

# Childhood Obesity and Overweight in Uganda: Evidence From the Uganda Demographic Health Survey 2016

Quraish Sserwanja (✉ [qura661@gmail.com](mailto:qura661@gmail.com))

GOAL

Linet M. Mutisya

Swedish Organization for Global Health

Emmanuel Olal

Yotkom Medical Centre

Milton W. Musaba

Busitema University

David Mukunya

Busitema University

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## Research Article

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# Abstract

**Background:** Childhood obesity is an emerging public health problem. Although previously a problem of high-income countries, low- and middle-income countries are now registering higher proportions of overweight and obese children. Studies in Africa have mainly focused on undernutrition among children. This paper explores the factors associated with childhood obesity and overweight in Uganda using data from the Uganda Demographic and Health Survey (UDHS) of 2016.

**Methods:** We used Uganda Demographic and Health Survey (UDHS) 2016 data of 4,338 children less than five years. Multistage stratified sampling was used to select study participants and data were collected using validated questionnaires. We used multivariable logistic regression to determine factors associated with obesity and overweight among children under the age of five in Uganda.

**Results:** The prevalence of overweight and obesity was 5.0% (217/4338) (95% CI: 4.3–5.6) with overweight at 3.9% (168/4338: 95% CI: 3.2–4.3) and obesity at 1.1% (49/4338: 95% CI: 0.8–1.5). Boys were more likely to be overweight or obese (adjusted odds ratio: aOR = 2.00; 95% CI 1.42–2.82) compared to girls. Furthermore, children from the Western region (aOR = 1.61; 95% CI 1.07–2.44) compared to those from the North, children below the age of 49 months and those with mothers who were overweight or obese (aOR = 3.36; 95% CI 1.53–7.34) were more likely to be obese or overweight compared to their counterparts who were above 48 months and those with underweight mothers respectively.

**Conclusion:** The present study showed male sex, older age of the children, nutritional status of the mothers and region of residence were associated with overnutrition among under five children in Uganda.

## Background

Childhood obesity and overweight are an emerging public health problem [1] affecting over 38 million children under the age of five globally [1–3]. Children are classified as overweight or obese if their weight-for-height is greater than two or three standard deviations above the World Health Organization (WHO) child growth median [3, 4]. Although childhood obesity was previously a problem of high-income countries, low- and middle-income countries have been registering more cases and this is contributing to the double burden of disease [3, 5].

Obesity arises from a complex interaction between behavioral, metabolic, environmental, and various socioeconomic determinants. These drivers spurn changing food systems, reduced physical activity, and indiscriminate marketing that promotes obesogenic foods [1, 6, 7]. Equally, childhood obesity has been attributed to other risk factors such as high birth weight, maternal obesity, maternal smoking, consanguineous marriage, and poor breastfeeding [4, 8–10]. Similarly, overweight and obesity are more prevalent among children attending affluent primary schools compared to those in rural public schools [11, 12]. This could, in part be explained by limited physical activity, excessive sugar consumption and uncensored food adverts that promote obesogenic diets for children in such schools [7, 9, 13].

Tackling childhood obesity is critical because of its myriad health and socioeconomic consequences. Childhood obesity is linked to premature mortality and adverse mental health in both the short and long-term. Furthermore, overweight and obese children suffer higher risks of early chronic diseases onset, for example, diabetes, dyslipidemias, cardiovascular illnesses and some cancers [1, 14, 15]. Likewise, they are reported to have low educational attainment because of poor psychosocial wellbeing [1, 4]. Childhood obesity also results in higher costs to health systems, and greater financial burden to households [1].

Studies in Africa have primarily focused on the study of undernutrition and not overnutrition among children. The few studies exploring childhood overweight and obesity have mostly come from Nigeria and South Africa, and only a few from other countries in sub-Saharan Africa [12]. In Uganda, demographic health surveys (DHS) reported a prevalence of 3–4% between 2011 and 2016 [16, 17]. Nevertheless, the distribution and determinants of obesity were not articulated. Understanding the distribution and determinants of obesity is vital in designing public health messages and interventions [11, 14]. This paper aimed at exploring the factors associated with childhood obesity and overweight in Uganda using data from the Uganda Demographic and Health Survey (UDHS) of 2016.

## Methods

### Study design and participants

UDHS 2016 was a nationally representative cross-sectional study conducted using validated questionnaires. UDHS is a periodical survey that is carried out every five years as part of the MEASURE DHS global survey and collects information on demographic, health and nutrition indicators. The survey was conducted between June and December 2016 using stratified two-stage cluster sampling design that resulted in the random selection of a representative sample of 20,880 households [18, 19]. The households were randomly selected in two stages: clusters (or enumeration areas) were drawn in the first stage and then a count within each cluster led to a list of households from which was conducted a systematic sampling with equal probability [18]. A detailed explanation of the sampling process is available in the UDHS 2016 report [18]. A systematic random draw was conducted amongst the selected households to choose households whose women/ mothers' and children's anthropometric measurements (weight and height) were taken. Anthropometric measurements were done on a subsample of about one-third of households [18]. Weight was taken with an electronic SECA 878 flat scale while a Shorr Board® measuring board was used for height [18]. Children less than 24 months were measured lying down.

Our secondary analysis excluded children whose BMI z-score were missing or was recorded as “Flagged cases”. In the children's dataset, a final weighted sample of 4338 was analyzed after excluding flagged cases and those with missing values. Written permission to access the whole UDHS database was obtained through DHS program website at the address <https://dhsprogram.com/>

### Variables

#### Outcome variables

The BMI z-scores based on WHO 2006 reference population were used to assess over nutrition (obesity and overweight) [20]. The outcome over nutrition (coded as 1) combined both overweight and obesity. Children whose BMI z score was over two were considered as overweight and those with a BMI z score greater than three were considered as obese [20].

## Independent variables

Independent variables were categorized into children, parents' and household characteristics that were chosen basing on previous studies [20-22] and availability in the UDHS data base.

**Parental characteristics.** Maternal nutritional status (underweight, normal and over nutrition), mother's level of education (no education, primary, secondary and tertiary), father's level of education (no education, primary, secondary and tertiary), mother's age (15-24, 25-34, 35-49), mother's marital status (married and not married), mother's working status (working and not working).

**Household characteristics.** Wealth index of household (categorized into quintiles: richest, richer, middle poorer and poorest), type of residence (urban and rural), number of household members (less than 5 and 5 and above), sex of household head (female and male) and region (North, East, West and Central).

**Children's characteristics.** Age of the child in months (0-12, 13-24, 24-36, 37-48, 49-59), sex of the child (male and female) and stunting status (stunted and not stunted).

## Statistical analysis

We used the SPSS analytic software version 25.0 Complex Samples package for this analysis. Weighted data was used to account for the unequal probability sampling in different strata. Frequency distributions were used to describe the background characteristics of the children. Pearson's chi-squared tests were used to investigate the significant differences between childhood obesity and overweight and the explanatory variables. Bivariable logistic regression was also conducted and we present crude odds ratio (COR), 95% confidence interval (CI) and p-values. Independent variables found significant at p-value less than 0.25 in the bivariable analysis were included in the multivariable model. Adjusted odds ratios (AOR), 95% Confidence Intervals (CI) and p-values were calculated with statistical significance level set at p-value < 0.05. All variables in the model were assessed for collinearity, which was considered present if the variables had a variance inflation factor (VIF) greater than 10. However, none of the factors had a VIF above 3. Sensitivity analysis was done comparing children who were obese or overweight with those who were normal after excluding those who were thin.

## Results

The mean age of children was 28.34 with a standard deviation (sd) of 17.20 months while that of the mothers was 28.80 (sd 6.83). Boys made up 52% of the study participants, and the majority of children were between 13–24 months (28%), resided in rural areas (77.8%) and belonged to households with size of 5 and above members (67.2%). The mean weight, height, number of household members and BMI z-

score were 11.5 kilograms (sd 3.57), 83.5 centimeters (sd 14.0), 6 members (sd 2.7) and 0.20 (sd 1.19) respectively. Of the 4,338 children, 5.0% (217/4338) (95% CI: 4.3–5.6) were overweight or obese (overweight 3.9% (95% CI: 3.2–4.3) and obesity 1.1% (95% CI: 0.8–1.5). More detailed characteristics of study participants are shown in Table 1.

Table 1  
Background characteristics of under 5 children  
years as per the 2016 UDHS

<b>Characteristics</b>	<b>N = 4338</b>	<b>%</b>
<b>Mother's BMI<sup>a</sup></b>		
Underweight	349	8.0
Normal	2948	68.0
Overweight	1034	23.8
<b>Residence</b>		
Urban	883	20.4
Rural	3455	79.6
<b>Region</b>		
North	871	20.1
West	1128	26.0
East	1225	28.2
Central	1115	25.7
<b>Household size</b>		
5 and above	3091	71.2
Less than 5	1247	28.8
<b>Mother's working status</b>		
Not working	918	21.2
Working	3420	78.8
<b>Mother's marital status</b>		
Not Married	589	13.6
Married	3749	86.4
<b>Mother's education Level</b>		
No Education	488	11.2
Primary Education	2673	61.6
Secondary Education	901	20.8
Tertiary	277	6.4

<b>Characteristics</b>	<b>N = 4338</b>	<b>%</b>
<b>Wealth Index</b>		
Poorest	986	22.7
Poorer	891	20.5
Middle	854	19.7
Richer	769	17.7
Richest	839	19.3
<b>Age Mum</b>		
15–24	1372	31.6
25–34	1982	45.7
35–49	984	22.7
<b>Age of child</b>		
Less than 12	1017	23.4
13–24	920	21.2
25–36	859	19.8
37–48	842	19.4
49–59	700	16.1
<b>Child's stunting status</b>		
Yes	1214	28.0
No	3124	72.0
<b>Head Household</b>		
Female	1115	25.7
Male	3223	74.3
<b>Sex of child</b>		
Female	2148	49.5

<b>Characteristics</b>	<b>N = 4338</b>	<b>%</b>
Male	2190	50.5
		55
		5
		66
		3f
		444
		888
<b>Fathers' education<sup>b</sup></b>	148	
<b>N</b>		
No education	266	6.1
Primary	1309	
Primary	1981	45.7
	78	
	66	
	66	
	66	
Secondary	972	22.4
Tertiary	422	9.7
<b>Child nutritional status</b>		
Obesity	49	1.1
Overweight	168	3.9
Not overweight	4121	95.0

<sup>a</sup>Missing 7, <sup>b</sup>missing 697

## Factors Associated With Childhood Obesity Or Overweight

Results from multivariable logistic regression (Table 2) showed that mother's nutritional status, sex of the child, region, and child's age were associated with childhood obesity and overweight. Boys were more likely to be over nourished (aOR = 2.00; 95% CI 1.42 to 2.82) compared to girls, as well as children from

the Western region (aOR = 1.61; 95% CI 1.07 to 2.44) compared to those that are from the North. Children who were older (above 12 months) and those with mothers who were overweight or obese were more likely to have obesity or overweight compared to those with underweight mothers and their counterparts who were less than 12 months, respectively.

Table 2  
Predictors of obesity and overweight among under 5 children in Uganda

<b>Characteristics</b>	<b>Obesity and overweight</b> N = 217 N (%)	<b>P-value</b>	<b>Crude model</b> COR (95%CI)	<b>P-value</b>	<b>Adjusted Model</b> AOR (95%CI)
<b>Mother's BMI</b>		0.016		0.019	
Underweight	7 (3.2)		1		1
Normal	150 (68.8)		<b>2.59 (1.21–5.55)*</b>		<b>2.50 (1.15–5.43)*</b>
Overweight	61 (28.0)		<b>3.01 (1.39–6.50)*</b>		<b>3.36 (1.53–7.34)*</b>
<b>Sex of child</b>		< 0.001		< 0.001	
Female	72 (33.0)		1		1
Male	146 (67.0)		<b>2.07 (1.47–2.90)*</b>		<b>2.00 (1.42–2.82)*</b>
<b>Region</b>		0.001		0.004	
North	36 (16.7)		1		1
West	81 (37.5)		<b>1.81 (1.21–2.69)*</b>		<b>1.61 (1.07–2.44)*</b>
East	56 (25.9)		1.12 (0.71–1.76)		1.08 (0.68–1.71)
Central	43 (19.9)		0.94 (0.57–1.55)		0.87 (0.51–1.46)
<b>Residence</b>		0.158		0.218	
Rural	181 (83.4)		1		1
Urban	36 (16.6)		0.77 (0.51–1.38)		0.81 (0.54–1.22)
<b>Stunting status</b>		0.005		0.012	
No	138 (63.6)		1		1
Yes	79 (36.4)		<b>1.51 (1.10–2.08)*</b>		1.39 (0.97–2.00)

\*Significant at p-value < 0.05

<b>Characteristics</b>	<b>Obesity and overweight</b> N = 217 N (%)	<b>P-value</b>	<b>Crude model</b> COR (95%CI)	<b>P-value</b>	<b>Adjusted Model</b> AOR (95%CI)
<b>Working status</b>		0.121		0.152	
Not working	37 (17.0)		1		1
Working	181 (83.0)		1.34 (0.90–2.00)		1.35 (0.90–2.01)
<b>Age of the child</b>		< 0.001		< 0.001	
49–59	12 (5.5)		1		1
37–48	30 (13.8)		2.07 (1.04–4.15)*		2.15 (1.07–4.30)*
25–36	54 (24.9)		3.80 (1.96–7.37)*		3.76 (1.95–7.26)*
13–24	64 (29.5)		4.30 (2.30–8.04)*		4.27 (2.29–7.98)*
Less than 12	57 (26.3)		3.42 (1.80–6.48)*		3.77 (2.01–7.08)*
<b>Father's Education</b>		0.195		0.292	
No Education	8 (4.4)		1		
Primary Education	111 (61.3)		1.82 (0.91–3.66)		
Secondary Education	44 (24.3)		1.44 (0.71–2.94)		
Tertiary	18 (9.9)		1.33 (0.55–3.24)		
<b>Wealth Index</b>		0.295		0.410	
Poorest	38 (17.6)		1		
Poorer	50 (23.1)		1.48 (0.95–2.32)		
Middle	46 (21.3)		1.42 (0.88–2.29)		

\*Significant at p-value < 0.05

Characteristics	Obesity and overweight N = 217 N (%)	P-value	Crude model COR (95%CI)	P-value	Adjusted Model AOR (95%CI)
Richer	44 (20.4)		1.50 (0.90–2.50)		
Richest	38 (17.6)		1.18 (0.69–2.03)		
<b>Age Mum</b>		0.205		0.265	
15–24	78 (35.9)		1		
25–34	99 (45.6)		0.87 (0.60–1.26)		
35–49	40 (18.4)		0.70 (0.45–1.08)		
<b>Household size</b>		0.243		0.308	
5 and above	147 (67.7)		1		
Less than 5	70 (32.3)		1.18 (0.86–1.64)		
<b>Household Head</b>		0.074		0.127	
Female	67 (30.9)		1		1
Male	150 (69.1)		0.76 (0.53–1.08)		0.74 (0.52–1.05)
<b>Mother's marital status</b>		0.356		0.496	
Not married	34 (15.7)		1		
Married	183 (84.3)	55 5 66 3f 444 888	0.84 (0.51–1.38)		

\*Significant at p-value < 0.05

Characteristics	Obesity and overweight N = 217 N (%)	P-value	Crude model COR (95%CI)	P-value	Adjusted Model AOR (95%CI)
<b>Mothers' education level</b>	148	0.355		0.346	
<b>N</b>					
No education	17 (7.8)		1		
Primary	1309				
Primary	136 (62.7)		1.51 (0.90–2.53)		
	66				
	66				
	66				
Secondary	47 (21.7)		1.54 (0.84–2.84)		
Tertiary	17 (7.8)		1.89 (0.85–4.19)		
*Significant at p-value < 0.05					

## Sensitivity Analysis

After excluding children who were thin, and remaining with only children who were obese, overweight and had normal BMI z-score, the prevalence of over-nutrition was 5.2% (95% CI: 4.4–5.7) with overweight at 4.0% (95% CI: 3.3–4.5) and obesity 1.2% (95% CI: 0.9–1.5). Similar to the original analysis, age and sex of the child, region and nutritional status of the mother remained positively associated with childhood obesity and overweight. No major significant differences were observed except a slight increase in the strength of association with children less than 12 months (aOR 4.21; 95% CI 2.23–7.94) versus (aOR 3.77; 95% CI:2.01–7.08) compared to those aged 49–59 months in the sensitivity and original analysis respectively.

## Discussion

This study provides evidence on the factors associated with childhood obesity and overweight in Uganda from the recent UDHS of 2016. We revealed that, 5% (217/4338, 95% CI: 4.3–5.6) of the children were either overweight or obese.

In this study, childhood overnutrition was associated with maternal overnutrition. This is in agreement with findings, a similar study in Nepal which showed that the risk of childhood obesity is increased in cases of maternal overweight and obesity both pre and during pregnancy which predisposes them to obesity in later life [23]. Various plausible mechanism can explain this relationship. Firstly, genetic factors and obesity-promoting environment enhances the effect of genes related to body fatness. For example, changing environmental conditions that would allow a pregnant woman to have easier access to foods that are high energy dense, would make changes in the expression of genes related to body fatness [24]. Therefore, consumption of these foods is associated with maternal overnutrition which explains its role in predisposing newborns to high birthweight and obesity [24]. Furthermore, sedentary behaviors coupled with low levels of physical activity and poor food choices which are generally energy dense increases their odds being obese [25, 26].

It is implicit that the prevalence of childhood overweight and obesity is relatively high in urban areas and households with poor socio economic status compared to those in rural areas [25, 27]. A review that compared overweight prevalence in low and middle income countries did not show significant differences between the richest and the poorest quintiles [23], agreeing with our findings. Overweight and obesity was not associated with wealth index and place of residence. This may be partly explained by the economic growth resulting from rapid nutrition transition ensuing in rural and urban areas across difference socioeconomic groups often characterized by a dramatic shift towards consuming inexpensive foods that are high in fat and sugar [28]. Further, the wealth index as a measure of socioeconomic status expresses some methodological weakness that partly explain a weak association [29].

This study demonstrated that the male sex was significantly associated with childhood overweight or obesity. A study by Beatrice J et al. [30] and another by Dubois et al. [31] were consistent with our finding. Biological influences may partly explain the observed association as body composition between sexes start early in the fetal and postnatal periods [32, 33]. Girls have been shown to have less third trimester fetal growth compared to boys [33]. After birth, girls tend to have greater fat mass and less fat-free mass, which is linked with less energy intake and less calorie needs for girls compared to boys [32, 34, 35]. Furthermore, girls have more circulating leptin, a hormone that suppresses appetite and promotes energy utilization [32, 36]. Gender-based stereotypes that are practiced by some parents such as a feminine identity being characterized by eating less portions may partly explain the observed finding [32]. Evidence has shown that some parents tend to be more concerned about girls' weight status than boys' hence the boys are usually given more food [32, 37]. Gender behavioral differences in sleeping, physical activity and television-watching have been observed with girls being shown to sleep less and engage in less physical activity and watch television more than boys [32, 38, 39]. These behaviors have been significantly associated with overweight and obesity [39, 40].

In this study the age of a child was associated with overweight and obesity. A study conducted in Cameroon found a similar association [20]. Children aged 49 months and below had increased odds of having over-nutrition compared to the older counterparts aged between 49 and 59 months. This association was stronger among the younger children less than 37 months and weakened in older

children between 37 and 48 months. Toddlers and preschoolers' total diet and activity level play an important role in determining a child's weight [41]. As such, older children are more active compared to the younger ones, hence the more energy they expend [41]. Other plausible mechanism that explains this association include environmental and behavioral factors such as socio-economic conditions, consumption of high calorie and fast foods and lifestyle changes [20, 41].

Children from Western Uganda were more likely to have over nutrition compared to those from the Northern region. Evidence shows that the Western region has the second highest GDP per capita, with the Northern region, having some of the poorest districts in Uganda [42, 43]. Additionally, the Western region receives higher amounts of rainfall and produce more crop yields which have led to a higher level of food security [43]. All these factors lead to increased food availability and hence over-nutrition. Northern Uganda has some of the poorest and most food insecure sub-regions which could partly be attributed to the fact that the region experienced a long civil war which greatly affected the economy and agricultural production [19]. Furthermore, most people in the Northern part of Uganda are pastoral communities with some being nomadic which may negatively affect the production and consumption of the foods from agricultural origin (crops) as they mostly focus on mainly pastoral activities [19]. The increased poverty and decreased agricultural production led to decreased food availability and access to food in Northern Uganda.

## **Strengths**

We used a nationally representative sample and weighed the data for analysis and therefore our results are generalized to all Ugandan children below five years. Secondly, we used data with a large sample size which was collected, entered and cleaned by a team of trained and highly experienced scientists hence limiting mistakes in the data set.

## **Limitations**

Lack of other measures of overweight and obesity e.g., skin fold measurements, data on chronic disease biomarkers e.g. lipid profile, measure of physical activity, analysis of nutritional characteristics such as dietary habits which would allow assess the development of overweight and obesity. The cross-sectional design is limited by lack of temporality hence causality inferences cannot be made.

## **Conclusion**

This study established the determinants of overweight and obesity as maternal nutritional status (BMI), region of residence, sex, and age of the children. children from western Uganda were more likely to be overweight and obese compared to those from northern Uganda.

Strategies to improve the nutritional status in children should be focused across all socioeconomic groups. Advocating for a sustained political commitment and the collaboration of many private and

public stakeholders is paramount to curb childhood obesity epidemic. Preventive interventions need to be strengthened especially in Western Uganda and among boys, children aged below 49 months and those whose mothers have a high BMI. Initiatives like lifestyle modifications and proper nutrition should be encouraged to reduce overweight and obesity in mothers and promoting measures such as surveillance of weight gain during antenatal consultation and nutritional follow-up of boys. Further studies including nutritional characteristics are needed to understand the association with child age and sex and will help in refining preventive strategies against childhood overnutrition in Uganda.

There is need to address socio-economic (contextual) factors mainly poverty and regional inequalities. There is also need for further studies to explain why stunting is highest among women with the highest wealth index.

## **Abbreviations**

**EA** Enumeration area

**AOR** Adjusted Odds Ratio

**CI** Confidence Interval

**COR** Crude Odds Ratio

**DHS** Demographic Health Survey

**UDHS** Uganda Demographic Health Survey

**OR** Odds Ratio

**SD** Standard Deviation

**WHO** World Health Organization

**BMI** Body Mass Index

**SPSS** Statistical Package for Social Science

**USAID** United States Agency for International Development.

**Kg** Kilogram

**Cm** Centimeter

## **Declarations**

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No funding was obtained for this study.

## **Availability of data and materials**

Access to the DHS data sets is openly available upon requests made to MEASURE DHS on their website (URL: <https://www.dhsprogram.com/data/available-datasets.cfm>).

## **Authors' contributions**

QS conceived the idea, drafted the manuscript, performed analysis, and interpreted the results. LMM participated in drafting and reviewing the first version of the manuscript, interpretation of results and drafted the subsequent versions of the manuscript. DM, EO and MWM participated in the design of the study and helped in results interpretation and writing. All authors read and approved the final manuscript.

## **Ethics approval and consent to participate**

High international ethical standards are ensured for MEASURE DHS surveys as ethical approval from the country is obtained from a national ethical review board and local authorities before implementing the survey [44, 45] and well-informed verbal consent is sought from the respondents prior to data collection [45, 46]. This data set was obtained from the MEASURE DHS website (URL: <https://www.dhsprogram.com/data/available-datasets.cfm>) after getting their permission and no formal ethical clearance was obtained since we conducted secondary analysis of publicly available data.

## **Consent for publication**

Not applicable.

## **Competing interests**

All authors declare that they have no competing interests.

## **Author details**

<sup>1</sup> QS is currently a project coordinator at GOAL, Khartoum, Sudan.

<sup>2</sup>LMM is coordinating a maternal and child health project at Swedish Organization for Global Health, Mayuge, Uganda.

<sup>3</sup>OE is a Clinical Supervisor and Senior Medical Officer at Yotkom Medical Centre, Kitgum, Uganda and currently a master of public health student.

<sup>4</sup>DM is currently a lecturer at the public health department, Busitema University, Tororo, Uganda.

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