Original Research Article||

Determinants of Underweight Children: A Cross-sectional Study in Enset-based Systems of Sidama Regional State, Ethiopia

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Abstract

Undernutrition is a significant public problem in Ethiopia. The country has made some progress in reducing malnutrition rates over the past decade, but the problem remains acute, particularly in rural areas where most of the population resides. The Sidama region of Ethiopia is one of the areas with a high prevalence of malnutrition, with underweight children being a particular concern. The region is characterized by enset cultivation, a starchy plant with high nutritional value. Despite the potential benefits of enset-based diets, undernutrition remains a significant problem in the region, suggesting that other factors beyond food availability and quality may contribute. Therefore, the study investigated the determinants of underweight children in the enset-based system of Sidama Regional State, Ethiopia. The study employs a cross-sectional research design, and data were collected from 620 households using a survey questionnaire. Chi-square and binary logistic regression analyses were used to analyze the data. Various factors influence the weight of a child. Among them are the mother's age, educational background, access to clean drinking water, the time interval between successive births, the frequency of antenatal visits, and the mother's hand-washing practices. Moreover, the age of younger siblings and the household's level of wealth, measured by an asset index, also play a significant role in determining a child's weight. However, certain factors can negatively impact a child's weight, including the total number of individuals living in the household, the incidence of diarrhea in the child, and the child's age. Considering these factors when evaluating a child's weight is essential, and interventions should be designed accordingly to address them. The study's findings offer stakeholders and decision-makers insightful information to develop effective interventions to address the issue of underweight children in the study area.

Key words: Body weight, Children, Enset, Sidama

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INTRODUCTION

Undernutrition remains a critical public health challenge globally, particularly in low- and middle-income countries (LMICs). Recent estimates indicate that 149 million children under five suffer from stunting, while 45 million experiences wasting. Sub-Saharan Africa bears a disproportionate burden, with Ethiopia reporting a 24% prevalence of underweight children, disproportionately affecting rural areas (Amare et al., 2019).

Ethiopia has implemented various initiatives to address undernutrition nationwide. The 2019 Food and Nutrition Policy, introduced to enhance nutritional health across all age groups, emphasizes an integrated strategy combining targeted nutritional interventions with broader socioeconomic measures. Furthermore, the Seqota Declaration reflects Ethiopia's pledge to eradicate undernutrition among children under two by 2030. To strengthen these efforts, the country launched the National Nutrition Program (NNP) I (2008–2015) and NNP II

(2016–2020), prioritizing cross-sector collaboration to deliver effective nutrition-focused solutions (FDRE, 2015; NiPN, 2020).Despite these efforts, the problem of undernutrition remains a significant public health challenge in the country(Korir et al., 2024).The second phase of the NNP, launched in December 2016, focuses on the critical 1000-day window from pregnancy to a child's second birthday (Kennedy et al., 2020).

The Ethiopian Demographic and Health Survey 2019 report indicates that in Ethiopia, 37% of children under age five are stunted, 7% are wasted, 21% are underweight, and 2% are overweight (EPHI & ICF, 2021). Likewise, the Sidama regional state is one of the regions in Ethiopia with a high prevalence of undernutrition among children. The region has a unique food system, where the staple food is enset corm, and pseudo-stems are used to make a variety of foods, and where most of the population relies on it for their livelihoods (G. Egziabher et al., 2020). Existing studies in Ethiopia have examined the socio-economic determinants of malnutrition (Sahiledengle et al., 2022). However, gaps remain in understanding how these factors interact within enset-dependent communities. Specifically, the role of health-related practices (e.g., antenatal care, hygiene) alongside socio-demographic variables remains understudied in this context. This study addresses this gap by examining the multifactorial drivers of underweight children in Sidama, providing evidence for targeted interventions.

RESEARCH METHODS

Study Area and Population

One of Ethiopia's regional states is the Sidama Region. Following a 2019 referendum in which 98.52% of voters supported increased autonomy, the Sidama Region was officially established on June 18, 2020. This involved its separation from the Southern Nations, Nationalities, and Peoples' Region (SNNPR) and the restructuring of the former Sidama Zone. The region derives its name from the Sidama ethnic group, who are indigenous to the area. Geographically, Sidama is bounded by the Oromia Region to the south—except for a small central stretch bordering the Gedeo Zone—and to the north and east. Its western edge is demarcated by the Bilate River, which separates it from the Wolayita Zone. Major urban centers include Hawassa (the regional capital), SNNPRS, Yirgalem, and Wendo. As of 2017, the population stood at approximately 3.2 million. The region's infrastructure includes 879 kilometers of year-round accessible roads and 213 kilometers of seasonal highways, yielding a road density of 161 kilometers per 1,000 square kilometers (NEBE, 2019).

The Sidama Region, Ethiopia's primary coffee-producing area, plays a pivotal role in bolstering the nation's foreign currency reserves. Data from the Central Statistics Agency (CSA) reveals that during the fiscal year ending in 2005, the combined output of Sidama and Gedeo reached 63,562 metric tons of coffee, as verified by the Ethiopian Coffee and Tea Authority's inspection records (ICO, 2019).

The region also possesses extensive yet underutilized water resources. Inadequate infrastructure, limited access to clean water, poor sanitation practices, and low public awareness of hygiene and environmental health contribute significantly to disease prevalence and mortality rates in the broader SNNP area. Culturally, livestock—particularly cattle—hold immense value in Sidama society, where ownership signifies wealth and social standing. Individuals without cattle are often marginalized, viewed as incomplete members of the community (MoWIE, 2018).

Operational Definition

Child nutritional status: Nutritional indicators were analyzed using the WHO Anthro software (version 3.1.0) and categorized based on the World Health Organization's growth reference criteria. Three anthropometric indices were derived for children: height-for-age (HAZ), weight-for-height (WHZ), and weight-for-age (WAZ), Z-scores, which assess stunting, underweight, and wasting, respectively.

Asset Index: Constructed using Principal Component Analysis (PCA) based on household ownership of 15 assets. Households were categorized into quintiles: very poor, poor, middle, rich, very rich (Vyas & Kumaranayake, 2006).

Enset Dominance: Defined as households deriving >50% of dietary calories from enset products, verified through dietary recall surveys.

Sample selection

The study participants were children under five years and their mothers (mother–child pair). The number of respondents included in the study was 620. The sample size was determined based on the formula suggested by Groves et al. (2009) as follows:

$$n = (z^2)(r)(1-r)(f)(k)/(p)(n_h)(e^2)$$

- **Zα/2**(1.96) = critical value from the standard normal distribution at a 95% confidence level (α=0.05),
- ***r*** = expected prevalence of the outcome,
- ***f*** = design effect (deff) accounting for clustered sampling, assumed as **1.5** based on standard household survey practices,
- ***k*** = non-response adjustment factor (**1.1**), applied to mitigate incomplete participation,
- ***p*** = proportion of the target subgroup within the total population (**15%** or **0.15**),
- ***nh*** = average household size (**5** individuals),
- ***e*** = margin of error (**5%**), the maximum acceptable threshold for precision.

In order to capture a representative respondent, a multi-stage sampling technique was used. In Woredas, encompassing both enset-growing and non-enset-growing areas, were strategically selected through purposive sampling, prioritizing regions where enset (or alternative crops) served as the primary staple food. The woredas were Wondogenet, Shebedino, Hawassa Zuria, Malga, Goricha, and Boricha. In the second stage, one Kebele per Woreda was randomly selected through simple random sampling to ensure representative inclusion. In the third stage, households were selected from each Kebele proportionally. A total of 620 participants were systematically selected to ensure proportional representation and minimize selection bias. Household lists, obtained from Woreda and Kebele administrative offices in the sampled areas, served as the sampling frame, with systematic sampling applied to finalize participant selection.

Data Collection and Measurements

The data were collected using a survey questionnaire and a key informant interview schedule. Both closed and open-ended questions were prepared to generate the required data. After developing a questionnaire, the researcher conducted a pre-test before carrying out a survey to improve the questions in terms of content clarity and language usage to collect appropriate data during the survey.

Data Analysis

The data collected through the survey questionnaire were entered into SPSS 26 software after checking for its completeness manually. Then, the data were cleaned for inconsistency and missing values. Finally, the data were analyzed using *Chi*-square and binary logistic regression analysis. Binary logistic regression analyses were employed to identify the socio-economic and demographic factors that influence underweight children. The model is specified as:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

Where p = probability of underweight, β0 = intercept, and βk = coefficients for predictors (e.g., maternal education, household size).

Variable Definitions and Hypothesis

Below is the list of variables from the attached document, categorized by name, type, unit of measurement, and expected sign based on the study's hypotheses and results:

Table 1. List of variables and expected signs based on the study's Hypothesis

Variable Name	Variable Type	Unit of Measurement	Expected Sign
Mother's Age	Continuous	Years	Positive (+)
Mother's Educational Status	Categorical (Ordinal)	Levels (e.g., no education, primary, etc.)	Positive (+)
Total Household Size	Continuous	Count of individuals	Negative (-)
Source of Drinking Water	Categorical (Binary)	Piped vs. non-piped	Positive (+)
Toilet Facility Type	Categorical (Binary)	Improved vs. non-improved	Positive (+)
Birth Interval	Categorical (Ordinal)	Categories (e.g., <2 years, >2 years)	Positive (+)
ANC Visits	Categorical (Binary)	Yes/No	Positive (+)
Experience Diarrhea	Categorical (Binary)	Yes/No	Negative (-)
Hand Washing Practice	Categorical (Binary)	Yes/No	Negative (-)
Child's Sex	Categorical (Binary)	Male/Female	Negative (-) (Male as risk)
Child's Age	Continuous	Years	Negative (-)
TLU (Tropical Livestock Unit)	Continuous	Livestock count (standardized)	Positive (+)
Enset Dominance	Categorical (Binary)	Enset vs. non-enset	Negative (-)
Asset Index	Categorical (Ordinal)	Quintiles (very poor to very rich)	Positive (+)

RESULTS AND DISCUSSION

In this section of the article, the researchers present the results of the study on the effect of socio-economic and demographic factors on underweight children as follows:

Table 2. The relationship between Selected Characteristics and Children's Body Weight

Characteristics	Weight for Age (WAZ)				Total		x^2 (p-value)
	Under weight		Normal				
	n	%	*n*	%	*n*	%	
Educational status of mother							
Unable to read and write	86	51.2	194	42.9	280	45.2	
Able to read and write	46	27.4	115	25.4	161	26.0	13.10
Only primary education	22	13.1	50	11.1	72	11.6	(0.011)
Secondary education	11	6.5	73	16.2	84	13.5	
College diploma and above	3	1.8	20	4.4	23	3.7	
Source of drinking water							
Others	70	41.7	107	23.7	177	28.5	19.44
Piped into dwelling	98	58.3	345	76.3	443	71.5	(0.000)
Kind of toilet facility							
Others	131	78.0	303	67.0	434	70.0	6.98
Improved	37	22.0	149	33.0	186	30.0	(0.008)
Birth interval							
First birth	2	1.2	20	4.4	22	3.5	24.26
1-2 years	96	57.1	162	35.8	258	41.6	(0.000)
>2 years	70	41.7	270	59.7	340	54.8	
ANC visit							21.41
No	20	11.9	12	2.7	32	5.2	(0.000)
Yes	148	88.1	440	97.3	588	94.8	
Experience diarrhea							17.36
No	133	79.2	413	91.4	546	88.1	(0.000)
Yes	35	20.8	39	8.6	74	11.9	
Hand washing practice of the caregiver							
No	67	39.9	120	26.5	187	30.2	10.34
Yes	101	60.1	332	73.5	433	69.8	(0.001)
Sex of children							
Female	62	36.9	232	51.3	294	47.4	10.22
Male	106	63.1	220	48.7	326	52.6	(0.001)
Enset dominant							8.351
Non-enset dominant	71	42.3	250	55.3	321	51.8	(0.004)
Enset dominant	97	57.7	202	44.7	299	48.2	
Asset index							
Very poor	53	31.5	74	16.4	127	20.5	
Poor	37	22.0	84	18.6	121	19.5	23.07
Middle	30	17.9	105	23.2	135	21.8	(0.000)
Rich	27	16.1	87	19.2	114	18.4	
Very rich	21	12.5	102	22.6	123	19.8	

n = 620: Underweight *n* = 168, Normal *n* = 452

The results of table 2 showed a statistically significant relationship between the educational status of a mother and the body weight of children (x^2 = 13.01, p< 0.05). That means mothers' education promotes the healthy weight of children. Likewise, there is a statistically significant relationship between drinking water source and children's body weight (x^2 = 19.44, p< 0.001). Similarly, there is a statistically significant relationship between the kind of toilet facility and children's body weight (x^2 = 6.98, p< 0.01).

There is a statistically significant relationship between birth interval and children's body weight (x^2 = 24.26, p< 0.001). Furthermore, there is a statistically significant relationship between ANC visit and body weight of children (x^2 = 21.41, p< 0.001). In addition, there is a statistically significant relationship between experiencing diarrhea and body weight of children (x^2 = 17.36, p< 0.001).

There is a statistically significant relationship between the sex of children and body weight of children (x^2 = 10.22, p< 0.001). Likewise, there is a statistically significant relationship between enset dominance and the body weight of children (x^2 = 8.35, p< 0.001). Moreover, there is a statistically significant relationship between the asset index and body weight of children (x^2 = 23.07, p< 0.001).

Table 3. Mean Comparison of Continuous Variables*

Variables	Weight for Age (WAZ)				t-test	p-value
	Underweight (n=168)		Normal (n=452)			
	Mean	SD	Mean	SD		
Age of mother	30.4	4.71	31.4	5.05	-2.13	0.034
Total household size	5.6	2.00	5.1	1.69	2.82	0.005
Child age	3.6	1.02	3.4	0.92	2.20	0.028
TLU	5.6	6.74	7.4	6.85	-2.99	0.003

*'Independent Samples t-tests (sig 2-tailed) were used to compare means of variables between Underweight and Normal in the households'

The results of Table 3 showed that there is a significant difference between children with normal weight and those who are underweight, depending on the mother's age. The result of the independent samples *t*-test was significant (t = -2.31, *p*<0.05), indicating that the average age of mothersignificantly differed between the normal weight (Mean = 31.40) and underweight children (Mean = 30.40). Thus, a child with older aged mother has a better chance to have normal weight than those who has younger aged mother.

As summarized in Table 3, there was a significant difference in the size of the total household between children with normal weight and those who were underweight.The result of the independent samples *t*-test was significant (*t* = 2.82, *p*<0.01), indicating that the average total household sizesignificantly differed between the normal weight (Mean = 5.10) and underweight children (Mean = 5.60). Therefore, a child living with large household has a greater chance of being underweight than those who livewith small household.

According to Table 3, there is a significant difference between normal weight children and underweight children in the child's age. The result of the independent samples *t*-test was significant (t = 2.20, *p*<0.05), indicating that the average child agesignificantly differed between the normal weight (Mean = 3.40) and underweight children (Mean = 3.60). Thus, a child with an older age experience underweight than those who has younger aged mother.

As indicated in Table 3 showed a significant difference between normal weight children and underweight children on the TLU. The result of the independent samples *t*-test was significant (t = -2.99, *p*<0.01), indicating that the average TLUsignificantly differed between the normal weight (Mean = 7.40) and underweight children (Mean = 5.60). As a result, a child living in a household with a large amount of livestock has a better chance of being of normal weight than a child living in a household with a small amount of livestock.

Table 4. The Binary Logistic Regression Output

Variables	B	S.E.	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
						Lower	Lower
Age of the mother	0.12	0.03	23.72	0.000	1.13	1.08	1.19
Educational status	0.25	0.11	5.62	0.018	1.28	1.04	1.57
Total Household Size	-0.33	0.07	25.28	0.000	0.72	0.63	0.82
Source of drinking water	0.85	0.23	13.90	0.000	2.33	1.49	3.64
Kind of toilet facility	0.42	0.25	2.82	0.093	1.52	0.93	2.49
Birth interval	0.44	0.19	5.21	0.022	1.55	1.06	2.25
ANC visit	1.34	0.47	8.17	0.004	3.82	1.52	9.57
Experience diarrhea	-1.04	0.30	11.93	0.001	0.35	0.20	0.64
Hand washing practice	0.83	0.23	13.04	0.000	2.29	1.46	3.60
Sex of Children	-0.63	0.21	8.63	0.003	0.54	0.35	0.81
Child age	-0.31	0.11	7.58	0.006	0.73	0.59	0.92
TLU	0.01	0.02	0.47	0.495	1.01	0.98	1.05
Enset dominant	-0.33	0.22	2.29	0.130	0.72	0.47	1.10
Asset index	0.19	0.09	4.75	0.029	1.21	1.02	1.44
Chi-square			138.58				
Sig.			0.000				

The age of a child's mother has a positive and statistically significant effect on their children's body weight status ($B = 0.12$, $p < 0.001$) as shown in table 4. The odds ratio value indicates that if a mother's age increases by one unit, a child has a 1.13 chance of having a normal body weight regardless of the other independent variables in the model. This indicated that a mother's age positively affects the body weight status of her children.

A mother's education level has a positive and statistically significant effect on her children's body weight status ($B = 0.25$, $p < 0.05$). The odds of respondents with a higher education level having normal-weight children are 1.28 times higher than those with a lower education level. This revealed that sampled mothers with a higher education level have a better chance of having normal-weight children than those with a lower education level.

The total household size of the sampled child's mother has a negative and statistically significant effect on the body weight status of children ($B = -0.33$, $p < 0.001$). It can be inferred from the odds ratio values that if the total household size of a sampled child's mother increased by one unit, a child has a 0.72 chance of being underweight regardless of other independent variables in the model. This indicates that total household size has a negative effect on the body weight status of children.

The source of drinking water has a positive and statistically significant effect on the body weight status of children ($B = 0.85$, $p < 0.001$). The odds of respondents with piped water being normal-weight children is 2.33 times higher than those without piped water. This revealed that sampled mothers with piped water have a better chance of being normal-weight children than mothers without.

Birth interval has a positive and statistically significant effect on body weight status of children ($B = 0.44$, $p < 0.02$). The odd of respondents with high birth interval being normal weight children is 1.55 times higher than those with low birth interval. This revealed that sampled mothers with high birth intervals have a better chance to be normal weight children than mothers with low birth intervals. ANC visit has a positive and statistically significant effect on body weight status of children ($B = 1.34$, $p < 0.001$). The odd of respondents with ANC visits being normal-weight children is 3.82 times higher than those without ANC visits. This revealed that sampled mothers with ANC visits have a better chance of being normal weight children than mothers without ANC visits.

Diarrhea has a negative and statistically significant effect on children's body weight status ($B = -1.04$, $p < 0.001$). The likelihood of a mother experiencing diarrhea being normal weight children is 0.35 times lower than the likelihood of a mother not experiencing diarrhea. This revealed that sampled mothers who had diarrhea had a higher chance of having underweight children.

Hand washing practice has positive and statistically significant effect on body weight status of children (B

=0.83, p <0.001). The odds of respondents who have hand washing practice being normal weight children is 2.29 times higher than those respondents who have no hand washing practice. This revealed that sampled mothers who have hand washing practice have better chance to be normal weight children than those mothers who have no hand washing practice.

Children's sex has a negative and statistically significant effect on their body weight status (B =-0.63, p<0.001). Male children are 0.54 times less likely than female children to be normal weight. This revealed that male children have a better chance of being underweight than female children.

Age of achild has a negative and statistically significant effect on theirbody weight status (B = -0.31, p <0.01). It can be inferred from the values of odds ratio that if a child increased their age by one unit, a child has a 0.73 chance of decreasing their weight regardless of other independent variables in the model. This indicated that child age has a negative effect on body weight status of children.

Asset has positive and statistically significant effects on body weight status of children (B =0.19, p <0.03). The odds of respondents who were Enset dominant have normal weight children is 0.73 times higher than those respondents who were non-enset dominant. This revealed that Enset dominant households have a better chance of being normal-weight children than non-enset dominant.

DISCUSSION

There has been much research on the relationship between a mother's age and her children's body weight, and the findings generally support a positive correlation between these variables. Fall et al. (2015), Dhana et al. (2018), and Heslehurst et al. (2019) found that maternal age was positively associated with children's body weight, even after controlling other factors such as maternal education, income, and race/ethnicity. The study further indicated that each one-year increase in maternal age at childbirth was associated with a 0.03 increase in children's BMI z-score, even after adjusting for other factors. This means that older mothers tend to have children with higher body weight compared to younger mothers. One possible explanation for this finding is that older mothers may have different dietary or lifestyle habits compared to younger mothers, which could also influence their children's body weight. Likewise, the finding of Haile et al. (2020) approved that children whose mother's age is below 20 (OR = 5.75, 95%CI = 1.44, 23.1)) were more likely to be underweight compared with children whose mother's age is above 45.

The study found that there is a positive relationship between the education status of mothers and the body weight of their children. The finding of Haile et al. (2020) indicated that children whose mothers had no education and primary education only (OR = 1.65, 95% CI 1.05, 2.59 and OR = 1.43, 95% CI 1.15, 1.78, respectively) were more likely underweight compared to children whose mothers had higher education. This relationship can be attributed to various factors, such as increased knowledge and awareness of healthy eating habits, access to healthier foods, and the ability to make informed decisions about nutrition and physical activity. Mothers with higher education levels tend to have greater knowledge and awareness of the importance of healthy eating habits and physical activity for their children's health. They are more likely to understand the nutritional needs of their children and to provide them with balanced meals that contain adequate amounts of essential nutrients. Moreover, education is associated with socio-economic status, which can impact access to healthy foods. Mothers with higher education levels are more likely to have better-paying jobs, which can provide them with the financial resources to purchase healthy food for their families.

The study found that household size has a negative effect on the body weight status of children. This means that as the size of a household increases, the likelihood of children being overweight or obese also increases. There are several possible explanations for this relationship. One reason may be related to food availability and access within larger households. As the number of people in a household increases, there may be more competition for food resources, which can lead to a decrease in the amount of healthy food available to everyone (Chen, et al., 2021). Additionally, larger households may have more limited access to healthy food options due to economic constraints or geographic location. Another possible explanation is related to social dynamics within larger households. For example, children in larger households may be exposed to more sedentary behavior, such as watching TV, and less physical activity due to limited space or resources. Furthermore, children in larger households may be subject to more stress and lower levels of parental involvement due to the demands of managing a larger household, which can lead to unhealthy coping mechanisms and behaviors.

The finding proved that there is a positive relationship between the source of drinking water and children's body weight. According to VanCooten et al. (2019), access to clean and safe drinking water can have a significant impact on children's growth and development, including their body weight. One reason for this relationship is that access to safe drinking water can help prevent waterborne diseases and infections, which can affect children's overall health and nutrition. When children are sick, they may experience reduced appetite and energy levels, which can lead to weight loss and stunted growth. By contrast, children who have access to clean and safe drinking water are less likely to suffer from waterborne illnesses and can maintain better health and nutrition. In addition, Abdulahi et al. (2017) indicated that access to clean water can also promote hydration, which is important for maintaining healthy body weight. Studies have shown that dehydration can lead to overeating and weight gain, as the body may mistake thirst for hunger. By ensuring that children have access to clean and safe drinking water, parents and caregivers can help them maintain proper hydration levels. Furthermore, providing children with clean and safe drinking water that is free from harmful contaminants can help promote healthy growth and development.

Birth interval, the time elapsed between the birth of a child and the conception of the next child, has a positive effect on children's body weight. That means short birth intervals were associated with decreased weight gain in children. The results of Gizaw and Kumera (2018) indicated that longer birth intervals were associated with higher body weight in the second-born child, even after controlling for a variety of demographic and socio-economic factors. That means, longer birth intervals may also have positive effects on child health, specifically in terms of body weight. Therefore, the positive effect of birth interval on children's body weight found in this study adds to the growing body of evidence supporting the importance of family planning and the potential health benefits of longer birth intervals.

According to the results of the study, ANC (Antenatal Care) visits have a positive effect on children's body weight. ANC visits are an important aspect of maternal and child health care services, as they provide expectant mothers with essential health care and education to ensure a healthy pregnancy and delivery. The study conducted by Woldeamanuel and Tesfaye (2019) found that ANC visits have a significant impact on children's body weight. The study analyzed data from the Ethiopian Demographic and Health Survey (EDHS) and showed that children born to mothers who received at least four ANC visits during their pregnancy had a significantly higher body weight than children born to mothers who had fewer ANC visits. The study found that the positive effect of ANC visits on children's body weight was mediated by various factors. For instance, mothers who received ANC visits were more likely to be informed about the importance of exclusive breastfeeding, which could lead to better nutrition for their infants. Additionally, mothers who received ANC visits were more likely to receive treatment for anemia and other infections, which could improve their overall health and lead to better nutrition for their infants.

Diarrhea is a common problem among children that can have a negative impact on their overall health, including their body weight. According to a study conducted by Kassie et al. (2019), experiencing diarrhea can result in a significant reduction in a child's body weight. The researchers found that children who had experienced diarrhea in the previous two weeks had a significantly lower body weight compared to children who had not experienced diarrhea. The negative impact of diarrhea on body weight can be attributed to several factors. One of the main factors is malabsorption, which occurs when the body is unable to absorb nutrients from food due to the rapid passage of stool through the intestines (Wasihun et al., 2018). This can result in a deficiency of important nutrients, such as vitamins and minerals, which can lead to stunted growth and lower body weight. Another factor that can contribute to the negative impact of diarrhea on body weight is loss of appetite. Children with diarrhea may experience nausea, vomiting, and abdominal pain, which can lead to a decreased desire to eat (World Health Organization, 2017). This can result in a reduced intake of calories and nutrients, further exacerbating the negative impact of diarrhea on body weight.

Hand washing is a common hygiene practice that has been shown to have a positive impact on health outcomes. The study found that mothers' hand-washing practices can positively influence their children's body weight. Research by Kwami et al. (2019), Nalule et al. (2022), Petermann-Rocha et al. (2023), and Taddese et al. (2020) examined the relationship between mothers' hand-washing practices and children's body weight. These studies revealed that mothers who frequently washed their hands had children with lower body weights compared to mothers who did not wash their hands as often. Additionally, the positive association between mothers' hand-washing practices and children's body

weight was found to be stronger in children who were breastfed. The mechanisms underlying the relationship between mothers' hand washing practices and children's body weight are not entirely clear. One possible explanation is that hand washing reduces the transmission of infectious agents that can lead to diarrhea and other illnesses, which can cause children to lose weight (Dreibelbis et al., 2014). Another possible explanation is that mothers who practice good hygiene may also engage in other healthy behaviors that can influence their children's body weight, such as providing healthier foods and encouraging physical activity (Muthuri et al., 2016).

The study found that the sex of children may have an impact on their body weight. For example, Sahiledengle et al. (2022) found that males were 1.8 times more likely to become underweight than females [AOR: 1.8 (1.14– 2.85)]. Likewise, EDHS (2016) also indicated that children were more likely to be underweight if they were male (OR = 1.16, 95%CI = 1.02, 1.33).Another study by Hsu et al. (2018) reported that the sex of the first-born child might also influence body weight, with girls who are the first-born more likely to be overweight or obese than boys who are the first-born. Similarly, a study by Bohn et al. (2020) and Shah et al. (2020) found that the sex of the second-born child may influence body weight, with second-born boys being more likely to be overweight or obese compared to second-born girls.

The study found that a child with older age is more likely to be underweight than those who have younger. A longitudinal study conducted in urban Ethiopia by Mezmur et al. (2017) indicated that as the age of children increases, they have a higher probability of being underweight. The study analyzed data collected between 2000 and 2011 and assessed the trends in socio-economic and behavioral determinants of maternal, neonatal, and child health and nutritional status. On the other hand, a study conducted by Biro and Wien (2010) examined the association between child age and body weight status in a sample of 1,034 children aged 2 to 18 years. The researchers found that older children were more likely to be overweight or obese than younger children, with the most significant increase in risk occurring during adolescence. Specifically, the odds of being overweight or obese were 1.17 times higher for each year of age beyond five years, with the most significant increase in odds occurring between ages 10 and 14 years. Older children may have more opportunities to engage in sedentary behaviors, such as watching television or playing video games, which can contribute to excess calorie intake and weight gain.

The study established a positive correlation between the household asset index and children's body weight. That means children from households with a higher asset index were less likely to be underweight and more likely to be overweight or obese. Similarly, a study conducted in Vietnam by Amugsi et al. (2020) found that children from households with a higher asset index had a lower risk of being underweight than those from lower asset index households. These findings can be explained by the fact that households with higher asset indexes tend to have better access to food, healthcare, and other resources that promote healthy growth and development in children. Tesfaw and Zewotir (2021) also added that wealthier higher quality and more nutritious food, contributing to better overall health and growth. They can also afford to provide their children with better healthcare, which can prevent and treat conditions that may lead to being underweight or overweight.

CONCLUSIONS

The study highlights the importance of various demographic, socio-economic, and health-related factors on the normal body weight of a child in the Sidama regional state. The findings suggest that maternal factors, such as age and educational status, play a crucial role in ensuring the healthy growth of their children. Access to clean drinking water, practicing hand washing, and timely antenatal visits were also found to positively impact a child's normal weight. In contrast, household size, diarrhea episodes, and child age were found to negatively impact children's normal body weight. Therefore, interventions should focus on improving maternal education, increasing access to clean drinking water, and promoting healthy hygiene practices to improve the nutritional status of children. This study can serve as a valuable resource for policymakers, healthcare providers, and other stakeholders working towards improving child health and nutrition in low- and middle-income countries.

AUTHOR CONTRIBUTIONS

Atsede Seyoum was responsible for data management, statistical analysis and drafting of the manuscript. Admasu Tsegaye and Aregash Samuel contributed to data analysis and manuscript development and review. All authors have read and approved the final version of the manuscript.

DECLARATION

The authors declare that there is no conflict of interest.

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