

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF PUBLIC HEALTH

UNDERNUTRITION AND ASSOSIATED FACTORS AMONG ADOLESCENT GIRLS ATTENDING SCHOOL IN GURAGE ZONE, SOUTHERN ETHIOPIA: COMPARATIVE CROSS-SECTIONAL STUDY.

BY: TOFIK AKMEL

A THESIS REPORT TO BE SUBMITED TO DEPARTMENT OF PUBLIC HEALTH , COLLEGE OF MEDICINE AND HEALTH SCIENCE, WOLKITE UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENT OF MASTER OF PUBLIC HEALTH DEGREE IN PUBLIC HEALTH NUTRITION.

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Abbreviations and Acronym

AOR	Adjusted odd ratio
BAZ	Body mass index-for-Age Z score
BMI	Body mass index
CI	Confidence interval
EDHS	Ethiopian demographic health survey
FAO	Food and agricultural organization
HAZ	Height for age Z score
HEW	Health extension worker
KMO	Keiser Maier's Olkin
MDD	Minimum Dietary Diversity
NNP	National Nutrition Program
PCA	Principal Component analysis
SD	Standard Deviation

Abstract

Background: Nutritional status of adolescent girls has not received due attention in many developing countries including Ethiopia. However, adolescent is the second most rate of growth period regarding physical growth in life cycle after infants. Clear disparities of undernutrition between urban and rural adolescents were not well known. Therefore the objective of the study was to assess undernutrition and associated factors among rural and urban adolescent girls.

Methods: A Comparative cross-sectional study design was employed to assess undernutrition and associated factors among adolescent girls attending schools in Gurage zone. Computer generated simple random sampling technique was used to select study participants. A pretested structured interviewer administered questionnaires with anthropometric measurements was used. Multivariable binary logistic regression model was used to assess the association between dependent and independent variables for each outcome**.**

Results: The overall prevalence of thinness and stunting were 6.3% (95% CI: 4.8–8.0) and 8.6% (95% CI: 6.7–10.8) respectively. Thinness was 6.0% (95% CI: 3.9–8.4) and 6.4% (95% CI: 4.3–8.5) among rural and urban adolescents respectively. Likewise, stunting was 10.1% (95% CI: 7.0–13.0) in rural and 7.1% (95% CI: 4.7–9.7) in urban dwellers. Poor dietary diversity [AOR: 4.70(95% CI 1.1-19.9)] and Occurrence of diarrhea [AOR: 16.9(95% 5.-49.77] in urban and absence of hand washing [AOR: 4.0(95% CI: 1.3-12.3)] in rural were significantly associated with thinness. Poor dietary diversity [AOR: 10.07(95% CI: 3.24-31.24] and absence of waste disposal system [AOR: 3.63(95% CI: 1.07-12.24)] were significantly associated with stunting in rural adolescents.

Conclusion and recommendation: The prevalence of thinness was nearly similar to urban and rural adolescent. Stunting was higher among rural adolescent than urban. Attention should be given from different stakeholders to focus maintaining of food varieties, creating awareness about handwashing and waste disposal system for adolescents.

Key words; Adolescent, stunting, thinness

1. Introduction

1.1 Background

The World health organization (WHO) defined adolescents as individuals between the ages of 10-19 years(1).Adolescence is the second most rate of growth period regarding physical growth in life cycle after infants, due to this their nutritional needs are high and accompanied by the gradual development of reproductive organs, secondary sexual characteristics and menarche in girls(2). Adolescent is a stage of receptivity to new ideas and a point at which lifestyle choices may determine an individual's life course(3–6).

Worldwide, there are about 1.2 billion adolescents, representing more than 18% of the global population. Nearly 90% of them live in developing countries, and approximately 600 million are female(7). In Ethiopia, 20–26% of the populations are adolescents(8).

According to WHO, the recommended indicator to assess the nutrition status of adolescents are thinness (low body mass index for age) and stunting (low height for age), where the former is a result of mainly acute (short term), and the latter shows chronic (long term) nutritional deficiency(9–11). Thinness defined as low body mass index (BMI) for age, which graded into mild-I, moderate-II, and severe-III and can be a marker of undernutrition although thin children are not necessarily undernourished whereas stunting is low height for age and again which graded in to mild-I, moderate-II, and severe-III(4–6).

During adolescence, the hormones mediating pubertal growth, pubertal sex hormones, and growth hormones normally rise together and are responsible for the optimal skeletal growth and sexual development which are modulated to a great extent by nutritional factors(12–14) .

Due to rapid growth, during adolescent period, the dietary requirement of adolescents is higher for most nutrients than at any other period of life(15). If their requirement is not met, at this age, they are likely to develop serious nutritional deficiency(15).

1.2 Statement of the problem

Globally, adolescent undernutrition is a serious public health problem in both developed and developing countries, but is disproportionally keeping sever in developing countries, especially in Asia (32–65%) and Africa (4–30%), making them more vulnerable to low productivity, poor health, and early deaths. In Sub-Saharan Africa, the prevalence of adolescent undernutrition is 15–58%, which is higher from other African countries(16–18). In low and middle-income countries, 67% of rural and 50% urban adolescents had a higher magnitude of thinness(19).

Every year, more than 1.2 million adolescents die worldwide and nutrition related problem is the foremost risk factor contributing to the main causes of death(20). Undernutrition starts before birth, goes into adolescence and adult life, and can span into generations and results in short stature, thinness, and is associated with deficiencies in muscular strength. In addition, it can reduce resistance to infection and other debilitating conditions that reduce productivity(23–26). High requirements for growth, their eating patterns and lifestyles, and their risk-taking behaviors; their susceptibility to environmental influences and hard physical work, as commonly observed in low-income countries, additional physiological stress and nutritional requirements and gender discrimination in adolescents are the main associated factors for adolescent undernutrition(14,24,25).

The government of Ethiopia has initiated Growth and Transformation Plan II, Second National Nutrition Program (NNP II), and Seqota declaration to fight against nutritional problems of the country. Nonetheless, the prevalence of adolescent under-nutrition is still high, because these programs has focus on under five and pregnant women nutrition and consider adolescents are low risk for under-nutrition(8) .

Evidences showed that adolescent girls in many contexts are a marginalized and disempowered group and consequently face diminished opportunities and choices(26).Moreover; nearly 80% of Ethiopian populations have been living in the countryside areas in which there is high fertility rates and low socioeconomic status (8) .

Nutritional status of adolescents requires close monitoring because they represent the next generation of parents. To address nutritional problems of adolescents, it is crucial to assess their current nutritional status. There is limited information available about the nutritional status of adolescent girls in Gurage zone. Previous comparative studies were conducted in urban and rural area of the same district and may not show the clear disparities of undernutrition between urban and rural adolescent girls. Furthermore any similar study was conducted in the study area. Thus, the present study was undertaken to assess undernutrition and associated factors among adolescent girls attending school in the rural and urban schools of Gurage zone.

1.3. Significance of the study

The findings of this study would be crucial for Gurage zone health department to implement interventions of undernutrition of the adolescent girls by decreasing the rates and burden of thinness and stunting. The finding of this study would also have a potential contribution for Wolkite University to build and make plan to support adolescent nutrition. The result of this study would also be helpful for researchers, health professionals and policy makers as references for their works. Finally, findings obtained from this study might assist decision makers to plan and implement nutrition intervention programs to benefit school adolescent girls those participated in the study.

2. Literature review

2.1. Prevalence of undernutrition among adolescent girls

Globally, the prevalence of thinness among adolescent girls was 8.4% and the trends of prevalence of thinness decreased from 9.2% in 1975 to 8.4% in 2016(27). In low and middle-income countries, 67% of rural and 50% urban adolescents had a higher magnitude of thinness(19).However, the prevalence of thinness is highest in south Asia and Africa which were 41% and 12.5%, respectively (28).

A study conducted at Asian and Sub-Saharan Africa countries revealed the highest prevalence of undernutrition among adolescent girls in Nigeria (32.9%)(29) . A study done in Khagrachari District, Bangladesh, shows that 13.67% of adolescent girls were severely stunted and 20.33% were moderately stunted(30).Another study done in rural areas of Bangladesh shows that 32% of the adolescent girls were stunted (4).Study done in urban area of India show that, the prevalence of stunting ranges from 11.7% to 34.2% (31–33). A study conducted at paschim medinipur district, rural area of west Bengal, show that Prevalence of stunting was 34.20% and the prevalence of thinness was 40.94% (34).

A Studies done in rural area of Asembo and Mumias, Kenya, and Tunisia reported that the prevalence of thinness was 15.6% and 1.3%, respectively (35,36).A study conducted in rural area of East Africa show that the overall magnitudes of undernutrition was 16.50%(37).

A national level survey on adolescent girls reported that 14% of adolescent girls were thin (38). According to the Ethiopia Demographic and Health Survey (EDHS) 2016 report, the prevalence of thinness among Ethiopian adolescent girls was 29% (21). Similarly, in Addis Ababa, the capital of Ethiopia, 6.2% of adolescents were found to be thin(38)and a study conducted among adolescent girls in rural communities of northern Ethiopia showed the prevalence of stunting ranges from 12.5%-47.4%, whereas thinnest is between 12.6% and 58.3% (22).

A study conducted in Afar Regional state, Megale district, show that the overall prevalence of thinness was 15.8% and the overall prevalence of stunting was 26.6% (8). The prevalence

of severe thinness and stunting were 3.8 and 7.6%, respectively. Another study conducted in Axum Town show that the overall prevalence of thinness among adolescent girl was 12.6%(39).Again a study conducted in Damot sore district, southern Ethiopia, show that the overall prevalence of stunting (low height-for-age) and thinness (low body mass index-for-age) among adolescent girls was 29.6% and 19.5% , respectively(40).

Furthermore, a study conducted in Dangla Town, Northwest Ethiopia, show that the prevalence of thinness was 1.4% and stunting was 15% (41) and a study conducted at Debark district, North West Ethiopia; show that the overall magnitude of stunting among adolescent girls in schools of Debark district was 20.1%(42). The magnitude of stunting (24.2%) was higher among rural than urban school adolescent girls (16%). And the overall prevalence of thinness among adolescent girls in schools of Debark district was 10.3%. The prevalence of thinness was higher among urban adolescent girls (12.1%) than rural (3.9%)(42).

A study conducted at Soro district, Hadiya Zone; show that the overall prevalence of the thinness among female adolescents attending high schools was 6.8%. It was higher among students schooling in rural areas 18.7% than those in urban areas 4.8. However there was no statistically significant difference in thinness among adolescent girls in rural and urban high schools(43).

2.2. Factor associated with undernutrition

2.2.1 Sociodemographic factors

A study conducted in Afar Regional state, Megale district, show that thinness and stunting were higher among adolescent girls who were early adolescent girls than those who were late adolescents (8). This study also indicated that early age of adolescent girls were more thin (10.1%) than late adolescents 2.2%.(8). Another study conducted in Axum Town show that early adolescent girls were 2.7 times more likely to become thin as compared to late adolescent girls (39).

A study conducted at Damot sore district, southern Ethiopia; show that both stunting and thinness were more prevalent among older/late adolescent girls than younger/early adolescent

girls: 35.6% vs. 25.7% and 21.8% vs. 17.9%, respectively. This indicates that both stunting and thinness were increasing with the increasing age of girls especially during older adolescence period(8). The study findings show that older adolescent girls have higher odds of developing stunting as compared to their counterparts(8).Also a study conducted at Debark district, North west Ethiopia, show that rural adolescent girls s who were in the middle adolescent age were more likely to be thin as compared to adolescent girls in the late adolescent age (42). Urban adolescent girls who were in the early age were more likely to be thin as compared to late adolescent age(42). Adolescent girls who were in the early and middle adolescence age were more likely to be thin as compared to adolescent girls in the late adolescence age(42). Similarly, a study conducted at Hawzen District, Tigray regional state, Northern Ethiopia: show that stunted adolescents were higher among low-grade level adolescents (grade 4–8) as compared to high-grade level adolescents (44).

A study conducted in Axum Town show that adolescent girl students whose mothers had not been taken formal education were more likely to be thin as compared to those whose mothers are completed college and above education (39). Another study conducted in damot sore district, southern Ethiopia, show that adolescent girls whose mothers' education was primary level were 44.0% less likely to be thin when compared to those girls whose mothers had no formal education (40). In similar study, adolescent girls from educated mothers were less likely to be prone to stunting when compared to those from non-educated one. Adolescent girls whose mothers had secondary education have 47.0% lower odds of developing stunting while those girls whose mothers attended more than secondary education have 75.0% lower odds to develop stunting as compared to mothers who had no formal education(40). Also a study conducted at Hawzen District, Tigray regional state, Northern Ethiopia: show that Unemployed mothers were higher among stunted adolescents as compared to the counterpart(44).

A study conducted in damot sore district, southern Ethiopia; show that adolescent girls whose fathers' education level was primary were 52.0% less likely to be thin while girls whose fathers' education was secondary level were 55.0% less likely to be thin as compared to those girls whose fathers had no formal education(40).

A study conducted at Debark district, North West Ethiopia; show that the overall adolescent girls who were from farmer mothers were more likely to be thin as compared to adolescent girls from merchant mothers (42).

A study conducted in Dangila Town, Northwest Ethiopia, show that the number of family members was one of the strongest predictors for thinness, adolescents who lived in the household with more than 5 family members were more likely to be thinner than those who lived in the household with five or less family size (41).

A study conducted in Axum Town show that adolescent girls from a family with first wealth quintile were more likely to become thin as compared to those adolescent girls from a family with fourth wealth quintile(39). Similarly, adolescent girls from a family with second wealth quintile were more likely to be thin as compared to those adolescent girls from family with fourth wealth quintile(39). A study conducted at Debark district, North West Ethiopia; show that adolescent girls who were in the middle wealth class group were more likely to be thin as compared to adolescent girls in the upper wealth class group(42). Adolescent girls who were in the lower wealth class group were more likely to be stunted as compared to adolescent girls in the upper wealth class group (42). Similar study conducted at soro district, Hadya zone, show that adolescent girls attending high schools were higher odds of being thin in the low wealth tertile households as compared to those from households with higher Wealth tertile (43). Furthermore, a study conducted in damot sore district, southern Ethiopia, show that those adolescent girls whose household wealth tertile was lower/poor were more likely to be stunted than adolescent girls whose household wealth tertile was higher/rich(40).

2.2.2 Dietary related factors

A study conducted in Axum Town show that adolescent girls who used inadequate dietary diversify were more likely to be thin as compared to those who used adequate dietary diversify in the past 24 h preceding the survey(39). Similarly, a study conducted at soro district ,Hadya zone, show that adolescent girls with inadequate dietary diversity were four times more likely to be thin than their counterparts who had adequate dietary diversity(43).

A study conducted in Damot sore district, southern Ethiopia; show that those female adolescents who usually eat two meals and less per day were more likely to be thin as compared to those who usually eat three meals per day(40). Another study conducted in Dangila Town, Northwest Ethiopia, show that the frequency of food intake had association with stunting, adolescents who took food two or less time per day were more likely to be stunted than those who took more than two times per day (41).

2.2.3 **Health related factors**

A study conducted in Axum Town show that adolescent girl students who began menstruation were 50% less likely to be thin than those who did not begin menstruation (39).Also, a study conducted in Afar Regional state, Megale district, show that adolescent girls who did not start menstruation were more likely to be stunted as compared with adolescent girls who started menstruation(8).

A study conducted at Debark district, North West Ethiopia, show that those adolescent girls who were at the middle-age stage were more likely to be stunted as compared to late adolescent stage at first menstruation(42).

A study conducted in Dangila Town, Northwest Ethiopia, show that having illness had a significant association with thinness; adolescents who had illness within fifteen days prior to the study were almost three folds more likely to be thinner than their counterparts(41).

2.2.4 Environmental factors

A study conducted at Soro district, Hadya zone, and show that the odds of being thin were more than two times higher among adolescent girls who use drinking water from unimproved source than adolescent girls who use drinking water from improved source(43)..

A study conducted in Afar Regional state, Megale district, show that those who had not had home latrine were more likely to get stunted as compared with those who had home latrine(8).Another study conducted at Debark district, North west Ethiopia, show that the odds of being stunted among adolescent girls who had no latrine at home is increased by 95%

compared to those who had home latrine(42). Also a study conducted in Dangila Town, Northwest Ethiopia, show that Unavailability of latrine had a significant association with stunting, adolescents from families who did not have latrine were more likely to be stunted compared with families who had latrine (41).

A study conducted in Dangila Town, Northwest Ethiopia, show that hand washing practice was another predictor for stunting, adolescents who did not wash their hands before eating were more likely to be stunted compared to those adolescents who did wash their hands (41).

2.2.5 Health and nutrition information

A study conducted in Dangila Town, Northwest Ethiopia, show that the odds of having stunting was higher among adolescents whose family had no radio as compared to their counterparts(41). Another study conducted at Debark district, North West Ethiopia, show that adolescent girls who had the lowest media exposure are higher to develop stunting as compared to those who have very often media exposure(42).

2.3. Conceptual framework

This conceptual framework is used to asses' undernutrition and associated factors among adolescent girls in the urban and rural schools of Gurage zone.

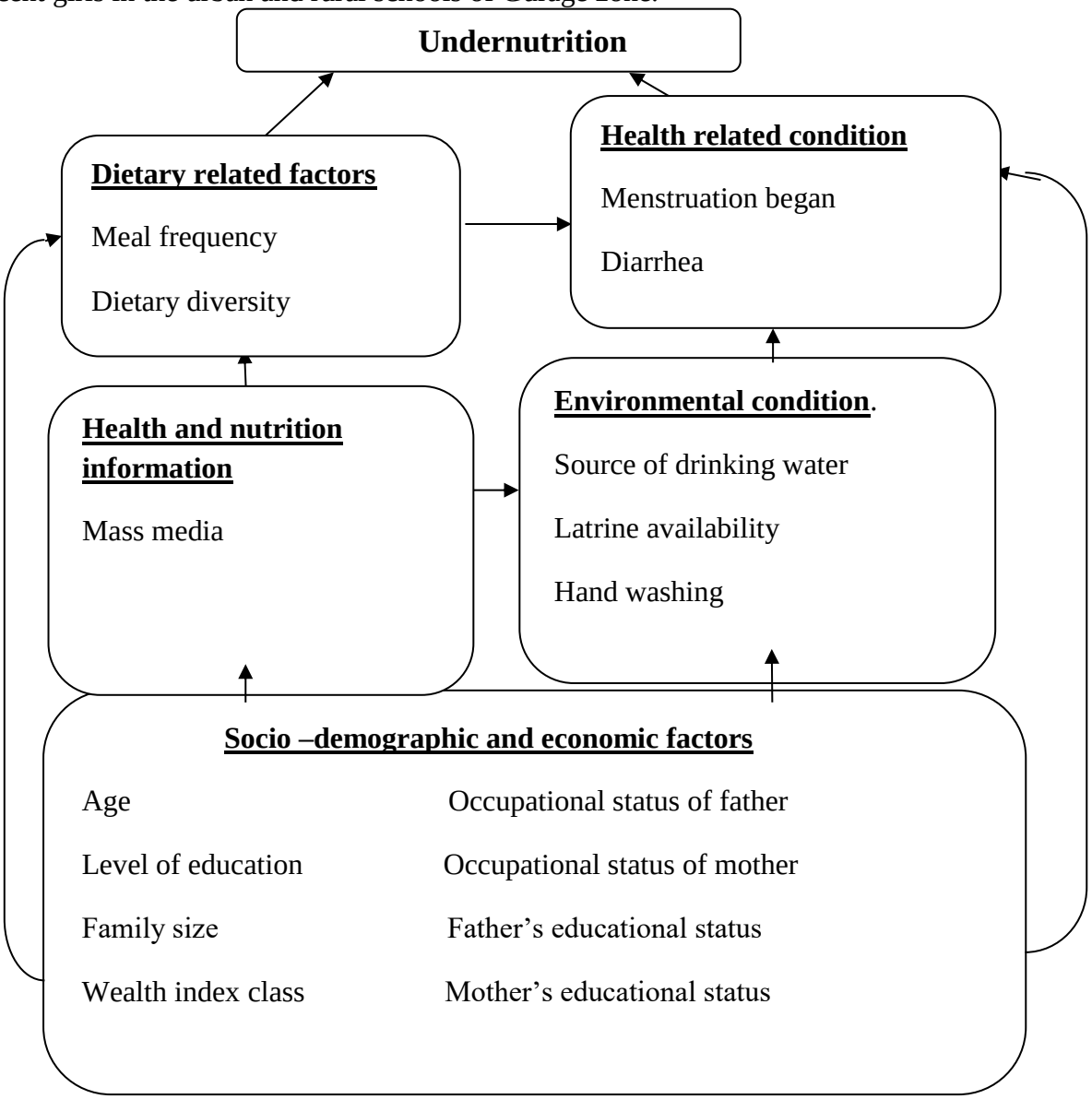


Figure 1 Conceptual framework for undernutrition and associated factors among adolescent girls in the urban and rural schools of Gurage zone, 2022 developed after reviewing different literatures (41–43).

3. Objective

3.1. General objective

- To assess the prevalence of undernutrition and associated factors among adolescent girls attending school in the rural and urban schools of Gurage zone, Southern Ethiopia, 2022.

3.2. Specific objectives

- To compare the prevalence of undernutrition among adolescent girls in the rural and urban schools of Gurage zone.
- To identify factors associated to thinness among adolescent girls in the schools of Gurage zone.
- To identify factors associated to stunting among adolescent girls in the schools of Gurage zone.

4. Method and Material

4.1. Study setting and period

- ✓ The study was conducted in Gurage zone; SNNPR. Gurage zone has a total population of 1,827,404 dwelling in 16 rural wereda and 5 urban administrations of which 52% comprises female population according to 2014 EC zonal government's report. In Gurage zone, there are 694 schools (97secondary and 597 primaries).In the year 2014, a total of 200,121 students (from grad 5-12) have been enrolled in primary (132,308) and secondary (67,813) schools; of which 97,181 of the students are female and 102,940 are male. There are a total of 44,583 adolescent girls from grade 5 to grade 12 students in all the primary and secondary schools. This study was conducted in selected districts and Towns of Gurage Zone, Southern Ethiopia on undernutrition and associated factors among adolescent girls attending schools from May 3, 2022 to May15, 2022.

4.2. Study design

A comparative cross-sectional study design was conducted.

4.3. Population

4.3.1. Source population

The source populations of this study were all adolescent girls attending schools (primary and secondary) in Gurage zone.

4.3.2. Study population

School-going adolescent girls selected randomly for the study from randomly selected rural and urban school of Gurage zone that fulfil eligibility criteria.

4.4. Eligibility criteria

4.4.1. Inclusion criteria

School-going adolescent girls who are resident of selected district or Town for at least 6 month

4.5 Sample size determination and procedure

4.5.1. Sample size determination

Sample size was determined by using two population proportion formulae for all specific objectives with assumptions of power 80%, confidence interval of 95%, one to one ratio and 2 design effects.

Table 1: Sample size determination for undernutrition and associated factors among adolescent girls in Gurage zone schools,Southern Ethiopia,2022.

Specific objective	Sample size	Reference
Specific objective 1 (Prevalence of under nutrition, thinness p1=12.1% & p2=3.9%)	=390 after considering 10% non-response rate it is=429 again after considering 2 design effect it is 858.	42
Specific objective 2 (Factor associated with thinness, source of drinking water, 13% &43%)	=82 after considering 10% non-response rate it is=90 again after considering 2 design effect it is 180.	43
Specific objective 3 (Factor associated with Stunting, wealth index, 25%&40.3%)	=320 after considering 10% non-response rate it is=352 again after considering 2 design effect it is 704	40

Finally, the calculated sample size by using each specific objective was compared. Then the largest sample size was taken. Therefore, the largest sample size was 858 (429 for urban and 429 for rural).

4.5.2. Sampling technique and procedure

In Gurage zone, there are a total of 21 woreda (16 rural and 5 urban) and 694 schools (97secondary and 597 primary) are found. Initially, all woreda were stratified to urban and rural. Then, a simple random sampling technique was used to select 30% of districts among rural and urban. Accordingly; 2 Town administration and 5 rural districts were selected. Similarly, a simple random sampling technique was used to select 30% of schools (grades 5–12) from both urban and rural schools. Accordingly; 4 schools from Urban/Town administration and 36 schools from rural districts were selected. A multistage sampling technique was used to select these schools. The student's classroom registers was used as a sampling frame. Then computer generated random sampling technique was used to select study participants in each schools. For more detail, sample size proportional allocations in districts are summarized as follow.

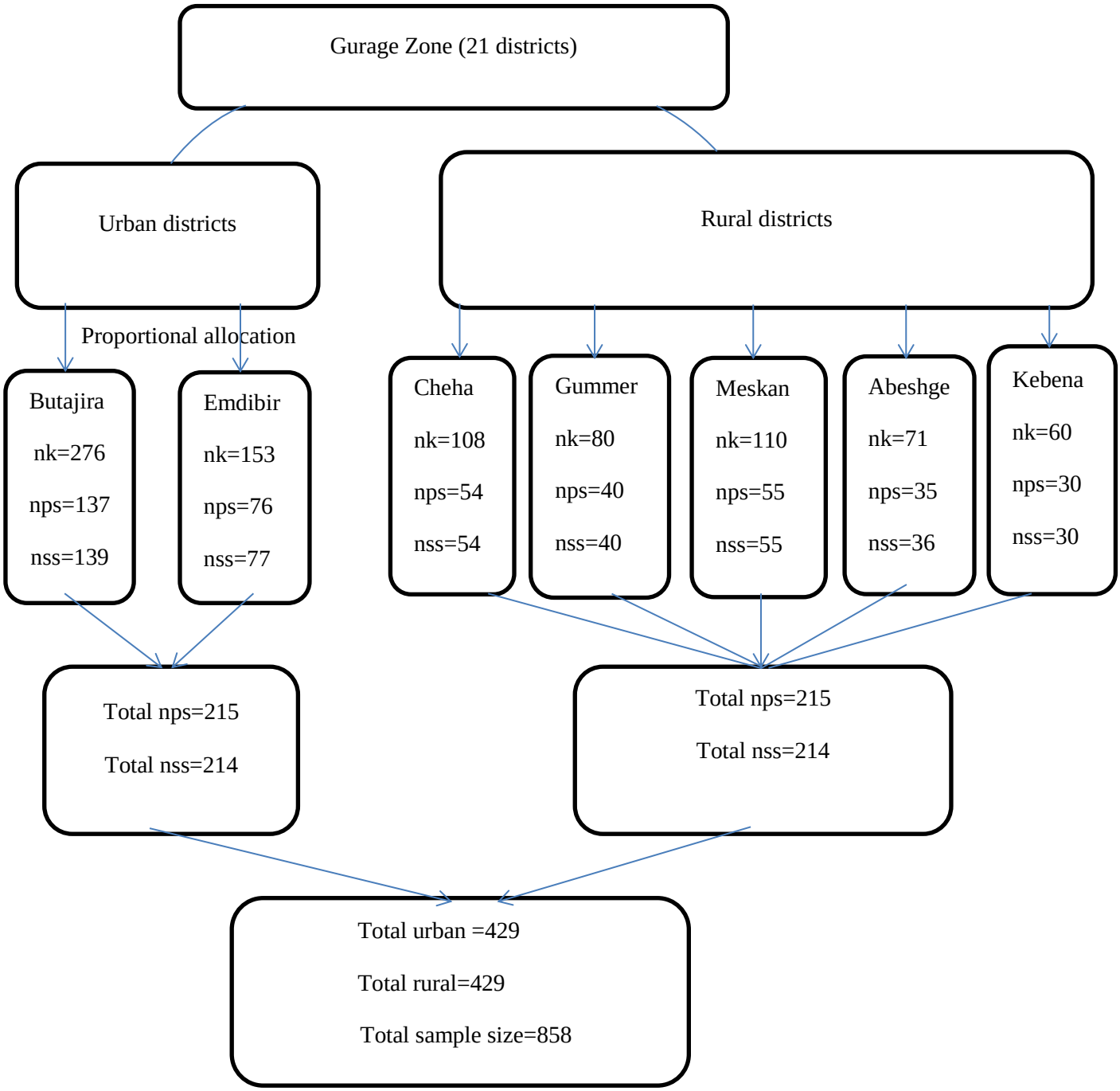


Figure 2 Schematic presentation of sampling procedure for under nutrition and associated factors among adolescent girls attending schools in urban and rural schools of Gurage zone, 2022(Where nk=total sample size required for each district, nps=required sample size from primary schools and nsss=required sample size from secondary schools).

4.6. Study variables

4.6.1. Dependent variable

- Nutritional status (thinness and stunting)

4.6.2. Independent variables

Socio –demographic and economic factors

- Age
- Ethnicity
- Occupational status of father
- Religion
- Mother's educational status
- Marital status
- Level of education
- Occupational status of mother
- Family size
- Father's educational status
- Wealth index class

Dietary related factors

- Meal frequency
- Dietary diversity

Environmental condition

- Source of drinking water
- Latrine availability
- Waste disposal
- Water treatment
- Hand washing

Health related condition

- Menstruation began
- Age at 1st menarche
- Diarrhea

Health and nutrition information

- Mass media

4.7. Operational definition

- **Adolescents**: individuals in the age group of 10–19 years of age (1).
  - **Early adolescents**: adolescents in the age group of10–13years of age(1).
  - **Middle adolescents**: adolescents in the age group of 14–16yearsofage (1).
  - **Late adolescents**: adolescents in the age group of 17–19years of age(1).
- **Thinness**: BMI-for-age <-2z score (4–6).
- **Stunting**: height-for-age<-2z score (4–6).
- **Poor dietary diversity**: adolescent girls who consumed (<5 food groups) from the ten food items in the previous 24-hours (45).
- **Improved source of water**: Include piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, and rainwater (21). .
- The variable mass media exposure was constructed from the frequencies of reading newspapers/magazines, watching television, and listening to radio together (46). Accordingly:
  - ✓ **not exposed**: All the three indicators are zero (Not at all)(42) .
  - ✓ **Lowest exposed**: the highest value of all the three indicators is 1, i.e., exposed less than once a week to any one or all of the indicators(42) .
  - ✓ **Moderately Exposed**: the highest value of all the three indicators is 2, i.e., exposed at least once a week to any one or all of the indicators(42) .
  - ✓ **Very often exposed**: the highest value of all the three indicators is 3, i.e., very often exposed to any one or all of the indicators(42) .
- **Urban**: per the Ethiopian urban planning law, an urban center is a locality with a minimum population size of 2000 inhabitants, at least 50% of whom are engaged in non-agricultural activities (44).
- **Water treatment**: adding bleach, boiling, filtration, if the household used either of them were taken as using appropriate water treatment methods, and if the household used neither of them considers inappropriate water treatment(47).

4.8. Data collection tool and procedure

Interviewer- administered pre-tested structured questionnaire along with anthropometric measurements was used to collect data. The questionnaires were prepared after reviewing different literatures.(41–43).The tool includes information on socio-demographic and economic condition, environmental factors, health related factor, nutrition information factors and dietary-related factors. Stadiometers with a sliding headpiece attached to a digital weight scale was used to measure height and weight, respectively. Height was measured to the nearest 0.1cm while weight to the nearest 0.1kg in standing position. Each participant was weighed with minimum clothing and no footwear. The study participant's wealth status was assessed by using questionnaire adopting from Ethiopian Demographic and Health Survey, 2016 (EDHS). Minimum dietary diversity (MDD) was assessed by interviewing participants to report how many of the 10 food items they consumed in the previous 24 hours before the survey. Dietary diversity questionnaires were prepared based on Food and Agricultural Organization (FAO) guideline 2016. Two supervisors who have second-degree in public health and six data collectors who have first-degree/diploma in nursing/HEW were involved in the data collection process. The data was collected from the schools where students are found.

4.9. Data quality management

The questionnaire was prepared first in English and then translated to Amharic and back to the English language to check its consistency. Two days training was provided to data collectors and for supervisors. During the data collection time, close supervision and monitoring was carried out by supervisors to insure the quality of the data. Pre-test was done among 5% of the samples in rural and urban schools among Gurage zone district schools before the actual data collection was commenced. The scales were carefully handled and periodically calibrated by placing standard calibration weights of 2kg iron bars on the scale. Furthermore, social desirability bias was attempted to reduce through interviewing the participants relatively in privacy secured area. Likewise, recall bias was tried to minimize by asking what kind of food items they consumed in each mealtime (breakfast, lunch, snack, and dinner. The collected data was manually checked for

completeness, consistency, and clarity on daily basis by the principal investigator and supervisors

4.10. Data analysis

Data was cleaned, coded, and entered to Epi-data version 4.6 and was exported to SPSS version 21 statistical packages for statistical analyses. Anthropometric measurements were converted to height-for-age z scores and BMI-for-age z scores using the world health organization Anthroplus software version 1.0.4. The income status was analyzed through PCA. Descriptive summary statistics was carried out to describe study participants according to different characteristics by using table. Bivariate logistic regression analysis was done to check the association between individual explanatory and outcome variables. Then, a variable with a p-value of less than 0.25 were considered for multivariable logistic regression analysis. In the multivariable analysis, a p-value of less than 0.05 and an odds ratio with 95% CI were used to declare the presence and the strength of association between the independent and outcome variable. The Hosmer and Lemeshow test was used to diagnose the model fitness and the model was adequate.

4.11. Ethical considerations

Ethical approval of the research proposal was obtained from Institutional Health Research Ethics Review Committee (IHRERC) of Wolkite University. Then, Permission letter was taken from Gurage Zonal Education department to each selected districts education office and from selected education office to the selected schools. Finally an official permission letter was obtained from each school to proceed with the data collection. Participation was after both informed consent and assent was obtained. The purpose and the importance of the study was explained, and verbal informed consent was secured. Voluntary engagement and confidentiality were retained to facilitate detailed and truthful self-disclosure.

5. Result

5.1 Socio-demographic and economic characteristics

A total of 837 adolescent girls with response rate of 97.5 % were participated. Half (51.4%) of adolescent girls were middle adolescent age group. Regarding family sizes, 283(67.1%) in urban and 209 (50.4%) in rural schools adolescents were live in family size of five and below (table 2).

Table 2: Socio-demographic and economic characteristics of study participants in rural and urban schools of Gurage zone, Southern Ethiopia, 2022(n=837).

Variables	Categories	Schools		
		Urban ,n(%) 422(50.4)	Rural(%) 415(49.6)	Total N,(%) 837(100)
Age category	Early adolescent(10-13)	235(55.7)	89(21.4)	324(38.7)
	Middle adolescent(14-16)	184(43.6)	246(59.3)	430(51.4)
	Late adolescent(17-19)	3(0.7)	80(19.3)	83(9.9)
Family Size	Less or equal to 5	283(67.1)	209(50.4)	492(58.8)
	Greater than 5	139(32.9)	206(49.6)	345(41.2)
Religion	Muslim	202(47.9)	270(65.1)	472(56.4)
	Orthodox	181(42.9)	118(28.4)	299(35.7)
	Protestant	35(8.3)	23(5.5)	58(6.9)
	Others specify	4(0.9)	4(1)	8(1.0)
Ethnicity	Gurage	358(84.8)	355(85.5)	713(85.2)
	Oromo	2(0.5)	1(0.2)	3(0.2)
	Kebena	20(4.7)	41(9.9)	61(7.3)
	Amhara	28(6.6)	18(4.3)	46(5.5)
	Other	14(3.3)	0(0)	14(1.7)
Marital status	Single	422(100)	415(100)	837(100)
	Married	0(0)	0(0)	0(0)
Level of	Primary	404(95.7)	311(74.9)	715(85.4)

education	Secondary	18(4.3)	104(25.1)	122(14.6)
	Unable to read and write	71(16.8)	74(17.8)	145(17.3)
	Read and write	101(23.9)	128(30.8)	229(27.4)
Father's educational status	Primary school	126(29.9)	144(34.7)	270(32.3)
	Secondary school	55(13.0)	56(13.5)	111(13.3)
	College and above	69(16.4)	13(3.1)	82(9.8)
	Jobless	49(11.6)	15(3.6)	64(7.6)
	Government employed	86(20.4)	29(7)	115(13.7)
	Privet employed	44(10.4)	24(5.8)	68(8.1)
Father's Occupational status	Daily labourer	34(8.1)	46(11.1)	80(9.6)
	Merchant	127(30.1)	30(7.2)	157(18.8)
	Farmer	68(16.1)	241(58.1)	309(36.9)
	Other	14(3.3)	30(7.2)	44(5.3)
	Unable to read and write	112(26.5)	98(23.6)	210(25.1)
	Read and write	69(16.4)	126(30.4)	195(23.3)
Mother's educational status	Primary school	145(34.4)	161(38.8)	306(36.6)
	Secondary school	49(11.6)	22(5.3)	71(8.5)
	College and above	47(11.1)	8(1.9)	55(6.6)
	House wife	252(59.7)	276(66.5)	528(63.1)
	Government employed	74(17.5)	12(2.9)	86(10.3)
Mother's Occupational status	Privet employed	13(3.1)	13(3.1)	26(3.1)
	Daily labourer	10(2.4)	13(3.1)	23(2.7)
	Merchant	68(16.1)	97(23.4)	165(19.7)
	Other specify	5(1.2)	4(1.0)	9(1.1)
	Lower class	174(41.2)	106(25.5)	280(33.5)
Wealth class	Middle class	97(23.0)	198(47.7)	295(35.2)
	Upper class	151(35.8)	111(26.7)	262(31.3)

5.2 Dietary related factors

Majority, 362(85.5%) of urban and 321(77.3%) of rural adolescent girls were ate three and more meal per day. Regarding 24 hours dietary score for assessing Minimum Dietary Diversity, the overall proportion of adolescent girls with good dietary diversity score (at least consumed five food groups out of ten food groups) was 349 (82.7%) and 329(79.3%) for urban and rural respectively (Table 3).

Table 3: Dietary related characteristics of adolescent girls attending schools in rural and urban schools of Gurage zone, Southern Ethiopia, 2022(n=837).

Variables	Categories	Schools		
		Urban ,n(%) 422(50.4)	Rural, n(%) 415(49.6)	Total 837, (%)
Meal frequency	Greater or equal to3 times per day	362(85.8)	321(77.3)	683(81.6)
	Less than 3 times per day	60(14.2)	94(22.7)	154(18.4)
24 hours dietary score for assessing Minimum Dietary Diversity (MDD)	Good dietary diversity	349(82.7)	329(79.3)	678(81.0)
	Poor dietary diversity	73(17.3)	86(20.7)	159(19.0)

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5.3 Environmental conditions

The majority of the adolescents, 328(77.7%) in urban schools were used private pipe for drinking water, while 256(61.7%) of rural adolescent girls were used public tabs .Nearly, both urban and rural adolescent girls have similar proportion of functional latrine at their home, 400(94.8%) and 398(95.9%) in urban and rural respectively. More than three fourths, 385(91.2%) of urban and 73(17.6%) adolescents had waste disposal system at their home. Regarding to hand washing, 331(78.4%) of urban and 326(78.6%) of rural adolescent girls had the habit of washing their hand after toilet (Table 4).

Table 4: Environmental related characteristics of adolescent girls attending schools in rural and urban schools of Gurage zone, Southern Ethiopia.2022(n=837)

Variables	Categories	Schools		Total N,(%) 837(100)
		Urban ,n(%) 422(50.4)	Rural(%) 415(49.6)	
Source of drinking water	private pipe	328(77.7)	4(1.0)	332(39.7)
	private well	3(0.7)	100(24.1)	103(12.3)
	Public tap	76(18.0)	256(61.7)	332(39.7)
	River	0(0.0)	46(11.1)	46(5.5)
	Others	15(3.6)	9(2.2)	24(2.9)
Availability Of Latrine	Yes	400(94.8)	398(95.9)	798(95.3)
	No	22(5.2)	17(4.1)	39(4.7)
Availability Of Waste Disposal System	Yes	385(91.2)	73(17.6)	458(54.7)
	No	37(8.8)	342(82.4)	379(45.3)
Application of Water Treatment	Yes	75(17.8)	135(32.5)	210(25.1)
	No	347(82.2)	280(67.5)	627(74.9)
Distance From Water Source	Less or equal to 30 meters	321(76.1)	10(1.2)	331(39.5)
	Greater than 30 meters	101(23.9)	405(48.4)	506(60.5)
Habit Of Hand Washing After Toilet	Yes	331(78.4)	326(78.6)	657(78.5)
	No	91(21.6)	89(21.4)	180(21.5)

5.4 Health and nutrition related information.

Only nine (2.1%) from urban and 12(2.9%) of rural adolescent girls had very often exposed nutrition information .More than half 233 (55.2%) of girls from urban and 321(77.3%) in rural were began to see menstruation. Nearly half of adolescent girls from both urban 155(66.5%) and 168(52.3%) rural schools had started their first menarche with in the age range of 11-13. Regarding to diarrhea, 31 (7%) from urban and 55(13.3%) from rural had diarrhea in the last two weeks (Table 5).

Table 5: Health related and nutrition information characteristics of adolescents attending schools in rural and urban schools of Gurage zone, Southern Ethiopia, 2022(n=837)

Variables	Categories	Schools		Total N,(%) 837(100)
		Urban ,n(%) 422(50.4)	Rural(%) 415(49.6)	
Nutrition related information				
Mass Media Exposure	Not exposed	90(21.3)	68(16.4)	158(18.9)
	Lowest exposed	284(67.3)	261(62.9)	545(65.1)
	Moderately exposed	39(9.2)	74(17.8)	113(13.5)
	Very often exposed	9(2.1)	12(2.9)	21(2.5)
Health related characteristics				
Beginning of Menstruation	Yes	233(55.2)	321(77.3)	554(65.0)
	No	189(44.8)	94(22.7)	283(33.8)
Age At First Menarche	Age 11-13	155(66.5)	168(52.3)	323(58.3)
	Age 14-15	72(30.6)	147(45.8)	219(39.5)
	Age 16-19	6(2.9)	6(1.9)	12(2.2)
Occurrence of diarrhoea In Last Two Weeks	Yes	31(7.)	55(13.3)	86(10.3)
	NO	391(92.7)	360(86.7)	751(89.7)

5.5 Prevalence of undernutrition

The overall prevalence of thinness and stunting among adolescent girls were 6.3% (95% CI: 4.8–8.0) and 8.6% (95% CI: 6.7–10.8) respectively. The prevalence of thinness was nearly similar to urban 6.4% (95% CI: 4.3–8.5) and rural 6.0% (95% CI: 3.9–8.4) schools whereas the prevalence of stunting was higher among rural adolescent girls 10.1% (95% CI: 7.0–13.0) than urban 7.1% (95% CI: 4.7–9.7).

5.6 Factors associated with thinness

In the bivariate logistic regression analysis, a variable with a p-value of less than 0.25 were considered for multivariable logistic regression analysis. Accordingly, family size, meal frequency, dietary diversity, availability of latrine, availability of waste disposal system, use of water treatment, distance from water source, habit of hand washing, diarrhea and wealth index in urban school girls and family size, meal frequency, dietary diversity, availability of latrine, availability of waste disposal system, distance from water source, habit of hand washing, and beginning of menstruation in rural schools were associated with thinness. In the multivariate logistic regression, dietary diversity, diarrhea and family size in urban and dietary diversity, habit of hand washing and beginning of menstruation in rural school girls were significantly and independently associated with thinness in p-value of <0.05.

In urban schools, adolescent girls who had poor dietary diversity were 4.7 times more likely to be thin as compared to those who had good dietary diversity in the past 24 hour preceding the survey [AOR = 4.7, (95% CI: 1.11,19.90)]. Having illness had also a significant association with thinness, adolescents who had diarrhea within fifteen days prior to the study were 17 times more likely to be thinner than their counterparts [AOR=16.97, (95% CI: 5.79, 49.77)].Family size was negatively associated with thinness[AOR=0.2 , (95% CI: 0.41,0.90]. (Table 6)

Table 6: Logistic regression analysis of factors associated with thinness among adolescent girls attending schools in urban schools of Gurage zone, Southern Ethiopia, 2022.

Variables	Categories	BMI			
		Thin, n (%)	Not thin, n (%)	COR (95% CI)	AOR (95% CI)
Number of family lived in HH	Less or equal to 5 Members	14(51.9)	269(68.1)	1	1
	>5 Members	13(48.1)	126(31.9)	1.98(0.9-4.34)	0.19(0.41-0.90)
Dietary diversity	Good dietary diversity	10(37.0)	339(85.8)	1	1
	Poor dietary diversity	17(63.0)	56(14.2)	10.29(4.48-23.61)	4.70(1.11-19.9)
Occurrence of diarrhea in last 2 weeks	Yes	13(48.1)	18(4.6)	19.44(7.98-47.39)	16.97(5.79-49.77)
	No	14(51.9)	377(95.4)	1	1

In rural schools, adolescent girls who had poor dietary diversity were 5 times more likely to be thin as compared to those who had good dietary diversity in the past 24 hour (AOR = 5.02, 95% CI: 1.54, 16.33).Adolescent girls who did not wash their hands after toilet and before eating were almost 4 times more likely to be thinned as compared to those adolescents who did wash their hands [AOR =4.06, 95 % CI = 1.34, 12.31]. Beginning of menstruation was negatively associated with thinness (AOR = 0.07, 95% CI: 0.02, 0.21). Adolescent girls who began menstruation early were 93% less likely to be thin than their counterpart. (Table 7)

Table 7: Logistic regression analysis of factors associated with thinness among adolescent girls attending schools in rural schools of Gurage zone, Southern Ethiopia, 2022

Variables	Categories	BMI			
		Thin, n (%)	Not thin, n (%)	COR (95% CI)	AOR (95% CI)
Dietary diversity	Good dietary diversity	10(40.0)	319(81.8)	1	1
	Poor dietary diversity	15(60.0)	71(18.2)	6.73(2.90-15.61)	5.02(1.54-16.33)
Habit of hand washing after toilet	Yes	8(32.0)	318(81.5)	1	1
	No	17(68.0)	72(18.5)	9.38(3.89-22.59)	4.06(1.34-12.31)
Beginning of Menstruation	Yes	6(24.0)	315(80.8)	0.07(0.03-0.20)	0.07(0.02-0.21)
	No	19(76.0)	75(19.2)	1	1

5.7 Factors associated with stunting

In the bivariate logistic regression analysis, a variable with a p-value of less than 0.25 were considered for multivariable logistic regression analysis. Accordingly, age of adolescents, family size, meal frequency, dietary diversity, availability of latrine, availability of waste disposal system, use of water treatment, distance from water source, habit of hand washing, beginning of menstruation ,age at menarche, diarrhea and wealth index in urban and family size, meal frequency, dietary diversity, availability of latrine, availability of waste disposal system, habit of hand washing, age at menarche, diarrhea and wealth index in rural school girls were associated with stunting. In the multivariate logistic regression, hand washing in urban and dietary diversity, availability of waste disposal system and age at menarche in rural school girls were significantly and independently associated with stunting in p-value of <0.05.

Adolescents who did not wash their hands after toilet and before eating were almost 16 times more likely to be stunted compared to those adolescents who did wash their hands [AOR =15.77, (95 % CI = 1.11, 22.4)].

In rural schools, adolescent girls who had poor dietary diversity were 10 times more likely to be stunted as compared to those who had good dietary diversity in the past 24 h preceding the survey [AOR = 10.07, (95% CI: 3.24,31.24)]. Adolescent girl students who didn't have waste

disposal system were 3.6 times more likely to be stunting than those have [AOR = 3.63, (95% CI: 1.07, 12.24)]. Early age at menarche was negatively associated with stunting in rural adolescent girls, [(AOR = 0.02, (95% CI: 0.001, 0.29)]. (Table 8)

Table 8: Logistic regression analysis of factors associated with stunting among adolescent girls attending schools in urban schools of Gurage zone, Southern Ethiopia, 2022.

Variables	Categories	Stunting			
		Stunted, n (%)	Not stunted, n (%)	COR (95% CI)	AOR (95% CI)
Habit of hand washing after toilet	Yes	13(48.1)	318(80.5)	1	1
	No	14(51.9)	77(19.5)	46.12(13.58-156.6}	15.77(1.11-22.4)

Table 9 Logistic regression analysis of factor associated with stunting among adolescent girls attending in rural schools of Gurage zone, Southern Ethiopia.

Variables	Categories	Stunting			
		Stunted, n (%)	Not stunted, n (%)	COR (95% CI)	AOR (95% CI)
Dietary diversity	Good dietary diversity	8(19.00)	321(86.1)	1	1
	Poor dietary diversity	34(81.0)	52(13.9)	26.23(11.5-59.8)	10.07(3.24-31.24)
Availability of waste disposal system	Yes	22(52.4)	320(85.8)	5.48(2.80-10.74)	3.63(1.07-12.24)
	No	20(47.6)	53(14.2)	1	1
Age At First Menarche	Age 11-13	15(42.9)	153(43.5)	0.1(0.02-0.52)	0.02(0.001-0.29)
	Age 14-15	17(48.6)	130(45.5)	7.6(1.42-40.95)	0.04(0.002-0.56)
	Age 16-19	3(8.6)	3(1.0)	1	1

6. Discussions

This study was aimed on studying the prevalence and associated factors of undernutrition (stunting and thinness) and its disparities among urban and rural adolescent girls attending schools in Gurage zone, Southern Ethiopia.

The overall prevalence of thinness was lower than study conducted at Damote sore districts, Southern Ethiopia, 19%[40], Afar Regional state, Megale district 15.8%[8], National level survey 14%[38], Africa 12.5%[28],Asembo and Mumias, kenya 15.6% [37], South Asia 41% [28] and global prevalence 8.4% [27]. The justification for the study conducted at Afar Regional state, study was entirely in rural schools, whereas this study was conducted in both urban and rural schools and this could reduce the prevalence. Where as to the global prevalence, South Asia and Kenya study, there was a time gap between the current study versus these studies; in meantime, there was implementation of different programs, like Sequota Declaration to fight against undernutrition and its determinants. These interventions could reduce the prevalence of this study.

Nevertheless, the prevalence of thinness was higher than a study conducted at Dangla Town 1.4% [41] and Tunisia 1.3% [36] .These studies had conducted entirely on urban schools whereas the current study had conducted in both urban and rural schools; this could make higher prevalence of the current study. However, the prevalence of thinness, 6.2% in Addis Ababa [38] and 6.8% in Hadiya Zone, Soro district [43]; were consistence with this study. This similarity may be due to closer geographical location.

Likewise, this study revealed that the overall prevalence of stunting was 8.6 %(95%CI: 6.7-10.8). The overall prevalence of stunting was lower than study conducted in Damotsore district, Southern Ethiopia,29.6%[40], Afar Regional state, Megale district 26.6%[8],Rural community of northern Ethiopia 12.5%-47.4%[22], Urban area of India 11.7%-34.2%[31-33], rural area of West Bengal 34.20%[34] and Bangladesh 32%[4].

The study conducted at Damotsore district, Southern Ethiopia and Afar Regional state, Megale district were entirely in rural schools, whereas these studies were conducted in both urban and rural schools and this could reduce the prevalence. Furthermore, it might be due to a difference in barriers in stunting such as cultural differences and other socio-demographic

characteristics .As to the rural community of northern Ethiopia's study, there was a time gap between the current study versus study conducted in northern Ethiopia; in meantime, there was implementation of different programs, by governmental and nongovernmental organizations especially in the first two years of life. This intervention could have a direct contribution to improving the nutritional status of adolescents because stunting is due to the effect of malnutrition starting from the first 1000 days. The West Bengal and Rajabanshi India's studies enrolled entirely participants aged from 10 to 14 years-old who are believed to be highly prone to stunting whereas in this study, participants were age from 10 to 19 years old. [34].

The prevalence of thinness among adolescent girls lived in rural and urban was nearly similar; 6.0% (95% CI: 3.9, 8.4) and 6.4 %(95% CI: 4.3, 8.5) respectively. This might be due to almost similar living condition of urban and rural parts of study area. Furthermore the culture, occupation and economic status of both urban and rural area are somewhat similar.

Adolescent girls lived in rural area are more affected by stunting, 10.1% (95% CI: 7.0, 13.0) than those who were lived in urban area 7.1 %(95% CI: 4.7, 9.7). This finding is supported by studies carried out in different areas of the world: a study conducted in Debark district, North West Ethiopia; in rural 24.2% in urban 16%,study in India ranges from 22.7% to 31.5% in rural and 17.6% to 29.4% in urban [31-33], west Bengal India 35.7% in rural and 29.0% in urban [34] and South Asia's ranges from 30 to 60% in rural whereas 15 to 39% in urban [28], This disparity might be due to adolescent girls in urban has a good intake of a diversified diet than their counterpart rural residents [45]. Besides, adolescent girls from rural area were more likely to live in a poor socioeconomic condition that might affect their dietary intake.

Similarly, poor health-seeking behavior in the rural residents might limit them from gaining access to nutrition services [45]. Intestinal parasitic infections are also common in rural inhabitant that would lead them to malabsorption, anemia, and other problem [16]. In general, this finding indicated that adolescent girls from rural settings are the more vulnerable to stunting that could further lead them to complications.

A significant association was observed between thinness and dietary diversity among urban adolescent school girls. Being thin was 4.7 and 5 times (urban and rural respectively) more likely higher among adolescent girls with poor dietary diversities as compared to adolescent girls who had good dietary diversity. The finding agrees with studies which were conducted in different parts of Ethiopia like Axum Town[39],Soro district ,Hadiya zone,[43] , rural Tigray region [29]. This might be due to the fact that increased demands of nutrients during adolescent period could lead to thinness if dietary diversity is inadequate.

Urban adolescents girls who had diarrhea within fifteen days prior to the study were 17 times more likely to be thin than their counterparts. This finding was in line with study conducted at Dangila Town [41].Diarrhea plays a major role in the etiology of under nutrition because of diarrhea results in high energy expenditure, lower appetite, disruption of metabolic equilibrium, nutrient losses and mal-absorption[21,47]..

Rural adolescent girls who did not wash their hands after toilet and before eating were 4 times more likely to be thin as compared to those adolescents who did wash their hands. This finding was in line with the study findings in Dangila Town [41]. Hand washing practice is essential to prevent diarrhea and other feco-oral diseases, which in turn may contribute to the nutrition interventions. Adolescent girl students who began menstruation were 93% less likely to be thin than those who did not begin menstruation .This finding is in line with the finding of other previous study done in Axum Town.[39] This might be because early commencement in menstruation status is an indicator of good nutritional status. Family size was negatively associated with thinness in urban adolescent girls.

The odds of being stunted were 10 times more likely higher among rural adolescent girls with poor dietary diversities as compared to adolescent girls who had good dietary diversity. The finding agrees with study which was conducted in rural Tigray region [29]. This might be due to the fact that increased demands of nutrients during adolescent period could lead to stunting if dietary diversity is inadequate.

Urban adolescent girls who did not wash their hands after toilet and before eating were 15.8 times more likely to be stunted as compared to those adolescents who did wash their hands. This finding was in line with the study findings in Dangila Town [41]. Hand washing

practice is essential to prevent diarrhea and other fec-oral diseases, which in turn may contribute to the nutrition intervention.

Significant association was observed between stunting and waste disposal system in rural adolescent girls .Rural adolescent girls who didn't have waste disposal system were 3.6 times more likely to develop stunting as compared to having waste disposal system. Such an association was not surprising. In areas where there is scarcity of proper waste disposal facilities, bare foot walking may serve as a means of contracting parasitic infections and in turn leads to undernutrition. Age at menarche was negatively associated with stunting in rural adolescent girls. Adolescent girls who began menstruation early were 93% less likely to be thin than their counterpart. This finding is in line with the finding of other previous study done in Axum [39]. This might be because early commencement in menstruation status is an indicator of good nutritional status. The finding of this study implies that adolescent undernutrition is a public health concern which needs development and strengthening of nutrition interventions .Furthermore, stunting in rural adolescent girls is more public health concern than urban girls and it needs special attention for their nutrition interventions.

7. Limitation of the study

The recall bias might be happen during assessing the type of foods by adolescents to determine the dietary diversity among them. Obtaining the exact age of the students were challenging due to not knowing the birth date (especially rural adolescent girls), however every options were used to estimate the age of adolescent girls for the study. The data collection period was in post-holiday by Muslim and Christian followers and it might affect dietary diversity factors. Responses of some variables were better to confirmed by observation and may cause information bias.

8. Conclusion and Recommendation

8.1 Conclusion

The prevalence of thinness was nearly similar to both urban and rural adolescent girls. But stunting was higher among rural adolescent girls than urban. Dietary diversity and occurrence of diarrhea were important factors contributing to thinness for urban adolescent girls whereas dietary diversity and hand washing were associated with thinness for rural adolescent girls. Dietary diversity, availability of waste disposal system and age at menarche were associated with stunting in rural adolescent girls whereas hand washing was associated to stunting in urban adolescent girls.

8.2 Recommendation

Attention should be given from government and nongovernmental organizations to increase nutrition sensitive agriculture to focus maintaining of food varieties. Creating awareness for adolescent girls to wash their hands before eating and after toilet, to practice appropriate waste disposal system and to increase their health seeking behavior to treat diarrhea .Finally, further studies shall be done to realize the real cause of the undernutrition among adolescents by using controlled study designs.

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Annexes I: Informed consent

Informed consent agreement form Wolkite University College of medicine and health sciences Department of public health nutrition Postgraduate program Hello. My name is _____ from Wolkite University College of medicine and health sciences, and now I am conducting a survey on undernutrition and associated factors among adolescent girls.

Title: undernutrition and associated factors among adolescent girls attending school in the rural and urban districts of Gurage zone, Southern Ethiopia, 2022.

Purpose/Objective: To do comparative assessment of undernutrition and associated factors among urban and rural adolescent girls in Gurage zone districts.

Participation: You have been selected by chance among other participants.

Potential risk: During the participation of the study, you may waste about 10 minutes. Otherwise, there will no injections, drawing of blood or anybody fluid involved. In general, participating in this study has no potential risks.

Potential benefit: Participating in this study had no direct financial benefits, but you may acquire or increase knowledge related to thinness and associated factors.

Confidentiality and privacy: Participation in this survey is voluntary and you can choose not to take part. All information you give will be confidential and will be used to make a general report. No names will be included in the report and there will be no way to identify you as one of the people who gave information. If you have any questions about the survey, feel free to ask me. For detail information you can contact the investigator through;

Cell phone- 0913104635 and **e-mail**: **tofakmel1@gmail.com.**

Declaration of informed consent: I have read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating and the contact address for any queries. I have

been given the opportunity to ask questions for things that may have been unclear. I was informed that I have the right to withdraw from the study at any time or not to answer any question that I do not want. Therefore, I declare my voluntary consent to participate in this study with my initials (signature)

Signature of respondent's _____Date: _____

Name of School----------level of School: primary----------secondary----------

Interviewer name---------- signature ----------

Supervisors name ---------- ----------signature----------

Checked on date----------

The outcome is (thick one) Complete_____ Incomplete_____

Time interview started---------- Time interview ended----------

Annex III: Structured questionnaire (quantitative) (English)

Part one : socio demographic and economic characteristics

S.no	Question	Answer	Skip to /Remark
101	How old are you?	1.Early adolescent(10-13) 2.Middle adolescent(14-16) 3.Late adolescent(17-19)	
102	No of family live in the HH	1. < or equal to 5 2. Greater than 5	
103	What is your religion	1.Muslim 2.Orthodox 3.Catholic 4.protestant 5.Others specify	
104	Ethnicity	1.Gurage 2.Oromo 3.Amhara 4.Other	

105	Marital status	1.Single 2.married	
106	Level of education	1.Primary 2.Secondary	
107	Father's educational status	1.Unable to read and write 2. Read and write 3. Primary school 4. Secondary school 5. College and above	
108	Occupational status of Father	1. Government employee 2. Farmer 3. Daily laborer 4. Merchant 5.Other specify	
109	Mother's educational status	1.Unable to read and write 2. Read and write 3. Primary school	

		4. Secondary school 5. College and above	
110	Occupational status of mother	1. House wife 2 .Government employed 3.Privet employed 4.NGO employed 5.Daily laborer 6.Merchant 7.Other specify	
111	House hold Wealth class(assessed by questionnaire)	Use the following questionaire	

Questionnaire for assessing wealth index for rural house holds

S.N	Question	Available Yes = 1 No= 0
111.1	Does your household have own farming land and size?	___ yes (1) ___ no (0)
111.2	……Improved Latrine?	___ yes (1) ___ no (0)
111.3	……Kitchen?	___ yes (1) ___ no (0)
111.4	…… Cows?	___ yes (1) ___ no (0)
111.5	……Animal transport?	___ yes (1) ___ no (0)
111.6	……Safe source of drinking water?	___ yes (1) ___ no (0)
111.7	……Ownership of farm animals?	___ yes (1) ___ no (0)
111.8	…..Separate room for sleeping from animals?	___ yes (1) ___ no (0)
111.9	…..Hens?	___ yes (1) ___ no (0)
111.10	….Sheep/got?	___ yes (1) ___ no (0)
111.11	……Telephone (mobile)?	___ yes (1) ___ no (0)
111.12	……Radio?	___ yes (1) ___ no (0)
111.13	……Wood for cooking?	___ yes (1) ___ no (0)

Questionnaire for assessing wealth index for urban house holds

S.N	Question	Available Yes = 1 No= 0
111.01	Does your household have: electricity?	___ yes (1) ___ no (0)
111.02	…… a television?	___ yes (1) ___ no (0)
111.03	…….. Vehicle for transportation?	___ yes (1) ___ no (0)
111.04	…… … a refrigerator?	___ yes (1) ___ no (0)
111.05	…… an electric mitad?	___ yes (1) ___ no (0)
111.06	… a bed with cotton/sponge/spring mattress?	___ yes (1) ___ no (0)
111.07	…… Cabinet?	___ yes (1) ___ no (0)
111.08	…… Table?	___ yes (1) ___ no (0)
111.09	….. Chair?	___ yes (1) ___ no (0)
111.10	….. Sofa?	___ yes (1) ___ no (0)
111.11	…. Does any member of your household have a bank account?	___ yes (1) ___ no (0)
111.12	……Pit latrine?	___ yes (1) ___ no (0)
111.13	……STOVE for cooking food?	___ yes (1) ___ no (0)
111.14	……Drinking water of Piped to yard?	___ yes (1) ___ no (0)

Part two: Dietary related factors

S no	Question	Response	
201	Meal frequency	1.>or equal to3 times per day 2.<3 times per day	
202	Dietary diversity(summarized by the following questionnaire)	1.Good dietary diversity 2 Poor dietary diversity	

24 hours dietary score for assessing Minimum Dietary Diversity (MDD)

S.N	Food categories	Description/examples to be adapted Consult Appendix 2 and replace the example foods below with items commonly consumed in the survey area(s)	Consumed Yes = 1 No= 0
202.1	Foods made from grains	Porridge, bread, rice, pasta/noodles or other foods made from grains	___ yes (1) ___ no (0)
202.2	White roots and tubers and plantains	White potatoes, white yams, manioc/cassava/yucca, cocoyam, taro or any other foods made from white-fleshed roots or tubers, or plantains	___ yes (1) ___ no (0)
202.3	Pulse	Mature beans or peas (fresh or dried	___ yes (1)

	s (beans, peas and lentils)	seed), lentils or bean/pea products, including hummus, tofu and tempeh	___ no (0)
202.4	Nuts and seeds	Any tree nut, groundnut/peanut or certain seeds, or nut/seed “butters” or pastes	___ yes (1) ___ no (0)
202.5	Milk and milk products	Milk, cheese, yoghurt or other milk products but NOT including butter, ice cream, cream or sour cream	___ yes (1) ___ no (0)
202.6	Meat ,poultry and fish	Beef, pork, lamb, goat, rabbit, wild game meat, chicken, duck or other bird	___ yes (1) ___ no (0)
202.7	Eggs	Eggs from poultry or any other bird	___ yes (1) ___ no (0)
202.8	Dark green leafy vegetables	List examples of any medium-to-dark green leafy vegetables, including wild/foraged leaves	___ yes (1) ___ no (0)
202.9	Vitamin A-rich vegetables,	Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside (see Appendix 2 for other less-common vitamin A-rich vegetables) and List examples of any other vegetables	___ yes (1) ___ no (0)

	roots ,tubers and Other vegetables		
202.10	Vitamin A-rich fruits and Other fruits	Ripe mango, ripe papaya (see Appendix 2 for other less-common vitamin A-rich fruits) and List examples of any other fruits	___ yes (1) ___ no (0)

Part Three: Environmental conditions

S no	Question	Response	Skip to/remark
301	What is your main source of drinking water	1.private tap 2.private well 3. public tap 4.Other specify	
302	Do you have latrine	1.Yes 2.No	
303	Do you have waste disposal system?	1.Yes 2.No	

304	Do you treat water before use?	1.yes 2.No	
305	water source distance	1. < or equal to 30 meter 2. Greater than 30 meter	
306	Hand washing after toilet	1.Yes 2.No	

Part Four: Health and nutrition information factors

S no	Question	Response	
401	Mass media exposure(summarized by the following questionnaire)	1. Not exposed 2. Lowest exposed 3. Moderately Exposed 4. Very often exposed	
401.1	Mass media exposure	1.Do you read newspapers/magazines? 2. Do you watch television? 3. Do you listen a radio?	

Part Five: Health-related factors

S no	Question	Response	
501	Menstruation began	1.yes 2.No	

502	Age at first menstruation	1) 11 to13 2) 14 to 15 3) 16 to 17	
503	Diarrhea	1. Yes 2. No	

Part Six: Anthropometric measurement

S no	Question	Response	
601	Age of adolescent	In number----------	
602	Weight of adolescent	In kg----------	
603	Height of adolescent	In cm----------	
604	Knee height(only for those having kyphosis and scoliosis)	In cm----------	

Annex III: የስምምነት መግለጫ ፎርም - በአማርኛ

ወልቂጤ ዩኒቨርሲቲ ህክምናና ጤና ሳይንስ ኮሌጅ

የስርዓተ-ምግብ ትምህርት ክፍል የድህረ-ምረቃ ፕሮገራም

እንደምን አደራችሁ/ዋላችሁ! ስሜ……እባላለው።በአሁኑ ሰኣት የኮረዳ ሴቶች ስርዓተ ምግብ በተመለከተ እድሚአቸው ከ10 እስከ 19 አመት ድረስ ባሉት ተማሪዎች ላይ ጥናት እያካሄድኩ ነው።እርስዎ ከሌሎች የጥናቱ ተሳታፊዎች ውስጥ በእድል ነው የተመረጡት፤ስለዚህ ከጥናቱ ጋር የተያያዙ ጥያቄዎችን እጠይቀዎታልሁ። በጥናቱ ለመሳተፍ የርእስዎ ፈቃደኝነት ነው፤ካልተመቸዎ መጠይቁን ማቋረጥ ይችላሉ።በዚህ ጥናት መሳተፍ ምንም አይነት ገንዘብ አያስገኝም።ነገር ግን በዚህ ጥናት መሳተፍ ስለ ስርዓተ ምግብ እና ተያያዥ ሁኔታዎች ጋር በተያያዘ እውቀት ያገኛሉ ወይም ያለዎትን እውቀት ያዳብራሉ።በዚህ ጥናት መርፌ መውጋት የለም፣ደምም ሆነ ማንኛውም የሰውነት ፈሳሽ አይወሰድም።ከርስዎ የሚወሰደው ማንኛውም መረጃ ምስጢራዊ እና ለሌሎች ማህበረሰብም ማጠቃለያ ሪፖርትነው።ሪፖርት ሲደረግ ስም አይፃፍም፤እንዲሁም እርስዎ መረጃውን እንደሰጡ አይገለፅም።ጥያቄ ካለዎት ያለምንም ፍርሃት በግልፀኝነት መጠየቅ ይችላሉ። ለተጨማሪ መረጃ በዚህ ማግኘት ይችላሉ። ስ.ቁ *0913104635* ኢሜል tofakmel1@gmail.com

ብቀጥል ምን ይመስለዎታል? 1. ይቻላል 2. አይቻልም

የተጠያቂ ፊርማ……..…… ቀን……

ቃለ-መጠይቅ አድራጊ ስም……ፊርማ……..

የተቆጣጣሪ ስም……..……..ፊርማ……

መጠይቁ የተረጋገጠበት ቀን……..…

መጠይቁ ሙሉ ነው……..ሙሉ አይደለም……

IV: መጠይቅ - አማርኛ ቅጽ

ክፍል አንድ ኢኮኖሚያዊና እና ማህበራዊ ሁኔታዎች በተመለከተ

ተ.ቁ	ጥያቄ	መልስ	ምርመራ
101	እድሜሽ ስንት ነው?	1.የመጀመርያ የጉርምስና እድሜ(10-13) 2.የመካከለኛ የጉርምስና እድሜ(14-16) 3.የመጨረሻ የጉርምስና እድሜ(17-19)	
102	የቤተሰብ አባላት ብዛት?	1. 5 እና ከ5 በታች 2. ከ5 በላይ	
103	ሀይማኖት?	1.ሙስሊም 4.ሌላ ካለ ይገለፅ 2.ኦርቶዶክስ 3.ፕሮቴስታንት	
104	ብሄር?	1.ጉራጌ 4.አማራ 2.ቀቤና 5.ሌላ ካለ ይገለፅ 3.ኦሮሞ	
105	የጋብቻ ሁኔታ ?	1.ያላገባች 2.ያገባች	
106	የትምህርት ደረጃ ?	1.የመጀመሪያ ደረጃ (5-8ኛ ክፍል የተማረች) 2.ሁለተኛ ደረጃ (9-12ኛ ክፍልየተማረች)	

107	የአባት የትምህርት ደረጃ?	1.ያልተማረ /ማንበብ መፃፍ የማይችል 2.ማንበብና መፃፍ የሚችል 3.ከ1-8ኛ ክፍል የተማረ 4.ከ9-12ኛ ክፍል የተማረ 5.ኮሌጅና ከዚያ በለይ የተማረ	
108	የአባት የስራ ዓይነት ?	1.ስራ የሌለዉ 5.ነጋዴ 2.የመንግስት ድርጅት ተቀጣሪ 6.ገበሬ 3.የግል ድርጅት ተቀጣሪ 7.ሌላ ካለ ይገለፅ 4.የቀን ሰራተኛ	
109	የእናት የትምህርት ደረጃ?	1.ያልተማረ ች/ማንበብ መፃፍ የማትችል 2.ማንበብና መፃፍ የምትችል 3.ከ1-8ኛ ክፍል የተማረ ች 4.ከ9-12ኛ ክፍል የተማረች 5.ኮሌጅና ከዚያ በለይ የተማረች	
110	የእናት የስራ ዓይነት?	1.የቤት እመቤት 4.የቀን ሰራተኛ 2.የመንግስት ድርጅት ተቀጣሪ 5.ነጋዴ 3.የግል ድርጅት ተቀጣሪ 6.ሌላ ካለ ይገለፅ	
111	የቤተሰብ የሀብት ደረጃ(መጠይቅ በመሙላት የሚገኝ)	ቀጥሎ በቀረበውን መጠይቅ የሚሞላ	

የቤተሰብ የሀብት መጠን መለኪያ መጠይቅ (ለገጠር ነዋሪዎች)

ተ.ቁ	መጠይቅ መኖሩን ማረጋገጫ	መኖሩን ማረጋገጫ
111.1	……ቤተሰቦችሽ የራሳቸው የሆነ የእርሻ መሬት አላቸው?	አለ = 1, የለም= 0)
111.2	……የተሻሻለ ሽንት ቤት አለ ?	አለ = 1 , የለም= 0
111.3	……ማድ ቤት አለ ?	አለ = 1 , የለም= 0
111.4	…… ከብቶች አሉ?	አለ = 1 , የለም= 0
111.5	……የእንስሳት መጓጓዣ አላችሁ?	አለ = 1 , የለም= 0
111.6	……ንጹህ የመጠጥ ውሀ ?	አለ = 1 , የለም= 0
111.7	……የሚያርስ በሬ?	አለ = 1 , የለም= 0
111.8	…..ሰው እና እንስሳ የተለየ ቤት አለው??	አለ = 1 , የለም= 0
111.9	…..ዶሮ አለ?	አለ = 1 , የለም= 0
111.10	….ፍየል/በግ አለ?	አለ = 1 , የለም= 0
111.11	…ሞባይል ስልክ?	አለ = 1 , የለም= 0
111.12	……ሬድዮ?	አለ = 1 , የለም= 0
111.13	……ማብሰያ እንጨት?	አለ = 1 ,0 የለም

የቤተሰብ የሀብት መጠን መለኪያ መጠይቅ (ለከተማ ነዋሪዎች)

ተ.ቁ	መጠይቅ መኖሩን ማረጋገጫ	መኖሩን ማረጋገጫ አለ = 1፣የለም= 0
111.01	ቤተሰቦችሽ የራሳቸው የሆነ የመብራት ቆጣሪ አላቸው?	አለ = 1 , የለም= 0)
111.02	……ቴሌቭዥን ?	አለ = 1 , የለም= 0
111.03	……መኪና/ሞተር ?	አለ = 1 , የለም= 0
111.04	…..ፍሪጅ?	አለ = 1 , የለም= 0
111.05	…… የኤሌክትሪክ ምጣድ?	አለ = 1 , የለም= 0
111.06	……አልጋ?	አለ = 1 , የለም= 0
111.07	……ካቢኔት/መሳቢያ ?	አለ = 1 , የለም= 0
111.08	……ጠረጴዛ?	አለ = 1 , የለም= 0
111.09	…..ወንበር?	አለ = 1 , የለም= 0
111.10	…..ሶፋ?	አለ = 1 , የለም= 0
111.11	ከቤተሰብ አባላት ውስጥ የባንክ አካውንት ያለው አለ?	አለ = 1 , የለም= 0
111.12	…በሊሽ የተሰራ መጸዳጃ ቤት?	አለ = 1 , የለም= 0
111.13	……ምግብ ማብሰያ ስቶቭ?	አለ = 1 , የለም= 0
111.14	……የሚሰራ የውሀ ቧንቧ?	አለ = 1 ,0 የለም

ክፍል ሁለት ፡የአመጋገብ ሁኔታ በተመለከተ

ተቁ	ጥያቄ	መልስ	ምርመራ
201	በቀን(በ24 ሰዓት) ውስጥ ስንት ጊዜ ትመገቢያለሽ?	1.3 እና ከዚያ በላይ 2.ከ3 በታች	
202	ስንት አይናት ምግብ (ብዛት) ትመገቢያለሽ?	ቀጥሎ በቀረበው መጤቅ የሚሞላ	

የ24 ሰዓት የግለሰብ የአመጋገብ ብዙሃነት

አሁን ደግሞ ባለፉት 24 ሰአት ውስጥ የተዘረዘሩትን የምግብ አይነቶች መመገቦትን ወይም አለመመገቦትን እጠይቆታለው			
ተ.ቁ	የምግብ አይነት/ ክፍሎች	ምሳሌ(ዝርዝር)	የአመጋገብ ሁኔታ 0 ወይም 1
202.1	ከእህል ዘር የሚሰሩ ምግቦች	ማሽላ፤በቆሎ፤ገብስ፤ጤፍ፣ስንዴ፣ገንፎ፣ዳቦ፣ሩዝ፣ፓስታ ወይም ሌሎች ከጥራጥሬ የሚሰሩ ምግቦች	___ አዎ (1) ___ አይ(0)
202.2	ከነጭ ስራስር ምግብ ኤነቶች፣ቀይስር	ነጭ ድንች፣ስካር ድንች፣ቀይስር፣ጎደሬ ወይም ሌሎች የስራስር ምግቦች	___ አዎ (1) ___ አይ(0)
202.3	ከጥራጥሬ የሚሰሩ ምግቦ	የደረቀባቄላ፤የደረቀአተር፤ምስር፤ለውዝ እና ከነዚህየተሰሩምግቦች	___ አዎ (1) ___ አይ(0)
202.4	ለውዝ እና መሰል ጥራጥሬዎች	ለውዝ፤የለውዝ ቅቤ፣ኦቾሎኒ፤ቅቤ	___ አዎ (1) ___ አይ(0)

202.5	ወተት እና የወተት ውጤቶች	አይብ፤እርጎእናሌሎችየወተትውጤቶች(ቅቤን ሳይጨምር)	___ አዎ (1) ___ አይ(0)
202.6	ስጋ እና ዓሳ	ማንኛውምሊበሉየሚችሉበአካባቢየሚገኙስጋ ዎችየበሬስጋ፤የጥጃስጋ፤የፍየልስጋ፤የዶሮስጋናዓ ሳ	___ አዎ (1) ___ አይ(0)
202.7	እንቁላል	ማንኛውምእንቁላል	___ አዎ (1) ___ አይ(0)
202.8	ጥሬአቸውን የሚበሉ ቅጠላቅጠሎች	ጎመን፤ሰላጣ	___ አዎ (1) ___ አይ(0)
202.9	በቫይታሚን ኤ የበለፀጉ ቅጠላቅጠል እና ሌሎች ቅጠላቅተሎች	ቲማቲም፤ሽንኩርትእናሌሎችበአካባቢየሚገኙ ፍራፍሬናቅጠላቅጠሎች	___ አዎ (1) ___ አይ(0)
202.10	በቫይታሚን ኤ የበለፀጉ ፍራፍሬዎች እና ሌሎች ፍራፍሬዎች	ዱባ፤ማነጎ፤ፓፓያ፤ሎሚ፤ብርቱካንናሙዝእናበ አካባቢየሚገኙበበቫይታሚንኤየበለፀጉቅጠላቅ ጠሎች	___ አዎ (1) ___ አይ(0)

ክፍል ሶስት ፡የአካባቢ ሁኔታ የሚዳስስ መጠይቅ

ተቁ	ጥያቄ	መልስ	ምርመራ
301	የመጠጥ ዉሀ ከየት ነዉ የሚያገኙት?	1.የግል ቧንቧ 4. ከወንዝ 2.ከጉድጓድ 5.ከሌላ 3.የህዝብ ቦኖ	
302	ሽንት ቤት አለዎት?	1.አዎ 2.የለኝም	
303	የቆሻሻ አወጋገድ ሰርዓት አለ ?	1.አዎ 2.የለንም	
304	እቤት ውስጥ ውሀ አክመው	1.አዎ 2.አይደለም	

	ይጠቀማሉ?		
305	የውሃ መገኛ ቦታ ከመኖሪያ ቤት ያለው ርቀት	1.30 ሜትር እና ከዚያ በታች 2.ከ30 ሜትር በላይ	
306	ከመጸዳጃ ቤት መልስ እጅን ይታጠባሉ?	1.አዎ 2.አይ	

ክፍል አራት ፡የጤናና የአመጋገብ ስርዓትን በተመለከተ ያላትን የመረጃ

ተ.ቁ	ጥያቄ	መልስ	ምርመራ
401	የጤናና የአመጋገብ ስርዓትን በተመለከተ ያላትን የመረጃ ሁኔታ	1.ጋዜጣ/መጽሄት ታነቢያለሽ? 2.ቴሌቭዥን ትከታተያለሽ? 3.ሬድዮ ታደምጫለሽ?	

ክፍል አምስት ፡ከጤና ጋር በተያያ ጉዳዮች

ተ.ቁ	ጥያቄ	መልስ	ምርመራ
501	የወር አበባ ማየት ጀምረሻል?	1.አዎ 2.አይ	
502	ለመጀመርያ ጊዜ የወር አበባ ማየት የጀመርሽው በስንት አመትሽነው ?	1. 11-13 2. 14-15 3. 16-17	

503	ባለፈው 15 ቀናት ውስጥ ተቅማት ነበረብሽ?	1.አዎ 2.አይ	

ክፍል ስድስት የእድገት ክትትል መለኪያዎች

ተ.ቁ	ጥያቄ	መልስ	ምርመራ
601	የከረዳዋ እድሜ	በቁጥር----------	
602	የከረዳዋ ክብደት	በኪ .ግ----------	
603	የከረዳዋ ቁመት	በሜትር----------	
604	ከጉልበት በታች ያለው እግር ርዝመት(የሰውንት መጉበጥ ላለባቸው ብቻ የሚለካ)	በሜትር----------	