Prevalence of Overweight/Obesity and Associated Factors Among Under-Five Children in Ethiopia: Evidence From the 2019 Ethiopia Mini Demographic and Health Survey (Emdhs); A Multilevel Analysis

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Posted Date: August 19th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-724918/v1

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Prevalence of overweight/obesity and associated factors among under-five children in Ethiopia: Evidence from the 2019 Ethiopia Mini Demographic and Health Survey (EMDHS); A Multilevel Analysis

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Abstract

Background: Childhood overweight and obesity are emerging public health challenges of the 21st century. There was a 24% increase in the number of overweight children under the age of five years in low-income countries. Despite the significant risk of childhood overweight/obesity for non-communicable diseases, premature death, disability, and reproductive disorders in their adult life, little attention has been given. Therefore, we aimed to assess the prevalence of overweight/obesity and associated factors among under-five children.

Methods: This study was conducted using data from a nationally representative sample of the 2019 Ethiopia Mini Demographic and Health Survey (EMDHS). The Mini EDHS was a community-based cross-sectional study that covered all the administrative regions of Ethiopia. The data collection was conducted between March 21, 2019, to June 28, 2019. Both descriptive
and analytic findings were produced using STATA version 14. For associated factors, a
multilevel binary logistic regression model was fitted to account for the hierarchical nature of
the data. Adjusted odds ratio (aOR) with 95% confidence interval (CI) was reported to show
the strength of association and statistical significance.

Results: A total 5,164 under-five children were included in this study. The overall prevalence
of overweight/obesity was 2.14 % (95% CI; 1.74-2.53) (more than two standard deviations
(+2SD) above the median of the reference population) based on the body mass index (BMI) Z-
score. The odds of overweight/obesity was higher among children aged less than 6 months
(aOR= 5.19; 95%CI: 2.98-9.04), 6-24 months (aOR = 1.97; 95%CI: 1.18-3.29), delivered by
caesarean section (aOR = 1.75; 95% CI: 1.84-3.65), living in Addis Ababa city (aOR = 2.16;
95%CI: 1.59-7.81), Oromia region (aOR = 1.93; 95CI: 1.71-5.24), having mothers with the age
40-49 years (aOR = 3.91; 95%CI: 1.90-16.92), uses traditional contraceptive methods (aOR =
2.63; 95%CI: 1.66-10.47), and households headed by male (aOR = 1.71; 95%CI: 1.84-3.48).

Conclusion: This study showed that childhood overweight/obesity is the problem in Ethiopia.
There was an interplay of several factors that affect childhood obesity including child factors,
maternal socio-demography, and healthcare utilization, and geography of residence. Therefore,
strategies to reduce childhood overweight and obesity should consider a multitude of
contributing factors.

Keywords: Under-five children, Overweight/obesity, Prevalence, Ethiopia

Background

According to the world health organization (WHO), overweight and obesity are defined as
abnormal or excessive fat accumulation that can impair health (1). In 2019 and 2020, an
estimated 38.2 and 39 million children under the age of 5 years were overweight or obese,
respectively (1). Although childhood overweight and obesity have been considered the
problems of high-income countries, are now on the rise in low- and middle-income countries.
While these countries continue to deal with the problems of infectious diseases and
undernutrition, childhood overweight and obesity are "double burdens" and the most serious
public health challenges of the twenty-first century. Since 2000, the number of overweight
children under the age of 5 has increased by nearly 24% in Africa (1, 2).

The number of overweight and obese children under the age of five has nearly doubled
from 5.4 million in 1990 to 10.3 million in 2014, in Africa (3). According to 26 Demographic
and Health, Surveys carried out in SSA since 2010, overweight and obesity in the children
within the age group of 0-59 months was reported 6.8% (4). Different studies suggest that
childhood overweight and obesity in sub-Saharan Africa (SSA) is likely to be worsened by the
current transition in nutrition and physical activity that is characterized by increased use of
energy-saving devices, availability of cheap high calorie-dense foods, and limited participation
in physical activity generally (5).

In low-income Sub-Saharan countries including Ethiopia, childhood obesity is not yet
perceived as an emerging health issue and receives little attention. According to the annual
report of UNICEF in 2017, there was an overall increment of the prevalence of overweight
among children from 1.7 to 3.6% in Ethiopia (6). According to 26 Demographic and Health
Surveys carried out in SSA since 2010, it was reported 3% in Ethiopia (4). Although many
studies have been conducted on the undernutrition of under-five children in Ethiopia, few
studies reported that the combined prevalence of childhood obesity and overweight which was
10.7% and 3.4%, 7.3% for obesity and overweight, respectively in Hawassa town, and 13.8%
in Gondar town and the pooled prevalence among children and adolescents in Ethiopia 11.30
(7-9).
Childhood overweight and obesity are linked to more deaths than underweight and are associated with a higher chance of breathing difficulties, increased risk of fractures, hypertension, early markers of cardiovascular disease, insulin resistance, psychological effects, and adulthood obesity, premature death, and disability and resulting in an increased risk of non-communicable diseases and reproductive disorders later in their life(1, 10).

Previous studies have reported many factors that were associated with overweight and obesity in under the age of five children. These are socioeconomic status, maternal education level, marital status, smoking during pregnancy, sex of the child, birth weight and the child’s birth rank, residence, age of the child, body mass index (BMI) of parents, high dietary diversity, consumption of sweet food, time spent in watching television>2hr/day, living in the grass field area, religion (7, 11-13).

Despite the rising of childhood overweight and obesity in Ethiopia, there is a paucity of information with robust statistical analysis. Therefore, this study aimed to assess the prevalence of overweight/obesity and determinants among under-five-aged children by using the current Ethiopia demographic and health survey data (EDHS). Thus, this finding could be input in designing effective preventive strategies to alleviate the rising burden of early childhood overweight/obesity and its consequential morbidity and mortality in children and later adulthood life.

**Methods and Materials**

**Study setting, design, and population**

This study used the 2019 Ethiopian Mini-EDHS data which was collected by the Ethiopian Public Health Institute (E PHI), in partnership with the Central Statistical Agency (CSA) and the Federal Ministry of Health (FMOH). Ethiopia is located in North-eastern Africa between 3° and 15° North latitudes and 33°48′ and East longitudes. The country has nine regional states and two city administrations (Addis Ababa and Diredawa) (13, 14). The survey was conducted
in a nationally representative sample and provided estimates at national and regional levels for rural and urban areas (15).

A community-based cross-sectional study was conducted and data collection was done from March 21, 2019, to June 28, 2019. In this survey, 8,663 households were included and, data were collected from 5,753 children < 60 months, 8,855 women of reproductive age (age 15-49) from and 40,659 household members (15).

A stratified two-stage cluster sampling technique was applied. In the first stage, a total of 305 enumeration areas (EAs) (93 in urban areas and 212 in rural areas) were selected with probability proportional to EA size (based on the 2019 EPHC frame). In the second stage, a fixed number of 30 households per cluster were selected with an equal probability systematic selection from the newly created household listing. From all selected households, height and weight measurements were collected from children age 0-59 months, and women age 15-49 were interviewed using the Woman’s Questionnaire (15).

Data source

Before downloading the data, an approval letter was obtained from the DHS and then the data set was downloaded from the DHS website (http://www.measuredhs.com). The kids’ record data set was used from the downloaded data sets. Anthropometric data of under-five children and various pertinent socio-demographic variables were extracted from the data sets. The nutritional status of U5 children was measured using the weight-for-height (WFH) index. The WFH index was later categorized into normal weight (above minus two standard deviations (−2 SD) and below plus two standard deviations (+2 SD) from the median of the reference population), underweight (below minus two standard deviations (−2 SD) from the median of the reference population) and overweight and obese (more than two standard deviations (+2 SD) above the median of the reference population) based on the BMI Z-score (1, 12, 16).

Study variables
The outcome variable for this study was overweight/obesity in under-five children and it was coded as “1”, whereas those children who were categorized as underweight, and normal were coded as “0”. The independent variables were: Individual-level factors such as child age, child sex, birth order, twin child, delivered by caesarean section, mother’s education status, current age, marital status, child ever born, age of mother at first birth, number of household members, sex of head of households, water source, toilet facility, wealth index, and contraceptive use. The community-level factors such as residence, region, and the altitude of clusters.

Data management and statistical analysis

Before analysis, we cleaned, categorized, and recorded different variables using STATA version 14. A total of 5,164 under-five children were included in this analysis after excluding those children whose BMI z-scores were missing or were recorded as out of plausible limits” or “Flagged cases”, as their values were unusable. These data were recorded in the database under special codes which corresponded either to responses that were considered inconsistent with other responses in the questionnaire and thought to be probably an error or to responses whose value was “Don’t know” (12, 16).

Both descriptive such as frequencies and proportions and analytic statistics were computed. A weighted analysis was done to compensate for the unequal probability of selection between the strata due to the non-proportional allocation of samples to different regions, places of residence, and non-response rate among study participants (15). Since demographic and health survey (DHS) data had a clustering and hierarchical nature. The individual-level factors (level 1) were nested within communities (level 2). A two-level mixed-effect logistic regression model was fitted to estimate both the independent (fixed) effect of the explanatory variables and the community-level (random) effect on our dependent variable childhood overweight/obesity (14). The rate of childhood overweight/obesity varies from cluster to cluster, a cluster-level random intercept was introduced in the mixed logit model. The within-
cluster correlation was measured using intracluster correlation (ICC) which was 21.6 % which indicated that the variations of overweight/obesity in under-five children were attributable to the difference at cluster level factors. The likelihood ratio test was applied to test the significance of the variance of random intercept. Adjusted odds ratio with corresponding 95% confidence level was computed and reported to show the strength of the association and its significance. Variables having a p-value less than 0.05 were considered as having a significant association with the outcome variable. The deviance information criteria (DIC) was used to check the model goodness of fit.

Results

Socio-demographic characteristics

A total of 5,164 under-five children were included in the analysis. About 57.54 % of children were found between the ages of 25 to 59 months and in a balanced male-to-female proportion where 50.87 % were boys. A majority 75.07 % were rural residents and 39.82 % were from the Oromia region. Only 2.31 % and 5.16 % of children were twin and delivered by caesarean section, respectively (Table 1).

Household and maternal characteristics

From mothers in the reproductive age, the majority 22.30 % were in the age category of 30-34 years, the last 1.81 % were in the age category of 45-49 years. At the first birth, about 42.07 % of women were under the age of 18 years. Regarding the education status of mothers, the majority 53.92 % had no formal education followed by primary, secondary, and above 35.19%, 7.29%, and 3.60 %, respectively. About 86.98 % of heads of households were male and the majority 23.57 % of households were in the poorest wealth index rank (Table 2).

Prevalence of overweight/obesity among under-five children in Ethiopia
Among all under-five children, the weighted analysis indicated that 2.14% (95% CI; 1.74-2.53) had overweight/obesity. The majority (90.44 %) of under-five children were in the normal range of weight for height SD scores (Z-scores), 7.42% underweight and 2.14% overweight/obesity (Figure 1).

**Model building**

In this analysis, four models were fitted. The first model was the null model (Model 0) containing no independent variables which were used to check the variability of overweight/obesity in the community and provide evidence to assess random effect using the intraclass correlation coefficient (ICC). The ICC in the null model was 0.21, which means about 21.60% of the variations of overweight/obesity in the under-five-aged children were attributable to the difference at cluster level or community-level factors. The second (Model I) contains individual-level variables and the third (Model II) contains community-level variables. Both individual and community level variables were fitted simultaneously with the outcome variable in the fourth model (Model III). The model comparison was done using deviance and the fourth model with the lowest deviance (831.10) was selected as the best-fitted model (Table 3).

### Table 3: Random effect and model comparison for factors associated with childhood overweight/obesity.

| Measures                      | Null model | Model I          | Model II         | Model III         |
|-------------------------------|------------|------------------|------------------|-------------------|
| Intraclass correlation coefficient (ICC) | 21.60 %    | 18.54 %          | 16.35 %          | 15.15 %           |
| Intercept                     | 0.90(0.42-1.92) | 0.75 (0.32-1.73) | 0.64 (0.26- 1.62) | 0.59 (0.21-1.63)  |
| Akaike information criterion (AIC) | 913.24      | 893.77           | 915.84           | 903.10            |
| Model fitness                 | Log-likelihood | -454.62          | -422.89          | -443.92           | -415.55            |
| Deviance                      | 909.24      | 845.78           | 887.84           | 831.10            |
Factors associated with overweight/obesity

In the bivariable multilevel binary logistic regression analysis, child age, child sex, current maternal age, maternal age at first birth, maternal educational level, sex of household head, child ever born, household wealth index, contraceptive use, child delivered by caesarean section, household toilet facility, residence, region and altitude of the cluster were associated with childhood overweight/obesity (p-value <0.25). In the multivariable multilevel binary logistic regression analysis child age, maternal age, sex of household head, contraceptive use, child delivered by caesarean section, and region were significantly associated with under-five children overweight/obesity (p-value < 0.05) (Table 4).

Children in the age category of fewer than six months were 5.19 times more likely to be overweight/obese as compared to those children 25-59 months (aOR= 5.19; 95%CI, 2.98-9.04). Similarly, children in the age group of 6 -24 months were 1.97 times more likely to be overweight/obese as compared to those children 25-59 months (aOR = 1.97; 95%CI, 1.18-3.29). Maternal age was significantly associated with the nutritional status of under-five children. Children whose mothers age 40-49 years were 3.91 times more likely to be overweight/obese as compared to the children with maternal age from 15 -19 years (aOR = 3.91; 95%CI, 1.90-16.92). The odds of overweight/obesity was higher in those children whose household head was male. Those children in the household headed by males had 1.71 times higher odds of overweight/obesity when compared to those children in the household headed by a female (aOR = 1.71; 95%CI, 1.84-3.48). Contraceptive use was another factor significantly associated with childhood overweight and obesity. Under-five children whose mother used traditional contraceptive methods were 2.63 times more likely to have overweight/obesity when compared to those children whose mother used modern contraceptive methods (aOR = 2.63; 95%CI, 1.66-10.47). Furthermore, children delivered by caesarean
section were 1.75 times more likely to be overweight/obese as compared to their counterparts (aOR = 1.75; 95% CI, 1.84-3.65). The risk of overweight/obesity was 2.16 times higher in children's lives in Addis Ababa administrative city as compared to children in Tigray region (aOR = 2.16; 95% CI, 1.59-7.81). Likewise, under-five children in the Oromia region were 1.93 times at higher risk of overweight/obesity as compared to children who live in the Tigray region (aOR = 1.93; 95% CI, 1.71-5.24) (Table 4).

Discussion

Even though the prevalence of childhood under-nutrition is decreasing in Ethiopia, overweight/obesity emerging as a public health problem (7). Hence, this study assessed the prevalence of overweight/obesity and associated factors among under-five children in Ethiopia. The prevalence of overweight/obesity in this study was 2.14 % (95% CI; 1.74-2.53). The factors associated with childhood overweight/obesity were: age of children, living regions, delivery by caesarean section, age of mothers, contraceptive use of mothers, and sex of head of households.

The 2.14% magnitude of overweight/obesity was consistent with the study done in Bahir Dar town which was 6.9 % (17). The current finding was lower than the findings of the study in different settings; 13.8% in Gondar (7), the combined prevalence was 10.7 % in Hawassa with 7.3 % overweight and 3.4% obesity (9) and 7% the global prevalence (18).

The prevalence of overweight/obesity in this study was also lower than a study conducted in Cameroon which was 8% (19), in Kenya 20.3% (20), in Sub-Saharan Africa 6.8% (4) in Nigeria 23.6% (21). A study done in Iran reported that 11.8% overweight and 15% obese (22), in urban and rural Vietnam, 21.1% and 7.6%, respectively (23). In Malawi, the combined prevalence of childhood overweight and obesity was 14.5% with the 8.7% overweight and 5.8% obesity (24), in Mozambique 11.9% (7.7% overweight and 4.2% obesity) (24), and in Brazil, the overweight was 9.7% (25). In Iraq the combined prevalence of overweight and
obesity was 11.2% (7.6% overweight and 3.6% obesity) (26), in Iran 35.7% (12% overweight and 23.7% obesity) (27), and in Brazil, it was 21.9% with the 14.4% overweight and 7.5% obese (28). The observed difference might be due to the variations in socio-cultural and socio-economic status in dietary intake, lifestyle, and study time.

In the current study, the age of the child was significantly associated with childhood overweight/obesity. The odds of overweight and obesity was 5.19 times higher among children whose age group fewer than six months as compared to those children in the age group of 25-59. Similarly, children in the age category of 6-24 months had 1.97 times higher odds of overweight and obesity when compared to those children in the age group of 25-59 months. This finding was in agreement with the study conducted in Gondar, Hawassa, Ethiopia, and Cameroon (7, 9, 11, 29). In these study findings, younger children had a higher risk of becoming overweight or obese than their older comparative age groups. The possible reason might be that when the age of the child increases, the chance of joining the school would increase and this may attribute to physical activity, which would lead to increased metabolic activity and energy requirements. The other possible explanation maybe during the early childhood period physiologically the percentage of body fat decreases and muscle tissue increases and children get thinner. This study report suggests that age-specific nutritional counselling programs and strategies during childhood are necessary.

The present study showed that maternal age was significantly associated with the overweight and obesity of under-five children. The odds of under-five children overweight and obesity was 3.91 times higher among children whose maternal age was 40-49 years as compared to those children whose maternal age from 15-19 years. The possible explanation might be as the age of mothers increase, the body mass index (BMI) also does increase. Studies reported that there is a positive association between the BMI of mothers and the overweight and obesity of children (30). For this association, the following reasons were suggested: these include
inheritance of genes that enhance susceptibility, and the behaviors of poor eating habits (31, 32).

This study revealed that the risk of overweight and obesity was higher in those children whose households were headed by males. Those children in the household headed by males had 1.71 times higher odds of overweight and obesity when compared to those children in the household headed by a female. This might be because of the food security status of the household. Pooled estimate from Systematic-review and meta-analysis in Ethiopia indicated that the households headed by males had two-fold times higher odds of food security when compared to the female-headed households (33). Hence, those households headed by males might encourage their children to take energy-dense foods that are high in fat and sugars and change in modes of transportation, which increases sedentary life this leads to physical inactivity.

Contraceptive use was another factor significantly associated with childhood overweight and obesity. Under-five children whose mother used traditional contraceptive methods were 2.63 times more likely to have overweight and obesity when compared to those children whose mother used modern contraceptive methods. The possible reason might be those mothers who use traditional contraceptive methods may have low awareness about the effects of energy-dense foods that are high in fat and sugars, physical inactivity due to sedentary lifestyles. However, the comparative category of mothers of under-five children who use modern contraceptive methods may have good awareness because of the variety of health education during attending for the family planning schedule in health facilities.

Furthermore, children delivered by caesarean section were 1.75 times more likely to be overweight and obese as compared to their counterparts. The association between caesarean delivery and childhood overweight and obesity is not clear. However, the possible reason can be the weight of the child at birth. Studies showed that child overweight at birth was a risk for
caesarean delivery as well as for overweight and obesity in later life (34, 35). The other suggested possible mechanism was the hygiene hypothesis (36, 37). In this hypothesis, caesarean delivery deprives the chance for the new-born baby to be exposed to maternal vaginal faeces, the bacteria from which are a major source for the intestinal bacteria of the new-born. As a result, as compared with those born vaginally, new-borns delivered by caesarean section had fewer intestinal Bifidobacteria and Bacteroides both of which were reported to be protective factors against later obesity (38, 39). The association was also supported by indirect epidemiological evidence, in addition to hygiene theory (40). Caesarean delivery was associated with a lower umbilical leptin concentration and it reduces the rate of early breastfeeding both of which were reported to be associated with an increased risk of later overweight and obesity (41-44).

The risk of overweight and obesity was 2.16 times higher in children living in Addis Ababa administrative city as compared to children in the Tigray region. Likewise, under-five children living in the Oromia region were 1.93 times at higher risk of overweight and obesity as compared to children living in the Tigray region. This variation might be due to differences in the habit of food eating, and sedentary lifestyle. Because of the better socio-economic status of the population, and the better access to high-calorie diets in Addis Ababa compared to the Tigray regions of the country.

**Strengths and limitations of the study**

The study used a large survey and nationally representative data including regional variation, factors at individual and community levels. However, there were some limitations to this study. The cross-sectional nature of the data prevents causality from being inferred between the independent and dependent variables. This study only focused on the specific factors of overweight and obesity but did not include missed variables such as dietary intake, feeding habits of the children, maternal nutritional status, and the weight of the child at birth these
might be the residual confounding factors. This study assessed the information from the five years before the survey period; it might be prone to recall bias, particularly for age or other retrospective data relying on memory of past events.

**Conclusion**

This study showed that the prevalence of overweight/obesity among under-five was 2.14% in Ethiopia. Age of children, living regions, delivery by caesarean section, age of mothers, contraceptive use of mothers, and sex of head of households were statistically associated factors with childhood overweight/obesity. Therefore, giving emphasis to children with these above characteristics and formulating preventive programs and policies during children’s early years are highly recommended.

**Abbreviations:**

aOR, adjusted odds ratio; AIC, Akaike information criterion; BMI, body mass index; CI, confidence interval; cOR, crude odds ratio CSA, central statistics agency; EA, enumeration areas; EMDHS, Ethiopian mini demographic and health survey; EPHI, Ethiopian public health institute; FMoH, Federal ministry of health; ICC, Intraclass correlation coefficient; PHC, Population and housing census; SSA, Sub-Saharan Africa.

**Ethics approval and consent to participate**

The primary researchers of the 2019 Ethiopia Mini Demographic Health Survey obtained ethical clearance, and there was no need for ethical clearance for this secondary analysis. However, we obtained an authorization letter on May 28, 2021, to download the EMDHS-2019 data set from the [http://www.measuredhs.com](http://www.measuredhs.com) website. The obtained data were treated strictly confidential and were used only for this study.

**Availability of data and materials.**
The Mini Demographic and Health Surveys (DHS) 2019 data set is available at https://dhsprogram.com/data/availabledatasets.cfm. The DHS Program is authorized to distribute, at no cost, unrestricted survey data files for legitimate academic research. Registration is a prerequisite for access to data. The data sets are publicly available to all registered users and downloaded from the website.

**Competing interests**

The authors declare that they have no competing interests.

**Funding**

The author(s) received no funding for this work.

**Authors' contributions**

MAG involved in the study from the conception to designing, acquisition of data, analysis, and interpretation, and drafting of the manuscript. MMM, SH, HA, and BBW involved in the interpretation and drafting of the manuscript. All authors read and approved the final manuscript and agreed to be personally accountable for the author's contributions and to ensure that questions related to the accuracy or integrity of any part of this study.

**Acknowledgments**

We would like to thank the Measure Demographic and health survey (DHS) international program for providing the data set.

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Figure 1

Nutritional status in under-five aged children in Ethiopia: Data from Ethiopia Mini Demographic and Health Survey (EMDHS 2019).