

Fat Soluble Vitamins (A, E and K) Intake Among a Sample of Jordanian University Students

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Abstract: The present study evaluates the fat soluble vitamins (A, E and K) intake in a selected group of female and male university students living in Amman and Zarqa, Jordan. Eighty subjects (40 males, 40 females), aged 19-25 years, participated as random volunteers in the study. Students were asked to fill out a self-reported questionnaire that included questions on their eating and smoking habits. Also, their weight, height and body mass index (BMI) were measured. Dietary intake of total fat and fat soluble vitamins (A, E and K) were evaluated by means of a 3 days food record (2 weekdays and 1 weekend day). The nutrient calculations were carried out using the USDA's food composition tables. This study showed that about (36%) of the students were either overweight or obese (46% male students compared to 26% female students). The mean calculated daily intake of all vitamins for both sexes are below the recommended dietary allowances (RDA) except vitamin K intake for female students which was above the recommended adequate intake (AI). 90% of males and 70% of females had daily dietary intakes below two-thirds of the recommended dietary allowances (RDAs) for vitamin A. While, 90% of both genders had vitamin E intakes below two-thirds of the RDAs. For vitamin K, 70% of male students and only 30% of female students had daily intakes below two-thirds of the RDAs. Results indicate that university students may be at risk of deficiencies of mentioned vitamins. They would benefit from a nutrition and health promotion program to reduce the tendency of overweight and obesity among students, particularly males and to improve students' eating habits.

Key words: FFQ • Fat soluble vitamins • DRI • Vitamin status • RDA • Jordan

INTRODUCTION

Vitamins are organic compounds that cannot be synthesized by humans and therefore must be ingested to prevent metabolic disorders. They are organic compounds required in trace amounts to promote a multitude of body functions [1]. Inadequate intake or subtle deficiencies in several vitamins are risk factors for chronic diseases such as cardiovascular disease, cancer and osteoporosis. Vitamins are divided into two groups: water-soluble (B-complex and C) and fat-soluble (A, D, E and K). Unlike water-soluble vitamins that need regular replacement in the body, fat-soluble vitamins are stored in the liver and fatty tissues and are eliminated much more slowly than water-soluble vitamins. Because fat-soluble vitamins are

stored for long periods, they generally pose a greater risk for toxicity than water-soluble vitamins when consumed in excess. Eating a normal, well-balanced diet will not lead to toxicity in otherwise healthy individuals. However, taking vitamin supplements that contain mega doses of vitamins A, D, E and K may lead to toxicity.

Dietary Reference Intakes (DRI) are dietary standards for desirable and/or safe vitamin intake levels published by the Food and Nutrition Board of the National Academy of Sciences National Research Council. DRIs include three sets of values: recommended dietary allowances (referred to as RDAs) which are intended to meet the nutrient needs of healthy individuals; tolerable upper intake levels (UL) which are designed to help people avoid harmful effects caused by consuming too much of a nutrient and

adequate intakes (AI), which are established when there is not enough scientific evidence to set an RDA and are based on diets known to be nutritionally adequate for U.S. and Canadian populations [2].

Vitamin A refers to a family of fat soluble compounds called retinoids, which have vitamin A activity. Retinol is the predominant form and 11-*cis* retinal is the active form important for vision. Approximately 50 of the more than 600 carotenoids can be converted to vitamin A. The current RDA for vitamin A is 900 and 700 µg/d for males and females, aged 19-30 years, respectively. Preformed vitamin A is found only in animal products, including organ meats, fish, egg yolks and fortified milk. Retinol-binding protein binds vitamin A and regulates its uptake and metabolism. Vitamin A is critical in vision (particularly night vision), the immune response and epithelial cell growth and repair, among other functions. Vitamin A deficiency is marked by xerophthalmia, night blindness and increased disease susceptibility.

Vitamin D (calciferol) is not a true vitamin, since humans are able to synthesize it with adequate sunlight exposure. Vitamin D may also be ingested in the diet in the form of vitamin D₃, a prohormone. Food sources include fortified milk, saltwater fish and fish-liver oil. Vitamin D deficiency is associated with rickets in children. In adults, vitamin D deficiency leads to secondary hyperparathyroidism, bone loss, osteopenia, osteoporosis and increased fracture risk. [3].

Vitamin E is fat soluble and composed of a family of 8 related compounds, the tocopherols and the tocotrienols. Vitamin E, like other antioxidants, can scavenge free radicals and may, as a result, prevent oxidative damage to lipid membranes and low-density lipoprotein (LDL). Vitamin E is also needed in immune function and supplementation enhances cell-mediated immunity in elderly patients [4]. The current RDA for vitamin E is 15 mg /d, for both sexes aged 19-30y. Major dietary sources of vitamin E include salad oils, margarine, legumes and nuts. In people who take supplements (approximately 1 in 3 people), however, the greatest contributor to total intake is supplements. Vitamin E deficiency is rare and is seen primarily in special situations resulting in fat malabsorption, including cystic fibrosis, chronic cholestatic liver disease, abetalipoproteinemia and short bowel syndrome.

Vitamin K is fat soluble and essential for normal clotting, specifically for production of prothrombin. It is also necessary for normal bone metabolism. The current RDA for vitamin K is 120 and 90 µg/d for males and females, aged 19-30 years, respectively. Dietary sources of

vitamin K include dark green vegetables, particularly spinach, but it is also synthesized by intestinal bacteria. Vitamin K deficiency, which results in clotting disorders, occurs when either intake is inadequate or intestinal bacteria, which synthesize vitamin K, are altered.

Dietary habits of young Jordanian adults are affected by the fast-food market. As a consequence, Inadequate intake of vitamins, overweight and obesity, in combination with unhealthy life style, such as smoking and physical inactivity, may increase the risk of chronic diseases. In this regard, nutritional knowledge may act as a deterrent against fast food trend. Thus, universities may contribute significantly in reducing the prevalence of obesity among the young population through the promotion of healthy eating habits. Universities may provide an ideal forum for reaching out to a large number of young adults through nutrition education programs that may positively influence students' eating habits by advocating for the adoption of healthy food choices. Most studies examining vitamin status were carried out in the United States and Europe. Universities and colleges are potentially important targets for the promotion of healthy lifestyles of the adult population. However, little is known concerning the fat soluble vitamins intake and nutritional and health related behavior of Jordanian university students. Using dietary intake assessment, the present study evaluates the fat soluble vitamins status in a selected group of Jordanian university students living in Amman and Zarqa, Jordan.

MATERIALS AND METHODS

Subjects: Eighty (40 males, 40 females) students, (17 males and 28 females from Applied Science University, Amman and 23 males and 12 females from Zarqa community college) aged 19-25 years, participated as random volunteers in this study. Short subjective questionnaires were answered by subjects concerning their health, nutritional practices, use of vitamin supplementation and medication. Data were collected by trained students from Applied Science University enrolled in nutrition courses, during Feb-May, 2005.

Dietary Intake: Dietary intake of total fat and fat soluble vitamins (A,E and K) were evaluated by means of a 3 days food record (2 weekdays and 1 weekend day). To this end, all of the participants were instructed on how to record their daily dietary intake. Food quantities were calculated using household measurements (plate, glass, slice, spoon, etc.) during the three periods. Then individual records

were reviewed and the nutrient calculations were carried out using the USDA's food composition tables [5]. The responded individual food items were converted to average daily intake of vitamins A,E and K for each participant. The average daily intakes of individual vitamin items were summed to compute the total intake from each vitamin.

Statistical Analysis: Statistical analyses of each vitamin were characterized by means, standard errors and percentage of nutrient intake. Comparisons of mean differences were calculated by Student's t-test.

RESULTS

Mean age, height, weight and body mass index (BMI) of these subjects are given in Table 1. Mean BMI was different between the two genders. A large proportion of males (35.7%) reported smoking as compared to the women students (3.6%).

The estimated mean daily intakes of total fatty acids and Vitamin A,E and K, calculated from the dietary record data are presented in Table 2. The mean calculated daily intake of all vitamins for both sexes are below the recommended dietary allowances (RDA) except vitamin K intake for female students which was above the recommended adequate intake (AI). The percentage of nutrient intake for vitamins A,E and K with values below two-thirds (RDA<67%) or more than 100% of the recommended dietary allowances are indicated in Table 3. Ninety percent of males and 70% of females had daily dietary intakes below two-thirds of the recommended dietary allowances (RDAs) for vitamin A. Wile, 90% of both genders had vitamin E intakes below two-thirds of the RDAs. For vitamin K, 70% of male students and only 30% of female students had daily intakes below two-thirds of the RDAs.

DISCUSSION

The current study showed that about 46% of male students and 26% of female students were either overweight or obese (Mean BMI 27.9 and 23.1 for males and females, respectively). These results are in agreement with other studies in Jordan as well as other regional countries. Among Jordanian adults the overall prevalence of obesity was 49.7%; 32.7% in males and 59.8% in females [6,7]. Jordan population and Family Health Survey (JPFHS,2002) indicates that, the mean BMI of women in Jordan is 26.6, higher than the normal BMI range of

Table 1: Characteristics of the participants

Variable	Males (n = 40)	Females (n =40)
Age (y)	22.2±2.3*	21.9±0.8
Height (cm)	179.2±9.1	161.8±3.4
Weight (kg)	89.9±18.1	60.3±10.9
BMI (kg m ⁻²)	27.9±4.7 (46%)**	23.1±4.1 (26%)**
Using multivitamin supplements	4.7%	3.5%
Cigarette smoking	39.7%	13.6%

n = number of individuals studied, BMI = Body mass index

*Mean±S.D., **proportion of subjects with BMI>25 kg m⁻²

Table 2: Estimated daily intakes (mean±S.D) for total fat and Vitamins

Nutrients	Males	Females
Vitamin A (mcg RAE)	554.1±98.8	391.5±31.8
Vitamin E (mg)	4.99±0.8	2.73±0.9
Vitamin K (mcg)	69.3±9.9	118.2±10.3
Fat (g)	48.6±4.5	42.4±4.8
Total fatty acids		
Saturated (g)	17.4±2.5	12.6±4.3
Monounsaturated (g)	18.7±4.8	10.7±4.2
Polyunsaturated (g)	8.4±2.9	5.2±1.3

Table 3: percentage of subjects at risk of vitamin deficiency

	Dietary intake, U.S.RDA/AI *					
			>100%		<67%	
	M	F	M	F	M	F
Vitamin A (µg/d)	900	700	10.0	10.0	90.0	70.0
Vitamin E (mg/d)	15	15	10.0	0.0	90.0	90.0
Vitamin K (µg/d)	120	90	20.0	50.0	70.0	30.0

*RDA/AI for males and females, aged 19-30 years

18.5- 24.9. Forty-one percent of women fall in the normal BMI category. Five percent of women fall below the cut off of 18.5, indicating that the level of chronic energy deficiency is relatively low in Jordan. However, an alarming proportion of women-more than half (54%)- have a BMI of over 25 and thus can be considered overweight or obese [8].

The national behavioral risk factor survey in Jordan conducted in 2004 indicated increase in the prevalence of obesity among Jordanian adults to 19.5% in 2004, a 52.3% increase from the 2002 prevalence of 12.8%. In 2004, approximately 55.0% of adult respondents (52.3% of men and 57.1% of women) were categorized as either overweight or obese[9]. In the United States, 35% of the college students are reported to be overweight or obese (BMI=25) [10].

In the present study, the mean daily nutrient intakes of vitamin A, vitamin E, vitamin K and total fat were estimated by the FQF method. The total fat intake was 48.6 g for males and 42.4 g for female students. About 35.8% of the total fat came from saturated fatty acids for males, while in female students saturated fatty acids contribute about 30% of the total fat intake. Most male and female students consume <67% of the RDA for vitamins A, E and K. Therefore, students should be encouraged to increase their consumption of foods rich in these vitamins like green vegetables (spinach, salads, broccoli), fruits and vegetable oils.

The nutritional status of female students at Jordan universities was studied by Rawashdeh [11]. Eighty female students aged 19 to 21 Y participated in this study. The mean daily intake of total fat was 99.4 g, monounsaturated fats 30.2 g, polyunsaturated fats 27.6 g and saturated fats 41.6 g. At the same time their vitamin A intake was 509 RE (27.3% less than RDA) and vitamin E 20 mg (33.3% above the RDA). A recent cross-sectional survey of 220 students (43.6% male and 56.4% female), aged 20±1.9 years, was conducted in Lebanon [12]. This study showed that the majority of the students (64.7%) were of normal weight (49% male students compared to 76.8% female students). The prevalence of overweight and obesity was more common among male students compared to females (37.5% and 12.5% vs. 13.6% and 3.2%, respectively). In contrast, 6.4% female students were underweight as compared to 1% males. Eating habits of the students showed that the majority (61.4%) reported taking meals regularly. Female students showed healthier eating habits compared to male students in terms of daily breakfast intake and meal frequency. 53.3% of female students reported eating breakfast daily or three to four times per week compared to 52.1% of male students. There was a significant gender difference in the frequency of meal intake ($P=0.001$). Intake of colored vegetables and fruits was common among students. A total of 30.5% reported daily intake of colored vegetables with no gender differences (31.5% females vs. 29.2% males). Alcohol intake and smoking were not common among students.

In a Longitudinal dietary study in China during 1989-1993 on a sample of 5625 adults aged 20-45 y the average daily intake of fat was 67.8 g [13]. In another study, a self-reported questionnaire was administered to 540 students, ranging in age from 19-24 years participated in the study which showed that 80.5% of students had a normal BMI and 16.6% of students were underweight with the prevalence of BMI>30 obesity being very low in this study sample. Young Chinese female students had a

greater desire to be thinner (62.0%) than males (47.4%). [14]. Ohno *et al.* [15] found that the Mean daily nutrient intake of Nepalese subjects of Fat 31.9 g and 30.8 g; Saturated fatty acid 9.96 g and 11.08 g; Monounsaturated fatty acid 11.06 g and 10.01 g; Polyunsaturated fatty acid 6.02 g and 4.97 g; Vitamin A 462 µg RE eq and 519 µg RE eq and for Vitamin E 5.8 mg and 5.0 mg for males and females respectively.

Nutrition scientists generally believe that healthy diets are the ones with most diverse diets. The nutrients essential for meeting nutritional requirements are not all usually found in a single food item; they are however present in a diet composed of a number of foods [16]. Diverse diets have been shown to protect against chronic diseases [17]. Accurate assessment of dietary intakes, when based on self-report in free-living populations poses significant scientific challenges. All standard dietary assessment methods including food records, dietary recalls and list-type methods such as food frequency questionnaires (FFQ), are subjected to considerable error and bias and none of these can be considered as a 'gold standard' measure [18]. However, FFQ has become a common way to estimate usual food intake because it usually requires less than thirty minutes to complete.

In terms of eating habits, university students usually do not follow healthy eating habits. The typical university student diet is high in fat and low in fruits and vegetables. Students often select fast food due to its palatability, availability and convenience. Eating habits and dietary intakes are changing rapidly in the developing world. Substantial increase in the intakes of fats, sugars and salt have led to imbalanced nutrition and overnutrition. Food consumption pattern is considered from the most factors that lead to chronic diseases. High intake of fat and cholesterol foods leads to cardio vascular disease (CVD), while foods rich in complex carbohydrates, dietary fibers, fruits and vegetables may prevent diabetes, CVD and some types of cancer [19].

These results suggest that improvements in the diet and nutritional status are needed in this people group, although such improvements may take time. Improving students' knowledge about nutrition and healthy eating habits may promote healthy body weight management among students and reduce the prevalence of overweight and obesity. A recent study conducted among college students reported that increased knowledge of dietary guidance, Dietary Guidelines for Americans 2005, appeared to be positively related to more healthy eating patterns thus the better eaters had a higher level of

knowledge about nutrition [20]. Therefore, developing a nutrition education programs for university students which encourage increase consumption of fruits and vegetables is recommended for a good health.

CONCLUSION

Results indicate that university students may be at risk of deficiencies of mentioned vitamins. They would benefit from a nutrition and health promotion program to reduce the tendency of overweight and obesity among students, particularly males and to improve students' eating habits. Biochemical assessment may be needed to confirm that there is low status and based on that supplementation, fortification or changing of eating habits can be considered.

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