

DEBRE MARKOS UNIVERSITY

COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF PUBLIC HEALTH

TRENDS AND CONTRIBUTING FACTORS IN THE CHANGES OF IRON-RICH FOOD INTAKE AMONG CHILDREN AGED 6-59 MONTHS IN ETHIOPIA: EVIDENCE FROM EDHS 2005-2019.

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A THESIS SUBMITTED TO DEPARTMENT OF PUBLIC HEALTH, COLLEGE OF HEALTH SCIENCE, DEBRE MARKOS UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTERS OF PUBLIC HEALTH IN EPIDEMIOLOGY.

MAY, 2017

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LIST OF ABBREVATIONS AND ACRONYMS

AIC	Akaike Information Criterion
ANC	Anti Natal Care
AOR	Adjusted Odds Ratio
DHS	Demographic and Health Survey
EA	Enumeration Area
EDHS	Ethiopian Demographic and Health Survey
EMDHS	Ethiopian Mini Demographic and Health Survey
EPHI	Ethiopian Public Health Institute
FMOH	Federal Ministry of Health
IRFI	Iron Rich Food Intake
PCV	Proportional Change in Variance
PNC	Post Natal Care
SSA	Sab Saharan Africa
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WFP	World Food Program
WHO	World Health Organization

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ABSTRACT

Background: Despite national efforts to combat childhood anemia, iron-rich food consumption remains unsatisfactory. Iron deficiency is one of the most common nutritional deficiencies among children in Ethiopia.

Objectives: This study was aimed to describe the trends and contributing factors for the change of iron rich-food intake among children aged 6-59 months in Ethiopia based on Ethiopian demographic and health surveys (EDHSs) data.

Methods: A repeated cross-sectional study design was conducted by using EDHSs 2005, 2011, 2016 & 2019.A total weighted sample size of 3938, 5593, 5330 and 2554 were considered in 2005,2011,2016 and 2019, respectively. A two stage stratified cluster sampling technique was used to identify children aged 6-59 months. Logistic based decomposition analysis was performed to determine trends and contributing factors in the change of iron rich food intake over time. In addition, multilevel logistic regression analysis was employed to identify the associated factors of iron rich food intake. Significant variables were reported with a p-value less than 0.05.

Result: In the entire period iron rich food intake increased from 9.16 % to 20.68%. For this increment, change in population proportion of educated mothers contributed just nearly 66.45%.

Individual level factors: mother`s education (primary AOR=2.83, 95% CI:2.05, 3.92;secondary AOR=1.94, 95% CI:1.13, 3.33 & higher AOR=2.74, 95% CI:1.47, 5.1), religion (muslim AOR=2.03 95% CI:1.16, 3.54), wealth index (richer AOR=1.48, 95% CI:0.79, 2.75), ANC visit (>=4 AOR=1.99, 95% CI:1.12, 3.25) were positively associated with iron rich food intake, however religion (others AOR=0.02, 95% CI 0.00, 0.95), number of household members (5-10 AOR=0.55, 95% CI:0.4, 0.77 &>=11 AOR=0.37, 95% CI:0.15, 0.88), number of under 5 children in household (>=3 AOR=0.41, 95% CI:0.26, 0.63), wealth index (middle AOR=0.56, 95% CI:0.33, 0.95), place of delivery (health facility AOR=0.62, 95% CI:0.45, 0.87) and child age (>=24 AOR=0.57, 95% CI:0.42, 0.79), whereas, community level factors: region (Afar AOR=0.11, 95% CI:0.02, 0.67, Amhara AOR=0.29, 95% CI:0.12, 0.72 and Somali AOR= 0.02, 95% CI 0.00, 0.14) were negatively associated with iron rich food intake.

Conclusion: The change of iron-rich food consumption among children aged from 6–59 months in Ethiopia was low between 2005 and 2019. To increase the consumption of the iron rich food among children aged 6-59 months in Ethiopia national government and ministry of health should strengthen nutrition education, women empowerment and minimize socio-economic difference for sustainable iron rich food consumption increment.

Keywords: Iron Rich Food Intake, Trends, Contributing Factors, EDHS

1. INTRODUCTION

1.1. Background

Iron-rich food intake refers to the consumption of foods that are high in iron, which is a crucial mineral for the body. Iron is an essential element for the production of hemoglobin, which is a protein in red blood cells that carries oxygen throughout the body [1-3][Ross, 2020 #34;Supplements, August 17`, 2023 #29]. It is also a crucial component of numerous other proteins and enzymes that the body needs for healthy growth and development[3]. Iron is an important nutrient that plays a dominant role in many metabolic processes[4, 5].

Iron rich food exists in two main forms in the food. Heme iron found in animal food products, particularly in meat, poultry, and fish, and it is more easily absorbed by the body compared to non-heme iron. Non-heme iron found primarily in plant based foods, such as legumes (Lentils, chickpeas, beans) and cereals. It is less readily absorbed by the body but it can be enhanced with the presence of vitamin C or other enhancers [1, 6-10].

Young children's diets frequently do not include iron-rich foods like meat, eggs, legumes, and fortified cereals, particularly in rural or low-income areas. Ethiopian children typically consume relatively low iron-rich food which is 24% in Ethiopia, and many have limited access to it because of cultural norms, financial limitations, and food availability [8].

Adequate iron food intake especially for young children is very essential since it serves for body growth and development. Dietary iron improves nutrition and it helps to preventing iron deficiency anemia, which affects children`s cognitive and physical development that lead to fatigue, weakness, and impaired immune function[2, 9]. Consumption of iron rich food increases with increasing age, house hold wealth and maternal education [8]. However, too much iron can harmful for health. Therefore the average daily recommended iron intake is needed and it varies with age and sex[2]. Despite these recommendations practices of inadequate iron intake is common in many parts of the world.

Iron deficiency is a major public health concern in many developing nations, especially among children, because it can impair cognitive development and general health. This study focuses on the factors that influence the availability, accessibility, and consumption of iron-rich foods such as meat among children aged 6-59 months. It also assesses how socioeconomic, demographic,

geographic and health related factors have influenced dietary patterns, as well as the impact of health-care initiatives and policies targeted at promoting nutrition. The study's findings should offer important insights into public health policies, food security programs, and children's general nutritional status in Ethiopia.

1.2. Statement of the Problem

Currently inadequate iron intake is a major public health problem in the World, particularly among children aged 6-59 months, which is a critical period for growth and development [11-13]. Despite the availability of iron-rich foods, many children in this age group suffer from inadequate iron intake, which is leading to iron deficiency (ID) that affects their physical growth, cognitive development and overall health [14, 15]. According to World health Organization (WHO) estimation of 2007 indicated that iron deficiency is the commonest micronutrient shortage which affects approximately 42% children worldwide from this figure African children are mostly affected by this problem [4, 16]. According to the World Food Program (WFP) in 2024, revealed that over 2 billion people are affected by micronutrient deficiencies in the world. People of vulnerable groups such as pre-school age children one in three and women of reproductive age two in three are suffering by micronutrient deficiency globally [17]. According to the Ethiopian Demographic and Health Survey 2016 (EDHS) report showed that 57% of children age 6-59 months suffered by anemia in Ethiopia from this the Somali Region has the highest level of childhood anemia (83%), followed by Afar (75%) and Dire Dawa (72%) while the Amhara Region has the lowest anemia prevalence among children (42%) [8]. The recent 2019 Ethiopian mini demographic and health survey (EMDHS) report showed that consumption of iron rich food is low in young children (6-23 months) which is 24% in Ethiopia [7].

Inadequate iron consumption at critical stages of childhood development can lead to iron deficiency which is a major consequence of anemia, cognitive and motor delays, reduced immunological function, and stunted growth [18-21]. So addressing iron deficiency through dietary changes and supplements is critical for promoting optimal health and development in young children.

According to earlier research, preschool children who consumed insufficient amounts of iron grew more slowly, had weakened immune systems, and poorer cognitive [22]. Other recent studies revealed that the percentage of iron-rich foods consumed by young children varies from 11.77% in low- and middle-income countries (LMICs) to 90% in high-income countries (HICs) [12, 23-26]. Iron consumption among Ethiopian children aged 6–59 months was found to be strongly correlated with both individual-level factors, such as low antenatal care (ANC) visits, institution delivery, child age, gender, birth order, family with high wealth index and media

exposure and community-level factors, such as regions and community women's education [12, 23, 25-27].

Various efforts focus to preventing inadequate iron intake among under five children in the globe through iron supplementation especially in young children, food fortification such as wheat flour, rice, and salt with iron, community-based programs especially in rural areas ,and education or promotion about iron-rich foods such as lentils, eggs, meat, and dark leafy vegetables at home [17, 28, 29].

Improving iron-rich food consumption in Ethiopia requires identifying source of variation, determinants and contributing factors of the prevalence of iron rich food intake by using multivariate decomposition analysis technique, which is not still done in national level by using the data of Ethiopian Demographic and Health Surveys (EDHSs 2016&2019).

Despite the above facts, there is limited evidence of trends in iron rich food intake status of children aged 6-59 months in Ethiopia. Therefore, the purpose of this study was to analyze the trends and contributing factors in the change of iron rich food intake among children aged 6–59 months in Ethiopia.

1.3. Literature Review

1.3.1. Trends of Iron Rich Food Intake among Children

The overall consumption of iron-rich food intake among children aged from 6-59 months were increased for the past 10 years in Ethiopia since from 2005 to 2016[26]. According to a study conducted in Ethiopia, the proportion of iron-rich food intake by children aged 6–59 months was slightly increased from 9.25% in EDHS 2005 to 10.86% in EDHS 2011, and sharply increased to 17.49% in EDHS 2016[26]. Similar study which conducted in Ethiopia showed that the proportion of good consumption of iron-rich foods among children aged 6–59 months is increased by 27.9% in EMDHS 2019[25].

1.3.2. Factors Associated Iron-Rich Food Intake

1.3.2.1. Individual Level Factors

1.3.2.1.1. Socio-Economic Factors of the House Hold

A study conducted on iron-rich food consumption and associated factors among children aged 6–23 months in sub-Saharan Africa in 2020 maternal and paternal education, maternal working status, wealth index, media exposure and mothers occupation were significantly associated with consumption of iron-rich foods [12]. Similar study done in Sab-Saharan Africa (SSA) by 2024 on determinants of iron-rich food deficiency among children under 5 years in a comprehensive analysis of Demographic and Health Surveys (DHS) showed that the overall prevalence of iron-rich food deficiency among under five children in the entire sample was 56.75% which is high and only two from five children gate adequate iron intake. Factors of maternal education, revealed a reduced likelihood of iron-rich food deficiency in the sample. Likewise, paternal education, with both primary education and higher education showed decreased odds of iron-rich food deficiency. [19]. A study conducted on Individual and community level factors associated with iron rich food consumption among children aged 6–59 months in Ruanda by 2022 showed that mothers secondary education and above, married mothers, rich wealth status and media exposure were associated with iron-rich food consumption [30]. A Study conducted on Iron-rich food consumption and associated factors among children aged 6–23 months in Sierra Leone by 2023 mothers occupation was significant factors associated with iron-rich food intake [31]. Similar study conducted on iron-rich food consumption and associated factors among children aged 6-23 months in Indonesia by 2024 showed that highly educated, relatively rich economic

status and mothers who access of mass media has a statistically significant with good consumption of iron-rich foods [32]. According to EDHS 2016 report the study done in Ethiopia showed that mothers' educational status and household wealth index were not significant with the micronutrient (MN) intake among children aged 6–23 months [8].

A study conducted on spatial distribution of iron rich foods consumption and its associated factors among children aged 6–23 months in Ethiopia showed that primary and secondary and above mother's education level and rich and middle household wealth status were statistically significant factors for good consumption of iron rich foods [23]. A study done on micronutrient intake status and associated factors among children aged 6–23 months in the emerging regions of Ethiopia in 2020 showed that mothers occupation was significantly associated with the MN intake status [11]. Study done on spatial variations and determinants of iron containing foods consumption among 6–23 months old children in Ethiopia by 2024 showed that the overall, consumption of iron rich food is 27.14% and women's education levels factor was statistically significant with the dependent variable [33]. A study conducted on iron-rich food consumption and predictors among children aged 6–59 months old in Ethiopia in 2024 the findings clearly showed that the proportion of good consumption of iron-rich foods among children aged 6–59 months was 27.99%. Children born to mothers who were Catholic followers, children born to mothers who completed primary education or a higher education and being born to the poorer family, richer and richest, were significantly associated with iron-rich food consumption among children aged 6–59 months old [25]. A study done on iron-rich food consumption, and predictors among 6–59-month old children in Ethiopia in 2024 factors explained that being married parents, children born to mothers who completed a primary education, secondary education, higher education, being born to the medium family, rich family, media exposure, were significantly associated with iron-rich food consumption among children aged 6–59 months old[26]. A study conducted by 2024 on socio-economic and spatial inequalities in animal sources of iron-rich foods consumption among children 6–23 months old in Ethiopia a decomposition analysis showed that magnitude of iron-rich animal source foods consumption among children 6–23 months old in Ethiopia is low (24.2%). Mother`s education (21%) and household wealth index (10%) were contribute to the wealth-related inequalities [34].

1.3.2.1.2. Demographic Factors

A study conducted on iron-rich food consumption and associated factors among children aged 6–23 months in sub-Saharan Africa in 2020 child age was significantly associated with consumption of iron-rich foods [12]. A Study conducted on Iron-rich food consumption and associated factors among children aged 6–23 months in Sierra Leone by 2023 children's age, was significant factors associated with iron-rich food intake however, maternal age was decreased the odds of iron rich food consumption[31]. Similar study conducted on iron-rich food consumption and associated factors among children aged 6-23 months in Indonesia by 2024, showed that children aged 18-23 months was a statistically significant with good consumption of iron-rich foods[32]. According to EDHS 2016 report the study done in Ethiopia showed that child's age was significantly associated with the micronutrient (MN) intake status among children aged 6–23 months [8].

A study conducted on spatial distribution of iron rich foods consumption and its associated factors among children aged 6–23 months in Ethiopia showed that child aged 12–17 months and 18–23 months, were statistically significant factors for good consumption of iron rich foods [23]. A study done on micronutrient intake status and associated factors among children aged 6–23 months in the emerging regions of Ethiopia in 2020 showed that age of a child, was significantly associated with the MN intake status [11]. A study done on Individual and community level determinants of iron intake among children 6–59 months old in Ethiopia in 2022 experienced that age of children and sex of the child have a significant association with iron intake among children aged 6–59 months in Ethiopia [27]. A study conducted on iron-rich food consumption and predictors among children aged 6–59 months old in Ethiopia in 2024 the findings clearly showed that the proportion of good consumption of iron-rich foods among children aged 6–59 months was 27.99%. Being 24–59 month-old children, was significantly associated with iron-rich food consumption among children aged 6–59 months old [25]. A study done on iron-rich food consumption, and predictors among 6–59-month old children in Ethiopia in 2024 factors explained that being children born to mothers aged 20 to 34 years old, mothers aged ≥ 35 years old, was significantly associated with iron-rich food consumption among children aged 6–59 months old[26]. A study conducted by 2024 on socio-economic and spatial inequalities in animal sources of iron-rich foods consumption among children 6–23 months old in Ethiopia a decomposition analysis showed that magnitude of iron-rich animal source foods consumption

among children 6–23 months old in Ethiopia is low (24.2%). Children being in the older age group (12–23 months) (2.4%) was contribute to the wealth-related inequalities [34].

1.3.2.1.3. Health Related Factors

A study conducted on iron-rich food consumption and associated factors among children aged 6–23 months in sub-Saharan Africa in 2020 current breastfeeding status, number of ANC visit, institution delivery and postnatal check with in two months(PNC) were significantly associated with consumption of iron-rich foods [12]. Similar study done in Sab-Saharan Africa (SSA) by 2024 on determinants of iron-rich food deficiency among children under 5 years in a comprehensive analysis of Demographic and Health Surveys (DHS) showed that factors of postnatal visits contributed significantly to reducing the odds of iron-rich food deficiency, along with antenatal visits, which also had a positive impact [19]. A study conducted on Individual and community level factors associated with iron rich food consumption among children aged 6–59 months in Ruanda by 2022 showed that PNC was associated with iron-rich food consumption [30]. A Study conducted on Iron-rich food consumption and associated factors among children aged 6–23 months in Sierra Leone by 2023 children's breastfeeding status, frequency, and timing of ANC and taking drugs for intestinal parasites were significant factors associated with iron-rich food intake [31]. Similar study conducted on iron-rich food consumption and associated factors among children aged 6-23 months in Indonesia by 2024, showed that antenatal care visits <6 times, took medication for deworming and antiphrastic over the past 6 months, children who were not breastfeeding were statistically significant with the good consumption of iron-rich foods [32]. According to EDHS 2016 report the study done in Ethiopia showed that child currently breastfeed, was not significant with the micronutrient (MN) intake among children aged 6–23 months [8].

A study done on micronutrient intake status and associated factors among children aged 6–23 months in the emerging regions of Ethiopia in 2020 showed that recent ANC was significantly associated with the MN intake status [11]. A study done on Individual and community level determinants of iron intake among children 6–59 months old in Ethiopia in 2022 experienced that ANC visit, birth order and institution delivery have a significant association with iron intake among children aged 6–59 months in Ethiopia [27]. Study done on spatial variations and determinants of iron containing foods consumption among 6–23 months old children in Ethiopia

by 2024 showed that health facility delivery and current breast-feeding status factors were statistically significant with the dependent variable [33]. A study conducted by 2024 on socio-economic and spatial inequalities in animal sources of iron-rich foods consumption among children 6–23 months old in Ethiopia a decomposition analysis showed that antenatal care (ANC) visits (14.6%), was contribute to the wealth-related inequalities [34].

1.3.2.2. Community level factors

A study conducted on iron-rich food consumption and associated factors among children aged 6–23 months in sub-Saharan Africa in 2020/2021 factors of residence and sub-region of SSA were significantly associated with consumption of iron-rich foods [12]. A study done in Sab-Saharan Africa (SSA) by 2024 on determinants of iron-rich food deficiency among children under 5 years in a comprehensive analysis of Demographic and Health Surveys (DHS) showed that the factor of resident in rural area was slightly higher odds of iron-rich food deficiency[35].

Similarly another Study also, conducted on Iron-rich food consumption and associated factors among children aged 6–23 months in Sierra Leone by 2023 the factor of region was significantly associated with iron-rich food intake [31]. According to EDHS 2016 report the study showed that region and residence were significantly associated with the MN intake status among children aged 6–23 months [8]. A study conducted on Spatial distribution of iron rich foods consumption and its associated factors among children aged 6–23 months in Ethiopia in 2020/21 experience showed that the regions of Amhara , Afar and Harari were statistically significant factors for good consumption of iron rich foods [23]. A study done on micronutrient intake status and associated factors among children aged 6–23 months in the emerging regions of Ethiopia in 2020/21 showed that residence and region were significantly associated with the MN intake status [11]. A study done in Individual and community level determinants of iron intake among children 6–59 months old in Ethiopia by 2022 experience showed that regions and community women`s with high education were have a significant association with iron rich food intake among children 6–59 months in Ethiopia [27]. Study done on spatial variations and determinants of iron containing foods consumption among 6–23 months old children in Ethiopia by 2024 showed that factor of region, was statistically significant [33]. A study conducted on iron-rich food consumption and predictors among children aged 6–59 months old in Ethiopia by 2024 the findings clearly explained that the proportion of good consumption of iron-rich foods among

children aged 6–59 months was 27.99%. Being residents of the Afar, Amhara, and Somali region were significantly associated with iron-rich food consumption among children aged 6–59 months old [25]. A study done on iron-rich food consumption, and predictors among 6–59-month old children in Ethiopia by 2024 explained that being residents of the Tigray, Oromia, Benishangul Gumuz, Gambela, and Dire Dawa regions were significantly associated with iron-rich food consumption among children aged 6–59 months old [26].

1.3.3. Conceptual Framework of the Study

The following conceptual framework adapted after the review of different literatures (Figure-1).

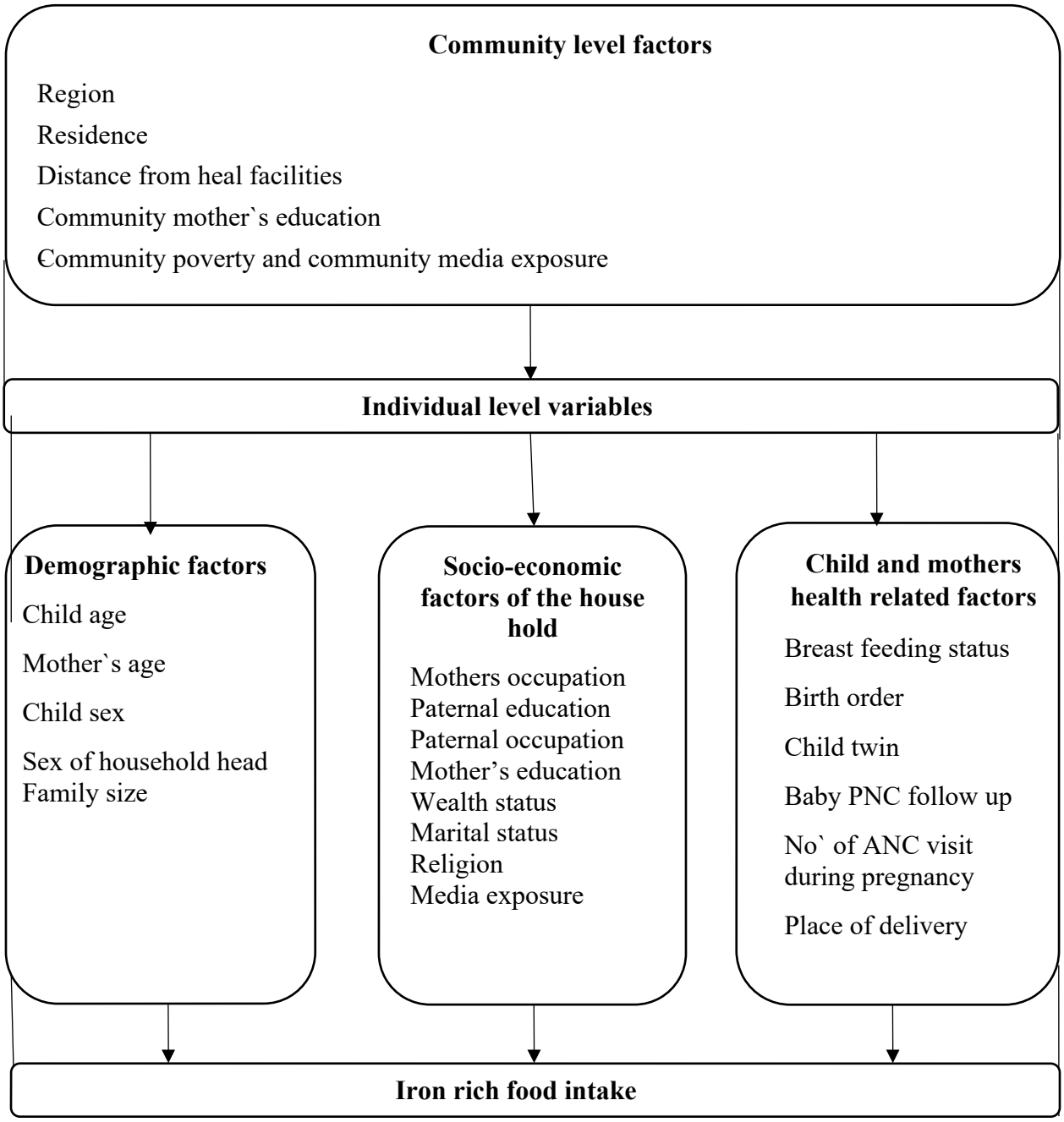


Figure 1. A conceptual framework for factors of iron rich food intake in Ethiopia **[12, 23, 25-27, 30-33]**

1.4. Justification of the Study

Prevalence of low iron intake is one of the major causes of iron deficiency anemia in under-five children, which may have long-term effects on growth, cognitive development, and overall health. Despite various public health interventions, such as iron supplementation and the trends and contributing factors for influencing the consumption of iron-rich food was not well represented by the scholars. Although Ethiopia has made progress in stride or combating malnutrition mainly micronutrient deficiency such as iron, it still poses a big challenge within the nation. Hence, this study can provide insights that were informed policymakers and health programmers for appropriate interventions to enhance dietary practices and nutritional education integrated at young childhood. By investigating the factors responsible for change in the consumption of foods rich in iron, the socio- economic, demographic and health related factors affecting food choices were come to light. This was necessary to address public health problem and public health strategies for planning dietary interventions, efficient resource allocation in the most affected areas, appropriate monitoring and evaluation for the impact of relevant implementations on child hood nutrition problem in Ethiopia. Therefore, this study was conducted to fill the gap, by examining socio- economic, demographic, health related and geographic factors that influencing trends or patterns and contributing factors of iron-rich food consumption in order to take further intervention and nutrition improvement for the future in under five children.

1.5. Significance of the Study

Studying the trends and contributing factors in the changes of iron-rich food intake among children aged 6-59 months in Ethiopia, using data from the Ethiopian Demographic and Health Surveys (EDHS) conducted between 2005 and 2019, holds significant public health importance. Iron deficiency poses a critical concern globally, particularly in developing nations like Ethiopia where children are especially vulnerable. Analyzing these trends could offer valuable insights into the nutritional status of Ethiopian children, guiding the development of targeted interventions and policies. By leveraging longitudinal data from multiple EDHS surveys, this study could track changes over time, identify patterns, and shed light on potential factors influencing iron-rich food intake. Moreover, the study contributes to evidence-based decision-making in public health and nutrition programs, filling research gaps and supporting sustainable development goals related to child nutrition and well-being in Ethiopia.

2. OBJECTIVES

2.1. General Objective

- To investigate trends and contributing factors in the change of iron-rich food intake among children aged from 6-59 months in Ethiopia by using EDHS data from 2005 to 2019.

2.1. Specific Objectives

- To determine the trends of iron-rich food intake among children aged from 6-59 months in the last 15 years.
- To identify contributing factors in the change of iron-rich food intake among children aged from 6-59 months in the 15 years.
- To identify the factors that associated with iron rich food intake among children aged 6-59 months in Ethiopia based on the recent MEDHS 2019 data.

3. METHODS AND MATERIALS

3.1. Study Area and Period

This study was conducted in Ethiopia from January 1, 2017 to May, 2017 by using Ethiopian demographic and health surveys (EDHSs) 2005, 2011, 2016 and 2019. Ethiopia is a country in the horn of Africa which located 3^0-14^0N and 33^0 – 48^0 and bordered by Djibouti, Eritrea, Kenya, Somalia, South Sudan, and Sudan. It has 9 regional states (Tigray, Afar, Amhara, Oromia, Benishangul gumez, Gambella, Somalia, Harari and Souther nations, nationalities and people`s(SNNP)) and 2 self-Administrative Cities (Addis Ababa and Dire dawa) during surveys [36] (Figure 2).

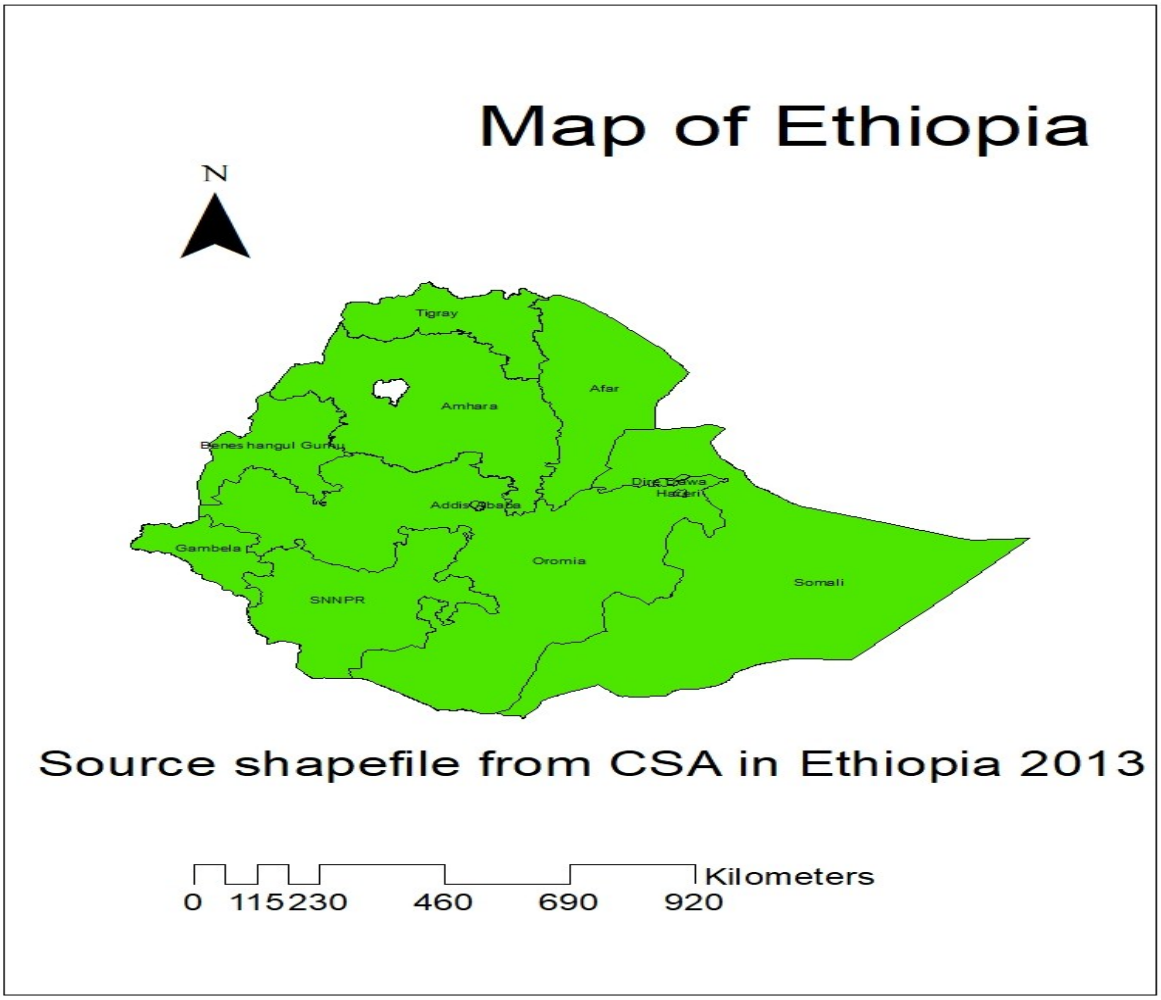


Figure 2.Map of the study area

Ethiopia is the second most populous country in the continent of Africa after Nigeria. Majority of the population were practice agricultural activities so Agriculture remains the main driver of rapid economic growth and development [37]. According to UNICEF for every child, report in 2018 the total number of population in Ethiopia is 98 million among this 13 million is under five children from this population group stunting affects 5.4 million under five children (39%) and under nutrition accounts for 45 percent of child mortality under the age of five [38, 39].

3.2. Study Design

Repeated cross-sectional study design was conducted based on EDHSs dataset 2005 to 2019.

3.3. Data Source

The four consecutive EDHSs from 2005 to 2019 data were used for this study. This study will be utilized data set from four consecutive Ethiopian Demographic and Health Surveys (EDHSs) from 2005 to 2019 which were collected by the Central Statistical Agency (CSA) in coordination with the Federal Minister of Health (FMOH) and Ethiopia Public Health Institute (EPHI). It was conducted in Ethiopia, every five years. The primary goal of the EDHSs is to provide updated health and health-related metrics, including maternal and child mortality, family planning, vaccination rates, and maternal healthcare service utilization. Consent letter for the use of this data will be gained from measure DHS and the data set will be downloaded from the DHS website https://www.dhsprogram.com/data/dataset_admin/login_main.cfm.The EDHSs data are part of the worldwide DHS project which was funded by the United States Agency for International Development (USAID) and was implemented by the Ethiopian Central Statistical Agency (CSA) [7, 8].

3.4. Population

3.4.1. Source Population

- All children aged from 6-59 months residing in Ethiopia during 2005, 2011, 2016 and 2019 surveys were used as source of population.

3.4.2. Study Population

- All children aged from 6-59 months in the selected enumeration areas and households residing in Ethiopia during Ethiopian Demographic and Health Survey (EDHS) years were used in a study population.

3.5. Eligibility Criteria

3.5.1. Inclusion Criteria

- All children aged from 6-59 months in the designated enumeration areas and households during the survey years were included

3.5.2. Exclusion Criteria

- Children aged from 6-59 months however, who do not have data at least one out of four food items for the assessment of iron rich food intake were excluded from the study.

3.6. Sample Size Determination and Sampling Procedures

This study was utilized EDHSs data which used a stratified, two stage cluster sampling technique to select Enumeration Areas (EAs) and households [7, 8]. Stratification was accomplished by separating each region into urban and rural areas. The 2005 data was collected based on the 1994 population and housing census frame and 2011 and 2016 data was collected based on 2007 population and housing census frame and 2019 data was collected based on the 2019 Population and Housing Census frame [7, 8, 40, 41]. In the first stage, regions were stratified into urban and rural areas from the list of population [7, 8, 40, 41]. In the second stage, each enumeration areas or clusters were selected with equal probability with a systematically/independently and then households were selected in each EA. For each EDHS data (2005, 2011, 2016 and 2019) sample were stratified and selected in two stage sampling technique. In 2005 EDHS, a representative sample was collected from 145 urban and 395 rural enumeration areas. In 2011 EDHS, a national representative sample was obtained from 624 clusters and from 187 urban and 437 rural enumeration areas. In 2016 EDHS, a representative sample was collected from 645 clusters, of which 202 in urban areas and 443 in rural enumeration areas. In 2019 EMDHS, a national representative sample also, found from 305 enumeration areas of which 93 urban and 212 rural enumeration areas. Therefore, adequate weighted sample size of 3938 children in 2005, 5593 in 2011, 5330 in 2016 EDHSs and 2554 in 2019 EMDHS were taken [7, 8, 40, 41].

The following chart shows sample size determination of each survey years (Figure-2).

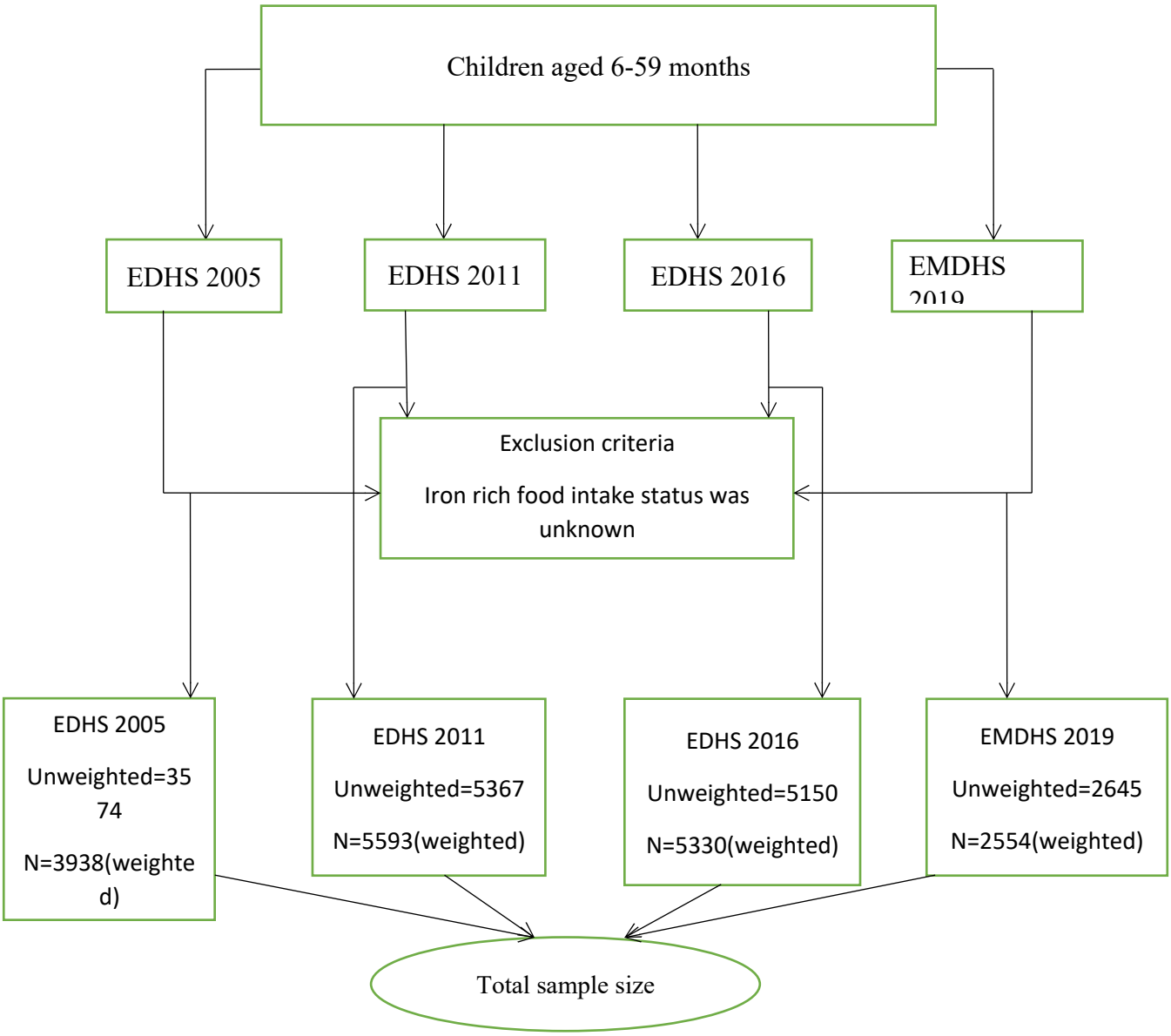


Figure 3.A Schematic presentation of sampling procedure.

3.7. Variables of the Study

3.7.1. Dependent Variable

Iron rich food intake (yes or good and no or poor)

3.7.2. Independent Variables

Individual level variables: Socio-demographic and economic factors (age of mother`s or respondent, mother's education, marital status, religion, mother`s occupation, paternal education,

paternal occupation, family size, sex of house hold head, wealth status and media exposure. Child related factors (child age in months, child sex, number of under 5 children in the household). Health related factors of the child and mother`s(birth order, child is twin, breast feeding status, baby postnatal follow up within two months, number of ANC visit during pregnancy and place of delivery).

Community level variables: Residence, region, community mother`s education, community poverty, community media exposure and distance from health facilities)

3.8. Operational Definitions

Trends: a specific measure of variability to identify and track changes over time.

Good iron-rich food intake: Children consumed at least one iron-rich food item among the four food items: meat (beef, pork, lamb, chicken, etc.), egg, organ meat (liver, heart, or other organs), and fish or shellfish at any time in the last 24 hours before the interview were considered as good iron-rich food intake [7, 8, 40-42] .

Poor iron-rich food intake: Children didn`t history of iron-rich food intake within the past 24 hours before the interview were considered as poor iron-rich food intake [7, 8, 40, 41].

Media exposure: It was assessed using three variables: frequency of watching television, reading a newspaper, and listening to radio. Mothers who were exposed at least one media considered as they had media exposure [7, 8].

Aggregated community level variables: Necessary variables were not found in EDHSs data set that aggregated from individual level variables in the cluster by using cluster numbers to see cluster effect on children`s aged 6-59 months iron rich food intake.

**Community mother`s education:** It was aggregated from individual mother`s education level in the cluster by using national median value which categorized lower and higher proportion[43].

Community poverty: It was aggregated from mother`s wealth index in the cluster level by using national median value which categorized as lower and higher proportion[44].

Community media exposure: Proportion of mother`s who had media exposure in a cluster that categorized as lower and higher proportion by using median value.

3.9. Data Processing and Analysis Technique

Data obtained from EDHS program official data base www.dhsprogram.com, through online request by preparing the objectives of the study then permission was guaranteed by data archivist after that data cleaning, coding and sample weighting were done by using SPSS statistical software version 25.0 and Data analysis also done by using STATA statistical software version 17.0. Before doing any analysis, the data were weighted by sample weighting to ensure the representativeness of the survey sample and to get reliable estimates and standard errors.

After the data were cleaned, categorized, coded and weighted, the trend was assessed by using descriptive statistical analysis stratified by selected respondent characteristics separately by divided into four phases, for first phase (2005-2011), second phase (2011-2016), third phase (2016- 2019) and overall phase (2005-2019) to seen the differences in iron-rich food intake prevalence over time. EDHS 2005, 2011, 2016 and 2019 data were appended together and then survey year also created for the same time after extracting and generating important community level variables by using each survey cluster numbers for trend and decomposition analysis. Logit-based Multivariate decomposition analysis technique was performed for the analysis of factors that contributing the change in iron rich food intake and to identify source of variation over the period in the last 15 years.

The multivariate decomposition was decompose the components of differences in proportion attri butable to the different groups into a component attributable to compositional change between th e groups and a component attributable to the effect of population behavior or the effect of charact eristics. The multivariate decomposition analysis is the statistical analysis of the change in event that results in the difference of outcome between any two surveys [45].

The decomposition analysis was used to compare the difference in two time periods and identify the sources of variations of iron rich food intake prevalence among children aged 6-59 months. The difference between any two surveys was explained by the compositional changes or characteristics of surveys (endowments), which is explained and by the effects of those characteristics (coefficients) that is not explained. Thus, the overall change in iron rich food intake between two surveys will finally be additively decomposed in an endowment or characteristics component and coefficient or effect of characteristics component by using

STATA statistical software. In the nonlinear model, the response variable is a function of a linear combination of predictors and regression coefficients [45].

$$Y = F(X\beta) = logit(Y) = X\beta$$

Where$Y$ represent the dependent variable

X represents a set of predictor variables

β denote set of regression coefficients

The proportion difference in Y between the two surveys of A and B can be decomposed as

$$Y_A - Y_B = F(X_A\beta_A) - (X_B\beta_B)$$

Let the recent 2019 MEDHS and reference 2005 EDHS datasets were denoted by A and B respectively.

For logistic regression, the log-odds or logit of the iron rich food intake was given by[45]

$$\begin{aligned} logit(A) - logit(B) &= F(X_A\beta_A) - F(X_B\beta_B) \\ &= \underbrace{\left[F(X_A\beta_A) - F(X_B\beta_A)\right]}_{E} + \underbrace{\left[F(X_B\beta_A) - F(X_B\beta_B\right]}_{C} \end{aligned}$$

Where; E represents endowments, which is explained by characteristics. An endowment is a change in iron rich food intake due to differences in characteristics. C denotes coefficients or effect of characteristics which is unexplained. The coefficient is the change in iron rich food intake due to the effect of predictor variables

The equation can be presented as:

$$logit(A) - logit(B) = \left[\beta_{0A} - \beta_{0B}\right] + \sum X_{ijB} * \left[\beta_{ijA} - \beta_{ijB}\right] + \sum \beta_{ijB} * \left[X_{ijA} - X_{ijB}\right]$$

Before multivariate decomposition analysis multi-collinearity was checked between each independent variables and statistical significance was declared at a p-value of less than 0.05. Multilevel analysis was done to identify factors associated with iron rich food intake among children`s aged from 6-59 months in Ethiopia by using the recent EMDHS 2019 data. Factors

influencing the outcome variable were identified with in multilevel binary logistic regression models. For multivariable multilevel analysis, four models were fitted. The first model was null model which used to identify the extent of cluster variation without any independent factors, the second model was the random intercept model adjusted for individual level factors, the third model fitted to with community level factors and the fourth model was fitted both individual and community level factors simultaneously. The best-fitted model was model IV which selected based on using the higher likelihood test and the lower deviance value during model comparisons. Variation between clusters were assessed using odds ratio (OR), Intra class correlation coefficient (ICC), and proportional change in variance (PCV). The Median Odds Ratio (MOR) is the median value of the odds ratio between the cluster at the lower and the higher risk when randomly picking out two clusters. Iron rich food intake heterogeneity between clusters was quantified with intra class correlation coefficient (ICC).

$$ICC = \frac{\sigma^2_u}{\sigma^2_u + \sigma^2_e}$$

Where, σ^2_u- is the community (cluster) level variance and σ^2_e - is a residual variance

$$MOR = \exp ¿$$

where VA is the area level variance, and 0.6745 is the 75th centile of the cumulative distribution function of the normal distribution with mean 0 and variance 1[46].

The proportional change in variance (PCV) reveals the total variation attributed by individual and community level factors. Before multilevel analysis multi-collinearity was checked by using variance inflation factors (VIF). All variables have VIF less than 5 and tolerance greater than 0.1. Before multivariable multilevel analysis bi-variable multilevel analysis was done. Then variables which have p-value <0.25 were considered as a candidate variables for multivariable multilevel binary logistics regression analysis and p-value<0.05 after multivariable multilevel binary logistics regression analysis were statistically significant for iron rich food intake.

3.10. Ethical Considerations

Ethical approval and clearance was obtained from Debre Markos university ethical review committee. In addition, permission letter was obtained from the Ethiopian Health and Nutrition Research Institute Review Board[7, 8]. A written consent was obtained by downloading Ethiopian Demographic and Health Surveys (EDHSs) dataset from the International Review Board of Demographic and Health Surveys (DHS) program data archivists after submitting a concept note and description of this study. After the data was downloaded from the measure DHS website www.dhsprogram.com researcher was maintained the confidentiality of the data.

4. RESULT

4.1. Characteristics of Study Population

A total weighted of 3938, 5593, 5330 and 2554 children aged 6-59 months were enrolled in EDHS 2005, 2011, 2016 and 2019, respectively. Based on socio-demographic and economic characteristics of children aged 6-59 months and households report more than two third of the study population in all four surveys were in the age of 24-59 months old and also, similarly two third of mothers age between 20-34 years old. In the fourth EDHS survey the proportion of having 3 and above number of under five children in the household decrease from 18.3 % to 13.1% as well as number of household members in the family who had five and above were also decreased from 79.1 % to 71.3% in 2005 and 2019 respectively. More than four fifth 88.1% in 2005, 86% in 2011, 86.2% in 2016 and 86.7% in 2019 household were leaded by males. According to maternal educational status more than half of the mother`s in all four surveys were not found formal education but it was decreased from higher proportion (78.8%) of mother`s no education in 2005 to lower proportion (54.1%) in 2019. Both the higher (10.6%) and lower (3.5) proportion of mother`s secondary and above educational status was recorded in 2019 and 2011 respectively. More than four fifth of the household (93.2%), (87.7%), (93.8%) and (94.2%) were currently married in 2005, 2011, 2016 and 2019 respectively. Regarding to household wealth status more than one fifth of the household in all four survey were both poorest and poorer (Table 3).

More than two third of household 92.9% in 2005, 88.6% in 2011, 90.2% in 2016 and 73.8% in 2019 were lived in rural areas. More than two fourth of household distant from health facilities were a big problem (70.9%) in 2005, (75.3%) in 2011and (60.7%) in 2019 but there is no reports about distant to health facilities in the last EMDHS 2019 (Table 1).

With regard to child and mother`s health care related reports of this study the highest proportion (2.3%) of twin birth was reported similarly both in 2016 and 2019. The highest proportion (70.6%) of mother`s no ANC visit during pregnancy was found in 2005. However, the highest proportion (40%) of four and above mother`s ANC visits during pregnancy was recorded in 2019. Both the highest and lowest proportion (94.8 %) and (51.4%) of home delivery was reported in 2005 and 2019 respectively (Table 2).

Table 1:-Percentage distribution of community level characteristics of respondents in 2005, 2011, 2016 & 2019 EDHS.

Characteristics	Category	Weighted Frequency (%)			
		2005 N=3938	2011 N=5593	2016 N=5330	2019 N=2554
Residence	Urban	281(7.1)	635(11.4)	524(9.8)	670(26.2)
	Rural	3657(92.9)	4958(88.6)	4806(90.1)	1883(73.8)
Region	Tigray	267(6.7)	632(6.7)	594(6.6)	309(6.8)
	Afar	46(1.1)	93(1.0)	90(1.0)	89(1.5)
	Amahara	809(20.5)	2185(23.0)	1713(19.1)	888(19.4)
	Oromia	1609(40.8)	3938(41.4)	3900(43.5)	1809(39.5)
	Somali	186(4.7)	273(2.9)	401(4.5)	324(7.1)
	Benishangul	39(0.9)	110(1.2)	98(1.1)	55(1.2)
	SNNP	900(22.8)	2005(21.1)	188(21.0)	933(20.4)
	Gambella	1(0.2)	30(0.3)	21(0.2)	19(0.4)
	Harari	9(0.2)	24(0.2)	21(0.2)	13(0.3)
	Addis Ababa	51(1.2)	182(1.9)	199(2.1)	134(2.9)
	Dire Dawa	13(0.3)	32(0.3)	39(0.4)	24(0.5)
Community mother`s education	Lower proportion	3265(83.5)	7203(76.3)	6827(76.2)	2268(50)
	Higher proportion	644(16.5)	2236(23.7)	2130(23.8)	2267(50)

Community media exposure	Lower proportion	2877(67.1)	7689(82.7)	7081(79.1)	
	Higher proportion	1410(32.6)	1720(18.3)	1875(20.9)	
Community poverty	Lower proportion	2924(68.0)	6681(70.6)	3782(42.2)	3024(66.4)
	Higher proportion	1376(32.0)	2782(29.4)	5175(57.8)	1530(33.6)
Distance from health facilities	Big problem	3068(70.9)	7148(75.3)	5438(60.7)	
	Not a big problem	1261(29.1)	2343(24.7)	3518(39.3)	

Table 2:- Percentage distribution of health-related characteristics of child and mother`s in Ethiopia in EDHS 2005, 2011, 2016, 2019.

Characteristics	Category	Weighted Frequency (%)			
		2005	2011	2016	2019
		N=3938	N=5593	N=5330	N=2554
Current breastfeeding status	No	1058(24.4)	7559(29.0)	2953(33.0)	1268(31.3)
	Yes	3272(75.6)	6742(71.0)	6003(67.0)	2786(68.7)
Birth order	1	656(15.7)	1770(18.6)	1594(17.8)	985(21.5)

	2-4	1868(43.1)	4171(43.9)	3883(43.4)	2024(44.2)
	>=5	1806(41.7)	3561(37.5)	3479(38.8)	1568(34.3)
Child is twin	No	4278(98.8)	9325(98.1)	8747(97.7)	4472(97.7)
	Yes	52(1.2)	177(1.9)	209(2.3)	106(2.3)
Number of ANC visits	No visit	1891(70.3)	3566(58.1)	2204(37.0)	756(24.0)
	1-3	451(16.7)	1353(21.1)	1813(30.4)	1007(32.0)
	>=4	350(13.0)	1217(19.8)	1945(32.6)	1386(44.0)
Place of delivery	Home delivery	4102(94.8)	8538(89.9)	6578(73.4)	2351(51.4)
	Health facility	224(5.2)	957(10.1)	2379(26.6)	2226(48.6)
Baby postnatal care Follow up	No	2414(95.3)	5223(95.9)	5432(91.0)	2692(85.5)
	Yes	118(4.7)	224(4.1))	540(9.0)	456(14.5)

Table 3:- Socio-demographic and economic characteristics of children aged 6-59 months and households in EDHS 2005, 2011, 2016, 2019.

Characteristics	Category	Weighted Frequency (%)			
		2005	2011	2016	2019
		N=3938	N=5593	N=5330	N=2554
Childs age	6-11	501(11.6)	1118(11.8)	1066(11.9)	477(10.4)

in months	12-23	922(21.3)	1904(20.0)	1989(22.2)	1019(22.3)
	>=24	2906(67.1)	6479(68.2)	5902(65.9)	3081(67.3)
Mothers Age	15-19	170(3.9)	316(3.3)	241(2.7)	181(3.9)
	20-34	2950(68.1)	6835(71.9)	6429(71.8)	3317(72.5)
	>=35	1210(28.0)	2350(24.7)	2286(25.5)	1080(23.6)
Mother`s education	No education	3410(78.8)	6638(69.9)	5976(66.7)	2477(54.1)
	Primary	737(17.0)	2538(26.7)	2370(26.5)	1615(35.3)
	Secondary & above	183(4.2)	325(3.5)	610(6.8)	486(10.6)
Religion	Orthodox	1798(41.5)	3673(38.7)	3104(34.7)	1560(54.1)
	Catholic	59(1.5)	86(0.9)	85(0.9)	17(0.4)
	Protestant	879(20.3)	2240(23.6)	1965(21.9)	1249(27.3)
	Muslim	1502(34.7)	3294(34.7)	3619(40.4)	1670(36.5)
	Others	90(2.1)	202(2.1)	184(2.1)	82(1.8)
Number of household members	<5	905(20.9)	2251(23.7)	2288(25.5)	1312(28.7)
	>=5	3424(79.1)	7250(76.3)	6668(74.5)	3266(71.3)
Number of	<3	3536(81.7)	7918(83.3)	7455(83.2)	3978(86.9)

under 5 children in household	>=3	793(18.3)	1583(16.7)	1502(16.8)	599(13.1)
Sex of household Head	Male	3813(88.1)	8174(86)	7723(86.2)	3967(86.7)
	Female	517(11.9)	1327(14.0)	1233(13.8)	611(13.3)
Wealth Index	Poorest	1006(23.2)	2151(22.6)	2130(23.8)	1061(23.2)
	Poorer	928(21.4)	2113(22.2)	2050(23.0)	995(21.7)
	Middle	915(21.1)	1952(20.5)	1897(21.2)	857(18.7)
	Richer	846(19.5)	1858(19.6)	1590(17.7)	810(17.7)
	Richest	633(14.6)	1427(15.0)	1284(14.3)	855(18.7)
Current marital status	Married	4033(93.2)	8333(87.7)	8404(93.8)	4314(94.2)
	Others	296(6.8)	1168(12.3)	552(6.2)	264(5.8)
Sex of child	Male	2159(49.9)	4861(51.2)	4625(51.6)	2350(51.3)
	Female	2170(50.1)	4641(48.8)	4332(48.4)	2350(48.7)
Partner`s education	No education	2508(58.6)	4725(50.4)	4044(48.0)	
	Primary	1322(30.9)	3905(41.6)	3378(40.0)	
	Secondary & above	447(10.5)	746(8.0)	1007(11.9)	

Mother`s Occupation	Not working	2920(67.6)	4325(45.9)	4878(54.5)
	Working	1399(32.4)	5092(54.1)	4078(45.5)
Partner`s occupation	Not working	36(0.8)	87(0.9)	6571(7.8)
	Working	4250(99.2)	9310(99.1)	7785(92.2)
Mother`s media exposure	No	2747(63.7)	3964(41.8)	6071(67.8)
	Yes	1566(36.6)	5514(58.2)	2885(32.2)

4.2. Overall Trends of Iron-Rich Food Intake among Children`s aged 6-59 Months in Ethiopia

Trends of Iron Rich Food Intake Rate in Ethiopia by Selected Characteristics

Trends of iron rich food intake proportion among children aged 6-59 months in Ethiopia showed variation based on different characteristics. Iron rich food intake increment was observed in most of the characteristics. However, decrement also showed in some of the characteristics in each phases. Based on rural residents, the largest increment was observed during the second phase of the study period (2011-2016) with 6% point change followed by third(2016-2019) and first (2005-2011) phases with 2.1% and 1.8% point changes respectively and the overall change (2005-2019) was 9.9% point change. With regard to region, the largest point change was observed in Addis Ababa administrative town , Harari and Oromia region with 25.4%,19.2% and 19% point change increment in the second phase respectively and the largest 17.4 % overall change observed in Southern Nation and Nationalities People region (SNNPR) followed by 17% point change in Benishangul Gumz region. But the largest decrement of iron rich food intake was showed in the first phase in Addis Abeba by 11.9% point change, in Harari by 4.2% point change

and in Afar by 2.9% point change. Similarly in the third phase the largest decrement was observed by 12.2%, 9.2%, 8.3% and 6.1% point change in Oromia, Gambella, Harari and Somali region respectively (Table 4). Based on children`s age both child aged 6-11 and 12-23 months showed increment of iron rich food intake proportion in all four phases (Table 5). Similarly households who have both <5 and >=5 family members were showed increment of iron rich food intake prevalence in all four phases (Table 4). Number of under 5 children in household <3 also showed increment of iron rich food intake in all four phases (Table 5).

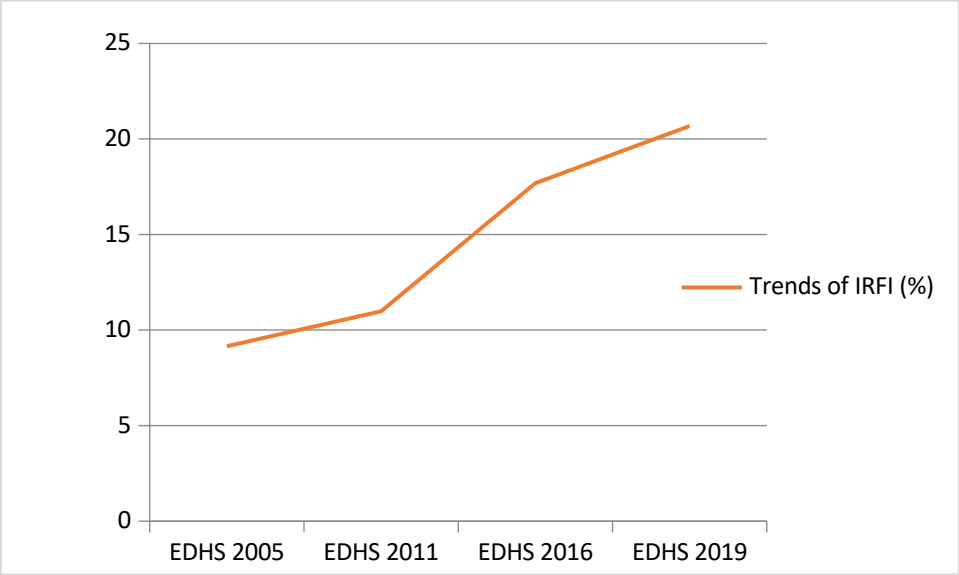


Figure 4.Trend of Iron rich food intake in Ethiopia

Table 4:- Trends of IRFI by selected socio-demographic and economic characteristics of household EDHS 2005, 2011, 2016 and 2019.

Characteristics	Weighted IRFI %				Point difference in IRFI rate			
	2005	2011	2016	2019	Phase I	Phase II	Phase III	Overall
	N	N	N	N	2011-2005	2016-2011	2019-2016	2019-2005
	3938	5593	5330	2554				

Residence	urban	22.0	19.3	35.7	27.9	-2.7	16.4	-7.8	5.9
	Rural	8.1	9.9	15.9	18.0	1.8	6.0	2.1	9.9
Mother`s age	15-19	15.5	11.4	32.4	21.6	-4.1	21.0	-10.8	6.1
	20-34	9.7	11.5	18.4	20.7	1.8	6.9	2.3	11.0
	>=35	6.6	8.8	13.2	20.1	2.2	4.4	6.9	13.5
Mother`s education	No education	7.5	9.0	32.4	11.3	1.5	23.4	-21.1	3.8
	Primary	11.0	14.4	16.4	28.4	3.4	4.0	10.0	17.4
	Secondary& above	32.0	26.7	13.2	35.4	-5.3	-13.5	22.2	3.4
Region	Tigray	16.8	18.0	28.8	30.4	1.2	10.8	1.6	13.6
	Afar	6.7	3.8	6.6	6.6	-2.9	2.8	0	- 0.1
	Amahara	8.4	8.1	8.1	19.6	- 0.3	0	15.5	11.2
	Oromia	9.3	14.3	33.3	21.1	5.0	19.0	-12.2	11.8
	Somali	6.8	5.3	7.0	0.9	-1.5	1.7	-6.1	-5.8
	Benishangul	7.7	15.3	18.8	24.4	7.6	3.5	5.9	17.0
	SNNP	6.6	4.6	14.9	24.0	-2.0	10.3	9.1	17.4
	Gambella	24.4	30.2	29.3	20.1	5.8	-0.9	-9.2	-4.3
	Harari	15.9	11.7	30.9	22.6	-4.2	19.2	-8.3	6.7
	Addis Ababa	25.3	13.4	38.8	37.0	-11.9	25.4	- 1.8	11.7
	Dire Dawa	16.5	17.1	21.6	23.8	0.6	4.5	2.2	7.3

Religion	Orthodox	11.5	12.2	20.0	22.2	0.7	7.8	2.2	10.7
	Catholic	7.5	0	40.9	0	-7.4	40.9	- 40.8	-7.5
	Protestant	7.9	11.5	16.9	23.0	3.6	5.4	6.1	15.1
	Muslim	7.4	9.9	15.9	19.0	2.6	6.0	3.1	11.6
	Others	3.0	6.6	23.5	0.3	3.6	16.9	-23.1	-2.6
Number of household members	<5	9.1	15.3	21.8	27.6	6.2	6.5	5.8	18.5
	>=5	9.1	9.8	16.5	17.8	0.7	6.7	1.3	8.7
Sex of household head	Male	9.4	11.1	17.5	21.3	1.7	6.4	3.8	11.9
	Female	6.6	9.6	20.0	16.4	3.0	10.4	-3.6	9.8
Wealth Index	Poorest	6.0	7.4	12.0	9.0	1.4	4.6	-2.3	3.7
	Poorer	6.1	8.3	14.5	1 8.7	2.1	6.2	4.2	12.6
	Middle	8.5	10.2	17.5	16.1	1.7	8.3	-2.4	7.6
	Richer	10.6	12.3	17.4	31.1	1.7	5.1	13.7	20.5
	Richest	17.7	20.4	35.5	32.1	3.3	15.1	-3.4	14.4
Current marital status	Married	9.1	11.5	17.7	20.4	2.4	6.2	2.7	11.3
	Others	9.8	5.8	20.4	25.5	-3 9	14.6	5.1	15.7
Community mother`s education	Lower proportion	8.0	9.8	16.3	11.9	1.8	1.6	-4.4	3.9
	Higher proportion	14.1	14.5	23.3	29.4	0.4	8.8	6.1	15.3

Community poverty	Lower proportion	7.4	9.0	15.7	16.4	1.6	6.7	0.7	9.0
	Higher proportion	12.6	15.7	19.5	28.8	3.1	3.8	9 .4	16.2
Media exposure	No	6.4	8.2	14.0	-	1.8	5.8	7.6	-
	Yes	13.8	13.0	25.9	-	-0.8	12.9	12.1	-
Mother`s Occupation	Not working	9.0	8.4	16.3	-	-0.6	7.9	7.3	-
	Working	3.3	13.6	20.0	-	10.3	6.4	16.7	-
Partner`s Occupation	Not working	37.8	10.7	9.8	-	-27.1	-0.9	-28	-
	Working	8.8	10.9	18.4	-	2.1	7.5	9.6	-
Partner`s Education	No education	8.1	9.2	13.6	-	1.1	4.4	5.5	-
	Primary	6.8	11.2	19.0	-	4.4	7.8	12.2	-
	Secondary & Above	22.8	20.0	29.8	-	- 2.8	9.8	7	-
Community media exposure	Lower proportion	7.1	10.0	15.5	-	2.9	5.5	8’4	-
	Higher proportion	13.0	15.5	27.5	-	2.5	12.0	14.5	-
Distance from health	Big problem	8.6	9.5	17.3	-	0.9	7.8	8.7	-
	Not a big	10.3	15.9	18.6	-	5.6	2.7	8.3	-

facilities	problem

Table 5:- Trends of IRFI by selected child related characteristics of among children aged 6-59 months EDHS 2005, 2011, 2016 and 2019.

Characteristics		Weighted IRFI %				Point difference in IRFI rate			
		2005 N 3938	2011 N 5593	2016 N 5330	2019 N 2554	Phase I 2011-2005	Phase II 2016-2011	Phase III 2019-2016	Overall 2019-2005
Child`s age In months	6-11	4.7	10.7	16.6	19.3	6.0	5.9	2.4	14.6
	12-23	13.2	14.5	23.7	25.8	1.3	9.2	2.1	12.6
	>=24	8.5	8.4	13.3	16.3	-0.1	4.9	3. 0	7.8
Number of under 5 children in household	<3	9.8	11.9	19.6	23.5	2.1	7.7	3.9	13.7
	>=3	6.4	8.3	12.5	8.7	1.9	4.2	-3 .8	2.2
Sex of Child	Male	8.2	11.3	17.8	19.3	3.1	6.5	1.5	11.1
	Female	52.5	48.6	50.1	51.6	0.4	7.3	2	11.9

Table 6:- Trends of IRFI by selected child and mother`s health related characteristics of among children aged 6-59 months EDHS 2005, 2011, 2016 and 2019.

Characteristics		Weighted IRFI %				Point difference in IRFI rate			
		2005	2011	2016	2019	Phase I	Phase II	Phase III	Overall
		N	N	N	N	2011-2005	2016-2011	2019-2016	2019-2005
		3938	5593	5330	2554				
Birth order	1	9.6	14.5	23.6	25.5	1.9	9.1	1.9	15.9
	2-4	46.0	44.6	44.5	45.5	1.9	6.0	2.3	10.2
	>=5	31.9	30.8	27.6	22.3	-0.2	7.0	- 0.7	6.1
Child is twin	No	9.2	11.1	17.6	32.7	1.9	6.8	14.8	23.5
	Yes	2.8	2.4	13. 2	7.4	-0.4	10.8	-5.8	4.6
Number of ANC visits	No visit	9.4	10.6	19.3	13.9	1.2	8.7	-5.4	10.5
	1-3	8.8	13.8	18.2	23.0	5.0	4.4	4.8	14.2
	>=4	20.6	21.5	27.5	30.5	0.9	6.0	3.0	9.9
Place of delivery	Home delivery	8.4	10.2	14.4	16.1	1.78	4.2	1.7	7.7
	health facility	21.9	18.3	26.5	25.3	-3.6	8.2	-1.2	3.4
Baby postnatal care Follow up	No	9.4	12.0	21.0	23.5	2.6	9.0	2.5	14.1
	Yes	22.4	19.9	30.9	29.3	-2.5	11	-1.6	6.9
Current breastfeeding status	No	14.2	13.0	23.3	16.6	-1.2	10.3	-6.7	2.4
	Yes	7.9	10.8	17.1	21.3	2.9	6.3	4.2	13.4

4.3. Decomposition analysis

4.3.3. Decomposition analysis of Iron-Rich Food Intake among Children`s aged 6-59 Months in Ethiopia 2005-2019.

The overall iron rich food intake among children aged from 6-59 months in Ethiopia was significantly increased from 2005 to 2019.The overall decomposition result showed that the

change in iron rich food intake has been explained by the change in children aged from 6-59 months by population characteristics (composition or endowment) between 2005 and 2019 survey. About 66.45 percent increment in iron rich food intake was observed due to change in population proportion (characteristics) over time but the change due to differences in the effect of characteristics (coefficient) was not significant (Table 7).

Change in the mother`s educational status attributed nearly 18.36% for the increment of iron rich food intake and, while community mother`s education contributed 27.58 % for the change of iron rich food intake increment in Ethiopia.

The behavioral changes of mothers whose age category between 35 and 49 contributed 36.24% of iron rich food intake among children aged 6-59 months in Ethiopia over the past fifteen years compared to mother`s age from 15 to 19 (Table 7).

Table 7:- Overall decomposition of change in IRFI among children`s aged from 6-59 months in Ethiopia, from 2005 to 2019.

Iron rich food intake	Coefficient	p-value	95% CI.	Pct.
E	0.114	0.000	0.06, 0.168	66.45*
C	0.057	0.059	-0.002, 0.118	33.55
R	0.172	0.000	0.122, 0.222*	

Key:- E: endowment, C: coefficient, R: residual, *: p-value<0.05

Variables	Category	difference due to characteristics		difference due to coefficient	
		Coef	Pct	Coef	Pct
Residence	Urban	-0.002(-0.032, 0.027)	-1.31	-0.002(-0.013,0.009)	-1.37
	Rural(1)				
Mother`s	No education(1)				
educational	Primary	0.035(0.004, 0.065)	20.3*	0.007(-0.009,0.024)	4.20

status	Secondary & above	0.015(-0.000,0.03)	8.75	-0.003(-0.01,0.002)	-2.28
Community mother`s education	Lower proportion(1)				
	Higher proportion	0.046(0.003,0.09)	27.18*	0.015(-0.003,0.035)	9.07
Number of Household members	<5(1)				
	>=5	0.004(-0.005,0.015)	2.76	-0.053(-0.12, 0.012)	-31.26
Number of under 5 children in household	<3(1)				
	>=3	0.001(-0.002,0.005)	0.95	-0.003(-0.016, 0.01)	-1.81
sex of household head	Male(1)				
	Female	0.000(-0.000, 0.001)	0.25	0.009(-0.005, 0.024)	5.49
wealth index	Poorest(1)				
	Poorer	-0.001(-0.002, 0.000)	-0.62	0.014(-0.013,0.042)	8.41
	Middle	-0.000(-0.001,0.001)	-0.03	-0.009(-0.035,0.016)	-5.48
	Richer	-0.003(-0.007, 0.000)	-1.89	0.004(-0.02, 0.028)	2.44
	Richest	0.008(-0.005,0.021)	4.86	0.000(-0.023, 0.025)	0.48
Breastfeeding Status	No(1)				
	Yes	-0.001(-0.007,0.004)	-0.88	0.047(-0.016,0.111)	27.59
Birth Order	1(1)				
	2-3	0.004(-0.002, 0.011)	2.43	0.009(-0.037,0.055)	5.32
	>=4	0.003 (-0.023, 0.029)	1.96	-0.029(-0.092,0.034)	-16.82
Mother`s Age	15-19(1)				
	20-34	-0.000(-0.016,0.015)	-0.29	0.064(-0.043, 0.173)	37.52
	>=35	-0.01(-0.034, 0.014)	-5.84	0.062(0.001, 0.123)	36.24*

Child Sex	Male(1)				
	Female	-0.00..(-0.003,0.001)	-0.55	-0.00..(-0.035,0.034)	-0.23
ANC Visits	No visit(1)				
	1-3	0.011(-0.013,0.035)	6.48	0.011(-0.007,0.03)	6.69
	>=4	0.039(-0.003, 0.081)	22.59	0.001(-0.012, 0.016)	0.98
Place of Delivery	Home delivery(1)				
	Health facility	-0.035(-0.102, 0.03)	-20.67	-0.002(-0.008,0.004)	-1.22
Constant		-0.087(-0.274,0.100)	-50.44		

4.4. Multilevel Logistic Regression Analysis

The recent Ethiopian Mini Demographic and Health Survey (EMDHS) 2019 were used for multilevel logistic regression analysis.

Random effect

In the null model the intra-class correlation coefficient (ICC) result revealed that 37.38% of the total variation in iron rich food intake among children aged 6-59 months in Ethiopia was due to cluster level differences. The median odds ratio explained that iron rich food intake was heterogeneous between clusters. The highest median odds ratio was in the null model 3.81 which suggested that initial strong between cluster heterogeneity or it indicating varied between clusters in the consumption of iron rich food.

Further analysis revealed that 11.11% of variability of consumption of iron rich food was explained by the full model (PCV=11.11%) (Table 10).

Fixed effect

Before done multivariable multilevel logistic regression analysis bi-variable multilevel logistic regression was implemented to identify factors which have a p-value less than 0.25 were included in the multivariable multilevel analysis.

Marital status, breastfeeding status, sex of child and baby postnatal care follow up variables were not included in multivariable multilevel logistic regression analysis because of p-value higher than 0.25 during bi-variable analysis.

The final model was the best fitting model since it has high log likelihood ratio, low deviance and Akaike Information Criterion (AIC) (Table 10).

Individual level factors such as women`s education, religion, child age, wealth index, house hold numbers, number of under five children in household, place of delivery and number of ANC visits during pregnancy and community level factors of region and women`s community education were significantly associated with iron rich food intake in multivariable multilevel logistic regression analysis.

Women`s education level was significantly associated with an increased likelihood of iron rich food intake among children aged 6-59 months. women`s who attained primary education had 2.83 times higher odds of meeting iron rich food compared to those with no education (AOR 2.83, 95% CI: 2.05, 3.92). Women`s who attained both higher and secondary education also had 2.74 and 1.94 higher odds of meeting iron rich food intake compared to those who were no education (AOR=2.74, 95 CI:1.47,5.1 and AOR=1.94, 95 CI: 1.13,3.33), respectively (Table 8).

Child aged 6-59 months whose mother`s muslim religion followers meeting 2.03 higher odds of iron rich food intake compared to those orthodox followers (AOR=2.03, 95% CI: 1.16, 3.54). Despite these others follower such as catholic and traditional religious were 98% less likely to meet iron rich food intake compared to orthodox followers (AOR=0.02, 95%CI: 0.00, 0.95) (Table 8).

For children aged 6-59 months lived in Afar, Amhara and Somali regional state the odds of meeting iron rich food intake were 89%,71% and 54% lower than compared to those who lived in Tigray regional state (AOR=0.11,95 CI:0.02,0.67, AOR=0.29,95 CI:0.12, 0.72 and AOR=0.02, 95CI:0.00,0.14) respectively (Table 9).

Children aged 6-59 months in 5-10 and >=11 household members were significantly associated with iron rich food intake. Children who had 5-10 and >=11 household members were meeting 45% and 53% of lower odds of IRFI compared to those who had less than or equal to four house hold members (AOR=0.55 95%CI: 0.4, 0.77 and AOR=0.37, 95% CI: 0.15, 0.88) respectively (Table 8).

Number of under 5 children in house hold >=3 were meeting 59% lower odds of consumption of iron rich food compared to those children number <3 (AOR=0.41, 95% CI: 0.26, 0.63).

Children who were categorized in the level of richer wealth index 85% more likely to meeting iron rich food intake compared to the poorest (AOR=1.85, 95% CI:1.12,3.06).

Number of ANC visit during pregnancy >=4 were 1.99 higher odds of meeting iron rich food intake among children aged 6-59 months compared to those no ANC visit (AOR=1.9, 95% CI:1.22,3.25).

Child`s age were significantly associated with iron rich food intake. Child age >=24 months were 43% less likely to meeting iron rich food intake compared to those children aged 6-23 months (AOR=0.57, 95% CI: 0.42, 0.79).

Place of delivery also, was significantly associated with iron rich food intake among children aged 6-59 months in Ethiopia. Health facility delivery was 38% less likely meeting iron rich food intake compared to home delivery (AOR=0.62, 95%CI: 0.45, 0.87) (Table 8).

Table 8:-Multivariable multilevel logistic regression analysis of individual level factors associated with IRFI in Ethiopia, MEDHS 2019.

		Model I	Model II	Mode III	Model IV
Characteristics	Category		AOR (95% CI)		AOR (95% CI)
Women`s age	15-19		1		1
	20-34		0.89 (0.50, 1.59)		0.87(0.49, 1.55)
	>=35		1.39(0.70, 2.78)		1.28(.64, 2.5)
Women`s education	No education		1		1
	Primary		2.03(2.2, 4.17)**		2.83(2.05, 3.92)3**
	Secondary		2.06 (1.2, 3.52)*		1.94(1.13, 3.33)*
	Higher		2.9(1.57, 5.35)*		2.74(1.47, 5.1)2*
Religion	Orthodox		1		1
	Muslim		1.31(0 .81, 2.09)		2.03(1.16, 3.54)*
	Protestant		1.74 (1.05, 2.88)*		1.57(0.87, 2.84)
	Others		0.23(0 .00, 0.94)*		0.02(0.00, 0.95)*
Number of household members	1-4		1		1
	5-10		0.57(0.41, 0.8)*		0.55(0.4,0.77) *
	>=11		0.38(0.16, 0.9)*		0.37(0.15,0.88)*
Number of under 5 children In household	<3		1		1
	>=3		0.95(0.25, 0.6)**		0.41(0.26,0.63)**
Wealth index	poorest		1		1
	poorer		1.48 (0 .94, 2.31)		1.2(0.76,1.89)
	middle		0,71 (0 .43, 1.17)		0.56(0.33,0.95)*
	richer		2.38 (1.47, 3.85)**		1.85(1.12,3.06)*
	richest		2.28 (1.32 , 3.94)*		1.48(0.79,2.75)
Birth order	2-3		1		1
	>=4		1.23(0.78, 1.93)		1.23(0.78, 1.94)

Twin	No/single	1		
	Yes /multiple	0.7(0.16 2.98)		0.68(1.58, 2.98)
ANC visit	No visit	1		1
	1_ 3	1.54 (0.95, 2.52)		1.44(0.88,2.36)
	>=4	2.15(1.32, 3.5)*		1.99(1.22,3.25)*
Place of delivery	Home delivery	1		1
	Health facility	0.7(0.5, 0.97)*		0.62(0.45,0.87)*
Child age in months	6-23	1		1
	>=24	0.57 (0.42, 0.79)*		0.57(0.42,0.79)*
Constant		0.06 (0.02, 0 .15)		0.16(0.04, 0.58)*

Key:- 1=Reference group *= p-value <0.05, **=p-value=0.000 Others=Catholic, traditional& other

Table 9:- Community level factors associated with IRFI in Ethiopia, MEDHS 2019.

Community level factors	Category	ModelI	ModelII AOR(95% CI)	ModelIII AOR(95% CI)	ModelIV
Residence	Urban		1	1	
	Rural		0.68(0.35, 1.29)	0.9(0.43, 1.89)	
Region	Tigray		1	1	
	Afar		0.19 (0.04, 0.90)*	0.11(0.02, 0.67)*	
	Amhara		0.37 (0.16, 0.84)*	0.29(0.12, 0.72)*	
	Oromia		0.71 (0.33, 1.51)	0.46(0.18, 1.17)	
	Somali		0.03 (0.00, 0.16)**	0.02(0.00, 0.14)**	
	Benishangul		0.92 (0.26, 3.24)	0.84(0.2, 3.42)	
	SNNPR		0.68 (0.31, 1.50)	0.59(0.22, 1.56)	
	Gambela		0.42(0.06, 3.00)	0.44(0.05, 3.89)	
	Harari		0.54(0.06, 4.37)	0.37(0.03, 3.61)	
	Addis Abeba		0.89 (0.31, 2.56)	0.74(0.23, 2.36)	
	Dire dawa		0.62 (0.13, 3.00)	0.37(0.06, 2.11)	
Community Women education	Lower proportion		1	1	
	Higher proportion		2.07 (1.22, 3.49)*	1.31(0.73, 2.38)	

community level	Lower proportion	1	1
poverty	Higher proportion	1.47 (0.86, 2.51)	1.37(0.74, 2.55)
Constant		0.21 (0.08, 0.57)**	0.16(0.4, 0.58)*

Key:- 1=Reference group *= p-value <0.05, **=p-value=0.000

Table 10:- Random Effect and Model Comparison for IRFI in Ethiopia, MEDHS 2019.

Parameters	Null model (Model I)	Model II	Model III	Model IV
Variance	0.36	0.35	0.25	0.32
ICC%	37.38	34.95	28.07	32.36
MOR	3.81	3.55	2.95	3.31
PCV %	Reference	2.77	30.55	11.11
LLR	-1174.96	-1046.25	-1134.19	-1025.53
Deviance (-2LLR)	2349.2	2092.5	2268.38	2051.06
AIC	2353.93	2142.51	2298.38	2127.06
BIC	2365.78	2289.47	2387.3	2350.44

MOR=Median odds ratio, PCV=Proportional change in variance,

LL=Log-likelihood

5. DISCUSSION

Iron is an essential micronutrient element with regard to growth and development of young children. World Health Organization recommends iron supplementation for young children due to increasing the requirements of iron during the stage of rapid growth and development[47].

This study was aimed to describe trends, identify factors that contributed for the change in iron rich food intake among children aged from 6-59 months for the last fatten years and to identify determinant factors of IRFI in Ethiopia based on 2019 EMDHS data.

In this study the trends of iron-rich food intake among children aged from 6–59 months in Ethiopia was significantly increased from 9.15 in 2005 to 20.68% in 2019 (overall phase). This result showed iron rich food intake increment among children aged 6-59 months over time. It is supported by the study done in Ethiopia[26].This is due to the launching of maternal and child health program, implementation of National Nutrition Program (NNP) and socio-economic difference[22], initiative for Growth and Transformation Plan (GTP), Seqota Declaration[48, 49] on child feeding in Ethiopia.

In decomposition analysis 66.45% change of iron rich food intake increment was due to population characteristics or compositional changes between the study periods 2005 to 2019 (overall phase) over the last fifteen years. This change was attributed or influenced by mother`s educational status and community mother`s education.

From decomposition analysis mothers who had primary educational status contributed more than 20.3% the change of iron rich food intake among children aged 6-59 months in Ethiopia compared to no education. Similarly community mothers education who were had higher proportion contributed 27.18% in the change of iron rich food intake. This might be due to educated mothers had better knowledge, experience and information accesses to health service[22] or education on child feeding practice[50] and maternal and child health compared to un educated mother`s. In addition due to Government commitment towards mother`s empowerment through education.

Behavioral change of mother`s being aged from 35-49 contributed more than 36.24% iron rich food increment in the last fifteen years compared to 15-19 years old or younger mothers. This might be due to knowledge improvement or experience and behavioral or cultural changes on child feeding practice in older mothers compared to mothers age 15-19.

In multivariable multilevel logistic regression analysis explained that region, mother`s education, religion, wealth index, child age, number of household members, number of under 5 children in

household, place of delivery and ANC visit during pregnancy were key factors that significantly associated with iron rich food intake among children aged 6-59 months in Ethiopia.

In this study the odds of iron-rich food intake among children aged group from 24- 59 months were lower compared to child age 6-23 months. This finding was supported by the study done in Ethiopia [23, 25, 27]. But it disagreed with the study conducted in India[22]. This might be due to differences in socio-economic and cultural practice.

The odds of iron rich food intake among children whose mother`s having primary, secondary and higher education had higher odds of feeding iron rich food those compared to no education. Other previous similar studies were supported this finding in Ethiopia[23, 25, 26], Sub-Saharan Africa[12], Rwanda[30],Afghanistan[51],India[22]. This might be due to educated mothers exposed to various media source and better understanding and practice to feeding iron rich food for their child. In addition educated mothers improve child health behaviors and receive more information[22] from health workers and ensure better child feeding practice[50]. A study suggests that children born from uneducated mothers consume fewer iron rich food and more likely develop anemia compared to educated mothers [23, 30, 52].

Children from catholic followers had lower odds of iron rich food intake compared to orthodox followers. This study agreed to the study done in Ethiopia[25]. But children from Muslim followers had higher odds of iron rich food intake. This might be due to religious beliefs however further deep qualitative study is needed.

Children from wealthy family had higher odds of feeding iron rich food compared from the poorest family. This study supported by other similar studies done in Ethiopia[23, 25, 26], Rwanda[30] and Sab Saharan Africa[12]. This might be due to having high purchasing power of rich household that helps to access the required food for their children. Lack of divers food source for the intake of iron rich food[53].

Family size >=11 had lower odds of iron rich food intake among children aged 6-59 months compared due to counterpart. This might be due to resource or budget constraint because a large family size requires a large amount of food quantity and quality. However this study was not supported by the study done in Ethiopia.

Number of under 5 children in household >=3 had lower odds of iron rich food intake among children aged 6-59 months compared to those <3. This might be due to increasing child number which also increases food constraint in the household level.

Number of ANC visits >=4 had higher odds of iron rich food intake compared to those no visit. This findings supported by previous studies done in Sub Saharan Africa[12], Sierra Leone[31] . Since this might be due to more mothers get chance for health education[54]. During this time mothers receive valuable information and counseling [55] on child feeding practice on iron rich food than mothers no ANC visit.

Among children aged 6-59 months health facility delivery had lower odds of iron rich food intake compared to those home delivery. This finding disagreed with other previous study in Ethiopia[27]. This might be due to poor counseling on child feeding practice.

Children aged 6-59 months live in Afar, Amhara and Somali regional states had lower odds of iron rich food consumption compared to those in Tigray. This evidence was supported by previous study in Ethiopia[25]. This may be due to differences in cultural and traditional practice because these variations have effects on IRFI in these regional states.

6. STRENGTH AND LIMITATIONS OF THE STUDY

Strength

This study was used a large weighted sample size that might be representative of the national and regional level by residence in rural and urban.

Limitations

It utilized secondary data from the EDHSs therefore, it has a possibility of facing recall and reporting bias which leads under or over report on the intake of iron rich food information. In addition, due to secondary nature of the data important factors which influencing iron-rich food intake among children aged from 6-59 months was not included in this study.

The study was done by a repeated cross sectional study design on different settlements of individual households therefore; it cannot show changes in iron rich food intake over time for the same individual household.

7. CONCLUSION

In this study, iron-rich food intake among children aged from 6–59 months in Ethiopia was low between 2005 and 2019. Iron rich food intake was influenced by the factors of in multivariate decomposition analysis. In multivariable multilevel logistic regression analysis explained that

region, mother`s education, religion, wealth index, number of household members, number of under 5 children in household, child age, child sex, ANC visit during pregnancy, place of delivery, child sex and child age were significantly associated with iron rich food intake among children aged 6-59 months in Ethiopia.

To improve iron rich food intake among children aged 6-59 months in Ethiopia national government and ministry of health should strengthen nutrition education and prior attention given for women empowerment for sustainable iron rich food consumption increment.

8. RECOMMENDATIONS

For Ethiopian Government and Ministry of Health

Should strengthen and promote child nutrition program for children aged from 6-59 months in Ethiopia especially for mothers who have low educational status and rural settlements to increase iron rich food consumption.

Governmental efforts should target on Afar, Amhara, Somali and Gambella regional state to improve child health service and promote iron rich food intake practice based on intervention strategies like facilitating food preparation demonstration and evaluation on child nutrition in these regions.

For Health Professionals

Should promote iron rich food intake by giving emphasis for mothers on child health nutrition through education with community leaders involvement and integration.

For Non-Governmental Organizations

To promote iron rich food intake and to fill gaps on child health and nutrition service should empower mother`s with knowledge and decision making through Community-Based Nutrition Education and collaborate with community leaders and health professionals with in targeted areas.

For Health Researchers

I recommend for future researchers to conduct qualitative research which is to understand mother`s knowledge, belief and attitudes that influence on iron rich food intake that was not incorporated in quantitative research.

Community based cross-sectional studies are recommended to gate additional variables in EDHS and Longitudinal studies should be recommended to investigate changes over time and identify temporal relationship.

For Ethiopian mother`s

To improve children dietary iron rich food they should give emphasis on child health and nutrition by encouraging breastfeeding and getting continuous health professional consultation.

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10. ANNEXES

10.1. Annex I

The following socio demographic, economic and child and maternal health related structured questionnaires were used for data extractions in the surveys.

Table11:- Data Collection Tools or Questionnaires for Data Extraction

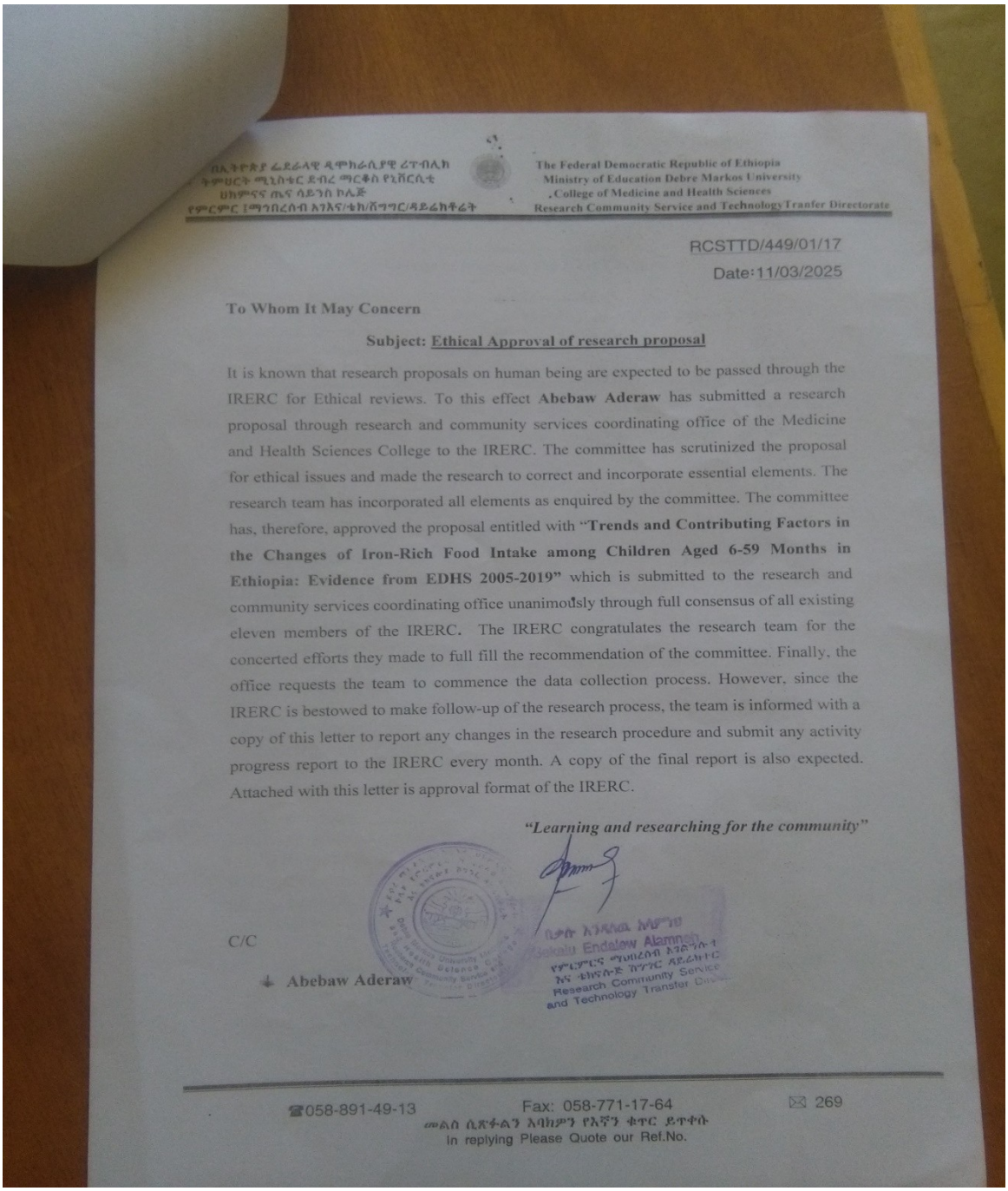
Number	Variables	Code of variables	Codes and categories
1	Case Identification	CASEID	-
2	Cluster Number	V001	-
3	Women`s individual sample weight(6 decimals)	V005	-
4	Women`s age in 5-years groups	V013	15-19 ------1 20-24---------2 25-29----------3 30-34----------4 35-39----------5 40-44----------6 45-49----------7
5	Primary sampling unit	V21	-
6	Stratification used in sampling design	V022	-
7	Region	V024	Tigray----1 Afar-------2 Amhara----3 Oromia------4 Somali--------5 Benishangu---6 SNNPR---------7 Gambell----------8 Harari----------9 Addis Ababa------10 Dire Dawa----------11
8	Place of residence	V025	Urban-------1 Rural----------2
9	Educational status	V106	No education----------1 Primary education--------2 Secondary education-------3 Higher education----------4
10	Religion	V130	Orthodox--------1 Catholic----------2 Protestant----------3 Muslim----------4

			Traditional----------5 Others----------6
11	Number of household members	V136	-
12	Number of children 5 and under in household	V137	-
13	Sex of household head	V151	Male-----1 Female-----2
14	Frequency of reading newspaper or magazines	V157	No at all----------0 Less than once a week---1 At least once a week--------2 Almost every day ----------3
15	Frequency of listening to radio	V157	No at all----------0 Less than once a week--1 At least once a week------2 Almost every day ----------3
16	Frequency of watching television	V157	No at all----------0 Less than once a week----1 At least once a week---------2 Almost every day ----------3
17	Wealth index combined	V190	Poorest---------1 Poorer----------2 Middle----------3 Richer----------4 Richest----------5
18	Currently breastfeeding	V404	No--------0 Yes---------1
19	Gave child eggs	V414G	No-------0 Yes----------1
20	Gave child meat(beef, pork, lamb, chicken, etc)	V414H	No-----0 Yes----------1
21	Gave child liver, heart, other organs	V414M	No------0 Yes----------1
22	Gave child fish or shellfish	V414N	No-------0 Yes----------1
23	Getting medical help for self: distance from health facilities	V467D	No problem------0 Big problem---------1 Small problem----------2
24	Current marital status	V501	Never in union------0 Married----------1 Living with partners------2 Widowed----------3 Divorced----------4 No living longer together----5
25	Partners education	V701	No education----------1 Primary education--------2

			Secondary education-------3 Higher education----------4
26	Partners occupation	V705	Not working------0 Working----------1
27	Women`s occupation	V717	Not working---------0 Working----------1
28	Birth order	BORD	-
29	Child is twin	B0	No--------0 Yes----------1
30	Sex of child	B4	Male---------1 Female----------2
31	Number of ANC visits during pregnancy	M14	-
32	Place of delivery	M15	Home delivery-----0 Health facility---------
33	Baby postnatal care follow up	M70	No-------0 Yes--------1
34	Child`s age in months	HW1	-
	Aggregated variables for this study		
35	Mother`s community education	-	Lower proportion---0 Higher proportion--------1
36	Community media exposure	-	Lower proportion---0 Higher proportion---------1
37	Community poverty level	-	Lower proportion---0 Higher proportion---------1
	Dependent variable		
38	Gave child iron rich food	-	No--------0 Yes----------1

10.2. ANNEX II

10.2.1. Ethical Clearance Letter



የኢትዮጵያ ፌደራላዊ ዲሞክራሲያዊ ሪፐብሊክ
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The Federal Democratic Republic of Ethiopia
Ministry of Education Debre Markos University
College of Medicine and Health Sciences
Research Community Service and Technology Tranfer Directorate

RCSTTD/449/01/17
Date:11/03/2025

To Whom It May Concern

Subject: Ethical Approval of research proposal

It is known that research proposals on human being are expected to be passed through the IRERC for Ethical reviews. To this effect **Abebaw Aderaw** has submitted a research proposal through research and community services coordinating office of the Medicine and Health Sciences College to the IRERC. The committee has scrutinized the proposal for ethical issues and made the research to correct and incorporate essential elements. The research team has incorporated all elements as enquired by the committee. The committee has, therefore, approved the proposal entitled with "**Trends and Contributing Factors in the Changes of Iron-Rich Food Intake among Children Aged 6-59 Months in Ethiopia: Evidence from EDHS 2005-2019"** which is submitted to the research and community services coordinating office unanimously through full consensus of all existing eleven members of the IRERC. The IRERC congratulates the research team for the concerted efforts they made to full fill the recommendation of the committee. Finally, the office requests the team to commence the data collection process. However, since the IRERC is bestowed to make follow-up of the research process, the team is informed with a copy of this letter to report any changes in the research procedure and submit any activity progress report to the IRERC every month. A copy of the final report is also expected. Attached with this letter is approval format of the IRERC.

"Learning and researching for the community"

ቤዛሁ አንዳለዉ አለምነህ
Bezalu Endalew Alamneh
የምርምርና ማህበረሰብ አገልግሎት
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Research Community Service
and Technology Transfer Directo

C/C
Abebaw Aderaw

☎058-891-49-13 Fax: 058-771-17-64 ✉ 269
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In replying Please Quote our Ref.No.

1.3. Annex III

10.3.1. Permission Letter

Nov 01, 2024

aderaw abebaw

DMU

Ethiopia

Request Date: 11/01/2024

Dear aderaw abebaw:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Trends and Contributing Factors in the Changes of Iron-Rich Food Intake among Children Aged 6-59 Months in Ethiopia: Evidence from EDHS 2005-2019.":

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 co-researchers 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

Data Archivist

The Demographic and Health Surveys (DHS) Program

Declaration

I undersigned MPH student declare that this thesis proposal is my original work for MPH student, in partial fulfillment of the requirement for the Degree of Master of Public Health in Epidemiology.

Submitted By:

Abebaw Aderaw (BSc)		**January 21/2025**
Name of Student	Signature	Date

Place of submission-Department of Public Health, College of Medicine and Health Science, Debre Markos University

This research proposal work submitted for examination with our approval as university advisors

Advisors:

1. Dr. Eskezyiaw Agidew(MPH, Assistant prof.)		**May 23/2025**
2. Yilkal Negesse (MPH in Biostatistics)		**May 23/2025**
	Signature	Date