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Associations between Various Nutritional Elements and Weight, Height and BMI in Children and Adolescents

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Abstract

Purpose: This cross-sectional study included 653 children aged 2–18 years located in Jeddah, Saudi Arabia (2015–2016). This study aimed to determine the association between dietary intake (daily, weekly and rarely) and anthropometric measurements.

Method: Both child and family questionnaire was given, followed by weight and height measurements. The questionnaire consisted of general demographic information, anthropometric measurements, analysis of various nutritional element of daily intake. Using one-way ANOVA test after checked all assumptions. Also, Welch test was using whiles the assumption of homogeneity of variance not satisfied by levene test.

Results: Higher mean BMI in children consuming legumes daily than weekly and rarely and also higher BMI mean in children drinking milk rarely than daily and weekly. While lower mean BMI in children drinking soft drinks rarely. For children height, the means among eating proteins, vegetables and drinking milk daily have lower heights mean than weekly and rarely. Height means in children who eating and drinking daily fat, fast food, and soft drinks have higher heights mean than weekly and rarely. Weight SDs with various nutrition elements shows no significant relation.

Conclusion: Different type of nutritional elements and its effect on children's growth so further studies should be made to identify the values of the level of food intake and its benefit on the child growth.

Keywords: Growth; Nutrition; Children; Diet

Introduction

Of children younger than 5 years old in 2013, it was estimated that 161.5 million were stunted, 50.8 million had low weight for height and 41.7 million were overweight or obese [1]. Therefore, the association between nutrition and growth in children is becoming important, particularly given the reported associations, both significant and non-significant, between specific nutrients and weight, height, or body mass index (BMI). The estimated average of daily requirements should be met in order to have sufficient growth of the child.

Carbohydrates are the primary source of energy and play a key role in maintenance of body weight. Whole grains, fruits, vegetables, and beans should form the majority of carbohydrate intake, because these foods also provide the nutrients that support growth and development in children. Fruit and vegetable intake also helps to prevent weight gain and reduces the risk of obesity [2,3]. Furthermore, increasing overall carbohydrate intake might increase the risk of insulin resistance in children as they become obese [4].

Although dietary fat is essential, higher consumption is associated with multiple diseases. While height might not be affected by fat consumption, weight is definitely affected. An adequate balance of polyunsaturated and monounsaturated fats should be considered while limiting saturated and trans fat products [5]. Protein is considered important for child growth. In particular, milk intake during childhood is crucial for growth and bone development, especially in girls [6].

The World Health Organization recommended that consumption of sugar-sweetened beverages should be reduced to <10% (equivalent to 50 g) of total intake [7] because of the limited nutritional value. However, because chocolate has a certain beneficial amount of protein, it is excluded from the sugar-related recommendations. Fast food is high in calories and low in nutritional value, increasing the risk of weight gain and serious diseases. Among adolescents, the consumption of fast food is highly associated with total energy and fat intake and inversely associated with daily intake of fruit, vegetables and milk [8].

This study aimed to determine the association between various nutritional elements and weight, height, and BMI in children and adolescents in Jeddah, Saudi Arabia.

Materials and Method

This cross-sectional study was conducted in Saudi Arabia, Jeddah and included 653 children aged 2–18 years who were randomly selected in 2015–2016; children older than 18 years were excluded (n=36). The child and family were interviewed using a questionnaire, followed by measurement of the child's weight and height. Written and verbal consent were obtained prior to completion of the questionnaire by the parents. Ethical approval for this study was obtained from the Research Ethics Committee of our hospital. Study setting: The questionnaire was been distributed randomly in multiple primary health care facilities coming for regular follow up.

The questionnaire consisted of general demographic information, anthropometric measurements and current frequency of intake (day, week or rarely) of protein (eggs, meat, chicken and fish), carbohydrates

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(bread, rice, macaroni and potatoes), fat (fried food, oils, butter and margarine) and legumes (beans, lentil and homos). A specific questionnaire was used to collect the frequency of intake (day, week or rarely) of milk, juice, fruits, vegetables, fast food, soft drinks and sweets.

Anthropometry Measurements

Weight was measured in kg on a scale, with the subjects in light clothing without shoes. Height was measured in centimetres using a medical height scale. BMI was defined as weight in kilograms divided by height in metres squared (kg/m^2) [8]. Weight and height percentiles were determined for each subject according to the Centres for Disease Control and Prevention (CDC) growth chart [9]. Normal weight was in the 5th–95th percentiles, and normal height was in the 5th–95th percentiles.

Statistical Analysis

Data was entered, coded, and analysed using statistical package for social science (SPSS), version 16. The analysis was done by finding the difference in BMI kg\m^2, height cm and weight SDs means among dietary factor by using one-way ANOVA test after checked all assumptions. Also, Welch test was using whiles the assumption of homogeneity of variance not satisfied by levene test. Percentages and frequencies of dietary factors frequency were calculated as descriptive statistics. The results were considered to significant with P(less than) 0.05. For these analyses, frequency of intake was categorised as daily, weekly or rarely. Daily represent the intake once or more than once a day while weekly represents the intake of nutrition every week. And rarely represents the intake from time to time or rarely.

Results

The study included 653 children and adolescence 304 boys, 313 girls (mean age: 8.9 ± 9 years; 50.2% males, 49.8% females). This study reported the daily intake of carbohydrate were 511 (90.3%), 32 (5.7%) were weekly. And daily intake of Juice were 383 (70.9%), 69 (12.8%) were weekly and 88 (16.3%) were rarely. The daily intake of Soft drinks were 151 (26.6%), 107 (18.8%) were weekly and 310 (54.6%) were rarely. The daily intake of Fruits were 254 (45.9%), 126 (22.8%) were weekly and 173 (31.3%) were rarely. And daily intake of Vegetables were 269 (48.7%), 91 (16.5%) were weekly and 192 (34.8%) were rarely. The daily intake of Protein were 453 (79.8%), 61 (10.7%) were weekly and 54 (9.5%) were rarely. And the daily intake of Milk were 387 (63.2%), 69 (11.3%) were weekly and 156 (25.5%) were rarely. The daily intake of Legumes were 159 (28.5%), 193 (34.6%) were weekly and 205 (36.8%) were rarely. And the daily intake of Fat were 300 (53.0%), 137 (24.2%) were weekly and 129 (22.8%) were rarely. The daily intake of Fast Food were 93 (16.3%), 274 (48.1%) were weekly and 203 (35.6%) were rarely. And the daily intake of Sweets were 425 (76.6%), 63 (11.4%) were weekly and 67 (12.1%) were rarely.

Mean BMI were higher with children consuming legumes daily than weekly and rarely (Figure 1). Mean BMI among drinking milk frequencies, p-value=0.051, children who rarely drinking milk have higher BMI than weekly and daily. Mean BMI among drinking soft drink frequencies, p-value=0.002, children who rarely drinking soft drink have lower BMI than weekly and daily (Table 1).

The mean height among children eating proteins frequencies, p-value=0.036, children who eating daily protein have lower height mean than weekly and rarely. For mean height among drinking milk frequencies, p-value=0.001, children who drinking daily milk have lower height mean than weekly and rarely. The mean of height among

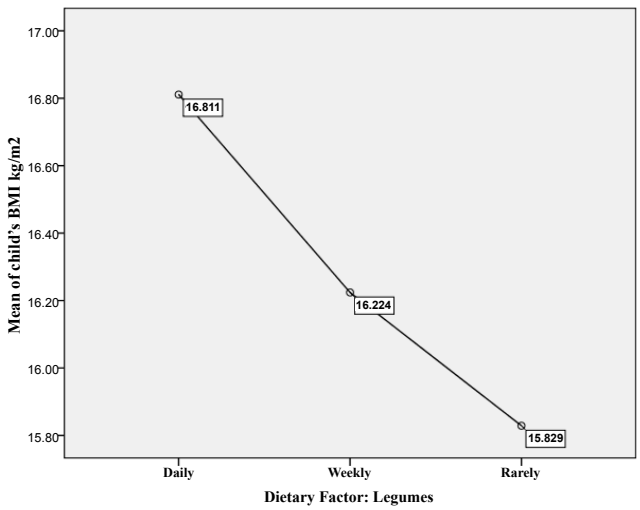

Figure: 1 Differences in mean body mass index (BMI) based on legumes consumption in children aged 2–18 years in Saudi Arabia.

Dietary elements	Eating Frequencies	BMI kg\m^2 (Mean ± SD)	P-value
Protein	Daily	16.2326 ± 2.61226	0.585
	Weekly	15.9414 ± 2.75426	
	Rarely	16.5128 ± 2.49573	
Fat	Daily	16.2007 ± 2.65757	0.893
	Weekly	16.3344 ± 2.59152	
	Rarely	16.1952 ± 2.56510	
Legumes	Daily	16.8109 ± 3.02461	0.012
	Weekly	16.2241 ± 2.43730	
	Rarely	15.8290 ± 2.34873	
Carbohydrates	Daily	16.2894 ± 2.66465	0.416
	Weekly	15.6812 ±2.18362	
	Rarely	15.8555 ± 2.04789	
Milk	Daily	16.0643 ± 2.62181	0.051
	Weekly	16.1811 ± 2.41450	
	Rarely	16.7976 ± 2.73345	
Fast Food	Daily	16.4093 ± 2.57207	0.122
	Weekly	16.4542 ± 2.82590	
	Rarely	15.9047 ± 2.40759	
Soft Drinks	Daily	16.7011 ± 2.78687	0.002
	Weekly	16.8452 ± 2.73009	
	Rarely	15.8672 ± 2.49064	
Juices	Daily	16.1074 ± 2.58090	0.511
	Weekly	16.4300 ± 2.70880	
	Rarely	16.4489 ± 2.81486	
Fruits	Daily	16.0097 ± 2.40413	0.220
	Weekly	16.2946 ± 2.97629	
	Rarely	16.5082 ± 2.69905	
Vegetables	Daily	16.1034 ± 2.54806	0.623
	Weekly	16.1485 ± 2.74109	
	Rarely	16.3736 ± 2.64522	
Sweets	Daily	16.1020 ± 2.51673	0.114
	Weekly	17.1587 ± 3.29436	
	Rarely	16.0994 ± 2.53670	

Values are reported as mean ± standard deviation

Table 1: Differences in body mass index (BMI) based on consumption frequency of various dietary elements by children aged 2–18 years in Saudi Arabia.

Dietary elements	Eating Frequencies	Height cm (Mean ± SD)	P-value
Protein	Daily	118.6 ± 19.51873	0.036
	Weekly	121.03 ± 19.81525	
	Rarely	126.13 ± 19.02476	
Fat	Daily	121.2 ± 19.39712	0.043
	Weekly	120.1 ± 20.70607	
	Rarely	115.6 ± 18.23115	
Legumes	Daily	119.9 ±19.74377	0.332
	Weekly	121.4 ±18.67010	
	Rarely	118.3 ±20.18113	
Carbohydrates	Daily	119.4 ± 19.60474	0.546
	Weekly	123.5 ± 16.12127	
	Rarely	119.8 ± 23.34302	
Milk	Daily	117.4 ± 19.57259	0.001
	Weekly	120.9 ±19.03879	
	Rarely	125.2 ± 18.91114	
Fast Food	Daily	123.9 ± 19.36573	0.014
	Weekly	120.7 ± 19.66110	
	Rarely	116.7 ± 19.21640	
Soft Drinks	Daily	127.4 ± 20.14589	0.0001
	Weekly	122.2 ± 19.75927	
	Rarely	115.4 ± 18.12335	
Juices	Daily	118.9 ± 19.24429	0.423
	Weekly	122.1 ± 19.30925	
	Rarely	121.3 ± 22.15197	
Fruits	Daily	118.1 ± 19.57903	0.138
	Weekly	120.3 ± 17.89437	
	Rarely	122.2 ± 20.51811	
Vegetables	Daily	116.7 ± 19.30312	0.006
	Weekly	121.3 ± 17.64534	
	Rarely	122.9 ± 20.37128	
Sweets	Daily	119.3 ± 18.99979	0.149
	Weekly	124.6 ±20.86058	
	Rarely	117.9 ± 21.65378	

Values are reported as mean ± standard deviation

Table 2: Differences in height based on consumption frequency of various dietary elements by children aged 2–18 years in Saudi Arabia.

Dietary elements	Eating Frequencies	Weight SD (Mean ± SD)	P-value
Protein	Daily	-1.0769- ± 1.41749	0.570
	Weekly	-.8481- ± 1.97376	
	Rarely	-1.2055- ± .94734	
Fat	Daily	-1.2043- ± 1.32095	0.170
	Weekly	-.9072- ± 1.54124	
	Rarely	-.9229- ± 1.63523	
Legumes	Daily	-.8119- ± 1.41580	0.071
	Weekly	-1.0493- ± 1.55371	
	Rarely	-1.2594- ± 1.37757	
Carbohydrates	Daily	-1.0524- ± 1.44995	0.070
	Weekly	-.6930- ± 1.56526	
	Rarely	-1.8731- ± 1.31065	
Milk	Daily	-1.1238- ±± 1.47401	0.405
	Weekly	-1.0446- ± 1.46520	
	Rarely	-.8728- ± 1.42109	
Fast Food	Daily	-1.2639- ±1.04036	0.228
	Weekly	-.9559- ± 1.54601	
	Rarely	-1.0933- ± 1.50271	
Soft Drinks	Daily	-1.0043- ± 1.52601	0.289
	Weekly	-.8361- ± 1.44442	
	Rarely	-1.1487- ±± 1.43208	
Juices	Daily	-1.1805- ±± 1.35510	0.224
	Weekly	-1.2252- ± 1.33688	
	Rarely	-.8252- ± 1.70934	
Fruits	Daily	-1.1633- ± 1.42488	0.317
	Weekly	-1.2006- ± 1.41879	
	Rarely	-.9275- ± 1.49888	
Vegetables	Daily	-1.2285- ± 1.40318	0.229
	Weekly	-.8976- ± 1.47094	
	Rarely	-1.0069- ± 1.47089	
Sweets	Daily	-1.0656- ± 1.45868	0.603
	Weekly	-1.0608- ± 1.36758	
	Rarely	-1.3181- ± 1.43233	

Values are reported as mean ± standard deviation

Table 3: Differences in weight based on consumption frequency of various dietary elements by children aged 2–18 years in Saudi Arabia.

eating vegetables children who eating vegetables daily have lower height mean than weekly and rarely. Height means in children who eating and drinking daily fat, fast food, soft drinks have higher heights mean than weekly and rarely (Table 2).

There were no significant correlation between weight SDs and various nutritional elements (protein, carbohydrates, fat, legumes, milk, juice, fruits, vegetables, fast food, soft drinks and sweets) (Table 3).

Discussion

The purpose of this study is to test the association between various nutritional elements and child height, weight and BMI with a random sample in Jeddah, Saudi Arabia. The studied sample included 2–18 year old participants. The previous findings regarding fat intake and anthropometric measures in children have been conflicting. Total fat consumption was not associated with height, weight or BMI in 215 Hispanic children [10]. A study in Munich, Germany proposed that higher rates of obesity were present in 158 primary school children who had a higher fat intake than in those with either a higher protein or carbohydrate intake; therefore, reduced total fat and saturated fat consumption is advised to improve health and reduce the risk of obesity [9]. Furthermore, calorie (fat) intake is correlated with weight [11]. In southwest Britain, the mean height and weight of children increased with reduced fat intake [12,13]. In Peru, weight and fat intake in children were strongly correlated, while height and fat intake were not correlated. Nutrition has an important impact on children growth and further studies need to be conducted [14]. A previous study on the patterns of growth and nutrition in children proposed that the level of effective protein intake is the principal factor controlling height growth. Children consuming adequate amounts of protein showed an optimal height for their age [11].

In the previous studies regarding carbohydrate intake; it was negatively correlated with both weight and height [15]. However, a high fibre intake does not affect child growth and is strongly associated with a reduced risk of obesity, particularly when consumed in the form of fruit, vegetables, legumes, and whole grains [16]. However, in the present study, BMI was significantly higher with more frequent legume intake, while height and weight did not differ based on legume intake.

A previous study conducted in the USA showed that milk intake in 4 year olds is positively associated with BMI [16]; another study

conducted in the USA showed that milk intake is associated with only height among 2–4 year olds, and there were no associations in children aged 5–10 years [17]. However, previous studies have shown that juice consumption is associated with shorter stature and greater weight. In the USA, 42% of children consuming ≥ 12 fl oz/day of juice had short stature (height <20th sex-specific percentile for age) vs. 14% of children drinking <12 fl oz/day, and obesity was more common in the children drinking the greater amount of juice [18]; these findings were supported by a study conducted in Tennessee, USA in which excessive fruit juice intake was associated with short stature and obesity in preschool children. The consistent lack of a relationship between fruit juice intake and growth parameters in children in the study does not support previous recommendations to limit the intake of 100% fruit juice to <12 fl oz/day [17]. Regarding soft drink consumption, there are more than 15 teaspoons of sugar and 240 calories in a 20 ounce soft drink [19]. From 1989 to 2008, calories from sugary soft drinks increased by 60% (from 130 to 209 cal/day) in children aged 6–11 years, and the percentage of children consuming soft drinks increased from 79% to 91% [20]. In the present study, a significant relation existed between soft drink consumption and mean BMI that showed lower mean BMI in children drinking soft drinks rarely than daily and weekly. Height was also significantly different based on soft drink consumption, higher heights mean when drinking soft drinks daily than weekly and rarely. In contrast, the differences in weight based on soft drink consumption were not significant.

Children are recommended to consume at least 5 servings of fruits and vegetables a day [21]. In a previous study in the USA, 95% of 866 children aged 2–5 years consumed fruit, vegetable(s), or both as part of their food intake on the recorded day. The majority of children were 2 years of age (34%), male (53%), and non-Hispanic White (35%). Only 12% of the children were identified as overweight [22].

The majority of research to date has focused on the relationship between fast food consumption and childhood obesity [23,24]; however, in a previous study involving 72,900 children (17 countries) and 199,135 adolescents (36 countries), frequent and very frequent fast-food consumption was reported in 23% and 4% of children and 39% and 13% of adolescents, respectively. Children in the frequent and very frequent groups had significantly higher BMIs than those in the infrequent group ($P<0.001$). However, adolescents in the frequent and very frequent groups had BMIs that were significantly lower than those in the infrequent group ($P<0.001$) [25]. Interestingly, recent research also indicates that fast food consumption might influence academic achievement and cognitive development [26]. One possible mechanism for a link between fast food and academic growth is the consumption of fewer specific nutrients. Because fast food meals are often deficient in a range of nutrients [27], children who eat fast food several times per week may be at risk of not receiving enough of these nutrients to develop optimally.

Regarding sweets, in a previous study conducted in the USA, candy consumers were less likely to be overweight/obese than the non-candy consumers in a sample of children and adolescents 2–18 years of age (n=11,182), despite higher energy and added sugar intake by the candy consumers [28].

Conclusion

In present there was a relationship between milk intake with both height and BMI. A stepwise reduction in total fat and saturated fat intake is desirable in primary school children and adolescents to improve health and prevent obesity. Families should be encouraged to increase fruit and vegetable consumption by children as sources of nutritional factors that support their growth. In addition, the consumption of soft drinks, fast food and sweets should be discouraged in primary school children and adolescents.

Declaration of Interest

The authors declare that there are no competing interests.

References

1. http://www.who.int/mediacentre/factsheets/fs342/en/
2. http://www.who.int/elena/titles/bbc/fruit_vegetables_ncds/en/. Accessed in September 2014
3. Gaesser GA (2007) Carbohydrate quantity and quality in relation to body mass index. J Am Diet Assoc 107: 1768-1780.
4. Milner JA, Allison RG (1999) The role of dietary fat in child nutrition and development: Summary of an ASNS workshop. American Society for Nutritional Sciences. J Nutr 129: 2094-2105.
5. http://www.nlm.nih.gov/medlineplus/ency/article/001979.htm. Accessed in August 2014
6. Kalkwarf HJ, Khoury JC, Lanphear BP (2003) Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in US women. Am J Clin Nutr 77: 257-265.
7. http://www.who.int/elena/titles/ssbs_adult_weight/en/. Accessed on 17 August 2015
8. Davis JL (2004) Fast food creates fat kids: Kids can gain 6 pounds a year from fast food. WebMD Health News.
9. Koletzko B, Dokoupil K, Reitmayr S, Weimert-Harendza B, Keller E (2000) Dietary fat intakes in infants and primary school children in Germany. Am J Clin Nutr 72: 1392S-1398S.
10. Shea S, Basch CE, Stein AD, Contento IR, Irigoyen M, et al. (1993) Is there a relationship between dietary fat and stature or growth in children three to five years of age? Pediatrics 92: 579-586.
11. Dugdale AE, Chen ST, Hewitt G (1970) Patterns of growth and nutrition in childhood. Am J Clin Nutr 23: 1280-1287.
12. Lagström H, Seppänen R, Jokinen E, Niinikoski H, Rönnemaa T, et al. (1999) Influence of dietary fat on the nutrient intake and growth of children from 1 to 5 y of age: The special turku coronary risk factor intervention project. Am J Clin Nutr 69: 516-523.
13. Rogers IS, Emmett PM; ALSPAC Study Team (2001) Fat content of the diet among preschool children in southwest Britain: II. Relationship with growth, blood lipids and iron status. Pediatrics 108: E49.
14. Trulson MF, Collazos C, Hegsted DM (1956) Growth and development of Peruvian children. I. Carquin and San Nicholás. Pediatrics 17: 510-523.
15. Ruottinen S, Rönnemaa T, Niinikoski H, Lagström H, Saarinen M, et al. (2009) Carbohydrate intake, serum lipids and apolipoprotein E phenotype show association in children. Acta Paediatr 98: 1667-1673.
16. DeBoer MD, Agard HE, Scharf RJ (2015) Milk intake, height and body mass index in preschool children. Arch Dis Child 100: 460-465.
17. Skinner JD, Carruth BR, Moran J 3rd, Houck K, Coletta F (1999) Fruit juice intake is not related to children's growth. Pediatrics 103: 58-64.
18. Dennison BA, Rockwell HL, Baker SL (1997) Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity. Pediatrics 99: 15-22.
19. United States Department of Agriculture Agricultural Research Service (2012) Nutrient data for 14400, carbonated beverage, cola, contains caffeine. National Nutrient Database for Standard Reference, Release 24.
20. Lasater G, Piernas C, Popkin BM (2011) Beverage patterns and trends among school-aged children in the US, 1989-2008. Nutr J 10: 103.
21. Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J, et al. (1996) Fruit and vegetable intakes of children and adolescents in the United States. Arch Pediatr Adolesc Med 150: 81-86.
22. Ramsay SA, Eskelsen AK, Branen LJ, Shultz JA, Plumb J (2014) Nutrient intake and consumption of fruit and vegetables in young children. ICAN 6: 332-344.

23. Pereira MA, Kartashov AI, Ebbeling CB, Van Horn L, Slattery ML, et al. (2005) Fast-food habits, weight gain and insulin resistance (the CARDIA study): 15-year prospective analysis. Lancet 365: 36-42.

24. Rosenheck R (2008) Fast food consumption and increased caloric intake: A systematic review of a trajectory towards weight gain and obesity risk. Obes Rev 9: 535-547.

25. Braithwaite I, Stewart AW, Hancox RJ, Beasley R, Murphy R, et al. (2014) Fast-food consumption and body mass index in children and adolescents: An international cross-sectional study. BMJ Open 4: e005813.

26. Purtell KM, Gershoff ET (2015) Fast food consumption and academic growth in late childhood. Clin Pediatr (Phila) 54: 871-877.

27. O'Donnell SI, Hoerr SL, Mendoza JA, Tsuei Goh E (2008) Nutrient quality of fast food kids meals. Am J Clin Nutr 88: 1388-1395.

28. O'Neil CE, Fulgoni VL 3rd, Nicklas TA (2011) Association of candy consumption with body weight measures, other health risk factors for cardiovascular disease and diet quality in US children and adolescents: NHANES 1999-2004. Food Nutr Res 55.