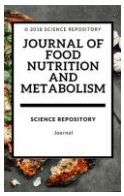

Available online at www.sciencerepository.org

Science Repository

Research Article

Effect of Food Preference and Mothers Nutritional Knowledge on Obesity in Schoolgirls in Saudi Arabia: A Case-Control Study

Zainab Jaffar Al-Nass[1*], Zeidan Abdu ZeidanAli[2] and Hayfaa Abdelmageed Ahmed Wahabi[3]

[1]Ministry of health. Eastern region, Qatif 31911, Saudi Arabia.
[2]College of medicine –Taibah University. Almadinah Almunawwarah 41311, Saudi Arabia
[3]Department of Family and Community Medicine, College of Medicine, King Saud University. Riyadh 11461, Saudi Arabia

ARTICLEINFO

Article history:
Received: 3 September, 2019
Accepted: 30 September, 2019
Published: 29 October, 2019

Keywords:
Childhood obesity
food preferences
mother knowledge

ABSTRACT

Background: Childhood obesity is a major public health challenge of the 21st century. Obese children have double the risk of being obese adults than children who are of normal weight. Obese children have increased risks of developing hypertension, dyslipidemia, and other cardio-metabolic morbidities.

Objectives: to investigate the effect of the children food knowledge and preferences on their BMI and the effects of mothers' nutritional knowledge on their children's BMI.

Methods: A school-based case-control study design was carried out in the Eastern Region of Saudi Arabia. Data collection was carried out from November 2017 to February 2018. A multistage stratified cluster random sampling technique was used. Four clusters (schools) were selected based on size and equal numbers of participants were included from each cluster. From each of grade 4th, 5th, and 6th, one class was selected randomly. The weight and height of each girl were recorded, BMI calculated, and the students were divided into obese/ overweight group and the normal weight group from which cases and control randomly selected thereafter**.** Out of total 442 students measured BMI, 348 were included in the study, 116 cases and 232 controls.

Data were collected by face to face interview with the girl, and a self-administrated questionnaire was sent to the same student's mother. Determinants of girls' obesity were calculated using regression analysis. Results were presented as adjusted Odds Ratio (aOR) and 95% confidence intervals (CI).

Result: After controlling for the confounding variables, more healthy food preferences in children and higher mother's knowledge were associated with 77% and 51% reduced odds of overweight-obesity (aOR = 0.23 95% CI 0.09–0.64 and aOR = 0.49 95% CI 0.33–0.71).

Conclusion: Healthy food preferences among girls and adequate nutritional knowledge among their mothers were significantly associated with decreased obesity in girls.

Limitations: The main limitations were its inability to assess causation and the potential for recall bias, especially in the questions related to behaviors; namely, physical activity and diet recall.

Background

Childhood obesity is a major public health challenge of the 21st century [1]. Obese children have double the risk of being obese adults than children who are of normal weight [2]. Globally, the prevalence of overweight and obesity increased by 27.5% in adults and 47.1% in children between 1980 and 2013 [3]. Eastern Mediterranean countries have one of the highest burdens of overweight and obesity in the world [4]. In Saudi Arabia, obesity is the most prevalent nutritional health problem, affecting more than half of the population (59%) [5]. Furthermore, the estimated prevalence of overweight and obesity is 19.6% in children aged 5 years and 9.4% in those aged 12 years [6].

Childhood obesity and overweight are defined as children aged 2–18 years with body mass indexes (BMIs) equal to or greater than the 95th

*Correspondence to: Zainab J Al-Nass, Ministry of health. Eastern region, Qatif 31911, Saudi Arabia; E mail: zainabjalnass@gmail.com

http://dx.doi.org/10.31487/j.JFNM.2019.03.02

and 85th percentiles respectively, of the age- and gender-specific BMIs [7]. Genetic and personal behaviors are associated with increasing BMI [8, 9]. However, these factors alone cannot explain the global obesity epidemic. Obesogenic environments, including the availability of fast, high-caloric foods; inactivity; and the widespread use of technology, carry a significantly higher risk of obesity for the whole population, including children [2, 9]. Moreover, healthy food practices inside the home, with the availability of healthy food and parental guidance, encourage healthier food choices in children [10].

Objectives

This study aimed to investigate the effect of the children food knowledge and preferences on their BMI and the effects of mothers' nutritional knowledge on their children's BMI. The socioeconomic factors were included in the analysis as confounders to the main investigated factors

I Methods

A school-based case-control study design was carried out in the Eastern Region of Saudi Arabia. As there is no co-education in Saudi Arabia, this study was conducted in a girls' primary school A multistage stratified cluster random sampling technique was used. Four schools were selected based on size and equal numbers of participants were included from each cluster. From each of grade 4th, 5th, and 6th, one class was selected randomly. Data collection was carried out from November 2017 to February 2018. Verbal consent was obtained from each student; upon their agreement to participate, written informed consent was sent to the mother for agreement and signature. Anthropometric measurements were taken (height and weight) by the principal investigator using a single digital scale. A standardized procedure was followed with shoes and heavy clothing removed. The weight and height of each girl were recorded to the nearest 0.1 decimal fraction, with the average of 3 measurements calculated. According to the anthropometric measurements of 442 students, the BMI for age was calculated as weight/height^2 in kilograms per square meter. Girls with high BMIs for their ages were grouped in the overweight-obese group. Those with normal BMIs for their ages were grouped in the normal BMI group. From these groups, 116 cases (overweight-obese) and 232 controls (normal BMI) were selected randomly for inclusion in the present study.

Case and control definitions

The cases were defined as female primary school students aged 9–12 years with high BMI for their age and gender. Children were defined as obese (calculated BMI more than or equal to the 95th percentile) or overweight (calculated BMI more than or equal to the 85th percentile to less than the 95th percentile) according to the age and gender-specific BMI from the growth charts for Saudi children and adolescents [7]. The controls were defined as female primary school students aged 9–12 years with normal BMI for their age and gender (from the 5th to less than the 85th percentiles), according to the growth charts for Saudi children and adolescents [7]. Students in special education programs (mentally Challenged), with genetic or endocrine diseases, or on diet programs due to any illness (as reported by the mother) were excluded from the study.

Sample size: The sample size was calculated for an unmatched case-control study with 95% confidence interval (CI), 80% power, and a ratio of case to control of 1:2. The probability of exposure among normal children is 32% to detect an odds ratio (OR) of at least 2.5 [11]. A design effect of 1.5 was used to account for the cluster sampling design. To account for non-response, the sample size inflation was 10% [12]. The calculated total sample size 348 (116 cases: 232 controls). The data collection tool was composed of 2 parts: 1. a self-administered questionnaire completed by the student's mother and 2. a face-to-face interview with the student. The mothers' questionnaire was design to collected data on:

1. Socio-demographic characteristics
2. Mothers' nutritional knowledge and attitude: We used the questionnaire that was developed and validated by Vereecken and Maes [13]. Nutritional knowledge was assessed by 10 statements. For each statement, the respondent was requested to mark one of 5 responses (Likert scale).

The mothers' attitude towards healthy nutrition was assessed by a Likert scale questionnaire. Eight statements were provided, and the mothers were asked to choose one response for each. The summations of the scores produced a single variable for mother's nutritional knowledge score, which ranged from 10 to 50 points. In addition to the mother's nutritional attitude score, which ranged from 8 to 40 points. The student face-to-face interview included the following questions:

1. Behavioral data (self-reported)
2. Assessment of food preference and food knowledge: These were assessed using a "choice experiment" method developed by Diehl and modified and validated by Gwozdza and Reisch [14]. It consists of 2-steps, 10 matched pairs of food cards that belonged to the same food category. One card showed a relatively healthy food while the other showed a relatively unhealthy food. For assessment of food preferences, each participant was asked, "Which food or drink do you prefer?". For knowledge, each participant was asked, "Which food or drink do you think is healthier?" The scoring systems for food knowledge and preferences ranged from zero (inadequate knowledge - preferences of unhealthy food) to 10 (best knowledge – preferences of healthy food). The investigators translated the questionnaire into the Arabic language using forward-backward translation. Pilot study done in 10 percent of sample size in similar sitting.

Definitions: for the purpose of the present study, the following definitions were considered:

1. Screen time: Time spent watching television, video games, or on the internet through computers. This time is recommended to not exceed 2 hours per day [15].
2. Physical activity: As recommended by the World Health Organization, children should perform at least 60 minutes of moderate to vigorous-intensity physical activity each day [16].
3. Junk food: Food containing few micronutrients with high amounts of fat, sugars, and energy [17].
4. Adequate fruit and vegetable intake: The recommended daily requirements of fruits and vegetable for children are 3–5 servings per day; each serving is equivalent to one medium piece of fruit or one cup of uncooked vegetables [18].

Statistical analysis: The data were coded, entered, and analyzed using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp.). Continuous data were tested for normality. Categorical data were summarized using frequencies and percentages. Pearson's chi-square tests were used to compare proportions between the cases and controls. P-values < 0.05 were considered statistically significant. Initially, a simple logistic regression model was used to determine the association between dependent and independent variables. The odds ratio (OR and 95% confidence intervals (CI) were computed for each categorical variable using binary logistic regression. Significant factors ($p<0.05$) were considered to be associated with BMI and included in the multiple logistic regression. the mothers' nutritional attitudes were not included in the model to avoid multicollinearity assumption of regression. Instead Mothers' nutritional knowledge was used because it was considered to be more clinically important.

Table 1: Comparisons of the sociodemographic characteristics of the cases and controls.

Variables	Cases (N = 116)		Controls (N = 232)		P-value
	Number	%	Number	%	
Student age (mean ± SD)	(10.034 ± 0.864)		(10.022 ± 0.860)		
9 years	37	31.9	78	33.6	-
10 years	42	36.2	76	32.8	
11 years	33	28.4	73	31.5	
12 years	4	3.4	5	2.2	
Body mass index (percentile)					
>5th to <50th	-	-	13	5.6	-
≥50th to <85th	-	-	219	94.4	
85th to <95th	98	84.5	-	-	
≥95th	18	15.5	-	-	
Mother age group* (mean ± SD)	(40.44 ± 5.84)		(45.88 ± 6.87)		
Up to 40 years	61	52.6	116	52.5	0.986
41 years and above	55	47.4	105	47.5	
Mother educational level*					
Up to secondary school	56	48.3	97	43.9	0.442
University and above	60	51.7	124	56.1	
Father age group (mean ± SD)	(41.16 ± 4.15)		(46.44 ± 5.24)		
Up to 45 years	60	51.7	120	54.3	0.653
More than 45 years	56	48.3	101	45.7	
Father educational level*					
Up to secondary school	49	42.2	74	33.5	0.113
University and above	67	57.8	147	66.5	
Monthly household income**					
Less than SR 10,000	31	27.7	26	13.1	0.001
More than SR 10,000	81	72.3	172	86.9	
Student pocket money					
<3 SR	10	8.6	22	10.0	<0.0001
3–5 SR	46	39.7	127	57.5	
6–8 SR	43	37.1	45	20.4	
≥9 SR	14	12.1	11	5.0	
Can't specify	3	2.6	16	7.2	
Parent obesity					
Yes	21	18.1	13	5.9	<0.0001
No	91	78.4	182	82.4	
Don't know	4	3.4	26	11.8	

*(N=116 cases, 221 controls) (** N= 116 cases, 198 controls)Chi-square tests were used to test for significance, a p-value of 0.05 was the cut-off level of significance.

II Results

A total of 116 cases and 232 controls were included in the study. Of the 348 questionnaires sent to mothers, 337 were completed (116 cases and 221 controls); the response rates were 91% in the students and 96.8% in their mothers. The socio-demographic characteristics of the study population are shown in (Table 1). Significantly more girls in the control group lived in a household with a monthly income >SR 10,000. However, significantly more girls in the cases had higher amounts of pocket money. Parent obesity was reported significantly more frequently

among the cases.

Table 2: Comparisons of the behavioral characteristics of the cases and controls.

Variables	Cases (N= 116)		Controls (N= 232)		P value
	Number	%	Number	%	
Daily TV watching time					
Up to 2 hours	18	15.5	116	50	<0.0001
More than 2 hours	98	84.5	116	50	
TV in bedroom					
Yes	3	2.6	1	0.4	0.110
No	113	97.4	231	99.6	
Physical activity (60 min.)					
Up to 2 days / week	51	44	31	13.4	<0.0001
Three to five days / week	55	47.4	90	38.8	
Six to seven days / week	10	8.6	111	47.8	
Junk food consumption					
Rare- sometimes	22	19	112	48.3	
Frequent –Daily	94	81	120	51.7	<0.0001
Restaurant meal /week					
Up to 3 times	64	55.2	17	73.7	0.001
More than three times	52	44.8	61	26.3	
Fruits-vegetable / day					
None	20	19.2	2	0.9	<0.0001
One –two pieces	55	47.4	119	51.3	
≥ 3 pieces	41	35.3	111	47.8	

Chi-Square test used as a test of significance, P value 0.05 is level of significance.

Table 2 shows obesity behavioral risk factors. Significantly more girls in the case group reported longer screen time exposure compared to that in the control group. The percentage of girls performing 60 minutes of physical activity 6-7 days/week was significantly higher in controls 47.8% than that in the cases 8.6%. Compared to the control group, cases were more likely to consume junk food daily (81%, P <0.0001) and less likely to consume ≥3 pieces of fruits or vegetables per day (35.3%, P <0.0001). Moreover, the cases more often reported eating at restaurants >3 times/week (44.8%) compared to the controls (35.3%), a difference that was statistically significant.

Table 3: Crude and adjusted odds ratios (ORs) for risk factors of overweight obesity in schoolgirls.

Variables	Reference category	Crude OR (95% CI)	Adjusted OR (95% CI)
household income ≥SR 10,000 §	Ref:<SR 10000	0.39 (0.22 - 0.71)*	0.29 (0.12 - 0.75)*
Student pocket money >SR 5 §	Ref: Up to SR 5	2.71 (1.68 - 4.37)**	3.90 (1.80 - 8.45)**
Parental obesity: no §	Ref: Yes	0.31 (0.15 - 0.65)*	0.341 (0.11 - 1.09)
Daily (TV) time >2 hours §	Ref: Up to 2 hours	5.44 (3.95 - 9.58)**	2.77 (1.19 - 6.42)*
Physical activity: Daily §	(≤ 5 times /week: Ref)	0.10 (0.051 - 0.21)**	0.10 (0.04 - 0.26)**
Junk food consumption: daily §	Ref: Sometimes	3.99 (2.34–6.78)**	3.83 (1.74–8.44)**
Daily fruit consumption: 3 or more §	Ref: <3	0.44 (0.30–0.65)**	0.45 (0.22–0.94)*
Eating at a restaurant: >3 § times/week	Ref: ≤ 3/ week	2.28 (1.43–3.64)*	2.66 (1.27–5.57)*
Student's food knowledge ¥		0.39 (0.31–0.48)**	0.54 (0.28–1.07)
Student's food preference ¥		0.19	0.23

		(0.138–0.27)**	(0.09 - 0.60)*
Mother's nutritional knowledge ¥		0.47 (0.38–0.58)**	0.48 (0.33–0.71)**

*p-value <0.05; **p-value <0.0001; (Ref): reference group; §: adjusted for monthly household income, student pocket money, parent obesity, screen time (TV, Internet); physical activity; junk food consumption; daily fruit consumption; and eating from a restaurant. ¥: adjusted for child food knowledge, food preferences, mother's nutritional knowledge, income, pocket money, and parent obesity.

Table 3 shows the crude and adjusted ORs for risk factors of obesity in girls. After adjusting for confounders, the following factors were associated with an increased risk of overweight/obesity in school-age girls. The OR of overweight-obesity was about 4 times higher in girls with high amounts of pocket money (>SR 5) (adjusted odds ratio [aOR] 3.9, 95% CI 1.80–8.45). A longer screen time exposure (TV) was associated with an approximately 3-fold increased risk of overweight/obesity (aOR 2.77, 95% CI 1.192–6.42). The frequent consumption of junk food was associated with 4-fold increased odds of overweight/obesity compared the odds in less-frequent consumers (aOR = 3.83, 95% CI 1.74–8.28). The odds of overweight-obesity were 2.6 times higher in girls reporting consumption of restaurant meals more than 3 times per week compared to the odds in less-frequent consumers (aOR = 2.66, 95% CI 1.27–5.57).

In contrast, the following factors were associated with a decreased risk of overweight-obesity in school-aged girls. The odds of obesity decreased by 71% in girls with higher monthly household income (≥10,000) compared to that for lower monthly household income (aOR = 0.294, 95% CI 0.115–0.751). The odds of overweight-obesity were 89.7% lower in girls meeting the recommended level of physical activity than in those who did not (aOR = 0.103, 95% CI 0.039–0.269). Consumption of adequate portions of fruits and vegetables (3 or more) was associated with 55% decreased odds of obesity (aOR = 0.45, 95% CI 0.219 –0.937). More healthy food preferences in children and higher mother's knowledge were associated with 77% and 51% reduced odds of overweight-obesity (aOR = 0.23 95% CI 0.09–0.64 and aOR = 0.49 95% CI 0.33–0.71).

Discussion

The results of our study indicated that school-girls' healthy food preferences and mothers' adequate nutritional knowledge were significantly associated with decreased obesity in girls. Although about 50% of the mothers in this study were university graduates, they had modest nutritional knowledge. This might be due to the fact that formal education in Saudi Arabia is deficient in health education, including healthy nutrition. Health literacy is an important determinant of health at the levels of individual adults and families [17, 18]. Measures to enhance health literacy such as food labels and nutritional facts on food items, educational programs for the community, and at-risk groups meetings were found to be effective in improving health literacy and, therefore, weight management [19]. Our study found that the risk of overweight-obesity differed by the income group; the odds of overweight-obesity decreased by more than 70% with increasing household income. The high prices of healthy food compared to those of unhealthy food could explain this finding. As the burden of diet-related disease increases, some countries have implemented measures such as taxes on unhealthy food items [20]. Implementation of taxes on unhealthy food may have a significant effect on the reduction of obesity, especially when combined with subsidies of healthy foods [21].

Our results revealed that the odds of obesity were 4 times greater in girls with higher amounts of daily pocket money than those in girls with less pocket money. These results could be explained by the wide availability, acceptability, and marketing of junk food in mass media that makes it attractive to children [22]. In the current study, more than two-thirds of the cases and half of the controls reported daily consumption of junk food. The odds of obesity were about 4 times higher in those who consumed junk food daily compared to those in infrequent consumers. These results agree with those of previous studies conducted in Saudi Arabia [23]. Behavioral risk factors are the most important modifiable factor for the prevention of the global burden of disease. These factors explain 19%–54% of the disability-adjusted life years (DALYs). Dietary factors were responsible for about 10% of the global DALYs in 2013 [24]. Restaurant-prepared foods are an important risk factor for obesity [25]. Our study showed that the odds of obesity were 2.66 times higher in children who ate in restaurants more than 3 times per week compared to those who did so less frequently. These results are consistent with those of previous studies [26, 28]. One possible explanation is the high caloric content, large portion size, and poor quality of dietary content including high levels of fat, sugar, and salt and low fiber in restaurant-prepared food.

In the current study, only 35% of cases and 47% of controls met the fruit and vegetable intake recommendations. Children who met this daily requirement had a 55% reduced chance of being obese as compared to those who did not. Multiple mechanisms are responsible for the anti-obesity effect of fruits and vegetables; including the replacement of energy-dense food with healthy fruit sugars that improve energy homeostasis. In addition, fruits and vegetables contain high amounts of fiber, which increases the duration of satiety and reduces energy expenditure [27]. Genetic predisposition is a risk factor for obesity, with higher risks in childhood [28]. In this study, we did not observe a statistically significant association between girls' and parents' obesity, which may be due to under-reporting of parent obesity. The odds of obesity decreased by more than 89% in girls who perform physical activity for 60 minutes for 6-7 days per week compared to the odds in those who were not physically active. This finding is consistent with those of previous studies [29, 30].

The study showed that about 50% of controls and more than 80% of cases exceeded the recommended screen time. Comparable findings were reported in previous studies [29, 31]. Screen media exposure is a risky practice as it associated with a sedentary lifestyle, reduced sleep duration, and higher energy intake. Furthermore, a systematic review concluded that screen exposure is one of the most important stimuli for overeating [32]. Advertising of unhealthy foods and unhealthy behaviors in programs targeting children affects children's food knowledge and choices and the likelihood of adopting healthy eating habits in the future

[33]. The relationship between healthy food, nutritional, knowledge, and obesity amongst children has been inconsistent in different studies [31, 32]. This discrepancy may be related to the mothers' food practices and their influence on the family's food choices. Our findings support this explanation. Overall, we found that a preference for healthy food in children was protective against obesity. Moreover, there was a strong correlation between mothers' nutritional knowledge and attitude, which indicated that mothers' knowledge regarding health and nutrition affected their attitude towards healthy eating. These results suggested that mothers' knowledge of healthy foods should be increased to guide children to healthier food choices [33]. A healthy diet has to be an easy choice; healthy food affordability and availability within the household and at school affect its acceptability and consumption by children [34].

The main limitations of the current study were its inability to assess temporality for causation and the potential for recall bias and assessment of behavior by self-reported question. Implication to practice: Establishment of health education, especially nutrition education in formal education curriculum, will improve health literacy in the Saudi population, particularly if reinforced by social norms. For instance, the school environment has to be a "non-obesogenic environment". Implication to research: Further studies are needed to address the issue of the current obesogenic environment, the reasons to consider non-healthy food choices, and methods to overcome these challenges.

Conclusion

Healthy food preferences among girls and adequate nutritional knowledge among their mothers were significantly associated with decreased obesity in girls.

Conflicts of interest

None.

References

1. Dehghan M, Akhtar-Danesh N, Merchant AT (2005) Childhood obesity, prevalence and prevention. *Nutr J* 4: 24. [Crossref]
2. Cairns G, Angus K, Hastings G (2009) The extent, nature and effects of food promotion to children: A review of the evidence to 2008. world health organization.
3. Ng M, Fleming T, Robinson M, Thomson B, Graetz N et al. (2014) Global, regional and national prevalence of overweight and obesity in children and adults during 1980-2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 384: 766-781. [Crossref]
4. Nasreddine L, Naja F, Akl C, Chamieh MC, Karam S et al. (2014) Dietary, lifestyle and socio-economic correlates of overweight, obesity and central adiposity in lebanese children and adolescents. *Nutrients* 6: 1038-1062. [Crossref]
5. Memish ZA, El Bcheraoui C, Tuffaha M, Robinson M, Daoud F et al. (2014) Obesity and associated factors--Kingdom of Saudi Arabia, 2013. *Prev Chronic Dis* 11: E174. [Crossref]
6. El Mouzan MI, Foster PJ, Al Herbish AS, Al Salloum AA, Al Omer AA et al. (2010) Prevalence of overweight and obesity in Saudi children and adolescents. *Ann Saudi Med* 30: 203-208. [Crossref]
7. El-Mouzan MI, Al-Herbish AS, Al-Salloum AA, Qurachi MM, Al-Oma AA (2007) Growth charts for Saudi children and adolescents. *Saudi Med J* 28: 1555-1568. [Crossref]
8. Hulst A Van, Gauvin L, Kestens Y, Henderson M, Barnett TA et al. (2015) Identifying risk profiles for childhood obesity using recursive partitioning based on individual , familial , and neighborhood environment factors. *Int J Behav Nutr Phys Act* 12: 17. [Crossref]
9. Lobstein T, Baur L, Uauy R (2004) Obesity in children and young people: A crisis in public health. *Obes Rev* 5: 4-104. [Crossref]
10. Vereecken C, Maes L (2010) Young children's dietary habits and associations with the mothers' nutritional knowledge and attitudes. *Appetite* 54: 44-51. [Crossref]
11. Kigaru DMD, Loechl C, Moleah T, Macharia-Mutie CW, Ndungu ZW (2015) Nutrition knowledge, attitude and practices among urban primary school children in Nairobi City, Kenya: a KAP study. *BMC Nutr* 1: 44.
12. Suresh K, Chandrashekara S (2012) Sample size estimation and power analysis for clinical research studies. *J Hum Reprod Sci* 5: 7-13. [Crossref]
13. Zarnowiecki D, Sinn N, Petkov J, Dollman J (2012) Parental nutrition knowledge and attitudes as predictors of 5-6-year-old children's healthy food knowledge. *Public Health Nutr* 15: 1284-1290. [Crossref]
14. Reisch LA (2011) Instruments for analysing the influence of advertising on children â€™ s food choices Instruments for analysing the influence of advertising on children's food choices. *Int J Obes* 35: S137-S143.
15. Tremblay MS, LeBlanc AG, Janssen I, Kho ME, Hicks A et al. (2011) Canadian Sedentary Behaviour Guidelines for Children and Youth. *Appl Physio Nutr Metab* 36: 59-64. [Crossref]
16. (2015) WHO | Physical activity and young people. *WHO*.
17. WHO (2016) Fiscal policies for diet and the prevention of noncommunicable diseases 36.
18. Hamad M, Dkheel A (2012) Dietary Guidelines for Saudis the healthy Food Palm General Directorate of Nutrition Director of General Directorate of Nutrition 1-32.
19. Shih S, Liu C, Liao LL, Osborne RH (2016) Health literacy and the determinants of obesity : a population-based survey of sixth grade school children in Taiwan. *BMC Public Health* 16: 280. [Crossref]
20. Cobiac LJ, Tam K, Veerman L, Blakely T (2017) Taxes and Subsidies for Improving Diet and Population Health in Australia : A Cost-Effectiveness Modelling Study. *PLos Med* 14: e1002232. [Crossref]
21. Powell LM, Chaloupka FJ (2009) Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q* 87: 229-257. [Crossref]
22. Boylan S, Hardy LL, Drayton BA, Grunseit A, Mihrshahi S (2017) Assessing junk food consumption among Australian children : trends and associated characteristics from a cross-sectional study. *BMC Public Health* 17: 299. [Crossref]
23. Al-Kutbe R, Payne A, de Looy A, Rees GA (2017) A comparison of nutritional intake and daily physical activity of girls aged 8-11 years old in Makkah, Saudi Arabia according to weight status. *BMC Public Health* 17: 592. [Crossref]
24. Alexander L, Anderson HR, Bachman VF, Biryukov S, Brauer M et al. (2015) Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: a systematic analysis for

the Global Burden of Disease Study 2013. *Lancet* 386: 2287-2323. [Crossref]

25. Maitland TE, Malcolm S, Handfield S (2015) Nutritional Knowledge and Practices , Lifestyle Characteristics and Anthropometric Status of Turks and Caicos Islands Elementary School Children. *West Indian Med J* 64: 29-36. [Crossref]
26. Shonkoff ET, Anzman-frasca S, Lynskey VM, Chan G, Glenn ME et al. (2017) Child and parent perspectives on healthier side dishes and beverages in restaurant kids ' meals : results from a national survey in the United States. *BMC Public Health* 18: 56. [Crossref]
27. Sharma SP, Chung HJ, Kim HJ, Hong ST (2016) Paradoxical Effects of Fruit on Obesity. Nutrients 8. [Crossref]
28. Elks CE, den Hoed M, Zhao JH, Sharp SJ, Wareham NJ et al. (2012) Variability in the heritability of body mass index : a systematic review and meta-regression. *Front Endocrinol (Lausanne)* 3: 29. [Crossref]
29. Mabry R, Koohsari MJ, Bull F, Owen N (2016) A systematic review of physical activity and sedentary behaviour research in the oil-producing countries of the Arabian Peninsula. *BMC Public Health* 16: 1003. [Crossref]
30. Al-muhaimeed AA, Dandash K, Ismail MS, Saquib N (2015) *original article* 275-281.
31. Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F et al. (2017) Screen Media Exposure and Obesity in Children and Adolescents. *Pediatrics* 140: S97-S101. [Crossref]
32. Chapman CD, Benedict C, Brooks SJ, Schiöth HB (2012) Lifestyle determinants of the drive to eat: A meta-analysis. *Am J Clin Nutr* 96: 492-497. [Crossref]
33. Skatrud-Mickelson M, Adachi-Mejia AM, MacKenzie TA, Sutherland LA (2012) Giving the wrong impression: Food and beverage brand impressions delivered to youth through popular movies. *J Public Heal (Oxf)* 34: 245-252. [Crossref]
34. Reisch LA, Gwozdz W, Barba G, De Henauw S, Lascorz N et al. (2013) Experimental evidence on the impact of food advertising on children's knowledge about and preferences for healthful food. *J Obes* 2013: 408582. [Crossref]