Dietary Energy Density and Fast Food Consumption of 16-21 year-old Adolescents

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ABSTRACT

Objective. This study was conducted to determine the dietary energy density of diets consumed by adolescents and characterize their fast food consumption.

Methods. Secondary data analyses were made on a selected group of adolescents aged 16–21 years (n=99) who were enrolled in a university located in Manila. A two-day non-consecutive 24-hour food recall was conducted to collect dietary data. Dietary Energy Density (DED) was calculated by dividing the available energy (from carbohydrate, protein and fat) by unit weight of foods and beverages consumed. To determine the DED of the total food and beverage intake, the following were obtained: (a) the mean energy (kilocalorie) value of total food and beverage consumed, the total amount of food consumed, and the total beverage consumed; (b) the mean total weight of food and beverage consumed, the total amount of food consumed, and the total beverage consumed; and (c) the mean DED of total amount of food and beverage consumed, total food consumed, and the total beverage consumed. Fast food consumers included respondents who reportedly ate fast food at least once during the two survey days while non-fast food consumers did not eat in any fast food establishment within the surveyed period. Data were analyzed using EpiInfo version 3.5.3 Data were reported as mean ± SD. Student's t-test was used to compare the means while the chi-square test was employed to determine the existence of a relationship between variables.

Results. Adolescents consumed fast foods on a typical school day. Fast food consumers had significantly higher mean intake of energy, carbohydrate, protein and fat than non-fast food consumers. The DEDs of beverage as well as food and beverage intake of fast food consumers were significantly higher than those of non-fast food consumers. Compared to non-fast food consumers, those who ate fast foods took significantly more energy-dense beverages (1.24 kcal/g versus 0.98 kcal/g; p = .0096) and meals (2.51 kcal/g versus 1.95 kcal/g; p = .0772); however, the DED of foods consumed did not differ significantly. There were significantly more fast food consumers who ate "medium" and "high" energy-dense foods than non-fast food consumers (28.8% and 6.8% versus 10% and 2.5%; p=0.038). Fast food consumption of the adolescents was not significantly associated with their nutritional status measured in terms of body mass index (BMI).

Conclusion. Adolescents consumed fast foods on a typical school day. Fast food consumers had significantly higher mean intake of carbohydrate, protein, fat, and calories compared to non-fast food consumers. Those who ate fast foods took significantly more energy-dense meals (food and beverage) and beverages than non-fast food consumers. Findings likewise showed that there are significantly more fast food consumers who ate "medium" and "high" energy-dense foods compared to non-fast food consumers. Thus, fast food establishments should offer a variety of food choices that includes low energy-dense food items. In this study, no association was found between fast food consumption and BMI.

Key Words: dietary energy density, fast food consumption, adolescent

Introduction

Adolescence is a nutritionally vulnerable period due to increased nutrient and energy requirements in response to pubertal growth spurt coupled with poor eating behavior as adolescents struggle to become adults. The World Health Organization[1] (WHO) has identified persisting nutritional problems of this age group that include under nutrition, iron deficiency anemia and other micronutrient deficiencies, obesity, early pregnancy, and inadequate diets and unhealthy lifestyles. Adolescents are particularly prone to poor eating behavior as they start to be independent in making food choices, experiment on fad diets, engage in meal skipping and excessive dieting and frequent consumption of fast foods that suit their socially active lifestyles.

Fast food establishments appeal to all age groups, but more so among adolescents, due to the varied food choices offered, their relatively affordable prices, their fast service, and their accessibility. Fast foods are "convenience foods obtained in self-service or 'take-away' eateries with minimal waiting… usually characterized as energy dense, low in micronutrients and fiber, high in simple sugars and salt, generally larger in portion size than conventional home-cooked and restaurant foods and highly palatable."[2] Due to

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their increasing popularity, several studies have reported the negative impact of fast food consumption on an individual's energy and nutrient intake, eating patterns, and overall diet quality.[2,3,4] Likewise, fast food consumption has been linked to excessive weight gain increasing one's risk to overweight and obesity and certain chronic diseases such as hypertension and Type 2 diabetes mellitus. [5,6,7,8,9]

Unhealthy weight gain occurs when there is an excessive intake of energy or calories leading to a positive energy imbalance with concomitant physical inactivity. Characterized as being energy-dense, frequent fast food consumption has been identified as one of the causative factors promoting weight gain. Furthermore, dining out increases the opportunity to choose and eventually consume high-energy density foods which contain more calories compared to low-density foods having fewer calories for the same weight of food. Although Filipino adolescents were not found to be overweight based on the 2008 FNRI national nutrition survey,[10] it is crucial that their dietary patterns be investigated since this is the period when life-long nutrition behaviors start to be established. The acquisition of healthy nutrition practices during adolescence ensures long-term health benefits throughout adulthood that would help mitigate the incidence of diet-related chronic diseases. In 2003, the WHO[11] recommended specific strategies that would prevent obesity among children and adolescents. These include: (1) promoting an active lifestyle; (2) limiting television viewing; (3) promoting the intake of fruits and vegetables; (4) restricting the intake of energy-dense, micronutrient-poor foods; and (5) restricting the intake of sugar-sweetened soft drinks.

In the local setting, there is a dearth of studies on the eating patterns of adolescents. There is only one local study conducted on the food intake of pre-adolescents (11-12 year-old).[12] Specifically, local studies on energy density and its impact on weight gain have not been undertaken. There is a need, therefore, to determine the Dietary Energy Density (DED) of diets consumed by adolescents and characterize their fast food consumption.

Methods

Subjects

A secondary data analysis was made of the study on "Association of Fast Food Consumption with the Nutritional Status of Undergraduate College Students Aged 16-21 Years Old of Philippine Women's University School of Fine Arts and Design"[13] which was conducted second semester of school year 2011-2012. The School of Fine Arts and Design (SFAD) is one of the three schools with the highest number of enrollees and whose students were allowed by school authorities to participate in the study. However, the students from the other two schools failed to participate since the third year students of one school were having their practicum while those in the other school were preparing for their course accreditation.

The SFAD had a population of 200 students. This number was decreased due to the difficulty of interviewing the sampled students and the failure to submit their parents' consent forms for those below 18 years old. Thus, a recalculation of the required sample size was performed, decreasing the confidence level and increasing the standard error.

The study population was stratified based on their year levels and a proportional allocation was used to obtain representative samples from each year level. A total of 103 Fine Arts and Design respondents participated in the study; however, only 99 completed the three-day food recall. An informed consent was obtained from the respondents who were 18 years old and above, while those below 18 years old obtained parental consent.

Fast Food Consumption

Fast food consumers include respondents who reportedly ate fast foods at least once during the three survey days while non-fast food consumers did not eat in any fast food establishment within the surveyed period. This inclusion criterion was based on the method employed by Bowman and Vinyard.[3]

Dietary Intake

The 24-hour food recall was used to collect dietary data. A one-day recall was conducted by the researchers through a face-to-face interview. Each respondent was asked to recall all foods and beverages consumed the previous day, from the time he woke up to the time he slept. Ingredients of mixed dishes were listed and the cooking methods, time and place of consumption as well as brand names of processed foods were recorded in the Food Recall Form. Estimates of the amount of each food consumed were listed in household measures. Food models and a set of measuring cups and spoons were used to assist each respondent in estimating the amounts and portion sizes of foods consumed.

The one-day food and beverage intake of the respondents were recorded for three days—two non-consecutive weekdays and one weekend. For this study, only the two non-consecutive weekday data were utilized and analyzed. The data were converted into gram equivalents using the Table of Weights and Measures of Foods. To compute the energy (in calories), carbohydrate, protein, and fat contents of the different foods, the "FCT + Menu Eval" application software developed by the Food and Nutrition Research Institute, Department of Science and Technology (FNRI-DOST), Philippines, 2002 was used.

The fast food items reportedly consumed were purchased and weighed to determine the gram equivalents of their serving portion sizes. Carbohydrate, protein, and fat

contents of each fast food were computed using the values obtained from "The Complete Book of Food Counts" by Netzer[14] and My Fitness Pal website.[15]

Dietary Energy Density

Wang et al.[8] defined Dietary Energy Density (DED) as "the amount of energy able to be metabolized per unit weight or value of food." Thus, DED was calculated by dividing the available energy (from carbohydrate, protein, and fat) by unit weight of foods and beverages or kilocalories per gram as shown below:

$$DED = \frac{\text{Energy value of food and/or beverage consumed}}{\text{Total weight of food and/or beverage consumed}}$$

To determine the DED of the total food and beverage intake, the following were computed: 1. the mean energy (kilocalorie) value of total food and beverage consumed, the total amount of food consumed, and the total beverage consumed; 2. the mean total weight of food and beverage consumed, the total amount of food consumed, and the total beverage consumed; and 3. the mean DED of total amount of food and beverage consumed, total food consumed, and the total beverage consumed.

Statistical Analysis

Data were analyzed using EpiInfo version 3.5.3. Data were reported as mean ± SD. Student's t-test was used to compare the means while the chi-square test was employed to determine the existence of a relationship between variables.

Results and Discussion

Results

A summary of the mean carbohydrate, protein, fat, and caloric intakes of adolescents for the two surveyed weekdays is shown in Table 1. Their caloric intakes ranged from 1,019 – 2,651 kcal. They consumed 112 – 316 grams of carbohydrate, 33 – 109 grams of protein, and 35 – 108 grams of fat.

Table 1. Summary of total intakes of adolescents (n = 99)

Total Intakes	Mean ± SD
Carbohydrates (g)	214 ± 102
Protein (g)	71 ± 38
Fat (g)	81 ± 46
Energy (kcal)	1835 ± 816

As expected, male adolescents consumed more calories and energy-giving nutrients compared to female adolescents. The data in Table 2 indicate that these differences were found to be highly significant ($p < .0001$).

Table 2. Energy and nutrient intakes of adolescents according to gender

Total Intakes	Gender		p-value
	Male (n = 38)	Female (n = 61)	
Carbohydrate	246 ± 119	194 ± 85	<0.0001
Protein	87 ± 45	60 ± 30	<0.0001
Fat	87 ± 47	77 ± 45	<0.0001
Energy	2017 ± 748	1721 ± 842	<0.0001

Table 3 shows that older adolescents (19–21 years) had higher intakes of carbohydrate, protein, and calories compared to younger adolescents (16–18 years). Fat consumption, however, was comparable although intakes of younger adolescents varied more than the older ones. The different consumption of the two groups was significant ($p < .0001$).

Table 3. Energy and nutrient intakes of adolescents according to age

Total Intakes	Age		p-value
	16-18 years old (n = 56)	19-21 years old (n = 43)	
Carbohydrate	201 ± 81	231 ± 123	<0.0001
Protein	69 ± 39	72 ± 38	<0.0001
Fat	81 ± 50	81 ± 41	<0.0001
Energy	1803 ± 875	1876 ± 740	<0.0001

Do fast food consumers have higher intake of carbohydrate, protein, and fat than non-fast food consumers? As seen in Table 4, adolescents who ate fast food at least once during the two surveyed days registered significantly higher mean intake of carbohydrate (226 grams versus 192 grams; $p = .0340$), protein (72 grams versus 69 grams; $p < .0001$), and fat (86 grams versus 73 grams; $p < .0018$) than those who did not eat any fast food. Moreover, the mean caloric intake of fast food consumers significantly increased to more than 300 kcal ($p < .0010$).

Table 4. Energy and nutrient intakes of adolescents according to fast food consumption

Total Intakes	Fast food consumers (n = 59)	Non-fast food consumers (n = 40)	p-value
Carbohydrate	226 ± 101	192 ± 102	0.0340
Protein	72 ± 39	69 ± 38	<0.0001
Fat	86 ± 49	73 ± 42	<0.0018
Energy	1969 ± 913	1636 ± 604	<0.0010

The energy density of food and/or beverage consumed by adolescents is presented in Table 5. They consumed energy-dense foods (3.06 kcal/g) which have higher energy density than the combined intake of foods and beverages (2.28 kcal/g). However, this group of adolescents did not engage in drinking too much sugar-sweetened beverages. The energy density of consumed beverages was lowest at 1.14 kcal/g.

Table 5. Summary of total food and beverage intake (n = 99)

Total Intakes	Energy (kcal)	Weight (g)	Energy Density
Food only	1733 ± 755	707 ± 335	3.06 ± 2.35
Beverage only	102 ± 134	160 ± 183	1.14 ± 1.88
Food and beverage	1835 ± 816	867 ± 368	2.28 ± 1.25

To determine the variation in the DED values of the total intakes of adolescents, the coefficient of variation (CV) was computed. As shown in Table 6, the least variable DED is the food and beverage consumption while the most variable is the DED of beverage intake.

Table 6. Coefficient of variation (CV) of DED values

Total Intakes	DED values	CV
Food only	3.06 ± 2.35	0.768
Beverage only	1.14 ± 1.88	1.649
Food and beverage	2.28 ± 1.25	0.548

Table 7 shows that the DEDs of beverage as well as food and beverage intakes of fast food consumers were significantly higher than those of non-fast food consumers. Fast food consumers took more energy-dense beverages compared to those who did not eat fast foods (1.24 kcal/g versus 0.98 kcal/g; p = .0096). It was noted that meals (food and beverage) of fast food consumers are significantly more energy dense than meals of non-fast food consumers (2.51 kcal/g versus 1.95 kcal/g; p = .0772). When only food intake was considered, the DED of foods consumed by fast food consumers and non-fast food consumers did not differ significantly.

Table 7. Dietary energy density (DED) of meals taken by adolescents according to fast food consumption

DED	Fast food consumers (n = 59)	Non-fast food consumers (n = 40)	p-value
Food only	3.50 ± 2.84	2.27 ± 1.00	1.0000
Beverage only	1.24 ± 2.06	0.98 ± 1.59	0.0096
Food and beverage	2.51 ± 1.48	1.95 ± 0.71	0.0772

When DEDs were ranked according to "low", "medium", and "high" values, both fast food consumers and non-fast food consumers were found to consume "low" energy-dense food and beverages (Table 8). However, there were significantly more fast food consumers who ate "medium" and "high" energy-dense foods compared to non-fast food consumers (28.8% and 6.8% versus 10% and 2.5%; p = 0.038).

Table 8. Ranking of total DED values according to fast food consumption

Total DED Ranking	Fast food consumers (n = 59)		Non-fast food consumers (n = 40)		Total (n= 99)	
	No.	Percent	No.	Percent	No.	Percent
Low	38	64.4	35	87.5	73	73.7
Medium	17	28.8	4	10.0	21	21.2
High	4	6.8	1	2.5	5	5.1
Total	59	100.0	40	100.0	99	100.0

** p = 0.038*

Cut-off levels of Total DED:

Low < 2.5

Medium 2.5 – 4

High > 4

Is fast food consumption associated with the nutritional status of adolescents measured in terms of body mass index (BMI)? The data presented in Table 9 indicate the non-existence of an association between BMI and fast food consumption. Although there were more fast food consumers (12.1%) than non-fast food consumers (7.1%) with above normal BMI, these differences were not statistically significant.

Discussion

Fast Food Consumption Among Adolescents

Adolescents in this study were found to consume fast foods on a typical school day. This trend may be due to a number of reasons. One major factor for choosing and deciding to eat a certain food is its taste and palatability. For young individuals, however, they find convenience foods appealing due to other reasons. These may range from economic (e.g. their affordable prices) to personal reasons (e.g. ability to independently decide what to choose from a variety of food items offered). In a recent study by Babey, Wolstein and Diamant,[16] another factor was noted to influence the fast food intake of adolescents. They reported that adolescents who reside and go to schools in places with more fast food establishments and convenience stores

Table 9. BMI classification of adolescents according to fast food consumption

Fast food consumption	BMI classification						Total		p-value
	Under		Normal		Above Normal				
	No.	%	No.	%	No.	%	No.	%	
Fast food consumers	10	10.1	37	37.4	12	12.1	59	59.6	
Non-fast food consumers	9	9.1	24	24.2	7	7.1	40	40.4	
									0.472
Total	19	19.2	61	61.6	19	19.2	99	100.0	

tended to consume more fast food and soft drinks than those residing near healthier food outlets such as grocery stores, produce vendors, and warehouse stores.

Why do our adolescents frequent fast food restaurants and convenience stores? The school where the study was conducted is located in an area in close proximity to fast food establishments. College students were found to consume convenience foods despite the presence of a school canteen where a variety of meals are offered. Due to a lack of local studies on the consumption patterns and eating behaviors of adolescents, the impact of eating fast food on individual caloric intake and diet quality has not been examined. This baseline information is deemed crucial in order to improve the dietary patterns of adolescents and prevent adult obesity.

Impact of Fast Food Consumption on Energy and Nutrient Intake

Adolescents who consumed fast food on a typical weekday recorded significantly high mean intakes of carbohydrate, protein, fat, and energy compared to non-fast food consumers. In fact, their mean caloric intakes ranged from 1,056 – 2,882 kcals while those who did not eat fast food ranged from 1,032–2,240 kcals. A mean caloric intake of 2,882 kcals is 42 kcals higher than the recommended energy intake of 2,840 kcals for Filipino male adolescents 16–18 years old.[17] An excessive caloric intake due to frequent fast food consumption could translate to weight gain or obesity particularly among individuals with sedentary lifestyles.

These findings are consistent with US-based data set on the impact of fast food consumption on an adolescent's energy and nutrient intakes. Bowman et al.[18] noted that American children and adolescents who consume fast food had more total energy consumption and with poor diet quality than those not eating fast food. Likewise, a longitudinal cohort study by Schmidt et al.[4] pointed out that frequent fast food consumption is positively associated with higher intakes of energy, total fat, saturated fat, and sodium.

Dietary Energy Density and its Probable Implications on Body Weight

Findings of the present study have established that beverage as well as food and beverage intakes of fast food consumers are high energy-dense meals or snacks compared to home-prepared foods. Fast foods are considered energy-dense due to their high fat content and their lack of ingredients having high water or moisture content such as fruits and vegetables. Since generally fast foods lack fruits and vegetables, they are also low in fiber and complex carbohydrates. On the other hand, consumption of a variety of low energy-dense foods is linked with reduced energy intake due to their relatively low fat content.

Ranking DEDs into "low", "medium", or "high" values underscored further the high energy-dense meals characteristic of fast foods. Although fast food and non-fast food consumers typically consumed "low" energy-dense fast foods, a higher percentage of the former consumed "medium" or "high" density fast foods while a lower percentage of the latter consumed "high" energy-dense meals (35.6% versus 12.5%). The level of energy-dense meals taken by fast food consumers significantly differed from those who did not consume fast foods. It is therefore recommended that future studies rank DED values so as to better characterize the energy density levels of fast foods.

The DED values of beverages consumed were found to be highly variable, with a 1.649 coefficient of variation. This might be explained by the fact that softdrinks, iced teas, and juices dispensed in vendo machines could be diluted or concentrated in terms of their sugar and water content. This would greatly affect the computation of the energy density of beverages which was obtained by dividing total energy intake (in kilocalories) by the total weight of the beverage. This limitation was noted by Mc Caffrey et al.[19] They stated that "one dilemma when calculating ED (energy density) is whether to include beverages because they can disproportionately influence the calculation of ED."

Dietary energy density and its probable impact on body weight has been the subject of a number of investigations abroad. In particular, two studies[20,21] reported the presence of a significant longitudinal association between sugar-sweetened beverage (SSB) intake and percent body fat (PBF). Increased SSB was associated with increased body mass index (BMI) among male adolescents while increased fast food consumption was associated with increased PBF in females. In another study among Iranian adolescents, fast food consumption was associated with poor diet quality and high prevalence of overweight and obesity among Isfahani female adolescents. Two studies, however, reported different results. Richter et al.[22] noted that the dietary patterns of German adolescents were not significantly associated with being overweight (measured in BMI). Findings of the present investigation as well as that of the local unpublished study[13] failed to find an association between fast food consumption and BMI.

These inconsistent findings on the impact of fast food intake on body weight emphasize the need for more in-depth investigations on the multifactorial causes of obesity. Gain in weight cannot be attributed to a single dietary, environmental, or behavioral factor alone. In the present study, the small sample (N=99) has limited the analysis of causes of fast food consumption among our adolescents as well as eating behavior and variability of their dietary patterns. The type of fast food regularly consumed as well as their DED levels are worth looking into, particularly in urban centers where there is a proliferation of fast food establishments.

Dietary energy density has been proposed as an essential determinant of an individual's energy intake, greatly influencing body weight. The 2010 Dietary Guidelines for Americans encourages the consumption of a diet pattern that is low in energy density in the management of body weight. The 2010 Dietary Guidelines Advisory Committee justified this recommendation based on the "moderately strong evidence from methodologically rigorous longitudinal studies" in children and adolescents.[23]

Due to the possible impact of fast food consumption on body weight and its influence on the prevention and mitigation of chronic diet-related diseases during adulthood, additional local researches are needed to explore the energy density of convenience foods taken away from home versus home-prepared meals. Likewise, the definition of fast foods should be broadened and made more encompassing to include local foods (such as streetfoods that require deep fat frying) that are widely patronized by our youth. As our youth increasingly take their meals and snacks away from home, local studies need to be conducted that examine the dietary patterns of adolescents coming from different socio-economic levels in order to ascertain the impact of environmental factors in the development of specific eating behavior that can lead to overweight problems during adulthood.

Conclusion

Fast food consumption is part of the eating behavior of adolescents in this study. Results revealed that fast food consumers have significantly higher intake of carbohydrate, protein, fat, and calories than non-fast food consumers. Furthermore, the dietary energy densities of beverage as well as food and beverage intake of fast food consumers were significantly higher than those of non-fast food consumers. Fast food consumers took more energy-dense beverages compared to those who did not eat fast foods. Likewise, meals (food and beverage) of fast food consumers were significantly more energy-dense than meals of non-fast food consumers. In terms of the energy density levels of fast foods, there were significantly more fast food consumers who ate "medium" and "high" energy-dense foods compared to non-fast food consumers. No association, however, was found between fast food consumption and BMI. It is recommended that additional local researches, with bigger sample sizes, be conducted examining the energy density of away-from-home foods and beverages and how their consumption influences total energy intake and body weight.

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