Review Article

Vitamins Minerals and Fibres in Adolescence Diet

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Abstract

Adolescence is a unique developmental stage and has its own requirements apart from other developmental stages of humans. Due to increased growth and mental maturation nutrition during this period has its own characteristics that need to be discriminated.
Vitamins and minerals contribute the body for sustaining functions although they are not an energy source. Most of the vitamins are not produced in the body; therefore they must be taken with food. Also; calcium, iron and zinc requirement which are essential for growth are increased in this period. Adequate fiber presence in the diet is important for normal defecation as well as prevention of some chronic diseases. In addition, it may also plays role in decreasing serum cholesterol levels and risk of obesity.

Key Words: Adolescence; vitamins, minerals; nutrition

Introduction

Adolescence is a period with important opportunities for identification of risky behaviours for health, adopting and maintaining protection ways. Vitamins and minerals contribute the body for sustaining functions. Although they are not an energy source; they contribute lytic reactions of carbohydrates (CHO), proteins and fats; therefore also contribute to the energy production.

Minerals in Adolescence

Puberty is a fast-growing period and it increases requirement of many vitamins and minerals (Aykut, 2011; Büyükgebiz, 2013). The lifestyles change and affect adolescence nutrition. Unbalanced daily diet is a risk for inadequate mineral intake. A study by Seidler et al. studied adolescents aged 16 to 19 years (Seidler, Ksiazek, & Sobczak, 2013). He determined the daily intake of calcium, magnesium, phosphorus, sodium, potassium, iron, zinc and copper in that particular group. Potassium daily intake was low; less than 2350 mg and 1800 mg respectively for girls and boys compared to recommended values. However high sodium intakes for girls and boys exceeded recommended values by 2.1 and 2.8 times; respectively. Also in adolescent males intakes higher than the recommended doses of phosphorus, iron and copper were observed. Insufficient intake of calcium and magnesium estimated average requirements were noted in some cases. His results showed that the adolescents in that group had an unbalanced mineral content intake.

Similarly National Growth and Health Study data give valuable information about the diatary micronutrient adequacy among 2379 girls (L. Moore, Singer, Qureshi, Bradlee, & Daniels, 2012). Ninety percent of the girls failed to consume the recommended amounts of fruit, vegetables and dairy. Seventy-five percent of girls consumed meat group less than the recommended amounts. Majority of girls had inadequate intakes of calcium, magnesium, potassium, and vitamins D and E. On the contrary; In contrast, they

consumed >750 kcal/day from the category of solid fat and added sugars, about five times the recommended maximum intakes. These data elucidate the need of dietary interventions in this age group like educational programs, including family and parental coverage.

Calcium, iron and zinc requirement which are essential for growth are increased in adolescence (Aykut, 2011). Amount of calcium in the skeleton at birth is approximately 25 gram and it progressively increases during childhood and adolescence (Aykut, 2011; Erkan, 2011; Özön, 2006). Bone mineral content rapidly increases during 11-14 years in girls and 13-17 years in boys. Although when Peak Bone Density (PBD) acquired is not exactly known; it has been suggested that it is completed during adolescence (Özön, 2006). Approximately %51 and %25 of the PBD is acquired during growth period of puberty and peak period of growth rate; respectively (Aykut, 2011; Tarım, 2006). Bone mineralization may become insufficient in the rapid growth period of adolescence and fracture risk may arise because acceleration of bone mineralization follows acceleration of growth rate with 6-12 months of latency (Tarım, 2006). Forty-five percent of the bone mass is acquired in the adolescence period; therefore calcium storage in this period is crucial (Erkan, 2008). PBD is majorly (%60-80) affected from inheritance and it was suggested that it is also affected from environmental factors such as nutrition and exercise (Özön, 2006). For preventing osteoporosis or reducing the risk of osteoporosis; initially regulation of the nutrition, adequate calcium and vitamin D intake and regular exercise is quite important as pre-emptive measures in adolescence. Daily calcium requirement is 900-1300 mg for both genders (Mahan, K. and Escott-Stump, 2008; Özön, 2006).

For meeting calcium requirement of adolescent; intake of lipid, saturated fat and cholesterol must be below under recommended level; and fat-free or half-fat milk and milk products must be consumed by overweight adolescents for helping limitation of energy intake (Aykut, 2011). In addition, consumption of calcium-rich nutrients for 3-4 times in a day is recommended. At least 3 cup of milk or yogurt and 1-2 matchbox-sized cheese must present in meals daily. However, results of the studies indicate that calcium intake is usually decreased in this period (Erkan, 2011). However calcium supplementation is not always beneficial. An interesting study in Gambian adolescents showed that, twelve months of calcium carbonate supplementation before puberty had a long-term effect on the pattern of height growth. An earlier cessation of growth and shorter adult stature was the final result that cautioned against the application of calcium dietary recommendations between populations without supporting evidence (Prentice, Dibba, Sawo, & Cole, 2012).

Zinc involves more than 200 enzymes in the body. It is essential for protein production and gene “expression” (Board, 2001). It is also very important for growth and sexual development in adolescence. Zinc is vital to many body functions including vision, taste acuity, immunity, and metabolism of other micronutrients. So malfunctioning of one system affects the whole body. Adolescence particularly must have well functioning organs and systems especially in the process that they mature. Any deficiencies in the intake of micronutrients will affect the future health. Adolescents generally have unhealthy eating habits because of changing lifestyles. Zinc status also affects vitamin A use because zinc containing proteins are needed in its metabolism (Sandström, 2001). Adolescents aged 9-13 need 8 mg/day of zinc. Boys aged 14-18 need 11 mg/day of zinc whereas girls aged 14-18 need 9 mg/day of zinc. By the regulation of zinc levels by diet and supplementation, prevention of problems in children as shortness and low weight is possible (Mahan, K. and Escott-Stump, 2008). Zinc deficiency in adolescent girls is associated with poor cognitive functions and impaired taste acuity (Chiplonkar & Kawade, 2014). Meeting zinc requirements during adolescence may really be a problem. A study conducted in Spanish adolescents revealed that mean Zn intake was 11,36 mg/d, 76% of the recommended value for Spanish adolescents (Mesías, Seiquer, & Navarro, 2012). Here the effect of

diet is important. High phytate containing diets may interfere with the absorption of zinc. Mediterranean diet is an example to this condition. However zinc consumption in required amounts may allow the status of zinc to be acceptable during adolescence. Red meat, fish and all seeded grains are rich in zinc (Erkan, 2008). There are of course measures to be taken for zinc low intake. In a study conducted in Mexican adolescent girls; fortified milk intake was effective in increasing zinc intake and its plasma levels. The authors concluded that fortified milk may be a solution for zinc deficiency prevention and treatment in adolescent girls (Méndez et al., 2012). In a study zinc and micronutrient supplementation was effective in adolescent girls in improving vitamin A and zinc status (Chiplonkar & Kawade, 2012). The study showed that food supplementation caused significant elevations in plasma zinc, beta carotene and vitamin C.

There are individual differences determining need of iron in adolescence. Onset age of puberty, growth rate and duration of maturation involve in these differences. Need of iron in puberty is correlated with the increases of muscle mass and blood volume. Menstruation is an additional risk factor for iron deficiency in girls (Özön, 2006). Therefore iron lost with menstruation is added to the iron requirement in girls. Daily iron requirement is 12 mg in boys and 15 mg in girls (Erkan, 2011). Iron deficiency, especially in adolescent girls; is the most common nutrition deficiency in the low socioeconomic level and pregnant adolescents (Erkan, 2011). Iron absorption is low in individuals consuming vegetative nutrients; therefore they need at least twice as more iron for adequate iron intake (Özön, 2006). Several health problems may occur due to insufficient or excessive intake of nutrition requirements (Büyükgebiz, 2013).

Vitamins in Adolescence

Vitamins also play important role for maintaining body health. Most of the vitamins are not produced in the body, therefore they must be taken with food (Baysal, 2009).Normally, adequate vitamin intake is acquired with a healthy nutrition (Özön, 2006). Folic acid and vitamin B12 intake must be increased for performing DNA and RNA metabolisms during increased tissue production (Büyükgebiz, 2013). Daily folate requirement is 300 mg in ages 9-13 and 400 mcg in ages 14-18. Adolescents who generally have no breakfast or consume no orange juice or grain are in risk (Erkan, 2011).

Vitamin B6 and vitamin D are required for tissue and skeleton development (Büyükgebiz, 2013). Vitamin D also plays important roles in Ca balance, maintaining integrity of skeleton system, cell growth, cell difference and production, hormone secretion (Holick, 2004). Cancer, hypertension, type 1 and 2 diabetes, cardiovascular diseases, rheumatoid arthritis, multiple sclerosis, autoimmune diseases and schizophrenia has been associated with vitamin D insufficiency (Holick, 2004). Required daily consumption of vitamin D is 400 IU. Children, adolescents, young and adult male consume recommended vitamin D with their diet daily; however young and adult female consume low vitamin D amounts (C. Moore, Murphy, Keast, & Holick, 2004). Approximately %14 of the adolescents have vitamin D deficiency (Saintonge, Bang, & Gerber, 2009). In a statement from New Zealand targeted measurement of vitamin D levels is recommended for infants, children and adolescents with at least one risk factor for low vitamin D. In case of deficiency daily low-dose vitamin D supplements can be used, although barriers to adherence have been identified. Also high-dose intermittent vitamin D is recommended for children and adolescents (Paxton et al., 2013). According to the Society for Adolescent Health and Medicine Recommendations; providing vitamin D supplementation of 600 IU daily (400–800 IU daily, given preparation availability on market) for healthy adolescents, and at least 1,000 IU daily for adolescents who are at risk for vitamin D deficiency or insufficiency, in addition to vitamin D received through the diet or via sun exposure is required (Zeev Harel, Barbara Cromer, Amy D. DiVasta, Catherine M. Gordon, 2013).

Vitamin D and calcium have important anticancer effects in animal studies. An inverse relation between adolescent total vitamin D intake and proliferative benign breast disease was observed in a study (Su et al., 2012). In that study women in the highest quintile of vitamin D intake during adolescence had a 21 % lower risk of proliferative benign breast disease. Vitamin D affects general health. Association of vitamin D intake and cardiometabolic risk factors were evaluated in a study conducted in Azorean adolescents. In that study; a lower level of vitamin D intake was associated with worse metabolic profile (Moreira et al., 2014).

Serum vitamin D levels were significantly lower in adolescents with weight excess, abdominal obesity, hypercholesterolemia, higher levels of parathyroid hormone, insulin resistance, hyperinsulinemia and hypertension in a study conducted by Oliveira et al (Oliveira et al., 2014). In his study vitamin D insufficiency was primarily due to nutritional deficiencies and a vitamin D intake. That study also addresses the need in vitamin D intake even in sunny places like Brazil.

New cells need vitamins A, C and E for functioning; thiamine, riboflavin and niacin for metabolizing calorie requirement (Büyükgebiz, 2013). Vitamin A has roles in normal seeing, cell differentiation, gene expression, morphogenesis, fertility, growth and immune system (Saintonge et al., 2009). According to WHO the mean requirement of Vitamin A in adolescent group aged 10-18 is 330-400 µg RE/day and the recommended safe intake is 600 µg (WHO, 2004) . Grain and grain products are very important for health because they are rich in vitamins, minerals, carbohydrate (starch, fiber) and other nutrients. Although proteins in the cereals are low quality; combination with other nutrients (dry legumes or meat, milk, egg) may increase protein quality. Cereals are rich in vitamin E, group B vitamins (except vitamin B12) and especially vitamin B1 (thiamine) (Health, 2013). Most important vitamin A sources are liver, milk, carrot, margarine and cheese (Erkan, 2011). Consumption of vitamin A, C, B6 and folate is low in adolescents. Dietary vitamin C in adolescents and vitamin E in were lower than that the recommended daily doses in a study by Dybkowska et al (Dybkowska, Waszkiewicz-Robak, & Piekot, 2014). Among adolescents rate of having diets deficient in vitamins C and E was 47% to 67% in her study. Most important reason is insufficient and imbalanced nutrition in this age group (Büyükgebiz, 2013). Vitamin E is an antioxidant and daily requirement is 11 mg in ages 9-13 and 15 mg in ages 14-18. Vitamin C is a vitamin required for synthesis of collagen and other connective tissues. Its daily requirement is 45 mg in ages 9-13, 75 mg in boys aged 14-18 and 60 mg in girls aged 14-18. Smokers must take 35 mg of more vitamin C than non-smokers (Garriguet, 2010).

There is evidence that low concentration of biomarkers in the blood during adolescence (i.e., iron status; retinol; and vitamins B6, B12, C, and D) may be involved in development of chronic diseases, such as hypertension. Helena study in Europe evaluated whether iron biomarkers and vitamins in the blood are associated with blood pressure in European adolescents or not. In this study; levels of red cell folic acid and vitamin B6 in blood found to effect blood pressure to some extend in adolescents. The authors concluded on the importance of healthy eating behaviours in adolescents to avoid high blood pressures (de Moraes et al., 2014) .

Mental health and behaviours are related to vitamins. Both excess and low levels may affect neurological systems. An interesting study by Herbison et al. conducted in adolescents in West Australia evaluated B-group vitamins and adolescent mental health and behaviour association (Herbison et al., 2012). In the study low intake of vitamins B1, B2, B3, B5, B6, and folic was associated with higher externalising behaviour scores and reduced intake of vitamin B6 and folate was associated with higher internalising behaviour scores. The authors concluded that poor nutrition may have some effect in the pathogenesis of mental disorders.

A study conducted in Brazil showed that, mean energy consumption and distribution of

macro-nutrients were adequate on a daily basis. However in this study, vitamin and mineral intake was inadequate and high sodium and low levels of calcium consumption was the case. Among 14 to 18 year old females; also iron intake was low (Veiga et al., 2013).

Fibres in Adolescence

Adequate fiber presence in the diet is important for normal defecation as well as prevention of some chronic diseases. In addition, it may also plays role in decreasing serum cholesterol levels and risk of obesity. Daily fiber intake is usually adjusted as "age+5 grams" rule and the upper limit is "age+10 grams" (Health, 2013). Adherence to guidelines may improve dietary fibre intake. A good example of this is given in the study that showed adherence to the Korean national dietary guidelines in Korean adolescents correlated with improved intake of dietary fiber (Park, Na, Kim, Kim, & Sohn, 2012). In general population high fiber diet intake decreases risk and incidence of stroke as reported by a study enrolled 1647 subjects (Casiglia et al., 2013). Early exposure to risk factors of certain diseases is important. Certain preventive measures may be taken at early stages like adolescence. Breast cancer is an interesting example to this. Adolescent diet and risk of breast cancer association was evaluated by Liu at al. (Liu, Colditz, Cotterchio, Boucher, & Kreiger, 2014). In his study he enrolled women at ages of ages 25 to74 years, who were diagnosed with first primary breast cancer. Diet at ages 10-15 was assessed and inverse associations were found between intakes of dietary fiber, vegetable protein, vegetable fat, and nuts during adolescence and breast cancer risk. Also increasing dietary fiber may be a way of relieving childhood constipation. Fiber intake is associated with low cardiovascular risk. The consumption of fibres at early ages probably is better; like childhood and adolescence. A study that examined carotid artery stiffness and lower lifetime dietary fiber intake was published in 2012 (van de Laar et al., 2012). The results showed that subjects with stiffer carotid arteries consumed less fiber then than the ones with less stiff carotid arteries. Adolescent fiber consumption, inflammation, and body fat distribution was investigated in a study with 559 adolescents aged 14-18 years. The paper noted that dietary fiber intake was inversely associated with fat mass and serum leptin in males but not in females. In both genders, dietary fiber intake was negatively related to visceral adipose tissue, plasma C-reactive protein, and plasma fibrinogen and positively related to plasma adiponectin. Parikh et al. in their study concluded that greater consumption of dietary fiber was associated with lower visceral adiposity and multiple biomarkers implicated in inflammation (Parikh et al., 2012). With their findings they suggested inclusion of fiber-rich, nutrient-dense, plant-based foods. Also a similar finding was reported by Davis et al. who studied overweight Latino youth at ages 11-17 years. In his study increases in total dietary fiber and insoluble fiber was associated with decreases in visceral adipose tissue. In his study he found that small decreases of fiber intake (3 grams /day) had significant increases in visceral adipose tissue (Davis, Alexander, Ventura, Toledo-Corral, & Goran, 2009).

Among adolescents high intake of dietary fibre is associated with metabolic syndrome as stated by the authors of the paper which reported a cross-sectional analysis of 12 to 19 years old boys and girls participated in the National Health and Nutrition Examination Survey 1999-2002 (Carlson, Eisenmann, Norman, Ortiz, & Young, 2011).

Consumption of fiber rich food during childhood and adolescence will be an effective way of lowering future cancer diseases and atherosclerotic complications.

In conclusion, the nutrition requirements of adolescents are different from other age groups owing to increased growth and development. Vitamins, minerals and fibres must be consumed at adequate quantities during adolescence to achieve a healthy condition in the future life.

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