

Prevalence of vitamin-mineral supplement use among Jordan University students

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ABSTRACT

الأهداف: تحديد معدل استخدام المدعمات من الفيتامينات والمعادن، وعلاقتها مع خصائص ديموغرافية وأنماط حياتية مختارة. كذلك تحديد أسباب تناول المدعمات من الفيتامينات والمعادن، ومصادر التوصية لتناولها عند طلبة الجامعة الأردنية.

الطريقة: أُجريت دراسة مقطعية عرضية على طلبة الجامعة الأردنية - عمان - الأردن، خلال الفترة ما بين مارس 2005 وحتى سبتمبر 2005م. تم استخدام تقنية الاختيار الطبقي المتعدد المراحل. شملت الدراسة 1187 طالباً وطالبة، تراوحت أعمارهم ما بين 17-28 عاماً من مختلف كليات الجامعة الأردنية. جُمعت معلومات الدراسة من المشاركين عن استخدام المدعمات من الفيتامينات والمعادن خلال العام الماضي بالإضافة إلى معلومات عن خصائص ديموغرافية وأنماط حياتية مختارة، وكان ذلك باستخدام استبيان معد ومجرب مسبقاً، حيث تم تعبئة الاستبيان من المشاركين بوجود احد أعضاء فريق البحث.

النتائج: تبين أن المعدل العام لاستخدام المدعمات من الفيتامينات والمعادن هو (27.4%)، حيث بلغ المعدل عند الذكور (22%) وعند الإناث (30.2%). وأظهرت نتائج الدراسة بأن استخدام المدعمات من الفيتامينات والمعادن كان ذو دلالة إحصائية معنوية ($P < 0.05$) مع العمر، والجنس، ودخل الأسرة، والتدخين، والنشاط البدني، بالإضافة إلى النباتيين ومؤشر منسب كتلة الجسم. كما أظهرت نتائج الدراسة إن أكثر المدعمات من الفيتامينات والمعادن استخداماً هي الفيتامينات المركبة (10.4%)، ثم الفيتامينات والمعادن المركبة (10%). كان أكثر سبب يذكر لتناول المدعمات من الفيتامينات والمعادن هو للمعالجة. كما بينت الدراسة أن مصادر التوصية لتناولها كانت من الأطباء (45.8%).

خاتمة: إن معدل انتشار استخدام المدعمات من الفيتامينات والمعادن متدني جداً، وأكثر المستخدمين لها هم من الإناث، والغير المدخنين، وذوي الدخل الأسري المرتفع، والنشطاء بدنياً، والنباتيين، وذوي القيمة الطبيعية لمؤشر منسب كتلة الجسم. كما بينت الدراسة إن السبب الرئيسي لاستخدام المدعمات من الفيتامينات والمعادن هو للمعالجة، ومصادر التوصية لتناولها هم الأطباء والصيادلة.

Objectives: To determine the prevalence, reasons, source of information of vitamin-mineral supplement uses, and their relationship with selected demographic and lifestyle characteristics among Jordan University students.

Methods: A cross-sectional survey was carried out at Jordan University, Amman, Jordan from March to September 2005. The survey included 1187 students aged 17-28 years. A multistage stratified sampling technique was used to recruit the participants from different majors at Jordan University. A self-administered questionnaire containing questions on use of vitamin-mineral supplement during the last year, demographic, and lifestyle characteristics was completed.

Results: The overall prevalence of vitamin-mineral supplement use during the last year reported by students was 27.4% (males 22%, and females 30.2%). Vitamin-mineral supplement use among university students was significantly ($p < 0.05$) associated with age, gender, family monthly income, smoking status, physical activity, vegetarian status, and body mass index. The most frequently used supplements were multivitamins (10.4%) and multivitamins-multi minerals (10%). The most frequently given reason for supplement use was for treatment. The main frequently reported source of information was a physician (45.8%).

Conclusion: The overall prevalence rate of vitamin-mineral supplement use is very low. Supplement users are more likely to be: females, nonsmokers, of higher income, physically active, vegetarians, and of normal body mass index. The main reason for supplement use is for treatment, and the major source of information on supplements is by physicians and pharmacists.

Saudi Med J 2008; Vol. 29 (9): 1326-1331

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Received 30th April 2008. Accepted 19th August 2008.

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Recently, there has been much interest throughout the world in the role of vitamin-mineral supplements in prevention and treatment of chronic diseases, such as cancer and coronary heart disease.^{1,2} However, it is well documented that micronutrient deficiencies, affect at least 2 billion people worldwide, and will result in deficiency diseases with devastating consequences.³⁻⁵ Millions of lives are saved each year, and the quality of life of many more is improved by dietary supplements.^{5,6} Therefore, vitamin-mineral supplements had been considered by policy makers and many public health officials worldwide as an important strategy in the prevention and treatment of chronic and micronutrient deficiency diseases. Several studies conducted worldwide reported that prevalence rates of vitamin-mineral supplement use among university students in United States of America (USA) varied from 47-74%,⁷⁻¹¹ South Africa¹² (42%), and Korea¹³ (58%). Moreover, industry sales of supplements are growing. In the United States alone, dietary supplement sales increased by nearly 80% from 1994 to 2000.¹⁴ Several epidemiological studies in western populations had indicated that the prevalence of vitamin-mineral supplement use is significantly associated with younger age, female gender, higher family monthly income, non-smoker, physically active lifestyle, vegetarian status, and normal body mass index (BMI).¹⁵⁻²⁰ Several studies and scientific reports have indicated the reasons behind taking supplements by people included: to maintain general good health,²¹ to ensure adequate nutrition,²² to enhance physical appearance,²³ and to promote weight loss.²⁴ Numerous epidemiological studies have been conducted on sources of information of supplement use. Family, friends, advertising media (such as television, magazines, newspapers, and internet web sites), doctors, pharmacists, nurses, and nutritionists were the main sources of information on the need for supplementation.^{11,12} Recent studies and reports in Jordan indicated a high prevalence of chronic diseases and micronutrient deficiency diseases such as coronary heart disease, cancer, obesity, diabetes, osteoporosis, anemia, and sub-clinical vitamin A deficiency.²⁵⁻²⁷ The objectives of this survey were to determine the prevalence, reasons, and sources of information of vitamin-mineral supplement use among Jordan university students, as well as the relationship with selected demographic and lifestyle characteristics.

Methods. A cross-sectional survey on vitamin-mineral supplement use was conducted on 1500 students attending Jordan University, Amman, Jordan between March and September 2005. Jordan University is a large sized and a public university, it consists of 11 faculties, located in Amman the capital of Jordan. A multistage stratified sampling technique was used

to recruit the participants of the study, which was approved by the deanship of student affairs. At the first stage of selection, 5 faculties (medicine, dentistry, agriculture, science, and humanities) were selected using a systematic random sampling technique. At the second stage of selection one class from first, second, third, and fourth years in each faculty were randomly selected. Classes were visited by the research team to clarify the study, the students showed their willingness to participate in the study. Then a schedule for the next visit was given to complete the questionnaire. At the second visit, informed consent was obtained from each participant, and a self-administered questionnaire was completed by the students in the presence of a member of the research team. A total of 1187 students aged 17-28 years (788 females, 399 males) completed the study. Students were excluded from the study due to: unwillingness to participate (n=123), handing in incomplete questionnaires (n=88), and non-attendance of class (n=102). Thus, the response rate for sample respondents was 79.1% (1187/1500). The remaining 1187 subjects were included in the statistical analyses.

A pre-tested questionnaire consisted of 2 sections. The first section of the questionnaire included general demographic information such as age, gender, family monthly income, as well as information on selected lifestyle characteristics such as smoking status, physical activity, vegetarian status, and body height, and weight. Age was categorized as, 17-20 years, and 21-28 years. Gender was categorized as males and females. Family monthly income, in Jordanian Dinar (JD), was categorized as <300 JD, 300-500 JD, and >500 JD. Smoking status was categorized as never, former, or current smoker. Physical activity was assessed by asking subjects how frequently per week they exercised enough to work up a sweat. Subjects were classified as active if they exercised to a sweat 3 or more times per week. Subjects were classified as physically inactive if they did not exercise to a sweat with a frequency less than 3 times per week. Vegetarian status was classified as vegetarian and non-vegetarian. Weight and height were self-reported by subjects. The body mass index (BMI) was computed using the widely accepted method of weight (Kg) divided by the square of height (m²). The BMI was classified, based on (World Health Organization, 1997),²⁸ into 3 categories: normal (BMI=18.5-24.9 Kg/m²), overweight (BMI=25-29.9 Kg/m²), and obese (BMI≥ 30 Kg/m²). The second section of the questionnaire included a series of questions on students' use of vitamin and mineral supplement during the last year. If participants reported taking a supplement, they were asked to indicate the number, name, frequency of use, dosage, reasons for use, and source of information of the supplement. Each supplement was classified into

one of 3 product type classes based on their general nutrient/ingredient composition. The 3 classes were: vitamins, minerals, and vitamin-mineral combinations.

Data entry and statistical analysis were performed using the Statistical Package for Social Science (SPSS) program, for windows (version 11.5, SPSS Inc., Chicago, Illinois). Frequency and range checks were performed initially to detect errors in the data entry. Detected errors were corrected by rechecking the original data forms. Descriptive statistics such as means and standard deviation were used to summarize the quantitative variables. Proportions and percentages were used to summarize category variables. Chi-square test (χ^2) examined the relation between demographic, lifestyle characteristics, and vitamin-mineral supplement use, and to compare males and females relative to vitamin-mineral supplement use. *P* values ≤ 0.05 were considered for statistical significance.

Results. The study sample included a total of 1187 students, of this number 33.6% (n=399) were males and 66.4% (n=788) were females. The female to male ratio was approximately (2:1). The mean age for all subjects was 20.1 ± 1.3 years (range = 17-28 years). Nearly 63% of the students were between the ages of 17-20 years. Most (83.8%) were of normal weight. More than one quarter of students (26%) had a low level of family monthly income. Approximately 17% of students were current smokers. Approximately 27% of students were physically active compared with 73% of students who were physically inactive. Overall, 27.4%, (n=325), of students reported having used vitamin-mineral supplements during the past year. Table 1 shows the prevalence of vitamin-mineral supplement use among students by demographic and lifestyle characteristics. Gender was significantly ($p=0.002$) associated with vitamin-mineral supplement use. Females were more likely to use vitamin-mineral supplements than males. Age was also significantly associated with vitamin-mineral supplement use. Students with an age group between 17-20 years were more likely to use vitamin-mineral supplements than students with an age group between 21-28 years. There is a significantly increasing pattern in supplement use with increasing family monthly income. Nearly one third (32.0%) of students with incomes of 500 JD and more took supplements compared with 25.8% of students with incomes between 300 JD and 500 JD, and 17.7% of students with incomes less than 300 JD. Smoking was significantly associated with supplement use. Non-smokers were more likely to use supplements than current smokers or former smokers. Also, physical activity was significantly associated with supplement use. Physically active students were more likely to use supplements than

Table 1- Prevalence of vitamin-mineral supplement use among students by demographic and lifestyle characteristics.

Characteristic	Vitamin-mineral supplement users n (%)	<i>P</i> -value
Overall (N=1187)	325 (27.4)	-
Gender		0.002
Male (n=399)	87 (21.8)	
Female (n=788)	238 (30.2)	
Age		0.005
17-20 years (n=723)	221 (30.6)	
21-28 years (n=439)	100 (22.8)	
Family monthly income (JD)		0.001
< 300 JD (n=299)	53 (17.7)	
300-500 JD (n=225)	58 (25.8)	
> 500 JD (n=621)	199 (32.0)	
Smoking status		0.001
Non-Smoker (n=924)	276 (29.9)	
Former smoker (n=53)	7 (13.2)	
Current smoker (n=203)	41 (20.2)	
Physical activity		0.027
Physically active (n=206)	65 (31.6)	
Physically inactive (n=564)	145 (25.7)	
Vegetarian status		0.0001
Vegetarian (n=279)	102 (36.6)	
Non-vegetarian (n=872)	212 (24.3)	
Body mass index (Kg/m²)		0.019
Normal (<25) (n=964)	277 (28.7)	
Overweight (25≤30) (n=146)	29 (19.9)	
Obese (≥30) (n=37)	6 (16.2)	

JD - Jordanian dinar

physically inactive students. Also, vegetarian status was significantly associated with supplement use. Vegetarians were more likely to use supplements than non-vegetarians. Data analysis showed that BMI was significantly associated with supplements use. Students with a normal BMI were more likely to use supplements than overweight or obese subjects. The major 5 sources of supplement information were physician (45.8%), pharmacist (24.2%), family member (9.7%), personal information (8.4%), and friends (6.1%). Table 2 summarizes information regarding the prevalence of use of vitamin-mineral supplements in the studied sample. The leading supplements taken by students were vitamins, vitamin-mineral combinations, and minerals. Within the vitamin group, the 3 leading vitamins taken by subjects were multivitamins, vitamin C, and vitamin B12. Regarding vitamin-mineral combinations, the most commonly used combinations by subjects were multivitamin-multi minerals, vitamin C with iron, and vitamin D with calcium. As for minerals, the 2 most commonly used minerals as reported by students were iron, and calcium. Overall, the most frequently used supplements were multivitamins, multivitamins-multi minerals, vitamin C, iron, and vitamin B12. Females had significantly ($p=0.001$) higher mineral intake than

Table 2 - Prevalence of use of vitamin-mineral supplements by gender.

Vitamin- mineral supplement	Males (n=399)	Females (n=788)	Total (n=1187)	P-value
	n (%)			
<i>Vitamins</i>	145 (36.3)	325 (41.2)	470 (39.6)	0.52
Multivitamins	35 (8.8)	89 (11.3)	124 (10.4)	0.95
Vitamin C	38 (9.5)	77 (9.8)	115 (9.7)	0.95
Vitamin B12	22 (5.5)	41 (5.2)	63 (5.3)	0.65
Vitamin A	11 (2.8)	27 (3.4)	38 (3.2)	0.52
Vitamin E	12 (3.0)	25 (3.2)	37 (3.1)	0.95
Vitamin B complex	10 (2.5)	27 (3.4)	37 (3.1)	0.52
Folic acid	9 (2.3)	24 (3.0)	33 (2.8)	0.48
Antioxidant combination (Vitamin A + Vitamin E + Vitamin C)	8 (2.0)	15 (1.9)	23 (1.9)	0.52
<i>Vitamin-mineral combination</i>	46 (11.5)	147 (18.7)	193 (16.2)	0.01
Multivitamins – multiminerals	33 (8.3)	86 (10.9)	119 (10.0)	0.10
Vitamin C with iron	4 (1.0)	27 (3.4)	31 (2.6)	0.10
Vitamin D with calcium	4 (1.0)	20 (2.5)	24 (2.0)	0.50
Vitamin C with calcium	5 (1.3)	14 (1.8)	19 (1.6)	0.52
<i>Minerals</i>	8 (2.0)	96 (12.2)	104 (8.8)	0.001
Iron	4 (1.0)	71 (9.0)	75 (6.3)	0.001
Calcium	4 (1.0)	25 (3.2)	29 (2.4)	0.02

The percentage do not add to 100% because some respondents reported taking more than one vitamin-mineral supplement

Table 3 - Reasons for use of vitamin-mineral supplements as reported by students.

Reason	Males	Females	Total	P-value
	n (%)			
Treat disease	78 (53.8)	145 (44.6)	223 (47.4)	0.07
Enhance physical appearance	25 (17)	69 (21.2)	94 (20)	0.53
Supplement diet	17 (12)	43 (13.2)	60 (12.8)	0.96
Promote health	13 (9)	35 (10.8)	48 (10.2)	0.95
Prevent disease	12 (8.2)	33 (10.2)	45 (9.6)	0.95
Total	145 (100)	325 (100)	470 (100)	

males, particularly iron ($p=0.001$), and calcium ($p=0.02$) intakes. There was no statistically significant ($p>0.05$) difference between males and females regarding other types of vitamin-mineral supplements. Table 3 shows that reasons for use of vitamin-mineral supplements as reported by students were: to treat disease, to enhance physical appearance, to supplement diet, to promote health, and to prevent disease. There was no statistical significance ($p>0.05$) between males and females regarding reasons for vitamin-mineral supplement use.

Discussion. The results of this study showed that the overall prevalence rate of vitamin-mineral supplement use, during the last year, among university students was 27.4%. This overall prevalence rate of vitamin-mineral supplement use is lower than that found in several studies conducted worldwide, particularly among university students in USA where the rate varied from 47-74%,⁷⁻¹¹ in South Africa¹²

(42%), and in Korea¹³ (58%). Results of the present study show that vitamin-mineral supplement users were more likely to be of younger age, females, with a higher family monthly income, non-smokers, physically active, vegetarians, and of normal body weight (Table 1). Our study findings are in full agreement with findings from several studies in the developed world.¹⁵⁻²⁰ These results might indicate that supplement users as compared with non-users are likelier: to be health conscious, and to be at a greater awareness of health and healthy lifestyles. Among the survey participants, the most frequently used supplements were multivitamins (10.4%) and multivitamins-multi minerals (10%). Moore and Saddam¹⁰ reported that the most frequently used supplements were multivitamins (60%), vitamin C (37%), calcium (30%), vitamin E (19%), and iron (16%). Also studies in Korea¹³ and South Africa¹² reported that, the most frequently used supplements were multivitamins and vitamin-mineral

combination. The prevalence rates of most commonly reported supplements in our study is similar to the pattern of use, but much lower than that reported by the previous studies. Other studies reported that the main reasons for vitamin-mineral supplement use were to prevent illness, to improve overall health and well being, to supplement an inadequate diet, to improve energy, and to enhance physical appearance.^{7,10,12,23} Our study findings demonstrated that in Jordan reasons for use of supplements are mainly for treatment of diseases based on physician and pharmacist advice, whereas in developed countries reasons for use of supplements are mainly for disease prevention.

In this study, physicians and pharmacists were found as the primary source of information on supplements. This is inconsistent with the findings of other studies.^{9,11,12} The study recommends that health care providers should emphasize the need for concentrated efforts to use supplements for prevention among the general population rather than just only for treatment of diseases. Jordan, like other developing countries, is witnessing an epidemiological transition, which is characterized by an increase of non-communicable diseases, which is the leading cause of death in Jordan, and micronutrient deficiency diseases such as nutritional anemia (13-50%), iodine deficiency (33.5%), vitamin A deficiency (47%), and osteoporosis (23%).²⁶⁻³¹ Several studies and scientific reports in Jordan indicated a high prevalence of risk factors for chronic and micronutrient deficiency diseases such as unhealthy diet, smoking, and physical inactivity.^{25,26,30,31} A survey³² on the consumption of major food groups in Jordan indicated that food consumption is lower than the recommended intake by the dietary guidelines.³³ Also, variety, availability, and affordability of foods are inadequate among Jordanians. In addition, there is no mandatory fortification policy of stable foods in Jordan. This may indicate inadequate dietary intake of vitamins and minerals in the Jordanian diet. Furthermore, Jordan as a developing country has higher rates of smoking (45%) compared to developed countries.³⁴⁻³⁶ Also, the prevalence of current smoking among Jordanian university students was 28.6%.³⁶ It is well known that cigarette smoking is a major risk factor for chronic diseases and reduces plasma antioxidant concentrations.^{37,38} However, antioxidants may be of a great benefit in improving the quality of life by helping to prevent or postpone the onset of degenerative diseases.²⁹ Regarding physical inactivity, our results indicated that 73.2% of students were physically inactive whereas studies and scientific reports indicated that the levels of physical inactivity among Jordanian adult males and females were over 50%.²⁵ These results might indicate a more unhealthy, less illness-preventive lifestyle for Jordanians.

In developed countries, to prevent and treat chronic diseases and micronutrient deficiencies, new strategies were implemented to adopt healthy lifestyles, particularly following a healthy diet, being more physically active, and quit smoking. Also, mandatory food fortification policies of stable foods, as well as, encouragement of vitamin mineral supplement uses. In addition, great efforts have been carried out in developed countries to raise the awareness of the general public as well as health care providers to the importance of healthy lifestyles by health and nutrition education.^{1,5} Despite the high prevalence of chronic and micronutrient deficiency diseases, as well as a high prevalence of their risk factors in Jordan, no strategy that had been initiated to combat these problems in the previous decades. Recently, the Royal Philanthropic Gratiuity of King Abdullah II was lunched in December, 2002. The King called for a universal multivitamin-mineral tablet supplementation for all Jordanian school children. The vitamin-mineral supplement was added to biscuits provided in the school lunch meals and was served to all students in grades one through 6. The initiative covered 550,000 school children and was implemented in 2006.^{26,30,39} The King ordered policy makers and health planners to undertake a thorough investigation of this problem as well as to recommend the appropriate strategies to combat chronic and micronutrient deficiency diseases and their related risk factors. Our study has some limitations. First, it was performed in a single university, and therefore the sample may not be representative of the total population of university students in Jordan. It is highly recommended that an investigation of the prevalence of vitamin-mineral supplement use with a larger sample representing all Jordanian university students, as well as at the national level, be conducted in the near future. Second, the data presented are self-reported and may be subject to recall bias.

In conclusion, the overall prevalence rate of vitamin-mineral supplement use, among Jordan university students, is very low compared with the prevalence rate among university students in developed countries. Supplement users are more likely to be: females, nonsmokers, of higher family monthly income, physically active, vegetarians, and of normal body mass index. The main reason for supplement use is for treatment, and the major source of information on supplements is by physician and pharmacist.

References

1. Rock CL. Multivitamin-multimineral supplements: Who uses them? *Am J Clin Nutr* 2007; 85: 277S-279S. Review.
2. Boutayeb A, Boutayeb S. The burden of noncommunicable diseases in developing countries. *Int J Equity Health* 2005; 4: 2.

3. Food and Agriculture Organization of the United Nations. Undernourishment around the World. In: The State of Food insecurity in the World 2004. Rome: The Organization; 2004.
4. Diaz JR, Cagigas A, Rodriguez R. Micronutrient deficiencies in developing and affluent countries. *Eur J Clin Nutr* 2003; 57 Suppl 1: S70-S72.
5. Muller O, Krawinkel M. Malnutrition and health in developing countries. *CMAJ* 2005; 173: 27-48.
6. Caballero B. Fortification, supplementation, and nutrient balance. *Eur J Clin Nutr* 2003; 57 Suppl 1: S76-S78.
7. Ranelli PL, Dickerson RN, White KG. Use of vitamin and mineral supplements by pharmacy students. *Am J Hosp Pharm* 1993; 50: 674-678.
8. Spencer EH, Bendich A, Frank E. Vitamin and mineral supplement use among US medical students: A Longitudinal study. *J Am Diet Assoc* 2006; 106: 1975-1983.
9. Driskell JA, Krumbach CJ, Ellis DR. Vitamin and mineral supplement use among college Athletes. *J Am Diet Assoc* 1998; 98 Suppl 1: A17.
10. Moore KL, Saddam AM. Dietary supplement use among undergraduate college students. *J Am Diet Assoc* 1999; 99 Suppl 1: A96.
11. Herbold NH, Visconti BK, Frates S, Bandini L. Traditional and nontraditional supplement use by collegiate female varsity athletes. *Int J Sport Nutr Exerc Metab* 2004; 14: 586-593.
12. Steele M, Senekal M. Dietary supplement use and associated factors among university students. *South Afric J Clin Nutr* 2005; 18: 17-30.
13. Kim SH, Han JH, Zhu Qy, Keen CL. Use of vitamins, minerals, and other dietary supplements by 17- and 18-year-old students in Korea. *J Med Food* 2003; 6: 27-42.
14. Blendon RJ, DesRoches CM, Benson JM, Brodie M, Altman DE. Americans' views on the use and regulation of dietary supplements. *Arch Intern Med* 2001; 16: 805-810.
15. Knudsen VK, Rasmussen LB, Haraldsdottir J, Ovesen L, Bulow I, Knudsen N, et al. Use of dietary supplements in Denmark is associated with health and former smoking. *Public Health Nutr* 2002; 5: 463-468.
16. Messerer M, Johansson SE, Wolk A. Sociodemographic and health behavior factors among dietary supplement and natural remedy users. *Eur J Clin Nutr* 2001; 55: 1104-1110.
17. Ishihara J, Sobue T, Yamamoto S, Sasaki S, Tsugane S; JPHC Study Group. Demographics, lifestyles, health characteristics, and dietary intake among dietary supplement users in Japan. *Int J Epidemiol* 2003; 32: 546-553.
18. Tsang SN, Herbold NH, Pycz L. Dietary supplement use among active multi-ethnic adults. *J Am Diet Assoc* 2007; 107 Suppl 1: A34.
19. Radimer K, Bindewald B, Hughes J, Ervin B, Swanson C, Picciano MF. Dietary supplement use by US adults: Data from the National Health and Nutrition Examination Survey 1999-2000. *Am J Epidemiol* 2004; 160: 339-349.
20. Lyle BJ, Mares-Perlman JA, Klein BE, Klein R, Greger JL. Supplement users differ from nonusers in demographic, lifestyle, dietary and health characteristics. *J Nutr* 1998; 128: 2355-2362.
21. Kaufman DW, Kelly JP, Rosenberg L, Anderson TE, Mitchell AA. Recent patterns of medication use in the ambulatory adult population of the United States. *JAMA* 2002; 287: 337-344.
22. Eldridge AL, Sheehan ET. Food supplement use and related beliefs: survey of community college students. *J Nutr Educ* 1994; 26: 259-265.
23. Dorsch KD, Bell AB. Dietary supplement use in adolescents. *Curr Opin in Pediatr* 2005; 17: 653-657.
24. Tamim H, Dumit N, Terro A, Al-Hourany R, Sinno D, Seif F, et al. Weight control measures among university students in a developing country: a cultural association or a risk behavior. *J Am Coll Nutr* 2004; 23: 391-396.
25. Directorate of Disease Surveillance, Department of Noncommunicable Disease, Ministry of Health. Behavioral Risk Factor Survey. Amman, Jordan: Ministry of Health; 2004 [cited 2005]. Available from URL: <http://www.moh.gov.jo>
26. Alwan A, Kharabsheh S. Nutrition in Jordan. A review of the current nutritional trends and major strategic directions of the National Food and Nutrition Policy. Amman, Jordan; 2006. [Cited 2007]. Available from URL: <http://www.moh.gov.jo>
27. Khatib IM. High prevalence of subclinical vitamin A deficiency in Jordan: a forgotten risk. *Food Nutr Bull* 2002; 23 (3 Suppl): 228-236.
28. World Health Organization. Report of a WHO consultation on obesity. Preventing and managing the Global Epidemic, Geneva; 1997. Available from URL: <http://www.who.int/nut/obs.htm>
29. Alwan A. Noncommunicable diseases: a major challenge to public health in the region. *East Mediterr Health J* 1997; 3: 6-16.
30. Ministry of Health (MOH). Annual Statistical Book. Amman, Jordan; 2006 [Cited 2007]. Available from URL: <http://www.dos.gov.jo>
31. Karabsheh S, Qarqash W. A National Survey on Iron Deficiency Anemia and Vitamin A Deficiency. Ministry of Health (MoH) in Collaboration with WHO, UNICEF, and CDC, Amman, Jordan; 2002 [Cited 2004]. Available from URL: <http://www.dos.gov.jo>
32. Department of Statistics (DOS). Household Income and Expenditure Survey. Amman, Jordan 2002. Available from URL: <http://www.dos.gov.jo>
33. US Department of Health and Human Services; US Department of Agriculture. Dietary Guidelines for Americans, 2005. 6th ed. Washington, DC: US Government Printing Office; 2005.
34. World Health Organization. Global Cancer rates could increase by 50% to 15 million by 2020. *Saudi Med J* 2003; 24: 560-566.
35. Ministry of Planning and United Nation Development Program (UNDP). Jordan Human Development Report. Amman, Jordan; 2000.
36. Haddad L, Malak M. Smoking habits and attitudes towards smoking among university students in Jordan. *Int J Nurs Stud* 2002; 39: 793-802.
37. Cross CE, Traber M, Eiserich J, Vliet AVD. Micronutrient antioxidants and smoking. *Br Med Bull* 1999; 55: 691-704.
38. Gutteridge JM. Lipid peroxidation and antioxidants as biomarkers of tissue damage. *Clin Chem* 1995; 41: 1819-1828.
39. Department of Nutrition, Ministry of Health. Evaluation study of school Children's Multi-vitamin Supplementation Program. Ministry of Health. Amman, Jordan; 2004 [Cited 2006]. Available from URL: <http://www.dos.gov.jo>