UNIVERSITY FOR DEVELOPMENT STUDIES

UNHEALTHY DIETARY BEHAVIOUR AND ASSOCIATED FACTORS AMONG WOMEN AND CHILDREN IN SELECTED SUB-SAHARAN AFRICAN COUNTRIES

BIRHAN EWUNU SEMAGN

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BY

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THESIS SUBMITTED TO THE DEPARTMENT OF SOCIAL AND BEHAVIORAL CHANGE, SCHOOL OF PUBLIC HEALTH, UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN COMMUNITY HEALTH AND DEVELOPMENT

August, 2025

DECLARATION

Student

I hereby declare that this thesis is the result of my original work and that no part of it has been presented for another degree in this University or elsewhere:

Candidate's

signature: **B.E.S** Date: 12/12/2024

Name: **Birhan Ewunu Semagn**

Supervisor

I hereby declare that the preparation and presentation of the thesis were supervised following the guidelines on supervision of the thesis laid down by the University for Development Studies.

Supervisor`s

signature .....

Date: 16/12/2024

Name: **Prof. Abdulai Abubakari**

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ABBREVIATIONS

ANC: Antenatal Care

AOR: Adjusted Odds Ratio

CI: Confidence Interval,

COR; Crude Odds Ratio

DHS; Demographic and Health Survey

EDHS; Ethiopian Demographic and Health Survey

EMDHS: Ethiopian Mini Demographic and Health Survey

IPUMS: Integrated Public Use Micro Data Series

MDD: Minimum dietary diversity

NCD: Non communicable diseases

PMA; Performance Monitoring for Action

SSA: Sub Saharan Africa

SSBs: Sugar -Sweetened Beverages

WHO: World Health Organization,

UNICEF: United Nations Children's Fund

ABSTRACT

Healthy diet is essential for optimal health and development. Zero consumption of fruits and vegetables and increased intake of sugar-sweetened beverages (SSBs) have been linked to the global burden of obesity and chronic disease. However, there is limited evidence on the burden and correlates of zero fruit/vegetable consumption and SSB intake among children and women in Sub-Saharan Africa (SSA).

This cross-sectional study used data from the 2019 Ethiopian Mini Demographic and Health Survey (weighted sample: 1,459 children aged 6–23 months) and IPUMS-PMA datasets from Burkina Faso and Kenya (3,759 women aged 15–49 years). Data were cleaned and analyzed using STATA version 14. Mixed-effect logistic regression was used to identify factors associated with dietary behaviors.

In Ethiopia, 69.3% of children had zero fruit/vegetable consumption. Children from households with middle (AOR = 0.55; 95% CI: 0.35–0.86) and rich (AOR = 0.37; 95% CI: 0.23–0.60) wealth status, mothers aged 25–34 (AOR = 0.44; 95% CI: 0.29–0.69), and mothers with ≥4 ANC visits (AOR = 0.57; 95% CI: 0.39–0.83) had reduced odds of zero consumption. Children aged 12–18 months (AOR = 0.41; 95% CI: 0.28–0.59) and 19–23 months (AOR = 0.26; 95% CI: 0.17–0.40) also had lower odds. Higher odds were observed among children from peripheral regions (AOR = 4.40; 95% CI: 1.39–13.97) and those delivered at health facilities (AOR = 1.52; 95% CI: 1.00–2.30). In Burkina Faso and Kenya, 50.4% of women consumed SSBs. Higher odds were found among women with primary (AOR = 1.35) and secondary (AOR = 1.46) education, employment (AOR = 1.28), savory/fried snack consumption (AOR = 1.61), and minimum dietary diversity (AOR = 1.67). Lower odds were seen among those with moderate (AOR = 0.74) and severe (AOR = 0.71) food insecurity.

This study highlights concerning dietary patterns in SSA. Low fruit and vegetable consumption among Ethiopian children and high SSB intake among women in Kenya and Burkina Faso call for urgent public health interventions.

Keywords: Fruits, Vegetables, Childhood nutrition, Sugar, Non-communicable disease, Africa

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Healthy diet is vital for enjoying the full potential of good health, well-being, proper development, and growth(WHO). Unhealthy dietary behaviors, such as, added sugars, and salt and a low intake of fruits, vegetables have been linked with the global epidemic of non-communicable disease (NCD) like diabetes mellitus ,cancer and cardiovascular disease(Busnatu et al., 2022; WHO.,2023).With an estimated annual death of 41 million(71% of all death globally), NCDs are the world's largest killer(Bigna & Noubiap, 2019; WHO., 2023). NCDs are causing catastrophic health expenditures, its effect is worst in Low -and Middle-Income Countries (LMIC)(Murphy et al., 2020). Therefore, it's important to investigate the burden of unhealthy dietary behavior in a track of tackling the risk factors of NCDs.

Sub-Saharan Africa(SSA) is experiencing nutrition transition moving from a diet high in whole grains, vegetables, fruit, legumes and nuts, to diets with high salt, sugars and fats, and low fruits and vegetables(Holdsworth et al., 2020).The nutritional transition coupled with other risk factors like physical inactivity, alcohol and smoking results in rapid increase in the burden of NCDs in SSA (Bigna & Noubiap, 2019). Over the past two decades (1990 to 2017), all-age total disability adjusted life years (DALYs) due to NCDs increased by 67%(Gouda et al., 2019). In Africa, it is expected that by 2030, NCDs will become the leading cause of mortality and morbidity surpassing the continuing agenda of maternal, perinatal and infectious diseases(Chikowore, Kamiza, Oduaran, Machipisa, & Fatumo, 2021).

NCDs take highest share from the global high burden of ill-health among women(Firoz et al., 2022).Women in SSA region are victims of high burden of NCD (Yaya, Ekholuenetale, &

Bishwajit, 2018). SSA regions, which is characterized by urbanization and rapid economic growth, is becoming attractive market for Sugar-Sweetened beverage consumption (SSBs) (Audain, Levy, & Ellahi, 2019; Malik & Hu, 2022).

There is an increasing trend of obesity/overweight in SSA children. Unhealthy diet is one of the main contributing factors for such rise(Choukem, Tochie, Sibetcheu, Nansseu, & Hamilton-Shield, 2020). Moreover, Global consumption of fruits and vegetables remains under the amount that is recommended (Kalmpourtzidou, Eilander, & Talsma, 2020). A previous sub-continental study found that 47% of children in Sub-Saharan Africa consumed no fruits or vegetables (Hailu et al., 2022).

Despite NCDs are an important public health concern in SSA, there is scarcity of evidence about the burden and correlates of NCD risk factors specifically SSBs and Zero fruits/vegetables consumption among women and children in this region. This study aimed at providing evidence on the burden of Zero-fruits/vegetables consumption among children in Ethiopia and SSBs consumption among women in two SSA countries (Kenya and Burkina Faso).

1.2. Objectives

General Objective

- To assess the magnitude of unhealthy dietary behavior and associated factors among women and children in selected SSA countries.

Specific Objectives

- ✓ To determine the magnitude of Zero fruits/vegetables consumption among children aged 6-23 months in Ethiopia
- ✓ To identify factors associated with Zero fruits/vegetables consumption among children aged 6-23 months in Ethiopia
- ✓ To assess the magnitude of SSBs consumption among women aged 15-49 years old in two SSA countries (Kenya and Burkina Faso)
- ✓ To identify factors associated with SSBs consumption among women aged 15-49 years old in two SSA countries (Kenya and Burkina Faso)

1.3. Significant of the study

This study is the first of its kind to record the extent and contributing variables of Ethiopian children's zero fruit and vegetable consumption. The results of the study will provide baseline information for the design, monitoring, and assessment of public health interventions aimed to address diet-related NCD

1.4. Conceptual Framework

Outcome Variable 1: Zero fruits/vegetables consumption

This is the proportion of children who did not consume any vegetables or fruit during the previous day. This indicator is based on the consumption of food groups (vitamin A-rich fruits

and vegetables, and other fruits and vegetables). These were part of the 24-hour dietary recall used to estimate Minimum Dietary Diversity (MDD) in the Ethiopian Mini-Demographic and Health Survey (EMDHS) data set. Children were counted if there was no consumption of either food groups(Organization, 2021).

Independent Variables: Variables were selected by consulting literature (Cooke et al., 2007; Demsash et al., 2022; Eshete, Kumera, Bazezew, Mihretie, & Marie, 2018; Hailu et al., 2022; Peltzer & Pengpid, 2010; Rasmussen et al., 2006) and based on their availability in DHS dataset.

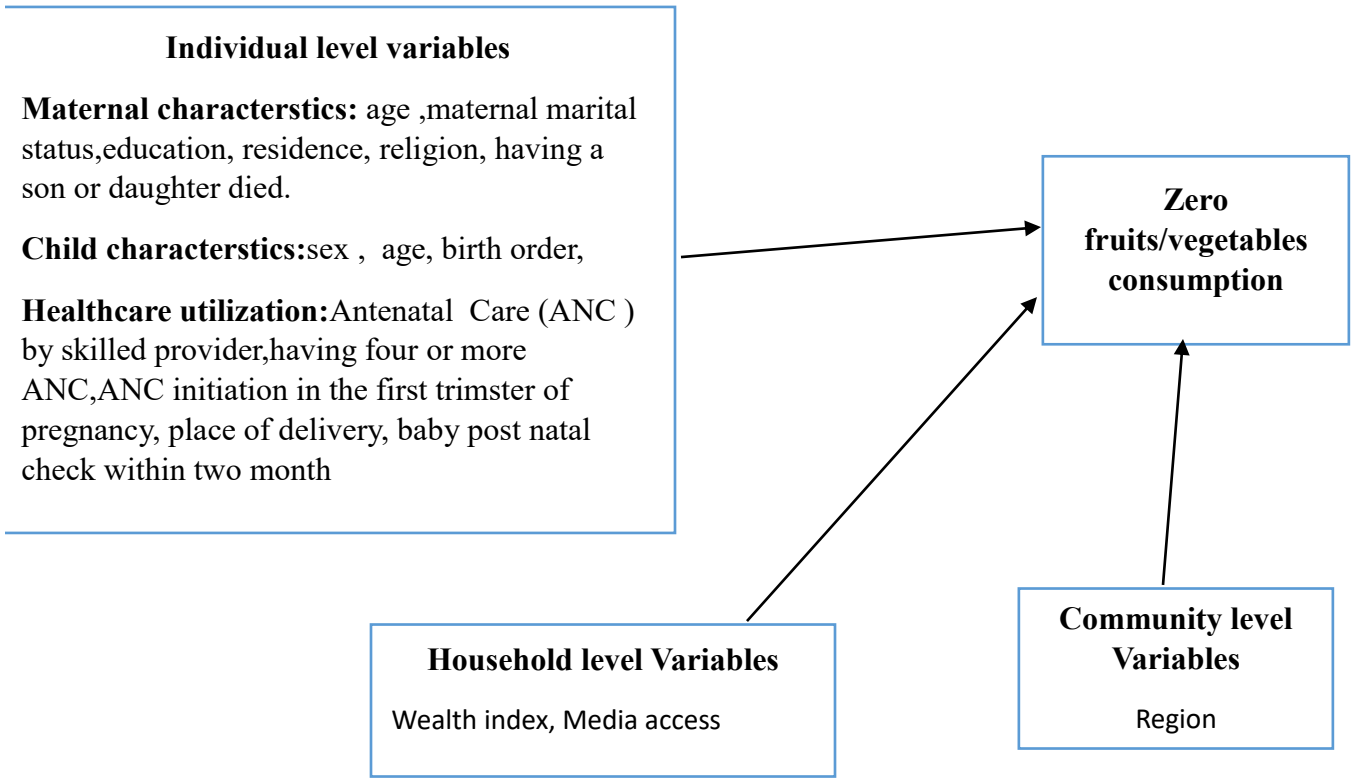

Figure 1**;** A conceptual framework for determining the magnitude and factors associated with Zero Fruits/Vegetable consumption among children aged 6-23 months in Ethiopia.

Outcome Variable 2: Sugar sweetened beverage consumption

SSBs consumption is measured by asking a woman if she drank yesterday during the day or night, whether at home or anywhere else "Any sugar-sweetened beverages like sweet fruit drinks, soft drink/fizzy drinks, sweet tea, sugar-sweetened milk tea"(FAO, 2021; PMA).

Independent Variables:

The independent variables were chosen in the light of the current state of knowledge of their association with consumption of SSBs (Chang et al., 2022; Amanda Silva Fontes et al., 2020; Norliza, Muhammad Afiq, Nur Azilah, Khor, & Halimatus Sakdiah, 2019; Supa Pengpid & Karl Peltzer, 2019).

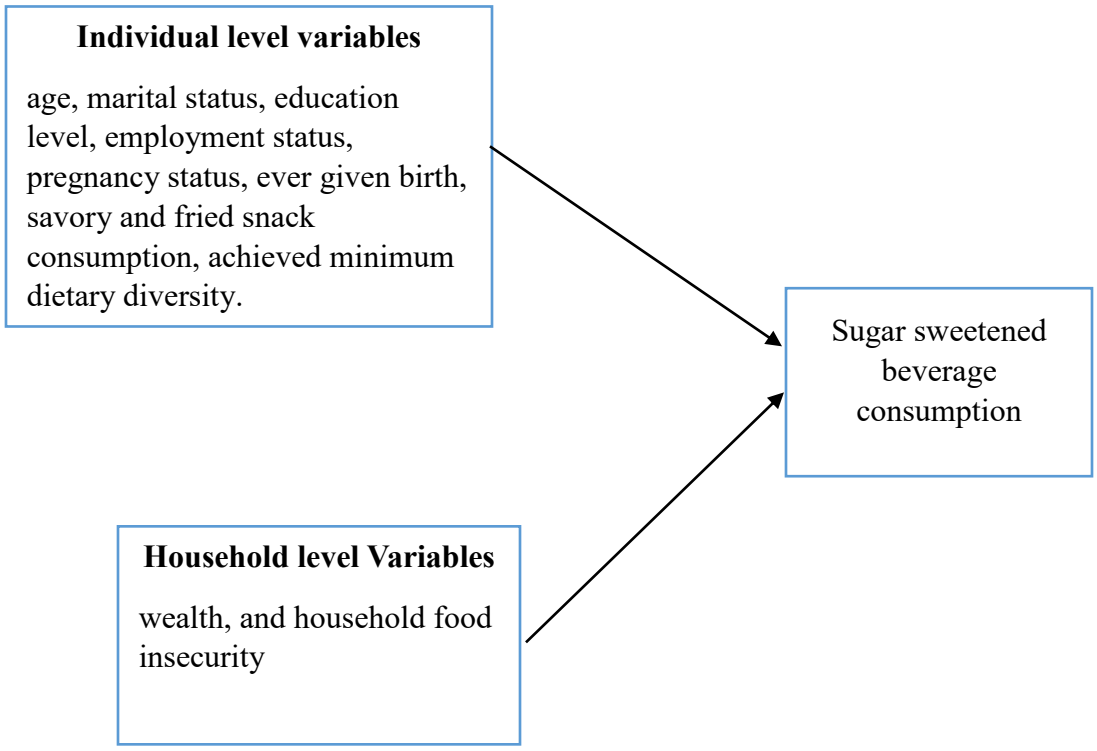

Figure 2**;** A conceptual framework for determining the magnitude and factors associated with Sugar Sweetened Beverage consumption among women in two SSA countries (Kenya and Burkina Faso).

1.5. General Methods

Study design and data source

This study is a cross-sectional study that used secondary data available from public datasets. The most recent national representative EMDHS 2019 (available from https://dhsprogram.com/) and the new nutrition survey piloted in two Sub-Saharan African Countries (Burkina Faso and Kenya)(available from : https://pma.ipums.org/pma/index.shtml) by Performance Monitoring for Action 2020 (PMA2020) program were used(Boyle, Kristiansen, & Sobek, 2022).

Population and sampling procedure

For the first outcome variable, this study included a weighted sample of 1459 young children aged between 6-23 months. The 2019 EMDHS used two stage stratified sampling technique(EPHI, 2019). For the second outcome variable,3759 women aged between 15-49 years old were included (Burkina Faso=2411, Kenya=2471). PMA nutrition survey 2018 (Burkina Faso and Kenya) used multi-stage stratified cluster sampling, where households are selected in sampled clusters, or enumeration areas (EA)(Performance Monitoring for Action (PMA), 2018).

Data management and analysis

After accessing the data data extraction, recoding, labeling, cross-tabulations and analysis were done using STATA Version 14. Prior to conducting any statistical analysis, the data was weighted to keep the representativeness of the survey and to get more reliable estimates. Frequencies and percentages were used for descriptive statistics. Continuous variable (age) was summarized as medians with interquartile range (iqr). For the inferential statistics we used multi-level logistic regression analysis because of the hierarchical structure of the DHS and PMA data that violates the assumption of independent observation and equal variance(EPHI, 2019).

Ethical Consideration

The present study used publicly available secondary data from DHS and IPUMS-PMA website. Permission was granted to access and use the data after submitting an online request that justify the objectives of the study. Ethical clearance was sought by the institutions that funded, commissioned, and managed the survey, and no further ethical clearance was needed. Any personal identifiers like names, house numbers, and phone numbers were not included in the dataset. Furthermore, as the study was based on secondary data analysis, gaining participants consent was not applicable

1.6. Overview of the thesis chapters

This thesis adheres to the guidelines provided for manuscript-based thesis writing in the Graduate School Handbook of the University for Development Studies and is structured into four chapters. The first chapter presents essential elements such as the background, objectives, conceptual framework, and general methods employed in the study. Building on this foundation, the second chapter encompasses a literature review, which analyzes and synthesizes existing research and knowledge relevant to the research topic.

In the third chapter, the study presents two manuscripts that correspond to the first and second outcome variables investigated. These manuscripts were prepared based on the author guidelines offered by PLOS ONE journal and BMC women's Health journal.

Finally, the fourth chapter offers a synthesis and analysis of the overall results presented in the previous manuscripts. It includes a general discussion that places the study's findings in the broader context of existing literature. Moreover, this chapter provides a conclusion that summarizes the key outcomes, implications, and potential avenues for future research. Additionally, it offers a recommendation based on the research findings.

The thesis is further enriched by the inclusion of appendices, which contain the questionnaire used in PMA 2020 and the Ethiopian Mini Demographic and Health Survey (EMDHS), focusing solely on the specific questionnaire utilized for the purpose of our study.

2. CHAPTER TWO

2.1 Literature Review

Nutrition transition in SSA and its consequence

There is rapid nutrition transition towards unhealthy diet in LMIC which is linked with globalization, industrialization, and urbanization (Baker et al., 2020). This means that instead of a low-fat, low-salt, rich-in-grains, and legumes diet, there is an increase in the consumption of ultra-processed foods, fats, and added sugar(Lufuke, Bai, Fan, & Tian, 2022).These dietary transition leads to the epidemiologic shift from high burden of communicable disease to an increasing trend of non-communicable disease in SSA(Mbogori, Kimmel, Zhang, Kandiah, & Wang, 2020; Yuyun, Sliwa, Kengne, Mocumbi, & Bukhman, 2020).In addition to the continued challenge of infectious disease, maternal death and undernutrition, SSA are facing an emerging challenge of NCD with cardiovascular disease as the primary cause of NCD mortality(Yuyun et al., 2020). Moreover, evidence showed that in SSA the prevalence of obesity is higher in women than men(Jaacks et al., 2019).

Sugar Sweetened beverage consumption and women in SSA

SSBs consumption among women is associated with increased risk of breast cancer mortality(Farvid et al., 2021; Koyratty et al., 2021) ,gestational hypertension(Barbosa et al., 2021), periodontal disease (Menezes et al., 2019),early onset colorectal cancer(Hur et al., 2021),liver cancer(Zhao et al., 2022), postpartum weight gain(Alderete et al., 2020), diabetes(Stern et al., 2019), depression(Werneck et al., 2021),stroke, coronary heart disease, and all-cause mortality(Mossavar-Rahmani et al., 2019). Also, evidence highlights the greater health risk of sugary soft drinks compared to sugar-containing foods(Sundborn et al., 2019). Previous

studies conducted among different population groups mainly in developed countries identify younger age, urban residence, perceived overweight, fruit consumption, having had processed meat, fried food from street vendors, obesity, household income, and a diagnosis of heart disease or depression as factors associated with SSBs consumption (Guo, Phung, & Chu, 2021; Miller et al., 2020; Supa Pengpid & Karl Peltzer, 2019). The increased consumption of SSBs in low- and middle-income countries, results in a high demand of public health interventions to the tackling of the problems early (Audain et al., 2019; Malik & Hu, 2019; Yang et al., 2017).

Zero fruit and vegetable consumption among children

Feeding practice during early life contributes to lifelong nutritional habits, and overall health (Grimm, Kim, Yaroch, & Scanlon, 2014; Riley, Rupert, & Boucher, 2018). Apart from short-term consequences of micronutrient deficiencies and diseases, inadequate consumption of fruits and vegetables also increases the risk of non-communicable diseases like cancer, cardio-vascular disease, obesity, and metabolic diseases like diabetes mellitus (Amiot-Carlin, 2019; Hodder et al., 2018) . Moreover, scientific evidences available shows that consumption of fruits and vegetables prevent cataract formation, coronary heart disease, stroke, chronic obstructive pulmonary disease, diverticulosis, cancer, depression and improve cognitive and mental health (Angelino et al., 2019; Conner, Brookie, Carr, Mainvil, & Vissers, 2017; Gehlich et al., 2019; Schönbach & Lhachimi, 2021; Van Duyn & Pivonka, 2000).

Even though there is no universal recommendation for the optimal number of servings of vegetables and fruits per day for infants and young children over six months of age, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) consider consumption of zero vegetables or fruits on the previous day as unhealthy child feeding practice (Organization, 2021).This indicator was added to the existing Infant and young child-feeding

practice indicators during the UN International Year of Fruits and Vegetables in 2021(Organization, 2021).

Generally, worldwide fruits and vegetables consumption is below the recommended level (Kalmpourtzidou et al., 2020). The burden of poor diets and the low fruits and vegetables consumption is high in low and middle-income countries (Darfour-Oduro, Buchner, Andrade, & Grigsby-Toussaint, 2018; Harris, Tan, Raneri, Schreinemachers, & Herforth, 2022; Mensah, Nunes, Bockarie, Lillywhite, & Oyebode, 2021). According to previous studies conducted at a sub-continent level, 47 % of children in Sub-Saharan Africa had zero fruits/vegetables consumption (Hailu et al., 2022).

Ethiopia is among the top five countries in Sub-Saharan Africa which has highest burden of zero fruits/vegetables consumption (69%) among children(Hailu et al., 2022). Previous studies which were conducted to assess dietary diversity among children in Ethiopia investigated the consumption of fruits and vegetables rich in Vitamin A as a single food group, and other fruits and vegetables as another food group and, among other food groups as part of the overall diet. Most of these studies demonstrate low consumption of fruits and vegetables among children age 6-23 months (Assefa & Belachew, 2022; Dafursa & Gebremedhin, 2019; Dangura & Gebremedhin, 2017; Jalata & Asefa, 2022; Keno, Bikila, Shibiru, & Etafa, 2021; Moga Lencha, Jebero Zaza, Ena Digesa, & Mulatu Ayana, 2022). For example a study conducted in southern Ethiopia reported 7.2% and 39.1% respectively of children who consumed Vitamin A rich, and other fruits and vegetables the day prior to the survey (Dangura & Gebremedhin, 2017). Another study in southern Ethiopia found 21.5% and 11.8%) consumption of vitamin A-rich fruits and vegetables ,and other fruits and vegetables(Dafursa & Gebremedhin, 2019). Furthermore, a nationwide study which used Ethiopian Demographic and Health Survey 2016 (EDHS) reported

25.1%-32.8% and 28.1%-31.6 % of Vitamin-A rich fruits and vegetables, and other fruits and vegetables consumptions respectively (Eshete et al., 2018).

Previous studies identified child's age, mothers' age, media exposure, maternal working status, household wealth, ecology, distance to the health facility, number of births a mother have in the last five years, and residence as factors significantly associated with children's zero fruits/vegetables consumption(Ballesteros, Zapata, Freidin, Tamburini, & Rovirosa, 2022; Hailu et al., 2022).

3. CHAPTER THREE

Zero fruits/vegetables consumption and associated factors among Children aged 6-23 months in Ethiopia: Mixed effect logistic regression analysis

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Abstract

Background: The first two years of life is a vital period for promoting optimal growth, development and health. The lifelong nutritional habit and overall health of children is influenced by their early age feeding practice. Ethiopia is among the top five countries in Sub-Saharan Africa with the highest burden of zero fruits/vegetables consumption. This study aims to access factors associated with zero fruits/vegetables consumption among children aged 6-23 months in Ethiopia.

Methods: The study analyzed Ethiopian Mini Demographic and Health Survey 2019 dataset with a total weighted sample of 1459 young children aged between 6-23 months and who were living with their mothers. Data cleaning, coding and labeling were done using STATA version 14 software. Multilevel mixed effect logistic regression model was employed to identify associated factors.

Results: Exactly 69.3% of children aged 6-23 months in Ethiopia had zero fruits/vegetables consumption. In the multivariable multilevel binary logistic regression analysis a child from household with middle (AOR = 0.55, 95% CI: 0.35, 0.86) and rich (AOR = 0.37, 95% CI: 0.23, 0.60) wealth index, mothers who aged between 25-34 years old (AOR=0.44, ;95%CI=0.29 – 0.69), mothers who were married/living with partner (AOR = 3.21 ; 95%CI: 1.58 – 6.52), children of mothers who follow Islamic religion (AOR = 0.34, 95% CI: 0.19, 0.61), mothers who had more than four ANC visits during their most recent pregnancy (AOR = 0.57; 95%CI: 0.39 – 0.83) ,children in age group of 12-18 month(AOR = 0.41, 95% CI: 0.28, 0.59), and 19-23 months (AOR = 0.26, 95% CI: 0.17, 0.40), health facility delivery (AOR = 1.52, 95% CI; 1.00–2.30),and small peripheral regions (AOR = 4.40, 95% CI; 1.39–13.97) were found to be

significant factors associated with children's zero fruits /vegetables consumption. The Interclass correlation coefficient (ICC) value in the null model was 0.34, which indicates that 34% of the variation in children's zero fruits /vegetables consumption was attributed to the variation between clusters.

Conclusion:

This study found that zero fruits/vegetables consumption among children aged 6-23 months in Ethiopia is high. Therefore, efforts should be made by stakeholders who are concerned about optimal diet and health of children to improve fruits/vegetables consumption of children particularly those from poor households, young mothers (15-24), and peripheral regions of Ethiopia. This could be done during ANC follow up visits and during nutrition counseling.

Key words: Fruits, Vegetables, childhood nutrition, diet, Ethiopia

Background

The first two years of life which is characterized by rapid growth rate, higher energy and nutrient requirement is a vital period for promoting optimal growth, development and health during early life(Romero-Velarde et al., 2016).Feeding practice during early life contributes to lifelong nutritional habit, and overall health (Grimm et al., 2014; Riley et al., 2018). Apart from short-term consequences of micronutrient deficiencies and diseases, inadequate consumption of fruits and vegetables also increases the risk of non-communicable diseases like cancer, cardio-vascular disease, obesity, and metabolic diseases like diabetes mellitus (Amiot-Carlin, 2019; Hodder et al., 2018) . Moreover, scientific evidences available shows that consumption of fruits and vegetables prevent cataract formation, coronary heart disease, stroke, chronic obstructive pulmonary disease, diverticulosis, cancer, depression and improve cognitive and mental health (Angelino et al., 2019; Conner et al., 2017; Gehlich et al., 2019; Schönbach & Lhachimi, 2021; Van Duyn & Pivonka, 2000).

Even though there is no universal recommendation for the optimal number of servings of vegetables and fruits per day for infants and young children over six months of age, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) consider consumption of zero vegetables or fruits on the previous day as unhealthy child feeding practice (WHO, 2021).This indicator was added to the existing Infant and young child-feeding practice indicators during the UN International Year of Fruits and Vegetables in 2021(WHO, 2021).

Generally, worldwide fruits and vegetables consumption is below the recommended level (Kalmpourtzidou et al., 2020). The burden of poor diets and the low fruits and vegetables consumption is high in low and middle-income countries (Darfour-Oduro et al., 2018; Harris et

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Ethiopia is among the top five countries in Sub-Saharan Africa which has highest burden of zero fruits/vegetables consumption (69%) among children(Hailu et al., 2022). Previous studies which were conducted to assess dietary diversity among children in Ethiopia investigated the consumption of fruits and vegetables rich in Vitamin A as a single food group, and other fruits and vegetables as another food group and, among other food groups as part of the overall diet. Most of these studies demonstrate low consumption of fruits and vegetables among children age 6-23 months (Assefa & Belachew, 2022; Dafursa & Gebremedhin, 2019; Dangura & Gebremedhin, 2017; Jalata & Asefa, 2022; Keno et al., 2021; Moga Lencha et al., 2022). For example a study conducted in southern Ethiopia reported 7.2% and 39.1% respectively of children who consumed Vitamin A rich, and other fruits and vegetables the day prior to the survey (Dangura & Gebremedhin, 2017). Another study in southern Ethiopia found 21.5% and 11.8%) consumption of vitamin A-rich fruits and vegetables ,and other fruits and vegetables(Dafursa & Gebremedhin, 2019). Furthermore, a nationwide study which used Ethiopian Demographic and Health Survey 2016 (EDHS) reported 25.1%-32.8% and 28.1%-31.6 % of Vitamin-A rich fruits and vegetables, and other fruits and vegetables consumptions respectively (Eshete et al., 2018).

Previous studies identified child's age, mothers' age, media exposure, maternal working status, household wealth, ecology, distance to the health facility, number of births a mother have in the last five years, and residence as factors significantly associated with children's zero fruits/vegetables consumption(Ballesteros et al., 2022; Hailu et al., 2022).

Though the Ethiopian Mini Demographic and Health Survey (EMDHS) report capture children's consumption of vitamin-A rich foods and other fruits/vegetables consumption, it did not show the burden of zero fruits/vegetables consumption and associated factors(EPHI, 2019).

In addition, while zero fruits/vegetables consumption by children is one of the indicators for assessing infant and young child feeding practices by WHO and the UNICEF, there is dearth of knowledge on the burden of zero fruits/vegetables consumption by children and associated factors in Ethiopia. Therefore, the present study aims to fill this research gap using the most recent nationally representative data. Besides, finding may serve as baseline to further develop an interventional study that will contribute for the big evidence gap on how to improve fruits and vegetables consumption of children (Graziose & Ang, 2018; Harris et al., 2022; Hodder et al., 2018).

Methods

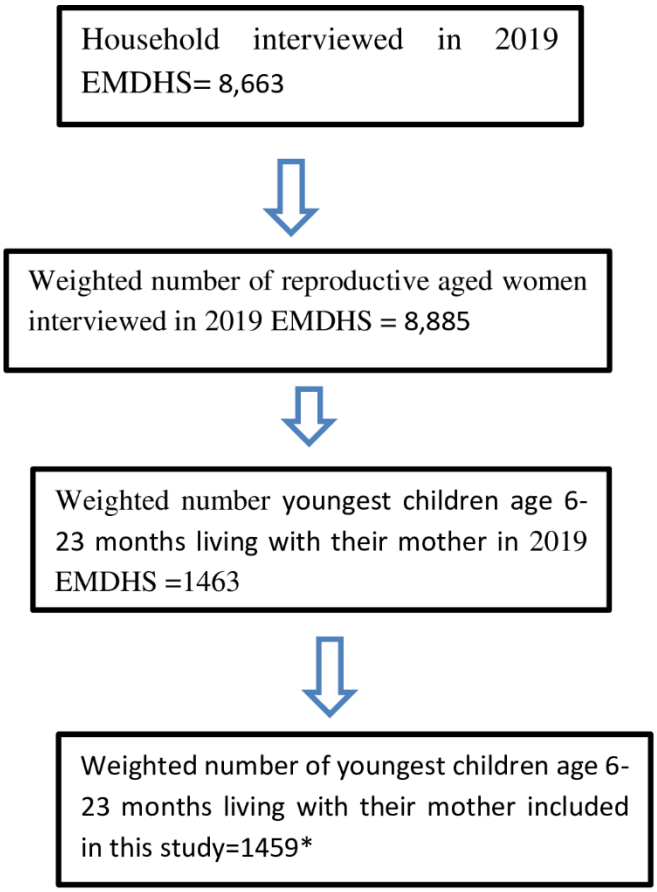
Study design, Data source, and Setting

This study is an analytical cross-sectional study that used data from the most recent national representative EMDHS 2019**.** The 2019 EMDHS was the second EMDHS and the fifth EDHS implemented by the Ethiopian Public Health Institute (EPHI), in partnership with the Central Statistical Agency (CSA) and the Federal Ministry of Health (FMOH). Data collection lasted from March 21, 2019, to June 28, 2019. For this study the data were obtained from the Demographic and Health survey (DHS) website (https://dhsprogram.com/) after submitting a request justifying the aim of the study. We used the Kids Record (KR) file of EMDHS data set which contains information related to pregnancy, postnatal care, immunization, health and nutrition data of mother child pair. Ethiopia is one of the low-income Sub-Saharan countries in

East Africa .At the time of the data collection Ethiopia had nine geographical regions and two administrative cities(EPHI, 2019).

Population and sampling procedure

This study is based on a weighted sample of 1459 young children aged between 6-23 months who were living with their mother (KR file), and born in the 2 years preceding the survey (Fig 3). The 2019 EMDHS used two stage stratified sampling technique. 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. In the second stage of selection, a fixed number of 30 households per cluster were selected with an equal probability using systematic sampling technique. All women aged 15-49 who were either permanent residents of the selected households or visitors who slept in the household the night before the survey were eligible to be interviewed. Finally, 8,885 women aged between 15-49 years old were interviewed. Further information related to the population, study area, data collection, sampling procedure, and questionnaires used in the survey were detailed in the 2019 EMDHS Report(EPHI, 2019).



*4 of the respondents responded don't know for the fruit/vegetable consumption of their children.

Figure 3: Illustrates the sampling procedure, and the final sample size considered in the study to assess the proportions of zero fruits/vegetables consumption, and associated factors among children aged 6-23 months in Ethiopia using 2019 EMDHS dataset.

Study variables

Outcome Variable: Zero fruits/vegetables consumption

This is the proportion of children who did not consume any vegetable or fruit during the previous day. This indicator is based on consumption of food groups (vitamin A-rich fruits and vegetables, and other fruits and vegetables). These were part of the 24-hour dietary recall used to estimate Minimum Dietary Diversity (MDD) in the DHS data set. Children were counted if there was no consumption of either food groups(WHO, 2021).

Independent Variables: Variables were selected by consulting literature (Cooke et al., 2007; Demsash et al., 2022; Eshete et al., 2018; Hailu et al., 2022; Peltzer & Pengpid, 2010; Rasmussen et al., 2006) and based on their availability in DHS dataset. Individual level variables were,maternal age ,maternal marital status,maternal education, , religion, sex of a child, child age, birth order,Antenatal Care (ANC) by skilled provider,having four or more ANC,ANC initiation in the first trimster of pregnancy, place of delivery, baby post natal check within two month , and having a son or daughter died. Household level variables like household wealth index (the EMDHS datasets had a variable labeled as wealth index and coded as "poorest", "poorer", "middle", "richer", and "richest". However, in the present study wealth index was recorded into three categories, "poor" (includes the poorest and the poorer categories), "middle", and "rich" (includes the richer and the richest categories), media access (a composite variable obtained by combining whether there was a radio and /or TV in the respondent's house; with a value of"0" if a woman didn't have either TV or Radio in her household and "1" if a woman has access to either of the media), household size ,Community level variables such as residence and region were (grouped in to three categories: metropolitan Harar and Drie-Dawa, large central regions Amhara, Oromia, South Nations and nationalities and Tigray, and Small peripheral regions Afar, Benishangul, Gambella, and Somalia).

Data management and analysis

After accessing the data from DHS website data extraction, recoding, labeling, cross-tabulations and analysis were done using STATA Version 14. Prior to conducting any statistical analysis, the data was weighted using sampling weight (v005/1000000), primary sampling unit (v021), and strata (v022) to keep the representativeness of the survey and to get more reliable estimates. Frequencies and percentages were used for descriptive statistics. For the inferential statistics we

used multi-level logistic regression analysis because the hierarchical structure of the DHS data violates the assumption of independent observation and equal variance(EPHI, 2019).

Assessment of community level clustering, and model comparison were done. The Interclass Correlation Coefficient (ICC) and Median Odds Ratio (MOR) were checked to assess whether there was clustering or not. Four separate models including the null model, model I (individual-level variables), model II (household and community-level variable), and Model III (models that include both individual, household and community level variables) were fitted. Model comparisons were done using a deviance test. The best fitted model with the lowest deviance, was chosen Table 2.

Finally, both bi-variable and multivariable multi-level logistic regression analysis were done using the best-fitted model (model III which included both individual, household and community level variables). Variables with a p-value ≤0.25 at the bi-variable analysis were considered for multivariable analysis, and variables with a p-value of ≤0.05 in the multivariable analysis were considered statistically significant. The STORBE guideline was followed in writing the manuscript (Von Elm et al., 2007).

Ethical Consideration

The present study used publicly available secondary data from DHS website. Permission was granted to access and use the data after submitting an online request that justify the objectives of the study. Ethical clearance was sought by the institutions that funded, commissioned, and managed the survey, and no further ethical clearance was needed. The Institutional Review Board approved procedures for DHS public-use of datasets that does not allow respondents, or households to be identified. Any personal identifiers like names, house numbers, and phone

numbers were not included in the dataset. Furthermore, as the study was based on secondary data analysis, gaining participants consent was not applicable.

Results

Socio-demographic characteristics, and proportion of zero fruits /vegetables consumption

Socio-demographic characteristics

This study was based on a weighted sample of 1459 youngest children age 6-23 months who were living with their mother. Most of the children were from rural areas (71.7%) , from large central regions (86.8 %) , had mothers aged 25-34 years (49.5%), had their mothers married/living with partner (95.3%) and ,had mothers with no formal education (44.4%).Most of the children also had mothers with no media access (64.4%) , who belong to orthodox religion (36.9%), who received ANC from skilled provider (75.6%),who attended four or more ANC (54.6%), and who did not attend ANC in their first trimester of pregnancy (70.9%). Majority of the study children were from households with poor wealth index (41.4%), household size of less than or equal to five (55.0%), and headed by males (86.1%). Moreover, the higher proportion of the study children were males (52.3%), within the age group of 12-18 months (43.9%), 2-4 birth order (47.3%), born in a health facility (55.1%), and with no post-natal check within two months (86.4%) of their birth (Table 1).

Proportion of zero fruits /vegetables consumption

The proportion of zero fruits/vegetables consumption was 69.3 % [95 % CI =64.56, 73.71]. The proportion of zero fruits/vegetables consumption is higher among children of mothers who reside in rural areas (50.9%), large central region (59.1%), had no formal education (33.5%), had no media access (48.0%),who did not attend four or more ANC (40.5%), and who did not had first

trimester ANC visit (50.8%). The proportion of zero fruits/vegetables consumption was also higher among children from poor household's wealth index (33.04%), with household size of less than or equal to five (36.9%), and of household headed by males (58.9%). Higher proportion of zero fruits/vegetables consumption was observed among children aged 12-18 months (30.4%) and with no post-natal care within two months of birth (60.8%) (Table 1).

Table 1: Socio-demographic characteristics of caregivers/mothers and their children aged 6–23 months by children's zero fruits /vegetables consumption.

	Zero 24 hours fruits/vegetables consumption						
Variables	**No**		**Yes**		**Total**		**Weighted Frequency**
	%	**CI**	**%**	**CI**	**%**	**CI**	
Type of place of residence							
Urban	9.8	[6.99,13.56]	18.47	[13.94,24.06]	28.27	[23.54,33.53]	412
Rural	20.88	[17.55,24.65]	50.86	[45.83,55.87]	71.73	[66.47,76.46]	1,047
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Geopolitical features of regions							
Metropolitans	1.94	[1.47,2.56]	2.2	[1.69,2.87]	4.15	[3.38,5.07]	60
Small peripheral regions	1	[0.78,1.28]	8.07	[6.30,10.29]	9.07	[7.28,11.26]	132
Large central regions	27.73	[23.44,32.47]	59.05	[54.02,63.90]	86.78	[84.38,88.86]	1,266
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Wealth-index							
Poor	8.34	[6.36,10.88]	33.04	[27.65,38.91]	41.38	[35.22,47.82]	604
Middle	6.84	[4.91,9.47]	12.03	[9.22,15.56]	18.88	[15.36,22.97]	275
Rich	15.49	[11.95,19.83]	24.26	[19.30,30.02]	39.74	[34.04,45.75]	580
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
House hold size							

Greater than five	12.54	[9.73,16.02]	32.44	[28.54,36.61]	44.98	[40.61,49.44]	656
Less than or equal to five	18.13	[14.74,22.11]	36.88	[32.48,41.52]	55.02	[50.56,59.39]	803
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Sex of household head							
Female	3.44	[2.34,5.03]	10.46	[7.76,13.96]	13.9	[11.17,17.18]	203
Male	27.23	[22.79,32.18]	58.86	[54.52,63.07]	86.1	[82.82,88.83]	1,256
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Mother's age category							
15-24	9.15	[7.15,11.64]	23.16	[19.70,27.03]	32.31	[28.36,36.54]	471
25-34	16.76	[13.87,20.11]	32.76	[29.18,36.56]	49.52	[45.84,53.21]	723
>=35	4.76	[3.27,6.89]	13.4	[10.77,16.56]	18.16	[15.49,21.19]	265
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Marital status							
Never in union/no longer living together	1.81	[0.94,3.48]	2.87	[1.82,4.49]	4.68	[3.13,6.94]	68
Married/living with partner	28.86	[24.37,33.80]	66.46	[61.98,70.66]	95.32	[93.06,96.87]	1,391
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Mother's education							
No education	10.93	[8.22,14.39]	33.51	[29.37,37.92]	44.44	[39.54,49.44]	648
Primary	13.59	[10.91,16.80]	28.16	[24.57,32.04]	41.74	[37.83,45.77]	609
Secondary	3.69	[2.32,5.82]	4.52	[3.15,6.45]	8.21	[6.27,10.67]	120
Higher	2.47	[1.61,3.77]	3.14	[1.91,5.14]	5.61	[4.02,7.79]	82
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1459
Media access (radio / TV)							
No media access	16.32	[13.21,19.99]	48.03	[43.31,52.79]	64.35	[59.19,69.20]	934
Has media access	14.24	[10.57,18.92]	21.4	[18.26,24.92]	35.65	[30.80,40.81]	517
Total	30.56	[26.17,35.35]	69.44	[64.65,73.83]	100		1,451*
Religion							

Orthodox	9.52	[7.00,12.84]	27.35	[22.31,33.03]	36.87	[30.87,43.31]	538
Muslim	11.53	[7.56,17.19]	20.98	[16.40,26.42]	32.5	[24.93,41.11]	474
Protestant	9.41	[6.48,13.49]	18.79	[13.62,25.34]	28.2	[20.81,36.98]	411
Catholic, traditional and other	0.21	[0.06,0.74]	2.22	[0.80,6.00]	2.43	[0.95,6.03]	35
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Sex of a child							
Male	15.67	[12.51,19.45]	36.67	[32.48,41.07]	52.34	[48.58,56.07]	764
Female	15	[12.27,18.22]	32.66	[28.59,37.00]	47.66	[43.93,51.42]	695
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Child age category							
6-11	7.45	[5.52,9.99]	25.14	[22.47,28.02]	32.59	[29.50,35.84]	476
12-18	13.44	[10.99,16.34]	30.43	[26.06,35.18]	43.87	[39.52,48.31]	640
19-23	9.78	[7.36,12.88]	13.76	[11.21,16.78]	23.54	[19.87,27.65]	343
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Birth order							
1	7.93	[6.17,10.15]	16.27	[12.97,20.21]	24.2	[20.48,28.35]	353
2-4	15.64	[12.89,18.85]	31.64	[27.53,36.05]	47.28	[43.06,51.53]	690
>=5	7.1	[5.12,9.77]	21.42	[18.29,24.93]	28.52	[24.94,32.40]	416
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
ANC from skilled provider							
No	5.66	[3.87,8.22]	18.7	[15.43,22.48]	24.36	[20.68,28.47]	355
Yes	25.01	[20.75,29.81]	50.63	[45.87,55.37]	75.64	[71.53,79.32]	1,104
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Attended 4+ ANC visits							
No	14.14	[11.31,17.54]	40.5	[36.17,44.98]	54.64	[50.29,58.91]	794
Yes	16.46	[13.32,20.17]	28.9	[25.33,32.76]	45.36	[41.09,49.71]	660
Total	30.6	[26.22,35.36]	69.4	[64.64,73.78]	100		1,454*
Attended ANC in the first							

trimester of pregnancy							
No	20.09	[16.92,23.69]	50.8	[46.12,55.46]	70.89	[67.51,74.05]	1,034
Yes	10.58	[8.19,13.57]	18.53	[15.92,21.46]	29.11	[25.95,32.49]	425
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Place of delivery							
Non-health facility	12.01	[9.10,15.69]	32.89	[27.67,38.57]	44.9	[38.18,51.80]	655
Health facility	18.66	[14.43,23.80]	36.44	[31.52,41.66]	55.1	[48.20,61.82]	804
Total	30.67	[26.29,35.44]	69.33	[64.56,73.71]	100		1,459
Baby postnatal check within 2 months							
No	25.62	[21.56,30.16]	60.77	[55.54,65.77]	86.39	[82.94,89.24]	1,257
Yes	5.13	[3.25,8.01]	8.47	[6.59,10.83]	13.61	[10.76,17.06]	198
Total	30.76	[26.29,35.62]	69.24	[64.38,73.71]	100		1,455*
Given birth to a boy or girl who was born alive but later died							
No	30.22	[25.89,34.93]	67.37	[62.69,71.72]	97.58	[96.32,98.42]	1,424
Yes	0.45	[0.15,1.35]	1.96	[1.22,3.14]	2.42	[1.58,3.68]	35
Total	**30.67**	**[26.29,35.44]**	**69.33**	**[64.56,73.71]**	**100**		**1,459**

*not dejure resident, and don't know were considered as missing and deleted from further analysis

Random effect (community-level clustering) and Model Comparison

The existence of community level clustering was assessed using the random effect model .The result of random effect model implies the presence of significant clustering given that the ICC value in the null model was 0.34, which indicates that about 34% of the total variation in zero fruits/vegetables consumption was attributable to the variation between clusters, moreover the value of MOR (95% CI) was 3.45(2.58 - 4.32) which shows that zero fruits/vegetables

consumption among children is significantly different between clusters. This means that, if we randomly choose children between the age of 6 and 23 months from various clusters, those from the cluster with highest zero fruits/vegetables consumption had 3.45 times the odds of doing so compared to those from the cluster with the lowest zero fruits/vegetables consumption.

Regarding model fitness, the final model (Model III) with lowest deviance was the best model for forecasting the association of independent variables with zero fruits/vegetables consumption (Table 2).

Table 2: Random effect model and model fitness comparison for factors associated with children's zero fruits /vegetables consumption, Ethiopia.

Parameter	Null model	Model **I**	Model **II**	Model **III ***
Variance (SE)	1.69(.34)	2.01(.43)	1.05(.25)	1.86(.42)
ICC	0.34	0.38	0.24	0.36
MOR (95%CI)	3.45(2.58 4.32)	3.9(2.76 4.96)	2.65(2.05 3.26)	3.68(2.62 4.74)
PCV	Reference	-0.19	0.38	-0.1
		Model comparison		
LL	-814.39	-751	-803.92	-725.67
Deviance	1628.78	1502	1607.84	1451.34

*The best fitted model with lowest deviance

Individual, household and community level factors associated with zero fruits /vegetables consumption among children aged 6-23 months

The variables with p-value< 0.25 in the bi-variable multi-level logistic regression analysis were residence, region, wealth-index, household family size, mother's age, mother's marital status, mother's educational level ,media access, religion, sex of a child, child age, birth order, ANC

from skilled provider, attended 4+ ANC visits, attended ANC in the first trimester of pregnancy, place of delivery, baby post-natal check within two month, and given birth to a boy or girl who was born alive but later died(Table 3).

Table 3: Bi-variable, and multi-variable multilevel logistic regression analysis of individual, household and community level factors associated with children's zero fruits /vegetables consumption.

Variables	COR	95%CI	AOR	95%CI
Type of place of residence				
Urban	1		1	
Rural	1.94***	1.11 - 3.36	0.96	0.46 - 1.99
Geopolitical features of regions				
Metropolitans	1			
Small peripheral regions	7.96***	3.00 - 21.15	4.40*	1.39 - 13.97
Large central regions	2.15***	1.02 - 4.54	1.00	0.38 - 2.63
Wealth-index				
Poor	1		1	
Middle	0.51***	0.34 - 0.77	0.55**	0.35 - 0.86
Rich	0.31***	0.22 - 0.45	0.37***	0.23 - 0.60
House hold size				
Greater than 5	1		1	
Less than or equal to five	0.68***	0.51 - 0.90	0.80	0.54 - 1.19
Sex of household head				
Female	1			
Male	1.02	0.67 - 1.55		

Mother's age category				
15-24	1		1	
25-34	0.72***	0.53 - 0.99	0.44***	0.29 - 0.69
>=35	1.16	0.76 - 1.75	0.56	0.30 - 1.06
Marital status				
Never in union/no longer living together	1		1	
Married/living with partner	2.21***	1.15 - 4.26	3.21**	1.58 - 6.52
Mother's Education				
Primary	0.74***	0.54 - 1.00	0.84	0.58 - 1.22
Secondary	0.38***	0.23 - 0.63	0.58	0.31 - 1.11
Higher	0.36***	0.19 - 0.66	0.69	0.32 - 1.47
Media access (radio / TV)				
No media access	1		1	
Has media access	0.56***	0.41 - 0.76	0.93	0.64 - 1.36
Religion				
Orthodox	1		1	
Muslim	0.90	0.55 - 1.46	0.34***	0.19 - 0.61
Protestant	1.03	0.62 - 1.72	0.74	0.42 - 1.31
Catholic, traditional and other	4.18***	1.04 - 16.77	2.97	0.71 - 12.46
Sex of a child				
Male	1		1	
Female	0.81***	0.62 - 1.06	0.77	0.57 - 1.04

Child age category				
6-11	1		1	
12-18	0.49***	0.35 - 0.68	0.41***	0.28 - 0.59
19-23	0.31***	0.21 - 0.45	0.26***	0.17 - 0.40
Birth order				
1	1		1	
2-4	1.03	0.73 - 1.45	1.16	0.74 - 1.81
>=5	1.72***	1.16 - 2.55	1.87	0.96 - 3.64
ANC from skilled provider				
No	1		1	
Yes	0.56***	0.39 - 0.80	0.93	0.59 - 1.48
Attended 4+ ANC visits				
No	1		1	
Yes	0.59***	0.44 - 0.79	0.57**	0.39 - 0.83
Attended ANC in the first trimester of pregnancy				
No	1		1	
Yes	0.79***	0.59 - 1.06	1.17	0.81 - 1.69
Place of delivery				
Non-health facility	1		1	
Health facility	0.79***	0.57 - 1.09	1.52*	1.00 - 2.30
Baby postnatal check within 2				

months				
No	1		1	
Yes	0.77***	0.52 - 1.12	0.77	0.50 - 1.19
Given birth to a boy or girl who was born alive but later died				
No	1		1	
Yes	2.07***	0.75 - 5.66	1.43	0.49 - 4.19

	COR* p<0.25**	**AOR *** p<0.001, ** p<0.01, * p<0.05**

In the multi-variable multi-level logistic regression analysis wealth-index, mother's age, mother's marital status, religion, child age, attended 4+ ANC visit, place of delivery and region were found to be significant factors associated with children's zero fruits /vegetables consumption. A child from household with middle and rich wealth index had 55% and 37% less odds of zero fruits/vegetables consumption (AOR = 0.55, 95% CI: 0.35, 0.86) and (AOR = 0.37, 95% CI: 0.23, 0.60) respectively compared to children with poor household index.

Children of mothers who aged between 25-34 years old were 56% times less likely to have zero fruits/vegetables consumption than children from mothers aged between 15-24 years old (AOR=0.44, ;95%CI=0.29 – 0.69). Also, children of mothers who were married/living with partner had 3.21 (AOR = 3.21; 95%CI: 1.58 – 6.52) times higher odds of zero fruits/vegetables consumption compared to children of mothers/caregivers who have never been in a union/no longer living together. Moreover, children of mothers, who follow Islamic religion, had 34%

lower odds of zero fruits/vegetables consumption (AOR = 0.34, 95% CI: 0.19, 0.61) compared to those of mother's who follow Orthodox religion.

Further, the study revealed that the odds of zero fruits/vegetables consumption among children aged 12-18 month, and 19-23 months were 41% (AOR = 0.41, 95% CI: 0.28, 0.59), and 26% (AOR = 0.26, 95% CI: 0.17, 0.40) respectively, lower compared to children aged 6-11 months.

Moreover, children of mothers who had more than four ANC visits during their most recent pregnancy had 57% (AOR = 0.57; 95%CI: 0.39 – 0.83) lower odds of zero fruits/vegetables consumption compared to their counterparts. The study also shows higher odds of zero fruits/vegetables consumption among children who were born in health facility compared to their counterparts (AOR = 1.52, 95% CI; 1.00–2.30).

Furthermore, among the community level variables region was identified as significant factor associated with zero fruits/vegetables consumption as children from small peripheral regions had 4.40 times (AOR = 4.40, 95% CI; 1.39–13.97) higher odds of zero fruits/vegetables consumption compared to children from the metropolitan regions (Table 3).

Discussion

Zero fruits /vegetables consumption is one of the UNICEF/WHO indicators of infant and young child feeding practices. Among Ethiopian children age 6-23 months, 69.3 % did not consume any vegetables or fruits a day preceding the survey. The proportion of zero fruits/vegetables consumption in our study is lower than a study that reported 77.5% and 76.3% of school adolescent respectively in Seven African countries and five southeast Asian countries consumed less than the recommended five servings of fruits and/or vegetable a day (Peltzer & Pengpid, 2010, 2012).The finding of the present study was also lower than the finding of a study

conducted to assess global variability of fruits and vegetables consumption, which reported that "78.0% of respondents from mainly low- and middle-income countries consumed less than the minimum recommended five daily servings of fruits and vegetables"(Hall, Moore, Harper, & Lynch, 2009). The proportion of zero fruits/vegetables consumption in the present study is higher than a study conducted among in-school adolescents in southeast Asian countries that revealed 28% consuming fruits less than once per day and 13.8 % of the participant consuming vegetables less than once per day(Peltzer & Pengpid, 2012). These discrepancies might be due to the difference in the, socio-demographic characteristics, geographic, climate and feeding habit of the respondents.

In multivariable multilevel logistic regression analysis household wealth index, mother's age, mother's marital status, religion, child age, attending 4+ANC, place of delivery and region were found to be statistically significantly associated with zero fruits/vegetables consumption among children aged 6-23 months.

In the present study wealth index was significantly associated with zero fruits/vegetables consumption. A child from household with middle and rich wealth index had low probability of zero fruits/vegetables consumption compared to children from poor households. This is in line with a study conducted to assess social in equality in fruits and vegetables consumption by household and socio-demographic characteristics in Argentina and Thailand (Ballesteros et al., 2022; Satheannoppakao, Aekplakorn, & Pradipasen, 2009).This might be because of several reasons. First of all, it might be because of access to healthy foods, children from middle- and high-income households may have better access to fruits and vegetables because their families can afford to purchase them. On the other hand, families with lower income may have limited access to healthy food options due to their financial constraints. Secondly the household's food

insecurity could be the reason for high zero fruits and vegetables consumption of children from poor household wealth index. Family with lower incomes may have poor access to food, which can lead to lack of access to healthy foods, including fruits and vegetables. Furthermore, it could be due to better complementary feeding practice of women from middle and rich household wealth index(Shagaro, Mulugeta, & Kale, 2021). Therefore, financially empowering and general socio-economic conditions of households could enhance household food security and for that matter fruits and vegetable consumption. Moreover, promoting complementary feeding for children will reduce zero fruits/vegetables consumption.

Mother's age and marital status was also found to be significant predictors of zero fruits/vegetables consumption. Children of mothers aged between 25-34 years old were less likely to have zero fruits/vegetables consumption compared to children of mother aged 15-24 years old. Also, children of mothers who were married/living with their partners had higher probability of zero fruits/vegetables consumption .This is in line with a study conducted among children of East and South African Countries that reported that being a young mother (15-24 years) is a risk factor for not meeting minimum dietary diversity for children of East Africa(Kang et al., 2019). This might be related to their experience in feeding young children as older mothers are more likely to have more experience in practicing complementary feeding and parenting than younger mothers. It could also be that older mothers have more financial muscles and attained higher educational level, which may enhance their ability to access variety of foods for their children compare to younger ones. Also, mothers in the 25-34 age group may have had more education and exposure to nutrition education programs, which can increase their knowledge and understanding of the importance of fruits and vegetables in their children's diets. Therefore, multisectoral collaboration to address the academic and financial needs of mothers could help

reduce zero fruits/vegetables consumption among children. Furthermore, giving training on parenting and feeding of children will contribute to the reduction of zero fruits/vegetables consumption.

Frequency of ANC service utilization and place of delivery were also associated with zero fruits/vegetables consumption. Children of mothers who had more than 4 ANC visit were less likely to have zero fruits/vegetables consumption compared to their counterparts, this might be due to the possibility of frequent contact with health professionals, which could expose them to sufficient nutritional counseling about feeding their children. This is in agreement with studies that report positive association of frequent ANC visits with dietary diversity of children age 6-23 months (Paramashanti, Huda, Alam, & Dibley, 2022) . It is undoubtedly that ANC present an opportunity for enhancing maternal and child nutrition in low and middle income countries as during ANC education on healthy eating including the importance of fruits and vegetables in the diet is conducted, which may result in increased awareness of mothers about the importance of healthy diet for their own health and the health of their children(Organization, 2016). This awareness may lead them to prioritize the feeding of fruits and vegetables that will lead to a reduction of zero fruits/vegetables consumption and eventually reduction in micronutrients deficiencies among children. Therefore, promoting frequent ANC visits could enhance dietary diversification, which could lead to increase fruits and vegetable consumption.

However, children who were born in health facility had higher probability of zero fruits/vegetables consumption as compared with their counterparts. This could be due to the fact that mothers with complicated pregnancies are more likely to deliver in a facility and complication during delivery is also linked with less frequent antenatal visits and mothers with less frequent ANC visits are less exposed to nutrition education.

Children aged 12-18 month, and 19-23 months had less probability of consuming zero fruits/vegetables compared to children aged 6-11 months. This is consistent with a study conducted in sub-Saharan Africa that revealed that children aged 6-11 months were less likely to have consumptions of iron-rich foods including iron rich fruit and vegetables (Akalu et al., 2021). This observation is normal as children 6-11 are in a transition between liquid/semi liquid foods and the mainly solid family foods as they have limited chewing abilities. It could also be due to in-appropriate complementary feeding practice among mothers of children aged 6-11 months old(Shagaro et al., 2021) or mother's perceptions that children before the age of 1 year should not consume fruits/vegetables.

This study also revealed that children of mothers who were Muslim were less likely to have zero fruits/vegetables consumption compared to children of mothers who practice orthodox religion. Although the feeding habit of a mother is influenced by many factors including culture, personal beliefs as well as, access to food , extensive fasting by mothers who are Orthodox Christians may influence complementary feeding practices(Birhanu, Gonete, Hunegnaw, & Aragaw, 2022).We recommend that future research should qualitatively explore the feeding experience of women while fasting.

Furthermore, region which is a community level variable was also significantly associated with zero fruits/vegetables consumption. Children in the small peripheral regions (Afar, Benishangul, Gambella, and Somalia) were more likely to have zero fruits/vegetables consumption as compared with children from the metropolitan regions. This difference could due to easy access to fruits/vegetables, and better awareness of mothers on the benefits of feeding fruits/vegetables to children in Metropolitan areas. Furthermore, the discrepancy might be due to poor

socioeconomic status of small peripheral regions that results from repeated drought (Ahmed, Page, Arora, & Ogbo, 2020).

This study has strength of addressing unaddressed topic in Ethiopia using nationally representative data as well as advanced modeling to estimate both individual, household and community level variables. However, due to the secondary nature of the data we are unable to incorporate more variables like accessibility to fruits and/vegetables, parental feeding habit and psychological variables. Despite this limitation we believe that the study could serve as a baseline for future researchers.

Conclusion

In Ethiopia, the proportion of zero fruits/vegetables consumption among children age 6-23 months is high. Zero fruits/vegetables consumption was significantly associated with household wealth index, mother's age, mother's marital status, religion, child age, attending 4+ANC, place of delivery and region. Therefore, efforts should be made by stakeholders who are concerned about optimal diet and health of children to improve fruits and vegetables consumption of children particularly those from poor households, young mothers (15-24 years), and those from peripheral region of Ethiopia. This could be done during ANC follow up visits and during nutrition counseling.

Abbreviations

ANC: Antenatal Care, AOR: Adjusted Odds Ratio. CI: Confidence Interval, COR: Crude Odds Ratio, DHS; Demographic and Health Survey, EDHS; Ethiopian Demographic and Health Survey, EMDHS: Ethiopian Mini Demographic and Health Survey, WHO: World Health Organization, UNICEF: United Nations Children's Fund

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Magnitude of sugar-sweetened beverage consumption and associated factors among women aged 15-49 years old in two Sub-Saharan African Countries

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Abstract

Background: The consumption of Sugar-Sweetened Beverages (SSBs) has been linked to the global epidemic of obesity and chronic disease. Following the economic growth, urbanization, and attractive market for beverage companies, the consumption of SSBs is a rising public health challenge in low and middle-income countries. Hence, this study aimed to assess the magnitude of SSBs consumption and associated factors among women of reproductive age group in two SSA countries.

Methods: This cross-sectional study used data from Integrated Public Use Micro Data Series-Performance Monitoring for Action (IPUMS-PMA) with a total sample of 3759 women aged 15-49 years old in Burkina Faso and Kenya. The data was collected on June - August 2018 in Burkina Faso, and May -August 2018 in Kenya. SSBs consumption was measured by asking a woman if she drank SSBs yesterday during the day or night, whether at home or anywhere else. A mixed-effect logistic regression model was employed to identify associated factors.

Result: Half (50.38%) [95%CI; 46.04, 54.71] of women consumed SSBs. Sociodemographic characteristics like primary education (AOR = 1.35; 95%CI: 1.05 – 1.74), secondary education (AOR = 1.46; 95%CI: 1.13 – 1.90), being employed (AOR = 1.28; 95%CI: 1.05 – 1.56),and dietary characteristics like consumption of savory and fried snack(AOR=1.61, ;95%CI=1.24 – 2.09 ,achieved minimum dietary diversity (AOR = 1.67; 95%CI: 1.38 – 2.01) , moderate household food insecurity (AOR = 0.74, 95% CI: 0.58, 0.95), and sever household food insecurity (AOR = 0.71, 95% CI: 0.56, 0.89) had significant statistical association with SSBs consumption.

Conclusion: Consumption of SSBs among women in two Sub-Saharan African countries (Burkina Faso and Kenya) is high. Having higher educational status, being employed, achieved minimum dietary diversity, and having low/no household food in-security were found to be significantly associated with SSBs compared with their counterparts. We recommend for further study in other African countries using objective measurements of SSBs consumption.

Key words: Sugar, Beverage, unhealth diet, non-communicable disease, Africa

Background

One of an ongoing public health problem around the world is the consumption of Sugar - Sweetened Beverages (SSBs) above the daily limits for free sugar(Audain et al., 2019; Malik & Hu, 2022). SSBs consumption includes the intake of all type of beverages containing free sugars like fruit juices, soft drinks/fizzy drinks, chocolate drinks (including those made with powders), sweet tea or coffee with sugar, fortified sweet drinks, malt drinks and energy drinks(Elizabeth A. Lundeen, Park, Woo Baidal, Sharma, & Blanck, 2020; WHO, 2017) Following the economic growth, urbanization and attractive market for beverage companies in low- and middle-income countries, the consumption of SSBs is now on the rise (Audain et al., 2019; Malik & Hu, 2022).

The consumption of SSBs has been linked to the global epidemic of obesity and chronic disease(Malik & Hu, 2022). Though it's not an exclusive cause of non-communicable disease different studies have shown the association between higher consumption of SSBs with the risk of type2 diabetes mellitus, obesity, hypertension, cancer, heart disease, kidney disease, bone disease, and all-cause mortality (Ahn & Park, 2021; Imamura et al., 2015; Malik & Hu, 2019; Qin et al., 2020; Rebholz et al., 2019). Moreover, consumption of SSBs has been associated with less healthy behaviors like low physical exercise, low consumption of fruit/vegetables, and more screen time (television, cell phones, computers and video games) (CDC, 2022; E. A. Lundeen, Park, Pan, & Blanck, 2018). Furthermore, SSBs consumption among women has been linked with increased risk of breast cancer mortality(Farvid et al., 2021; Koyratty et al., 2021) ,gestational hypertension(Barbosa et al., 2021), periodontal disease (Menezes et al., 2019),early onset colorectal cancer(Hur et al., 2021),liver cancer(Zhao et al., 2022), postpartum weight gain(Alderete et al., 2020), diabetes(Stern et al., 2019), depression(Werneck et al., 2021),stroke,

coronary heart disease, and all-cause mortality(Mossavar-Rahmani et al., 2019). Also, evidence highlights the greater health risk of sugary soft drinks compared to sugar-containing foods(Sundborn et al., 2019).

Previous research conducted among different population groups mainly in developed countries identified socio demographic characteristics (younger age, urban residence, household income), health characteristics (perceived overweight, obesity, diagnosis of heart disease or depression), and dietary characteristics (fruit consumption, having had processed meat, fried food from street vendors) as factors associated with SSBs consumption (Guo et al., 2021; Miller et al., 2020; Supa Pengpid & Karl Peltzer, 2019).

Though there is limited evidence on SSBs sale and consumption in Kenya, in 2018/19 a 30% increase in sugar production was forecasted with estimated annual consumption of 800,000 metric ton(Wanjohi et al., 2021).

The increased consumption of SSBs in low- and middle-income countries, call for evidence based public health interventions to tackle the problems early (Audain et al., 2019; Malik & Hu, 2019; Yang et al., 2017). Meanwhile there is dearth of knowledge on magnitude of SSBs consumption and associated determinants in SSA. This study aimed to 1) assess the magnitude of SSBs consumption among women of reproductive age group in two Sub-Saharan African countries and, 2) Identify factors that are associated with SSBs consumption among women of reproductive age group in two SSA countries This study may serve as a baseline to guide the development of targeted interventions to address diet related non-communicable diseases.

Methods

Study setting: This study is conducted in two Sub-Saharan Africa countries(Kenya and Burkina Faso).Kenya is a lower middle income country in East Africa with 47 administrative counties and population size of above 55 million(Worldometer). About 34% of households in Kenya are headed by women. Also, about half (45%) of women in reproductive age (20-49) in Kenya are obese or overweight (ICF., 2023).

Burkina Faso is a low income landlocked Sahelian country in West Africa. The country is divided into 13 regions, 45 provinces and 351 municipalities(Kaboré et al., 2020). The total population of Burkina Faso as at 2019 was about 21 million with 51.7% being women(UNICEF, 2020).

Global Nutrition Report estimates show that Burkina Faso has shown inadequate progress towards achieving the diet related non-communicable disease (NCD) targets as 10.1% of adult women and 3.4% of adult men are obese. In the same vein, diabetes is estimated to affect 6.6% of adult women and 9.3% of adult men(Repor).

Study design, and data source

Cross sectional study design was used. The data was obtained from the Integrated Public Use Micro data Series-Performance Monitoring for Action (IPUMS-PMA) website(Boyle et al., 2022). The data was initially collected by a project called PMA 2020. PMA 2020 is a project that collects data on households, women, and service delivery points (i.e., health facilities) in 11 priority countries that have pledged to participate in the Family Planning 2020 (FP2020) effort. From 2017 through 2018, the PMA2020 program piloted a new nutrition survey module in two Sub-Saharan African Countries (Burkina Faso and Kenya). IPUMS PMA is another project that provides an interactive web dissemination system for PMA data by coding variables consistently

across countries and survey years to facilitate pooling, trend analysis, and comparative research. So this study used the data collected in the 2018 nutrition survey of PMA, and harmonized by (IPUMS-PMA) (Zimmerman, Olson, Group, Tsui, & Radloff, 2017).We accessed the data through the website of IPUM-PMA (https://pma.ipums.org/pma/index.shtml) after submitting brief description about the aim of the study.

Population and sampling procedure

PMA nutrition survey in 2018 (Burkina Faso and Kenya) used multi-stage stratified cluster sampling, where households were selected in sampled clusters, or enumeration areas (EA).

In Burkina Faso 83 enumeration areas (EAs) were sampled, and in each EA, 43 households were randomly selected. Forty-five percent of households were then randomly sub-selected. The female-child questionnaire was administered to all women age 10-49 in sub-selected households (Performance Monitoring for Action (PMA), 2018).

Whereas in Kenya a sample of 151 EAs were drawn first, and then in each EA, 56 households were randomly selected. Twenty-five percent of households were then randomly sub-selected. Finally the female-child questionnaire was administered to all women age 10-49 years in sub-selected households(I. C. f. R. H. K. I. Performance Monitoring for Action (PMA), 2018).

This study included a sample of 3759 women of reproductive age group (age 15-49) (1868 from Burkina Faso and 1891 from Kenya).

Data collection

The PMA2020 Burkina Faso and Kenya used innovative mobile technology to collect nationally representative nutrition data. Data was collected on women 10-49 years of age. Open Data Kit

Collect (ODK), an open-source software that facilitates mobile assisted data collection, was used to create the survey platform. Local data collectors (trained in mobile assisted data collection), conducted interviews in households using smartphones equipped with ODK software. Data was then uploaded to a central server where it was validated and aggregated(*PMA2020 Nutrition Survey –Burkina Faso and Kenya:Measurement Innovations Report 2018*). Data collection was conducted between June and August 2018 in Burkina Faso and between May and August 2018 in Kenya.

Study variable measurements

Dependent Variable: SSBs consumption which is measured by asking a woman if she drank yesterday during the day or night, whether at home or anywhere else "Any sugar-sweetened beverages like sweet fruit drinks, soft drink/fizzy drinks, sweet tea, sugar-sweetened milk tea" with an optional answer of Yes, No, or No response(FAO, 2021; PMA).

Independent Variables:

The independent variables were chosen in the light of the current state of knowledge of their association with consumption of SSBs. The explanatory variables include age, marital status, education level, employment status, pregnancy status, ever given birth, savory and fried snack consumption, achieved minimum dietary diversity, wealth, and household food insecurity (Chang et al., 2022; Amanda Silva Fontes et al., 2020; Norliza et al., 2019; Supa Pengpid & Karl Peltzer, 2019).

Minimum Dietary Diversity (MDD) was measured by combining (aggregating) food groups and sub food groups into the 10 MDD food groups. These food groups were 1) Grains, white

roots and tubers, and plantains, 2) pulses (beans, peas and lentils),3) nuts and seeds,4) Diary,5) Meat, poultry and fish,6) Eggs,7) Dark green, leafy vegetables,8) Other Vitamin-A rich fruits and Vegetables,9) Other fruits, and 10) Other Vegetables. The 10 MDD groups are then summed into a score ranging from 0 to 10. Finally each woman is then coded "yes" or "no" for scoring ≥ 5 (FAO, 2021).

Household food insecurity: is measured using an 8 items (Annual food insecurity experience scale), and then categorized as "severe" if 6 or more of the statements were true, "moderate" if 4-5 were true, and "low/none" otherwise(F. a. A. O. o. t. U. N. FAO, 2023; Pinchoff, Turner, & Grace, 2021).

Data management and analysis

After accessing the data from IPUM-PMA website data re-coding, labeling, cross-tabulations and analysis were done using STATA Version 14. Prior to conducting any statistical analysis, the data was weighted using sampling weight (fnqweight), and strata to keep the representativeness of the survey and to get more reliable estimates. Descriptive analysis was utilized to show the respondents' socio-demographic characteristics (frequency and percentages – Table 1) and SSBs consumption by wealth index and household food insecurity (Bar graph). Bivariable analysis was used to indicate the possible associations between the dependent and independent variables (Table 2). Given that the hierarchical structure of the PMA data, we employed mixed-effect logistic regression for the inferential statistics. The presence of community level (EA) clustering was evidenced by Interclass Correlation Coefficient (ICC) of 0.44. Variables with a p-value ≤0.2 at the bivariable analysis were considered for multivariable analysis. Thus, all associations in

multivariable analysis whose p-value was less than 0.05 were considered statistically significant. Results are presented as Odds Ratios (ORs) with 95% confidence intervals (CIs).

Ethics consideration

The 2018 PMA nutrition Surveys can be downloaded from the website and are free to use by researchers for further analysis. To access the data from the IPUMS PMA website, a written request was submitted to the IPUMS. Permission was granted to use the dataset for this study; this was received from the IPUMS-PMA in February 2023. The PMA ensured international ethical standards of confidentiality, anonymity and informed consent, and availability of de-identified PMA datasets.

Results

Background and Household characteristics

This study analysed data of 3,759 women aged 15-49 years old in two Sub-Saharan Africa countries (Kenya, and Burkina Faso). The median age of the women was 27 years old with interquartile range of (20,35). The majority of the study participants (68.27%) were married/living with partner at the time of data collection, and only 7.93 % of them attended tertiary education. Furthermore, most (72.72 %) of them were unemployed, and 38.08% of the women lived in a household with sever food insecurity Table 4.

Table 4 Background and household characteristics of women aged 15-49 years old in Burkina Faso, and Kenya, IPUM-PMA data 2018. [N =3759]

	%	Frequency (N=3,759)
Sociodemographic characteristics		

Age category(years)		
15-19	20.65	776
20-34	50.84	1,911
35-49	28.52	1,072
Marital status		
Never Married	25.12	944
Currently married/living with partner	68.27	2,566
No longer living together	6.61	248
Highest level of school attended, general		
Never attended	34.93	1,313
Primary/Middle school	30.37	1,142
Secondary/post-primary	26.76	1,006
Tertiary/post-secondary	7.93	298
Employment status		
Not employed	72.72	2,734
Employed	27.28	1,025
Ever given birth		
No	27.12	1,019
Yes	72.88	2,740
Pregnancy status		
No	92.62	3,481
Yes	7.38	278

Dietary Characteristics		
Woman consumed yesterday: sugar-sweetened beverages		
No	49.62	1,865
Yes	50.38	1,894
Woman consumed yesterday: savory and fried snacks		
No	87.94	3,306
Yes	12.06	453
Achieved minimum dietary diversity		
No	57.52	2,162
Yes	42.48	1,597
Household characteristics		
Wealth score tertile		
Lowest tertile	29.8	1,120
Middle tertile	35.46	1,333
Highest tertile	34.74	1,306
Household food insecurity		
No/low	41.13	1,546
Moderate	20.79	781
Sever	38.08	1,431

Magnitude of women's sugar-sweetened beverages consumption

Half (50.38%) [95% CI; 46.04%, 54.71%] of women consumed SSBs in the 24-hour period of the survey date. The magnitude of SSBs consumption among women of reproductive age in two

SSA countries exhibited an upward trend in correspondence with rising household income. Specifically, within the lowest wealth tertile, 41% [33%, 49%] of women reported SSB consumption, while this proportion increased to 49% [43%, 55%] within the middle wealth tertile, and further escalated to 60% [56%, 65%] within the highest wealth tertile (Fig 1).

Additionally, SSBs consumption displayed an inverse relationship with household food insecurity levels. In households experiencing severe food insecurity, 46% [40%, 52%] of women reported SSB consumption. Within moderately food-insecure households, this figure rose to 48% [41%, 54%], and among households with no or low food insecurity, the proportion of SSB consumption was highest at 56% [50%, 61%] (Fig4).

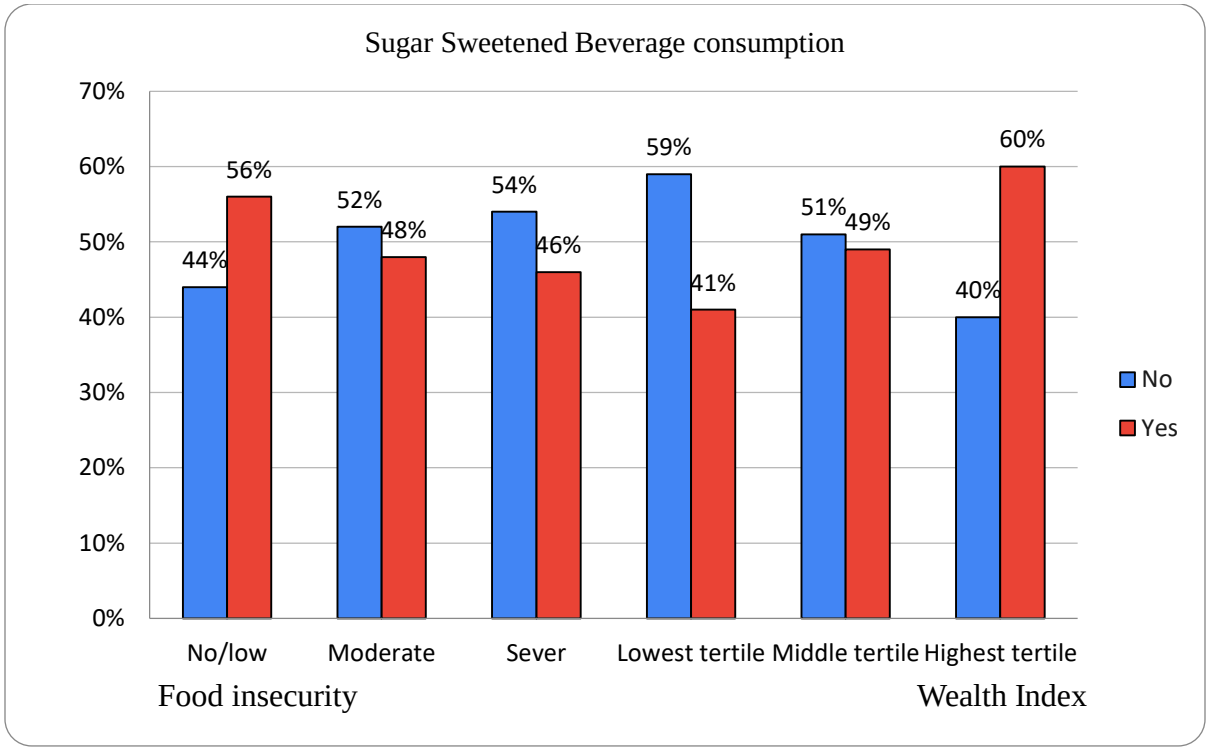

Figure 4: Distribution of Women's consumption of SSBs by Food Security and Wealth Index among women aged 15-49 years old in Burkina Faso, and Kenya, IPUM-PMA data 2018. [N =3759]

Bivariate analysis results factors associated with SSBs consumption

Bivariable mixed effect logistic regression analysis was fitted to identify variables for multivariable mixed effect logistic regression. Accordingly: Age, education level, employment status, savory and fried snack consumption, achieved minimum dietary diversity, wealth, and household food insecurity were candidate for the multivariable analysis at p-value< 0.2 Table 5.

Table 5: Bivariable mixed-effect logistic regression analysis of factors associated with women's SSBs consumption among women aged 15-49 years old in Burkina Faso, and Kenya, IPUM-PMA data 2018. [N =3759]

Variables	**Bivariate analysis**	
	COR	**CI**
Sociodemographic variables		
Age category		
15-19	1	
20-34	1.15*	0.94 - 1.42
35-49	1.09	0.87 - 1.38
Marital status		
Never Married	1	
Currently married/living with partner	1.08	0.90 - 1.29
No longer living together	1.19	0.85 - 1.69

Highest level of school attended, general		
Never attended	1	
Primary/Middle school	1.30*	1.02 - 1.66
Secondary/post-primary	1.52*	1.19 - 1.93
Tertiary/post-secondary	1.93*	1.33 - 2.81
Employment status		
Not employed	1	
Employed	1.39*	1.16 - 1.67
Ever given birth		
No	1	
Yes	1.00	0.84 - 1.19
Pregnancy status		
No	1	
Yes	1.14	0.84 - 1.56
Dietary Variables		
Woman consumed yesterday: savory and fried snacks		
No	1	
Yes	1.78*	1.37 - 2.30
Achieved minimum dietary diversity		
No	1	
Yes	1.85*	1.54 - 2.22
Household variables		
Wealth score tertile		

Lowest tertile	1	
Middle tertile	1.23*	0.95 - 1.60
Highest tertile	1.93*	1.42 - 2.63
Household food insecurity		
No/low	1	
Moderate	0.68*	0.54 - 0.86
Sever	0.61*	0.49 - 0.75
COR=Crude Odds Ratio	* p<0.2	

Factors associated with women's sugar-sweetened beverages consumption.

In the multi-variable mixed-effect logistic regression analysis education level, employment status, savory and fried snack consumption, achieved minimum dietary diversity, and household food insecurity were found to be significant factors associated with women's sugar-sweetened beverages consumption.

In this study level of education was significantly associated with SSBs consumption. Women with primary, and secondary education respectively were about 1.3 (AOR = 1.35; 95%CI: 1.05 – 1.74), and 1.5 (AOR = 1.46; 95%CI: 1.13 – 1.90) times more likely to consume SSBs compared to women with no education. Also, women who have some forms of employment were about 1.3 times more likely to have SSBs consumption than those who were unemployed (AOR = 1.28; 95%CI: 1.05 – 1.56).

Women who consumed savory and fried snack were about 1.6 times more likely to have SSBs consumption than those who did not consume savory and fried snack (AOR=1.61, ;95%CI=1.24

– 2.09). Moreover, women who achieved minimum dietary diversity were about 1.7 (AOR = 1.67; 95%CI: 1.38 – 2.01) times more likely to consume SSBs compared to women who did not achieve minimum dietary diversity.

Further the study revealed that household with moderate, and sever food insecurity decreased the likely of women's SSBs consumption by 74% (AOR = 0.74, 95% CI: 0.58, 0.95), and 71% (AOR = 0.71, 95% CI: 0.56, 0.89) respectively compared to households with no/low food insecurity Table 6.

Table 6: multi-variable mixed-effect logistic regression analysis of factors associated with women's SSBs consumption among women aged 15-49 years old in Burkina Faso, and Kenya, IPUM-PMA data 2018. [N =3759]

Variables	**AOR**	**95%CI**
Sociodemographic variables		
Age category		
15-19	1	
20-34	1.18	0.95 - 1.47
35-49	1.17	0.91 - 1.51
Highest level of school attended, general		
Never attended	1	
Primary/Middle school	1.35***	1.05 - 1.74
Secondary/post-primary	1.46***	1.13 - 1.90
Tertiary/post-secondary	1.34	0.90 - 1.99

Employment status		
Not employed	1	
Employed	1.28***	1.05 - 1.56
Dietary Variables		
Woman consumed yesterday: savory and fried snacks		
No	1	
Yes	1.61***	1.24 - 2.09
Achieved minimum dietary diversity		
No	1	
Yes	1.67***	1.38 - 2.01
Household variables		
Wealth score tertile		
Lowest tertile	1	
Middle tertile	1.07	0.82 - 1.40
Highest tertile	1.35	0.97 - 1.87
Household food insecurity		
No/low	1	
Moderate	0.74***	0.58 - 0.95
Sever	0.71***	0.56 - 0.89
AOR=Adjusted Odds Ratio	*** p<0.05	

Discussion

This study found that 50.38% of women within the age range of 15 to 49 years in two SSA countries (Kenya and Burkina Faso) reported consuming SSBs in the 24-hour period preceding the PMA 2018 nutrition survey. This agreed with a study that found an increased trend of high levels of SSBs consumption in low and middle income countries**(Malik & Hu, 2022)**.The magnitude of SSBs consumption in this study is also consistent with a study in Australia that shows that the past week prevalence of pre-packaged drinks containing free sugar among adult population aged 18+ was 47.3%(Miller et al., 2020). This is also consistence with a study conducted among low-income, overweight or obese pregnant women in western and southern Michigan, which revealed 48.2% consumption of SSBs (Chang et al., 2022).However the finding of the present study is lower than a study conducted among adult population in India that revealed 96.3% prevalence of SSBs consumption (Subramanian et al., 2023). This discrepancy might be because of the difference in the study population i.e. the study in India were conducted among all adults aged 18-80 years old, whereas the present study included only women aged 15-49 year old (Subramanian et al., 2023).The operationalization of SSBs consumption may also be the reason for the discrepancy i.e. while our study is based on single-day 24-hrs dietary recalls the study in India was based on asking how frequent respondents report drinking SSBs (daily, weekly, occasionally, or never)(Subramanian et al., 2023).

In the current study socio-economic variables like education level and employment status were found to be associated with SSBs consumption among women of reproductive age group in two SSA countries. Women with primary and secondary education were more likely to consume SSBs compared with women with no education. In contrast to the finding of this study, a study conducted among low-income, overweight or obese pregnant women in western and southern

Michigan, and among adults aged 18–30 years in Australia highlighted that individual with low educational status were more likely to consume SSBs(Chang et al., 2022; McNaughton, Pendergast, Worsley, & Leech, 2020).This discrepancy might be explained by the difference in awareness of healthy food choice between women from high income (Michigan, Australia) and low income (Africa) countries. In addition, our study found that women who were employed were more likely to consume SSBs. This is consistence with a study conducted in India, São Paulo and South Africa that revealed positive association between high socioeconomic class and consumption of SSBs (A. S. Fontes et al., 2020; Prioreschi, Ware, Draper, Lye, & Norris, 2022; Subramanian et al., 2023).

Dietary characteristics like consumption of savory and fried snack, and achieving MDD were also found to be associated with SSBs consumption. Consistence with a study conducted among adult population in South Africa, women who consumed savory and fried snack were more likely to take SSBs compare to those who did not consume savory and fried snacks (S. Pengpid & K. Peltzer, 2019). This might be related to the likely of simultaneous engagement of an individual in various unhealthy behaviors (S. Pengpid & K. Peltzer, 2019; Rocha et al., 2021). For instance if someone is a cigarette smoker he/she is more likely to be alcohol drinker (Jiang, Lee, & Ling, 2014), likewise, those who have been engaging in consumption of savory and fried snacks for a while, may have a strong desire to engage in other unhealthy dietary behavior like Consumption of SSBs.

Furthermore, our study found that women from household with moderate /severe food insecurity problem consume less SSBs compared to women from household with low/no food insecurity problem. This finding is also supported by a literature that showed that increased consumption patterns of SSBs in low and middle income countries is attributed to urbanization and economic

growth(Malik & Hu, 2022).Meaning those with no/low food insecurity problem might be economically sound and may be more likely to consume SSBs.

The strength of this study includes using appropriate statistical model for data that has hierarchical structure (women clustered in EAs). The study also describes SSBs consumption among reproductive age group using large sample size, representative of women of reproductive age group in two SSA countries (Kenya and Burkina Faso).

The limitation of this study could be that the analysis is on data from only two SSA countries. The 24-hour food consumption questionnaire may not measure the actual consumption of SSBs due to recall and, social desirability bias. Moreover, we have not included other potential factors like perceived overweight, a diagnosis of heart disease or depression due to the secondary nature of our data. Those limitations may impact on the interpretation of our findings in relation to the magnitude and correlates of SSBs intake and further studies in other African Countries with more comparable measurement of SSBs intake are needed to confirm these findings.

Conclusions

On the whole, this study illustrates that SSBs consumption among women in two SSA countries is high. Having higher educational status, being employed, achieved minimum dietary diversity, and low/no household food in-security were found to be significantly associated with consumption of SSBs.

Abbreviations

AOR: Adjusted Odds Ratio. CI: Confidence Interval, COR: Crude Odds Ratio, IPUMS: Integrated Public Use Micro Data Series, PMA; Performance Monitoring for Action, SSBs: Sugar -Sweetened Beverages

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Authors' Contribution

BES and AA conceived the research concept. BES acquired the data and performed the research analysis. BES prepared the initial draft of the manuscript. AA, SDK and BES critically revised the manuscript for intellectual content. All authors approved the final version of the manuscript.

Ethical approval and consent to participate

The 2018 PMA nutrition Surveys can be downloaded from the website and are free to use by researchers for further analysis. To access the data from the IPUMS PMA website, a written request was submitted to the IPUMS. Permission was granted to use the dataset for this study; this was received from the IPUMS-PMA in February 2023. The PMA ensured international ethical standards of confidentiality, anonymity and informed consent, and availability of de-identified PMA datasets.

Availability of data and materials

The datasets used and/or analyzed during the current study is publicly available. The data was extracted from IPUMS-PMA website (*https://doi.org/10.18128/D081.V7.3*) on February 22, 2023. Redistribution of IPUMS PMA data is not permitted under their terms of use.

Competing interests

The authors declare that no competing interests

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4. CHAPTER FOUR

4.1. General Discussions

The study's findings emphasize two important aspects of nutrition and food habits in Sub-Saharan Africa (SSA). First of all, it demonstrates the seriousness of poor fruit and vegetable consumption among Ethiopia's young children. Secondly, it highlights an alarming pattern of increased intake of sugar-sweetened beverages among women in SSA region.

Almost 70 % of children aged 6-23 months in Ethiopia had zero fruits/vegetable consumption. Due to the fact that feeding practice during early life contributes to lifelong nutritional habit, and overall health (Grimm et al., 2014; Riley et al., 2018),the consumption of fruits and vegetables by young children in Ethiopia is a major concern for their health and development. The findings of the present study is consistent with a study conducted in Gondar city in Ethiopia that revealed 63.7% of children had unhealthy food consumption(Jemere, Alemayehu, & Belew, 2023).This high burden of unhealthy diet consumption may be related to the influence of unhealthy food marketing and limited access to healthy dietary choice(Mc Carthy, de Vries, & Mackenbach, 2022).

In the multivariable analysis household wealth index, mother's age, mother's marital status, religion, child age, attending 4+ANC, place of delivery and region were found to be statistically significantly associated with zero fruits/vegetables consumption among children aged 6-23 months. The findings emphasize the necessity of taking the socioeconomic context and geographical disparities into account when developing tailored nutrition interventions in Ethiopia. Socioeconomic factors influence food preferences and nutritional status, and addressing these discrepancies is critical to promoting equitable access to healthy diets(Serasinghe et al., 2023). Furthermore, the relationships found between certain

characteristics of mothers and child fruit/vegetable eating underline the crucial role of mother education and health awareness in shaping early childhood nutrition.

Half (50.38%) of women in Burkina Faso and Kenya had sugar-sweetened beverages during the day preceding the survey date. The high use of sugar-sweetened beverages among women in Kenya and Burkina Faso is consistent with the global and SSA trend of increased consumption of such unhealthy, high salt, sugars and fats, and low fruits and vegetables diet (Baker et al., 2020; Holdsworth et al., 2020). This issue has sparked concern because of its link with the global epidemic of non-communicable disease (NCD) like diabetes mellitus, cancer and cardiovascular disease (Busnatu et al., 2022; WHO)

The current study revealed that Sugar sweetened beverage consumption is linked with higher socioeconomic status. This finding is consistent with the findings of a study conducted in Nigeria, Tanzania, and Uganda, which provided light on the consumption habits of ultra-processed foods, such as sugar-sweetened beverages, across various socioeconomic strata. According to the research, the prevalence of ultra-processed food intake was 12% among those in the lower socioeconomic group, while it was 32% among those in the upper socioeconomic group(Dolislager, Liverpool-Tasie, Mason, Reardon, & Tschirley, 2022). The observed factors related to this consumption pattern, such as educational level, employment status, savory and fried snack consumption, achieved minimum dietary diversity, and household food insecurity, highlight the problem's multifaceted nature. Interventions to limit the consumption of sugar-sweetened beverages should therefore address these variables through targeted awareness campaigns, enhanced nutritional education, and policy that promotes healthier food choices.

4.2. Conclusions

This study sheds light on the nutritional issues that women and young children in SSA experience. In Ethiopia, low consumption of fruits and vegetables among children are alarming and require immediate attention. In Burkina Faso and Kenya, there is excessive consumption of sugar-sweetened beverages among women. The factors linked to this unhealthy dietary habit highlight the need for comprehensive interventions that address socioeconomic, and healthcare-related issues.

4.3. Recommendations

- Organizations such as the United Nation Children's Fund (UNICEF), World Food Programme (WFP), and Action against Hunger (ACF) with focus on ensuring safe nutrition in SSA should develop and implement targeted public health campaigns and nutrition education programs aimed at women in SSA, with a focus on the identified factors associated with high sugar-sweetened beverage consumption.
- Ethiopian Ministry of Health (MOH), and Ethiopian Public Health Institute(EPHI) should strengthen child nutrition and growth monitoring program and put especial emphasis on children fruit and vegetable consumption.
- Ethiopian Ministry of Health (MOH) should also strengthen the integration of nutrition counseling and education into Ethiopia's existing antenatal care (ANC) programs to provide expectant women with critical information on the need of early fruit and vegetable introduction into their children's diets.
- There is the need for further studies to identify psychosocial factors that affect food choice at the community level and to introduce and test an evidence based public health interventions to promote healthy dietary consumption among women and children in SSA.

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APPENDICES

Questionnaires

Questions asked by EMDHS2019 and considered in this thesis for answering the first and second specific objectives

1.How old were you at your last birthday? ……. Years.

2.Does your household have:

A radio? YES NO

A television? YES NO

3.Have you ever attended school? NO YES

4.What is the highest level of school you attended:

PRIMARY

SECONDARY

TECHNICAL/VOCATIONAL

HIGHER

5.What is your religion?

ORTHODOX

CATHOLIC

PROTESTANT

MUSLIM

TRADITIONAL

OTHER--------

6.Are you currently married or living together with a man as if married?

YES, CURRENTLY MARRIED

YES, LIVING WITH A MAN

NO, NOT IN UNION

7.What is your marital status now: are you widowed, divorced, or separated?

WIDOWED

DIVORCED

SEPARATED

Now I would like to ask some questions about your children born in the last five years. (We will talk about each separately.)

8.Did you see anyone for antenatal care for this pregnancy? Yes No

9.Whom did you see? Anyone else?

HEALTH PERSONNEL

DOCTOR.

NURSE

MIDWIFE

HEALTH OFFICER

HEALTH EXTENSION WORKER

OTHER PERSON TRADITIONAL BIRTH ATTENDANT

OTHER

10.How many months pregnant were you when you first received antenatal care for this pregnancy?

.....Months Don't Know

11.How many times did you receive antenatal care during this pregnancy?

Number of times……. Don't know

12.Where did you give birth to (NAME)?

HOME

HER HOME

OTHER HOME

PUBLIC SECTOR

GOVERNMENT HOSPITAL

GOVERNMENT HEALTH CENTER

GOVERNMENT HEALTH POST

OTHER PUBLIC SECTOR

NGO

HEALTH FACILITY

OTHER NGO HEALTH

PRIVATE MEDICAL SECTOR

PRIVATE HOSPITAL.

PRIVATE CLINIC

OTHER PRIVATE MEDICAL SECTOR

OTHER……

13.Did any health care provider or a traditional birth attendant check on (NAME)'s health in the two months after you left (FACILITY IN which you gave birth)?

YES NO DON'T KNOW

14.Have you ever given birth to a boy or girl who was born alive but later died? YES NO

Questions asked by PMA Burkina Faso and Kenya Nutrition Survey and considered in this thesis for answering the third and fourth specific objectives

1.How old were you at your last birthday?.....years

2. What is the highest level of school you attended? (Only record formal schooling. Do not record bible or koranic school or short courses)

◯ Never Attended

◯ Primary

◯ Post-Primary/Vocational

◯ Secondary/'A' Level

◯ College (Middle Level)

◯ University

◯ No response

3.At present, aside from your household chores, do you have another job/occupation?

◯ Yes

◯ No

◯ No response

4.Are you currently married or living together with a man as if married? Probe: If no, ask whether the respondent is divorced, separated, or widowed.

◯ Yes, currently married

◯ Yes, living with a man

◯ Not currently in union: Divorced / separated

◯ Not currently in union: Widow

◯ No, never in union

◯ No response

5.Have you ever given birth?

◯ Yes

◯ No

◯ No response

6.Are you pregnant now?

◯ Yes

◯ No

◯ Unsure

◯ No response

Now I'd like to ask you about foods and drinks that you ate or drank yesterday during the day or night, whether you ate it at home or anywhere else. I am interested in whether you had the food items I will mention even if they were combined with other foods. For example, if you had a soup made with carrots, potatoes and meat, you should reply "yes" for each of these ingredients when I read you the list. However, if you consumed only the broth of a soup, but not the meat or vegetable, do not say "yes" for the meat or vegetable. As I ask you about foods and drinks, please think of foods and drinks you had as snacks or small meals as well as during any main meals. Please also remember foods you may have eaten while preparing meals or preparing food for others. Please do not include any food used in a small amount for seasoning or condiments (like chilies, spices, herbs or fish powder). I will ask you about those foods separately.

Did you eat...			
	YES	No	No Response
a. Any foods made from grains, like maize, rice, wheat, porridge,			

sorghum, bread, noodles			
b. Any vegetables or roots that are orange or yellow inside like pumpkin, carrots, squash or yellow sweet potatoes			
c. Any white roots and tubers or plantains like Irish potatoes, yams, cassava, white sweet potatoes			
d. Any dark green, leafy vegetables like sukumu wiki			
Did you eat...			
e. Any fruits that are dark yellow or orange inside like ripe mangoes, pawpaw			
f. Any other fruits			
g. Any other vegetables			
h. Any meat made from animal organs like liver, kidney, heart			
301. Did you eat...			
i. Any other meat, such as beef, pork, lamb, goat, chicken, duck, or dik dik			
j. Eggs			
k. Fresh or dried fish or shellfish			
l. Any foods made from beans, peas, lentils			
Did you eat... 009a=1 Y N NR			
m. Any nuts and seeds like groundnut or groundnut paste			
n. Any milk or milk products like cheese or mala			
o. Any savory and fried snacks like fried chips, crisps, puffs, samosas, or other fried foods			

p. Sugary foods, jiggery (sukari nguru), mandaazi, donuts, cake, sweet biscuits or candies			
Did you eat...			
q. Any sugar-sweetened beverages like sweet fruit drinks, fizzy drinks, sweet tea, sugar-sweetened milk tea			
r. Any condiments and seasonings used in small amounts for flavor, like spices, herbs, fish powder, tomato paste			
s. other beverages and foods like unsweetened tea or coffee, clear broth, alcohol			

Now I would like to ask you some questions about food. Please let me ask these questions to the person in the household who is primarily responsible for buying food and preparing meals. This could be the female head of household.

1.During the last 12 MONTHS, was there a time when you or others in your household were worried you would not have enough food to eat because of a lack of money or other resources?

◯ Yes

◯ No ◯ Do not know ◯ No response

2. Still thinking about the last 12 MONTHS, was there a time when you or others in your household were unable to eat healthy and nutritious food because of a lack of money or other resources?

◯ Yes ◯ No ◯ Do not know ◯ No response

3.During the last 12 months, was there a time when you or others in your household ate only a few kinds of foods because of a lack of money or other resources?

◯ Yes ◯ No ◯ Do not know ◯ No response

4. During the last 12 months, was there a time when you or others in your household had to skip a meal because there was not enough money or other resources to get food?

◯ Yes ◯ No ◯ Do not know ◯ No response

Ethical consent from DHS and PMA

Jan 16, 2023

Birhan Ewunu Semagn
Debre Berhan University
Ethiopia
Request Date: 01/16/2023

Dear Birhan Ewunu Semagn:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Magnitude of Zero Vegetable / Fruit Consumption and Associated Factors among Children age 6-23 months in Ethiopia: Multilevel analysis":

Ethiopia

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

Gmail Birhan Ewunu Semagn <ewunubirhan@gmail.com>

IPUMS PMA data extract is ready.

ipums@umn.edu <ipums@umn.edu> Wed, Feb 22, 2023 at 3:10 PM
To: ewunubirhan@gmail.com

Your IPUMS PMA extract is ready.
To retrieve your data, codebook, and command files, go to the link below.

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https://doi.org/10.18128/D081.V7.2

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IPUMS PMA, University of Minnesota, www.ipums.org

Thank you for your support.

Sincerely,
The IPUMS PMA Team