Consumption of Fruits and Vegetables among UmmAl- Qura University StudentsinMakkah, Saudi Arabia : A cross -section study

Samaa S. Elsoadaa[1]*, Amany M. Abdelhafez[1,2], Naeem M. Rabeh[3], Seham E. Zahran[1,4], Mostafa M. H. Osfor[1]

[1] Department of clinical nutrition, Faculty of applied medical sciences, Umm AlQura University, Saudi Arabia
[2]Department of Public Health, Faculty of Medicine, Ain Shams University, Cairo, Egypt
[3]Department of Nutrition and Food Sciences, Home Economic Faculty, Helwan University, Egypt.
[4] Department of Food Hygiene and Control, Animal Health Research Institute , Cairo, Egypt.
dr.samaaelsoadaa@yahoo.com

Abstract: The health benefits of adequate fruits and vegetables (FV) consumption are significant and documented. Moreover, increased fruit and vegetable consumption was associated with reduction in the development of chronic diseases. The main objectives of the present study were to describe the patterns of fruit and vegetables intake among Umm Al-Qura University students, and to identify the epidemiological factors associated with low level of consumption of FV. **Subjects and methods:** A cross- sectional study was carried among 703 students of Umm Al- Qura University (109 males, 594females) based on self-administered questionnaire composed of: demographic- socio- economic data, anthropometric measurements, physical activities, medical history (of the students and their parents) and dietary assessment including: 24hr recall to assess FV consumption. Statistical analysis was performed by using the Statistical Package for Social Science (SPSS V 16). **Result**: About 13.8% of males and 38.6% of females consume FV greater than or equal to five serving a day, indicating a gap of approximately 25 % between the males and females. Also, the parents' educational level was affecting positively the consumption of FV. Low FV consumption tended to decrease with low monthly income. **Conclusions:** Factors associated with higher level of intake of FV were female gender, higher educational level, and higher monthly income.
[Samaa S. Elsoadaa, Amany M. Abdelhafez, Naeem M. Rabeh, Seham E. Zahran, Mostafa M. H. Osfor.**Consumption of Fruits and Vegetables among Umm Al- Qura University Students: A cross- section study**. *Life Sci J* 2013;10(4):223-231]. (ISSN: 1097-8135). http://www.lifesciencesite.com. 30

Keywords: fruits, vegetables, consumption, 24hr recall.

1.Introduction

Eating a diet high in fruits and vegetables (FV) is associated with a decreased risk for many chronic diseases, including heart disease,**(Hu, 2003)** stroke,**(He *et al.*, 2006)**high blood pressure,**(Fung *et al.*, 2008)** diabetes,**(Montonen*et al.*, 2004)** and some cancers **(WHO, 2002, 2003; WHO,)**. Research also has found that replacing foods of high energy density (high calories per weight of food) with foods of lower energy density, such as FV, can be an important part of a weight-management strategy **(Tohill*et al.*, 2004; Rolls *et al.*, 2004).**

In addition, FV are good sources of many important nutrients, including potassium, vitamin C, folate, fiber, and numerous phytochemicals. The importance of FV as part of healthy diets is illustrated by the Dietary Guidelines for Americans 2005, in which two of the four recommended food groups are FV **(WHO, 2003)**.

The health benefits of FV consumption are significant and widely documented **(Lock *et al.*, 2005Bazzano, 2006;)**. According to reports from the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) **(WHO, 2003)**, daily consumption of five servings, or a minimum of 400 grams, of FV helps in preventing several diseases.

In a recent analysis of FV intake data using the specific My Pyramid recommended intakes by age, sex, and activity level, fewer than 1 in 10 Americans consume enough FV. Subgroups with higher recommendations for FV consumption based on caloric requirements did not have higher intakes. The primary contributors to total fruits intake among adults was whole fruits but among adolescents it was fruits juices. The largest single contributor to overall fruits intake was orange juice. Potatoes dominated vegetables consumption, particularly among adolescents where fried potatoes increased the median intake from 0.72 cups to 1.21 cups per day. Dark green and orange vegetables and legumes account for a small portion of vegetables intake and few people met specific recommendations for those vegetables subgroups **(Kimmons*et al.*, 2009).**

Globally, inadequate FV consumption is responsible for annual deaths of 2.7 million, 11% of strokes, 31% of ischemic heart diseases and 19% of gastrointestinal cancers **(WHO, 2002; 2003;WHO,).**

A number of mixed concentrated FV products have been studied, which may help certain individuals improve nutrient status. However, the possible health benefits of FV supplements havenot been systematically reviewed**(Amin *et al.*, 2011).**
The objectives of the present study were to:

1) Describe the patterns of fruits and vegetables intake among UQU students.
2) Identify the epidemiological factors associated with lowlevelof consumption of FV.

2. Subjects and Methods

2.1 Design and participants

A cross- sectional study was conducted during the academic year 2012-2013. The study included 703 students, 84.5 % females (n= 594) and 15.5 % males (n= 109), from different medical sections (medicine, laboratories, pharmacy, clinical nutrition, nursing, dentist and preparatory year) of Umm al-Qura University.

2.2 Instrument

A self-administered questionnaire was developed to assess FV intake among students and to identify the determinants of their FV intake. The questionnaire was administered to students between regular class periods. A total of 35 students with missing data for any of the study variables were excluded, resulting in a final sample of 703. Questionnaire was designed to obtain the following information:

2.2.1 Sociodemographic characteristics:

Including ; age, level of education, number of family members, level of parents education and income.

2.2.2 Medical history:

It included questions about the medical history of the study participants and their parents about present and past medical condition included (Diabetes – Hypertension – Cancer – Cardiovascular disease).

2.2.3 Dietary measurement method

- **24 hr recall:**

The researchers collected information of student's food intake for 3 days using diary-assisted 24-hour recall interviews, (2 weekdays and 1 weekend day) (Crawford *et al.*, 1994).

The 24- hour recall method has been widely and successfully used with students of university. We augmented the 24-hour recall interview with a food diary completed by students in advance of the interview in order to improve recall accuracy. Two questions were concerned with intake of FV: how many servings of fruit do you eat on a day? and how many servings of vegetables do you eat on a day? and the portion size of FV was specified and simplified by pictures to clarify and facilitate determination of the number of typical servings consumed. Fruit consumption included pure fruit juices and raw, cooked, canned, frozen or dried fruits. Vegetables included all raw, cooked, canned, frozen or dried vegetables.

2.2.4. Anthropometric assessment:

2.2.4.1 Weight:

Electronic balance was used to obtain theweight. The scale was placed on a hard-floor surface. Participants were asked to remove their heavy outer garments. The scale is checked using the standardized weights and calibration is corrected if the error is greater than 0.1 kg(Al-Rewashedh and Al-Dmoor,2010).

2.2.4.2 Height:

Height was measured for all participants, with the students bare footed and head upright. The height is measured with the measuring rod attached to the balanced beam scale. The floor surface next to the height rule was hard. The height was reported to the nearest 0.5 cm(Al-Rewashedh and Al-Dmoor,2010).

2.2.4.3 Body mass index (BMI) :

it was calculated as weight in kilograms divided by the square of height in meters and was categorized according to Mahan, and stump,(2008): < 18.5;under weight, 18.5 – 24.9; normal weight, 25 – 29.9; weight, 30 – 39.9;obese type I and >40;obese type II or very obese.**(**Gee and Mahan,2008)

2.3. Data analysis

All data collected were tabulated and statistical analysis was performed using the Statistical Package for Social Science (SPSS V 16) (SPSS Inc., Chicago, IL, USA.).Proportions were compared using chi-square test.Continuous variables were compared using independent sample t-test for two groups and ANOVA test for more than two groups. The outcome variable was divided as either consuming FV less than five times daily or equal to or greater than five times daily. Significance was set at $p<0.05$.

3. Results:

The demographic profile of the sample is presented in table (1), which shows that out of the 703 subjects, 15.5% were males and 84.5% were females. The majority of the sample were falling in the age group of 19 or more years (93.2%) . The highest percentage of study sample was from Medicine (36.1%), Most of the studied students (58.75%) had more than 6 members in their family. For fathers' educational levels (13.1%) had a master, (42.25%) had a bachelor, while (5.8%) had primary educational level. For mothers' educational level (5.68%) had a master, (37.55%) bachelor, while (11.70%) had primary educational level and illiterate.

Regarding the monthly income (56.47%) of the studied participants had a family income of more than 9000 SR per month, while (3.7%) had monthly income less than or equal 3000 SR.

Figure 1 shows that 76 students from the sample (10.9 %) were obese, while 401 students (57%) were in the normal weight range.

Table 2 shows that female students had significantly high mean daily intake of fruits and vegetables ($p< 0.05$).Students of colleges of dentistry and clinical nutritionhad higher intake than other students ($p< 0.05$).

Moreover,participants whose parents had higher educational level, and higher monthly income reported higher mean daily intake ($p< 0.01$) of FV. No significant difference in consumption of FV among different categories of body mass index was found ($p>0.05$).

Distribution of the studied students according to their adherence to the recommended daily intake of servingsof FV is presented in Table (3). Female students were more adherent to the recommended daily intake than male students as, 38.6% of female versus 13.8% of male were consuming 5 servings or more of FV per day ($p<0.001$). Significant difference was found between the different colleges with the highest intake being among dentistry and clinical nutrition students ($p<0.001$). Moreover, adherence to the recommended daily intake of servings was high among students whose parents had high educational level and high monthly income ($p<0.001$).

Only 34.7% of the 703 students in the study consumed five or more servings FV per day.While (6.4%) of the studied sample consumed less than two servingsof FV per day. Moreover 23.47% of the sampleconsumed two to less than three servings per day(Figure 2).

Table 1: Distribution of sample according to sociodemographiccharacteristics

Variables	Frequency	%
Age in years		
<19	48	6.80
≥19	655	93.20
Total	703	100
Gender		
Male	109	15.50
Female	594	84.50
Total	703	100
College		
Medicine	254	36.10
Pharmacy	37	5.30
Clinical Nutrition	112	16.00
Nursing	17	2.40
Dentistry	36	5.10
Laboratories	161	23.00
Preparatory year	86	12.20
Total	703	100
Number of family members		
- 3	34	4.84
4-6	256	36.41
> 6	413	58.75
Total	703	100
Fathers' educational level		
Illiterate	12	1.70
Primary	41	5.80
Intermediate	70	9.96
Secondary	191	27.20
Bachelor	297	42.25
Master	92	13.10
Total	703	100
Mothers' educational level		
Illiterate	28	3.98
Primary	82	11.70
Intermediate	88	12.50
Secondary	201	28.60
Bachelor	264	37.55
Master	40	5.68
Total	703	100
Monthly household income (SR*)		
–3000	26	4.00
– 6000	68	9.67
– 9000	212	30.16
> 9000	397	56.47
Total	703	100

*SR: Saudi Riyal

Table 2: Mean number of daily serving intake of FV among the studied students according to sociodemographic characteristics. (N=703)

Variables		Mean ± SD	*P*
Age			
	<19	3.65 ± 1.31	0.49
	≥19	3.62 ± 1.27	
Gender			
	Male	3.14 ± 1.03	<0.001
	Female	3.72 ± 1.29	
College			
	Medicine	3.62 ± 1.32	
	Pharmacy	3.53 ± 1.35	
	Clinical Nutrition	4.03 ± 1.20	<0.001
	Nursing	3.41 ± 1.24	
	Dentistry	4.26 ± 1.21	
	Laboratories	3.24 ± 1.12	
	Preparatory year	3.66 ± 1.26	
Number of family member			
	-3	3.16 ± 1.37	
	4-6	3.63 ± 1.28	0.09
	> 6	3.67 ± 1.25	
Fathers' educational level			
	Illiterate	2.29 ± 1.18	
	Primary	2.63 ± 1.20	
	Intermediate	2.91 ± 1.11	<0.001
	Secondary	3.38 ± 1.20	
	Bachelor	3.91 ± 1.20	
	Master	4.37 ± 1.00	
Mothers' educational level			
	Illiterate	2.66 ± 1.16	
	Primary	3.00 ± 1.11	
	Intermediate	3.11 ± 1.25	<0.001
	Secondary	3.23 ± 1.12	
	Bachelor	4.18 ± 1.12	
	Master	5.10 ± 0.30	
Monthly household income			
	– 3000	1.80 ± 0.51	
	– 6000	2.54 ± 0.92	<0.001
	– 9000	2.64 ± 0.72	
	> 9000	4.46 ± 0.89	
Exercises			
	Walking	3.62 ± 1.29	
	Running	3.33 ± 1.56	0.657
	Swimming	3.86 ± 1.23	
None		3.60 ± 1.24	
BMI			
	Under weight	3.56 ± 1.29	
	Normal	3.69 ± 1.27	
	Overweight	3.45 ± 1.30	0.459
	Obese I	3.66 ± 1.17	
	Obese II	3.50 ± 1.09	

Table 3: Distribution of the studied students according to their adherence to the recommended daily intake of servingsofFV(N=703)

Variables	Fruits &vegetables 5 servings or more per day		Fruits &vegetables less than 5 servings per day		X^2	*P*
	No.	%	No.	%		
Age						
<19	18	37.5	30	62.5	.177	.674
>19	226	34.5	429	65.5		
Total	244		459			
Gender						
Male	15	13.8	94	86.2	24.98	<0.001
Female	229	38.6	365	61.4		
Total	244		459			
College						
Medicine	93	36.6	161	63.4		
Pharmacy	11	29.7	26	70.3		
Clinical Nutrition	56	50.0	56	50.0		
Nursing	5	29.4	12	70.6	42.58	<0.001
Dentistry	20	55.6	16	44.4		
Laboratories	27	16.8	134	83.2		
Preparatory year	32	37.2	54	62.8		
Total	244		459			
Number of family member						
- 3	9	26.5	25	73.5		
4-6	94	36.7	162	63.3	1.53	.465
> 6	141	34.1	272	65.9		
Total	244		459			
Fathers' educational level						
Illiterate	1	8.3	11	91.7		
Primary	3	7.3	38	92.7		
Intermediate	8	11.4	62	88.6		
Secondary	48	25.1	143	74.9	73.47	<0.001
Bachelor	132	44.4	165	55.6		
Master	52	56.5	40	43.5		
Total	244		459			
Mothers' educational level						
Illiterate	4	14.3	24	85.7		
Primary	8	9.8	74	90.2		
Intermediate	17	19.3	71	80.7	166.8	<0.001
Secondary	36	17.9	165	82.1		
Bachelor	141	53.4	123	46.6		
Master	38	95.0	2	5.0		
Total	244		459			
Monthly household income						
– 3000	0	.0	26	100.0		
– 6000	3	4.4	65	95.6	267.1	<0.001
– 9000	1	0.5	211	99.5		
> 9000	240	60.5	157	39.5		
Total	244		459			
Exercises						
Walking	134	34.9	250	65.1		
Running	3	33.3	6	66.7	.086	.993
Swimming	11	36.7	19	63.3		
None	96	34.3	184	65.7		
Total	244		459			
BMI						
Under weight	31	30.1	72	69.9		
Normal	151	37.7	250	62.3		
Overweight	39	31.7	84	68.3	4.19	.381
Obese I	22	31.4	48	68.6		
ObeseII	1	16.7	5	83.3		
Total	244		459			

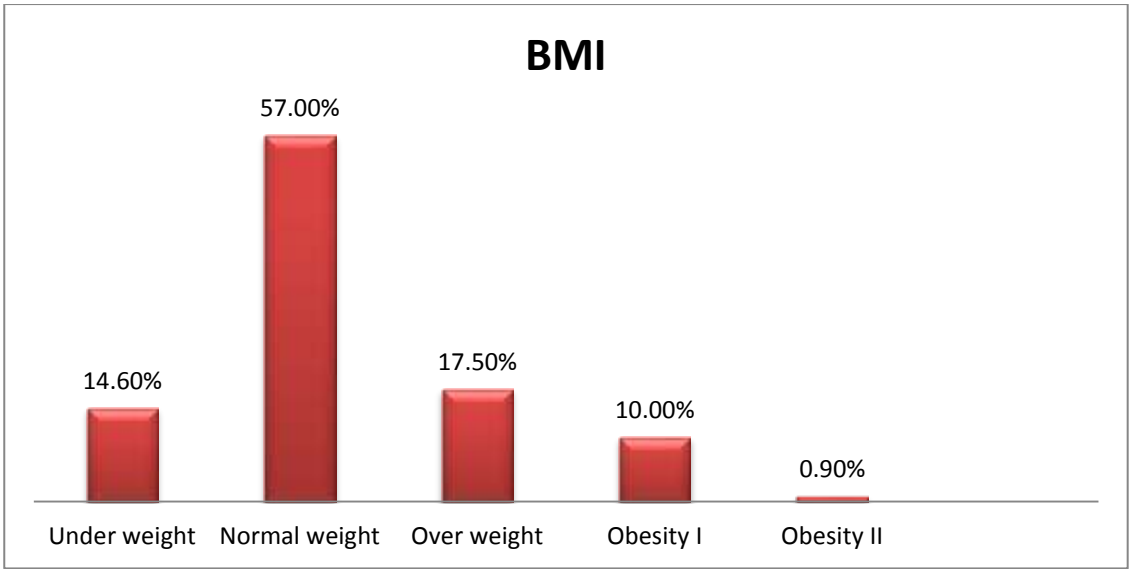

Figure 1: Distribution of students according to their BMI.

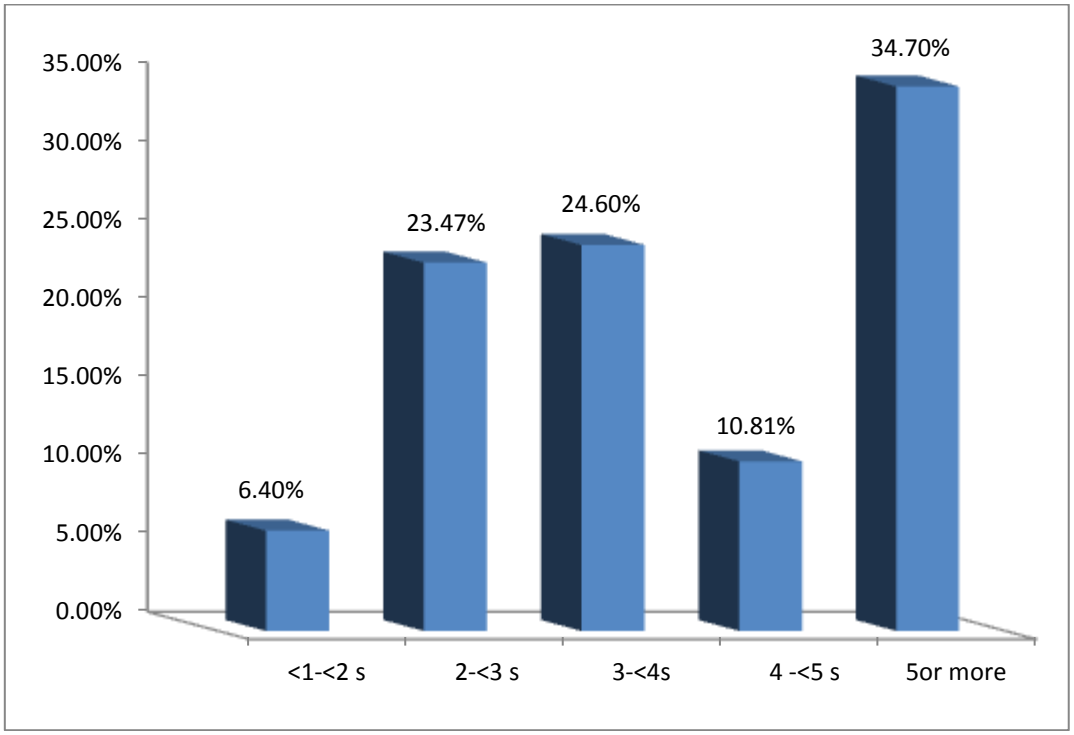

Figure 2: Frequency distribution of students who consumed varying serving levels of fruits and vegetables derived from an average of 3 days of 24hour dietary recalls.

4. Discussion

The importance of FV intake cannot be minimized due to its association with the prevention of chronic diseases**(Bertsias*et al.*, 2005).**A strong link between FV intake and cancer prevention has been well documented; it is estimated that approximately 30% of all cancers are accounted for by poor dietary habits **(WCRF, 1997).** Low FV intake is a known risk factor for the cancers of the lung and gastrointestinal tract, non-Hodgkin lymphoma and oral cancer **(Pavia *et al.*,2006).** Cardiovascular disease, the leading cause of death in Canada, also displays a reduced risk with high FV consumption **(Hung *et al.*, 2004).** High FV intake may also have a positive impact on bone mineral status **(Prynne *et al.*, 2006).**

The current study was conducted to describe the patterns of fruit and vegetable intake among UQU students, and Identify the epidemiological factors associated with the level of consumption of FV

The current study displays that 61.4% of female students didn't consume the recommended servings

of fruits and vegetable, however they had significantly higher, mean daily intake of fruits and vegetables than male. This result agreewith**Natalie*et al.*(2008)** who reported that women were significantly and consistently more likely to be consuming the recommended amount of FV than men. Also **Paquette (2005)** reported that more women than men perceived FV as healthy foods. Further studies also showed that gender was the most important factor of compliance with FV recommendations in adults **(Friel*et al.*, 2005).**

Regarding parents' education level, a significant association between high education and FV intake was observed among UQU students. Higher parents' education was associated with a greater proportion of students consuming FV greater than or equal to five times daily and higher parents' education level was associated with a greater mean daily consumption of fruits and vegetables.

The independent nature of both education and income on FV intake is supported by findings from **Turrell*et al.* (2003**), and **Natalie *et al.* (2008)**. Moreover other studies reported a significant association between household education achievement and FV intake in elderly Mexican-American women aged 50–76 **(Gregory-Mercado ,2006)** and New Zealander men and women aged 40–78 years **(Metcalf *et al.*,2006)**. The association with education may be related to nutrition education or perhaps knowledge of healthy nutrition and chronic diseases. This may also be linked with income, as people with higher education usually have a higher income as well.

Income is another important factor contributing to healthy eating. Previous epidemiological studies have reported a positive association between income and/or socioeconomic status (SES) and FV consumption or purchase **(Payette and Shatenstein, 2005; Ricciuto*et al.*, 2006).** These studies were in agreement with the present study which demonstrate that a significant association between total household income and the consumption of recommended servings of FV. Thisassociation can be explained through several mechanisms;first of all, FV are becoming less affordable, as the relative price of FV has recently increased in relation to the consumer price index **(USDA, 2006).** This can negatively impact consumption of FV, especially for those with low income. Secondly, lower income people are more likely to live in areas with fewer grocery stores, and the stores that are in close proximity may not offer healthy foods at an affordable price. However, **Pearson *et al.* (2005)** reported that FV price, SES, and lack of local grocery stores were not significant factors influencing FV intake in adults. One may suggest financial support to low income families to encourage healthy eating. However, an econometric analysis predicted that if supplemental resources were to be given to low income families, they would consume more meat, added sugars, and total fat, while their consumption of fruits, vegetables, grains, and dairy products would stay about the same **(Wilde *et al.*, 1999).** On the other hand, results from the Special Supplemental Nutrition Program for Women, Infants, and Children in Los Angeles indicate that specific financial supplements for the purchase of FV for low-income women will be used to purchase a variety of FV **(Herman *et al.*, 2006).**

Results revealed that there is no significant difference in consumption of fruits and vegetables among difference categories of body mass index. This is in agreement with the result of **Field *et al.*, 2003** who found that no association between consumption of fruit and vegetables and change in BMI during adolescence. Also **He *et al.* (2004)** whofound an inverse association between the increase of intake of fruits and vegetables over time and risk of obesity or weight gain.

There are numerous benefits of consuming a diet rich in fruits and vegetables, but it is not entirely clear why this type of diet would prevent obesity or excessive weight gain. One possible mechanism would be that fruits and vegetables might serve as healthy substitutes for more calorie-dense foods. The effect of substituting fruits and vegetables for calorie dense foods could be to lower caloric intake. However, it is possible to consume a diet rich in calorie dense foods, as well as fruits and vegetables. For example, a vegetarian burrito could contain several types of vegetables cooked in oil, cheese, sour cream, refried beans, and a large tortilla, thus it would be high in fat and calories, as well as provide one or more vegetable servings. Moreover, if a child occasionally substituted a piece of fruit for cookies, cake, or other sweets, it would be unlikely to have a material impact on total caloric intake over an extended period of time unless the child otherwise would be eating a very large serving of the sweets. Therefore, the lack of a strong relation between intake of fruits and vegetables and change in BMI should not be surprising.

5. Conclusion

This study reports that 65.3% of the studied sample consume FV below the recommendation. Factors associated with higher level of intake of FV were female gender, higher educational level, and higher monthly income**.**

6. Recommendations

Based on the study findings, the researchers recommend to:

1. Emphasize a healthy lifestyle, including eating healthy diet and maintaining physical activities with a particular emphasis on the importance of consuming at least five serving FV each day,

not only to the adults, but also in all age groups including the growing children and teenager; because as in the adage " The Prevention Is Better than Cure". So, the promotion and maintaining of a healthy eating from childhood would be a key factor for preventing chronic disease in later life.

2. Public health actions at national and international levels are necessary, and efforts need to be made to improve FV intake in our society.

Corresponding author:
Dr. SamaaSaiedElsoadaa, Assistance Professor, University of Umm Al Qura, Faculty of applied medical science, Clinical Nutrition Department, P.O. Box 715 Makkah, KSA
E mail: dr.samaaelsoadaa@yahoo.com

References:

Al-RewashedhYAA , Al-Dmoor M H. Anthropometry and Dietary Assessment of Males and Females Students at Mu'tah University.JAppl Sci. 2010; 10: 759-765.

Amin Esfahani , Julia M.W Wong, Jennifer Truan, Christopher R Villa, Arash Mirrahimi, Korbua Srichaikul and Cyril W.C Kendall. (2011). Health Effects of Mixed Fruit and Vegetable Concentrates: A Systematic Review of the Clinical Interventions. Journal of the American College of Nutrition 30 (5): 285-294.

Bazzano, L. A. (2006). The high cost of not consuming fruits and vegetables. J Am Diet Assoc, 106(9):1364-1368.

Bertsias, G., Linardakis, M., Mammas, I. and Kafatos, A. (2005). Fruit and vegetable consumption in relation to health and diet of medical students in Crete, Greece.Int J VitamNutr Res 75:107–117.

Crawford, P. B., Obarzanek, E., Morrison, J. and Sabry, Z. I. (1994). Comparative advantage of 3-day food records over 24-hour recall and 5-day food frequency validated by observation of 9- and 10-year-old girls. J. Am. Diet. Assoc. 94 (6), 626– 630.

Field, A. E., Gillman, M .W.,Rosner, B., Rockett, H .R. and Colditz, G .A. (2003). Association between fruit and vegetable intake and change in body mass index among a large sample of children and adolescents in the United States, International Journal of Obesity 27, 821–826.

Friel, S., Newell, J., Kelleher, C. (2005). Who eats four or more servings of fruit and vegetables per day? Multivariate classification tree analysis of data from the 1998 Survey of Lifestyle, Attitudes and Nutrition in the Republic of Ireland. Public Health Nutr 8:159–169.

Fung, T., Chiuve, S., McCullough, M., Rexrode, K., Logroscino, G. and Hu, F. (2008).Adherence to a DASH-style diet and risk of coronary heart disease and stroke in women. Arch Intern Med.168(7):713-720.

Gee M, Mahan LK, Escott-stump E .Nutrition for health and fitness. In Mahan LK &Escott-Stump E, eds. *Krause's food& nutrition and diet therapy*.12th ed. Philadelphia: USA Saunders ; 2008: 532-557.

Gregory-Mercado, K. Y., Staten, L. K., Ranger-Moore, J., Thomson, C. A., Will, J. C., Ford, E. S., Guillen, J., Larkey, L. K., Giuliano, A. R., Marshall, J. (2006). Fruit and vegetable consumption of older Mexican-American women is associated with their acculturation level. Ethn Dis 16: 89–95.

He, F. J., Nowson, C. A. and MacGregor, G. A. (2006). Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. Lancet.367(9507):320-326.

He, K., Hu, F. B., Colditz, G. A., Manson, J. E., Willett, W. C. and Liu, S. (2004). Changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women. Int J ObesRelatMetabDisord; 28: 1569–1574.

Herman, D. R., Harrison, G.G. and Jenks, E. (2006). Choices made by low-income women provided with an economic supplement for fresh fruit and vegetable purchase. J Am Diet Assoc 106:740–744.

Hu, F. B. (2003). Plant-based foods and prevention of cardiovascular disease: an overview. Am J ClinNutr.78(3 Suppl):S544-551.

Hung, H. C., Joshipura, K. J., Jiang, R., Hu, F. B., Hunter, D., Smith-Warner, S. A., Colditz, G. A., Rosner, B., Spiegelman, D. and Willet, W. C. (2004). Fruit and vegetable intake and risk of major chronic disease. J Natl Cancer Inst 96:1577–1584.

Kimmons, J., Gillespie, C., Seymour, J., Serdula, M. and Blanck, H. M. (2009). Fruit and vegetable intake among adolescents and adults in the United States: percentage meeting individualized recommendations. Medscape J Med.11(1):26.

Lock, K., Pomerleau, J., Causer, L., Altmann, D. R. and McKee, M. (2005). The global burden of disease attributable to low consumption of fruit and vegetables: Implications for the global strategy on diet. Bull World Health Organ, 83(2):100-108.

Metcalf P, Scragg R, Davis P. (2006). Dietary intakes by different markers of socioeconomic status: results of a New Zealand workforce survey. N Z Med J 18: U2127.

Montonen, J., Knekt, P., Jarvinen, R. and Reunanen, A. (2004).Dietary antioxidant

intake and risk of type 2 diabetes.Diabetes Care. 27(2):362-366.

Natalie, D., Riediger, B. S. c., Mohammed, H., Moghadasian, (2008). Patterns of Fruit and Vegetable Consumption and the Influence of Sex, Age and Socio-Demographic Factors among Canadian Elderly Journal of the American College of Nutrition, Vol. 27, No. 2, 306–313.

Paquette, M-C. (2005). Perceptions of healthy eating. Can J Public Health 96:S15–S19,.

Pavia, M., Pileggi, C., Nobile, C. G. and Angelillo, I. F. (2006). Association between fruit and vegetable consumption and oral cancer: a meta-analysis of observational studies. Am J ClinNutr 83:1126–1134.

Payette, H. and Shatenstein, B. (2005).Determinants of healthy eating in the community-dwelling elderly people. Can J Public Health 96:S27– S31, S30.

Pearson T, Russell J, Campbell MJ, Barker ME. Do 'food-deserts' influence fruit and vegetable consumption—cross-sectional study. Appetite 2005;45:195–97.

Pearson, T., Russel, J. and Campell, M. J. (2005). Barker ME: Do "food deserts' influence fruit and vegetable consumption? - a cross-sectional study. Appetite 45:195–197.

Prynne, C. J., Mishra, G. D., O'Connell, M. A., Muniz, G., Laskey, M. A., Yan, L., Prentice, A. and Ginty, F. (2006). Fruit and vegetable intakes and bone mineral status: a cross sectional study in 5 age and sex cohorts. Am J ClinNutr 83:1420–1428.

Ricciuto, L., Tarasuk, V. and Yatchew, A. (2006). Socio-demographic influences on food purchasing among Canadian households. Eur J ClinNutr 60:778-790.

Rolls, B. J., Ello-Martin, J. A. and Tohill, B. C. (2004). What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? Nutr Rev. 62(1):1-17.

Tohill, B. C., Seymour, J., Serdula, M., Kettel-Khan, L. and Rolls, B. J. (2004). What epidemiologic studies tell us about the relationship between fruit and vegetable consumption and body weight.Nutr Rev. 62:365-374.

Turrell G, Hewitt B, Patterson C, Oldenburg B. (2003). Measuring socio-economic position in dietary research: is choice of socio economic indicator important?.Public Health Nutrition. 6(2):191-200

USDA, 2006 consumer price index.

WHO (2003). Diet, nutrition, and the prevention of chronic diseases., Report of a joint WHO/FAO expert consultation, Technical Report Series 916.

World Cancer Research Fund. (1997). "Food, Nutrition, and The Prevention of Cancer: A Global Perspective. Washington, DC: American Institute for Cancer Research.

10/2/2013