

Chapter IX

Factors influencing Fruit and Vegetable Intake in Adolescents

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Abstract

Fruit and vegetable intake (FVI) is an important factor in the preservation of health and the prevention of disease. Many dietary habits established during adolescence continue into adulthood, such as FVI. According to the World Health Organization, the daily FVI of adolescents was below the recommended values worldwide, despite the long-term health benefits associated with FVI. In this chapter, we updated and expanded previous research about factors influencing FVI during adolescence. Due to inductive thematic analysis based on Social Ecological Theory and Social Cognitive Theory, we identified three key factors that influence FVI: (a) individual factors (e.g., gender, age, knowledge, self-efficacy, taste preference and liking of FV, outcome expectations/expectancies, skill in preparing fruit and vegetable); (b) social factors (e.g., parents intake and modeling, parents and family support, family meals, peers influence); and (c) environmental factors (e.g., income, parents occupational status, parents education, household availability, school availability, neighborhood, television viewing). Development strategies and effective intervention programs aimed to increase FVI and to promote adolescents' healthy dietary behaviors could be achieved by understanding the relationship between FVI and above factors.

Keywords: Fruit, Vegetable, Intake, Adolescence, Individual, Social, Environmental, School

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Fruit and Vegetable Global Outlook

Fruit and vegetable intake (FVI) is an important factor in the preservation of health and the prevention of disease. A variety of fruits and vegetables provides several essential nutrients that we need for optimal growth and repair, such as water, dietary fibers, vitamins, minerals, phytochemicals, with most fruits and vegetables are low fat foods needed in a healthy diet [1]. According to the World Health Organization (WHO) recommendations, and most national and international dietary guidelines around the world, all individuals should consume 400 grams of fruit and vegetables daily, or five servings of fruit and vegetables per day as a minimal amount [2-4]. Starting at childhood, high FVI seems to decrease prevalence of many chronic diseases, such as coronary heart disease (up to 31%), cancer (12-20%), stroke (up to 19%), while 2.7 million deaths per year are attributable to diets low in fruits and vegetables worldwide [2, 5]. A review from 52 low- and middle-income countries showed that 77.6% of men and 78.4% of women consumed less than the minimum recommended daily servings of fruits and vegetables [6]. Another study in five Asian countries showed that 63.5% of men and 57.5% of women had inadequate FVI [7]. In developed countries like USA and Australia, authors reported similar low FVI [8, 9]. Furthermore, studies conducted among adolescents in developing and developed countries showed insufficient FVI as reported in adults [8, 10]. Recent study in Curitiba [11] estimated frequency and adequacy of FVI among 341 Brazilian adolescents. Authors shown that only 3.5% of Brazilian adolescents have adequate FVI. Another cross sectional study among 402 adolescents in Tabriz, Iran reported only one third of adolescents had the optimal FVI, with 30.3% and 34.6% adolescents consumed recommended daily servings of fruits and vegetables, respectively [12]. Furthermore, data from five Southeast Asian countries (16,084 adolescents aged 13-15 years) shown that 76.3% of adolescents had FVI less than five servings per day [7]. Developed countries had similar results concerning FVI in adolescents. De-Bourdeaudhuij and colleagues [13] investigated predictors of daily FVI in nine European countries that, with 13305 adolescents recruited. Only 43.2% and 46.1% eat fruit and vegetables daily, respectively. EAT-2010 study (Eating and Activity among Teens) that examined physical activity patterns, eating behaviors and weight among 2,793 adolescents in United States, found the mean daily intake of fruit and vegetable of 2.7 servings per day only [14]. Authors concluded that developing strategies and intervention programs aimed to increase FVI and promoting adolescents' healthy dietary behaviors can be achieved by exploring the relationship between FVI behaviors and variables such as individual, social and environmental factors.

Adolescents and Diet

WHO defines adolescents as people who are 10-19 years of age [15], while other extended range from 10 to 20 years of age [16]. Adolescence is characterized by rapid physical growth, with hormonal, cognitive, and emotional changes. Adolescence is divided into three stages, with each stage has different characteristics. Early adolescence (10-13 years of age) is characterized by the start of puberty and increased cognitive development. Middle adolescence (14-16 years of age) characterizes increased independence and experimentation.

Late adolescence (17-20 years of age) is a time for making important personal decisions to start adulthood [16-18]. Many lifestyle habits that are established during adolescence have been reported to have a significant influence on the social and behavioral aspects of life for this age group [19]. At the same time, adolescence is an intense anabolic period where adolescents require a high quality diet, with adequate amount of energy, vitamins and minerals to support their physical growth. In addition, unhealthy eating behaviors during adolescence can negatively affect health and contribute to chronic diseases later in life, and are difficult to change once established [20]. FVI during adolescence influences many different perspectives. Several authors proposed comprehensive theoretical models of eating behavior among adolescents, with FVI affected by multiple interacting factors [21, 22]. The researchers adopted a theoretical framework based on Social Cognitive Theory (SCT) and the Social Ecological theory (SET) to explain adolescent's FVI [21-23]. SET has been employed through individual, social and environmental context [22, 23], while SCT explains behavior by the interaction of person's behavior, personal factors, and the environment factors [24]. The following sections highlight the effects of these factors for adolescents FVI.

Individual Factors

Age

Dietary behavior seems to change as children become adolescents. FVI often declines when entering adolescence, and energy-dense foods and beverages intake increases [22, 25]. Research reported negative correlation between age and FVI during the adolescent period. In addition, parental influence declines as adolescents get older while level of self-efficacy for choosing their own foods influenced by their peers increases [26]. Previous studies including quantitative research showed FVI decreased with age in 60% of studies reviewed while 40% of studies reported no correlation between age and FVI [22]. Al-Hazzaa and colleagues found FVI decreased with age in Saudi adolescents [27]. Similar results were found in Ghana, where younger adolescents (12-15 years old) had higher FVI than older adolescents (16-18 years old) [28]. A recent study conducted in Iran found that adolescents over 14 years old have low FVI; older adolescents had more authority to select and consume foods they preferred [12].

Gender

Gender differences in FVI are widely documented in many studies, with strong correlation found between FVI and gender [12]. Most studies reported that girls consume more fruits and vegetables than boys [21, 29, 30]. They are more concerned with health and body image, have greater knowledge, outcome expectations/expectancies, self-efficacy and role models [31]. On other hand, review of 98 papers by Rasmussen and colleagues [22] found that girls have a higher or more frequent intake of fruit and vegetables than boys in 27 studies, but 18 studies found no gender differences and only four papers report opposite result were boys had higher or more frequent intake than girls. Similar results were reported among Kuwaiti adolescents, where more boys regularly consumed vegetables (26.0% vs. 22.1%) and

fruits (17.5% vs. 11.8%) as compared to girls [32]. Youth Risk Behavior Survey with US adolescents found a large percentage of girls at risk for inadequate intakes of fruits and vegetables [33]. Resent study [34] explored eating habits, physical activity, and sedentary behaviors among Iraqi adolescents in Mosul City (723 adolescents, 350 boys and 373 girls). Authors reported significantly higher FVI among girls than boys. Similar results were reported among Mexican adolescents. Authors reported significant gender difference in FVI, with 15.2% of girls ate three or more fruits and vegetables per day as compared to 6.7% of boys [30]. Gender difference found might reflect the fact that boys have more independence in their food choices in some communities (e.g., eating away from home) than girls, and that can be a risk factor for poor dietary habits [21].

Knowledge

Nutrition knowledge can influence our food behavior as how and why we eat healthy food [21]. School based intervention study on 3878 American adolescents from Minnesota reported knowledge as important predictor for FVI [35]. Authors investigated the meanings of “healthy” and “unhealthy” eating and the importance of healthy eating among twenty-five structured focus groups of 203 adolescent girls and boys. It seems that adolescents had a significant amount of knowledge regarding healthy foods, and they believed that healthy eating involves moderation, balance, and variety, where fruits and vegetables were the most commonly mentioned healthy foods [36]. In addition, knowledge was positive predictor of daily FVI among adolescents in five European countries out of nine (Austria, Belgium, Portugal, Spain and Sweden) [13]. Furthermore, more girls (61%) than boys (55%) knew the daily fruit recommendations, and almost a similar percentage of girls and boys (24%, 23%; respectively) knew the daily vegetable recommendations [37]. Similarly, a cross-sectional study conducted among Saudi adolescent's girls reported that knowledge was potential determinant of FVI [38]. American Children and adolescents (aged 8 to 15 years) who participated in ten week youth gardening programs identified the health benefits of eating fruit and vegetable, and were more willing to eat nutritious food at the end of program [39]. However, knowledge seems not to be isolated factor for healthy food choices since several studies didn't find any association between FVI and knowledge [40-42].

Self-Efficacy

Self-efficacy is defined as "the power to produce desired changes by one's actions" [43]. It has been recognized as an important factor that enables a change in the individual attitude towards healthy eating in adolescents, and the most important predictor for eating behavior such as FVI [21, 44, 45]. Fitzgerald and colleagues [44] examined the relationship between self-efficacy, parent and peer support for healthy and unhealthy eating, and food intake patterns among 483 Irish adolescents aged 13–18 years. Authors reported that higher self-efficacy was associated with healthy food intake such as FVI. On the other hand, in a sample of 1321 adolescents from Denmark, authors reported the same self-efficacy related to FVI [46]. Similar results were reported among Saudi adolescents [38]. Granner and Evans [47] found that FVI was significantly correlated with self-efficacy among American adolescents

aged 11-15 years who participated in cross-sectional study aimed to evaluate scales that measure constructs related to Social Cognitive Theory related to FVI.

Taste Preference for Fruit and Vegetable

Taste preference or liking has been found to be an important factor that influences FVI among adolescents. Several studies reported smell, shape, deliciousness, diversity, color, and good or bad experiences after eating fruits and vegetables as important factors for FVI. Recent reviews [22, 48] found taste preference or liking as strong factors associated with an increased FVI. A review of longitudinal and cross-sectional FVI studies in adolescents [29] reported preference being the most consistent influences on FVI. De-Bourdeaudhuij et al. [13] reported that preferences and liking have been shown to be good predictors of FVI in adolescents in most European countries (seven out of nine). In a Pro Children project, twelve focus groups with school children aged 10-11 years old from Rotterdam (the Netherlands) and Ghent (Belgium-Flanders) identified taste preferences and taste as personal factors related to FVI [49]. In addition, FVI tends to decline during the transition from adolescence to young adulthood, where most of the young adults had low FVI. Larson and colleagues [50] identified longitudinal correlates of FVI in early young adults followed-up for 5 years (1495 adolescent at baseline in 1998-1999 and follow-up in 2003-2004). Results showed that, after adjusting for baseline intake only, tastes preferences were identified as correlates of FVI during young adulthood across gender. Sometimes adolescents' FVI were associated with unpleasant and negative taste for vegetables or salads intake, or previous experiences. Many adolescents perceived green vegetables as healthy foods but they disliked it due to their bland or unpleasant taste [41]. In the school environment, adolescents sometimes demonstrated negative experiences as fruits being squashed in their bags, and adolescents not preferring to take it to the school [49, 51]. Usually adolescents have ingrained tastes which is a big challenge. For this matter, we should always convince them to change their eating behavior through offering adolescents different fruit and vegetable choices and/or options.

Outcome Expectations/Expectancies

Outcome expectations/expectancies describes expected positive or negative set of beliefs about the outcome of behavior [43]. Granner and Evans [47] found that health or positive outcome expectations of FVI (grow bigger muscles, become better in sports, be healthier, have energy to run, play, and think) were significantly correlated with FVI among American middle school students (aged 11-15 years old). Another study explained dietary behaviors among 357 adolescent girls from low-income communities in Australia. Authors measured the outcome expectations/expectancies referring to the benefits/values placed on anticipated outcomes of healthy eating (e.g., eating at least three servings of fruit and four servings of vegetables each day, choosing foods low in fat and added sugar, and monitoring portion sizes). The authors found outcome expectancies were more strongly associated with behavior than outcome expectations; they suggested that girls may recognize the benefits of healthy eating considering those benefits to be values [52]. Recent study reported similar results among American youth (aged 8-18 years old), where positive outcome expectations had

direct effects on youth diet quality [53]. A qualitative research [54] among Tehranian adolescents (aged 11-14 years old) found positive outcome expectations/expectancies among adolescents, as eating fruits made them feel good due to the taste. Eating vegetables was reported as delightful and made the food tasty, while FVI was indicated as useful for health, being energetic, better vision, enhancing body resistance, and better learning. On the other hand, McClain and co-workers [55] conducted a literature review from 16 countries, to understand the correlation between effective dietary intake and promotion of healthy dietary behaviors among children (age <13 years) and adolescents (age > 13-18). Thirty-five studies tested for outcome expectation correlates for fruit, juice, and vegetable consumption did not show consistent relationships between outcome expectations and dietary outcomes.

Skill in Preparing Fruit and Vegetable

Possessing skills to prepare healthful foods among adolescents would promote improvements in diet quality. In general, when adolescents helping their parents in preparing meals, more nutrient-rich eating patterns and healthier food choices were demonstrated [56-59]. Rakhshanderou et al. [54] found that girls who had skills in preparing fruits and vegetables (e.g., cleaning, washing correctly, peel, cut, and slicing) ate more fruit and vegetable, while some girls cited preparing skill as barriers of FVI. Similarly, a family-based newsletter intervention aimed to increase FVI in adolescents through two newsletter packs (recipes and tip sheets) over a one-month period encouraged adolescents on trying new fruit and vegetables. By preparing and shopping fruits and vegetables with their parents, authors reported improved use of fruit and vegetables at home as meals and snacks [23]. In contrast to above findings, Nago and colleagues [60] found preparing skills as barriers to FVI in Beninese adolescents aged 13 - 19 years. Adolescents preferred fruits to vegetables because of its uncomplicated use (e.g., no need to cook fruits). In addition, girls consumed more vegetables during weekends because there is more time for cooking. Moreover, some studies reported gender differences in preparing skills between girls and boys. Girls were more involved in preparation and cooking while boys helped in preparation tasks only; older adolescents who were living with one parent were more involved in preparing meals on a regular basis than younger adolescents living with two parents [61, 62].

Social Factors

Parental Intake and Modeling

Parental FVI and modeling are important social factors, and have been found to be strongly associated with adolescent FVI and food preferences. Adolescents usually live with their parents, share FV that are available in the home, with adolescent usually have the same culture of eating as their parents. Many studies conducted in developed and developing countries well documented this association [13,22-24,48,49]. Studies used different methods to assess parental FVI and modeling, such as parent's report of modeling, adolescent's report of parental role modeling, or utilized both parents and adolescents report. All studies reported

positive association between parental intake and adolescent FVI no matter of methodology used. A recent study conducted in the United States utilized both parents and adolescents' reports of parental role modeling. Authors found significant association for fruit and green salad at dinner only, with participants were more likely to meet FVI recommendations [63]. Similar results were reported among African American and Caucasian adolescents where parental modeling was significantly correlated with FVI [47]. Pedersen and colleagues [46] found Denmark adolescents are influenced by parents when it comes to FVI more than their friends. Intervention study conducted among adolescents and their parents found that parental FVI is a significant predictor of adolescent fruit FVI when parents increase their FVI and provide more FV to be accessible to their children at home [24]. Tehranian adolescents learned how to eat FV from their parents, with positive dietary patterns found for the entire family [54]. Unfortunately, sometimes parental role modeling it not always the easiest thing to utilize, which was reported in a qualitative study conducted among Ecuadorian adolescents. Some parents reported that they are not always good role models for their children, having constant struggle to encourage their children to eat healthily and trying to be good role models especially for FVI [51].

Parents and Family Support

In general, parents and family support play a principal role to encourage their children to consume more FV by supervising adolescents' nutritional behaviors and establishment rules about household nutrition. A literature review from 16 countries conducted by McClain and colleagues [55] found parents' support correlated with FVI among adolescents. Also, active parental encouragement was found to be related to FVI among adolescents from nine European countries [13]. Furthermore, Rasmussen and colleagues [22] reported in their review that three out from three studies found positive association between FVI and parents support. Similar results were documented in intervention and longitudinal studies [23, 64]. In the HOME Plus study, authors confirmed the associations between parent's role for FVI at snacks and dinner in 160 parents and their children (aged 8-12 years). Encouragement of parental role modeling of FVI at snacks and salad at dinner is warranted and may increase healthful dietary habits among children [63]. Shokrvash et al. [12] reported that practical and emotional support were the most important factors of family support associated with adolescents FVI among Iranian adolescents, with low emotional support for boys and low practical support for girls were found to be significant predictors of low FVI. Irish parents' restricted certain unhealthy foods within the home to limit their consumption in aim to encourage their children to use healthy foods as fruits and vegetables [42].

Family Meals

Eating family meals has been found to have a positive impact on adolescents' dietary quality and better nutritional intake including increased FVI [21]. Furthermore, family meal frequency is inversely associated with engagement in use of drugs and alcohol, disordered eating behaviors, depression, and suicide [65, 66].

Gillman and colleagues conducted a study to examine the association between frequency (e.g., most nights, infrequently) of eating family meals (dinner), and the dietary intake patterns of adolescents [67].

The authors found that adolescents who consumed family dinners more frequently consumed 0.8 more servings of fruits and vegetables as compared to those who never or rarely ate family dinners. Another longitudinal study examined the FVI and family meals relation among 18,177 adolescents [69]. Results showed that adolescents who ate four or five family meals per week 22% less likely reported poor fruit intake, 19% less likely reported poor vegetable intake, and 19% less likely reported poor dairy intake, and infrequently skipped breakfast. This positive effect was highlighted as the number of family meals (six or seven) increased per week. A qualitative study examined the differences between Irish children and adolescents perceptions of factors influencing their food choices. Focus group discussions were conducted with 29 young people aged between 9-18 years. The authors concluded that participation in family meals is important in influencing their food choices including FVI [42]. Another study conducted among 520 Saudi adolescent girls (aged 13-19 years) found positive associations between family meal frequency and increasing three major meal intakes, also a significant increase in the FVI, dairy products, grain and bread products, meat and fish, and legumes [68]. Longitudinal study [64] determined if family meal frequency during adolescence is associated with diet quality during young adulthood. Authors reported that family meal frequency during adolescence predicted higher intakes of fruit, vegetables, dark green and orange vegetables during young adulthood, and increased social eating in young adulthood which is an important time for adolescents to interact with family and friends.

Peer Influence

Peer influence or friends influence is an important social factor and challenging issue during adolescence [26]. Researchers found correlation between adolescents and their friend eating behaviors, with understanding similarities and differences between friends in their eating habits can help dietitians and health professionals to design a diet and lifestyle interventions. EAT-2010 (Eating and Activity among Teens) trial [14] examined the association between adolescents and their friends healthy eating behaviors, specifically concerning breakfast, fruit, vegetable, whole-grain, and dairy food intake. Authors found significant correlation between adolescents and their best friends vegetable intake, also for whole-grain and dairy food intakes, but no associations were seen among friends for fruit intake.

Granner and Evans [47] reported similar results among middle school adolescents in United States, where peer influence is significantly correlated to FVI. Sometimes friends have negative influence for healthy eating by encouraging adolescents to consume unhealthy foods, with Irish adolescents reported significant peer support for unhealthy eating [44]. Similar results were found among 757 Denmark adolescents, with population FVI was less influenced by friends than by parents [46].

Environmental Factors

Income

Several studies reported income as the major determinate of dietary intake, with families with higher income having the affordability to purchase more expensive food such as FV comparable to lower income families [70, 71]. In Sao Paulo, Brazil, it has been found that 52% of adolescents who had a household income equal to or lower than \$ 75.00, consumed less than one FV serving/daily, while adolescents who had a higher income consumed between 140 g and 460 g of FV per day [72]. Positive association between FVI and family income was reported in several studies among American [73], Canadian [74] and Norwegian adolescents [75].

Recent study reported positive association between income and FVI in the international Health Behavior in School-Aged Children study, research collaboration aimed to describe young people's well being, health behaviors and their social context within the WHO and 44 countries across Europe and North America. Among the low-income Norwegian adolescents who participated in this study, they were more likely to eat low FVI than the higher income adolescents [76]. In addition, Denmark adolescents with low income have low FVI combined with high fast food outlet exposure, and low exposure to supermarkets to buy FV [77]. In two years follow-up study conducted in Australia, families who spend more money use more FV in their diet [78]. On the other hand, FV are cheap and available in Ghana during the whole year, especially in harvest seasons from June to August, and all adolescents from different socioeconomic level had frequent daily FVI [28].

Parental Occupational Status

It has also been shown that parental occupational status has a strong relationship with adolescents FVI. In an early review of family correlates for FVI, all the studies included in this review found parent's occupational status was positively correlated with fruit intake [23]. Another review study found the same positive association with FVI [22].

The parental occupational status might affect three major meal intakes and parental supervision of adolescents' eating habits, which causes unhealthy eating patterns among adolescents [21].

Father occupational status is determinant of healthy eating; if father had high occupation status, the adolescents were eating healthier food while mother occupational status is not always associated with eating healthier [79]. Traditionally, mother is responsible for grocery shopping and meal preparation, and because of her work schedule there is a possibility for insufficient time for meal preparation and FV, which can further decrease food availability and parental support for healthy eating habits as FVI [80]. Iranian adolescents whose mother is employed mother had lower FVI, while adolescents with an unemployed mother had higher FVI [12].

Parental Education

The level of parents' education influence adolescents FVI. Recent study in Brazil reported that the head of the household (father, mother) who had a higher education had a better knowledge about healthier food choices, especially for FVI [72]. Increased level of education is usually combined with higher income that leads to purchasing expensive foods as FV, and enhanced knowledge about the benefits of FVI. A review of studies examining the association between parental education and FVI reported positively association between two factors [23]. In longitudinal Norwegian study conducted in 896 adolescents (mean age 12.5 years) parents' education level was positively related to FVI among adolescents [75]. In Ghana, level of mother's education predicted FVI among adolescents, while no correlation was found between father educational level and FVI [28]. Lawrence and colleagues [81] reported that mothers with low education level had more barriers and less knowledge for healthy eating. Furthermore, these mothers often bought cheapest food that usually not includes FV. Canadian cross-sectional study with 18,524 adolescents identified the impact of socio-demographic factors on FVI pattern. It seems that parental education positively impacts adolescent FVI. PRO-GREENS project that took place in ten European countries found parents with higher educational level as significant mediators for more frequent daily FVI in children, although correlation was modest or absent in some countries [82].

Household Availability

Household availability is defined as how plentiful and visible FV is in the house [83]. Most studies showed strongly correlation between household availability and FVI [61,84]. Fruit and vegetable availability at home depends on many factors, such as income, parental education, time, benefit of FV from parents view. Early studies found home availability as the strongest correlate to adolescent FVI. One of the largest studies conducted on 4,746 adolescents in USA (Project EAT-I) reported that home availability significantly affected adolescents FVI [84]. Another qualitative study identified personal, behavioral, and environmental influences on FVI among low-income black American adolescents from Mississippi. Authors found household availability as a barrier to FVI by some of the subjects, who identified other relatives' homes (especially grandmother's house) and restaurants as a source of vegetables than fruits [61]. A European study examined the determinants of FVI in normal weight compared to overweight boys; authors found that availability of FV at home was related to increased FVI consumption in overweight boys [13]. Recent review reported an association between vegetable home availability and vegetables intake in adolescents from sixteen countries where parent and adolescents report household availability [85]. Adolescents reported availability more likely to be associated with vegetable intake as compared to parent report. In the PRO-GREENS project, authors reported availability as a significant mediator for fruit intake in Finland, and for vegetable intake in Finland, Germany and Iceland [82]. Furthermore, household availability for fruit and vegetable was related to parental education level in Norway [75]. A qualitative study examining availability of fruits and vegetables at home among Iranian adolescents found fruit household availability was associated with more frequent intake as compared to vegetables [54].

School Food Availability

Adolescents spend most of their time in the school, with school environment has a large and powerful influence (positive or negative) on adolescents eating behavior, especially FVI [26, 86]. Previous cross-sectional study that included 598 adolescents in 165 American schools examined the association between the dietary behaviors and the availability of school vending machines *a la carte* (e.g., candy, chips, and cookies) programs, and fried potatoes begin served at school lunch. Results indicated *la Carte* availability was positively associated with total and saturated fat intake and inversely associated with FVI. Vending machines were negatively correlated with fruit consumption. Serving fried potatoes' at school lunch was positively associated with FVI [87]. In Australian longitudinal study, researchers found that adolescents who managed to avoid purchasing food or drink from vending machines at school frequently consumed fruit [78]. Authors concluded that adolescents may prefer the taste of fruit over high energy foods, and adolescents should be encouraged to take home-prepared school lunches and snacks, while schools should remove vending machines from their campuses [78].

Another study conducted in USA found the availability of FV at school has a positive impact on low-income adolescents, who had higher FVI if they ate school food, but not for the high income adolescents who had lower FVI if they ate school food. This is mitigated via income related disparities in adolescent FVI, and this mitigation is beneficial for low-income students [88]. Sometimes, school availability was not related to adolescents FVI. European group recommended more research to study how the school environment can affect FVI, through health education aspects and availability of healthy/unhealthy snacks in school environment [13].

Neighborhood Environments

Few studies demonstrated that neighborhood environment might influence dietary intake in adolescents [89, 90]. The neighborhood has been defined as “the area around one’s place of residence, as stores within walking distance from home and restaurants within county boundaries” [90]. The findings concerning relationship between neighborhood environment and adolescent FVI have been mixed. Some studies found that greater access to neighborhood convenience stores, restaurants, and fast food facilities, has been associated with low FVI, obesity and low diet quality [90-92].

Riediger and colleagues [74] found that low FVI among Canadian adolescents from low-income families might be related to living in neighborhoods with fewer grocery stores, and not offer healthful foods with reasonable price. Other studies have shown an apposite association between FVI available in convenience stores that are closer to residential households, and higher FVI in adolescents [93]. Recent study among American adolescents showed minimal significant association between the neighborhood environment and healthful dietary intake as FVI, and lower BMI in adolescents [94].

Television Watching

Many adolescents in the world found television (TV) watching as the most popular leisure-time activity. A growing number of studies found TV watching has obesogenic effect in adolescents, as well as decreases FVI, fiber intake, physical activity and increases energy-dense foods and beverages intake. [95-97]. Moreover, during TV watching adolescents are exposed to food commercials, with products with lower nutritional value and energy-dense products more often available in home, with this phenomena might affect children health [98]. A review study identified negative association between FVI and TV watching, as a sedentary lifestyle behavior among adolescents [99]. TV watching in adolescents was associated with decreased fruit juice intake [50]. Furthermore, in large school-based cross-sectional study conducted among 2908 Saudi adolescents aged 14-19 years, authors reported that TV watching was inversely correlated with FVI and breakfast intake [27]. Also, TV watching was positively associated with home availability of energy-dense snacks among Australian adolescents but not with healthy food as fruits and vegetables [100]. However, little is known about the potential mechanisms of TV watching and healthy or unhealthy eating behaviors among adolescents [95, 96].

Conclusion

Fruit and vegetable intake is found to be less than the minimum recommended (five daily servings) among adolescents from the developed and developing countries. Several factors (individual, social and environmental) affect FVI in adolescents. Taste preference and liking fruits and vegetables (individual factors), parental intake and family meals frequency (social factors), and household income and availability (environmental factors) are the most important factors that affect adolescent FVI. Adolescence is a critical period in the development of healthy dietary behaviors that prolongs into adulthood. A combination of individual, social and environmental factors is related to FVI, and the relationship between these factors is complex. There is an increasing need for better understanding of how these factors affect FVI in adolescents in aim to develop multilevel intervention strategies based on social and ecological theories and models, to help adolescents to adopt healthy choices as FVI especially in developing countries.

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