**Study of the predictive factors of body mass index in a group of Iranian undergraduate students**

Hakimeh S. Sajjadi [1], Ali Akbar Shaikhi Fini [2], Mitra Yousefzadeh [2], Abdolvahab S. Samavi [2]

[1.] Hormozgan University of Medical Sciences, Ostandari Blvd, Bandar Abbas, Iran
[2.] University of Hormozgan, Minab Street, Bandar Abbas, Iran
hakimeh.sajjadi@yahoo.com

**Abstract**: As part of research, predictive factors of body mass index (BMI) such as nutritional behavior (NB), nutritional knowledge (NK), attitude toward nutrition (ATN), physical exercise (PE) and demographic variables of age and gender among undergraduate students (US) of hormozgan university, Iran were studied, in a correlation trial. Two hundred seventy five US (137 boys and 138 girls) were randomly selected, responded to the study questionnaire and then weighed as the height was measured using a standard protocol in order to calculate BMI. Predictor factors such as NB, NK, ATN and PE were significantly positive for the normal BMI while age and gender were not positively predicted the normal BMI. Among the predicted variables, NB and PE had more important roles for explain the normal body mass index variance. It is concluded that, nutritional behavior and physical exercise could be an applicable approach for predict the health status of students.

**Keywords:** undergraduate students; BMI; nutritional behavior and knowledge; attitude towards nutrition; physical exercise

## 1.    Introduction

Wrong nutritional trends and the related disorders in advanced countries are increasing considerably (Mokdad et al., 2000), even some of scientific communities called it as epidemiology (WHO, 2006). Until most recently the importance of obesity and overweight among children had not been emphasized enough. It is estimated that, there are a total of 155 million overweight children and around 30-45 million are classified as obese (Azizi et al., 2001a). Much concern is being expressed both about the early consequences and lifetime effects of obesity in both children and adolescents. In Iran, obesity and overweight are under investigations. Overweight and obesity are caused by an imbalance between physical activity and nutritional intake. According to the obtained results, 18% of teenagers in Tehran were suffered from overweight and obesity (Azizi et al., 2001a). Another study reported that 12-18% of teenagers (11-19 years old) were suffered from cardiovascular risks like high bad cholesterol or LDL-C (low density lipoprotein cholesterol) and those aged >6-12 years had high triglycerides and low good cholesterol or HDL-C (high density lipoprotein cholesterol) (Azizi et al., 2001b).

The researchers were focused on behavioral and cognitive subjects linked to psychological - physical pathologies. Cox et al. (2006) referred to some problems as emotional failures, alcoholism, smoking, illegal drugs and eating disorders and reported that it seems that relationship between behaviors and nutrition are more complex than smoking and drinking alcohol, so that quantitative indices can used easily to assess alcohol and Psychoactive drugs but nutritional behaviors are more complex and multidimensional in terms of evaluation. Some indices as rate of the food intake, food calorie, feelings of satiety and anorexia and overweight are various factors that evaluate some aspects of nutritional behaviors.

One of the most acceptable and common indices in most of the researches is body mass index (BMI) that is calculated via weight and height of the person and it is a rather reliable index of body fat in most of the people. It is worth to mention that BMI doesn't measure body fat directly, but the researches showed that BMI has linear correlation with direct evaluation of body fat such as weighting under water and dual energy x-ray absorptiometry (DXA) (Mei et al., 2002). There are various standards about this index, but one of the most common standards is classification of the degrees of this index by Centers for Disease Control and Prevention (CDC).

According to the classification of this center, the range of BMI for teenagers and adults is such as BMI range 18.5 - 24.9 is defined as normal BMI and the upper and lower limit of this range is defined and abnormal BMI. In the current research the classification of this center is used as BMI of this range that was considered as normal and lower and also upper amounts of this range was considered as abnormal. BMI in most of the researches is related to a wide range of health issue (increasing risk of cardiovascular diseases, diabetic, cancer and arthritis)

(Callee et al., 1999). So BMI is considered as an important variable in health researches. Hence, one of the important scopes of experiments is the examination of the factors related to BMI. In some of the studies, cognitive variables (memory, attention range and etc) are investigated as BMI predictive (Pothos et al., 2008). In other studies, some indices as food external index, emotional factors and abstain eating are supported as BMI predictive (Braet and van Strien, 1997; Van Strien et al., 2009; Aboserea et al. 2011). Some of the researches also referred to some factors as stress, anxiety and depression as probable predictor of BMI and moderator effects of some variables such as gender and physical activity (Pothos et al., 2008). In recent researches, some variables such as knowledge, attitude and performance of guidance and high school students about healthy nutrition were investigated (Azadbakht et al., 2001) so that results did showed a small percentage of teenagers that have good nutritional performance and in most of the cases their attitude and performance is not according to their nutritional knowledge (Mohammadi et al., 2000, in adults).

Nutritional knowledge is not the only effective factor on nutritional behaviors (Kline, 1993) and there are other variables that were more effective in this regard. So, in the current study, according to the past researches results and the importance of BMI predictive factors in programming and intervention on nutritional behaviors of students, some predictive variables were investigated. Therefore, general objective of the current research is the examination of BMI predictive variables among the undergraduate students of hormozgan university, Iran. So the partial aims of the research were the investigations of nutritional knowledge, nutritional behavior, attitude toward nutrition, physical exercise variables and also demographic variables such as age and gender as BMI probable predictor among undergraduate students.

According to the research aims, the research hypotheses are presented as the followings:

1- Nutritional knowledge variable predicts normal BMI positively and significantly.

2- Attitude toward nutrition variable predicts normal BMI positively and significantly.

3- Nutritional behavior variable predicts normal BMI positively and significantly.

4- Physical exercise variable predicts normal BMI positively and significantly.

5- Age variable predicts normal BMI positively and significantly.

6- Gender variable predicts normal BMI positively and significantly.

## 2. Material and methods

This experiment is correlative research so that normal BMI is considered as criterion variable and gender, age, nutritional knowledge or behavior, attitude toward nutrition and physical exercises are considered as predictive variables. To analyze data, descriptive statistics such as mean, standard deviation and frequency tables were used and in the prediction of criterion variable by predictive variables, logistic regression, enter method is used. The research statistic population was undergraduate students in Hormozgan University who were studied in 2009 and 2010. A total number of three hundred volunteers (150 girls and 150 boys) of undergraduate students were selected from university statistics center randomly then research questionnaires were given to the selected students. Considering that, 275 students could the completed the questionnaire and returned it. Questionnaire and method of collecting data were used according to work of Azadbakht et al. (2001). Questionnaire was contained 34 items including, nutritional knowledge or behavior, attitude toward nutrition and their age and gender.

The providers of the questionnaire reported the test – retest reliability coefficient equal to 0.75 and examined the validity of the questionnaire by factor analysis method and evaluated it at a good level. BMI also was calculated from measured height and weight of participants. Data collected from experiment were analyzed by SPSS statistical software (version 16).

## 3. Results

Descriptive statistics of the research variables were shown in Tables 1 and 2. To assess hypothesis of the current study, Correlative matrices of predictive and criterion variables was calculated. As a consequence, nutritional behavior had the highest correlation with BMI variable while gender variable showed the lowest correlation (Table 3).

In addition, when logistic regression analysis carried out, applying goodness of fit tests of model is necessary. The results of omnibus tests for the coefficients of the model showed significant chi-square value ($X2$ (6, N = 275) = 261.207, p <0.001) and indicates that model variables are suitable to predict criterion variable.

The results obtained by McCreary (2002) showed were not significant so that P level equals 0.73 in this regard that is considered another index of model fit and was agreement with the observed results in the presented study. Generally, the results of the analysis showed that, the criterion variable was properly predicted by the model in 94.2 % of cases (Table 4).

Table 1. Descriptive statistics of research continuous variables

| Variables | M | SD | Min | Max |
|---|---|---|---|---|
| Age | 20.6 | 5.33 | 18 | 24 |
| Nutritional knowledge | 16.44 | 3.09 | 11 | 22 |
| Nutritional attitude | 18.28 | 1.16 | 16 | 20 |
| Nutritional behavior | 5.10 | 1.60 | 3 | 7 |

Table 2. Descriptive statistics of research categorical variables

| Variables | Gender | | | Body Mass Index | | |
|---|---|---|---|---|---|---|
| | Girl | Boy | Total | Normal | Abnormal | Total |
| Frequency | 138 | 137 | 275 | 171 | 104 | 275 |
| Percent | 50.2 | 49.8 | 100 | 62.2 | 37.8 | 100 |

Table 3. Correlative matrices of predictive and criterion variables

| Variable | BMI | Exercise | Age | Knowledge | Attitude | Gender | Behavior |
|---|---|---|---|---|---|---|---|
| BMI | ------ | | | | | | |
| Exercise | 0.64** | | | | | | |
| Age | -0.48** | -0.48** | | | | | |
| Knowledge | 0.53** | 0.45** | -0.52** | | | | |
| Attitude | 0.21** | 0.19** | -0.11 | 0.051 | | | |
| Gender | 0.07 | 0.004 | 0.038 | 0.039 | 0.30** | | |
| Behavior | 0.69** | 0.40** | -0.42** | 0.46** | 0.15* | -0.004 | ------ |

Note: $P<0.05^*$, $P<0.01^{**}$

Table 4. The predictive model of criterion variable classification and the prediction amount

| Observed | Predicted | | |
|---|---|---|---|
| | Abnormal BMI | Normal BMI | % of Correct predicted |
| Abnormal BMI | 93 | 11 | 89.4 |
| Normal BMI | 5 | 166 | 97.1 |
| Total | | | 94.2 |

Table 5. The existing variables in predictive model, Wald statistics and significance level

| Variables | B | Wald | Df | Significant |
|---|---|---|---|---|
| Nutritional behavior | 1.74 | 38.68 | 1 | P<0.001 |
| Exercise | 4.03 | 35.45 | 1 | P<0.001 |
| Nutritional knowledge | 0.31 | 6.22 | 1 | P<0.01 |
| Nutritional attitude | 0.90 | 9.14 | 1 | P<0.05 |
| Age | 0.00 | 0.00 | 1 | -------- |
| Gender | 1.02 | 3.05 | 1 | -------- |

The above analyzed model explained the range 61 to 83% of normal BMI variance and correct prediction for normal and abnormal BMI was 97.1% and 89.4%, respectively. The following table presents Wald statistics and the related freedom degree and significance level for each predictive variable. As a consequence, it is shown that nutritional behavior variables, physical exercise, nutritional knowledge and attitude toward nutrition significantly predicted normal BMI, while demographic variables (age and gender) were not significant predictors of normal BMI.

**4.  Discussion**

In the current study because of increscent the overwhelming obesity and overweight in developing countries and the increasing trend of this phenomenon in Iran, BMI predictive factors were investigated as one of the common indices of obesity and overweight. According to the results of previous researches, some factors such as nutritional behavior (NB), nutritional knowledge (NK), attitude toward nutrition (ATN), physical exercise (PE) and demographic variables of age and gender were investigated as predictive variables of body mass index. As it was said in the results section, some factors such as NB, NK, ATN and PE predict normal BMI significantly and four hypotheses of the research were supported. On the other hand, demographic variables (age and gender) don't predict normal BMI significantly and fifth and sixth hypotheses were not supported.

The current research findings obtained similar results in compatible with the studies inside and outside of Iran. Study of the results obtained from Sadrzadeh Yeganeh et al. (2005) showed relationship of the obesity with some the nutritional behaviors among high school girls. In another study (Azadbakht et al., 2001), it was shown that despite having good nutritional knowledge, NB of high school students was at low level. This was important because it shown the strong influence of nutritional behavior on being in a good weight range and this

result is supported in the current study and predictive variable of nutritional behavior is referred as the most important BMI predictive variable. The various studies showed that NB, NK and ATN are good variables to investigate the nutritional trend of people and their weights (Mohammadi et al., 2000; Buttriss, 1997). Another variable that in the current research is significant to prediction of normal BMI is physical exercise. The results observed in the current study is similar to the findings of the same researches carried out in this field (Lahti-Koski et al., 2002; Henmingsson and Ekelund, 2007; Metallinos-Katsaras et al., 2007). In all of these researches, PE did showed significantly positive relationship with normal BMI.

Although the above results supported the hypotheses 1-4, two other results of the current study related to hypotheses of demographic variables of age and gender resulted unlike and not supported as significant predictors of normal BMI. In different researches, obesity and overweight were reported more among men than women (McCreary, 2002) and by increasing age, the weight of the person was increased and their BMI is far from the normal status. For example, in study conducted by Najafi et al. (2006), obesity was increased by increasing age. One of the probable reasons of non-significance of gender predictive variable could related to the difference of the results in different studies and the lack of constant gender differences in BMI status of people. For example, gender in study carried out by Najafi et al. (2006) was not reported as significant variable. In terms of non-significance of age predictive variable, one of the probable reasons of the study carried out on students with the mean age of 16.2 is due to the rather wide age range among selected people (age range of 15-17), age variable is not significant predictor for normal BMI. It is worth to mention that in the current study, the simple correlation between age and normal BMI is calculated -0.47 that is significant and it indicates that by increasing age, BMI will be far from normal status (Najafi et al., 2006).

Generally, the current research findings indicate that the examination of the effective factors on obesity, overweight and BMI status of people requires a systematic and multidimensional view that considers important factors such as NB, NK and ATN beside some factors as physical exercise, age and gender. So it is appropriate to consider them together in intervention programs about student's health status.

Although it is attempted to investigate the predictive factors of normal BMI but research limitations restricts the generality of the findings. One of the most important limitations of the current research is using the self report questionnaire that reduces the reliability of the research data. It is recommended in the future studies to assess the predictor variables used objective indices such as calculating the daily calorie and observing people in real condition of nutrition. Other limitation of the research was implementation the research among undergraduate students that makes the generalization of the results to other educational environments more difficult. It is recommended to carry out it in the other educational courses and compare the results with the existing study findings. Finally all of the investigated factors in this research were not effective factors on normal BMI and other factors were more effective in the prediction of normal BMI. Considering other variables instead of the investigated variables in this study such as the social economics status, education level, full breakfast, the amount of daily calorie and etc can be important in nutrition of today's society and further researches is needed to help address the problem of obesity in this group of undergraduate students.

**Corresponding Author:**
Dr. Hakimeh S. Sajjadi
Center of emergency care,
Hormozgan University of Medical Sciences,
Ostandari Blvd, Bandar Abbas, Iran.
E-mail: hakimeh.sajjadi@yahoo.com

**References**
1.  Mokdad AH, Serdula MK, Dietz WH. The Continuing epidemic of obesity in United States. J. Am. Med. Assoc., 2000; 284: 1650-1651.
2.  The WHO fact sheets No 311: obesity and overweight. Geneva: world health organization. Sept. 2006.
3.  Azizi F, Allahverdian S, Mirmiran P, Rahmani M, Mohammadi F. Dietary factors and body mass index in a group of Iranian adolescents:Tehran lipid and glucose study 2. Int. J. Vita. Nutr. Res. 2001; 71: 123-7.
4.  Azizi F, Rahmani M, Madjid M, Allahverdian S, Ghanbili J, Ghanbarian A. Serum levels in an Iranian population of children and adolescents: Tehran lipid and glucose study. Eur. J. Epidemiol., 2001; 17: 281-8.
5.  Cox WM, Fadardi JS, Pothos EM. The addiction-Stroop test: theoretical considerations

and procedural recommendations. Psychol. Bulletin. 2006; 132: 443–476.

6. Mei Z, Grummer-Strawn LM, Pietrobelli A, Goulding A, Goran MI, Dietz WH. Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. Am. J. Clin. Nutr. 2002; 7597–985.

7. Callee EE, Thun MJ, Petrelli JM. Body-mass index and mortality in a prospective cohort of U.S. adults. New England J. Med. 1999; 341: 1097–1105.

8. Pothos EM, Calitri R, Tapper K, Brunstrom JM, Rogers PJ. Comparing measures of attentional bias relating to eating behavior. Appl. Cognitive Psychol. 2008; 22: 1–17.

9. Braet C, van Strien T. Assessment of emotional externally induced and restrained eating behaviour in nine to twelve-year-old obese and non-obese children. Behavior Res. Therapy 1997; 35, 863–873.

10. Van Strien T, Herman CP Verheijden MW. Eating style, overeating, and overweight in a representative Dutch sample: does external eating play a role? Appetite 2009; 52: 380–387.

11. Aboserea M, Abdelgawad M and wafik W. Early Detection of Breast Cancer among Females at Fakous District, Sharqia Governorate, Egypt. Life Science Journal. 2011; 8(1):196-203.

12. Azadbakht L, Mirmiran P, Momenan AA, Azizi F. Assessment knowledge, attitude and practice of guidance and high school students in district 13 of Tehran about healthy nutrition, (Persian) Journal of Endocrinology and Metabolism, 1382, Shahid Beheshti Medical Sciences University, the fifth year. 2001; 4: 416-409.

13. Mohammadi F, Mirmiran F, Bayegi F, Azizi F. Correlation between knowledge, attitude and practice of feeding the inhabitants of district 13 of Tehran with major non-communicable disease risk factors: the Tehran Lipid and Glucose Study (Persian). Research in Medicine, Year 26, Appendix 3 (Abstracts of First Congress of Prevention p. 199) 2000.

14. Kline P. The handbook of psychological testing.London: Routledge 1993; 26-8.

15. Sadrzadeh Yeganeh H, Alavi Naeini A, Dorosti Motlagh A. Correlation between Obesity and feeding behavior in high school girls in Kerman, Quarterly Payesh, , sixth year, No. III, 2005; 199-193.

16. Buttriss JL. Foodand nutrition: attitudes, beliefs and khowledge in the United Kingdom. Am. J. Clin. Nutr. 1997; 65 Suppl: S1985-95.

17. Henmingsson E, Ekelund U. Is the association between physical activity and body mass index obesity dependent? Int J Obes 2007; 31: 663-668.

18. Metallinos-Katsaras SE, Freedson SP, Fulton EJ, Sherry B. The association between an objective measure of physical activity and weight status in preschoolers. Obes. 2007; 15: 686-694.

19. Lahti-Koski M, Pietinen P, Heliovaara M, Vartianinen E. Associations of body mass index and obesity with physical activity, food choices, alcohol intake, and smoking in the 1982-1997 FINRISK studies. Am. J. Clin. Nutr. 2002; 75: 809-817.

20. McCreary DR. Gender and Age Differences in the Relationship between Body Mass Index and Perceived Weight: Exploring the Paradox-International Journal of Men's Health 2002; 1: 1.

21. Najafi SS, Momennasab M, Tarrahi MJ. Prevalence of overweight among 64-25 years old population in Khoramabad(Persian),2004, Journal of Diabetes & Lipid Disorders 2006; 8(2): 176-167.

3/5/2011