effects, positive effects and the cost.

In most cases, the determinant factor is usually the cost of training that would influence the decision of whether to train for sustainable agriculture as a way of promoting it or not (Iskander, 2007). The other crucial factor that has to be considered is the positive and negative effects of sustainable agriculture. In this case, both short-term and long-term effects of the decision made have to be considered when making the decision.

In this instance, the two other remaining factors were considered for the TOPSIS method; preserving the ecosystem and increasing the crop yield. This is because when a nation decides to settle on the economic factor alone, they would most likely settle to use it as the topmost factor for training in the basis of promoting sustainable agriculture. This would not be right as there are other crucial factors that have to be considered as well.

### 3. Applying the TOPSIS method

The three factors were considered in the TOPSIS method since they were used as the options that were considered when coming up with the decision of the most ranked factor. The economic factor (A), ecosystem factor (C) and the crop yield factor (B) were considered in the decision making process.

For the application of the models, an expert team was formed. The experts determined the criteria that could be used. They used pairwise comparison matrices to calculate the criteria weights using the AHP method. At this stage, the AHP method had to be introduced as we could not assume or guess the weights of criteria. The weight of criteria had to be calculated at the evaluation stage of the research. They have to be based on the basis of objectives and the sub-weights of criteria on their related criterion which will then be calculated using the AHP method so as to come up with the results of the weights of criteria and weight of sub-criteria (Luo, 2012). In this case, there were no sub-criteria weights. Using the weights of criteria that had been calculated using the AHP method, the experts followed the TOPSIS method steps to rank the effectiveness of the factors. The team of experts was considering the three major factors including economic, ecosystem and increase in crop yield. The factors had both positive and negative effects of settling on them. The weight of criteria that was used was derived using the AHP method. The tables below show the results of both methods starting with the AHP

then the TOPSIS method. The analysis in table 2 was arrived at using the TOPSIS steps.

Table 1: Alternative weights obtained using the AHP method.

| Positive effects of the factors | Weights |
|---------------------------------|---------|
| A                               | 174     |
| B                               | 751     |
| C                               | 74      |

Table 2: Results obtained using the TOPSIS method.

| Alternative factors | $S_i^*$ | $S_i'$ | $C_i^*$ |
|---------------------|---------|--------|---------|
| A                   | 41.4    | 22     | 5       |
| B                   | 83      | 40.5   | 83      |
| C                   | 24.8    | 33.8   | 57.7    |

#### 4. Results

According to this information, the best alternative was the crop yield since the positive effects that it has will drive forth all other factors. If the crop yield increases, the economic status of both the region and the farmers will definitely increase. This is because when the crop yield increases, depending on what type of farming the farmers are practicing (for example if the crop yield of a horticulture farmer increases), this means that they have a lot of produce to sell thus increasing personal income and the nation's as well (Min, 2009). If the farmer does not produce horticultural produce, the surplus crops they get can be sold within the region thus increasing personal income. Increase in crop yield would be ranked as the most effective factor of training in the basis of sustainable agriculture. There was a weakness involved however while using the TOPSIS method. One of the major challenges faced was that other methods like AHP method had to be incorporated to generate the weight of the criteria as it could not be randomly assumed. That was the only challenge faced during the research period.

#### 5. Conclusion

Sustainable agriculture is positive and has a lot of benefits for those implementing it. The major benefit that a region would get is economic growth for both the region and the farmers due to increased crop yield. The other benefit that will be experienced is the preservation of the ecosystem for future generations. Through the research findings, increased crop yield has been ranked the most effective factor that should be used in the promotion of sustainable agriculture. This factor is what should drive a nation to adopt and train both the required government officials and the farmers to practice sustainable agriculture. Crop yield is ranked the most effective factor as it automatically influences other factors that will aid in the promotion of sustainable farming.

#### Recommendations:

The TOPSIS method cannot be used alone; it has to go hand in hand with the AHP method unless there is a provided weight of criteria that can be used in the TOPSIS method. For one to come up with an extensive qualitative and quantitative result the TOPSIS steps have to be carefully followed or one might risk having results that are not reliable. The use the AHP method should have been noted earlier as this would have made the whole research process easy. All alternative goals should be exhausted; this also includes the sub alternatives too so as to come up with the best solution for the problem. These two methods, TOPSIS and AHP will help one come up with the best and most effective solution to a problem that has alternative solutions.

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#### Appendices

- A.  $\Sigma$  -sum of all
- B.  $\lambda$  -lamda
- C.  $\epsilon$  -equals to

1/26/2012

## A Study for Analyzing Effects of Design Parameters in the Sand Casting Process of Aluminum Alloy

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**Abstract:** The use of aluminum alloys are of significant use in industry. Studying of design parameters of such products is important as not much work has been done for optimizing it. The generic formulation involves the flow, velocity, continuity fluid dynamics and shape related issues. The time for filling the mould and shape factor also play major role in performance of the casting process. In this paper, a simple shape is chosen, designed and mould is finalized. From casting and then design experiments with the stated parameters, an optimized design values have been obtained. The effects of each design parameter aid us to identify and prioritize them for improvement of the process. This give first rough cut estimate of the variables in sand casting process.

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**Keywords:** Sand casting; Optimized design; Pareto Analysis; Design of Experiments

### Introduction:

This paper is about experimental study of design parameters of Al alloys using casting processes. Casting processes by using aluminum alloy is of great significance in industry [1]. In sand casting process, metal is being melted and pouring into a preformed cavity called mold [2] and expandable molds are used in our case. Wood is a common pattern material because it is easily worked into shape [3]. These days pattern can be made in rapid and fast product manufacturing machines like Rapid Prototyping Machine [6]. In the typical mold for a sand casting there are set of channels through which a molten metal flows to the mold cavity is called gating system. Typical gating system consists of a pouring cup and a sprue receiving the poured melt, runner a channel through which the melt is supplied to the gates through which the molten metal enters the mold cavity. A gating system may include a riser a cavity connected to the gating system feeding the casting when it is shrinking. Air within the mold cavity and gases formed when a molten metal contacts the mold surface are removed through the vents. The interior cavities of a casting are formed by a separate inserts called cores. Cores are usually made of sand and backed [5]. A mold frame (flask) consists of two parts: cope (the upper part) and drag (the lower part). A mold cavity is formed in the process of pattern molding, when the pattern (commonly wooden) is embedded in sand in the flask forming an impression of the casting. After the sand packing the pattern is removed from the flask and the cores and the gating system are arranged. Cores,

runner and gates are arranged in the drag; pouring cap and sprue are placed in the cope. Then the two parts of the mold are assembled and poured. After the metal has solidified and cooled to a desired temperature, the casting is removed from the mold by the process called shakeout [6]. The gating system (gates, sprues and risers) provides paths for the molten metal to flow into the mold as given in Figure 1.

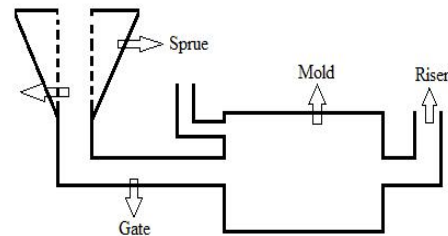


Figure 1 Basics components of casting system

Gates have to promote high volume, low velocity flow. Gating system consists of gate is the end of the runner in a mold where molten metal enters the mold cavity and consists of top and bottom gates. Also consists of Sprue is the vertical channel from the top of the mold to the gating and riser system. Also, a generic term used to cover all gates, runners and risers. Be formed straight, cylindrical and tapered. Also consists of Riser is a reservoir of molten metal provided to compensate for the contraction of the metal as it solidifies. There are single or more than two risers at the center [6,7]. The provision of a sprue base well at the bottom of the



sprue helps in reducing the velocity of the incoming metal and also the mould erosion. A general guide line could be that the sprue base well area should be five times that of the sprue choke area and the well depth should be approximately equal to that of the runner [6].

The function of a riser is to feed the casting during solidification so that no shrinkage cavities are formed. The requirement of risers depends to a great extent upon the type of metal poured and the complexity of the casting. The mathematical analysis has been collected from [5, 6, 7]. The casting experiment is performed and we measured the data i.e. gate diameter, height of mould, height of material, height of the mould box, pattern surface area and volume (from Solidworks™ software), length and diameter of sprue and riser positioning details etc. After discussion and studying literature, we concluded to analyze the following: a) The gates (bottom or upper gate); b) Sprue analysis (whether to put it straight or parabolic); c) Riser details (only positioning)

With this information, we describe the mathematical model and then use data to calculate and analyze. The analytical model related to the gating systems, sprue and risers influence the casting performance. It is necessary to analyze the casting using relationships, which has been discussed in literature [1] [2]. The bottom gate configuration is shown in figure 2.

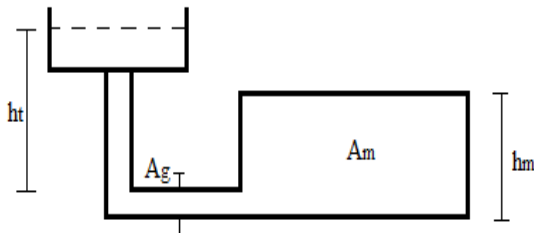


Fig.2: Bottom Gate

The parameters for the bottom gate casting process are  $A_g$ =in-gate area,  $A_m$  = cross-sectional area of casting,  $h_t$ = filling height,  $A_s$  is gate area and  $h_m$  is height of casting. The relationship for the bottom gate casting process is

$$t_p = \frac{2 A_m}{A_g \sqrt{2g}} (\sqrt{h_t} - \sqrt{h_t - h_m})$$

For the top gate casting process, the relation is

$$\text{Filling time for the mold} = \frac{\text{Volume of mold}}{\text{Gate area} \times \text{Velocity}}$$

$$t_p = \frac{A_m h_m}{A_s V_g}$$

To ensure that liquids melt is clean and degassed. Atmospheric gases can be introduced to the metal through aspiration. Aspiration occurs when pressure anywhere in the liquid falls below atmospheric pressure which most often in the vertical sprue [6]. The often condition is when sprue is tapered. The taper is required to avoid aspiration as shown in figure 3 can be calculated using Bernoulli's equation. The final equation is

$$\frac{A_2}{A_3} = \sqrt{\frac{h_c}{h_t}}$$

This equation provides an estimate of the maximum taper ratio required to prevent aspiration. If Bernoulli's equation is applied along the whole length of sprue parabolic shaped riser is generated.

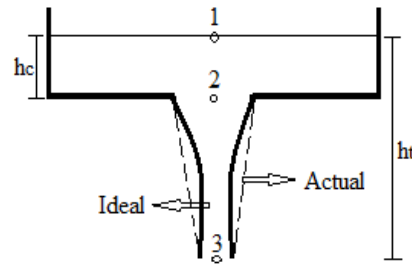


Fig.3: Geometry of Sprue for Casting [6]

The above equation can be modified as

$$d = \sqrt{d_1^2 \sqrt{\frac{h_1}{h}}}$$

$$d = c h^{-0.25}$$

**Development of Parts and Experimentation:**

A split wooden or metal master pattern is made of the shape to be cast. One half of the pattern is positioned on a bottom board and surrounded by the drag flask (bottom) half of the molding. A parting compound, such as talc, is sprinkled over the pattern to facilitate separation of the pattern from the mould prior to pouring the liquid metal. It must be sufficiently strong to hold the mould shape. Often fine sand is placed against the pattern and then a coarser sand mixture is used to fill the rest of the drag. Fine sand provides a relatively good surface

finish on the cast part. The sand is packed tightly to ensure that the shape of the pattern is retained and excess sand removed. The drag is inverted and the top half, or cope, of the mould prepared in the same manner as the drag. A feeding system for delivery of the molten metal is formed in the cope. This typically consists of a pouring basin, a sprue (vertical metal transfer channel), runners (horizontal transfer channels) and in gates connecting the runners to the mould cavity. The feeding system can be made part of the pattern or can be carved into the split mould after the pattern has been removed. In addition to the feeding system, riser cavities are designed into strategic positions.

These serve as reservoirs of molten metal which are fed into the casting as it cools to compensate for solidification shrinkage. The cope and drag are separated and the pattern removed. A core of sand mixed with resin or ceramic is placed in the mould to form the hollow of the pipe. The strength of the core must be higher than the rest of the mould to prevent damage from the inrush of molten metal. The cope and drag are reassembled and clamped together, ready for receipt of the metal. The metal is poured from a small ladle into the sprue, flows into the mould cavity and solidifies. Once solidification is complete the mould is broken and the cast part removed, all sand cleaned off and the riser and feeding system are cut away. To sand cast complex shapes, the sand must be sufficiently strong to hold the mould shape.

One of the most common casting processes specified is Sand Casting [6]. This process is divided into two different methods, typically chosen by the foundry based upon size, quantity and alloy being cast. The two methods rely upon the same type of tooling (called patterns and core boxes), but utilize different sand systems. The size of castings produced in sand molds spans the full range of casting weights from ounces to tons. Low volume castings are typically produced by hand, with low pressure molding of the sand. The gating system that allows the molten metal to fill the mold can either be part of the pattern (preferably) or cut into the sand manually. By Software Solid Work, we can draw the next shape which is the pattern before the casting processes as shown in figures 4 below.

After making the mould, we have the advantage of better dimensional tolerances and improved surface finish. Although the sand casting of simple shapes. We got three different shapes before and after the sand casting processes are pattern, top and bottom gates. By Software Solid Work, we can draw the previous shapes as shown in figures 5 and 6 respectively.

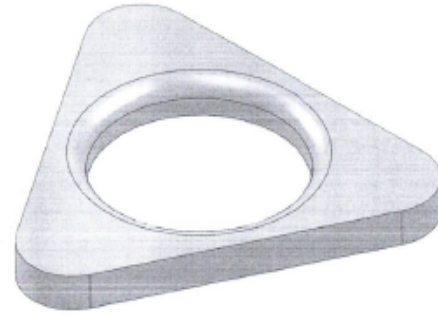


Fig.4: The Pattern used

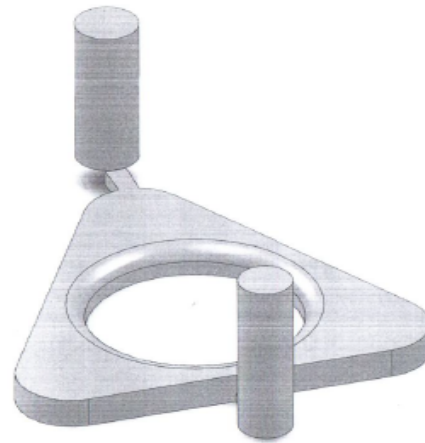


Figure 5 Bottom gate

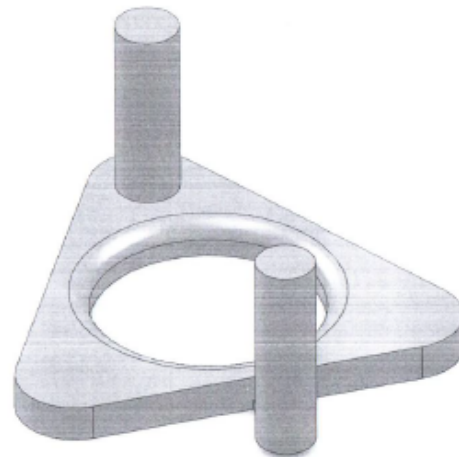


Figure6: The Top Gate

#### Parameter Details and Analysis:

During the experiment procedures, we took data (measured and calculated) and given dimensions after measured from experiment in Table.1.

Table 1: Data &amp; Given Dimensions

|                                    |          |
|------------------------------------|----------|
| Diameter of ingate for bottom gate | 17.55 mm |
| Diameter of ingate for top gate    | 24.5 mm  |
| Filling height, $h_t$              | 50 mm    |
| Height of casting, $h_m$           | 50 mm    |
| Diameter of sprue (Large)          | 29 mm    |
| Diameter of sprue (Small)          | 12 mm    |
| Height of sprue, $h$               | 51 mm    |
| Height of riser, $h$               | 17 mm    |
| Height of sprue, $h_c$             | 49.5 mm  |
| Diameter of riser                  | 25.5 mm  |
| Height of riser, $h$               | 36.5 mm  |
| Thickness of riser, $t$            | 16.5 mm  |

By Software Solid Work, we can calculate  $A_m$  (Surface area) & volume of mold,

$$A_m = 15080.38 \text{ mm}^2, \text{ Volume} = 49192.41 \text{ mm}^3$$

- At bottom gate:

$$\text{Diameter for } A_g = 17.55 \text{ mm}$$

$$A_g = \frac{\pi}{4} d^2 = \frac{\pi}{4} (17.5)^2, \quad A_g = 241 \text{ mm}^2$$

$$t_p = \frac{\text{Area of mold}}{\text{Gate area}} \frac{1}{\sqrt{2g}} 2 (\sqrt{\text{static head}} - \sqrt{\text{static head}} - \sqrt{\text{height modal}})$$

$$t_p = \frac{2 A_m}{A_g \sqrt{2g}} (\sqrt{h_t} - \sqrt{h_t - h_m})$$

$$t_p = \frac{2 * 15080.38}{241 \sqrt{2 * 9810}} (\sqrt{53.5} - \sqrt{53.5 - 50})$$

$$t_p = 4.86 \text{ s}$$

- At top gate

$$\text{Diameter for } A_s = 24.5 \text{ mm}$$

$$A_s = \frac{\pi}{4} d^2 = \frac{\pi}{4} (24.5)^2, \quad A_s = 471.4 \text{ mm}^2$$

$$h_m = 50 \text{ mm}, \quad h_t = 50 \text{ mm}$$

$$A_m = 15080.38 \text{ mm}^2, \quad g = 9810 \text{ mm} / \text{s}^2$$

$$V_g = \sqrt{2 g h_t} = \sqrt{2 \times 9810 \times 50}$$

$$V_g = 990.45 \text{ mm}^3$$

$$t_p = \frac{A_m h_m}{A_s V_g} = \frac{15080.38 \times 50}{471.4 \times 990.45}, \quad t_p = 1.6 \text{ s}$$

The time for the top gate is less, but the material will be more turbulent. We are studying the flow effects [6], we leave this part and suggested design is the bottom gate and further analysis is done on it.

The parabolic type of sprue is recommended in most cases as it avoids the aspiration formed during casting process. This is given below:

We have,

$$\text{Diameter of sprue} = 29 \text{ mm}$$

$$A_{\text{sprue}} = \frac{\pi}{4} (29)^2$$

$$A_{\text{sprue}} = 661 \text{ mm}^2$$

$$\text{Volume of sprue} = A_{\text{sprue}} h$$

$$\text{Vol}_{\text{sprue}} = 661 \times 51 = 33711 \text{ mm}^3$$

$$h_c = 49.5 \text{ mm},$$

$$h_t = h_c + h$$

$$h_t = 49.5 + 17 = 66.5 \text{ mm}$$

It is appropriate to apply boundary conditions in order to design the parabolic sprue according to the details. We have boundary conditions as shown in figure 7.

- At  $h = h_0$ ,  $d = 29 \text{ mm}$
- At  $h = h_0 + 51 \text{ mm}$ ,  $d = 12 \text{ mm}$

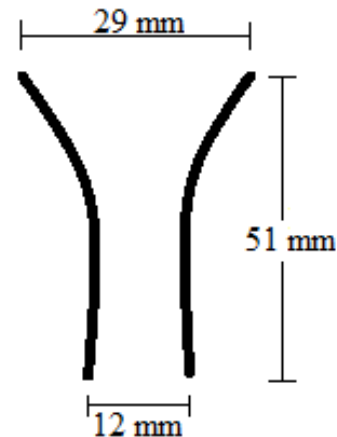


Fig.7: Boundary condition 1 &amp; 2

At boundary condition 1:

$$d = c h^{-0.25}$$

$$29 = c h^{-0.25}$$

$$c = 4 h_0^{-0.25}$$

At boundary condition 2:

$$12 = c (h_0 + 51)^{-0.25}$$

$$12 = (4 h_0^{0.25})(h_0 + 51)^{-0.25}$$

$$h_0 = 831.02 \text{ mm}$$

$$c = 21.4$$

So, required equation is

$$d = c h^{-0.25}$$

$$d = 21.4 (831.02 + 51)^{-0.25}$$

$$d = 0.39 \text{ mm, this is optimal diameter with minimum aspiration or air trapped.}$$

The riser is the last part in the casting process which solidifies in the end. This also play major part in casting to avoid the casting defects during pouring and when material will come out from the riser. For big castings, more than one riser is needed, but in our case we follow the practice of actual casters (based on judgment). However, an analysis is given which will aid the designers in positioning and selecting the riser.

We, have

$$\text{Diameter of riser} = 25.5 \text{ mm}$$

$$A_{\text{riser}} = \frac{\pi}{4} (25.5)^2$$

$$A_{\text{riser}} = 511 \text{ mm}^2$$

$$\text{Volume of riser} = 511 \times 51 = 26061 \text{ mm}^3$$

$$h = \text{height of metal in the mold} = 17 \text{ mm}$$

$$h_t = 36.5 + 17 = 53.5 \text{ mm, } h_m = 50 \text{ mm}$$

Riser position and location are shown in figure 8

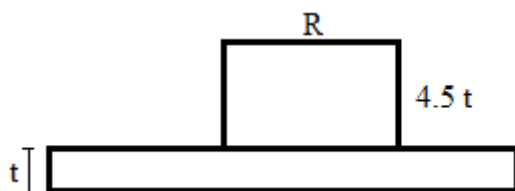


Fig 8: Riser position and location

$$t = \text{thickness} = 16.5 \text{ mm}$$

Location of the riser is also shown in figure 9.

$$4.5 \times 16.5 = 74.25 \text{ mm}$$

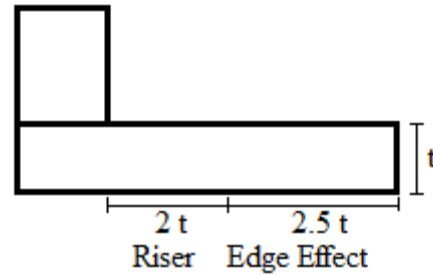


Fig.9: Riser Edge Effect

This mean, single riser is enough if feeding length is less than 4.5 times plate thickness. Sprue length single riser = 51 mm < 4.5 t.

### Results and Discussion:

Experiments (DOE) techniques enable designers to determine simultaneously the individual and interactive effects of many factors that could affect the output results in any design. DOE also provides a full insight of interaction between design elements; therefore, it helps turn any standard design into a robust one. Simply put, DOE helps to pin point the sensitive parts and sensitive areas in designs that cause problems in Yield. Designers are then able to fix these problems and produce robust and higher yield designs prior going into production [8]. For the formula of  $t_p$  for bottom gate, the DOE (Design of Experiments) is performed as it significantly affects the process and has following steps:

1. Start by choosing variables that affect the response, the inputs are (nominal values)
  - Ag : Diameter of gate = 241 mm<sup>2</sup> (calculated from experiment)
  - h<sub>t</sub> : Filling height = 53.5 mm (measured from experiment)
  - h<sub>m</sub> : Casting height = 50 mm (measured from experiment)

2. Run the simulation eight times to get the gain (our output measure) for all the combination of +1's and -1's of the three elements and this is what we get. There are 3 variables, so there will be  $2^3 = 8$  effects to be analyzed. Here, we will make changes in full factorial design,

$$\text{For a value of } d = 241 \text{ mm}^2,$$

- 1 correspond to 236 mm<sup>2</sup>
- +1 correspond to 246 mm<sup>2</sup>
- 0 correspond to  $d = 241 \text{ mm}^2$

3. Make main effects table and take averages of -1 and 1 and then calculate slope. The main effects are given below:

- a) Main effect of  $h_m$  on  $t_p$  in Table 2 as following:

Table 2: Main Effect of  $h_m$  on  $t_p$

| d  | $h_t$ | $h_m$ | $t_p$ |
|----|-------|-------|-------|
| -1 | -1    | -1    | 14.45 |
| 1  | -1    | -1    | 13.87 |
| -1 | 1     | -1    | 11.30 |
| 1  | 1     | -1    | 10.81 |
| -1 | -1    | 1     | 12.55 |
| 1  | -1    | 1     | 12.04 |
| -1 | 1     | 1     | 15.40 |
| 1  | 1     | 1     | 15.15 |

- Average  $t_p$  for  $h_m = -1 = \frac{14.45 + 13.87 + 11.30 + 10.81}{4} = 12.607$  s
- Average  $t_p$  for  $h_m = 1 = \frac{12.55 + 12.04 + 15.40 + 15.15}{4} = 13.785$  s
- The slope =  $13.785 - 12.607 = \frac{1.178}{2} = 0.58875$

The graph of main effect of  $h_m$  on  $t_p$  as shown in figure 10

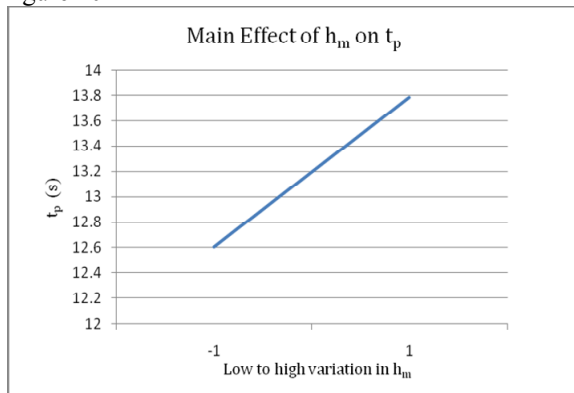


Fig.10: Main effect of  $h_m$  on  $t_p$

b) Main effect of  $h_t$  on  $t_p$  is

- Average of  $t_p$  for  $h_t = -1 = 13.227$
- Average of  $t_p$  for  $h_t = 1 = 13.165$
- The Slope = 0.031

The graph of main effect of  $h_t$  on  $t_p$  in figure 11 as following:

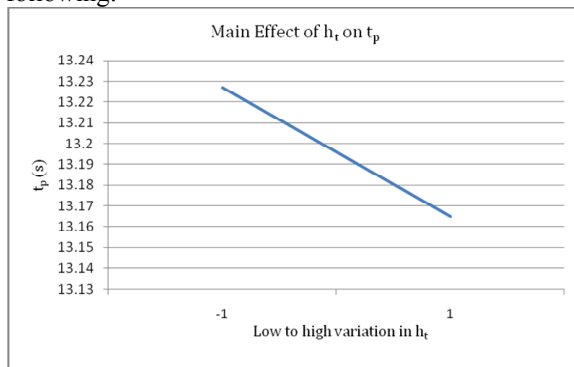


Fig.11: Main effect of  $h_t$  on  $t_p$

c) Main effect of d on  $t_p$  is

- Average  $t_p$  for  $d = -1 = 13.425$
- Average  $t_p$  for  $d = 1 = 12.967$
- The Slope = 0.229

The graph of main effect of d on  $t_p$  in figure 12

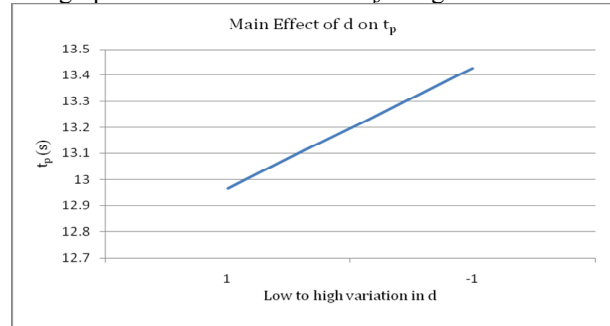


Fig.12: Main effect of d on  $t_p$

d) Interaction Effect of d and  $h_t$  is

- Average  $t_p$  for  $d = -1 = 13.152$
- Average  $t_p$  for  $d = 1 = 13.24$
- The Slope = 0.043

The graph of interaction effect of d and  $h_t$  on  $t_p$  in figure 13

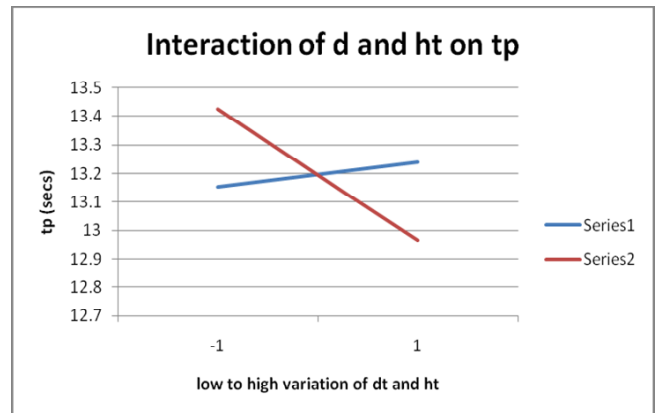


Fig.13: Interaction effect of d and  $h_t$  on  $t_p$

e) Interaction Effect of d and  $h_m$  on  $t_p$  is

- Average  $t_p$  for  $d = -1 = 13.157$
- Average  $t_p$  for  $d = 1 = 13.235$
- The Slope = 0.039

The graph of interaction effect of d and  $h_m$  on  $t_p$  in figure 14

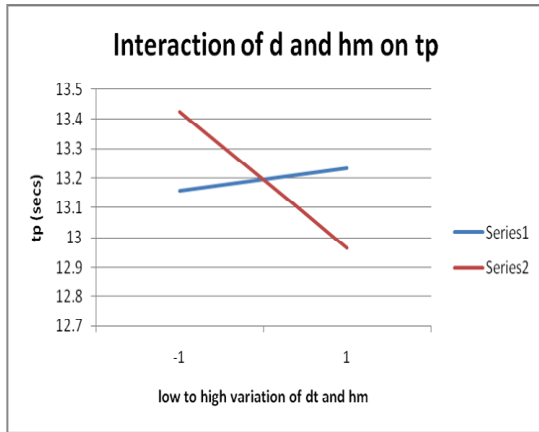


Fig.14: Interaction effect of d and  $h_m$  on  $t_p$

f) Interaction Effect of  $h_t$  and  $h_m$  on  $t_p$  is

- Average  $t_p$  for  $d = -1 = 14.717$
- Average  $t_p$  for  $d = 1 = 11.675$
- The Slope = 1.521

The graph of Interaction Effect of  $h_t$  and  $h_m$  on  $t_p$  in figure 15 as following:

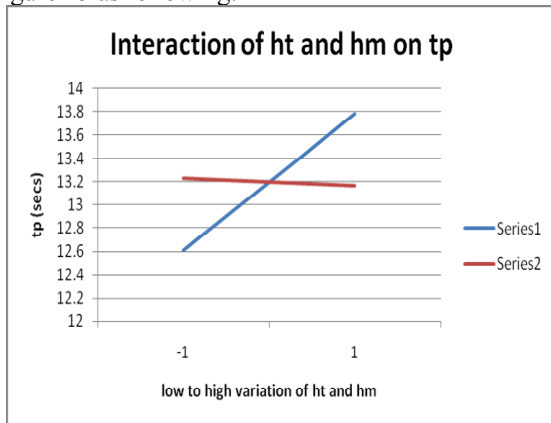


Fig.15: Interaction Effect of  $h_t$  and  $h_m$  on  $t_p$

Interaction effect of  $h_t$  and  $h_m$  on  $t_p$  is

- Average  $t_p$  for  $d = -1 = 13.175$
- Average  $t_p$  for  $d = 1 = 13.217$
- The Slope = 0.0212

The graph of Interaction Effect of  $h_t$  and  $h_m$  on  $t_p$  in figure 16

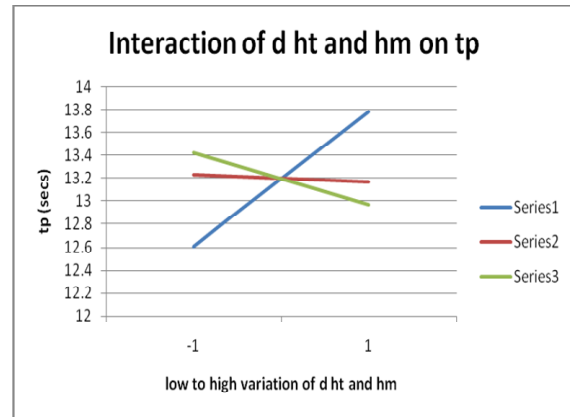


Fig16: Interaction effect of  $h_t$  and  $h_m$  on  $t_p$

The above stated results, it is experimentally proved that the main factors effecting are the interaction of  $h_t$  and  $h_m$ , then  $h_m$  and  $d$ . The  $h_t$  and  $h_m$  are the casting design related. We have analyzed for  $d$  and suggested the improved design of 'd', which has already been tested for different casting figures. Now, we have terms & coefficients in Table 3 as follows

Table 3: Terms & Coefficients

| Terms             | Coefficients |
|-------------------|--------------|
| Constants         | 15.15        |
| $h_m$             | 0.58875      |
| $h_t$             | 0.031        |
| $d$               | 0.229        |
| $d$ and $h_t$     | 0.043        |
| $d$ and $h_m$     | 0.039        |
| $h_t$ and $h_m$   | 1.521        |
| $d h_t$ and $h_m$ | 0.0212       |

The final governing equation covering all of the parameters is

$$t_p = 15.15 + 0.58875h_m + 0.031h_t + 0.229d + 0.043d * h_t + 0.039d * h_m + 1.521h_t * h_m + 0.0212d * h_t * h_m$$

Contribution of all variables on the  $t_p$  is shown in Pareto chart in figure 17 as follows:

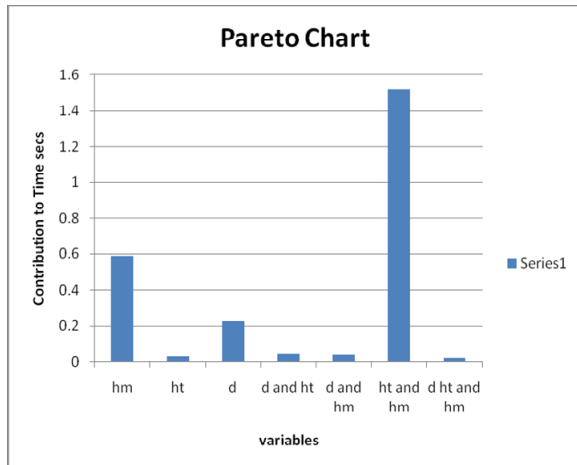


Fig.17: Prioritized results using Pareto chart

### Conclusion and Recommendations:

The sand casting process performed in the workshop has steps. The pattern has been made in Solidworks™ and separate experiments performed using bottom and top gate. Pattern is made in Solid works software and volume and surface area calculated there. Using standard mathematical routines, the experiment details are coded and calculations performed.

Three types of calculations performed are gates (bottom or top), sprue geometry effecting the design and number of risers needed. It was shown that the bottom gate is better as it avoid casting defects reducing effects of turbulent flow (not studied), but it is experimentally found to be best solution for casting using bottom gate. The sprue geometry of the parabolic best fit and mathematically solved for our case of figure and reduces aspiration. The last is the number of risers needed for such analysis. It is only one riser needed for such part.

Then DOE (Design of Experiment) was done to see the most contributing factors in casting design. The time for the bottom casting process is selected as this the major technique used in industry [6]. The number of variables in this routine is three and list of experiments performed are eight. The procedure is described in previous chapters and it is found that the interaction of  $ht$  and  $h_m$  is the most contributing in the overall design of the casting. This means that the designer has to focus on the geometrical details of the casting process. This is followed by  $h_m$  which is second contributing factor. The sprue diameter design 'd' are third contributing factors in our case. This 'd' is further used to design the casting diameter for our case and it helped to reduce the defects. A

mathematical model has been developed for the case specific model of the casting and in this process, contributing factors have been highlighted. The Pareto chart is used to analyze the process which can help to understand the significance of various factors in given scenario. It is recommended that for the sand casting of aluminum, focus should be on the mould, mould temperature, furnace temperature, temperature of the aluminum outside the furnace, using flux like  $CaCO_2$  in order to remove the thick cream on the aluminum. Use of parabolic sprue design is recommended in any casting type and number of risers depending upon the type of casting. The bottom gate is better option which improves the life of casted parts.

The future work include using die casting as available in our workshop, use of some other design of experimental method and comparing with this to improve process.

### Acknowledgement:

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## The Effect of Osteoporosis on Facial Dimensions and Indices

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**Abstract:** Osteoporosis is a common medical condition affecting over 5% of the population. It affects all bones, including those of the facial skeleton, which in turn might have an effect on facial dimensions and indices. We examined 196 healthy volunteer adults and 155 osteoporotic patients. Three longitudinal, transverse and diagonal measurements were taken and three indices were estimated. Osteoporosis was found to increased most of the dimensions in male and female patients. However, it decreases some parameters and indices that include upper facial length, total facial length, nasal width, upper facial index and prospective index. We also found that some of the studied parameters significantly changed in one gender, but did not change in the other. The parameters used in this study can be used as indicators of the effect of osteoporosis on facial dimensions. However, more studies are required to confirm the current findings considering the duration of the disease and the effect of treatment.

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**Key words:** Osteoporosis, Facial skeleton, Facial Indices

### 1. Introduction

Studying the morphology of the human face is one of the interesting fields of anthropometric research. It is a well-known fact that facial features differ among different races and ethnic groups [1]. Cephalometry is one of the important parts of anthropometry, in which the dimensions of the head and face are measured. There are several factors that affect facial parameters which include age and gender [2-5]. Cephalometric results are used in forensic medicine [3], plastic surgery [6], oral surgery [6] and dentistry [7].

Osteoporosis is a common medical condition affecting over 5% of the population [8] with a significant socioeconomic burden [9]. In 1994, the World Health Organization (WHO) published criteria for the diagnosis of osteoporosis based on bone mineral density (BMD) measurement at the spine, hip, or forearm with dual-energy X-ray absorptiometry (DEXA) [10]. With this classification, a patient with a BMD that is 2.5 SD or more below the mean BMD of a young-adult reference population (T score= -2.5 or less) has a diagnosis of osteoporosis. When the BMD is between 1.0 and 2.5 SD below that of the reference population (T-score= -1.0 to -2.5), the diagnosis is low bone mass (osteopenia), and when the BMD is 1.0 SD below the mean BMD of the reference population or greater (T-score= -1.0 or higher), the BMD is called normal. Patients with a fragility fracture are classified as osteoporotic (clinical diagnosis) regardless of T-score [11].

There is some evidence that radiological examination of the facial skeleton can be a cost-

effective adjunct to complement the early diagnosis and the follow up of osteoporosis [11]. Osteoporosis affects all bones, including those of the facial skeleton. It has been reported that patients with osteoporosis have hearing impairment and vertigo due to involvement of bones of the inner ear particularly in postmenopausal women [12-14]. Due to relatively high cost of DEXA, there have been some payment cuts for its use in osteoporosis diagnosis in the USA [15]. The case might be even worse in other countries with lower income. The current study prompts to establish a cheap method that can be used to diagnose osteoporosis by comparing the mean facial dimensions and indices of normal male and female adults with patients with confirmed osteoporosis who have no other medical conditions using WHO criteria for the diagnosis. Comparison of facial indices of the normal and osteoporotic patients may help in early diagnosis and follow up of the future complications of the disease.

### 2. Material and Methods:

In total, 196 healthy volunteer adults with an average age of 56 years (108 males and 88 females), and 155 patients with osteoporosis (T score= - 2.5 or less for at least 6 months) with an average age of 59 years (90 males and 65 females) participated in the study. The subjects are all native Egyptians, Resident in Mansoura, Egypt. All were otherwise healthy and selected randomly and showed no apparent facial deformities or scars.

The measurements were carried out using the method described by **Didia and Dapper** [16]. They were taken by the same physician using Martin spreading caliber. Each parameter was measured with



the subject sitting and the head unsupported and placed in anatomical position with facial muscles relaxed and mouth closed and breathing quietly.

- **Landmarks:** The landmarks used in the study are defined as follows (Figure 1):

1. **Nasion:** the point on the root of the nose where the mid-sagittal plane crosses the nasofrontal suture.
2. **Subnasale:** the point at which the nasal septum merges with the upper cutaneous lip in the mid-sagittal plane.
3. **Menton:** the lowest point on the lower border of the mandible in the mid-sagittal plane.
4. **Gonion:** the most lateral point on the mandibular angle identified by palpation.
5. **Zygon:** the most lateral point of the zygomatic arches.

- **Measurements:** The taken measurements (parameters) (Figure 2) were:

**A. Longitudinal:**

1. Upper facial (Nasal) length (UFL): Nasion to Subnasale.
2. Lower facial length (LFL): Subnasal to Menton.
3. Total facial length (TFL) : Measured from Nasion to the Menton.

**B. Transverse:**

1. Bizygomatic breadth (face width) (BB): Between the two Zygions.
2. Mandibular (bigonal) width (MB): between the 2 Gonions.
3. Nose Width (NB): Between the most lateral points on the wings (ala) of the nasal cartilage [17].

**C. Diagonal measurements:**

1. Gonion to Nasion (GN).
2. Gonion to Subnasale (GS).
3. Gonion to Menton (GM).

- **Indices:** The following indices were calculated from the above parameters as follows:

1. **The upper facial index (UFI):** the proportion of the UFL to the TFL. It was calculated as follows:  $UFI = UFL/TFL \times 100$
2. **The lower facial index (LFI):** the proportion of the LFL to the TFL. It was calculated as follows:  $LFI = LFL/TFL \times 100$
3. **The prospective index (PI):** It was calculated according to **Jahanshahi et al.** [17] as follows:  $PI = TFL/BB \times 100$

**Statistical Analysis:**

All data were analyzed using students't-test. P value  $\leq 0.05$  was considered statistically significant.

**3.Results:**

The results of the present study are shown in table 1 and figures 3,4. Table (1) shows the results of the t-test analysis in male and female volunteers

separately to compare all the studied parameters and indices in our control and patients volunteers. A general look at the results shows that male controls tend to have larger measurements than female controls. When comparing controls with patients, there is a general trend in the female patients to have larger measurements in all the parameters and indices that was statistically significant except in the "Gonion to Subnasale" parameter, and upper and lower facial indices. The least prominent difference was observed in the bizygomatic parameter.

In males, osteoporosis show variable effect on the parameters and indices. Similarly to female patients, osteoporosis increase all the parameters and indices except on upper facial length and its related parameters (nasal width, Gonion to nasion) and indices (upper facial index, prospective index) where osteoporosis decreases the measurements. These effects range from highly significant effect to non-significant effect (Gonion to Menton).

Additionally, apart from the nature of the effect (an increase or decrease), the extent of the effect of osteoporosis was variable when comparing male and female patients. For example, despite that bizygomatic breadth was the least affected parameter in female patients; it was one of the most affected parameters in male patients.

**4.Discussion:**

In the current study, we investigated the effect of osteoporosis on variable facial parameters and indices in the adults. The age range of this study (50-60 years) is significant since the facial growth changes are maximum below 17 years [19, 20] and the incidence of the disease is commonly above 50 years [21]. We found that the nature and extent of the effect of osteoporosis is variable within and between both genders. On analysis of the nature of mentioned changes, osteoporosis increases all facial dimensions in female patients to a variable extent. However, osteoporosis increases most of the dimensions in male patients and decreases some parameters and indices that include upper facial length, total facial length, nasal width, upper facial index and prospective index. Collectively, these parameters and indices may reflect an effect on the size of the nose.

It is difficult to explain why osteoporosis increases these dimensions in females while decrease them in males. This may be explained by the fact that postmenopausal osteoporosis is associated with sex hormone changes [11], Furthermore, we found that some of the studied parameters significantly change in one gender, but does not change in the other. This might be explained by difference in duration of the disease and the difference in medications used to manage it. However, some parameters have similar

nature of change that was statistically significant in both genders.

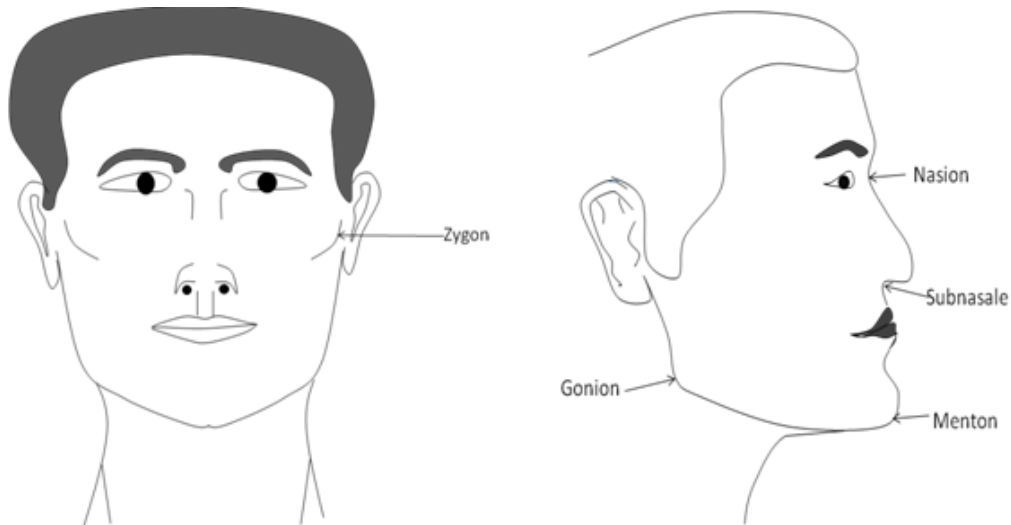
Therefore, these parameters can be used as indicators of the effect of osteoporosis on facial dimensions. However, more studies are required to confirm the current findings. We suggest that any future studies should take into consideration the duration of the diseases and the effect of the type of

treatment used to manage osteoporosis on facial dimensions.

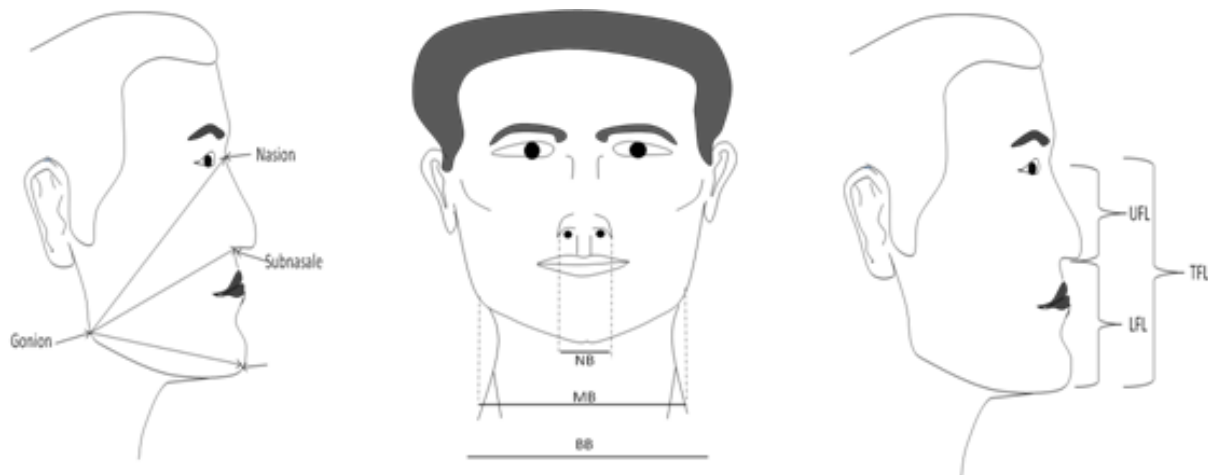
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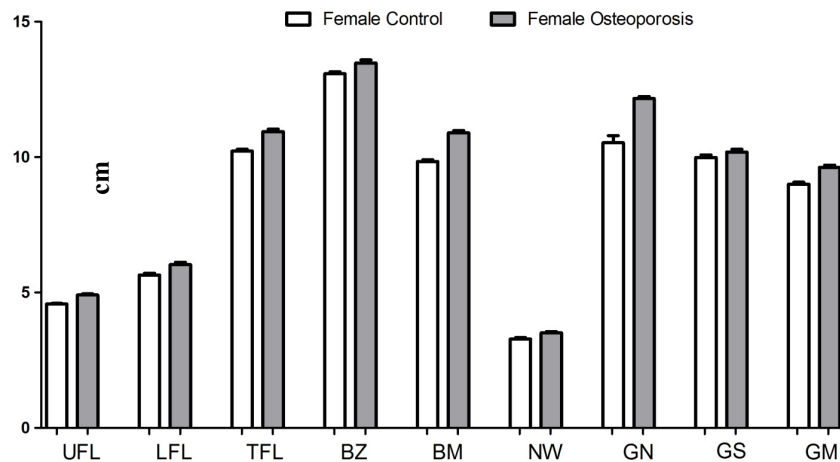
**Figure 1:** This figure shows the facial landmarks that were used in the current study.



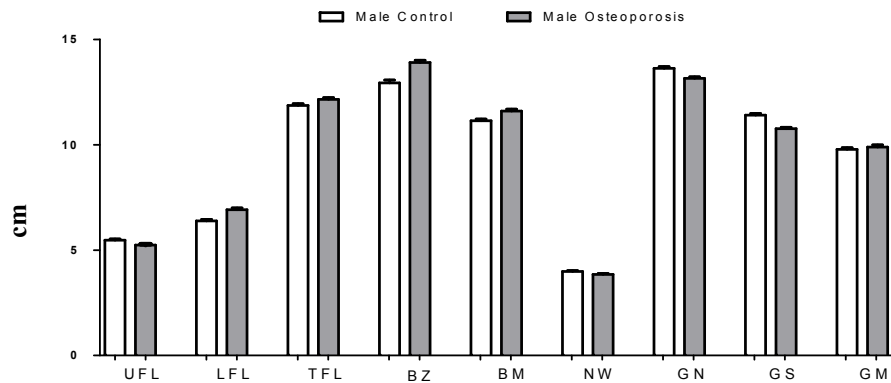
**Figure 2:** This figure shows the facial parameters that were used in the current study.

**Table 1:** This table shows the results of t-test analysis of all the parameters and indices which were used in the study. CTL= control (for males N=108, for females N=88), PT= patients (for males N=90, for females N=65), SEM= standard error of mean.

| Parameter or Index              |          | Male<br>(Mean±SEM) | P-value | Female<br>(Mean±SEM) | P-value |
|---------------------------------|----------|--------------------|---------|----------------------|---------|
| Upper Facial Length (cm)        | Control  | 5.47±0.05          | 0.001   | 4.58±0.02            | <0.0001 |
|                                 | Patients | 5.23±0.04          |         | 4.90±0.04            |         |
| Lower Facial Length (cm)        | Control  | 6.38±0.06          | <0.0001 | 5.64±0.06            | 0.0005  |
|                                 | Patients | 6.91±0.08          |         | 6.03±0.08            |         |
| Total Facial Length (cm)        | Control  | 11.86±0.08         | 0.01    | 10.23±0.06           | <0.0001 |
|                                 | Patients | 12.15±0.08         |         | 10.94±0.09           |         |
| Upper Facial Index (percentage) | Control  | 46.19±0.36         | <0.0001 | 44.95±0.37           | 0.97    |
|                                 | Patients | 43.20±0.40         |         | 44.97±0.45           |         |
| Lower Facial Index (percentage) | Control  | 53.81±0.36         | <0.0001 | 55.05±0.37           | 0.97    |
|                                 | Patients | 56.80±0.40         |         | 55.03±0.45           |         |
| Prospective Index (percentage)  | Control  | 92.86±1.10         | 0.001   | 78.25±0.37           | 0.001   |
|                                 | Patients | 87.94±0.97         |         | 81.68±1.10           |         |
| Bizygomatic Breadth (cm)        | Control  | 12.93±0.19         | <0.0001 | 13.08±0.07           | 0.002   |
|                                 | Patients | 13.90±0.10         |         | 13.48±0.11           |         |
| Bimandibular Breadth (cm)       | Control  | 11.14±0.07         | 0.0001  | 9.84±0.07            | <0.0001 |
|                                 | Patients | 11.60±0.08         |         | 10.90±0.09           |         |
| Nasal width (cm)                | Control  | 3.98±0.04          | 0.02    | 3.28±0.05            | 0.001   |
|                                 | Patients | 3.84±0.04          |         | 3.51±0.04            |         |
| Gonion to Nasion (cm)           | Control  | 13.63±0.08         | <0.0001 | 10.53±0.2            | <0.0001 |
|                                 | Patients | 13.15±0.07         |         | 12.17±0.07           |         |
| Gonion to Subnasale (cm)        | Control  | 11.40±0.07         | <0.0001 | 9.98±0.09            | 0.1     |
|                                 | Patients | 10.76±0.06         |         | 10.19±0.09           |         |
| Gonion to Menton (cm)           | Control  | 9.77±0.08          | 0.3     | 9.00±0.07            | <0.0001 |
|                                 | Patients | 9.88±0.1           |         | 9.62±0.08            |         |



**Figure 3:** This graph shows the measurement of variable parameters in female controls and patients. UFL=upper facial length, LFL=lower facial length, TFL=Total facial length, BZ=bizygomatic width, BM=bimandibular width, NW=nasal width, GN=Gonion to Nasion, GS=Gonion to Subnasale, GM=Gonion to Menton.



**Figure 4:** This graph shows the measurement of variable parameters in male controls and patients. UFL=upper facial length, LFL=lower facial length, TFL=Total facial length, BZ=bizygomatic width, BM=bimandibular width, NW=nasal width, GN=Gonion to Nasion, GS=Gonion to Subnasale, GM=Gonion to Menton.

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## The impact of Accounting Standards on Earnings Persistence: Evidence from Iran

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**Abstract:** In this research, we evaluated earnings persistence based on the accounting standards. Therefore, two time intervals were considered, a 5-year period (1996-2000) before the execution of accounting standards and a 5-year period (2001-2005) after the execution of accounting standards. To extract the necessary data, audited financial statements and existing software packages such as DENA SAHM and comprehensive stock exchange software packages were used. Research results show that accounting standards can affect earnings persistence.

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**Keywords:** Profit Quality, Earnings Persistence, Accounting Standards

### Introduction

Consecutive developments and rapid improvements occurring in the fields of activity and different types of economic units have intensified the necessity of preparation and supply of relevant and reliable information by economic units. One fundamental prerequisite for confidence of investors and creditors in the direction of productive economic activities and ultimately economic development is to provide information that may be useful in making financial, economic and business decisions.

On the other hand, the net profit reported by business units which is one of the items and elements of financial statements is used in several methods of performance evaluation and value determination of a company. For this reason, a better image of financial condition of unit performance will be achieved if financial reporting system can provide the quantitative and qualitative information required by financial analysts and other users of financial statements for evaluating the profit quality. One method for measuring profit quality is earnings persistence. Considering the fact that observance of accounting standards based on the previous studies can help in earnings persistence and quality, this question is raised that if observance of those standards in Iran can lead to the same result as well. In this research, we examine that if earnings persistence is influenced by the accounting standards.

### Literature review

In the study made by Chani et al. (2002) titled "A New Model for Public Financial Reporting", he provided some models for evaluating the financial condition of public organizations. He also believed that

there were several indexes for evaluating financial condition that can be used in the public sector. According to Chani et al., the only prerequisite for using those indexes is the availability of comparable information provided through the same methods. This may only be done through matching the accounting methods. One of the most efficient ways is to codify accounting standards.

Holtasen (2003) investigated and compared the quality of financial reports and accounting standards which are the basics for preparing financial statements. He then came to the conclusion that besides accounting standards, different motivations as well as influence of other organized elements will also affect the outputs of any accounting system and financial statement. Therefore, codification of accounting standards could not be considered as the only solution to improve the quality of financial statements in any economic sector.

In a study made by Wallas (2004) titled "Investigating the Role of International Board of Accounting Standards in Coordinating the Accounting and Auditing Standards of Public Sector And the Differences of These Standards with Accounting Procedures of Different Countries", he came to the conclusion that one might hope to witness in the future the coordination of accounting and auditing standards of public sector in most countries and even equalization of accounting procedures among economic and public sectors. The point that will hinder the achievement of this goal in a short term is the difference on financial tools in economic sectors and different countries.

### Domestic Studies

In his paper titled "The Responsibility to Codify Accounting Standards; Government or Public Sector", Bozorg Asl (2003) evaluated the necessity of accounting regulations and experiences of developed and developing countries. He then considered two options for codifying accounting standards, government and public sector.

In the study made by Kordestani (2004) titled "The Relation between Profit Quality and Market Reaction", he dealt with cash and unexpected profit changes in the companies of Tehran stock exchange market and evaluated profit quality based on earnings persistence, profit forecast capability and the relation of profit and operational cash flow using regression models. He showed that:

1. Considering profit quality based on the earnings persistence, profit forecast capability and the relation between operational cash flow and profit elements, there was no significant relation between profit quality and market reaction to cash profit.
2. Considering profit quality based on the profit forecast capability, the relation between operational cash flow and profit and the relation between operational cash flow and profit elements, there is no significant relation between profit quality and market reaction to profit increase.
3. Considering profit quality based on the earnings persistence, profit forecast capability and the relation between operational cash flow and profit elements, there is no significant relation between profit quality and market reaction to cash profit.
4. Considering profit quality based on the earnings persistence, profit forecast capability, the relation between operational cash flow and profit and the relation between operational cash flow and profit elements, there is no significant relation between profit quality and market reaction to unexpected profit changes.

In a study made by Noravesh et al. titled "Investigating the Relation of Undertaken Items Estimation Error and the Quality of Undertaken Items and Profit Quality (Earnings Persistence)", he concluded that there was a positive relation between the quality of undertaken items and profit quality. In another study made by Shourvarzi et al. (2008) titled "Stability of Profit Cash Elements", he came to the conclusion that the division of cash profit was the promising of stability or profit continuation in the next years.

#### Foreign Studies

Some of the researchers (Lipe, 1990) consider forecast capability specifically as the capability of previous profits to forecast future profits. Therefore,

$$EARN_t = \theta_0 + \theta_1 ME_t + \theta_2 EARN_{t-1} + \theta_3 STANDARD + \theta_4 EARN_{t-1} \times STANDARD + \theta_5 MB_t \times EARN_{t-1}$$

such forecast capability is related to the decrease of profit change deviations. In the study made by Chani et al. (2002) titled "A New Model for Public Financial Reporting", he provided some models for evaluating the financial condition of public organizations. He also believed that there were several indexes for evaluating financial condition that can be used in the public sector. According to Chani et al., the only prerequisite for using those indexes is the availability of comparable information provided through the same methods. This may only be done through matching the accounting methods. One of the most efficient ways is to codify accounting standards. High quality profit provides the ground for optimal allocation of resources as it helps policy makers to decide on the allocation manner of financial and human resources for economic development by providing financial information with actual value. In a study by Ricol (2004) and Richardson et al. (2005) titled "Investigating the Relation between Reliability of Undertaken Items, Earnings Persistence and Share Prices", they developed Oslavan's work (1996) and removed its disadvantages.

#### Research Method

Since this research is of correlation researches type, regression analysis is used to test the model. In regression analysis, the goal is to forecast the changes of one or more than one dependent variables by considering the changes of independent variables. Furthermore, since we want to evaluate earnings persistence based on accounting standards, two time intervals will be taken into consideration, a 5-year period (1996-2000) before the execution of accounting standards and a 5-year period (2001-2005) after the execution of accounting standards. To extract necessary data, audited financial statements and existing software packages such as DENA SAHM and comprehensive stock exchange software packages were used.

#### Research Method

In this research, correlation research method is used and the relation between dependent and independent variables is investigated using statistical methods such as regression and correlation test. On the other hand, this research uses previous data. Statistical society of this research includes the companies working in the stock exchange within 2006 to 2005. In this research, 6300 data were extracted by using Tadbir Pardaz software packages and the compressed files of stock exchange organization. Considering the model used to evaluate earnings persistence, research necessary data is as follows:

Where, *EARN* is the profit before unexpected items which is measured through dividing by average assets due to the effects of companies sizes. It was extracted by using the profit and loss statement of company.

*MV* is the market value of each share which was extracted by using explanatory notes of company's financial statements. *BV* is the book value

of each share which was extracted by using explanatory notes of company's financial statements. *MV/BV* is the ratio or market value to the book value of company shares and is used to identify the companies with a high growth.

**Results**

Table 5 shows the relation between the profits before unexpected items within 2 consecutive years.

**Table 1. The Relation between the Profits before Unexpected Items within 2 Consecutive Years**

| Regression Statistics              |          |                    |               |                      |       |
|------------------------------------|----------|--------------------|---------------|----------------------|-------|
| Correlation Coefficient            |          | 0/914              |               |                      |       |
| Determination coefficient          |          | 0/836              |               |                      |       |
| Modified determination coefficient |          | 0/836              |               |                      |       |
| Standard Error                     |          | 0/583              |               |                      |       |
| No. of Observations                |          | 1124               |               |                      |       |
| Variance Analysis                  |          |                    |               |                      |       |
| P_value                            | F_value  | Average Squares    | Total Squares | Freedom Degree       |       |
| 0.0000                             | 5724.265 | 1944.095           | 1944.095      | 1                    | Model |
|                                    |          | 0.340              | 381.58        | 1122                 | Error |
|                                    |          |                    | 2325.153      | 1123                 | Total |
| Estimation of Parameters           |          |                    |               |                      |       |
| P_value                            | T_value  | Standard Deviation | Estimation    |                      |       |
| 0.000                              | 9.579    | 0.042              | 0.405         | Fixed                |       |
| 0.000                              | 75.659   | 0.013              | 0.948         | Profit of the Year T |       |

Based on the above model, it can be seen that profit is increasing each year and that the profit

of each year is determined by the profit of the previous year up to 84%.

**Table 2. Regression between the profits before unexpected items within 2 consecutive years**

| Determination coefficient | P_value | F_value | Probability level | Coefficient |                       | Year |
|---------------------------|---------|---------|-------------------|-------------|-----------------------|------|
| 0.882                     | 0.000   | 927.544 | 0.000             | 0.388       | Year                  | 1997 |
|                           |         |         | 0.000             | 0.962       | Profit of the Year t1 |      |
| 0.840                     | 0.000   | 649.660 | 0.000             | 0.669       | Fixed                 | 1998 |
|                           |         |         | 0.000             | 0.865       | Profit of the Year t1 |      |
| 0.772                     | 0.000   | 419.698 | 0.031             | 0.303       | Fixed                 | 1999 |
|                           |         |         | 0.000             | 0.930       | Profit of the Year t1 |      |
| 0.808                     | 0.000   | 520.518 | 0.005             | 0.366       | Fixed                 | 2000 |
|                           |         |         | 0.000             | 0.926       | Profit of the Year t1 |      |
| 0.798                     | 0.000   | 486.746 | 0.038             | 0.299       | Fixed                 | 2001 |
|                           |         |         | 0.000             | 0.944       | Profit of the Year t1 |      |
| 0.806                     | 0.000   | 512.029 | 0.008             | 0.398       | Fixed                 | 2002 |
|                           |         |         | 0.000             | 0.954       | Profit of the Year t1 |      |
| 0.860                     | 0.000   | 748.114 | 0.000             | 0.551       | Fixed                 | 2003 |
|                           |         |         | 0.000             | 0.884       | Profit of the Year t1 |      |
| 0.774                     | 0.000   | 411.223 | 0.000             | 0.696       | Fixed                 | 2004 |
|                           |         |         | 0.000             | 0.871       | Profit of the Year t1 |      |
| 0.863                     | 0.000   | 765.942 | 0.003             | 0.458       | Fixed                 | 2005 |
|                           |         |         | 0.000             | 1.030       | Profit of the Year t1 |      |

Based on the above table, each year it explains the levels of the next year, but the least explanation level has occurred in 1999 and 2004 and

about 77% of profit level of each year has been explained by the profit of the previous year. But for the year 1997, we witness an 88% determination

coefficient which has been considered as an appropriate model for these years.

Finally, they are omitted from the model based on standardization table and the following model is obtained.

Table 3. Regression after omitting additional variables from the model

| Regression statistics              |          |                    |                |               |       |
|------------------------------------|----------|--------------------|----------------|---------------|-------|
| Correlation coefficient            |          | 0.917              |                |               |       |
| Determination coefficient          |          | 0.841              |                |               |       |
| Modified determination coefficient |          | 0.841              |                |               |       |
| No. of observations                |          | 1260               |                |               |       |
| Variance analysis                  |          |                    |                |               |       |
| P_value                            | F_value  | Average squares    | Freedom degree | Total squares |       |
| 0.000                              | 1977.582 | 654.745            | 3              | 1964.234      | Model |
|                                    |          | 0.331              | 1121           | 654.745       | Error |
|                                    |          |                    | 1125           | 2618.967      | Total |
| Estimation of parameters           |          |                    |                |               |       |
| P value                            | T value  | Standard deviation | Estimation     |               |       |
| 0.000                              | 11.159   | 0.045              | 0.504          | Intercept     |       |
| 0.000                              | -4.500   | 0.002              | -0.011         | MB            |       |
| 0.000                              | 69.069   | 0.013              | 0.923          | EARN          |       |
| 0.000                              | -3.494   | 0.006              | -0.020         | STANDARD*EARN |       |

The above model is statistically significant and expresses 84% of the profit levels. But before any conclusion based on the model, we must see if the above model is an appropriate model.

#### Investigating the Appropriateness of the Model

The following diagrams confirm relative normality of data and stability based on estimations diagram against residual is fixed variance.  $C-V=1.622$  expresses non-correlation of residual. Therefore, the estimated model is an appropriate model.

On this basis, a model can be written as follows:

Logarithm of the next year profit =  $0.504 - 0.011 X$  Ratio of market value to book value of each share +  $0.923 X$  year profit logarithm –  $0.020 X$  standard year  $X$  year profit logarithm

The above model may be rewritten as follows:

Next year profit logarithm (for the standard year) = year profit log.  $x 0.903 +$  ratio of market value to the book value of each share  $x 0.011 - 0.504$

Next year profit logarithm (for the nonstandard year) = year profit log.  $x 0.923 +$  ratio of market value to the book value of each share  $x 0.011 - 0.504$

In this model, in case of using accounting standards, changing each unit in the current year profit to a level of 0.903 will affect the profit of the next year and in case of not using accounting standards, changing each unit in the current year profit to a level of 0.923 will affect the profit of the next year.

On this basis, observance of Iranian standards will have a negative effect on the profit. Based on probability level and its comparison with significance level, it can be said that the assumption Zero or the assumption that accounting standards do not have any effect on earnings persistence will be rejected at a level of 5% and it can be accepted with a 95% confidence that **Accounting Standards Affect on the Earnings Persistence.**

#### Summary & Conclusion

The following hypothesis was tested in this study: Accounting standards affect earnings persistence.

To evaluate this hypothesis, earnings persistence was investigated by considering the relation between the profit of each year and the profit of the next year.

Considering the tests performed, it can be said that assumption Zero or the assumption that accounting standards do not have any effect on earnings persistence will be rejected at a level of 5% and it can be accepted with a 95% confidence that accounting standards affect on the earnings persistence. Furthermore, considering the evaluations made during 1996 to 2000 and 2001 to 2005, it was specified that the profit of companies in the first interval, i.e., when financial statements had not been prepared based on accounting standards, was more stable.



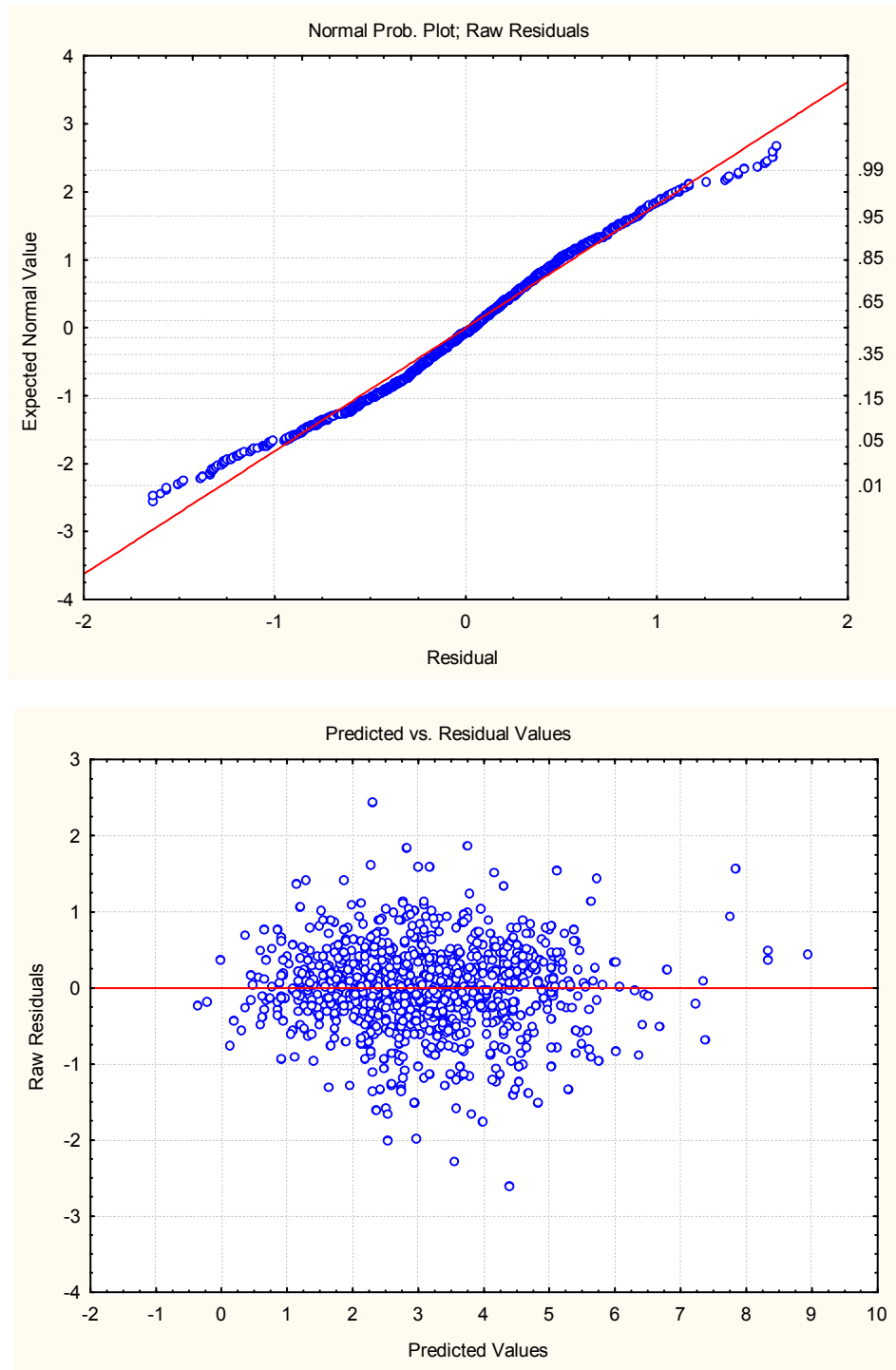


Diagram 10. Diagram of estimations vs. residuals for investigating variance stability

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**Iranian Nursing Students' Experiences and Viewpoints of Clinical Evaluation: a qualitative study**Mehrnosh Pazargadi<sup>1</sup>, Tahereh Ashktorab<sup>2</sup>, Sharareh Khosravi<sup>3</sup>, Safar Ali Esmaili Vardanjani<sup>4</sup>

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**Abstract:** Nursing students' clinical evaluation is an important subject in nursing clinical education. Some studies mentioned issues in nursing students' clinical evaluation that manifest in students' complaints and frequent meetings between students and instructors to discuss some problems in this area. Despite some efforts, this subject is still a major challenge for all people involved. So we need to know much more about it, especially from the view of nursing students because they are the one who are evaluated and are at the center of the experience. The aim of this study is determining nursing students' experiences and perspective about their clinical evaluation. This is a descriptive qualitative study. Participants were selected in nursing and midwifery schools of 3 medical Universities, involving baccalaureate nursing students in 3<sup>rd</sup> and 4<sup>th</sup> year of nursing education. Sampling method was purposive and was continued to the point of data saturation. Totally 40 students participated in 6 focus groups. Content analysis was applied to analyze the data. During analysis 4 themes and 10 subthemes were emerged including evaluators' issues (professional characteristics of educator, self-evaluation, clinical nurses), evaluation necessities (tool proficiency, practical evaluation), evaluation process (goal-oriented evaluation, evaluation time and type) and emotional environment of evaluation (relationship, confidence). Results showed many challenges nursing students confronted in clinical evaluation. They said they have issues with people participated in evaluation and their way of participation, strategies and methods used in evaluation, clinical evaluation planning and emotional environment in evaluation; which influence their clinical evaluation. It seems; considering the mentioned issues, clinical evaluation process needs an overall revise in order to correctly assess students' progress toward clinical learning objectives so facilitate the development of students into safe, ethical and accountable practitioners.

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**Keywords:** Iranian Nursing Students; Experiences; Viewpoint; Clinical Evaluation; qualitative study

**1. Introduction**

Nursing education contains two processes; theoretical and practical. Clinical education is the most significant and an undividable part of nursing education, which can be considered as the heart of professional education. In clinical education the knowledge will come into practice, skills are taught and existing realities can be understood. Nursing education programmers consider clinical education as the most important part of nursing education. They believe, in clinical education, nursing students can improve their theoretical knowledge by working in real clinical conditions and facing various circumstances and difficulties (McCarthy & Murphy, 2008; Elcigil & Sari, 2007).

Evaluation is a basic part of clinical education (Gaberson & Oermann, 2007; Shokati et al., 2012). Assessing clinical performance prepares the data for a better judgment in nursing students'

access to the clinical learning outcomes and their skills related to patient care standards. The final outcome in clinical evaluation is assurance of high quality and safe care of patients (Billings & Halstead, 2009). Some important subjects should be considered in clinical evaluations; students should apply critical thinking in clinical conditions, they should behave and cooperate properly and prioritize the problems, they should have required knowledge of clinical methods and must perform patient care properly (Duers & Brown, 2009). Another important point is that nursing students deserve applying a valid and reliable evaluation in order to observe the presence of needed abilities of a novice nurse (Billings & Halstead, 2009).

There are many issues in assessing clinical nursing skills that refer to the existence of various difficulties in this field (Coates & Chambers, 1992). Inconsistency of applied tools, disagreements in

evaluation process by clinical educators and lack of a proper framework for showing the students' progress are some instances of discussed problems. Most nursing students believe that clinical evaluation cannot distinguish the level of their theoretical and practical knowledge. Some of them think that evaluation tools ignore the students' skills. On the other hand, some studies represented the educator's evaluation as one of the most important experienced problems in clinical educators. Current problems in clinical evaluation lead to some complaints by nursing students, reported arguments in clinical evaluation and numerous meetings among the students and nursing educators in order to talk about such problems (Elcigil & Sari, 2007; Gaberson & Oermann, 2007; Bourbonnais et al, 2008; Wood, 1986; Sheikholeslami et al., 2012).

The researchers have seen the students' dissatisfactions due to their clinical evaluations as well. After announcing the results of clinical evaluation, many students complain about the evaluations scores. Regardless of all attempts, the clinical evaluation challenges still continue. As a whole, some issues like students' repetitive objections, existing problems in current methods, and inconsistency of clinical evaluations are the main requirements of doing new researches in this field in order to achieve more recent information. Since nursing students are under evaluation and are at the center of the experience, it is required to pay more attention to their experiences and viewpoints.

The qualitative method was applied in this research, because the researchers wanted to know about students' experiences and viewpoints of clinical evaluation in their own words. The qualitative research is a valuable conceptual approach to describe the life experiences. It is said that the data obtained in a qualitative study are conceptual and are formed according to the participants' concepts and views (Streubert Speziale & Carpenter Rinaldi, 2007).

In this research, nursing students' clinical evaluation is determined on the basis of their own experiences and viewpoints.

## 2. Material and Methods

This research is a qualitative descriptive study. Some qualitative studies claim no particular disciplinary or methodological roots. Such studies prepare a short comprehensive description of an incident or event. It is suggested that the qualitative descriptive method is a preferable method whenever a direct description of an incident is required (Polit & Tatano Beck, 2010).

Nursing students of nursing and midwifery schools of 3 medical sciences Universities formed the

study population. Sampling was purposive and continued to the point of data saturation (Streubert Speziale & Carpenter Rinaldi, 2007). The chosen students were in the 3<sup>rd</sup> and 4<sup>th</sup> year of nursing education in order to be experienced enough in being evaluated.

Data was gathered through semi structured focus group interviews using interview guide, sound recording and taking field notes. Focus groups were held, while one of the researchers worked as a guide and another one as an observer and note taker. This method was chosen because of obtaining proper data by the cooperation of participants. While being in the group, the students talk more comfortable and easier about the subject. On the other hand, the accuracy and precision of gathered data was emphasized by completing each others' statements. It is said that the group dynamic can persuade people to participate more effectively in the interview (Halcomb et al, 2007; Wong, 2008).

The students' experience was the center of the questions of interview guide. Firstly, a general question was asked; "What are your experiences of being evaluated", then some detailed questions were asked in order to clear all vague part of students' statements, including "What is your experience of a good evaluation?", "Have you experienced an evaluation by someone except for the educator?" and "How do you judge the applied evaluation methods during the clinical education?".

To hold the focus group meetings, participants were selected among volunteer students. The students' spare time was chosen to do the interviews. Interviews were held in a class at school. Totally 6 focus groups were performed and the interviews lasted 60 to 75 minutes on average. After each focus group, as soon as possible, the recorded data was listened over and over, and then the interviews were transcribed verbatim and compared to the main records again. It was done for increasing the accuracy and precision of the data.

Latent content analysis was applied to analyze the data. In this method, the researcher plays the role of an interpreter, who reviewed the data for finding its meaningful parts, then codifies, classifies and organizes them. This process continues in order to connect the meaningful patterns and structures. At this point, the meaningful units were distinguished first. Then the relevant codes were extracted and put into subgroups according to their similarities. The subgroups turned into the groups and finally, the themes were determined (Polit & Tatano Beck, 2010; Graneheim & Lundman, 2004).

Trustworthiness of findings was examined via the credibility, dependability, conformability and transferability. Constant involvement with research

subject was considered. Interviews scripts, extracted codes and some subgroups were discussed with participants and qualitative research experts, and their opinions were considered. A combination of data collecting methods was used (group interviews and field notes). Also various participants were selected among students of the 3<sup>rd</sup> and 4<sup>th</sup> years from different schools. All accomplished activities, were recorded precisely. On the other hand, all obtained data were approved by 4 other students out of the study, having approximately the same condition as the participants (Streubert Speziale & Carpenter Rinaldi, 2007; Halcomb et al, 2007; Boswell & Cannon, 2007).

Considering the ethical issues, the study was approved by ethical committee of medical sciences Universities. After offering the required information about the research goal and methods to the selected students, a written consent form was filled by all participants. They were assured that their information will be kept as a secret. Also they were told that they can leave the study whenever they want. All actions, i.e. recording the voice, were take place by the participants' permission. All needed steps, including proper archiving of written or recorded documents, were considered to keep the data as a secret.

### 3. Results

The participants expressed their own experiences about the challenges in clinical evaluation. 4 themes and 10 subthemes were emerged through analyzing the data. The emerged themes and subthemes included the evaluators' issues (professional characteristics of educator, self-evaluation, clinical nurses), evaluation necessities (tool proficiency, practical evaluation), evaluation process (goal-oriented evaluation, evaluation time and type) and emotional environment of evaluation (relationship, confidence).

#### Theme 1. Evaluators' issues

##### - Professional characteristics of educator

According to students, the educator's role is the most important one in clinical evaluation. They claimed that the educator should possess all required skills and information related to clinical education and the ward, in order to be a proper role model for the students who want to learn the clinical skills and must be evaluated by the educator. One of the students mentioned:

"First the teacher should teach us the correct form of the work, and then asks for a proper performance."

The students also believed that the experience and expertise of the educator should conform to the clinical education and ward. According to their idea, lack of such a concordance has been the origin of many difficulties. On the other hand, constant presence and participation of the educator in the ward

and proper acquaintance of students were other emphatic factors in their opinions. One of them mentioned the importance of educator's presence as follow:

"Sometimes we did our best during the teacher's absence, but our grades have been in a way as we haven't done anything at all."

Another student explained his satisfactory experience as follow:

"One of the teachers knew all students well, worked with them and guided them. After the evaluation, our grades were less than what we expected but it didn't bother us."

The students believed that the concordance in educators' work is one of the necessities in clinical education and evaluation. Dissatisfaction of a student is obvious in her statement:

"A teacher focuses on theoretical aspects, while the other one on simple practical works ... their performance is not compatible."

Another student referred to the level of strictness among different educators:

"We are classified during the clinical education. An educator is easygoing, while another is not ... I mean different grades for the same performance, due to different observers only."

Honest grading and evaluation by the educators was pointed out by the students repeatedly. They complained about dishonest scoring. One of the students analyzed it interestingly:

"One of the aims of evaluation is to persuade the unskillful and encourage the clever student. But getting the same grades would discourage all students. 16.5 or 17 don't differ."

##### - Self-Evaluation

In this aspect, the students claimed that they filled their evaluation forms, but they doubted its effect on their scores. One of the students said:

"Some teachers ask us to grade ourselves, however they pay no attention to the scoring."

##### - Clinical nurses

The students claim that if the clinical nurses want to take apart in education and evaluation, they should possess the needed skills and be aware of the students' clinical objectives in order to harmonize their expectations.

About the necessity of nurses' awareness, one of the students said:

"I think if anyone else except for the educators wants to take part in the process, he/she should know that what's the reason of students' presence in the ward ... then ask for their help."

Another student referred to necessity of nurses' abilities:

"The clinical nurse should have enough information and know how to work with the students as well ... in

this case it's fair to want their opinion about the evaluation".

### **Theme 2. Evaluation Necessities**

#### - Tools proficiency

Some students claimed that they have seen their evaluation forms at the beginning of their clinical course, but these forms played no role in their scores: "Evaluation forms are not considered important enough, finally most students get almost the same grades."

There were some other problems which were referred to by the students including incomplete forms, focusing on unimportant issues, having non-specific items, existence of unpractical items and not performing all mentioned items in evaluation form.

#### - Practical evaluation

The importance of practicality in evaluation was emphasized by the students, but they claimed that it had been ignored. According to the students, written homework was focused a lot, although it played no role in their clinical learning. Inefficiency of ward conferences was mentioned as well. The students believed that only the theoretical contents of the classes were repeated in such conferences. In order to solve this problem, some solutions were offered:

"Practical aspects should be covered during ward conferences because in the future we are going to work there in the future, and I think practical activities are more useful than theoretical ones."

They agreed with offering case presentations in clinical courses and emphasized the necessity of patient education and nursing rounds during the clinical education. They also complained that their final examinations were based on written exams, and mostly their practical performance was ignored:

"Unfortunately, the final written exam is the most important part of our evaluation at the end of the course."

### **Theme 3. Evaluation Process**

#### - Goal-oriented evaluation

The students claimed that they received the objectives, lesson plans and evaluation forms at the first day of clinical course, but they doubted about achieving the mentioned goals at the end of the course. One of the students mentioned.

"At first we receive a paper containing the goals, but during the clinical course there are not considerable changes in us and we usually don't follow those goals."

Another participant said:

"... They must consider our changes based on the goals in order to honest scoring, but a few teachers pay enough attention to these goals".

#### - Clarity of evaluation method

Considering the method and its clarity has been another important discussion among the students:

"... for example, I'm sure that I've done my best to do whatever the teacher asked, but my evaluation scores disagree this fact."

The students' confusion is obvious in this field:

"Eventually, we didn't get what the evaluation criteria are, and where our scores come from!!!"

#### - Time and type of evaluation

Some students emphasized on the necessity of ongoing evaluation during clinical education and final evaluation immediately at the end of the internship.

One of them complained about consequences of having no proper ongoing (formative) evaluation: "... but we were evaluated at the end of clinical course, either good or bad, there is no chance to change the problematic issues."

Another student who was satisfied with an educator's evaluation method stated: "... although this educator evaluated us at the end of our clinical course, she mentioned our strengths or weaknesses at the end of each week".

Regarding problems in summative evaluation one of the students claimed:

"A problem of final evaluation is that some educators tend to grade the students even one to two months after the clinical course. The educator should have done it at the last day of the course. Otherwise he/she may forget some important points of students' performances."

### **Theme 4. Emotional environment**

#### - Relationships

Relationships and behaviors of people toward the student in the ward and its effects on the evaluation were emphasized by the students over and over.

One of them described the crucial role of the educator as follow:

"Other peoples' behaviors toward the students depend on the student- educator relationship. How the educator introduces us is very important".

The clinical nurses' behavior was also mentioned by the students. According to them, proper behavior of clinical nurses leads to a better atmosphere to promote the learning and better evaluation. Most students complained about the lack of such an atmosphere though.

#### - Confidence

Necessity of considering the students' emotional condition and confidence was another discussed issue. Students believed that the educator's support is an important factor in this field.

The lack of such an atmosphere was explained as follow by a student:

"Nobody thanks us, not even once. All teachers are looking for a shortcoming in our performance. This stressful condition bothers us so much."

On the other hand, educator's confidence, responsibility and enthusiasm were focused as well. One of the students mentioned:

"I think teachers play the main role. If the teacher has no motive or incentive, the students will be the same."

Another student, who had worked with an enthusiastic educator, said:

"... Believe it or not, the educator did all nursing works so enthusiastically that it persuaded us to do the same."

#### 4. Discussions

Four themes including the evaluators' issues, evaluation necessities, evaluation process and emotional environment, were the obtained results of this study. These findings contain important points, which refer to students' attention to the clinical evaluation process.

According to the students, an educator should possess the knowledge, skill, recognition, constant presence, participation and consistency in working with students and being honest in scoring. However most of them complained about the lack of such circumstances. Some authors emphasized on the role of an educator as an evaluator in clinical courses and mentioned it as a difficult and challenging responsibility (Dolan, 2003). In a study performed by Viverais-Dresler and Kutschke (2001), students focused on the educators' efficiency and knowledge in clinical education and they wanted to work with skillful and experienced educators. In another study, the students emphasized on the availability of the educator as the most important factor in their clinical education/evaluation (Elcigil & Sari 2007). Meskell et al. (2009) have focused on the educators' participation in clinical circumstances in order to keep their own skills, and also on the importance of practical part of an educator's role. Another important subject mentioned by students in a study was that different educators had different expectations and criteria which adversely affected their learning (Elcigil & Sari 2007). Although conformity, stability and honesty should be considered in evaluations, the challenge of objective evaluation in which educators' personal viewpoint effects students' evaluation, is still a major problem (McCutchan, 2010; While, 1991).

Students, as those who are evaluated, should play an active role in their own evaluation. If it happens properly, they will know what they are expected to do, so they can recognize their strengths and weaknesses. In the present study, students claimed that their role has been ignored. However in a study it was cleared that there was no significant difference between the self- evaluation and the

educators' evaluation scores (Wiledman, 1989) which shows the students' ability in doing an honest self- evaluation. Also Belar et al. (2001) believe that self- evaluation is a proper method to determine students' clinical knowledge and skills, and the learner is a good source of information for his/her evaluation.

To play their role properly, clinical nurses must have necessary competencies in nursing students' education/evaluation and must be familiar with the clinical course objectives and students' responsibilities in the ward. Some authors recommend that clinical nurses must have enough and proper resources to perform their educational role (Lillibridge, 2007). On the other hand, students' supervision by clinical nurses is difficult due to the time limitation, nurses' responsibilities in the ward and also their low educational skills (Drennan, 2002), but at the same time educators said that clinical associates provide the opportunity for observing more students at the same time (Shofer et al, 1996).

Various methods should be applied in clinical evaluation. Studies emphasized on considering proper assessment tools along with other activities performed by the students (While 1991). Using assessment tools, written assignments, case presentations, ward conferences and ward exams were discussed by participants in the present study. It seems that students were aware of shortcomings of the tools. Paying little attention to assessment tools, using incomplete tools and existence of impractical items in the tools were considered by the students. There are studies regarding assessment tools. Walsh et al. (2010) said that in students' clinical evaluation, using an efficient tool is necessary, a vivid and clear tool to evaluate students' performances properly. However some authors believed that assessment tools generally have not the necessary consistency (Bourbonnais et al, 2008; Calman et al, 2002). McCutchan (2010) has mentioned the ambiguity of evaluation tools as well, and emphasized on the need for more researches in this area.

Participants also were concerned of the theoretical trend in clinical evaluation. Inefficiency of assignments and taking theoretical exams in the clinical course were mentioned challenges in this area. Practical assignments, applying theoretical knowledge in practice, case presentations, nursing rounds and taking practical and applicable exams were desired requests of the students in the present study, while believed that evaluating the behavioral skills via written examinations and oral interviews is a poor method (McCutchan, 2010).

Clinical objectives, education/evaluation methods and providing feedbacks are among various factors affecting clinical evaluation. Participants

believed that there was not enough attention to clinical objectives and also to the methods of achieving them. Lack of clarity in evaluation methods was another issue discussed by the students. They also emphasized on the necessity of proper ongoing evaluation (formative evaluation) through the clinical course and on time and correct final evaluation (summative evaluation). The importance of assessing the students' achievements based on clinical course objectives during clinical evaluation is emphasized by some authors (While, 1991). In a research, students complained that they are not sufficiently guided by their educators during their clinical work (Elcigil & Sari, 2007). The necessity of formative and summative evaluation is emphasized. It is said that the goal of a formative evaluation is clarifying the problems during the learning process, but the main elements of the students' performance will be considered for final scoring (summative evaluation) (McCutchan, 2010).

Others relationship and behavior specially the educators and clinical nurses, the necessity of considering the students' confidence, supporting and encouraging them and its impact on students' learning and evaluation were some of the repeated points mentioned by the students, it was obvious that they were dissatisfied regarding this important subject. Lee et al. (2002) said that a good relationship with the student is the most significant characteristics of a clinical educator. Elsigill and Sarry (2007) believed that existence of a good relationship between the educator and students is effective in the success of students' clinical performance. Also it is said that relationship problems, including tensions and educator's ignorance, decrease the students' interest. This condition may be continued to the point in which the student feels insecure and threatened (McCutchan, 2010). Students generally believed that positive feedbacks increase their confidence (Lo'fmark & Wikblad, 2001) and a supportive relationship is an important aspect of nursing education (McCutchan 2010). Assessing nursing students' proficiency and motivating them to learn better in a positive environment have been considered by many researchers (McCutchan 2010).

### Conclusion

The results of this study clarify various challenges of clinical evaluation in the view of nursing students. Results showed different factors affecting clinical evaluation. The students focused on the role of the people in clinical evaluation, different methods in clinical evaluation, the evaluation process, emotional environment and relationships in evaluation.

It seems; considering the mentioned issues, clinical evaluation process needs to be revised in

order to correctly assess students' progress toward clinical learning objectives so facilitate the development of students into safe, ethical and accountable practitioners.

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