



Association between dietary behaviours and weight status of school children: results from the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) -Kenya

Lucy-Joy Wachira, Stella Muthuri, Sophie Ochola, Vincent Onywera & Mark Tremblay

To cite this article: Lucy-Joy Wachira, Stella Muthuri, Sophie Ochola, Vincent Onywera & Mark Tremblay (2021) Association between dietary behaviours and weight status of school children: results from the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) -Kenya, *Child and Adolescent Obesity*, 4:1, 1-22, DOI: [10.1080/2574254X.2020.1842014](https://doi.org/10.1080/2574254X.2020.1842014)

To link to this article: <https://doi.org/10.1080/2574254X.2020.1842014>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 11 Nov 2020.



[Submit your article to this journal](#)



Article views: 2507



[View related articles](#)



[View Crossmark data](#)



Citing articles: 1 [View citing articles](#)

Association between dietary behaviours and weight status of school children: results from the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) -Kenya

Lucy-Joy Wachira ^a, Stella Muthuri ^b, Sophie Ochola ^c,
Vincent Onywera ^a and Mark Tremblay ^d

^aDepartment of Physical Education, Exercise and Sport Science, Kenyatta University, Nairobi, Kenya; ^bPopulation Dynamics and Reproductive Health Program, African Population and Health Research Center, Nairobi, Kenya; ^cDepartment of Foods, Nutrition and Dietetics, Kenyatta University, Nairobi, Kenya; ^dChildren's Hospital of Eastern Ontario Research Institute, Ottawa, Canada

ABSTRACT

Background: Sub-Saharan African countries are undergoing rapid urbanization resulting in vast changes in dietary habits. Dietary practices involving excess energy intake have been associated with overweight/obesity. We assessed the dietary behaviour of children and their relationships with weight status.

Methods: Data was collected in Kenya, as part of the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE). The study recruited 563 children aged 9–11 years from 29 schools in Nairobi. A seven-day food frequency questionnaire was used to assess dietary intake. Dietary behaviours such as consumption of breakfast, school lunch, meals prepared/eaten away from home, emotional eating and snacking while watching television were also assessed. Body mass index (BMI-for-age and sex) was used as the indicator of weight status.

Results: Of the sample, 53.5% were girls; 20.8% were classified as overweight/obese; 72.9% ate meals out of home regularly; 55.2% ate lunch provided by the school; and only 76% had breakfast on all weekdays. Eating more when happy, eating fried foods while watching television, and consumption of vegetables were positively associated with BMI. Majority of overweight children were female (56.6%) and the type of school attended predicted BMI, $F(6, 536) = 18.371, p < 0.0001, R^2 = 0.171$. BMI was negatively associated with consumption of cakes/pastries ($\chi^2 = 14.7, V = 0.165, p = 0.023$), potato crisps ($\chi^2 = 21.6, V = 0.197, p = 0.003$), and fast foods ($\chi^2 = 13.5, p = 0.036$). ANOVA results revealed no significant differences in the consumption of foods with BMI except for vegetables ($p = 0.003$).

Conclusions: Children have healthy diets rich in fruits and vegetables and low in energy-dense foods. Also, less healthy diets were observed in children with

CONTACT Lucy-Joy Wachira  wachira.lucy@ku.ac.ke  Department of Physical Education, Exercise and Sport Science, Kenyatta University, Nairobi, Kenya

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

lower BMI. There is need for interventions targeting the overweight/obese children, particularly those of higher SES.

ARTICLE HISTORY Received 7 April 2020; Accepted 22 October 2020

KEY WORDS Dietary behaviour; weight status; BMI; school children

Introduction

Obesity, defined as an excess in body fat accumulation, is associated with various adverse health outcomes (World Health Organization 2010). Overweight and obesity have been identified as increasing public health problems in both developed and developing countries (Ziraba et al. 2009). They are also recognized risk factors for various non-communicable diseases (NCDs) (Asfaw 2006). On the other hand, too little body fat is also a health risk, as the body needs a certain amount of fat to support normal physiological functions (Heyward 2006). In developing countries, under-nutrition among children has long been a major concern (Müller and Krawinkel 2005); however, with the changing lifestyles and dietary practices, many developing countries including Kenya, are facing the dual burden of both under-nutrition and over-nutrition among children (Kimani-Murage et al. 2015). Monitoring dietary behaviors is important for early identification of nutritional problems among children (Kimani-Murage et al. 2015). Dietary guidelines for children provide appropriate calorie intake and nutritional information for healthy growth and development, and for establishing healthy eating habits (Daniels et al. 2005).

It has been observed that as socioeconomic status increases, and as populations become more urban, diets that are high in complex carbohydrates give way to more nutrient-poor and calorie-dense varieties, with a higher proportion of fats and sugars (World Health Organization 2004a). This remains true for countries in Sub-Saharan Africa. The World Health Organization (WHO) Global Strategy on Diet, Physical Activity and Health calls for the achievement of energy balance through limiting the energy intake from fats, reducing the intake of free sugars, attaining a minimum level of dietary diversity, and increasing fruit and vegetable consumption in order to improve the health status of individuals (World Health Organization 2004b).

Literature indicates that diet quality follows a socioeconomic gradient where higher-quality healthier diets are associated with the affluent while nutrient-poor energy-dense diets are preferred by those in lower socioeconomic status (Drewnowski and Darmon 2005; Giskes et al. 2010). The nutrition transition witnessed in Kenya is characterized by changes in the

urban food environment associated with changes in the physical environment factors (accessibility), social factors and individual food choices and economic factors (affordability). For the urban poor, the most easily available and affordable diets are often unhealthy (Hawkes et al. 2017). Children have been influenced by the changes in dietary habits making them vulnerable to unhealthy diets characterized by energy-dense and nutrient-poor foods (Kimenju and Qaim 2016). Poor dietary practices characterized by intake of energy-dense, nutrient-poor foods, high in fat and sugar, and low in fibre are associated with increased prevalence of overweight and obesity and high-fat deposition (Hartline-Grafton et al. 2009). Factors associated with excess energy intake among children include increased portion sizes (Ello-Martin et al. 2005), increased consumption of sweetened beverages (Bleich et al. 2008), and increased snacking (Bellisle 2014) or snacking while watching television (Robinson 2001; Grossman et al. 2012). In addition, consumption of meals away from home, increased exposure to advertisements that encourage and promote consumption of unhealthy foods, and ease of access to fast food outlets, are all likely to influence dietary behaviours (Grossman et al. 2012). In rapidly urbanizing developing countries, the consumption of fast foods out of home, even for children, has become a common practice related to lifestyle transitions (Ayala et al. 2008). The maternal education level is also associated with eating behavior of children and adolescents as mothers are usually directly involved in planning their child's diet (Van Ansem et al. 2014).

Studies of dietary behaviour are needed in rapidly urbanizing countries such as Kenya. A systematic review (Ochola and Masibo 2014) on developing countries including Kenya, concluded that diets of school children and adolescents are characterized by limited dietary diversity, a low energy intake with minimal consumption of animal foods and fruits and vegetables, resulting in a deficiency in micronutrients. It also noted an emerging trend of consumption of high-energy snacks and beverages, particularly in urban areas. A previous study in Kenya (Kigaru et al. 2015) found higher than recommended consumption of fast foods and sweetened beverages among children in Nairobi. Studies also show that children are more likely to eat easily accessible foods that are in a ready to eat form (Patrick and Nicklas 2005). Several studies have shown a positive correlation between energy intake and body fat mass (Moreno et al. 2000; Ledikwe et al. 2006; Bowen et al. 2015), but others have not reported any relation (Bowen et al. 2015).

Most nutrition-oriented studies in Kenya have focused on under-nutrition, leaving a knowledge gap in over-nutrition. Given the emerging evidence of a nutrition transition among school-aged children in Sub-Saharan Africa (Onywera et al. 2012), it is important that dietary behaviours and their relationship to weight status be assessed to monitor trends,

inform future policy and programming, and contribute to the knowledge base. The purpose of this study was to determine dietary behaviours of school children in Nairobi, Kenya and their associations with measures of weight status.

Materials and methods

Study design

The findings presented in this paper are based on data collected as part of the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE). This was a large multi-national cross-sectional study conducted from 2011 to 2014 that aimed to determine the relationships between lifestyle behaviors and obesity among 500 children aged 9 to 11 years in each of the 12 countries (Katzmarzyk et al. 2013). The ISCOLE protocol included data collection from children, their parents, school administrators, as well as direct observations of the school environment. More details on the ISCOLE study protocol are provided elsewhere (Katzmarzyk et al. 2013). In the ISCOLE project, Kenya represented the low-income economy sample. At the time of the study, Kenya (a developing country in East Africa) was classified as a low-income country with a population of 41 million people and a human development index of 0.509 (low) (World Bank 2012). The study was conducted in Nairobi City County. Nairobi, a cosmopolitan capital city with a population of 3 million people, is home to an urban population rich in diverse social cultural and economic backgrounds emanating from the 42 tribes of Kenya and foreigners (NCPD 2013). The procedures followed were in accordance with the ethical standards in the Helsinki Declaration and the ISCOLE-Kenya study protocol was reviewed and approved by Kenyatta University Ethics Review Committee (KU/R/COMM/51/15 – PKU005/104), the National Council for Science and Technology, and the Nairobi County Council.

Sample size and sampling technique

The primary sampling frame was co-ed non-boarding primary schools in Nairobi County. To maximize variability, schools were first stratified into the two main types of schools; public (less affluent and run by the government), and private (mainly more affluent and owned or run by individuals, faith-based organizations, or non-governmental institutions). Schools were then further categorized based on tuition costs and incurred expenses into socio-economic status (SES) groups; low (LSES), middle (MSES) and high (HSES) to capture a range of economic classes. The recruitment of schools also

considered their geographical location to avoid clustering in one jurisdiction of Nairobi. A total of 29-day schools were included.

The secondary sampling frame consisted of classrooms with 9 to 11 year-olds from each school. One class in the school with children closest in age 10 years (i.e., 9 to 11 years) was identified and all children were targeted for the study. Informed consent forms were given to the children to take home for their parent/guardian to complete. Only those whose parent/guardian consented were recruited for the study, and only after they had also assented. Those whose data did not contain the primary study endpoints (age, sex, weight, height, and dietary pattern data) were excluded. A total of 563 children met all primary endpoints, forming the analytical sample.

Data collection

In Kenya, data collection was conducted across one school year in 2012. The ISCOLE study set stringent quality control measures during data collection, data cleaning and entry to ensure accuracy of data (Katzmarzyk et al. 2013). A pilot study was also done beforehand in a school in Nairobi to see the understanding and administrability of the instruments prior to data collection. In data collection, demographic information including age, sex, type of school attended (public or private school) and SES category of the participating school was obtained. Data on dietary behaviors were also collected.

Dietary intake

The ISCOLE Diet and Lifestyle questionnaire, a self-administered questionnaire was filled by the participating children at the school in the presence of trained research staff and in the absence of their parents. The research team offered assistance or clarifications needed during the filling of the questionnaire. Questions in this instrument were adopted from widely used and validated instruments from several different sources (U.S. Youth Risk Behaviour Surveillance System (CDC 2009) and Health Behaviour in School-aged Children (HBSC) Survey (Currie 2008)), and additional questions formulated by experts serving on the project's steering panel (described in the ISCOLE methods paper (Katzmarzyk et al. 2013)). A seven-day food frequency questionnaire was used to collect dietary data to describe children's food intake in the past week. This list was contextualized to make it relevant to the Kenyan situation by replacing a few of the food items with equivalent examples found in Kenya (as was done for other ISCOLE countries as needed). The number of times a food was consumed within the previous 7 days was noted and computed to determine the total frequency of consumption of food items. A similar scoring process was also used by

Janssen and colleagues (Janssen et al. 2004) in their study on overweight and obesity of Canadian adolescents.

In the same questionnaire, some dietary practices were assessed to highlight aspects of the home and school environment that are part of children's dietary behaviour. In order to better understand the interactions between television viewing and dietary intake, a brief 5-item FFQ was adapted from a published study (Van den Bulck and Van Mierlo 2004) that asks the children about the consumption of different types of snacks while viewing the television. In addition, a question on consumption of breakfast derived from a HBSC study (Currie et al. 2008) asked the children to indicate how often they usually have breakfast on weekdays and over the weekend. Another questions on school lunches derived from a published survey (National Center for Health Statistics: National Health and Nutrition Examination Survey 2012) asked participants to indicate how many times in the past week they eat lunch provided by the school. There was also a question on the number of meals taken that were prepared or eaten away from home to assess the frequency of consumption of meals taken in places such as restaurants and fast food places. Emotional eating, as a psychological influencer of dietary behaviour was also assessed. In a question derived from a published study (Striegel-Moore et al. 1999), participants were asked to indicate instances that made them eat more food among the following; when worried, when happy, when mad, when sad, when bored, as a food treat and eating between meals even when not hungry. The filled questionnaires were checked for completeness at the time of data collection in order to ensure high-quality data.

Weight status

Direct measurements of weight and height were used to calculate body mass index [BMI] (kg/m^2). Height was measured with shoes removed, using a Seca 213 portable stadiometer (Seca, Hamburg, Germany). The measurement was repeated, and the average was used for analyses (a third measurement was obtained if the first two measurements were greater than 0.5 cm apart, and the average of the two closest measurements was used in analyses). The participants' weight was measured using a portable Tanita SC-240 Total Body Composition Analyzer (Tanita Corporation of America, Arlington Heights, Illinois). Two measurements were obtained, and the average was used in analyses (if the first two measurements were more than 0.5 kg or 2.0% apart, a third measurement was obtained and the closet two were averaged for analyses). The WHO references for BMI-for-age and sex (World Health Organization 2013) were used to interpret the BMI results using the following cut-points: 5th percentile and below [underweight]; from the 5th to 85th

percentile [normal weight]; >85th percentile to 95th percentile [overweight]; >95th percentile [obese].

Statistical analysis

The data were cleaned and checked for normality prior to analysis. Data analysis was conducted using SPSS (version 17, SPSS Inc. Chicago, Illinois). The descriptive results on participants' characteristics and BMI status were derived from cross-tabulations with significance by Pearson Chi-Square. Chi-square analyses including Cramer's V effect size analysis were conducted to determine associations between consumption of foods by sex, type of school attended, SES, and BMI. Multiple regression analyses were also conducted to establish associations between variables. These analyses were conducted independently in their specific clusters. Where multiple comparisons were done, confidence intervals are presented and p-values for determining statistical significance were adjusted to account for multiple comparisons. Data were also analysed using chi-square tests to establish associations between BMI and emotional eating and BMI and consumption of foods while watching television. One-way ANOVA (with Duncan's post hoc tests to indicate observed differences) was also done to compare means of participants' weekly frequency of consumption of foods and drinks by BMI. A p-value of <0.05 was considered significant.

Results

Participant characteristics

The characteristics of study participants are presented in [Table 1](#). There was a slight majority of girls (53.5%) and participants from public schools (52.4%) with about 78.3% of participants being of low and middle socioeconomic status.

Weight status

The majority (73%) of participants were of normal weight while 20.8% were classified as being overweight/obese. A higher proportion of overweight children were female (56.6%) and attended private schools (73.6%) while 80.3% of obese children were also from private schools. In addition, higher percentage (57.2%) of the children with normal weight and most of the underweight (89.5%) participants were from public schools.

Table 1. Characteristics of schools and study participants.

Study Participants N(563)		n %							
Age	9 years	207							
	10 years	36.8							
	11 years	278							
		49.4							
Sex		78							
		13.9							
	Males	262							
	Females	46.5							
Type of School attended		301							
		53.5							
	Public	295							
	Private	52.4							
SES of schools		268							
		47.6							
	LSES school	158	By Sex (n, %)	P value	By school type (n, %)	P value			
	MSES school	28.1	Males		Private				
	HSES school	358	Females		Public				
		63.6							
	47								
	8.3								
BMI for age	Underweight	38	6.7	19(50)	19(50)	0.827	4(10.5)	34(89.5)	<0.001*
	Normal (ideal)	411		189(46)			176(42.8)	235	
	Weight	73.0		222(54)			(57.2)		
	Overweight	53		23(43.4)	30		39(73.6)	14	
	Obese	9.4		(56.6)			(26.4)		
		61		31(50.8)	30		49(80.3)	12	
	10.8		(49.2)			(19.7)			

Abbreviations: n = total; SES = Socio Economic Status; LSES = Low Socio Economic Status; MSES = Middle Socio Economic Status; HSES = High Socio Economic Status. School SES defined by schooling costs/incurred expenses. † denotes BMI categorization by WHO reference of BMI-for-age and sex. Analysis: cross-tabulations with significance by Pearson Chi-Square, *represents *p* values significant at 0.05.

Dietary practices

Weekly frequency of consumption of different foods

There were higher means in the frequency of consumption of vegetables ($M = 5.3$, $SD = 1.7$), fruits ($M = 5.1$, $SD = 1.8$), dark green vegetables ($M = 4.9$, $SD = 1.9$) and other vegetables (carrots, cucumber, sweet potato) ($M = 4.8$, $SD = 2.0$) compared to other foods and drinks in a given week. Other foods that were consumed relatively frequently were whole grain bread or cereal ($M = 4.4$, $SD = 2.2$), meat alternatives such as beans, green grams, lentils, eggs, peanut butter, etc. ($M = 4.3$, $SD = 1.8$) and whole milk (homogenized) ($M = 4.2$, $SD = 2.2$) compared to energy-dense foods such as French fries ($M = 3.3$, $SD = 1.7$), soft drinks ($M = 3.2$, $SD = 1.7$), potato crisps ($M = 3.6$, $SD = 1.8$), cake/pastries ($M = 3.5$, $SD = 1.8$), fast food ($M = 3.2$, $SD = 1.9$), fried food ($M = 3.3$, $SD = 1.8$) and sweets ($M = 3.0$, $SD = 1.6$). It is notable that most of the participants reported healthy diets rich in vegetables and generally low in energy-dense foods.

Females had a significantly higher consumption of potato crisps ($p = 0.043$), whole grain bread or cereal ($p = 0.027$), fruits ($p = 0.017$), fruit juice ($p = 0.041$) and milk products ($p = 0.004$) than the males. Female pupils had a 1.4 times higher odds than males of consuming potato crisps (OR = 1.4; 95% CI: 1.02–1.99; $p = 0.041$). Participants from private schools consumed whole grains or cereals, vegetables and sweets more frequently than their counterparts in the public schools. In contrast, participants from public schools consumed foods/drinks positively associated with overweight and obesity (specifically, cake/pastries, energy drinks, French fries, cheese, ice-cream and fried food) more frequently. Participants from public schools were two times more likely to consume cakes/pastries or cheese than participants from private schools (OR = 2; 95% CI: 1.44–2.87; $p < 0.001$ and OR = 2.1; 95% CI: 1.37–3.29; $p = 0.001$, respectively). Results also indicated that participants from LSES schools consumed cakes/pastries, and fish more frequently than those from MSES and HSES, while those from HSES consumed whole grain bread/cereal and fruits more frequently than those from LSES and MSES.

Meals away from home

When asked how many meals (breakfast, lunch or dinner) they ate in the past week that were prepared away from home in places such as restaurants, fast food places, food stands, grocery stores or vending machines, 27.1% indicated that they did not have any meal away from home while 72.9% reported eating meals away from home. Nearly one in five (18.8%) had between 4 and 9 meals and 3.6% had more than 10 meals away from home in the past week. Findings also indicated that over half (55.2%) of the respondents ate lunch provided by the school.

Weekly frequency of consumption of breakfast

When asked how often they ate breakfast, 76% reported having breakfast on all weekdays, 7.1% had breakfast on only one weekday and 6.2% had breakfast on two weekdays. However, 2.8% did not have any breakfast on a weekday. Most (88.6%) reported having breakfast on all weekend days, 8.9% had breakfast on only one weekend day, and 2.5% did not have any breakfast on a weekend day.

Emotional eating

As shown in Table 2, less than half of the participants ate more when sad (33.6%) or mad (angry) (28.3%) while about a half of participants reported eating between meals even when not hungry (55.5%) and eating more when worried (50.7%) or bored (51.2%). Over 70% reported eating more when happy and as a food treat.

Food consumption while watching television

Table 3 presents consumption of selected foods while watching television. Many participants seemed to eat potato crisps, peanuts, fried foods, cookies and biscuits, ice-cream and fast food while watching television.

Factors associated with BMI

A multiple regression analysis was run to predict BMI from gender and type of school attended and results indicate that the type of school attended statistically significantly predicted BMI, $F(6, 536) = 18.371$, $p < 0.0001$, $R^2 = 0.171$.

There was no relationship between eating more when mad, sad, happy, worried, or bored, or eating food as a treat or when not hungry and being overweight/obese (Table 2). However, 14.4% of the participants who reported eating more when happy were classified as overweight/obese (OW/OB).

Although study participants reported eating while watching television, there was no association between eating unhealthy foods (potato crisps, peanuts, fried foods, cookies and biscuits, ice-cream and fast food) while watching television and being overweight/obese (Table 3).

Associations between frequency of consumption of selected food items and drinks and BMI

BMI levels were categorized into two groups; those who were overweight/obese and those who were not. Children who were overweight/obese reported consuming the following foods significantly less frequently than the normal/underweight children: cakes/pastries ($\chi^2 = 14.7$, $V = 0.165$, $p = 0.023$), potato crisps ($\chi^2 = 21.6$, $V = 0.197$, $p = 0.003$), fast foods ($\chi^2 = 13.5$, $V = 0.161$, $p = 0.036$) and other milk products ($\chi^2 = 13.5$, $V = 0.161$, $p = 0.017$). A multiple regression analysis was also run to predict BMI from the consumptions of these four food types and results indicate that they statistically significantly predicted BMI, $F(6, 536) = 18.371$, $p < 0.0001$, $R^2 = 0.171$. This means that for each increase in the consumption of cakes/pastries, potato crisps, fast foods and other milk products, there is a decrease in BMI by 0.023, 0.006, 0.003 and 0.017 BMI Z-scores, respectively.

Additional regression analyses also showed that those who were overweight/obese were 1.8 times more likely to have low consumption of cakes/pastries (OR = 1.8; 95% CI: 1.17–2.87; $p = 0.008$). ANOVA results in Table 4 to compare means of participants' weekly frequency of consumption of foods by BMI reveal a positive association in the consumption of vegetables with BMI ($p = 0.003$).

Discussion

The main findings show that the diet of the study population is mostly healthy, rich in vegetables and fruits and does not have a high consumption of energy-

Table 2. Associations of BMI status and Emotional Eating.

Questions	Response	Total	Weight (BMI) status n = 113 (20.8%)		p-value
			Not OW/OB n (%) [†]	OW/OB n (%) [†]	
I eat more when I'm worried	No	277(49.3)	219(39.0%)	58(10.3)	0.628
	Yes	285(50.7%)	230(40.9%)	55(9.8%)	
I eat when I'm mad	No	402(71.7%)	322(57.4%)	80(14.3%)	0.820
	Yes	159(28.3%)	126(22.5%)	33(5.9%)	
When I do something well I give myself a food treat	No	164(29.2%)	127(22.6%)	37(6.6%)	0.351
	Yes	398(70.8%)	322(57.3%)	76(13.5%)	
I eat more when I'm sad	No	372(66.4%)	296(52.9%)	76(13.6%)	0.611
	Yes	188(33.6%)	153(27.3%)	35(6.3%)	
I eat more when I'm happy	No	121(21.5%)	89(15.8%)	32(5.7%)	0.050*
	Yes	441(78.5%)	360(64.1%)	81(14.4%)	
I eat more when I'm bored	No	274(48.8%)	222(39.6%)	52(9.3%)	0.568
	Yes	287(51.2%)	227(40.5%)	60(10.7%)	
I eat between meals even if I'm not hungry	No	250(44.5%)	198(35.2%)	52(9.3%)	0.714
	Yes	312(55.5%)	251(44.7%)	61(10.9%)	

Chi-squared test results reported. [†]Denotes that proportions may exclude missing data.

^aSignificant (2-tailed) difference ($p < 0.05$)

Abbreviations: OW/OB = overweight/obese. BMI categorization by WHO reference of BMI-for-age and sex.



Table 3. Associations of BMI status and consumption of selected foods while watching television.

Questions	ALL					Those classified as Overweight/Obese n = 114 (20.2%) n (%) [†]					
	Response	NOT OW/ OB	OW/OB	TOTAL	p-value (OW/OB vs. not OW/OB)	Less than once a week	Once a week	2-4 Days a week	5-6 Days a week	Once a day, every day	Every day, more than once
Times I usually eat Potato chips/peanuts while watching TV	No	73 (13.0%)	13 (2.3%)	86 (15.3%)	0.198	29(5.2%)	31 (5.5%)	16(2.8%)	10(1.8%)	4(0.7%)	11(2.0%)
	Yes	376 (66.8%)	101 (17.9%)	477 (84.7%)		26(4.6%)	39(6.9%)	10(1.8%)	9(1.6)	5(0.9%)	9(1.6%)
Times I usually eat Fried food; chicken wings, chicken fingers, French fries, etc. while watching TV	No	99(17.6%)	16(2.8%)	115 (20.4%)	0.058	26(4.6%)	39(6.9%)	10(1.8%)	9(1.6)	5(0.9%)	9(1.6%)
	Yes	350 (62.2%)	98(17.4%)	448 (79.6%)		36(6.4%)	24(4.3%)	16(2.8%)	2(0.4%)	5(0.9%)	13(2.3%)
Times I usually eat Cookies, biscuits, chocolate or candy bars while watching TV	No	89(15.8%)	18(3.2%)	107 (19.0%)	0.322	36(6.4%)	24(4.3%)	16(2.8%)	2(0.4%)	5(0.9%)	13(2.3%)
	Yes	359 (63.9%)	96 (17.1%)	455 (81.0%)		34(6.1%)	26(4.6%)	10(1.8%)	5(0.9%)	2(0.4%)	5(0.9%)
Times I usually eat ice cream while watching television	No	132 (23.5%)	31(5.5%)	163 (29.1%)	0.671	34(6.1%)	26(4.6%)	10(1.8%)	5(0.9%)	2(0.4%)	5(0.9%)
	Yes	316 (56.3%)	82(14.6%)	398 (70.9%)		32(5.7%)	34(6.0%)	11(2.0%)	2(0.4%)	7(1.2%)	9(1.6%)
Times I usually eat fast foods such as pizza, hamburgers, etc. while watching TV	No	105 (18.7%)	18(3.2%)	123 (21.9%)	0.087	32(5.7%)	34(6.0%)	11(2.0%)	2(0.4%)	7(1.2%)	9(1.6%)
	Yes	344 (61.2%)	95(16.9%)	439 (78.1%)		8(1.4%)	10(1.8%)	7(1.2%)	10(1.8%)	17(3.0%)	55(9.8%)
Times I usually eat fruits/vegetables while watching TV	No	27(4.8%)	7(1.2%)	34(6.0%)	0.959	8(1.4%)	10(1.8%)	7(1.2%)	10(1.8%)	17(3.0%)	55(9.8%)
	Yes	422 (75.0%)	107 (19.0%)	529 (94.0%)							

Chi-squared test results reported. [†]Denotes that proportions may exclude missing data.. **Abbreviations:** OW/OB = overweight/obese, TV = Television. BMI categorization by WHO reference of BMI-for-age and sex.

Table 4. Association between BMI and frequency of consumption of foods/drinks.

FOODS CONSUMED	BMI categories					p value ANOVA
	All N = 563 Means (sd)	Under weight N = 38 Mean (sd)	Normal weight N = 411 Mean (sd)	Over weight N = 53 Mean (sd)	Obese (weight) N = 61 Mean (sd)	
Cake, pastries, or donuts	3.5(1.8)	3.5(1.9)	3.6(1.9)	3.3(1.9)	2.9(1.1)	0.089
Potato Crisps	3.6(1.8)	3.3(1.6)	3.7(1.8)	3.7(2.0)	3.2(1.5)	0.127
Regular cola or soft drinks (contain sugar)	3.2(1.7)	2.9(1.5)	3.2(1.7)	3.7(2.0)	3.2(1.6)	0.104
French fries	3.3(1.7)	3.6(1.9)	3.3(1.7)	3.7(1.9)	3.1(1.5)	0.232
Whole grain bread or cereal (Weetabix)	4.4(2.2)	4.1 (2.1)	4.4(2.2)	4.5(2.2)	4.4(2.3)	0.763
Energy drinks (Red Bull, Shark, etc.)	2.3(1.8)	2.1(1.7)	2.4(1.8)	2.4(2.0)	1.9(1.3)	0.151
Sports drinks (Lucozade, Gatorade)	2.9(1.9)	2.8(2.1)	3.0(2.0)	2.9(1.8)	2.5(1.5)	0.189
Fast food such as hotdog, pizza, hamburgers	3.2(1.9)	2.9(1.9)	3.3(1.9)	3.4(1.8)	2.9(1.4)	0.195
Fruits	5.1(1.8)	5.2(2.0)	5.1(1.8)	5.3(1.9)	5.3(1.8)	0.626
Vegetables	5.3(1.7)	4.4(2.1) ^a	5.4(1.7) ^b	5.1(1.8) ^b	5.6(1.6) ^b	0.003*
Diet cola or diet soft drinks	3.1(1.9)	3.1(1.9)	3.2(1.9)	2.9(2.0)	2.9(1.8)	0.712
Dark green vegetables (<i>sukuma wiki</i> , spinach, etc.)	4.9(1.9)	4.8(1.9)	4.9(1.9)	4.7(1.8)	5.2(1.9)	0.441
Other vegetables (carrots, sweet potato)	4.8(2.0)	4.6(1.9)	4.9(1.9)	4.5(2.2)	4.9(2.0)	0.427
Fruit juice	3.9(1.9)	3.5(1.9)	3.9(1.9)	4.4(1.9)	3.9(1.8)	0.111
Low fat milk (1%,2%,skim)	3.7(2.2)	4.1(2.1)	3.7(2.2)	3.9(2.3)	3.3(2.2)	0.203
Whole milk (homogenized)	4.2(2.2)	4.2(2.1)	4.2(2.2)	4.3(2.3)	4.0(2.2)	0.904
Other milk products (yogurt, chocolate milk)	3.7(1.9)	3.6(1.7)	3.8(1.9)	3.7(1.7)	3.2(1.6)	0.079
Meat alternatives (beans, green grams)	4.3(1.8)	4.2(1.9)	4.4(1.8)	4.1(1.8)	4.2(1.7)	0.719
Fish	3.3(1.8)	3.0(1.7)	3.3(1.8)	3.2(1.5)	2.9(1.5)	0.216
Cheese	2.2(1.7)	2.5(1.6)	2.2(1.7)	2.3(1.7)	1.9(1.5)	0.539
Ice Cream	2.9(1.7)	2.9(1.8) ^{ab}	3.1(1.8) ^b	2.9(1.8) ^{ab}	2.4(1.3) ^a	0.038*
Fried food such as chicken wings	3.3(1.8)	3.4(1.7)	3.3(1.8)	3.5(1.6)	3.2(1.8)	0.800
Sweets	3.0(1.6)	2.7(1.6)	3.0(1.6)	3.3(1.9)	2.9(1.6)	0.296

Definitions: *sukuma wiki* = kales. BMI categorization by WHO reference of BMI-for-age and sex, ANOVA test results reported. All data expressed as means and (SD), unless otherwise indicated. The superscript ^{a, b, ab} are derived from Duncan's post hoc tests to indicate specific observed differences. Categories with values within a row with different superscript letters are significantly different. *Significant (2-tailed) difference (p < 0.05).

dense foods. The frequency of consumption of various foods and drinks may be influenced by their availability, abundance, affordability, preferences, or the level of knowledge on their nutritive value. Our findings are probably largely driven by the affordability of certain types of vegetables and fruits in the city as well as the role of cultural eating habits and norms. Previous work in Kenya has, however, noted inadequate intake of dark green leafy vegetables and a high intake of fruits rich in vitamin C (Gewa et al. 2014).

The findings indicate a high prevalence (20.8%) of overweight and obesity among school children in Nairobi. These levels of overweight and obesity in our sample were comparable to projected population estimates. Being overweight/obese in childhood has been known to increase risk of adverse health effects in later life (Asfaw 2006). The prevalence of overweight and obesity was higher among girls and those attending private schools. A systematic review by Muthuri and colleagues (Muthuri et al. 2014) confirmed a trend towards increasing proportions of overweight/obesity in school-aged children in Sub-Saharan Africa over time. This was particularly true for urban residing children and those in higher SES.

The study findings show that less healthy diets tend to be observed in children with lower BMI. Those who consumed cakes/pastries, potato crisps and fast foods more frequently were *less likely* to be overweight/obese than those who did not. The effect sizes of these associations were found to be weak. Those who were *not* overweight/obese were reported to be 1.8 times more likely to have high consumption of cakes/pastries which is unexpected. It is possible that the portion sizes of unhealthy foods were greater among the overweight and obese children even when consumed less often. It may also be possible that other factors such as high physical activity levels (noted in this sample in separate analyses) are involved in regulating energy balance, or that there is a reporting bias. A similar study by Janssen and colleagues (Janssen et al. 2004) also found a negative relationship between sweets, potato chips and cake/pastries intake, and BMI which was attributed to under-reporting. There are mixed findings on the relationships between dietary fat and obesity in children. Some reviews have found both positive associations, weak associations (Kruger et al. 2006) and similar to our study, non-significant associations between dietary fat intake and adiposity (Field et al. 2004; Phillips et al. 2004). We also noted a significant difference between the frequencies of consumption of vegetables with BMI reporting significantly lower means for the underweight participants compared to the rest. An analysis of 17 studies on dietary intake and adiposity by Davis et al., (Davis et al. 2007) reported that several studies found no association between fruit and vegetable intake and childhood adiposity. Our study also found non-significant associations between weight status and sweetened drinks. Several larger and high-quality studies reported that sweetened beverage intake was related to obesity among children. The difference observed in

our study may be due to self-reporting biases, or that there is indeed no relationship in this sample, or the influence of other compensatory pathways in this sample (Muthuri et al. 2014a, 2014b). It is noteworthy that a health body weight does not necessarily means healthy.

Participants from public schools (lower SES) reported consuming more of the foods/drinks that are associated with a higher high risk for overweight and obesity, compared to those from private schools. Children attending public schools who mainly come from less affluent neighbourhoods may be consuming more of these unhealthy foods and snacks due to some lifestyle predisposing factors around the school, home and neighbourhood environment. Public school attending children are an easy target and market for such foods owing to less strict regulation of their movement in and out of the school compound during recess and lunch time, compared to higher cost private schools where children may only walk in and out of the school in the company of a parent/guardian. In the neighbourhoods, simple pastries and French fries that are cheap to prepare are often sold cheaply by the roadside making them readily available to school children many of whom walk home from school and tend to move freely within these highly walkable neighbourhoods. Ironically, although participants from public schools have unhealthier diets, the prevalence of overweight and obesity is much lower in this group. This could be due to other compensatory pathways observed in this sample. In results published elsewhere (Muthuri et al. 2014a, 2014b), it was noted that these group of children, who have less affluent lifestyles of hardship, accumulate excessively high physical activity volumes daily and it is possible that this is regulating energy balance.

Several dietary behaviors and practices were assessed in this study. Although none of these practices showed significantly associated with BMI, they reveal dietary behavior patterns that require further investigation. For instance, a majority of study respondents reported having frequently consumed meals prepared away from home, with many having eaten more than five meals away from home in the past week. Consumption of meals away from home is associated with consumption of unhealthy foods and weight gain (San Juan 2006; Bezerra et al. 2012). Frequent family outings coupled with eating meals away from home is increasingly becoming a common practice in developing countries (Ayala et al. 2008) since being able to afford meals outside the home or at restaurants is now seen as a marker of wealth or status (Dehghan et al. 2005). Eating away from home frequently, particularly when the options are not healthy could pose a substantial risk to the future health of children. The frequency of eating breakfast was also assessed by this study. While breakfast is a very important meal to provide energy for the day and positively impact children's health and well-being (Rampersaud et al. 2005), many study respondents reported that they did not eat breakfast on several days of the week including weekend days. A family's inability to afford a breakfast meal or

opting to leave home without breakfast due to lateness on a school morning may be reasons for skipping it. A review of 47 studies (Rampersaud et al. 2005) examining breakfast consumption found that children who reported eating breakfast consistently had a healthier nutritional profile than their breakfast-skipping peers, and that breakfast eaters consumed more daily calories yet were less likely to be overweight. It is important to note that the quality of the breakfast was not reported in our study, and in many of the others, yet this is another key aspect to consider.

In addition, it was noted that over a half of the respondents in this study ate lunch provided by the school, although the quality of the lunch was also not assessed. A similar study in Nairobi (Kigaru et al. 2015) reported that children who did not consume school lunch and did not carry packed lunch from home were given money to buy lunch or snacks. This made them more vulnerable to consuming the readily available unhealthy foods in the school's neighbourhood. A study by Jones and colleagues (Jones et al. 2015) concluded that sources of school-week lunches may have an important influence on dietary intake among children. The study also assessed emotional eating among the children. Evidence indicates that aspects of children's psychological state may determine their food behaviour and quality of nutrition (Aballa 2010). Eating in the absence of hunger, characterized as emotional eating, has been identified in children (Fisher and Birch 2002; Moens and Braet 2007). While many study respondents reported to eating more food when sad, worried, mad (angry), bored, or as a treat, or eating between meals even when not hungry, these aspects were not significantly associated with being overweight/obese. Previous studies have reported emotional eating, though infrequent (Van Strien and Oosterveld 2008), eating after experiencing negative emotions (Shapiro et al. 2007), and consumption of greater amount of calories when in a bad mood (Meers 2010). Lastly, our study assessed the consumption of different types of snacks while viewing the television. Television viewing provides a context that encourages frequent snacking or overeating and has been associated with the occurrence of overweight and obesity (Salmon et al. 2006); however, we found no association with being overweight/obese in our study. Many participants in this study reported eating potato crisps, peanuts, fried foods, cookies and biscuits, ice-cream and fast food while watching television. A similar study in Nairobi reported that the majority of participants ate while watching television either daily or at least 2–3 times in a week, and those that had access to a television had higher consumption of fast foods and sweetened beverages (Kigaru et al. 2015). Various other studies support a link between television viewing and increased consumption of nutrient-poor foods high in added sugars and fats (Wiecha et al. 2006). Caregivers should restrict the amount of time spent watching television especially while snacking.

Strengths and limitations of the study

Self-report dietary intake assessment is difficult with children since they tend to under-report or over-report their usual food intake, and have difficulty in quantifying foods eaten during the day. Under-reporting and over-reporting could bias the associations between diet and BMI toward the null. Consequently, the findings discussed here should be interpreted with these limitations in mind also considering that self-administered questionnaire among children could also have affected the accuracy of the data collected. We also note that the parental role including the mother's education level should be included when assessing dietary behavior of children, which has not been covered in our analysis. However, the strengths of our study include the large and heterogeneous sample across SES, objective measure of weight status, and the fact that levels of overweight and obesity in our sample were comparable to projected population estimates.

Conclusion and recommendations

The main findings of this study show that the diet of this population is mostly healthy and is generally low in energy-dense foods. Also, less healthy diets are observed in children in public schools and those with lower BMI. We recommend further research to investigate the already high and rising prevalence of overweight and obesity among children especially on other diet-related factors such as portion sizes of meals. There is need for public health strategies and interventions targeting the overweight and obese children, particularly those of higher SES. Nutrition policies should target to restrict or control accessibility, affordability and the sale of unhealthy fast foods to children. Parents could also be encouraged and supported to provide breakfast for their children, while families should be sensitized about regulating consumption of meals prepared away from home and snacking while watching television, to promote healthy habits in the lives of children.

Acknowledgments

The authors are thankful to the pupils and families who participated in the ISCOLE-Kenya study. We would like to thank the ISCOLE Coordinating Center staff at the Pennington Biomedical Research Center for data management. We would also like to recognize the Principal Investigators from the 12 participating countries who played a role in developing the ISCOLE research study protocol.

Disclosure statement

The authors declare that they have no conflict of interest.

Funding

ISCOLE was funded by the Coca-Cola Company. The funder had no role in the design and conduct of the study; collection, management, analysis and interpretation of the data; and preparation, review or approval of the manuscript.

ORCID

Lucy-Joy Wachira  <http://orcid.org/0000-0003-2805-5997>

Stella Muthuri  <http://orcid.org/0000-0001-5834-2247>

Sophie Ochola  <http://orcid.org/0000-0003-0726-2428>

Vincent Onyvera  <http://orcid.org/0000-0001-8351-4696>

Mark Tremblay  <http://orcid.org/0000-0002-8307-3568>

Data availability statement

All relevant data are within the paper.

Ethics statement

Written informed consent was obtained from all study participants (parent/guardian and children). The ISCOLE-Kenya study protocol was reviewed and approved by Kenyatta University Ethics Review Committee (KU/R/COMM/51/15 -PKU005/104).

References

- Aballa LA *Prevalence and risk factors for obesity among school aged children in Nairobi province, Kenya* (Doctoral dissertation, Kenyatta University). 2010.
- Asfaw A. 2006 Sep 1. The effects of obesity on doctor-diagnosed chronic diseases in Africa: empirical results from Senegal and South Africa. *J Public Health Policy*. 27 (3):250–264. doi:10.1057/palgrave.jphp.3200089.
- Ayala GX, Rogers M, Arredondo EM, Campbell NR, Baquero B, Duerksen SC, Elder JP. 2008 May 1. Away-from-home food intake and risk for obesity: examining the influence of context. *Obesity*. 16(5):1002–1008. doi:10.1038/oby.2008.34.
- Bellisle F. 2014. Meals and snacking, diet quality and energy balance. *Physiol Behav*. Jul 1; 134:38–43. doi:10.1016/j.physbeh.2014.03.010.
- Bezerra IN, Curioni C, Sichieri R. 2012 Feb 1. Association between eating out of home and body weight. *Nutr Rev*. 70(2):65–79. doi:10.1111/j.1753-4887.2011.00459.x.
- Bleich SN, Wang YC, Wang Y, Gortmaker SL. 2008. Increasing consumption of sugar-sweetened beverages among US adults: 1988–1994 to 1999–2004. *Am J Clin Nutr*. 89(1): 372–381.
- Bowen L, Taylor AE, Sullivan R, Ebrahim S, Kinra S, Krishna KR, Kulkarni B, Ben-Shlomo Y, Ekelund U, Wells JC, et al. 2015 Mar 24. Associations between diet, physical activity and body fat distribution: a cross sectional study in an

- Indian population. *BMC Public Health*. 15(1):281. doi10.1186/s12889-015-1550-7.
- CDC. (2009). U.S. youth risk behavior surveillance system. accessed 2012 Aug 11 <http://www.cdc.gov/HealthyYouth/yrbs>
- Currie C, editor. 2008. Inequalities in young people's health: HBSC international report from the 2005/2006 Survey (No.5). Geneva: World Health Organization.
- Currie C, Gabhainn SN, Godeau E, Roberts C, Smith R, Currie D, Pickett W, Richter M, Morgan A, Barnekow V. Eds. 2008. Inequalities in children's health: HBSC international report from the 2005/2006 Survey. Geneva: World Health Organization.
- Daniels SR, Arnett DK, Eckel RH, Gidding SS, Hayman LL, Kumanyika S, Robinson TN, Scott BJ, Jeor SS, Williams CL. 2005 Apr 19. Overweight in children and adolescents. *Circulation*. 111(15):1999–2012. doi10.1161/01.CIR.0000161369.71722.10.
- Davis MM, Gance-Cleveland B, Hassink S, Johnson R, Paradis G, Resnicow K. 2007 Dec 1. Recommendations for prevention of childhood obesity. *Pediatrics*. 120 (Supplement 4):S229–53. doi10.1542/peds.2007-2329E.
- Dehghan M, Akhtar-Danesh N, Merchant AT. 2005 Sep 2. Childhood obesity, prevalence and prevention. *Nutr J*. 4(1):24. doi10.1186/1475-2891-4-24.
- Drewnowski A, Darmon N. 2005 Jul 1. The economics of obesity: dietary energy density and energy cost. *Am J Clin Nutr*. 82(1):265S–73S. doi10.1093/ajcn/82.1.265S.
- Ello-Martin JA, Ledikwe JH, Rolls BJ. 2005 Jul 1. The influence of food portion size and energy density on energy intake: implications for weight management-. *Am J Clin Nutr*. 82(1):236S–41S. doi10.1093/ajcn/82.1.236S.
- Field AE, Austin SB, Gillman MW, Rosner B, Rockett HR, Colditz GA. 2004 Oct 1. Snack food intake does not predict weight change among children and adolescents. *Int J Obes*. 28(10):1210–1216. doi10.1038/sj.ijo.0802762.
- Fisher JO, Birch LL. 2002 Jul 1. Eating in the absence of hunger and overweight in girls from 5 to 7 y of age. *Am J Clin Nutr*. 76(1):226–231. doi10.1093/ajcn/76.1.226.
- Gewa CA, Murphy SP, Weiss RE, Neumann CG. 2014. Determining minimum food intake amounts for diet diversity scores to maximize associations with nutrient adequacy: an analysis of schoolchildren's diets in rural Kenya. *Public Health Nutr*. Dec 17(12):2667–2673. 10.1017/S1368980014000469
- Giskes K, Avendaño M, Brug J, Kunst AE. 2010. A systematic review of studies on socioeconomic inequalities in dietary intakes associated with weight gain and overweight/obesity conducted among European adults. *Obesity Rev*. Jun 11 (6):413–429. 10.1111/j.1467-789X.2009.00658.x
- Grossman M, Tekin E, Wada R. 2012 Dec 21. Fast-food restaurant advertising on television and its influence on youth body composition (No. w18640). National Bureau Economic Res.
- Hartline-Grafton HL, Rose D, Johnson CC, Rice JC, Webber LS. 2009 Dec 1. Energy density of foods, but not beverages, is positively associated with body mass index in adult women. *Eur J Clin Nutr*. 63(12):1411–1418. doi10.1038/ejcn.2009.102.
- Hawkes C, Harris J, Gillespie S. 2017. Urbanization and the nutrition transition. In *Global Food Policy Report*, (4): 34-41.
- Heyward V. 2006. *Advanced fitness assessment and exercise prescription* (5th ed). Champaign IL: Human Kinetics.

- Janssen I, Katzmarzyk PT, Boyce WF, King MA, Pickett W. 2004 Nov 30. Overweight and obesity in Canadian adolescents and their associations with dietary habits and physical activity patterns. *J Adolescent Health*. 35(5):360–367. doi10.1016/S1054-139X(04)00058-8.
- Jones AC, Hammond D, Reid JL, Leatherdale ST. 2015 Aug 17. Where should we eat? Lunch source and dietary measures among youth during the school week. *Can J Diet Pract Res*. 76(4):157–165. doi10.3148/cjdpr-2015-019.
- Katzmarzyk PT, Barreira TV, Broyles ST, Champagne CM, Chaput JP, Fogelholm M, Hu G, Johnson WD, Kuriyan R, Kurpad A, et al. 2013 Sep 30. The international study of childhood obesity, lifestyle and the environment (ISCOLE): design and methods. *BMC Public Health*. 13(1):900. doi10.1186/1471-2458-13-900.
- Kigaru DM, Loechl C, Moleah T, Macharia-Mutie CW, Ndungu ZW. 2015 Dec 29. Nutrition knowledge, attitude and practices among urban primary school children in Nairobi City, Kenya: a KAP study. *BMC Nutrition*. 1(1):44. doi10.1186/s40795-015-0040-8.
- Kimani-Murage EW, Muthuri SK, Oti SO, Mutua MK, van de Vijver S, Kyobutungi C. 2015 Jun 22. Evidence of a double burden of malnutrition in urban poor settings in Nairobi, Kenya. *PloS One*. 10(6):e0129943.
- Kimenju SC, Qaim M. 2016 Jun 1. The nutrition transition and indicators of child malnutrition. *Food Sec*. 8(3):571–583. doi10.1007/s12571-016-0566-x.
- Kruger R, Kruger HS, Macintyre UE. 2006 May 1. The determinants of overweight and obesity among 10-to 15-year-old schoolchildren in the North West Province, South Africa—the THUSA BANA study. *Public Health Nutr*. 9(3):351–358. doi10.1079/PHN2006849.
- Ledikwe JH, Blanck HM, Khan LK, Serdula MK, Seymour JD, Tohill BC, Rolls BJ. 2006 Jun 1. Dietary energy density is associated with energy intake and weight status in US adults. *Am J Clin Nutr*. 83(6):1362–1368. doi10.1093/ajcn/83.6.1362.
- Meers M *Emotional Eating in Preschoolers* (Doctoral dissertation, Bowling Green State University). 2010.
- Moens E, Braet C. 2007 Jun 30. Predictors of disinhibited eating in children with and without overweight. *Behav Res Ther*. 45(6):1357–1368. doi10.1016/j.brat.2006.10.001.
- Moreno LA, Sarria A, Lázaro A, Bueno M. 2000 Nov 1. Dietary fat intake and body mass index in Spanish children. *Am J Clin Nutr*. 72(5):1399s–403s. doi10.1093/ajcn/72.5.1399s.
- Müller O, Krawinkel M. 2005 Aug 2. Malnutrition and health in developing countries. *Can Med Assoc J*. 173(3):279–286. doi10.1503/cmaj.050342.
- Muthuri SK, Francis CE, Wachira LJ, LeBlanc AG, Sampson M, Onywera VO, Tremblay MS. 2014 Mar 27. Evidence of an overweight/obesity transition among school-aged children and youth in Sub-Saharan Africa: a systematic review. *PLoS One*. 9(3):e92846.
- Muthuri SK, Wachira LJM, Onywera VO, Tremblay MS. 2014a. Comparative study of physical activity patterns among school children in Kenya and Canada: results from the ISCOLE Project. *Afr J Physical Health Education Recreation Dance*. 20(2):765–779.
- Muthuri SK, Wachira LJM, Onywera VO, Tremblay MS. 2014b May 24. Correlates of objectively measured overweight/obesity and physical activity in Kenyan school children: results from ISCOLE-Kenya. *BMC Public Health*. 14(1):43. doi10.1186/1471-2458-14-436.

- National Center for Health Statistics: National Health and Nutrition Examination Survey. 2012. accessed 2019 March 17. www.cdc.gov/nchs/nhanes.htm
- NCPD. 2013. Kenya Population Situation Analysis. Government of Kenya and UNFPA, Nairobi, Kenya. https://www.unfpa.org/sites/default/files/admin-resource/FINALPSAREPORT_0.pdf.
- Ochola S, Masibo PK. 2014. Dietary intake of schoolchildren and adolescents in developing countries. *Ann Nutr Metab.* 64(Suppl. 2):24–40. doi:10.1159/000365125.
- Onywera VO, Adamo KB, Sheel AW, Waudo JN, Boit MK, Tremblay MS. 2012 May 9. Emerging evidence of the physical activity transition in Kenya. *J Phys Act Health.* 9(4): 554–562
- Patrick H, Nicklas TA. 2005 Apr 1. A review of family and social determinants of children's eating patterns and diet quality. *J Am Coll Nutr.* 24(2):83–92. doi:10.1080/07315724.2005.10719448.
- Phillips SM, Bandini LG, Naumova EN, Cyr H, Colclough S, Dietz WH, Must A. 2004 Mar 1. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. *Obes Res.* 12(3):461–472. doi:10.1038/oby.2004.52.
- Rampersaud GC, Pereira MA, Girard BL, Adams J, Metz J. 2005 May 31. Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *J Am Diet Assoc.* 105(5):743–760. doi:10.1016/j.jada.2005.02.007.
- Robinson TN. 2001 Aug 1. Television viewing and childhood obesity. *Pediatr Clin North Am.* 48(4):1017–1025. doi:10.1016/S0031-3955(05)70354-0.
- Salmon J, Campbell KJ, Crawford DA. 2006 Jan 16. Television viewing habits associated with obesity risk factors: a survey of Melbourne schoolchildren. *Med J Aust.* 184(2):64. doi:10.5694/j.1326-5377.2006.tb00117.x.
- San Juan PF. 2006 May 1. Dietary habits and nutritional status of school aged children in Spain. *Nutr Hosp.* 21(3):374–378.
- Shapiro JR, Woolson SL, Hamer RM, Kalarchian MA, Marcus MD, Bulik C. 2007 Jan 1. Evaluating binge eating disorder in children: development of the children's binge eating disorder scale (C-BEDS). *Int J Eating Disorders.* 40(1):82–89. doi:10.1002/eat.20318.
- Striegel-Moore RH, Morrison JA, Schreiber G, Schumann BC, Crawford PB, Obarzanek E. 1999. Emotion-induced eating and sucrose intake in children: the NHLBI growth and health study. *Int J Eat Disord.* 25(4):389–398. doi:10.1002/(SICI)1098-108X(199905)25:4<389::AID-EAT3>3.0.CO;2-4.
- Van Ansem WJ, Schrijvers CT, Rodenburg G, van de Mheen D. 2014 Dec 1. Maternal educational level and children's healthy eating behaviour: role of the home food environment (cross-sectional results from the INPACT study). *Int J Behavioral Nutr Physical Activity.* 11(1):113. doi:10.1186/s12966-014-0113-0.
- Van den Bulck J, Van Mierlo J. 2004 Oct 1. Energy intake associated with television viewing in adolescents, a cross sectional study. *Appetite.* 43(2):181–184. doi:10.1016/j.appet.2004.04.007.
- Van Strien T, Oosterveld P. 2008 Jan 1. The children's DEBQ for assessment of restrained, emotional, and external eating in 7-to 12-year-old children. *Intl J Eating Disorders.* 41(1):72–81. doi:10.1002/eat.20424.
- Wiecha JL, Peterson KE, Ludwig DS, Kim J, Sobol A, Gortmaker SL. 2006 Apr 1. When children eat what they watch: impact of television viewing on dietary intake in youth. *Arch Pediatr Adolesc Med.* 160(4):436–442. doi:10.1001/archpedi.160.4.436.

- World Bank. 2012. World Development Indicators 2012. World Development Indicators. Washington (DC): © World Bank. <https://openknowledge.worldbank.org/handle/10986/6014> License:CC BY 3.0IGO .
- World Health Organization. 2004a. Resolution WHA57.17. global strategy on diet, physical activity and health. In: fifty seventh World Health Assembly, Geneva, 17–22 Resolutions and decisions, annexes. Geneva (Switzerland):WHO Press.
- World Health Organization. 2004b. Obesity and overweight: WHO global strategy on diet, physical activity and health. Geneva (Switzerland):WHO Press.
- World Health Organization. 2010. Global recommendations on physical activity for health. Geneva (Switzerland):WHO Press.
- World Health Organization. 2013. Obesity and overweight: WHO child growth standards: growth reference data for 5-19 years. Geneva (Switzerland):WHO Press.
- Ziraba AK, Fotso JC, Ochako R. 2009 Dec 1. Overweight and obesity in urban Africa: A problem of the rich or the poor? BMC Public Health. 9(1):465. doi10.1186/1471-2458-9-465.