International Journal of Nutritional Sciences

Open Access

Austin Publishing Group

Research Article

Influence of the Home Environment on Diet Quality and Weight Status of Adolescents

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Received: May 24, 2016; **Accepted:** August 18, 2016; **Published:** August 23, 2016

Abstract

This cross-sectional study assessed the association of psychological, social, and environmental factors in the home environment with diet quality and Body Mass Index-for Age percentile (BMI-for-Age percentile) in a sample of 103 mother-adolescent dyads. Adolescents in the lowest home environment tertile had poorer diet quality, with lower compliance for total fruit, whole fruit, total vegetable, empty calories, and overall diet quality. Availability of healthy foods (p=0.00), healthy eating attitude (p=0.01), and accessibility to unhealthy foods (p=0.04) in the home were the strongest predictors of diet quality; whereas self-efficacy (p=0.02) and availability of healthy foods (p=0.02) emerged as significant predictors of BMI-for-Age percentile. These results highlight the role of the home environment in determination of diet quality and BMI of adolescents.

Keywords: Home Environment; Diet Quality; Obesity; Mother

Introduction

Childhood obesity has reached epidemic levels in the United States, with 31.8% of children, ages 2-19 years, exhibiting Body Mass Indices ≥85thpercentile [1]. Excessive body weight is of concern, as it associated with acute health complications including asthma, sleep apnea [2], insulin resistance [3], psychosocial distress due to negative body image [4] smaller social networks [5], and diminished quality of life [6]. The implications extend beyond childhood, as in later life obese children are at a higher risk of dyslipidemia [7], nonalcoholic fatty liver disease [8], orthopedic skeletal abnormalities [9], and metabolic syndrome [10].

Models of obesity should incorporate factors that impact the outcome in a context specific manner and be grounded in timely conceptual frameworks [11]. One widely used theory in health interventions is the Social Cognitive Theory [12,13,14], which focuses on the relationship and reciprocity between learning history, personal, and environmental factors of an individual [15]. More recently, the perspective provided by the Social Ecological Model (SEM) has been suggested to be even more appropriate for explaining complex behaviors [11,16] in terms of psychological, social, and environmental influences. The dynamic nature of this framework may elucidate mechanisms by which individuals interact with multiple segments of their environment in order to secure a nutritious diet and, subsequently achieve healthy weight status. Thus, exploration of the home environment within a social ecological framework will be the focus of this research.

The multi-dimensional nature of the home integrates numerous spheres of influence that are outlined by the SEM [11]. At the most proximal level, individual factors such as socioeconomic status, attitudes, and self-efficacy impact food choices and weight outcomes. For example, Socioeconomic Status (SES) disparities are related to overweight status, with higher rates of obesity among individuals with lower SES [17]. Attitudes toward healthy eating are another determinant of behavior [18], with greater fruit, vegetable [19,20] and grain [20] consumption among adolescents with desirable food-related attitudes. Finally, self-efficacy is a positive predictor of intakes of fruit, vegetable [21,22], and brown bread [23], as well as lower dietary fat [24] and unhealthy snacking [23]).These findings suggest that individual factors should be included in the assessment of the home environment.

The second component of the SEM incorporated in this research is the social environment. Social networks, including parents and friends, affect weight-related behaviors. For instance, frequency and regulation of family meals are linked to numerous positive outcomes, including diets richer in fruit/vegetables [2526], and whole grains [26]. Family meals are associated with additional health benefits such as lower soft drink intake [27] and less disordered eating [28]. Thus, it is not surprising that social aspects of mealtime are positively correlated with overall diet quality [27] and foster practices that are inversely related to obesity [29]. Social support also has been noted as a modifier of diet quality [30]; Adolescents with greater parental support are better able to secure healthy diets with more fruits and vegetables [31]. Finally, social and cultural norms developed at home also impact behavior by guiding what is considered appropriate, based on expectations of the society [16]. Thus, social features of the home will be incorporated in this study to discern their influence on diet quality and weight status.

Finally, the physical environment strongly influences obesogenic behaviors, as it modulates access to healthy foods and opportunities for activity. The relationships between home availability of healthy foods (positive) and unhealthy foods (negative) with diet quality are consistent [32,33,34]; intake of fruits and vegetables are significantly higher when they are available in the home [33,34]. A similar effect is seen also with unhealthy foods, where the presence of sweet/savory snacks and high-energy beverages was paralleled with the consumption of these items [32]. Presumably healthful eating within the context of the home is reliant on whether these foods are available at all [32].

Citation: Tabbakh T and Freeland-Graves JH. Influence of the Home Environment on Diet Quality and Weight Status of Adolescents. Int J Nutr Sci. 2016; 1(2): 1009.

In addition, households are shaped by the built environment - Characteristics of the surrounding neighborhood– such as proximity to public parks or walking trails, and perceived neighborhood safety [35]. Although the built environment has received more attention in the past decade, research on its impact on adolescent weight status is limited and inconsistent [36]. Assessments of perceptions of the built environment of neighborhoods (walkability, parks and playgrounds, sidewalks, and safety)on physical activity found that sidewalk characteristics are associated with sedentary behavior ($r=-0.20$, $p<0.01$) and light-intensity physical activity ($r=0.21$, $p<0.01$) [37].Other reports were that access to parks was associated with increased physical activity when sedentary behaviors were restricted ($p<0.05$) [38]. The presence of recreational space also has been linked to a higher odds of being in the upper quartile of physical activity participation (OR: 1.65, $p=0.02$) [39]. In contrast, some did not find an association between characteristics of the built environment and physical activity of children [40]. Thus, further research on the built environment is warranted.

A multidimensional perspective that includes psychological, social, and environmental domains of the home environment will be utilized in this research. A recently validated instrument, the Multidimensional Home Environment Scale (MHES) [41], will be the tool for assessment. To date research on the impact of the home environment has focused on social and environmental features, with limited consideration to psychological factors. This research extends the field by incorporating psychological factors in the home in order to more fully assess the impact of the comprehensive home environment on diet quality and weight status of adolescents.

Methods

Study design and participants

Participants included 206mothers and adolescents (103 dyads), aged 11-14 years, recruited from four local middle schools from a wide range of socioeconomic statuses. Verbal announcements and flyers were distributed to adolescents during physical education class and interested participants were contacted via email to obtain consent from adolescent and mother. Primary enrollment criteria for mothers were: 1) ability to read, and write English, 2) a child between 11-14 years old, and 3) access to the Internet. Inclusion criteria for adolescents were: 1) aged 11-14 years old and 2) access to the Internet. There were no exclusion criteria for this study. Adolescents who qualified for the study were contacted by email with a link to a secure, research-based website, Qualtrics©, for completion of the surveys. Mothers completed a demographics survey and both mothers and adolescents separately completed the MHES and Food Frequency Questionnaire (FFQ). Anthropometrics of adolescents were measured by author as part of FITNESSGRAM, a standardized curriculum tool for assessment of physical fitness and activity. Of all the participants enrolled, 18% decided not to participate in the study and were excluded from the analysis. The risks and benefits were explained and this study approved by The University of Texas at Austin Institutional Review Board.

Demographics survey

A 29-item questionnaire was administered to all mothers in the study. Mothers completed the survey on behalf of herself and the child. Demographics included items such as age, ethnicity, income level, and education status.

Multidimensional Home Environment Scale

The MHES was created to measure the comprehensive home environment. This scale is psychometrically sound and includes psychological, social, and environmental factors that impact weight-related behaviors in adolescents, from the perspective of the mother and the child. Two versions of the questionnaire were developed and validated in a separate validation sample of 114 mother-child dyads. High construct validity, internal consistency reliability (adolescent: $\alpha= 0.82$, mother: $\alpha= 0.83$) and test-retest reliability (adolescent: $r=0.90$, $p<0.01$; mother: $r=0.91$, $p<0.01$) were displayed. The final version of the questionnaire contained 32-items for adolescents and 36-item for mothers. Constructs evaluated by the instrument were psychological, social, and environmental; psychological (healthy eating attitude, self-efficacy, emotional eating, and mindless eating); social (frequency of family meals, regulation of family meals, social eating, social support, role modeling, and descriptive norms); and environmental factors (availability of healthy foods, availability of unhealthy foods, accessibility to unhealthy foods, physical characteristics of neighborhood, and neighborhood safety). Descriptive norms for healthy eating in adolescents were defined as their perceptions of health-related behaviors of other individuals. Availability of foods was expressed as whether specific food items were available in the home; whereas, accessibility was defined as whether the adolescent was allowed access to them. Additionally, social support, role modeling, and social and cultural norms were added further for a more thorough evaluation. Home condition and involvement in meal planning were assessed in mothers only. Subscale means were calculated by summing questions in each subscale and dividing by the number of items using adolescent reports only. The total home score was computed using a composite of all factors on the MHES that showed significant associations with either diet quality or BMI [41].

Food frequency questionnaire

A slightly condensed version of a 159-item food frequency questionnaire (Cronbach's alpha=0.72) and validated by comparison to diet records ($r=0.45$) [42] was used to evaluate dietary patterns of mothers and adolescents. The 116-item scale included a wide range of options for fruit and vegetables, breakfast foods, snacks, fast foods, and beverages, as well as ethnic and restaurant foods and used for both mothers and adolescents. Participants were asked to indicate frequency during a one-month period, and the serving size for each item. A medium reference size was provided to aid participants in portion estimation. For example, a medium serving of orange juice was defined as 8 fluid ounces, and participants were instructed to select small, medium, large, or extra large if they had half, one, one and a half, or two times the indicated medium serving. Single items were grouped according to food groups indicated by the Healthy Eating Index-2010 [43] and converted to appropriate amounts for each food group. Mixed foods were deconstructed into their main components and assigned to relevant food groups. Nutrient analysis was conducted using My Diet Analysis (Version 8.2.5, ESHA

Research, Inc, Salem, OR).

Healthy Eating Index - HEI-2010

The healthy eating index is a tool developed by the US Department of Agriculture to measure diet quality, according to key recommendations provided by the Dietary Guidelines for Americans (DGA) [43]. It computes a composite score, ranging from 0-100 points, based on adequacy and moderation of dietary components. This index utilizes a scoring system derived from energy density (per 1,000 Kcal), incorporating the most restrictive standards for demographics and energy levels (the minimum value required per recommendation). The adequacy portion of the index is composed of total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids. Moderation is derived from the second portion of the scale, which includes refined grains, sodium, and empty calories. Each item is assigned a minimum and a maximum score, with values that lie in between these scored proportionately. The same scale was used for both mothers and adolescents, as it has been validated for use in both populations [43].

Anthropometrics

Height and weight of adolescents were measured by the author using a stadiometer (Health-O-Meter® Professional Height Rod, McCook, IL) mounted on electronic scale (Health-O-Meter® Professional Mechanical Beam Scale, McCook, IL). Height was reported to the nearest 0.1 inch, with participants erect and barefoot, and weight to the nearest 0.01 pound. BMI-for-age was calculated for adolescents and percentile groups were classified as: healthy weight (5^{th}-85^{th}), overweight (85^{th}-95^{th}) or obese (>95^{th}) according to standard growth charts for boys and girls (Center for Disease Control and Prevention, 2012). BMI-for-Age was utilized for assessment of adolescent weight status in all analyses, except regression. Due to the relatively small sample size, BMI-for-Age percentile was used as a continuous variable in the regression model. Mothers were asked to self-report weight and height and were categorized as healthy weight (18.5-24.9), overweight (25-29.9), or obese (≥30).

Qualtrics©

Qualtrics© survey software (Provo, UT 2011) was used to administer surveys to mothers and adolescents. This data collection tool permits questionnaire responses in a user-friendly manner and enables researchers to manage surveys as link sent via electronic mail. This software offers extensive data security and privacy, through conformance with European and US Safe Harbor, Health Insurance and Portability and Accountability Act (HIPPA), and the Family Educational Rights and Privacy Acts (FERPA).

Statistical analyses

Analyses were conducted using Statistical Product and Service Solutions (Version 20.0, SPSS, Armonk, NY, 2011). Responses were included if both the mother and child from each dyad had complete surveys. Descriptive statistics such as means, frequencies, and standard deviations were used for demographic characteristics. Total home score was computed by aggregation of psychological, social, and environmental factors from the MHES scale. Subscales representing negative influences were reverse-coded such that a higher outcome reflected a healthier home environment. Diet quality was measured using the Healthy Eating Index - 2010 and scores for each component were expressed as mean percent of maximum score achieved. Home environments were divided into tertiles and one-way analysis of variance was used to explore differences in diet quality between groups. Associations between factors in the home environment (psychological, social, and environmental) with diet quality and BMI-for-Age percentile were examined using univariate regression. The overall impact of the home environment was assessed in a multiple linear regression via stepwise method, using variables that emerged as significant from model-1. In this method, all variables were introduced in the model in order of decreasing tolerance. To be retained, predictor variables must pass both tolerance and minimum tolerance tests. Variables that do not meet these criteria are excluded from the model.

Table 1: Demographic characteristics of adolescents, ages 11-14 years, and their mothers (n=103).

Demographic Characteristic	Adolescents (n=103)	Mothers (n=103)
	Mean±Standard Deviation	
Age(years)	12.5±1.0	44.3±6.3
Body Mass Index (kg/m²)	20.7±4.0	25.7±4.9
Sex	n (%)	
Male	51(49.5)	0(0.00)
Female	52(50.5)	103(100)
BMI[a,b] or BMI-for-Age Category[c]		
Underweight	3(2.9)	1(1.0)
Healthy Weight	70(68.0)	48(46.6)
Overweight/ Obese	30(29.1)	54(52.4)
Ethnicity		
White	68(66.0)	72(69.9)
Hispanic	23(22.3)	23(22.3)
African American	5(4.9)	5(4.8)
Asian	5(4.9)	3(2.9)
Other	2(2.0)	-
Age (years)		
11	19(18.4)	-
12	36(35.0)	-
13	27(26.2)	-
14	21(20.4)	-

[a]Body Mass Index computed as weight (kg)/height (m^2).
[b]BMI for adults.
[c]BMI-for-Age for adolescents using norms established by the Center for Disease Control and Prevention [56].

Results

Participant characteristics such as age, BMI-for-Age, and ethnicity are shown in (Table 1) and expressed as mean±standard deviation, frequencies, and percentages. Ages of adolescents ranged from 11-14 years and mothers, 31-62 years. Participants were equally distributed among boys and girls, with a third of the total sample in the overweight or obese BMI-for-Age category.

Diet quality scores, using the Healthy Eating Index-2010, according to home environment tertiles are reported in (Figure 1).

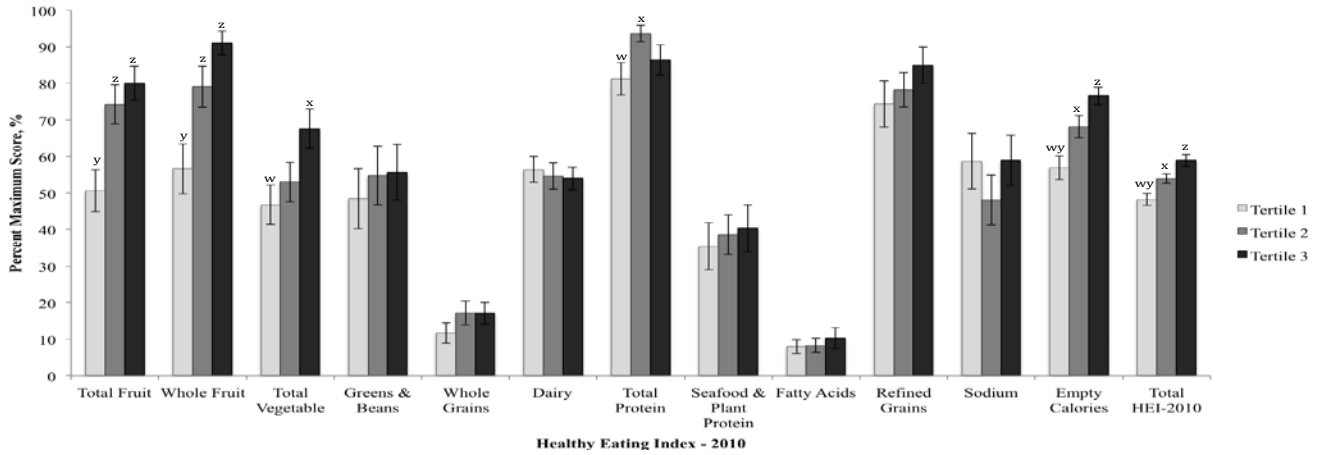

Figure 1: Diet quality scores using the Healthy Eating Index-2010, according to home environment tertiles in adolescents (n=103).
[a]Tertile 1 represents lowest home environment score.
[wx]Different superscripts within categories and sample indicate significant differences at p <0.05.

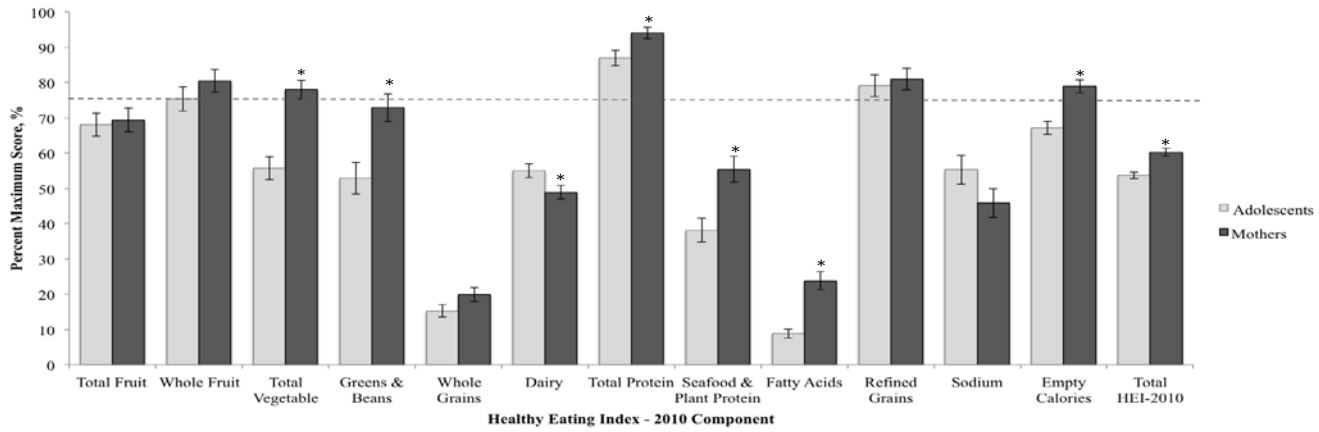

Figure 2: Comparison of diet quality, as measured by the Healthy Eating Index -2010, between mothers and adolescents (n=103).
*Indicates statistical significance at p<0.05.

Adolescent scores were categorized into tertiles, with increasing degrees of healthfulness of the home environment. Those in the lowest tertile had significantly lower scores on total fruit (p=0.00), whole fruit (p=0.00), total vegetables (p=0.02), empty calories (p=0.00), as well as total HEI-2010 (p=0.00) than participants in the upper tertile.

Figure 2 illustrates comparisons of diet quality, as measured by the Healthy Eating Index-2010, between adolescents and mothers. In sum, diet quality of the sample in this study was less than ideal, with whole grains, dairy, seafood and plant protein, fatty acids, sodium, and overall diet quality <75% HEI-2010 standards. Yet the total diet quality of mothers was superior to that of their adolescents (60.25±1.13 *vs.* 53.63±9.70, p<0.00), with higher values on all components, except dairy and sodium. Similarities in diet quality were observed for total fruit, whole fruit, whole grains, refined grains, and sodium.

Associations between psychological, social, and environmental features of the home environment in adolescents with diet quality and BMI-for-Age percentile of adolescents are depicted in (Table 2). Several parameters in the home appeared to be related to diet quality in the first model of univariate linear regression. These were healthy eating attitude, self-efficacy, mindless eating, frequency of family meals, social eating, social support, descriptive norms for healthy eating, availability of healthy foods, availability of unhealthy foods, accessibility of unhealthy foods, and physical characteristics of the neighborhood.

Results from model-1 with univariate associations were then used to determine choice of predictor variables in model-2. Only the factors that showed a significant association with the dependent variables - diet quality and BMI-for-Age percentile were included in the next step of multiple linear regressions via a stepwise method. The final model [F(3,99)=14.20, p=0.00] included healthy eating attitude (p=0.01), availability of healthy foods (p=0.00), and accessibility to unhealthy foods (p=0.04). All items resembling a negative influence in the home environment were reverse coded. Collectively, these three constructs explain30% of the variance in the model. Availability of healthy foods was the single most powerful predictor of diet quality in adolescents (β=0.35, p=0.00). Thus, every one-unit increase in the 5-item scale resulted in an expected 5% increase in the healthy eating index score. This suggests that the difference between the lowest and highest reports on this 5-item scale could account for a 25%

Table 2: Associations of psychological, social, and environmental characteristics of the home environment with diet quality and body mass index in adolescents using two regression models (n=103).

	Diet Quality				Body-Mass-Index-for-Age-Percentile			
	Model 1[a]		Model 2[b]		Model 1		Model 2	
	β[c](SE)[d]	p[e]	β(SE)	p	β(SE)	p	β(SE)	P
Healthy Eating Attitude	0.38(0.97)	0.00	0.24(0.95)	0.01	-0.25(0.42)	0.01	-	-
Self-Efficacy	0.40(0.85)	0.00	-	-	-0.34(0.36)	0.00	-0.24(0.39)	0.02
Emotional Eating	0.00(1.17)	0.97	-	-	-0.03(0.48)	0.73	-	-
Mindless Eating	0.25(0.92)	0.01	-	-	0.03(0.39)	0.76	-	-
Frequency of Family Meals	0.28(0.64)	0.00	-	-	-0.20(0.26)	0.04	-	-
Regulation of Family Meals	0.15(1.17)	0.13	-	-	-0.23(0.47)	0.02	-	-
Social Eating	0.21(1.01)	0.04	-	-	-0.09(0.42)	0.38	-	-
Social Support	0.24(1.15)	0.02	-	-	-0.04(0.48)	0.68	-	-
Role Modeling for Eating	0.00(1.16)	0.98	-	-	-0.15(0.47)	0.14	-	-
Descriptive Norms for Healthy Eating	0.29(1.26)	0.00	-	-	-0.21(0.53)	0.03	-	-
Availability of Healthy Foods	0.47(1.19)	0.00	0.35(1.23)	0.00	-0.34(0.52)	0.00	-0.24(0.55)	-0.02
Availability of Unhealthy Foods	0.22(1.23)	0.03	-	-	-0.03(0.52)	0.75	-	-
Accessibility of Unhealthy Foods	0.27(1.21)	0.01	0.18(1.10)	0.04	0.04(0.51)	0.66	-	-
Physical Characteristics of Neighborhood	0.21(1.23)	0.04	-	-	-0.13(0.51)	0.18	-	-
Neighborhood Safety	0.17(1.27)	0.10	-	-	-0.12(0.52)	0.23	-	-

[a]Univariate linear regression with independent variable regressed on body mass index-for-age percentile.
[b]Multivariate linear regression with significant independent variables from model 1 regressed on body mass index-for-age percentile.
[c]Standardized coefficient interpreted as the amount of a standard deviation change in BMI-for-age percentile associated with a 1 standard deviation change in each home environment factor.
[d]Standard error.
[e]Statistical significance at $p<0.05$.

improvement in overall diet quality. Also documents associations of the characteristics of the comprehensive home environment with BMI-for-Age percentile. All the variables measured in the home environment were inversely proportional to BMI-for-Age percentile, except mindless eating and accessibility to unhealthy foods. Healthy eating attitude, self-efficacy, frequency of family meals, family mealtime regulation, descriptive norms for healthy eating, and availability of healthy foods were regressed on BMI-for-Age percentile in the original model. Equations that contained the strongest predictor variables [$F(2,100)=9.58$, $p=0.00$], self-efficacy ($\beta=-0.24$, $p=0.02$) and availability of healthy foods ($\beta=-0.24$, $p=0.02$) were retained ($R2=0.16$).

Discussion

Classification of individuals according to their home environment revealed that adolescents residing in healthier homes were more compliant with dietary guidelines. Previously, Pinard observed that fat and sweet availability in the home of 5-17 year old children was related to elevated consumption of these items. Also, parental role modeling for healthy diet was linked with fruit and vegetable intake [44]. In younger children (6-11 years), Couch et al. (2014) found significant relationships between the home food environment and diet. In particular, encouragement for healthy eating was reported to be positively associated with fruit and vegetable intake ($\beta=0.68$, $p<0.01$); whereas availability of high-caloric foods was related to decreased dietary levels ($\beta=-0.27$, $p<0.01$) [31].

Diet quality scores were lower for adolescents compared to mother for total vegetables, greens and beans, whole grains, total protein, seafood and plant protein, fatty acids, and empty calories. However, some similarities were noted. For example, percent maximum scores of total fruit were 68.1% for adolescents and 69.4% for mothers, equivalent to approximately 1.7 cups of fruits. In research focused on adolescents aged 12-18 years, daVeiga et al. reported similar fruit intake between mothers (3.0 portions) and their boys (2.9 portions) and girls (3.1 portions) [45].

Comparisons between adolescents and mothers are in contrast to other analyses which report overall congruity between maternal and adolescent diets [45,46,47]. Other investigators observed that when mothers are preparers of food, their consumption of fruit and vegetables was significantly related to that of other family members ($p<0.01$) [46]. In this sample, percent of maximum score of vegetables was significantly lower in adolescents (55.7%) as compared with mothers (78.0%).

The ratio of monounsaturated and polyunsaturated fat compared to saturated fats should be noted. Percent of maximum score for fatty acids was 8.8% for adolescents and 23.8% for mothers, which translates to a fatty acid ratio of 1.3 and 1.5. Although a significantly higher ratio was observed in mothers, both adolescents and mothers consumed substantially below recommendations, indicating diets that are high in saturated fats and low in monounsaturated and polyunsaturated fats. Reports of age-comparable groups in the US show similar results, with more favorable fatty acid ratios in adult females (1.9) compared with adolescents (1.7).

Sex-specific associations have also been demonstrated between parent and adolescent, with comparability in fruit ($p<0.01$), vegetable ($p<0.01$), and dairy ($p<0.01$) in girls and only dairy in boys ($p<0.05$) [47]. Other researchers have reported a significant mother-son ($r=0.28$) but not mother-daughter ($r=0.18$) association in overall diet quality, as measured by the Healthy Eating Index -2005 [48]. In the present analysis, it was hypothesized that diet quality of adolescents and mothers would be related strongly. Yet overall scores of mothers (60.3%) were higher than those of adolescents (53.6%). The frequency of mothers (≈25% of total sample) who reported adherence to special diets, such as low-carbohydrate and weight loss, may have accounted for the greater diet quality observed in mothers.

Adolescent dietary outcomes were of special concern, as they were below recommendations for total fruit (68.1%), total vegetable (55.7%), greens and beans (52.9%), whole grains (15.3%), dairy (55%), seafood and plant protein (38.1%), fatty acids (8.8%), sodium (55.3%), empty calories (67.1%), and total HEI-2010 (53.6%). These findings are comparable to national reports on diet quality provided by the National Health and Nutritional Health Examination Survey (NHANES), 2011-2012. However, some noteworthy differences were found for total fruit (1.13 *vs*. 1.84 cups), total vegetable (0.93 *vs*. 1.85 cups), dairy (2.26 *vs*. 3.47 cups), and refined grains (6.09 *vs*. 5.09 ounce equivalents) were found, with adolescents in this study achieving slightly more favorable outcomes. These discrepancies could be attributable partly to the fact that national reports sampled a wider range of income levels, with particular attention to individuals below the 131% federal poverty line. It is well known that socioeconomic status impacts dietary outcomes, with a higher diet quality in more affluent individuals [48]. The inadequate diet quality observed in this research is of concern, as lack of a balanced diet could hinder future growth and development of these growing children. Furthermore, dietary behaviors established during this critical phase of life may be maintained throughout adulthood [21]. Findings from the regression analysis were congruent with research on the impact of the home food environment on diet quality, whereby availability of foods in the home appears as a consistent determinant of consumption of these foods [32,33]. In a sample of elementary school children, fruit and vegetable availability were significantly associated with actual intake of foods reported by a 5-7 day food record [33]. Similarly, availability of unhealthy foods such as chips and soft drinks in the home corresponded with elevated consumption of those foods [32]. This is likely because the food options to which an individual has access will either facilitate, or limit, healthy eating. In the present study, healthy eating attitude was observed as a predictor of overall diet quality. Thus, these results corroborate findings by Muzaffar (2014) that attitudes toward healthy eating translated into a greater intention to engage in healthy eating [50]. According to the Theory of Planned Behavior, attitudes precede intentions, as an individual will engage in a behavior when it is evaluated positively [51]. Indeed, Haerens et al. reported that adolescents with better attitudes toward three behaviors - intake of low-fat diet, fruit, and soft drinks - consumed diets that were lower in fat (boys: $\beta=-0.27$, $p<0.01$, girls: $\beta=-0.16$, $p<0.01$) and higher in fruit (boys: $\beta=0.18$, $p<0.05$, girls: $\beta=0.21$, $p<0.01$) [52]. Consequently, this investigation provides further support for the importance of attitudes as determinants of behavior.

Self-efficacy, the confidence of an individual to engage in healthy eating, has been widely discussed in the field as a positive influence on diet quality [22,23]. These results confirm the importance of the influence of self-efficacy on weight status of adolescents. Although implications of a critical link between food availability and diet quality are prominent in the literature [32,33], limited research exists on the direct effects on weight. In an analysis of the home food environment and various health-related measures, including BMI, other authors have found no significant associations between presence of healthy or unhealthy foods on BMI z-scores of adolescents [26,30]. The current research emphasizes the role of availability of healthy foods on BMI of adolescents and the need to consider food options in the home environment as potential modulators of obesity. The magnitude of the relationship between the various measures in the home was more evident for diet quality than for BMI-for Age percentile. Support for this stronger linkage may be accounted for by the fact that achievement of healthy BMI entails improvements in diet quality. Since obesity is a multifaceted disease, other factors (physical activity, genetic predisposition) also may play an important role [53].

Conclusions and Future Implications

The current research was undertaken to understand the influence of the multidimensional home environment on diet quality and BMI-for-Age percentiles of young adolescents. A secondary goal was to compare the diet quality of adolescents and mothers using the Healthy Eating Index-2010. It was observed that both groups, especially adolescents have less than ideal diet quality. In this sample, adolescent diet quality was lower than mothers, which is in contrast to other comparisons. Whole grain and fatty acid consumption diverged from recommendations and overall diet quality scores were <75% of maximum for both adolescents and mothers. Findings on availability and accessibility to healthy and unhealthy foods and associations with diet quality in this study are based on the perspective of the adolescent rather than the parent. These findings are novel, as parent reports may be biased and it was anticipated that as adolescents mature, they may be more likely to make decisions about diet that differ from their parents. The factors studied were chosen based on an extensive literature review highlighting the impact of healthy eating attitude [48], self-efficacy [21], emotional eating [54], and mindless eating [55] on diet quality in young adults. Other psychological stimuli such as mindful eating, intuitive eating, and disordered eating were not part of the instrument, yet reports on their associations with diet quality and BMI are warranted.

The cross-sectional nature of the study limits the ability to capture changes in behavior that may occur over time. Additionally, self-reports on weight and height in mothers are a limitation, as participants may have underreported weight. The genetic influence of obesity was not included, as it was beyond the scope of the study.

Several dietary inadequacies were noted, with low compliance for total fruit, whole fruit, total vegetable, empty calories, and overall diet quality, according to home environment tertiles. Associations between the home and diet quality were more pronounced than for BMI-for-Age percentiles. In specific, availability of healthy foods, healthy eating attitude, and accessibility to unhealthy foods were the most powerful predictors of diet quality; self-efficacy and availability of healthy foods were more prominent determinants of BMI-for-Age percentiles.

This research is unique, as it examines a broad range of parameters in the home environment and their potential impact on diet quality and weight status of adolescents. Findings from the current study emphasize the importance of employing conceptual frameworks that aim at multiple levels of influence to effect positive behavioral change. It may be beneficial for interventions to incorporate strategies to enhance healthy eating attitudes and self-efficacy, as well as providing adolescents and mothers with opportunities to restructure physical features of their homes. Future endeavors that consider these modifiable factors in the home environment may facilitate improvements of diet quality and BMI-for-Age in youth.

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Int J Nutr Sci - Volume 1 Issue 2 - 2016
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Citation: Tabbakh T and Freeland-Graves JH. Influence of the Home Environment on Diet Quality and Weight Status of Adolescents. Int J Nutr Sci. 2016; 1(2): 1009.