College of Natural and Computational Science Center for Food Science and Nutrition

Dietary Diversity in Addis Ababa mothers and children aged 6-36 months in: Assessing variation across a year (2022-2023).

Candidate: Eden Amare

A thesis to be Submitted to the Graduate Studies of Addis Ababa University in Partial Fulfilment of the Requirements for Degree of Master of Science in *Community Nutrition.*

June 5 2024

Addis Ababa, Ethiopia

Addis Ababa University
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School of Graduate Studies

Center for Food Science and Nutrition

DECLARATION

I, the undersigned declare that this is original work and has never been presented in this or any other university and that all source materials used for this thes is have been properly acknowledged.

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Place: Addis Ababa University, Addis Ababa, Ethiopia

Date of Submission: June 5, 2024

The thesis has been submitted for examination under approval of university advisors.

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Final Thesis Approval Form

As participants of the board of examiners of the final MSc thesis. Open defence, we declare that we have read and evaluated the thesis prepared by Eden Amare under the title allowed " **Dietary Diversity among mothers and children aged 6-36 months in Addis Ababa: Assessing variation across a year (2022-2023).”** and recommend for the degree of Master of Science in Community Nutrition.

Signed by the examining committee:

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Name of Internal Examiner	**Signature**	**Date**
Name of Chair Person	**Signature**	

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List of Abbrivations

EC	Eating competence
CI	Confidence Interval
DD	Dietary Diversity
DQI	Diet Quality Index
ESS	Ethiopian Statistics Service
EPHI	Ethiopian Public Health Institute
EMDHS	Ethiopia Mini Demographic Health Survey
FCS	Food consumption score
FANTA	Food and Nutrition Technical Assistance Project
FAO	Food and Agriculture Organization
FMOH	Federal Democratic Republic of Ethiopia Ministry of Health
HEI	Healthy Eating Index
IUER	Intrauterine Growth Retardation
LMICs	Low and middle-income countries
LW	Lactating Women
MDS	Mediterranean diet score
MDD	Minimum dietary diversity
PW	Pregnant Women
SD	Standard Deviation
SDG	Sustainable Development Goal
UNICEF	United Nation Children's Fund
WHO	World Health Organization
WFP	World Food Program

ABSTRACT

Background: Diverse diets provide the nutrients needed for an active and healthy life. However, lack of diversified diets are public health concern in worldwide and women and children in low- and middle income countries are disproportionality affected. In the face of increased food price these days, how do diets are affected in low income countries like Ethiopia remains to be studied.

Objective: This study aims to assess variations in women's and children's dietary diversity across a year. It also looked at the consumption status of each food group across a year.

Methods: The study employed within subject study design among 123 pairs of women and children (6-36 months) in five selected sub- cities in Addis Ababa, Ethiopia. Dietary data were collected from two consecutive years, on January 2022(the first round) and January 2023 (the second round).

Result: We found that the mean DDS of children increased by 26%, while that of women showed a slight reduction. Proportion of minimum DDS achieved in children was increased from 29 to 49%, where as that of women decreased from 12 to 10%. Consumption of milk and vitamin A rich vegetables were decreased, whereas legumes, other fruits and vegetables were increased. Prices of all the food items across the study period has significantly increased.

Conclusion and Recommendation: Therefore, in order to promote food-based dietary intervention, there should be food price stabilization and subsidizing nutrition relevant foods groups like animal source foods and vitamin A rich food sources. Nutrition sensitive sectors [agriculture] should aggressively work on diverse food availability to the level that enhance economic access of consumers. Community level awareness [education] should be further promoted regarding nutritional benefits of cheaper alternative foods that could somehow substitute the expensive high-quality food items. In doing so, we could promote urban food security.

Keywords: *dietary diversity, adult women, children 6-36 months, food price, within subject study, urban, Ethiopia*

1. INTRODUCTION

1.1 Background

Lack of diversified diets are public health concerns worldwide. Diverse diets provide the nutrients needed for an active and healthy life. Today, less than half of the world's population consumes diverse diets (IFPRI, 2024). Consequently, micronutrient deficiencies impact more than half of children under five and two-thirds of adult women (Stevens et al., 2022). Low and middle-income countries (LMICs) particularly shoulder the greatest burden of the problem.

Individual-level dietary diversity measures are proxy indicators for nutrient adequacy (Arimond et al., 2010). Thus, achieving adequate dietary diversity of women and children are crucial for health and nutrition outcomes. Diverse diets include—fruits, vegetables, legumes, nuts, grains, and various animal-source foods (ASFs). For many people, these nutrient-dense foods are unaffordable, not readily available, or not preferred for a variety of reasons (IFPRI, 2024).

Secondary data analysis from the 2016 Ethiopian Demographic and Health Survey (EDHS) by Woldegebriel et al. (2020) showed that only 8.5% of children in the country achieved the recommended minimum dietary diversity (DD) of four or more food groups out of seven. Evidence from studies conducted at various parts of Ethiopia showed one in four (25%) lactating women achieved the minimum DD (Fufa&Laloto, 2021; Mulaw et al., 2021; Molla et al., 2022).

Several factors hinder women and children from achieving the minimum DD, including socio-economic and demographic factors (Pandy et al., 2020), particularly mother's education, wealth index, age of a child, number of under-five children within the same household (Woldegebriel et al., 2020), status of women/mothers such as being involved in income generating activities and household decision making (Baye et al., 2021). Beyond such individual or household level factors, external environmental factors also affect the availability and accessibility of diverse food items.

With this respect, studies so far given attention on how seasonality affect dietary diversity across a year. These studies have showed a difference in DD at household level, being up to 8% higher in post-harvest season as compared to the pre-harvest (Abizari et al., 2017; Kabeta et al., 2023). In addition, variation in diet was observed in rural-urban residence type (Birhan et al., 2020). For instance, 18.5% among urban children, while 6.3% in rural Ethiopia were achieved the minimum DD (Woldegebriel et al., 2020). Like in most low-income countries, rural areas in Ethiopia also

inhouse the large proportion of the population and show disproportionally higher magnitude of undernutrition. Owing to this most of the studies assessing diet have focused on rural areas where consumption from own production make a significant part of their diet. However, people residing in urban areas rely mainly on the market where food price significantly affect the demand of consumers to various food items (Kuma, 2010; Hasan, 2018).

In recent years, inflation rate has been rising steadily in Ethiopia (ESS, 2023). This results in an automatic increase in food prices. To this background, little research attention has been paid to assess how food consumption is affected in terms of dietary diversity across time. This study, therefore, aimed at assessing how DD scores of women and children vary across a year, and evaluates whether there are changes in consumption of particular food groups across the study period. These were assessed through conducting within subject survey at two similar point across a year.

1.2 Statement of the problem

All populations are at risk for poor food consumption, but women and children are the most vulnerable groups (Birhan et al., 2020). The magnitude is particularly large in resource limited settings like Ethiopia. Furthermore, in a period of economic instability (inflation), consumers are more likely to change the composition of their expenditures. This is portrayed by a strong shift towards minimizing expenditure even for basic needs, such as quantity and quality of food (Ioannis, 2012; Omoteshoet *al*., 2016). In the previous few years, inflation rate in Ethiopia has been significantly increased from 15.8% (2019) to 33.7% (2022) (ESS, 2023). This significantly affects urban population relying largely on market for food consumption.

As food prices fluctuate due to inflation, households may face challenges in maintaining a diverse and nutritious diet. Studies have shown that higher food prices are associated with reduced dietary diversity (Hasan, 2018). For instance, Kuma (2010) evaluated trend of households food expenditure pattern in urban households of Ethiopia including Addis Ababa for a period of 10 years (1994-2004). The author found that the share of expenditure on animal source foods was increased by 3-fold (2.7 to 9.4%), while expenditure on cereals decreased (43 to 33%). The general inflation rate of the country during the studied period of 10 years (1994-2004) was increased from 7.59 to 13.67%.

Unlike the case in Kuma (2010) where inflation was relatively stable, in the previous few years inflation become significantly high in the country. Given a relatively stable income of consumers across a year, a single year inflation 2021 - 2022 was 33.7%. To this background, further studies assessing consumption patterns in urban settings of Ethiopia are strongly required.

1.3 Significance of the study

The present study provides baseline data with respect to how food consumption could vary across a year in the face of significant inflation in food commodities. The study identifies if there are changes/shift in consumption of food groups across the study period, this provides evidence for further intervention. Having such information could enhance inputs into nutrition sensitive program targeted towards food-based interventions.

Most previous studies have focused on factors affecting DD at household and individual levels. While this study focused on external factor that affect economic access of consumers, i.e., increasing food price. Again, unlike most existing studies that have assessed dietary diversity in women and children using a cross-sectional study design, our study evaluated how DD varies across time using a follow-up study design.

As the study focuses on food consumption of urban residents, it generates evidence that will direct various stockholders (government decision makers, development partners, and nutrition sensitive sectors) aimed at striving to ensure urban food security.

1.4 Research Question

The present study will answer the following research questions:

- To what extent do diet diversity score of women vary across a year in Addis Ababa?
- To what extent do diet diversity score of child vary across a year in Addis Ababa?
- Consumption of which food groups are affected across a year among mothers and children in Addis Ababa?

1.5. Objectives

1.5.1 General objective

- To evaluate how dietary diversity scores of women and children vary across a year (2022-2023).

1.5.2 Specific objectives

- To examine how dietary diversity score of women vary across a year in Addis Ababa.
- To examine how dietary diversity score of children vary across a year in Addis Ababa.
- To evaluate any change or shift in particular food groups consumed among women and children across a year in Addis Ababa.

2. LITERATURE REVIEW

2.1 Dietary Diversity

The number of various meals or food types consumed over a specific reference period is known as Dietary Diversity, according to the WHO and UNICEF. An indirect indicator of the quality of a household's diet and ability to meet its nutritional demands is the variety of diets and the patterns of food intake within it. Dietary diversity is a measure of an individual's access to different food sources, which in turn reflects the region's agricultural biodiversity, dietary requirements, and household and individual food security (Bulungu *et al.*, 2020). In low- and middle-income countries, dietary diversity has been verified as a measure of dietary quality for infants and early children, highlighting its importance in determining nutritional sufficiency (Thorne-Lyman *et al.*, 2019).

According to nutritional guidelines, eating an increased number of foods and food groups is advised, with an emphasis on the fact that no single item is complete and includes every nutrient needed for a healthy life. Therefore, a varied diet is necessary to meet needs for energy and micronutrients, particularly for children and adult women who are at risk of malnutrition. Poor diets that are lacking in essential nutrients are the main cause of health issues globally and have an effect on people's wellbeing at all ages (Leclercq *et al*., 2019). A varied and sufficient dietary intake pattern is essential for the general development and well-being of children, adolescents, pregnant women (PW), nursing women (LW), and children. Without being conscious of and paying attention to dietary habits. Malnutrition problems in adolescent girls, pregnant women, and nursing mothers cannot be resolved unless food consumption patterns and dietary diversity are recognized and prioritized. To lessen the burden of micronutrient insufficiency among the aforementioned vulnerable populations, particularly mothers and children, a number of groups advocate dietary diversification initiatives (Umallawala*et al.,* 2022). Eating is a periodic behavior that involves ingesting food through the mouth. This process is known as food intake. Numerous converging factors (such as the time of day, need state, sensory stimulation, social environment, etc.) combine to activate it at different times throughout the day. Improved food is thought to multiply the Sustainable Development Goals (SDGs) (Mekonnen *et al*., 2021).

Dietary diversity indicators are relatively simple to determine and use, and several have demonstrated an association with nutrient adequacy. They can be used as a stand-in for diet quality at the individual or mother and child level. (Ruel, 2003). In cultures where starchy staple foods are the norm and micronutrient deficiencies are more common, dietary diversification is particularly crucial (Ruel, 2003). A decrease in dietary diversity may result from households finding it difficult to afford a variety of foods during periods of inflation or financial crises (Thorne-Lyman et al., 2010). It has been demonstrated that dietary diversity within a household is related to both household income and adequate protein and calories (Swindale &Bilinksy, 2006).

Individual dietary diversity indices, like the Minimum Dietary Diversity for Women (MDD-W) and the Minimum Dietary Diversity (MDD) for children 6-23 months, can serve as a rough proxy for diet quality and nutrient adequacy (FAO & FHI, 2016; Moursi et al., 2008). While there is agreement on the need of dietary diversity, there are several techniques to measuring using different food groups and recall periods.Validated approaches like dietary diversity scores are crucial for evaluating maternal and child dietary diversity in low- and middle-income countries, MDD module for children from 6-23months (Bulungu *et al*., 2020).

2.1.1 Dietary diversity in Children and Mother

The nutritional status of children under two years of age is directly affected by their feeding practices and, ultimately, affects child survival (Stewart *et al*. 2013). The World Health Organization (WHO) defines minimum dietary diversity (MDD) as the consumption of 4 or more food groups from the 7 food groups for higher dietary quality and to meet daily energy and nutrient requirements of the seven recommended food groups for children aged 6–23 months whereas for mothers from 10 food groups (Maiga *et al*. 2022). These seven food groups were: grains, roots, and tubers; legumes and nuts; dairy products (milk, yogurt, cheese); flesh foods (meat, fish, poultry, and liver or organ meats); eggs; vitamin-A rich fruits and vegetables; other fruits and vegetables. The cut-off point was related with the better quality of diets for both children aged 6 to 23 months who are breastfeeding and not.

According to WHO reporttoday, less than half of the world's population consumes diverse diets rich in fruits, vegetables, and other nutritious foods. low-income countries, ensuring adequate dietary diversity for women and children is critical for public health and nutrition. Research has shown that many people in low-income communities do not consume the recommended levels of

dietary diversity, leading to nutrient inadequacy, especially among pregnant and lactating women (Kornatowski & Comstock, 2018).

According to a cross-sectional study conducted in Mekele, inappropriate complementary feeding practices remain a major public health issue in many poor countries, with many children falling prey of malpractice (Lutter *et al*., 2011). Only about a third of children aged 6 to 23 months met the bare minimum of dietary diversification (Mekbib*et al*., 2014). A health facility-based cross-sectional study conducted in Addis Ababa on minimum dietary diversity found that children with minimum dietary diversity were 59.9%. Mother's educational attainment and a higher household monthly income were positively connected with the minimal dietary diversity practice. Similarly, mothers' knowledge on dietary diversity and child feeding were positively associated with minimum dietary diversity of children (solomon*et al*., 2017). A study was undertaken on the nutritional status and dietary diversity of children below two years in Kasungu and Mzimba, Malawi have shown Minimum dietary diversity were 60% (Kuchenbecker *et la.,* 2017). In northern Ghana, a community-based cross sectional cluster survey found that 34.8% received minimum dietary diversity (≥4 food groups) (saaka*et al*., 2015). over the past 15 years, Ethiopia, has seen a significant decrease in child under-nutrition, but Childhood malnutrition still remains a major public health challenge in Ethiopia. According to the 2019 Ethiopian Mini Demographic and Health Survey 37%, 21% and 7% of children under five years were stunted, underweight, and wasted, respectively (FMH and EMDHS, 2019). However, this is hypothesized to be even worse in Amhara Region (the study area) due different social factors such as fasting animal source foods, which also obliges the child to fast. A meta-analysis conducted in Ethiopia on dietary diversity and feeding practice among children age from 6 to 23 months result showed that the pooled prevalence of dietary feeding practice among children age 6–23 months in Ethiopia was 23.25%. In the subgroup analysis, the lowest prevalence was observed in Amhara region (study area) (12.58%) (Tassew *et al.*, 2019).

Lactating mothers' nutritional inadequacy has an impact not only milk composition and production, but also on their and their infant's health. If the mother is malnourished during lactation, the nutrients delivered to the baby will be low of quality and quantity. Similarly, a comprehensive evaluation of studies conducted in Ethiopia found 41 %, while another community-based study conducted in the Gamo zone, Kucha district found 24.7 %and 14 %

respectively (Azene *et al*., 2021; Guja *et al*., 2021, Yihun and Kaleab, 2022).Ethiopia has a low minimum dietary diversity among pregnant women. In Ethiopia only 47% of women had to meet minimum dietary diversity at the national level, while 28% of women had to meet adequate dietary diversity in the SNNPR of Ethiopia, where women ate 3.7 out 10 food groups on average. A community based cross sectional study obtained from southern nation nationalities and people's region of Angecha district showed that, the prevalence of low dietary diversity was 9 52.2 %. The average dietary diversity score was 4.5 (± 1.58 SD) in which the score was ranged from 1 to 8(Boke MM, and Geremew AB, 2018). In Southwest Ethiopia, Jimma zone a community based cross-sectional survey conducted with title of Fighting Hidden Hunger: Diversity, Composition and Nutrient Adequacy of Diets of LW, shows that the prevalence of low DDS was 53.46% in three districts. Majority of the study participants consume cereals, fats and oils grains, and vegetables (97.3%-99.3%). The least consumed food groups were dairy products and fruits 25.1% and 12.9% respectively (Sirawdink and Forsidoac, 2016).

Nutrition Baseline Report of Graduation with resilience to achieve sustainable development project done on productive safety net program woreda of Amhara, Tigray Oromia and southern nation's nationalities and people regions, prevails that the mean meal frequency and dietary diversity of women in reproductive age including lactating mothers was 2.8 and 2.9 out of 9 food groups. Almost One third of the respondent females consumed three food groups while 28.3% of them ate 4 food groups and above (Bogale S, 2014). In south Gondar Amhara Ethiopia, a community based cross sectional survey conducted to examine the dietary diversity and associated factors among rural households' shows that only 16.2% had high dietary diversity, which mean they access seven or more food groups in their diets during the preceding 24 hours among twelve food groups(Keagaetsho& Downing, 2021).

A community based cross sectional survey with the title of Poor dietary diversity and low adequacy of micronutrient intakes among rural Indonesian lactating women from Sumedang district, West Java done in Southeast Indonesia prevails that the Mean Dietary Diversity Score (MDDS) of lactating mothers over 3 days was 4.3±1.2 among nine food groups. On average most commonly consumed food groups among study participants were starchy staples (mainly rice), followed by flesh foods other than meats, legumes and nuts. The consumption of organ meats and dairy products was low, ranging from 7 to 20%, respectively (Rahmannia S, *et.al*. 2019). A

hospital-based age and sex matched case-control study conducted in Bangladesh Dhaka prevails that the mean dietary diversity score of lactating mothers was 4.23±1.92 in cases and 4.89±1.80 in controls (Dhaka A, et.al. 2017). A survey drown from demographic and health survey in three developing countries by United States of America international development, Infant and young child nutrition project shows that the mean dietary diversity scores for women were 4.0 in Cambodia and Ghana, but only 3 in Haiti. Almost half of Haitian women consumed no more than 2 food groups, but only 10 percent in Cambodia and 14 percent in Ghana women consume more than two food groups (USAID, 2012). Research finding obtained from an analysis of the Ghana Demographic and Health Survey to verify the association between maternal and Child dietary Diversity in West Africa shows that the mean dietary diversity of lactating mothers was 5.45±2.28 from fifteen food groups (Amugsi DA, *et.al.* 2015).

In Kenya north eastern Africa, Mbagathi District Hospital, located at the edge of Kibera slum Nairobi, a descriptive cross- sectional survey shows that the mean dietary diversity score of lactating mothers was 4.3 (±1.0) from nine food groups. In Malawi a cross-sectional survey of Household food insecurity is associated with low dietary diversity among pregnant and lactating women in rural Malawi prevails that only 28.1% of lactating mothers meet the mean DDS from nine food groups. The finding confirms that food insecurity was directly associate with lower DDS of lactating mothers (Kang Y, *et.al.* 2019). A Community based cross-sectional study done in Rongai Sub-County; Nakuru, Kenya 75% of women in reproductive age group consumes foods from less than five food groups. The mean dietary diversity score of women in that investigation was 3.78 ± 0.99, which did not meet the mean dietary diversity threshold. The overall prevalence of low dietary diversity was 79% i.e. mean DDS < 5 from 9 food groups (Gitagia MW, 2019).

Research finding obtained from baseline community surveys conducted in Bangladesh, Vietnam, and Ethiopia as part of a large project (Alive and Thrive) aimed at reducing under nutrition and death caused by sub- optimal infant and young child feeding practices prevails that the mean DDS of lactating mothers were 4.1±1.2, 4.6± 1.1 and 2.8 ± 1.3, respectively from seven food groups (Nguyen PH, et.al. 2013). In Ethiopian, an institution based Cross sectional study conducted in Aksum Tigray show that the mean dietary diversity of lactating mothers was 3.4. From that investigation a total of 56.4 % lactating mothers had low dietary diversity (less than mean DDS) (Woldehawaria NB, *et.al* 2016). A study finding from community based cross sectional survey of Feeding practice nutritional status and associated factors of lactating mothers in samre woreda south eastern zone

of Tigray Ethiopia prevails that the mean dietary diversity of lactating mothers was 5 out of 14 food groups. The study showed that majority of lactating mothers i.e. 71.2% do not take additional meal during lactation. Almost all study participants consume cereal based foods (99.3%). Foods like Milk and milk products, Vitamin A rich fruits and vegetables, egg and meat were least consumed (Haileslassie *et al*., 2013). In conclusion, the trend of women and child dietary diversity scores over time in low-income countries reflects the persistent challenges in achieving adequate nutrition and dietary quality. Addressing factors such as household food security, access to diverse foods, and maternal education is vital for enhancing dietary diversity scores and fostering better health outcomes for women and children in low-income settings (Ruel, Marie T., and Harold Alderman, 2013)

2.2 Factor influencing maternal and children food consumption

2.2.1 Socioeconomic and Sociodemographic Status

Ethiopia has an abundantce of natural resources. The majority of Ethiopia's socioeconomic indicators are extremely low and, food shortages have aggregated the country's already weak. Maternal and childhood malnutrition diminishes productivity, leading to bad results for family and community, and the broader society. It is influenced not only by lack of adequate nutrition but also influenced by factors like socio demographic factors, socio-economic factors, nutritional knowledge of mother (James &Opiah, 2019), variations in rural-urban resident type for ease of geographic access (Birhan et al., 2020).

Furthermore, socio-economic factors such as household income, education level, and access might amplify the impact of food seasonality on dietary diversity. According to research by Keding et al. (2012) investigated the relationship between socio-economic status and dietary diversity among rural households in Nepal and found that households with higher socio-economic status were better able to cope with seasonal food shortages by diversifying their food sources and adopting strategies such as food storage and preservation. Understanding how age influences child food consumption during growth is essential for promoting optimal nutrition and health outcomes. A study by (Dai *et al*., 2009) explored age-related changes in dietary intake among children aged 6 months to 4 years old. The findings revealed significant variations in food preferences and consumption patterns across age groups, with younger children exhibiting a greater reliance on breast milk or on formula and older children gradually transitioning to solid

foods. This transition period is marked by rapid growth and development, needing nutrient intake to support the increasing energy requirements of the growing child. Furthermore, age-related variations in physical activity levels and metabolic rate can influence energy expenditure and appetite regulation, impacting food consumption patterns. Studies by Birch and Fisher (1998) and Reilly et al. (2005) investigated the relation between age, physical activity, and dietary intake, emphasizing the importance of promoting healthy eating habits and active lifestyles from an early age to mitigate the risk of excessive weight gain and associated health complications.

Religion influences the dietary practice, particularly among mothers and children, through various cultural and religious norms that govern food choices and consumption patterns. According to (Heiman *et al*., 2019), religious dietary guidelines, such as those found in Islam, Judaism, and Hinduism, can impact the diversity of foods consumed, often leading to restrictions or preferences for specific food groups Studies such as the work by (Sewenet & Schwarcz, 2021) emphasize how religious beliefs, notably among Ethiopian Orthodox Christian and Muslim influence dietary diversity. For instance, fasting practices during religious holidays, such as Lent and Ramadan, often involve abstaining from certain foods, affecting the variety of nutrients consumed. Additionally, religious ceremonies and traditions often dictate specific food preferences and taboos.

Many components of larger context can help, including food prices and trade policy, marketing laws, political stability, poverty, access to healthcare, agriculture and food systems, education, society, and culture, as well as aspects of the environment. These factors create an ideal environment for malnutrition to thrive. Malnutrition further predisposes African women and children for women and children in Sub-Saharan Africa the environmental and economic conditions impose an additional burden on their nutritional status pervasive poverty affects the quality of the diet for both mothers and children(Lartey, 2008).A high-quality diet decreased the risk of all manifestations of malnutrition by encouraging healthy growth, development, and immunity, Achieving a sustainable food system thus implies profound and simultaneous changes to agricultural production systems, food distribution practices, and diets (Ferrero *et al*, 2018).

2.2.2 Food practice

Food practices are material and ideational (cognitive) elements that contribute to distinct eating patterns within a geographic region or social group (Ellouze*et al* 2023). Material factors include food production systems that grow, transport, and distribute food; financial resources to acquire food; and meal preparation (acquisition, cooking, storage) and eating location. cuisine, ―rules‖ for meals, ceremonial uses of foods, prestige and status attributed to foods, and social organization (roles, status) around food production, preparation, and consumption. This article, focus on ideational aspects of culture as an entry point to shifting norms about how we grow, procure, and prepare our foods (Berkum *et al* 2018).

Food practices are primarily transmitted from parents to children (Kerrane, *et al* 2018). Social grouping's (eg, families, schools, and peers) structure and timing of meals, where food can be consumed (at table, with others, etc), and how to eat (eg, food manners, eating pleasure). Cuisine (food combinations, flavors, and seasonings) has a major influence in food acceptanceand helps shape food preferences among children. The acceptability of desirability for sustainable healthy diets will be influenced by sociocultural factors (Siegrist and Hartmann ,2020). Policies that promote using less processed food (to reduce packaging) and more cooking at home may discriminate or further subjugate women (Okpara and Anugwa). Where animal-source foods are preferentially offered to men, the promotion of plant-based foods may further condone women's inadequate access to animal-source food. In societies with many religions, exploring religious food practices would be relevant when considering system-wide actions, such as taxation on lamb or goat meat, symbols of religious affiliation, with high greenhouse gas emissions.

2.2.3 Maternal nutrition literacy

Healthy eating habits developed in childhood carryout into later life. Whilst some eating behaviours appear to have a genetic basis (Lalanne *et al*.2011), the early feeding environment is thought critical to the development of healthy eating behaviours that will ensure children to effectively self-regulate energy intake through the ability to recognize and respond appropriately to internal cues of satiety and hunger, and ultimately achieve and maintain a healthy weight status. Parental feeding practices piqued interest of both researchers and clinicians alike because they constitute modifiable risk factors for problematic child diet-related outcomes and appear to be amenable to intervention.

Mothers play a significant role in shaping the dietary intake of their young children through their own dietary intake and the foods they make available at home(Kueppers *et al*., 2018).According to EPHI survey in 2013 the relative contribution of each food groups to the overall consumption pattern among children in Addis Ababa percent contribution by food group are cereal/grain 19.9 legumes 2.7, root and tubers 3.4, flesh foods 1.1, dairy product 37.4, fat and oil 1.7, fruit and vegetable 10.5 and for women its cereal/grain 63.9, legumes 7.9, root and tubers 2.1, flesh foods 2.8, dairy product 0.9, fat and oil 1.5, fruit, and vegitables 10.5. Feeding practices are defined as content-specific, goal-directed strategies used by parents in attempt to control or modify their child's diet and eating behaviors (DiSantis *et al*. 2020) non-responsive feeding practices that are controlling, encourage children to eat for reasons other than hunger may interfere with a child's ability to self-regulate their energy intake, i.e., to adjust their eating in response to internal feelings of fullness or satiety. It is proposed that when parents fail to perceive or respond effectively to their children's internal indications of hunger or fullness, the child's ability to self-regulate may be impaired. Therefore, the way in which feeding is responsive is an important element of the caregiver-child interaction. Responsive feeding is defined as developmentally appropriate (not intrusive or controlling), prompt, and contingent responses to infant and child hunger and satiety (Black and Aboud, 2011). Also integral to responsive feeding are: establishing routines around mealtimes (eating at the same place and times), modelling appropriate behaviour (making healthy choices), and ensuring children are seated.

2.2.4 Food seasonality and access

Jones *et al*. (2014) studies the seasonal fluctuation in dietary diversity among mothers and children in rural Bangladesh. The findings revealed that food consumption patterns varied significantly across different seasons, with dietary diversity scores being lowest during the lean season when food availability was limited. During this time, households relied mainly on basic foods, resulting in reduced intake of micronutrient-rich foods such as fruits, vegetables, and animal-derived foods, which are essential for meeting the nutritional needs of mothers and children. Similarly, a study by Dangour*et al.* (2010) investigated the effect of food seasonality on dietary diversity and nutritional status among rural households in sub-Saharan Africa. The findings indicated that seasonal fluctuations in food availability influenced dietary choices and consumption patterns, with households experiencing food shortages during the lean season resorting to monotonous diets lacking in variety and nutritional quality. This resulted in

compromised dietary diversity and increased risk of malnutrition among mothers and children, particularly in regions with limited access to diverse food sources. Food prices play a significant role in shaping dietary diversity scores among women and children, impacting their access to a variety of foods. To this background, little study has been conducted on how dietary diversity is influenced in urban areas, particularly among vulnerable population groups, women and children across time. Food choice is about why people eat the foods they do, and selections are the outcome of processes that are complex, influenced by biological, psychological, economic, social, cultural, physical, and political factors (Chen *et al*. 2020 and Antonelli). According to Ecological Systems Theory, human behaviour depends on the interaction of various environmental factors and personal characteristics, such as genetics, gender, and age.The child's ecological niche includes family and peers, Variety and complexity of children's milieu increases throughout life.

Food environment is described as the collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage preferences and nutritional status(Swinburn*et al.*, 2013). The food environment is divided into four aspects to the food environment: the community nutrition environment (such as the type and location of eateries), the consumer nutrition environment (such as the availability of healthy food options), the organizational nutrition environment (such as the accessibility of food in places like schools), and the information environment. Teff, wheat, corn, maize, and sorghum are common staple foods in the study environment that are linked to inadequate food consumption, as well as a lack of variation in dietary practices (Geda *et al*., 2021) Due to this inadequate food consumption, there are widespread and serious issues with both chronic and acute food consumption in both rural and urban areas of the country (Fekadu *et al.*, 2019).

2.3 Importance of nutrition in early childhood

To grow and develop to their full potential, children must consume the appropriate meals at the appropriate times (Engle, 2020). The 1,000-day period from pregnancy until a child's second birthday is the most critical time for proper nutrition is during. In the first two years of life, breastfeeding saves lives, shields children from disease, boosts brain development and guarantees children a safe and nutritious food source (Giugliani, 2000). UNICEF and the World Health Organization (WHO) suggest that infants begin breastfeeding within one hour of birth, be

exclusively breastfed for the first six months, and continue breastfeeding until 2 years of age or beyond. At the age of 6 months, children need to begin eating their first foods (Piwoz*et al* 2019). Young children should be fed frequently and in adequate quantities throughout the day, and their meals must be nutrient-dense and comprised of a variety of food groups. Caregivers should prepare and feed meals with clean hands and dishes, and interact with their child to respond to her or his hunger signals. What, when and how children eat is more important before age 2 than at any other time in life. Yet, today, many infants and young children are not receiving the nutrition they have to survive and thrive. Children's first foods too often lack diversity and are low in energy and nutrients. Globally, one in three children aged 6–23 months is eating the minimum diverse diet needed for healthy growth and development. Young children's diets are frequently comprised of grains with little fruit, vegetables, eggs, dairy, flesh foods. Many are increasingly being fed sugary drinks and packaged snacks high in salt, sugar and fat. Poor diets in early childhood can cause to deficiencies in essential vitamins and nutrients such as vitamin A deficiency, which weakens children's immunity, increases their risk of blindness and can lead to death from common childhood diseases like diarrhea. Proper nutrition during early childhood is essential for healthy physical, cognitive, and social-emotional development.

2.4 Food price

2.4.1 Consumer price inflation

Food prices are a primary determinant of consumption patterns, and high food prices may have important negative effects on nutritional status and health, especially among poor people (Iannotti *et al* 2012). The global food price crisis of 2007-08 focused international attention on the effect of changes in food price on nutrition and health. Estimates from the United Nations Food and Agriculture Organization suggest that in 2008 an additional 40 million people were pushed into hunger by the global rise in cereal prices, and evidence is accumulating that dietary diversity and quality have been negatively affected by food price rises, particularly among the poorest. In contrast, the governments of wealthy countries are increasingly adopting fiscal measures that change the relative price of foods to promote healthy diets (Green *et al* .2013). Similar studies have suggested that imposing taxes on foods such as sugar sweetened beverages or foods high in saturated fats and could result in reductions in obesity and cardiovascular mortality, although

because of a lack of relevant data the actual impact of such taxes on different population subsections is largely unknown.

Fiscal approaches to control tobacco use have identified that responsiveness to raised tobaccprices is higher in low-income countries and among poorer households who spend a greater relative share of their income. Similar information on the differing response to food price changes by national and household income level is needed to help with the identification of food price policies to protect population health. A recent report by the Food and Agriculture Organization identified the absenceof a robust evidence base with which to guide policies on food price, and important questions remain concerning the impact of changes in food prices on food consumption, especially in poor populations (Ivanic *et al.* 2008). New evidence on malnutrition risks among 1.27 million children from 44 low- and middle-income countries quantifies the significant negative health effects caused by rising food prices (Nandy *et al*. 2016).

2.4.2 Food price and consumption

According to Central statistical services of Ethiopia the average annual food inflation rate for the country stood at (31.8 %) in 2023 compared to 40.2 % in 2022, about eight percentage point reduction compared to last year figure. Unlike the previous years, the inflation rate consistently stacked at double digit since 2019 with increasing trend. Particularly, in the year 2022 and 2023, the inflation rate has been significantly increased over 30 percent for most months. Internal and external factors forced the inflation to be at higher level; COVID19, internal conflict, and Russia-Ukraine war were the major factors. Prices of most food items have been consistently increased across the years (2022-2023). However, some food items presented different pattern. For instance, fruits and vegetables show seasonal variation in price. Likewise, price of fish does vary across the year. Price of edible oil has presented a considerable variation across the period that could be related to deficit or abundance in supply from abroad (ESS,2023). According to a secondary data analysis from the ESS for our study period, we have seen that price of food item increased dramatically.

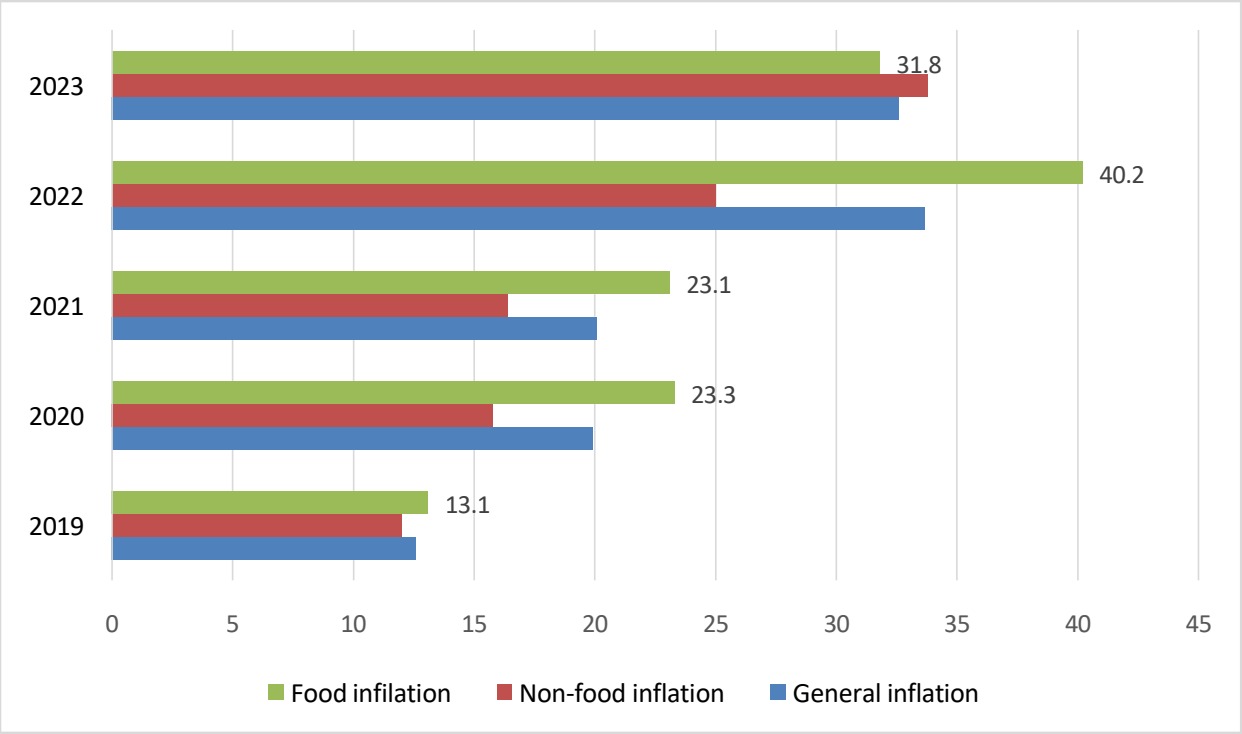


Figure 1**:** Trend of average annual food, non-food and general inflation rate (%) in Ethiopia across 2019-2023. Source: constructed by the author based on Ethiopian Statistical Service (2023).

Government gives much attention to the subsector to increase production and marketing through accelerated investment in infrastructure and adoption of better seed varieties and fertilizer technology to assure food consumption (Seid, 2011). Due to this poor food consumption both chronic and acute problems of food consumption are widespread and severe in both rural and urban areas of the country (Ruel *et al.*, n.d.). According to world bank report of food Price Crisis Observatory, the current financial crisis seems to have affected consumers' attitudes in many countries. The economic uncertainty and insecurity have led consumers to take decisions minimizing their costs, even for basic needs, such as food quantity and quality. In a period of inflation and unemployment, consumers are more likely to change the composition of their expenditures therefore there is a strong shift towards poor food consumption for cheaper products with lower nutritional value that leads malnutrition. In conclusion, fluctuations in food prices due to inflation have a direct impact on dietary diversity scores among women and children. Higher food prices can limit access to a variety of foods, leading to decreased dietary diversity. Empowering women economically and implementing income support programs during times of

food price shocks are crucial strategies to help maintain adequate dietary diversity scores in vulnerable populations (Bryan, E., & Quisumbing, A., 2023).

Women's empowerment in agriculture has been identified as a factor that can mitigate the negative effects of low production diversity on maternal and child nutrition (Malapit *et al*., 2015). This suggests that empowering women economically can help improve dietary diversity scores for both women and children, even in the face of challenges such as inflation in food prices. Additionally, income plays a crucial role in determining dietary diversity, highlighting the importance of effective income support programs during periods of food price shocks (Hasan, 2017).

Furthermore, the impact of food price inflation on dietary diversity extends beyond just access to food. Studies have shown that food price increases not only reduce dietary diversity but also lead to dietary deprivation and adjustments in consumption patterns among households (Onyango *et al*., 2023). As food prices rise, households may be forced to compromise on the variety and quality of foods they consume, ultimately affecting their overall dietary diversity scores.

3. MATERIALS AND METHOD

3.1 Study area

Study was conducted in Addis Ababa capital city of Ethiopia which is urban area with total population of 5,228,000 and 58.9 million are female and 58.98 million males with 11 sub-cities and 116 woredas with absolute location of 8.9806°Nand 38.7578°E. The prevalence of underweight in women of reproductive age was 22.3% (EDHS, 2016). The prevalence of underweight, stinting and wasting among children aged 6-24 month is 26.6%, 38.6% and 9.4% in Addis Ababa. The research was carried out in selected five sub-cities in Addis Ababa, namely Arada, Kirkos, Kolfe, Lideta, and Gulelie.

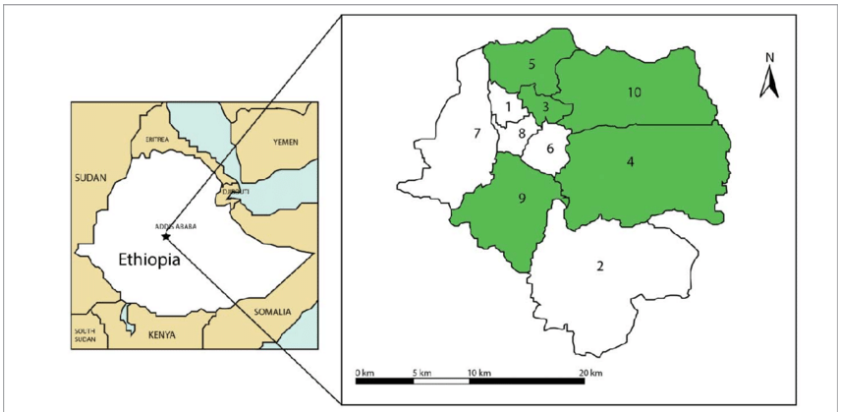


Figure 2. Map of Addis Ababa indicating five study sub-cities

3.2. Study design& period

A follow-up was employed by using within subject study design. The study was conducted in two consecutive years, where diet related measurement werecollected on January 2022 (the first round) and during January 2023 (the second round).For the first round, this study used a secondary data that was collected by another project where my supervisor (Prof. Kaleab) is a principal investigator. Then, for the second round, we collected a primary data.

3.3. Population

All women having children aged 6-24months residing in Addis Ababa are our target population. Our sample population were selected from the source population that are residing in the selected sub-cities serving as a sampling frame. Finally, eligible participants who consent to participate in the study were included as a study population.

3.4. Inclusion and Exclusion criteria

This study included women of child bearing age that are having children aged 6-23 months (at first round survey), residing in the selected sub cities and who gave their informed consent. Whereas those mothers who were seriously ill at the time of data collection, who are unable to hear and/or speak, and who are not willing to participate in this study were excluded from the study.Children outside of this age range were also exclude from the study.

3.5. Sample size determination

Sample sizes were determined at the two survey rounds taking the following assumptions and consideration.

Sample size for the first round

During the first round, a cross-sectional study design was followed and single population proportion formula was used, considering the following assumptions: (i) z-score of 1.96 at 95% confidence interval; (ii) margin of error of 0.05; (iii) prevalence of inadequate dietary intake for iron (15%) and vitamin A (90%) in urban women from the Ethiopia national food consumption survey (2003). A prevalence (P) of 0.15 was taken and a non-response rate of 15% making a total sample size of 235.

Sample size for the second round

In the second round, the sample size was determined based on within subject repeated measurement study design, considering the following assumptions: statistical power of the study 85%, α error probability 5%, small effect size of 0.3 (reference) and considering a non-response rate of 20%. Putting this assumption into G*Power sample size calculator, a total sample size of 123 mother-to-child pairs was determined.

3.6. Sampling procedure and Sampling technique

The study was used the method applied in first round survey. Accordingly, sample population were selected using the following approaches; multistage sampling technique was employed to reach at selected mother-to-child pairs during the first-round survey (Figure 3). The total sample size was allocated proportionally to the number of households having children 6–24 months in the study sub-cities. For the second-round survey, households having study subjects of interest were chosen by a systematic random sampling technique using the previous year's list as a sampling frame (i.e., n=230).

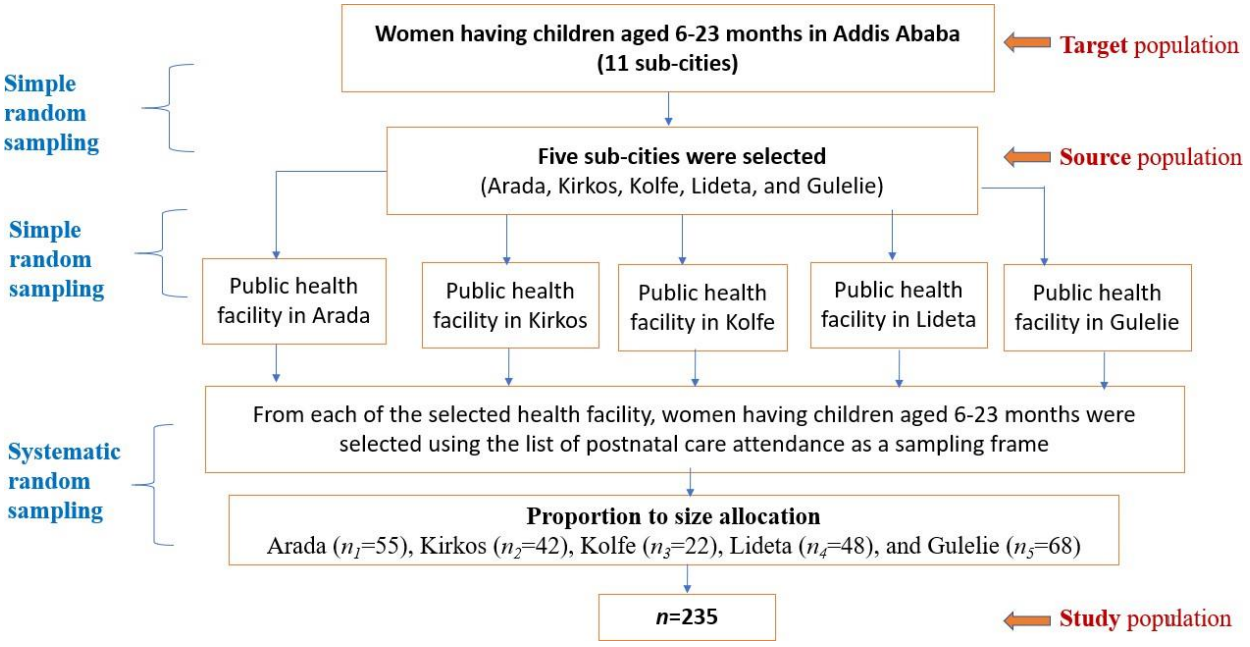


Figure 3 Schematic representation of sampling procedure for the first round survey

For the second round, we sub-sampled from the first round using proportional allocation to represent each sub-city: Arada (23.6%), Kirkos (17.9%), Kolfe (8.9%), Lideta (20.3%), and Gulelie (29.3%) to achieve a desired sample size for the second round, i.e., 123. This was done using systematic random sampling.

3.7. Data collection

Data was collected using interviewer-administered questionnaire to assess women and child diet diversity. These were developed based on the Ethiopian Demographic and Health survey and

different literatures. A structured survey questionnaire was used to generate information on households' socio-economic and demographic characteristics (wealth status, age, parents' educational status, religion, household size, nutrition literacy). While a semi-structured questions were used to assess food consumption at individual levels. Experienced data collectors were recruited from the study area and they were given training on the study tools to guide them conduct the data collection. The English version questionnaire was translated to Amharic language and then beck translated to English to ensure consistency of the content. The woman was asked to recall all foods and beverages that her child and herself have taken in last 24-hr prior to the interview. individual dietary diversity were computed for women from 10 food groups (FAO/FHI, 2016), and that of child dietary diversity from seven food groups (FANTA, 2006).

To Assess trend of food price across the follow-up period of the study in Addis Ababa (2022-2023) we acquired data from the Ethiopian statistical service (ESS) for food items related with our study, including monthly prices of cereals and legumes, fruit and vegetable, animal source food, and other consumable food items) for our study duration.

3.8. Study Variables

3.8.1. Dependent Variable

The dependent variables were WDDS and CDDS.

3.8.2. Independent Variable (Background Variable)

The independent variables included socio-economic and demographic characteristics (wealth status, age, parents' educational status, religion, household size, nutrition literacy), year of survey round and food price.

3.9. Data quality assurance

The qualities of the data were maintained by translating the English version questionnaire to Amharic language, then it was translated back to English to check its consistency. A pre-test was conducted on 5% of the calculated sample size and necessary amendment was made. Prior to data collection, a one-day training was provided to the data collectors and supervisors by a nutritionist about the overall purposes of the research, on how to approach the study participants, the content

of the questionnaire. Furthermore, completeness, accuracy, and clarity of the collected data were

checked carefully on a regular basis and the principal investigator provided corrective feedbacks on a daily basis to the data collectors. To minimize recall bias and social desirability bias, study participants were asked probing or leading question or were asked relating to the local events and isolation of the respondents respectively.

3.10. Data Analyses

All data were entered and analyzed using Microsoft Office Excel and SPSS statistical software version 2022. Data normality was tested using Shapiro-Wilk's test**.** Dependent sample t-test was used to compare mean changes across a year within the same study participants. When the data fail to assume normal distribution, non-parametric Wilcoxon test was used. Mean differences was considered statistically significant at p-value <0.05. Reference categories were defined as those usually associated with the least food consumption score in the literature. Similarly, cut-off points for women and child dietary diversity using ten and seven food groups based on guidelines proposed by the Food and Nutrition Technical Assistance Project, respectively (FANTA, 2016).

3.11. Ethical considerations

The study was conducted after its protocol has been reviewed and approved by both the institutional review board of College of Natural and Computational Sciences, Addis Ababa University (Ref No: CNCSDO/759/15/2023) and Addis Ababa city administration public health research and emergency management directorate (Ref. No: A/A/H/11034/227). In addition, permissions to conduct the study was obtained from each of the respective administrative units. A written informed consent was then obtained from all mothers/caregivers for their willingness to participate in the study. Whenever mothers/caregivers are unable to reads and write, oral consent was obtained. Participant's information sheet was included the objective of the study, benefits and possible risks. All the information collected from participants were kept confidential, in such a way that personal information not to be disclosed.

4. RESULT

4.1. Background characteristics of study participants

In the first round of the study 230 mothers and children aged 6-23 months were included. Among children, 45.5% were in the age group of 12-23 months. In the second round 123 participants were included, aged 18-36 months were included. The median age of the study children in the second round was 27 months, and the female to male sex ratio was nearly one, 95.1% of the children were cared by their mother. About 52% of the HHs had a household size of four or less.

Table 1Characteristics of study participants

Variables		Frequency *n* (%)		Variables		Frequency *n* (%)
Religion				*Education status of mothers/caregivers*		
	Orthodox	95 (77.2)			No formal education	8 (6.5)
	Muslim	24 (19.5)			Primary education (Grade 1-8)	39 (31.7)
	Protestant	4 (3.3)			Secondary education (Grade 9-12)	38 (30.9)
Wealth status §					Higher education	38 (30.9)
	Low	31 (25.2)		*Age of mothers/caregivers*		
	Middle	42 (34.1)			≤ 25 years	29 (27.4)
	High	50 (40.7)			26 – 30 years	39 (36.8)
Marital status					> 30 years	38 (35.8)
	Married	115 (93.5)		*Employment status of mother/caregiver*		
	Other †	8 (6.5)			Involved in income generation	44 (36.6)
Age of children (at first round)					Housewife	76 (63.3)
	6 – 11 months	56 (45.5)		*Occupation of husband*		
	12 – 17 months	36 (29.3)			Skilled labourer	20 (17.4)
	18 – 23 months	31 (25.2)			Unskilled daily wage labourer	27 (23.5)
Sex of children					Involved in petty trade	22 (19.1)
	Male	64 (52.0)			Professional job	40 (34.8)
	Female	59 (48.0)			Jobless	6 (5.2)

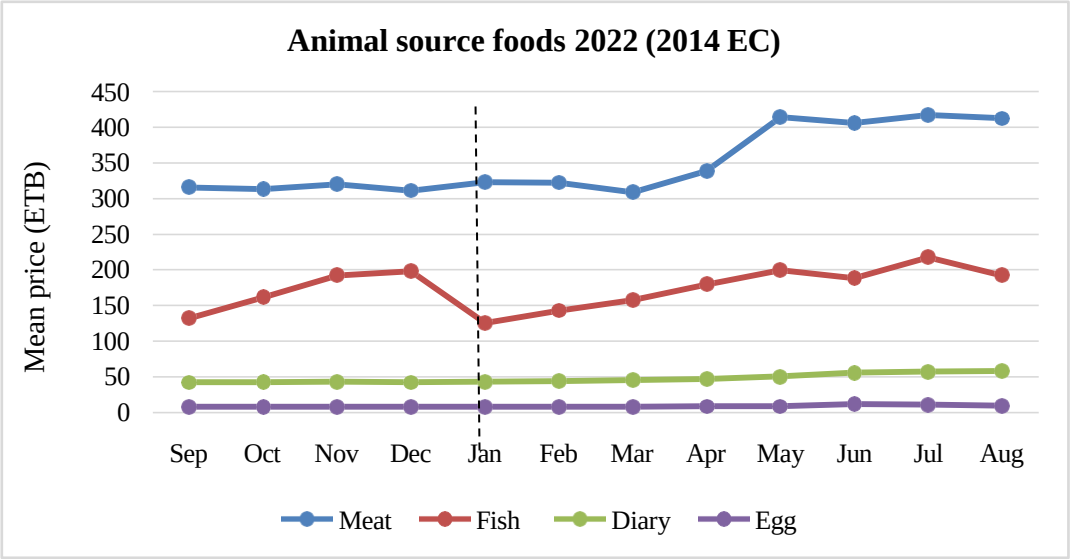
§ Wealth status is computed using principal component analysis. † Others to indicate: single, separated, or divorced.

The mean age of the mothers/ caregivers was 29 years (SD=6) and 63.3% of them were housewives (Table 1). About 8(6.5%) of the mothers had no formal education and 93.5% of the mothers were gone to school and of them, 39(31.7%) completed primary education (Grade 1-8), 38 (30.9%) completed secondary education, and 38 (30.9%) of the mothers completed higher

education. Regarding marital status, 93.5% of the interview were married, and 6.5% were divorced, separated, and single.

4.2. Trend of food price across the study period

Prices of most food items have been consistently increased across the follow-up period of our study. Regarding animal source foods, a consistent increase in egg and dairy products across time was observed. While, price of fish does vary across the year. Across the two consecutive years, price of meat show an increase from March and peaks on May (Figure 4).



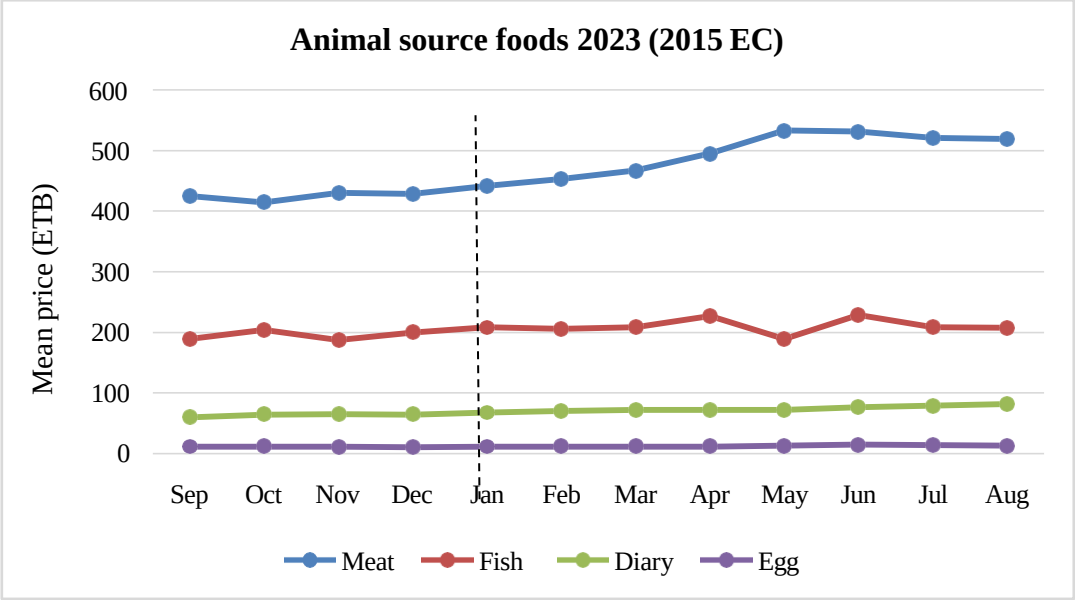
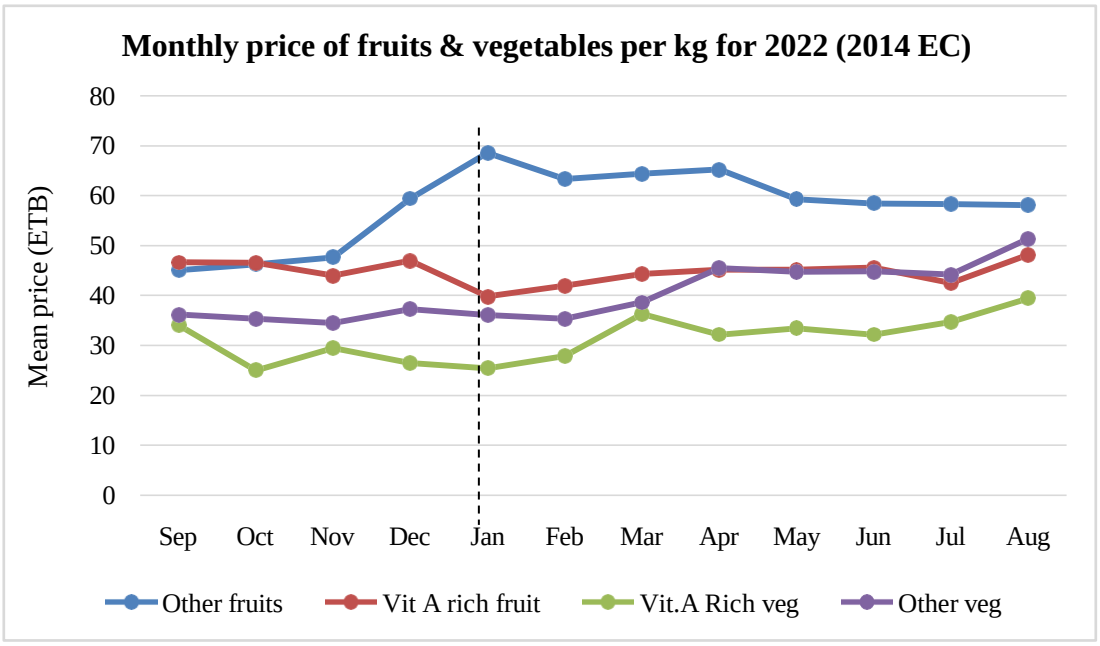


Figure 4.Trend of animal source foods price across 2014 and 2015 EC. Indicated price is for a kg of meat and fish; a dozen of eggs; and a litter of milk. Broken lines indicate prices at the first and second rounds of surveys. Aggregated mean monthly prices of meat was computed from beef, sheep and goat. ETB is for Ethiopian Birr.EC Ethiopian Calendar.

Fruits and vegetables showed a consistent pattern across a year in both consecutive years (Figure 5). Price of vitamin A rich vegetables generally get lower from October to January. Price of other vegetables are lower from September to November and reaches peak towards January. While prices of vitamin A rich fruits were relatively stable throughout a year in both the follow-up years.



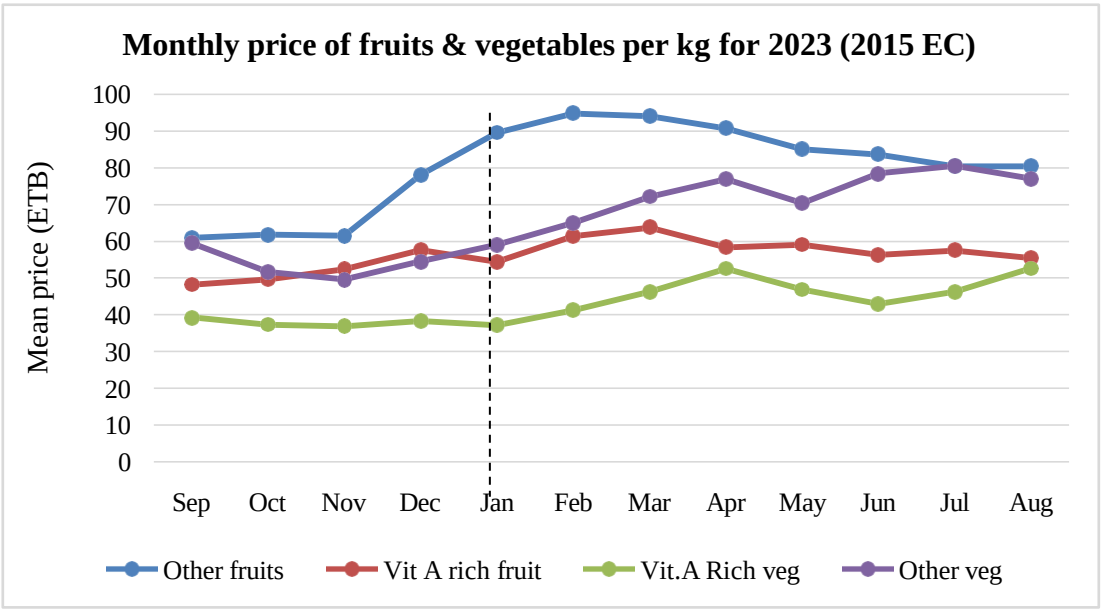


Figure 5. Trend of fruits and vegetables price across 2014 and 2015 EC.Indicated price is for a kg of fruits and vegetables. Broken lines indicate prices at the first and second rounds of surveys.

The following items were aggregated within the respective food groups: Vitamin A rich fruits (mango & papaya), other fruits (banana, orange, avocado, pineapple & lemon), vitamin A rick vegetables (kale, lettuce, spinach, carrot & pumpkin), and other vegetables (cabbage, tomato, green pepper & onion).

There were monthly fluctuations in the price of cereals and legumes during the year 2022 (2014 EC). This trend suggests a seasonal pattern in the price of cereals and legumes, also there was a considerable price upsurge in 2023 (2015 EC). We observed similar trend in products of cereals, including various types of past, macaroni, and backed products (bread & injera). Price of other common consumables food have also showed variation across the year, for instance, prices of edible oil, sugar, and coffee beans have presented a considerable variation across the study period.

4.3. Dietary diversity of children

Mean dietary diversity score of children in the first-round survey was 2.85. Nearly, one-third of the children (29.3%) were found to satisfy a minimum dietary diversity score of ≥ 4 food groups out of seven food groups. Whereas during the second round, the mean DDS was 3.6 and about half (49.6%) of the children were qualified to achieve the minimum DDS.

Figure 6 presents proportion of children consumed each food group across the survey rounds. Proportion of children consumed legumes and other fruits and vegetables food groups showed a significant rise in the second-round survey when compared to the first round, presenting a rise of 45.5 to 74.8% and 51.22 to 89.43%, respectively. Consumption of animal source foods (ASFs) show mixed finding. Flesh food remain the same at 5.69% during both rounds of measurements. Consumption of eggs increased from 17.07 to 21.14%. While proportion of children consumed dairy products decreased from 52.85 to 46.34%.

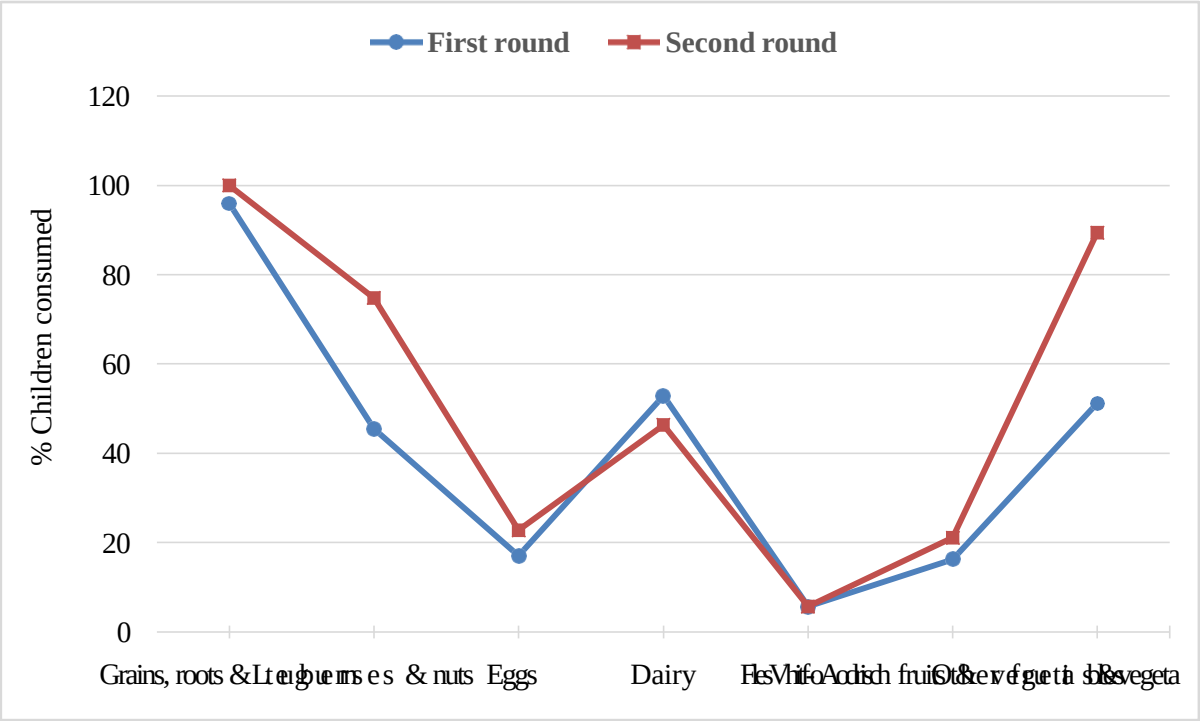


Figure 6**.** Dietary diversity of children by food groups during the first and second round surveys

4.4. Dietary diversity of women

Mean dietary diversity score of women was presented a slight reduction across the survey rounds, 3.37 in the first round and 3.28 in the second round. Proportion of women achieved the minimum dietary diversity score of ≥ 5 food groups out of ten was also showed a 12.3 % reduction across the survey rounds, from 12.2 to 10.7%.

Figure 7 presents proportion of women consumed each food group across the survey rounds. Women's dietary data by food groups have showed a shift in consumption of more legumes, nuts and seeds, while declining in consumption of animal source foods, vitamin A rich fruits and vegetables across time. For instance, increased consumption of beans & peas (74% to 83%), nuts and seeds (1.6 to 16.3%), while decrease in proportion of women consumed vitamin A rich green leafy vegetables (15.5 to 7.3%), other vit A rich fruits and vegetables (15.5 to 8.1%), diary (8.1 to 5.7%), and flesh foods (8.1 to 6.5%) were observed.

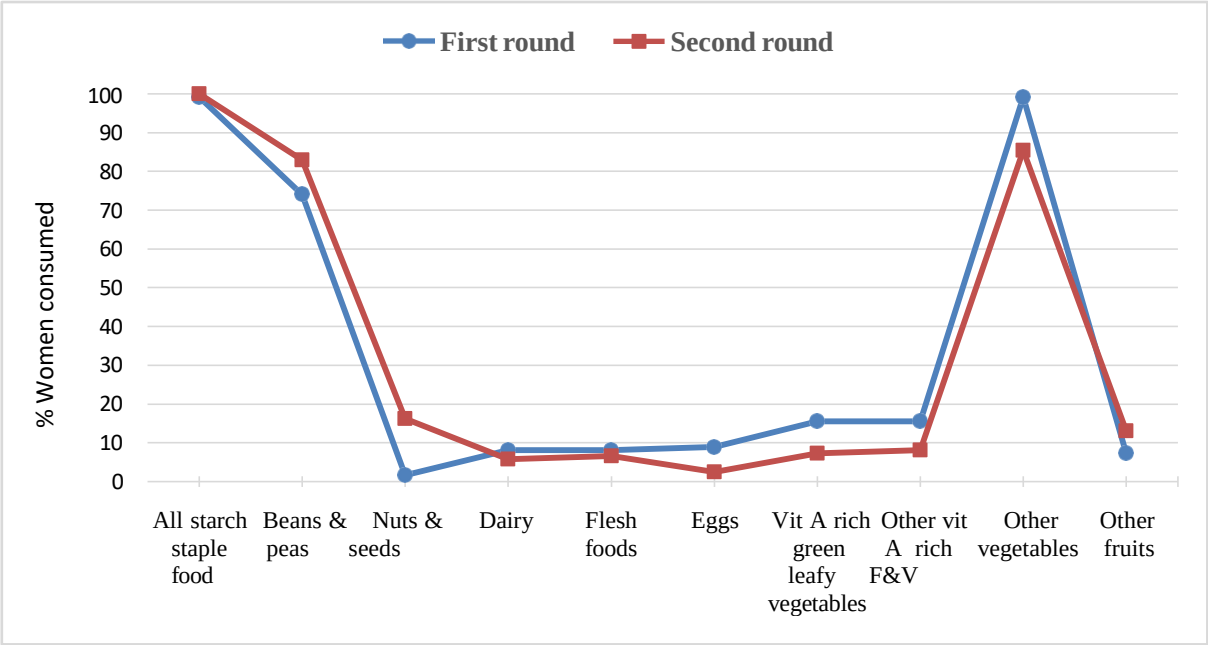


Figure 7.Women dietary diversity by food groups during the first and second round surveys

4.5. Mean differences in DDS in women and children across survey rounds

Table 2 presents differences in mean dietary diversity scores of women and children across survey rounds. The mean DDS of women show a slight but statistically non-significant reduction across survey rounds. Whereas, the mean DDS of children has significantly increased across time (p<0.001). When compared to the first round, a 26% increase in mean DDS of children was observed in the second round.

Table 2. Mean differences in dietary diversity scores of women and children across survey rounds in Addis Ababa (2014 - 2015 EC), n = 123.

	First round (Mean ± SD)	**Second round (Mean ± SD)**	**Paired difference (Mean ± SD)**	***p*-value (95% CI)**
Child DDS	2.85 ± 1.21	3.60 ± 0.97	-0.76 ± 1.50	< **0.001**
Women DDS	3.37 ± 0.96	3.28 ± 0.96	0.098 ± 1.36	0.453

Result from paired samples t-test. Paired difference is obtained from (DDS 1st round) – (DDS 2nd round). EC Ethiopian calendar; DDS Dietary diversity scores; SD Standard deviation; CI Confidence interval.

5. DISCUSSION

This study was aimed to assess to what extent do women's and children's DDS vary across a year. It also looked at the consumption status of each food group across a year. The study used within-subject study design where dietary data were collected in January 2022 and January 2023 from the same study participants. We found that mean DDS of children increased by 26%, while mean DDS of women showed a slight reduction. Regarding food groups consumed, reduced consumption of milk and vitamin A rich vegetables were observed, while cereals and flesh food kept constant. Consumption of legumes, other fruits and vegetables were increased. Food prices across the study period has significantly increased.

Unlike the case in rural areas where the inhabitants engage in farming and consume significant proportion of their own production, people residing in urban areas by and large relies on the market that is mainly governed by food prices. According to the Ethiopian statistical services (ESS), prices of food items increased dramatically with an average of 32% inflationacross the study period (ESS, 2023). During this period, women DDS was not changed significantly. However, we observed a 26% increase in child dietary diversity score from a mean value of 2.85 in January 2022 (2014 EC) to 3.60 in January 2023 (2015 EC) (p<0.001).

This paradoxical increase child DDS irrespective of the food price inflation could be attributed to child specific characteristics. From the dietary data of children, we observed an increasing pattern of DDS with increasing child age across the two rounds of measurements (see Figure 8). Several previous studies indicated such positive association between child age in months and child dietary diversity. This is showed in Ethiopia (Kuche *et al*., 2019), Ghana (Amugsi*et al.*,2015), Zambia (Marinda *et al*., 2018) and peri-urban area of Bangladesh (Haque et al., 2024). This association may be attributed to the intention that the introduction of appropriate complementary feeding practices tends to correspond with the advancing age of the child. Dangura and Gebremedhin (2017) also found that when the age of the child increases by a month, the dietary diversity increases by 0.04.

We observed the consumption of two food groups, legumes and other fruits and vegetables, showed larger increase during the second-round measurements, rise from 45.5 to 74.8% and 51.22 to 89.43%, respectively. Therefore, the observed increment in child DD in the second round could be attributed to these food groups. Consumption of ASFs did not show improvement

across time. For instance proportion of children consumed dairy products decreased (53% to 46%), flesh food remain the same at 5.7%. Only a slight increase in egg consumption (17 to 21%) was observed.

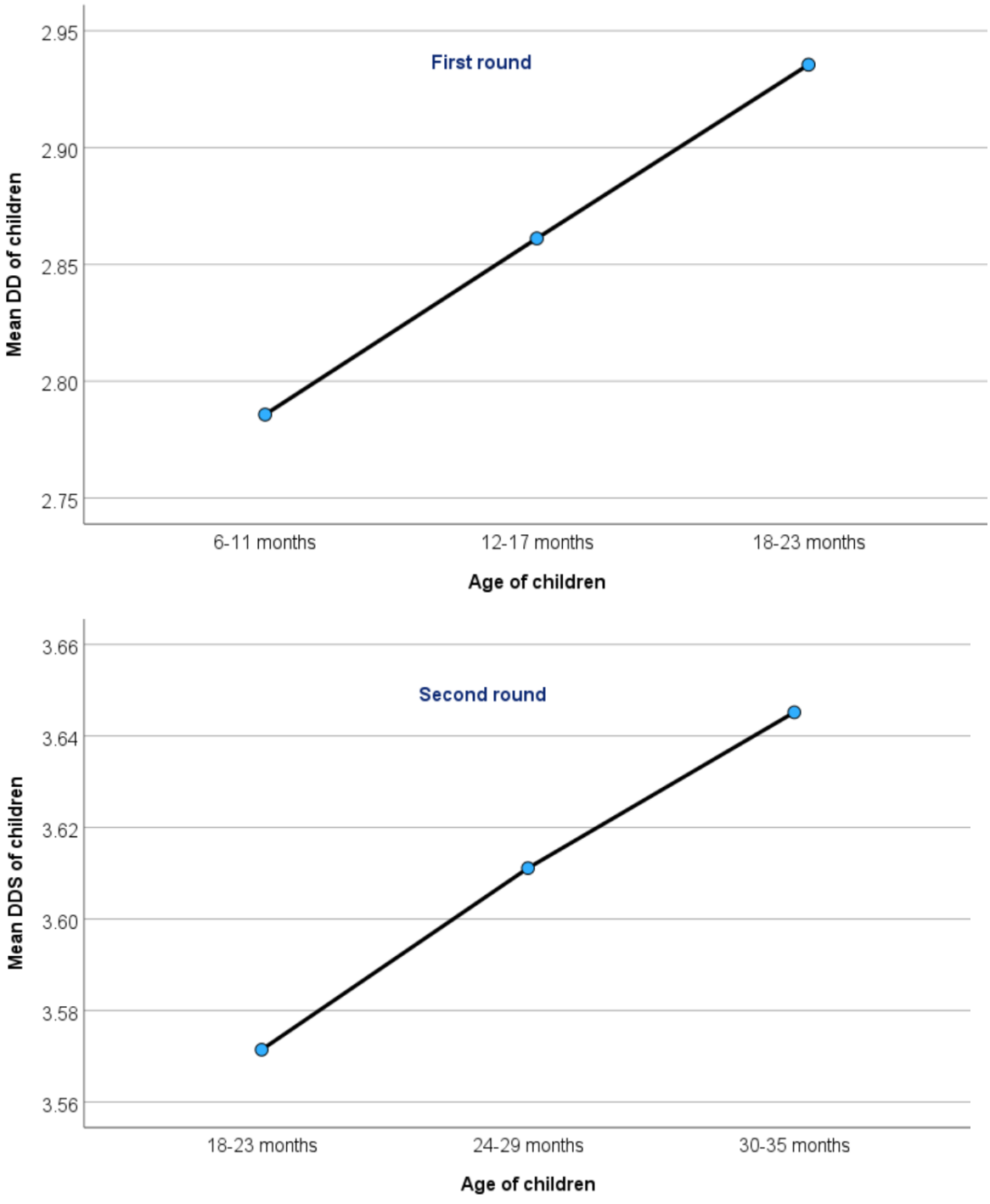


Figure 8. Mean dietary diversity of children with age during first & second round measurements

Women dietary diversity score did not change significantly across the study period. However, further disaggregation of women's dietary data by food groups have showed a shift in consumption of more legumes, nuts and seeds, while declining in consumption of animal source foods, fruits and vegetables across time. In line with this, studies have shown that increasing food price not only reduce dietary diversity but also lead to dietary deprivation and adjustments in consumption patterns among households (Onyango *et al.,* 2023). As food prices rise (Table 3), households may be forced to compromise on the variety and quality of foods they consume, ultimately affecting their overall dietary diversity scores.

Table 3Percent increase in price of food products in Jan 2023 compared to its Jan 2022 base

Food groups	**Food items**	**% price increase**
Cereals, legumes & their products		
	Cereals	21.26
	Roots & tubers	77.15
	Backed products	36.75
	Pasta/macaroni	46.46
	Legumes	21.15
Animal source foods		
	Meat	36.82
	Fish	65.38
	Diary	56.60
	Eggs	43.79
Fruits & vegetables		
	Vit. A Rich veg	46.43
	Other veg	63.99
	Vit A rich fruits	36.97
	Other fruits	30.66
Other common consumables		
	Sugar	70.73
	Edible oil	53.71
	Coffee beans	23.70

Our study showed that only one in ten women satisfy the recommended minimum DDS. This figure is lower that what has been reported studies done in various areas in Ethiopia among lactating women reporting 25% (Fufa&Laloto, 2021; Mulaw*et al.,* 2021; Molla *et al.,* 2022). This could be due to variation time of the year where that data was collected, socioeconomic status of study participants, or variations in study settings (being rural vs urban, community vs institution based studies).

Furthermore, proportion of women achieved the minimum recommended DDS of ≥ 5 food groups out of ten was also showed a 12.3 % reduction across the survey rounds, from 12.2 to 10.7%. For the same period, however, proportion of children meeting the minimum DDS has increased from 29.3% to49.6%. This shows huge variation in food consumption among members of the household that is favouring children. Similar findings were documented by Asma and Kotani (2023) as well as by Harris-Fry *et al.* (2017) showing intra-household inequality in consumption in resource poor setting that preferentially allocate foods to children than adults.

Strengths and limitations of the study

The study evaluated DD among vulnerable population - women and children. It assessed variation across a year using a within-subject study design that controls for several inter-individual variations. We inform readers to interpret our findings taking into account that the dietary data were collected during fasting season. As 77% of the study participants were Orthodox Christians, this could have affected the DDS of women. However, since we have done both rounds during fasting, the study is still empowered to show variation across a year.

6. CONCLUSIONS AND RECOMMANDATIONS

This study was aimed to assess to what extent do women's and children's DDS vary across a year. It also looked at the consumption status of each food group across a year. The mean DDS of children increased by 26%, while that of women showed a slight reduction. Consumption of milk and vitamin A rich vegetables were decreased, whereas legumes, other fruits and vegetables were increased.Consumption of cereals and flesh foods kept constant. Prices of all the food items across the study period has significantly increased.

Based on the findings of the present study, we set the following recommendations. Increasing food price has resulted in shift reduced consumption of ASFs like milk and vitamin A rich vegetables. In order to promote food-based dietary intervention, stockholders (government decision makers and development partners) should work on stabilizing food price inflation, and subsidizing nutritionally relevant foods groups like animal source foods and vitamin A rich food sources.Nutrition sensitive sectors [agriculture] should aggressively work on food availability to the level that promote economic access of consumers. Community level of awareness (education) should be further promoted regarding nutritional benefits of cheaper alternative foods that could somehow substitute the expensive high quality food items. In doing so, we could promote urban food security.

Future studies that intended to compare changes in DD across time among children need to consider age of children at recruitment. Apart from the theoretically recommended age that complementary foods should beinitiated(at 6 months of age), in contexts like ours, the child are likely to start consuming most of the food groups at later age.Future studies should also take seasonality and fasting periods into account in setting time of dietary data collection.

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ANNEX 1: INFORMATION SHEET AND CONSENT FORM

Information sheet

Greetings!

I am conducting a study entitled ―Food Consumption among mothers and children between age of 6- 36 months Addis Ababa Ethiopia:The study will be using a repeated within subject study design‖ and the data will be collected using structured interviewer administrated questionnaire. Which is a Master research project of Centre for Food Science & Nutrition, College of natural and computational sciences, Addis Ababa University?

- The study aims to evaluate the level of food consumption, among mothers and children in Addis Ababa vary across a year in selected sub city, worda in Addis Ababa, Ethiopia. This will provide potentially useful evidence on the contribution of food consumption score and DDS of child and mother. We do not expect any relevant risks in this study. Whatever information you provide will be kept confidential and anonymous. The results from this study will only be used for the purpose of further improving mothers' and children's nutrition. You have the right to refuse from participating in this research, if you do not wish to. You also have full right to withdraw at any time without explaining the reason why.

Experienced and trained data collectors conduct interviews at your residence. The interview will take maximum time about 1 hour.

If you need any further explanation at any point, you can contact Ms. Eden Amare (Mobile +251901061180). If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact of the Ethics Review board of the College of natural and Computational Sciences, Addis Ababa University that has reviewed & approved this research project (cnsethical@gmail.com).

Do you have any questions?

Do you agree to participate in the study?

If yes, read the consent form to the participant, date and sign it. If no, thank and proceed to the next participant.

Consent Form for "Food consumption among mothers and children aged 6-36 months in Addis Ababa: Assessing variation across a year.

I have been informed about the objectives, risks and benefits of the study. I have also been informed about my rights not to participate in the study and withdraw any time without any consequences. I have been able to ask questions about the study and my questions have been answered to my satisfaction. I understand that taking part in the study involves: a survey questionnaire to be completed by the enumerator; body measurement and collection of blood samples.

I understand that personal information collected about me that can identify me will not be shared beyond the study team. However, I agree that my information may be shared with other researchers for future research studies that may be similar to this study.

Based on the information provided above, I have agreed to participate in the study.

_____ _____ _____

Name of **participant** (legal representative) Date Signature

I have witnessed the accurate reading of the consent form with the potential participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

_____ _____ _____

Name of **witness** Signature Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____ _____ _____

Researcher's/Data collector's name Date Signature

ANNEX 2: QUESTIONNAIRE

ENGLISH VERSION QUESTIONNAIRE

Food Consumption among mothers and children between age of 6- 36 months Addis Ababa Ethiopia

Section 1: Basic information about the interview		
No.	**Questions**	**Coding Categories**
101	Code of the mother? 1st digit: code of the sub-city 2nd digit: code of the woreda 3rd and 4th digit: code of the household (01, 02, 03,…18)	[____|____|____|____] 1 Arada 6 nefasilkLafto 2 Kirkos 7 Akaki Kality 3 Yeka 8 Addis Ketema 4 Kolfe 9 Gulele 5Lideta
102	Where the mother live	[_____]
103	Date of interview?	[____|____|_____| DD MM YYYY
104	Status of the interview	Completed 01 Not at home 02 Refused 03 HH not found 04 Other_____ 05

Section 2: Background of the child and size of the household		
S.N.	**Questions**	**Choices/Answers/Codes**
201	Sex of Child	Boy 01 Girl 02
202	Date of birth	[_____|_____|_____| DD MM YYYY I don't know/not sure 88
203	What is the source of information on birth date	Birth certificate 01 Baptismal record 02 Clinic/Health card 03 Home record 04 Determined using local calendar events 0 Mother/caregiver recall 06 Recollection by other persons 07 Other..... 08
204	How many members do you have living in your household?	/___/___/
205	How many children are there under 15 years of age in your household?	/___/___/
206	How many adults aged 60 or more?	/___/___/
207	How many children are there under 5 years of age in your household?	One 01 Two 02 Three 03 Others (specify) 04

Section 3: Background information about the respondent			
S.N.	**Questions**	**Choices/Answers/Codes**	**Skip**
301	Relationship of respondent to the child	Mother 01 Primary caregiver 02 specify _____ 03	
302	Who is the head of this household?	Mother 01 Husband/Partner 02 Some other male beside the husband 03 Some other female beside respondent 04	
303	What is your religion?	Orthodox Christian 01 Protestant 02 Catholic 03 Muslim 04 Non-believer 05 Other (specify) _____ 06	
304	Have you ever attended school?	Yes 01 No 02	>306
305	What is the highest grade you completed?	Grade |___|___| Tech/voc. Certificate 13 University/College diploma 14 University/College degree or higher 15	
306	How old were you on your last birthday? (Age in completed years)	Age in years_____ Don't know 88	
307	**How old were you when you had your first child?**	Age in years____ Don't know- 88	
308	What is your current marital status?	Married/Living together 01 Single 02 Widowed 03 Divorced 04 Separated 05	If the an is number skip to **4**
309	**Is your husband/partner living with you now or is he staying elsewhere?**	Living together now 01 Living elsewhere now 02 Other (Specify)..... 03	

Section 4: Household economic status			
S.N.	**Questions**	**Choices/Answers/Codes**	**Skip**
401	**What is your husband's profession?** *(Multiple answers possible)*	Farmer/ Agricultural worker 01 Skilled laborer 02 Unskilled laborer 03 Business/ Traders 04 Professional jobs 05 Work at home 06 Jobless 07 Other (Specify)..... 09	
402	**Is your husband paid in cash or kind for this work or is he not paid at all?**	Cash only 01 Cash and kind 02 In kind only 03 Not paid 04	
403	**What is your occupation, that is, what kind of work do you mainly do?**	Farmer/ Agricultural worker 01 Skilled laborer 02 Unskilled laborer 03 Business/ Traders 04 Professional jobs 05 Work at home 06 Other (Specify) 08……..	
404	**Are you paid in cash or kind for this work or are you not paid at all?**	Cash only 01 Cash and kind 02 In kind only 03 Not paid 04	
405	**Do you own the home you live in?**	Owns house 01 Rents 02 Free housing 03 Others (specify)…….. 04	
406	**Do you have electricity in your house?**	Yes/ utility line 01 yes (solar ,biogas) 02 No 03	
407	**What type of fuel does your household** mainly **use for cooking?**	Electricity 01 LPG 02 Biogas 03	

		Kerosene 04 Charcoal 05 Wood 06 Straw/Shrubs/ Grass 07 Animal dung 08 Other(Specify)..... 09	
408	**Main material of the floor** **(OBSERVATION)**	Natural (earth/sand/ dung) 01 Rudimentary (wood/bamboo) 02 Finished (concrete, tiles, mosaic) 03 Other (Specify)..... 04	
409	**Main material of the roof** **(OBSERVATION)**	No roof 01 entary (Grass, Palm, leaves, Straw, sheeting, cardboard, bamboo) 02 d roof (metal, wood, corrugated tin, ment) 03 ed 04 Other (specify) ……05	
410	**Main material of the wall** **(OBSERVATION)**	No wall 01 Rudimentary wall (Mud, Cardboard, Palm, Bamboo, Straw, Leaves) 02 traditional wall made from stones 03 Finished wall (Concrete, Corrugated Wood) 04 Other (specify).....05	
411	**Any windows** **(OBSERVATION)** **Record "00" if none**	|__|__|	
412	**Does your household have?**		
412_1	**A watch?**	Yes 01 No 02	
412_2	**A radio?**	Yes 01 No 02	
412_3	**A television?**	Yes 01 No 02	
412_4	**A non- mobile phone?**	Yes 01 No 02	
412_5	**A mobile phone?**	Yes 01 No 02	
412_6	**A refrigerator?**	Yes 01 No 02	
412_7	**A table?**	Yes 01 No 02	

412_8	**A chair?**	Yes 01	No 02	
412_9	**An electric mitad?**	Yes 01	No 02	
412_10	**A kerosene lamp?**	Yes 01	No 02	
412_11	**A bicycle**	Yes 01	No 02	
412_12	**A motorcycle**	Yes 01	No 02	
412_13	**An animal drawn cart**	Yes 01	No 02	
412_14	**A car or a truck**	Yes 01	No 02	
413	**Do you have a garden where you grow vegetables and/or fruits?**	Yes 01 No 02		>41
414	**If yes, how do you use the produce?**	Sell all of it 01 Sell most of it 02 Use all for HH consumption 03 Other, specify _____04		
415	**Does any member of this household own any land that can be used for agriculture?**	Yes 01 No 02		>42
416	**How many (UNITS) of agricultural land domembers of this household own?**	Size _____ Unit _____ not want to tell 88 I don't know/not sure 99		
417	**How do you use the land?**	Self production01 For rent 02 I don't used at all 03		
418	**How many of the following animals do the household own?** **If none, enter "00"** **If unknown, enter "98**			
418_1	**Milk cows**			
418_2	**oxen, bulls**	|___|___|		
418_3	**Horses, donkeys, bulls?**	|___|___|		
418_4	**Goats?**	|___|___|		
418_5	**Sheep?**	|___|___|		
418_6	**Chickens?**	|___|___|		

Section 6A: Child 24 Hrs. Dietary Intake (Semi-quantitative)

I would like you to tell me what your child had eat/drunk after woke-up yesterday morning. Did s/he eat that food at home? What did s/he have next and at what time?

[Proceed through the day, repeating these questions as necessary, and record each food or drink including water consumed (as indicated in 3rd column). Remember to probe any snack or dink consumed between meals]

Time	Place eaten	Food/drink	Description of ingredients

1201_1: Day of the week (circle the day): [**Mon**-01], [**Tue**-02], [**Wed**-03], [**Thu**-04], [**Fri**-05], [**Sat**-06], [**Sun**-07]

1201_2: Probe for sickness; is your child sick in the previous one day? ☐ Yes ☐ No

1201_3: If "yes", how did the sickness affected his/her appetite? ☐ ☐ Decreased ☐ Increased

1201_4: Was the food intake unusual? ☐ Yes ☐ No

1201_5: Was it a fasting day? Yes ☐ No ☐

1201_6: Was it a market day? Yes ☐ No ☐

1201_7: Is s/he taking medication or supplement? Yes ☐ No ☐

Section 6B: To confirm the responses on the previous page, fill in the table below once again with the respondent to make sure that nothing was missed		
#	**Food Type**	**Did your child consume this food or type of food yesterday?** **1 for Yes & 0 for No**
Liquids:		
1	Plain water	
2	Infant formula	
3	Milk such as tinned, powdered or fresh animal milk	
4	Juice or juice drinks	
5	Clear broth	
6	Yoghurt	
7	Thin porridge	
8	Any other liquids	
Foods:		
9	Any porridge made from maize, barely, teff or other grains	
10	Any gruel (thin or watery made from rice, oats, wheat, or other grains)	
11	Any commercially fortified food (Cerifam, Fafa, mother's choice, etc.)	
12	Bread pasta, rice, or any other solid foods made from oats, maize, barely, wheat, sorghum, millet or any other grains	
13	Injera or *kita*	
14	*Enset*, white potatoes, white yams, bulla, *kocho*, cassava, or any other food made from roots.	
15	Pumpkin, carrot, squash, or sweet potatoes that are yellow or orange inside	
16	Dark green leafy vegetables (kale, spinach, amaranth leaves)	
17	Other vegetables (onion, cabbage, mushroom, starchy vegetables such as plantain)	
18	Ripe papaya or ripe mangos (other local vit A rich fruits)	
19	Other fruits (banana, apple, citrus fruits)	
20	Liver, kidney, heart - organ meats	
21	Any meat such as beef, pork, goat or lamb (excluding organ meat and chicken)	
22	Chicken, ducks, or other birds	
23	Eggs	
24	Fresh or dried fish or shellfish	
25	Legumes such as peas, lentils, beans, or pulses	
26	Nuts or seeds such as peanuts, groundnuts, sesame, or sunflower seeds	
27	Milk products such as cheese or yogurt	
28	Any food made from oil, fat, or butter	
29	Ready to use therapeutic foods (Plumpy Nut, F100)	
30	*Kolo*, chips, crisps, popcorn	
31	Candies, chocolates, cakes, cookies, or biscuits	
32	Spices or condiments	

Section 7A: Mothers/ caregivers 24 Hrs. Dietary Intake (Semi-quantitative)

I would like you to tell me what you had eat/drunk after woke-up yesterday morning. Did you eat that food at home? What did you have next and at what time?

[Proceed through the day, repeating these questions as necessary, and record each food or drink including water consumed (as indicated in 3rd column). Remember to probe any snack or dink consumed between meals]

Time	Place eaten	Food/drink	Description of ingredients

1201_1: Day of the week (circle the day): [**Mon**-01], [**Tue**-02], [**Wed**-03], [**Thu**-04], [**Fri**-05], [**Sat**-06], [**Sun**-07]

1201_2: Probe for sickness; are you sick in the previous one day?	☐ es	☐ o
1201_3: If "yes", how did the sickness affect your appetite?	☐ ecreased	☐ creased
1201_4: Was the food intake unusual?	☐ es	☐
1201_5: if yesterdayfood intake unusual how?		
1201_6: Was it a fasting day? Yes No	☐	☐
1201_7: Was it a market day? Yes No	☐	☐
1201_8: Is you taking medication or supplement? Yes No	☐	☐
1201_9: are mother/cargivers responding for the qustions	☐ yes	☐ No

	Section 7B: To confirm the responses on the previous page, fill in the table below once again with the respondent to make sure that nothing was missed	
#	**Food Type**	**Did you consume this food or type of food yesterday?**
		1 for Yes & 0 for No
1	Cereals	
2	starch staple food	
3	Roots	
4	Vitamin A rich vegetable	
5	Green leafy vegetable	
6	Other fruit	
7	Vitamin A rich fruit	
8	Other fruit	
9	Meat	
10	Egg	
11	Fish	
12	Legumes	
13	Bean	
14	Nut and seeds	
15	Dairy product	
16	Oil and fat	
17	Coffee and tea	
18	Alcohol drink	

ANNEX 3: ETHICAL CLEARANCE

COLLEGE OF NATURAL & COMPUTATIONAL SCIENCES
Addis Ababa University
OFFICE OF THE DEAN
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Ref.No. CNCSDO/759/15/2023
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Date June 09, 2023
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To Whom It May Concern

The College of Natural and Computational Sciences Institutional Review Board (**CNS-IRB**) Committee in its meeting held on **25/05/2023, Minute No. IRB/05/2015/2023** has examined the project proposal entitled "Food consumption score among mothers and children aged 6-36 months in Addis Ababa: Assessing variation across a year.'' **by Eden Amare** from the Addis Ababa University.

The proposal is approved for implementation for one year, effective June 09, 2023.

With regards,

Tileye Feyissa, (Prof)
Dean, College of Natural & Computational Sciences
Addis Ababa University

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Please Quote our reference number in your correspondence
"Examine all things; hold fast that which is good" "ሁሉን መርምሩ መልካሙን ያዙ"

ANNEX 4: SAMPLING METHOD