Assessing MyPlate Familiarity and Typical Meal Composition using Food Models in Children Aged 7-13

Jada L. Willis[1,*], Carol J. Howe[2] and Gina K. Alexander[2]

[1]*Department of Nutritional Sciences, Texas Christian University, TCU Box 298600 Fort Worth, TX, 76129 USA*

[2]*Harris College of Nursing and Health Sciences, Texas Christian University, TCU Box 298620 Fort Worth, TX, 76129 USA*

Abstract: The Dietary Guidelines for Americans serve as a basis for developing federal nutrition education materials for the public, such as MyPlate. MyPlate is a visual cue that uses food groups as a guide to building healthy plates at mealtime. The objective of this study was to determine factors associated with child familiarity with MyPlate guidelines and to determine if *typical meals* met MyPlate guidelines using food models. A convenience sample of 250 children (aged 7-13 years) and their parent/guardian were recruited at a local science and history museum. Children viewed a picture of the MyPlate icon and were asked to identify the picture. Next, participants used a nine-inch plate to build a typical meal (meals that they would regularly consume) from a buffet of food and beverages models (>65 items to choose from). Research team members took photographs of the plates. A Registered Dietitian Nutritionist determined the percentage of plates that met MyPlate guidelines. Eighty-six percent of children recognized the MyPlate icon upon viewing the image; 7.6% could accurately identify the icon by name. When participants were asked to build a typical meal, however, only 3.43% met MyPlate guidelines. The results of this study suggest that despite being familiar with MyPlate, children built typical meals that did not meet MyPlate guidelines.

Keywords: MyPlate, familiarity, child nutrition, fruit, vegetable.

INTRODUCTION

Nearly one in three children are overweight or obese [1-3]. Obesity is associated with immediate and long-term health problems for children and is a serious public health issue [4-11]. If left untreated, obesity in childhood is likely to continue into adulthood leading to a greater risk of diabetes and progressively worse cardiovascular outcomes [2]. The most common cause of obesity in children is a positive energy balance due to caloric intake in excess of caloric expenditure, combined with a genetic predisposition for weight gain [12]. Thus, early dietary patterns and behaviors in childhood can have long-term health consequences and underscore the need to explore children's understanding of current nutritional guidelines and their intent to eat healthy meals.

The U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services jointly issue the Dietary Guidelines for Americans targeting healthy Americans aged two years and older to promote health and reduce the risk of major chronic diseases [13]. In 2011, the current food guide, MyPlate, was unveiled. MyPlate is an uncomplicated visual cue prompting individuals to use food groups as a guide to

building healthy plates at mealtime. MyPlate consumer messages from the Center for Nutrition Policy and Promotion's MyPlate resources include: Everything you eat and drink over time matters; the right mix can help you be healthier now and in the future; make half your plate fruits and vegetables: focus on whole fruits and vary your veggies; make half your grains whole grains; move to low-fat or fat-free milk or yogurt; vary your protein routine; drink and eat less sodium, saturated fat, and added sugars; and start with small changes to make healthier choices you can enjoy. Yet, in the U.S., the overall diet quality of children is suboptimal [14]. It has been shown that boys and girls ages four to eight years of age have low average intakes of vegetables, dairy, and whole grains in comparison to recommended intake levels [15]. Moreover, boys and girls ages nine to thirteen years fall short of recommended intake levels for vegetables, dairy, whole grains (low-average) and fruits (low) [15]. All children exceed intake for added sugar [15]. Although MyPlate is widely used, few researchers have evaluated child awareness or familiarity. In addition, little is known about the extent to which a typical meal chosen by children would meet the MyPlate guidelines.

The objectives of this study were to: 1) determine factors (parent factors: race, ethnicity, income, education, and health literacy; child factors: age, gender, and weight status) associated with child familiarity of MyPlate; 2) assess children's familiarity

*Address correspondence to this author at the Department of Nutritional Sciences, Texas Christian University, TCU Box 298600 Fort Worth, TX 76129, USA; Tel: 817-257-7309; Fax: 817-257-5849; E-mail: jada.willis@tcu.edu

with MyPlate; and 3) identify the percentage of typical meals that met MyPlate guidelines.

MATERIALS AND METHODS

Study Design

The Institutional Review Board approved this study before recruitment and data collection (Approval Number: 1610-084-1709CR). Written informed consent (adults) and parent permission/child assent were obtained prior to participation in the study. This study utilized a cross-sectional descriptive design which involved one study visit that lasted approximately 15-20 minutes. All testing occurred at a local museum. Data collection occurred on Tuesday evenings and Saturday afternoons from November to December for a total of ten data collection sessions. Tuesday evenings were Family Night at the museum during which public schools from the Fort Worth area received free admission and free transportation to and from the children's museum.

Participants

Initial recruitment for the study consisted of a museum patron email, flyer, website, and on-site display. Children and their parent/guardian were recruited at the local museum using convenience sampling. Inclusion criteria were children 7–13 years old of any weight/physical activity status and their parent/guardian (≥18 years old) who spoke sufficient English to participate in research activities. Some parents had multiple children who met inclusion criteria and participated in the study. Exclusion criteria were individuals (children or parents) who were not cognitively or physically able to participate in the research activities [16].

Procedure and Measures

Before data collection, nine dietetics students and four nursing students were trained on all study procedures by study investigators. All testing occurred at the local museum from November-December. On Tuesday evenings and Saturday afternoons during that timeframe, approximately five to seven research team members, including dietetics and nursing faculty and students, were present during data collection. Research personnel would arrive approximately 20-30 minutes prior to each data collection period to set up the area for testing. Stations and food models were set up in the exact same manner systematically every time for a consistent testing environment. In addition, the team set up a privacy screen for anthropometric measurements and designated specific stations for consent and survey completion. After written consent/assent was obtained, each child and parent were given a participant ID and separated for data collection.

Measurements - Children

Anthropometrics

Children's height and weight were measured using a digital scale (Seca 803, Chino, CA, USA) and a portable stadiometer (Hopkins #680215, Hopkins Medical Products®, Caledonia, MI, USA). Using this data, Body Mass Index [BMI] (kg/m^2) was calculated as a continuous variable. Specific study procedures for height, weight, and BMI percentiles have been previously described elsewhere [16]. Waist circumference (WC) and hip circumference (HC) were measured in duplicate to the nearest 0.1cm using a tape measure (Seca, Chino, CA, USA). Waist-to-hip ratio (WHR) was calculated and recorded.

MyPlate Familiarity

Children were shown a laminated image of the MyPlate (full plate; ChooseMyPlate.gov) and asked if they could identify the icon. Research personnel recorded the participant response as *Yes*, *No* or *Don't know*. Next, participants were asked (while viewing a picture of the MyPlate image) - "Could you tell me what it is?" Responses were recorded as *MyPlate*, *No*, or *Other*. If the response was noted as *Other*, research personnel recorded the specific participant response.

Food Models

As a proxy, participants then completed the task of building a typical meal selecting from the food models provided (MyPlate Food Model Kit, Fast Food Model Kit, NCES Health and Nutrition Education, Olathe, KS, USA; Mexican Fast Food, Nasco, Fort Atkinson, WI, USA). Food models (> 65 items available) included a variety of fruits, vegetables, grains, protein, dairy, pre-built meals (i.e. pizza, enchiladas, and tacos), and beverages. For each of the ten periods of data collection, the food models were set up systematically for consistency across data collection sessions. At the start of the measurement, children were provided with a nine-inch plate and were asked to build a typical meal (meals that they would regularly consume) from a buffet of food and beverage models (>65 items). Children were instructed to choose any foods/beverages that represented a typical meal for

them. Once the participants made their typical meal, research team members took photographs of the plates. A Registered Dietitian Nutritionist visually analyzed the photos to determine the food groups represented (absent, adequate, additional servings), percentage of plates that met MyPlate guidelines, and plates that included junk food and cola.

Parents/Caregivers

While the children were completing measurements, parents completed demographic questions. Parent characteristics (age, gender, marital status, race, ethnicity, income, years of education) and child characteristics (age, gender, grade in school) were recorded and previously reported [16].

Statistical Analyses

The IBM SPSS version 24 statistical package (SPSS Inc., Armonk, NY) was used, and all values are expressed as mean±standard deviation (SD) unless otherwise indicated. Descriptive statistics included frequency and percentages for categorical variables and means (SD) for continuous variables. Using random-effects modeling, the research team examined associations between selected predictors (parent race, ethnicity, income, education, child age, gender) and the dependent variables, familiarity with MyPlate and typical meal. Frequencies were tabulated for non-continuous variables, including familiarity with MyPlate and some demographics. Statistical significance was set at $p < 0.05$.

RESULTS

Demographics

Participant characteristics are reported in Table **1**. Participants included 160 parents and 250 children. Fifty-three parents had more than one child participate in the current study. Age of parents/caregivers ranged from 24 to 80 years (39±9.97yrs). According to parent/caregiver reports, 71.4% were Caucasian, 28.7% were non-White, 32.5% were Hispanic, 16% were non-Hispanic African American, 5.2% were Asian, and 7.5% reported *other*. A total of 48.8% had obtained less than a four-year college degree. Parents indicated monthly household income by checking one of six categories from 0 to >$100,000; 44.1% indicated monthly household income >$75,000. Approximately 12% of the sample reported an annual income at or below the U.S. poverty threshold of $24,600 for a family of four in 2017 [17]. Of the children who participated, 42% were boys and 58% were girls.

According to their BMI percentiles-for-age, 53% of children had a healthy weight status, while 45.6% were overweight or obese.

Table 1: Parent and Child Demographics

Characteristic	Number (%)
Parent/Caregiver (n=160)	
Mean Age	39 years (SD 9.97)
Female	151 (70.9%)
Race/Ethnicity	
Caucasian	152 (71.4%)
African American	34 (16.0%)
Asian	11 (5.2%)
Other	16 (7.5%)
Ethnicity	
Hispanic	67 (32.5%)
Education	
Some H.S.	6 (2.8%)
H.S. Graduate	29 (13.6%)
Trade School	19 (8.9%)
Some College	50 (23.5%)
College Degree	67 (31.5%)
Graduate Degree	42 (19.7%)
Family Income	
< $25,000	26 (12.2%)
$25,000-$34,999	32 (15.0%)
$35,000-$49,999	33 (15.5%)
$50,000-$74,999	28 (13.1%)
$75,000-$99,999	52 (24.4%)
> $100,000	42 (19.7%)
Child (n=250)	
Mean Age	8.9 years (SD 1.6)
Boys	103 (42%)
Girls	147 (58%)
Weight Status	
Underweight	4 (1.6%)
Healthy Weight	132 (53%)
Overweight	61 (24.4%)
Obese	53 (21.2%)
Waist-to-Hip Ratio	0.87 (SD 0.06)

MyPlate Familiarity

Eighty-six percent of children (n=215) reported familiarity with MyPlate, while 12.8% reported that they
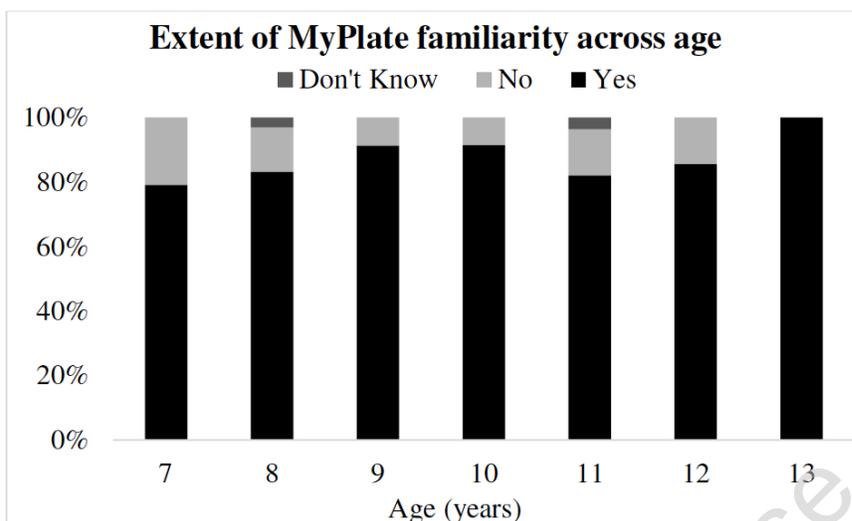
Figure 1: The extent of MyPlate familiarity in children ages 7-13 years. Children were shown the MyPlate image and asked if they could identify the image. Research personnel recorded the participant response as *Yes*, *No* or *Don't know*. Values are presented as percentages.

Table 2:   Identification of MyPlate – *Other*

Description of MyPlate – *Other*	Percentage
What you're supposed to eat	31.5%
Naming of food category (i.e. fruits, vegetables, dairy, grains, proteins), different types of food	17.5%
Food plate	16.0%
Healthy plate/meal	14.7%
Food chart, graph, or diagram	9.8%
Food pyramid	6.3%
Other – "foods you like, that's the limit of foods you're supposed to have each day, eat your colors program at school."	2.8%
Tells you where to put your food	1.4%

were not familiar (n=32) with the image. There was a small percentage of children (1.2%; n=3) that did not know if they had seen the MyPlate image (see Figure **1**). Of those who reported familiarity with the MyPlate image, 7.6% could identify MyPlate by name, while 36% said *don't know* and 55% said *other*. Common responses for the 55% marked as *other*s are reported in Table **2**. Figure **2** shows 47.9% of eleven-year-olds and 54.5% of twelve-year-olds were able to identify MyPlate by name. In comparison, only 3% of 8-year-olds, 4.4% of 9-year-olds, 8.5% of ten-year-olds and 12.5% of 13-year-olds could identify MyPlate by name. A chi-square test was performed to examine the relation between MyPlate identification and age and showed significant differences, X^2 (12, N=272) = 0.89, $p<0.001$. Eight-year-olds answered yes significantly less than expected (-2.6), while 11- and 12-year-olds answered yes significantly more than expected (5.6 and 3.2 respectively, $p<0.05$). No factors (parent factors: race, ethnicity, income, education and health literacy; child factors: age, gender, and weight status) were associated with child familiarity of MyPlate. No correlates were found between demographic characteristics of the parent/caregivers and children's familiarity with MyPlate.

Food Models – Building a Typical Meal

Of the 250 plates children built to represent a typical meal, 46 typical meals were excluded by research investigators for being unrealistic or excessive (see Figure **3**). The average number of items/meal of the 46 plates excluded was 7.54±2.67. Therefore, 204 typical meals were analyzed for this current study. The average number of items on each plate was 4.98±1.72 items. Grapes were the most frequently selected item (51/204 = 25.0%), while the least selected item was the fried fish square (2/204 =0.01%).
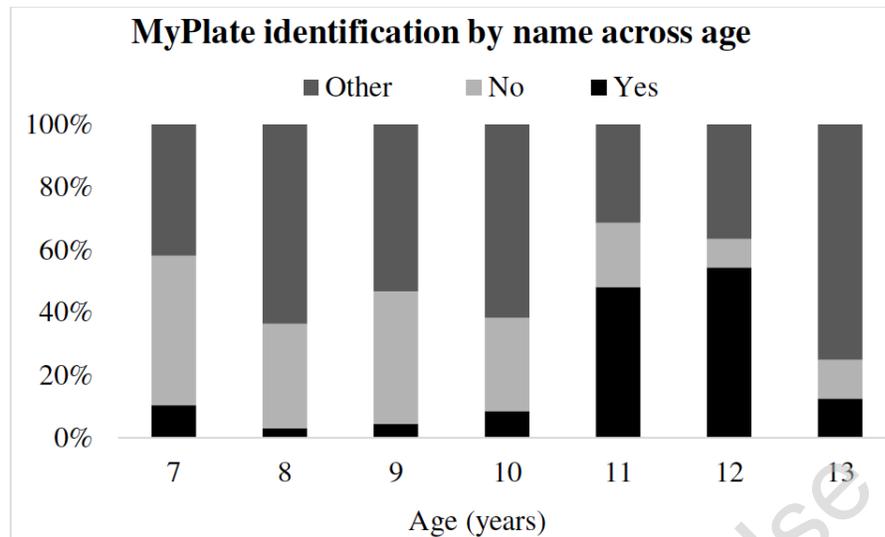
Figure 2: The extent of MyPlate identification by name in children ages 7-13 years. While viewing the MyPlate image, children were asked, "Could you tell me what it is?" Responses were recorded as *MyPlate*, *No*, or *Other*. Values are presented as percentages.

Figure 3: Examples of unrealistic/excessive typical meals that were excluded from further analyses. Of the 250 plates children built to represent a typical meal, 46 typical meals were excluded by research personnel for being unrealistic or excessive.

Of the 204 plates, 3.43% (n=7) met MyPlate guidelines, meaning one-half of the plate was fruits/vegetables, one-quarter of the plate included a protein, one-quarter of the plate included a grain, and a dairy serving was present. Table **3** lists the presence or absence of food groups and whether there were adequate servings or additional servings on the plate. The majority of children did not include a whole grain, and more than half of the children did not include a dairy or vegetable serving. Conversely, one-quarter of the children chose an additional serving of refined grains or fruit. Over one-third of children included junk food or cola in their typical meal, although more than half included milk (57.4%%; see Table **4**). Not all typical meals included a beverage.

DISCUSSION

This study adds to the body of research on MyPlate familiarity, adoption, and dietary choices of children by proxy. This study aimed to determine the factors associated with child familiarity of MyPlate guidelines; assess children's familiarity with MyPlate; determine the makeup of typical meals (using food models), and identify the percentage of typical meals that met MyPlate guidelines. Interestingly, we found no association between factors (parent factors: race, ethnicity, income, education and health literacy; child factors: age, gender, and weight status) and child familiarity of MyPlate. We found that the majority of children (~86%) recognized the MyPlate icon upon viewing the image; however, only 7.6% could

Table 3:   Typical Meal Compositions

Food Group (Out of 204 meals)	Absent	Adequate Serving	Additional Servings
Fruit	73 (35.8%)	80 (39.2%)	51 (25.0%)
Vegetable	110 (53.9%)	52 (25.5%)	42 (20.6%)
Grain			
Whole grain	170 (83.3%)	32 (15.7%)	2 (1.0%)
Refined grain	60 (29.4%)	91 (44.6%)	53 (26.0%)
Protein	38 (18.6%)	131 (64.2%)	35 (17.2%)
Dairy	114 (55.9%)	73 (35.8%)	17 8.3%)

Count; %. Reasons why the typical meals did not meet MyPlate guidelines.

Table 4:   Beverages

Beverages (n=141)	Number	Percentage
Milk	81	57.4%
Cola	46	32.6%
Water	6	4.26%
Tomato juice	5	3.55%
Apple juice	2	1.42%
Cranberry juice	1	0.71%

accurately identify the icon by name. These findings indicate that since MyPlate was unveiled in 2011, the majority of children are familiar with the updated guidelines. Yet when participants were asked to build a typical meal, only seven plates (3.43%) met MyPlate guidelines. Thus, the overwhelming majority of the typical meals would not be considered healthy. The basic premise of MyPlate is that everything an individual eats and drinks over time matters for optimal health now and in the future. Our findings highlight the importance of emphasizing nutrition principles and encouraging children to aim for a healthier eating pattern over time.

Other results of the study that merit discussion are the meals the children *typically* consume. Although the current study did not examine diet quality, previous studies have assessed the relationship between MyPlate familiarity and diet quality [18]. In that study, at least 81% of Americans who expressed familiarity with MyPlate also reported superior diet quality, and this number was increased (87.5%) among those who recounted trying MyPlate [18]. Researchers showed that familiarity with MyPlate positively correlated with a respondent's overall pattern of using nutrition information when eating outside the home [18].

Eating more vegetables and fruit is a recommendation of the 2015 Dietary guidelines, but children and adolescents are not meeting recommendations [19]. In our study, more than half of the children did not build a typical meal to include a vegetable serving (see Table **3**). Previous studies report similar findings, with significant implications for obesity [20-22]. One-quarter of the children in this sample included an additional serving of refined grains (simple carbohydrates) or fruit, implying their intent to consume these in a typical meal. This finding is of particular concern, given the theoretical link between overconsumption of simple carbohydrates and obesity and cardiovascular disease [23,24].

The beverage selection was another important finding of this study. Only 141 children selected a beverage as part of their meal. Encouragingly, 57.4% selected milk as their choice beverage. However, 32.6% of children selected a beverage that was sweetened with added sugars (sugar-sweetened beverage [SSB]) as part of their daily consumption. SSBs encompass a variety of drink types, including sodas/soft drinks, juices with added sugar, Kool-Aid, sports drinks, energy drinks, and sweet tea [25-27]. Bleich *et al*. reported that 63.5% of children aged 6–11 and 65.4% of adolescents aged 12–19 reported

consuming at least one SSB on a given day [28]. However, children in our study were half as likely to choose an SSB versus the national average. SSB consumption in children and adolescents is a public health issue, as research suggests that reducing SSB consumption would improve children's overall health [29].

In summary, over 47% of our sample had an unhealthy weight status, which is 1.5 times the national rate of obesity (32%). While we did not find an association between weight status and MyPlate familiarity in our sample, we do recognize the significance of their inability to meet MyPlate guidelines when asked to build a meal they would typically consume. The need for intervention is clearly demonstrated through this descriptive analysis of familiarity with MyPlate among children and families in a museum setting.

LIMITATIONS

There were some limitations in the current study that have been previously reported [16]. Children may have been subject to social desirability bias while choosing what to place on their plate as they may have believed healthier options would be viewed favorably by others. Another limitation was utilizing food models. The plates may not have accurately reflected what children eat, as portion sizes may not be representative. Further, we did not ask children if they ate prior to building their typical meal, presuming that hunger may have influenced their selections or even led some to build a plate that may have been deemed excessive. Lastly, since we had only 15 minutes for data collection in a busy museum environment, we did not ask participants if they gained an understanding of MyPlate, nor if they could build a plate that met MyPlate guidelines.

CONCLUSIONS

The present findings indicate that the majority of children in our study were familiar with MyPlate. However, despite this familiarity with MyPlate, only 3.43% of typical meals met MyPlate guidelines. Meals were least likely to include whole grains, dairy and vegetables, and most likely to exceed recommendations for refined grains and fruit, which closely resembles data from USDA. Although the children were not specifically asked to build a plate that met MyPlate guidelines, successful implementation of the MyPlate guidelines would presumably mean more children would build representations of a typical meal that meets the guidelines. Judging from our sample, the MyPlate guidelines may not be creating the behavior change necessary to change consumption habits. Parents, teachers, school food providers, and the healthcare system could improve by collaborating efforts in addressing low child nutrition literacy. Future studies are needed to investigate the ability of children to build a plate that meets MyPlate guidelines in addition to a typical meal, comparing the two for nutritional content in a variety of populations. In addition, further exploration of the relative roles of children and their parents in meal decisions would inform nutrition health education. We encountered several children who were familiar with dietary guidelines, but the majority demonstrated that they did not choose a typical meal representing recommended food groups and portions.

REFERENCES

[1]   Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA 2014; 311(8): 806-814.
https://doi.org/10.1001/jama.2014.732

[2]   O'Connor EA, Evans CV, Burda BU, Walsh ES, Eder M, Lozano P. Screening for obesity and intervention for weight management in children and adolescents: a systematic evidence review for the US Preventative Services Task Force. Evidence Synthesis No. 150. AHRQ Publication No. 15-05219-EF-1. Rockville, MD: Agency for Healthcare Research and Quality: AHRQ 2017.

[3]   Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of obesity among adults and youth: the United States, 2011-2014. NCHS Data Brief 2015; 219: 1-8.

[4]   BeLue R, Francis LA, Colaco B. Mental health problems and overweight in a nationally representative sample of adolescents: effects of race and ethnicity. Pediatrics 2009; 123(2): 697-702.
https://doi.org/10.1542/peds.2008-0687

[5]   Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. Pediatrics 1998; 101(3 Pt 2): 518-525.

[6]   Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. Pediatrics 1999; 103(6 Pt 1): 1175-1182.
https://doi.org/10.1542/peds.103.6.1175

[7]   Gilliland FD, Berhane K, Islam T, *et al*. Obesity and the risk of newly diagnosed asthma in school-age children. Am J Epidemiol 2003; 158(5): 406-415.
https://doi.org/10.1093/aje/kwg175

[8]   Luppino FS, de Wit LM, Bouvy PF, *et al*. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. Arch Gen Psychiatry 2010; 67(3): 220-229.
https://doi.org/10.1001/archgenpsychiatry.2010.2

[9]   Reilly JJ, Methven E, McDowell ZC, *et al*. Health consequences of obesity. Arch Dis Child 2003; 88(9): 748-752.
https://doi.org/10.1136/adc.88.9.748

[10] Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public-health crisis, common sense cure. Lancet 2002; 360(9331): 473-482.
https://doi.org/10.1016/S0140-6736(02)09678-2

[11]   Jastreboff AM, Kotz CM, Kahan S, Kelly AS, Heymsfield SB. Obesity as a disease: The Obesity Society 2018 position statement. Obesity (Silver Spring) 2019; 27(1): 7-9.
https://doi.org/10.1002/oby.22378

[12]   Kumar S, Kelly AS. Review of childhood obesity: from epidemiology, etiology, and comorbidities to clinical assessment and treatment. Mayo Clin Proc 2017; 92(2): 251-265.
https://doi.org/10.1016/j.mayocp.2016.09.017

[13]   Watts ML, Hager MH, Toner CD, Weber JA. The art of translating nutritional science into dietary guidance: history and evolution of the Dietary Guidelines for Americans. Nutr Rev 2011; 69(7): 404-412.
https://doi.org/10.1111/j.1753-4887.2011.00408.x

[14]   Ramsay SA, Eskelsen AK, Branen LJ, Shultz JA, Plumb J. Nutrient intake and consumption of fruit and vegetables in young children. Infant Child Adolesc Nutr 2014; 6(6): 332-344.
https://doi.org/10.1177/1941406414549622

[15]   U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015-2020 Dietary Guidelines for Americans. 8th Edition. Current eating patterns in the United States. December 2015. [cited 2018 Oct 26] Available from: https://health.gov/dietaryguidelines/2015/guidelines/

[16]   Howe CJ, Alexander G, Stevenson J. Parents' underestimations of child weight: implications for obesity prevention. J Pediatr Nurs 2017; 37: 57-61.
https://doi.org/10.1016/j.pedn.2017.06.005

[17]   The poverty guidelines updated periodically in the Federal Register under the authority of 42 U.S.C. 9902(2). U.S. Department of Health and Human Services. Office of the Assistant Secretary for Planning and Evaluation. Published 1/26/2017 [cited 2018 May 10] Available from: https://aspe.hhs.gov/2017-poverty-guidelines#threshholds

[18]   Tagtow A, Raghavan R. Assessing the reach of MyPlate using National Health and Nutrition Examination Survey data. J Acad Nutr Diet 2017; 117(2): 181-183.
https://doi.org/10.1016/j.jand.2016.11.015

[19]   Townsend MS, Shilts MK, Styne DM, et al. Vegetable behavioral tool demonstrates validity with MyPlate vegetable cups and carotenoid and inflammatory biomarkers. Appetite 2016; 107: 628-638.
https://doi.org/10.1016/j.appet.2016.09.002

[20]   Agudo A, Cabrera L, Amiano P, et al. Fruit and vegetable intakes, dietary antioxidant nutrients, and total mortality in

Spanish adults: findings from the Spanish cohort of the European Prospective Investigation into Cancer and Nutrition (EPIC-Spain). Am J Clin Nutr 2007; 85(6): 1634-1642.
https://doi.org/10.1093/ajcn/85.6.1634

[21]   Kim SA, Moore LV, Galuska D, et al. Vital signs: fruit and vegetable intake among children - the United States, 2003-2010. MMWR Morb Mortal Wkly Rep 2014; 63(31): 671-676.

[22]   Wall CR, Stewart AW, Hancox RJ, et al. Association between frequency of consumption of fruit, vegetables, nuts and pulses and BMI: analyses of the international study of asthma and allergies in childhood (ISAAC). Nutrients 2018; 10(3).
https://doi.org/10.3390/nu10030316

[23]   Aller EE, Abete I, Astrup A, Martinez JA, van Baak MA. Starches, sugars and obesity. Nutrients 2011; 3(3): 341-369.
https://doi.org/10.3390/nu3030341

[24]   Orlando A, Cazzaniga E, Giussani M, Palestini P, Genovesi S. Hypertension in children: role of obesity, simple carbohydrates, and uric acid. Front Public Health 2018; 6: 129.
https://doi.org/10.3389/fpubh.2018.00129

[25]   McGuire S, Ervin RB, Kit BK, Carroll MD, Ogden CL. Consumption of added sugar among U.S. children and adolescents, 2005-2008. NCHS data brief no 87. Hyattsville, MD: National Center for Health Statistics. Adv Nutr 2012; 3(4): 534.
https://doi.org/10.3945/an.112.002279

[26]   Libuda L, Kersting M. Soft drinks and body weight development in childhood: is there a relationship? Curr Opin Clin Nutr Metab Care 2009; 12(6): 596-600.
https://doi.org/10.1097/MCO.0b013e32833189f6

[27]   Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. Am J Prev Med 2004; 27(3): 205-210.
https://doi.org/10.1016/j.amepre.2004.05.005

[28]   Bleich SN, Vercammen KA, Koma JW, Li Z. Trends in beverage consumption among children and adults, 2003-2014. Obesity (Silver Spring) 2018; 26(2): 432-441.
https://doi.org/10.1002/oby.22056

[29]   Bleich SN, Vercammen KA. The negative impact of sugar-sweetened beverages on children's health: an update of the literature. BMC Obes 2018; 5: 6.
https://doi.org/10.1186/s40608-017-0178-9