



ARSI UNIVERSITY

COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF PUBLIC HEALTH

Determinants of Breast Cancer among Women Attending Oncology Units at Asella Referral and Teaching Hospital, Southeast Ethiopia

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Abstract

Introduction: Breast cancer represents a malignant growth originating in breast tissue and the most frequent cancer diagnosis among women around the world. In 2020 it shows more than 2.3 million new case and about 685,000 deaths on a globally. The overall load seems to be climbing, especially in low and middle income countries due to late diagnoses along with poor access to treatment and fragile health setups as key reasons for this trend

Objective: To identify the determinants of breast cancer among women attending Asella Referral and Teaching Hospital in Arsi Zone, Asella Town, Etiopia, in 2025.

Methods: A health facility case-control study was conducted among 384 participants (cases=77 confirmed cases and controls=307) from september to October, 2025. A systematic random sampling for controls and consicutive sampling were used for cases. Data were collected via kobotoolbox and card review. Data accuracy was ensured through daily suporvisoin, training and pretest evaluation. Data was exported to SPSS versoin 26, for analysis. Descriptive analysis, bivariate and multivariable logistic regression analysis was conducted to assess the association of determinants factors and breasrt cancer. Adjusted Odds ratio with (95%CI) confidence interval was used to report the association.

Result: Determinants of breast cancer which were significant are rural residency (AOR=2.64 (1.39,5.01), no physical ingagement practice (AOR=2.92(0.93,9.35), BMI 25-29kg/m2 (AOR=6.67(2.17,13,70), low vegetable conseptoin (AOR=1.88(1.08,4.34) postmenopausal status (AOR=1.25(1.04,3.28), history of abortion(AOR=4.01(1.65,9.74), long term usage of oral contraceptive method (AOR=2.51(1.06,5.94), history of breast trauma(AOR=4.34(2.06,8.38), and history of breast infection (AOR= 4.18(1.71,10.21) with 95% confidence interval. Others signifikan factors were family history of any cancer related disease (AOR=3.26(1.93, 11.5), and family history of breast cancer spencificaly (AOR=5.75(2.41, 13.5) with 95%CI.

Conclusoin: Rural residence, higher BMI, low vegetable intake, post menopausal status, abortion, infection and traumatic history of breast, family history of breast and any cancers related disease were independently identified as determinants of breast cancer. Strengthening prevention and early detection method, promoting healthy life style and comprehensive reproiductive health care system were vital for reducing the burden of breast cancer.

Key words: Arsi, Breast Cancer, Case-control, Determinants, Ethiopia, Womens Health.

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Abbreviations/Acronyms

ACS	American Cancer Society
ARTH	Arsi University Asella Teaching and Referral Hospital
BC	Breast Cancer
BMI	Body Mass Index
CBE	Clinical Breast Examination
EPHI	Ethiopian Public Health Institute
FMoH	Federal Ministry of Health
FPG	Fasting Plasma Glucose
HMIS	Health Management Information System
IARC	International Agency for Research on Cancer
NCCP	National Cancer Control Plan
SBE	Self-breast Examination
SSA	Sub-Saharan Africa
TNBC	Triple-negative Breast Cancer
WCBA	Women of Childbearing Age
WHO	World Health Organization

1 Introduction

1.1 Backgrounds

Breast cancer represents a malignant growth originating in breast tissue and the most frequent cancer diagnosis among women around the world (1). In 2020 it shows more than 2.3 million new case and about 685,000 deaths on a globally. The overall load seems to be climbing, especially in low and middle income countries due to late diagnoses along with poor access to treatment and fragile health setups as key reasons for this trend (2). Inadequate healthcare structures, Limited care options, and Delayed detection are the major factors driving the increase in these areas (3). The World Health Organization stepped in with the Global Breast Cancer Initiative to tackle the problem launch programs likes Early screening, Fair and women focused services form the core of its approach (4) .

In sub-Saharan Africa, Breast cancer incidence was rising due to modifiable risk factors, such as elevated fasting plasma glucose levels, alcohol consumption, high body mass index, reduced physical activity, and tobacco use (5). Reproductive behavior also play a role in the rise, like later age at first childbirth, fewer total pregnancies, and shorter breastfeeding periods (6).

In Ethiopia 30-33% were breast cancer from all any female cancer cases, with higher incidence at rural areas and real gaps in community knowledge about breast cancer and access to early screening and treatement (7). Ministry of health launch national cancer control plan to entegrate acceseble cancer care, early diagnosis, prevention and treatement (8). Despit these efforts lack awareness, late stage diagnosis, and inaduate prevention and treatement infrastructures were persisted (9).

Healthy lifestyle and reproductive health changes can prevent 30-50% of breast cancer according to estimates world widely (4). The clinical characterstics and complexity of breast cancer which is influenced by hormonal receptor and tumor type, make the diagnosis and treatement more difficult with limited resource (10).

1.2 Statement of the problem of the study

According to World Health Organization (WHO) and International Agency for Research on Cancer, estimates 2.4 million new cases, and approximately 67,000 deaths were reported only in 2022 (11). Breast cancer accounts about 25% of all cancer case among women, with high incidence rate, but had high survival rate due to advanced diagnostic and treatment programs (12). In Europe, breast cancer was also the most common disease diagnosed with over 50,000 new cases; but due to advanced health system with early detection and treatment services, survival rates are comparatively high (13).

Africa is experiencing high growth of breast cancer incidence reporting over 186,000 newly diagnosed cases and more than 85,000 deaths annually, due to low prevention method, late stage diagnosis, and limited treatment service (14). Especially in Ethiopia it was the most prevalence case among female cancers, approximately 33% of all cancers with the majority of presented with advanced stage (15). The burden is also high in Oromia region, including Asella, due to lack of awareness on prevention method and early screening, as well as limited advanced laboratory diagnosis cases were present with advanced stage (16).

In sub-Saharan Africans the fast growing burden of breast cancer has a great impact at individual level, households, community and national level, which worsen the challenges of health system with limited resource between 1990 to 2019 (17). Ethiopia alone in 2019, approximately 5,900 newly diagnosed cases and 4,110 deaths were recorded, with a serious of public health concern, due to low community awareness, late stage diagnosis, and limited treatment service (18,19). Compared to western countries the survival rate of our country is below 40%, due to the health system was struggling with limited resource, trained personnel advanced diagnostic center, necessary cancer treatments and low public awareness (20,21).

Various determinants were linked with breast cancer, such as aging, marital status, educational level, early menarche, late menopausal status, oral contraceptive usage, lack of breast feeding, obesity, low physical activity engagement, and family history of cancer especially history of breast cancer (22). However in Ethiopia breast cancer researches were highly restricted at urban setting especially Addis Ababa, which lacking various cultural, social and economical contexts, particularly areas like Arsi zone little is known about these determinant factors which is influenced socio economic disparities, traditional beliefs and rural urban disparities (17).

Ethiopia adopted the national cancer control plan (NCCP) for the response of cancer burden (2016-2020) to strengthen prevention method, early detection, diagnosis, treatment and palliative care service (8). The plan focused on integrating cancer care at primary health care, training of health care workers, expanding advanced diagnostic and treatment service, to rise the public awareness of cancer risks and screening.

Several implementation challenges were persisted with the national policy due to poor integration of cancer care to primary health care, lack of resource, lack public awareness and community outreach campaign, especially in rural areas (23). Especially in Arsi zone where limited health care infrastructure, the challenges exacerbate persistent delays in screening, early detection, and treatment service (24).

The study was aimed to identify determinants of breast cancer among women attending oncologic unit at Asella Referral and Teaching Hospital from September to October 2025, by evidence to address the local data gaps and support culturally appropriate early prevention and detection strategies development. The findings are expected to inform zonal, regional and national level to reduce the burden of breast cancer, by promoting prevention and early detection as well as screening, to improve equitable access cancer care.

1.3 Significance of the Study

Breast cancer is the growing burden of public health issues with rising of incidence of the disease in Ethiopia with limited prevention, and control efforts; especialy in Oromia like Arsi zone and Asela town. The study was aimed to fill the major gaps by focusing on key determinant factors of breast cancer; thes affect women seeking cancer screening and care at oncologic unit, Asela Refferal and Teaching Hospital.

Various determinant factors were linked with breast cancer risk; such as postmenopausal status, body mass index, family history of any cancer related and specifically breast cancer, long term oral contraceptive usage, and breast infection or trauma. Most of these elements can be modified and preventable. So; public health programs can be benefited from this study.

The study provides usefull guidance, creat public awereness, promoting early screening, community campaign with specific determinants, and buidsknowledge with limited resource about breast cancer. Longitudinal works and intervention could draw fro this study results.

Policy makers, researchers, and health care providers can build an evidence for making guidelines and better dicisoins to decrease the burden of breast cancer by promoting feasible early detection and health education method for women.

2. Literature Review

Introduction to Literature Review

Breast cancer is the significant public health challenge of women cancer, with its raising incidence and complex outcomes shaped by socio-demographic, lifestyle, reproductive and family history factors. For developing effective prevention, early detection and intervention strategies, particularly in low resource countries with late stage diagnosis and limited screening availability which worsen the burden of the disease, understanding these factors is very essential factor. This literature review synthesise evidence from diverse geographic and socioeconomic contexts to identify how these factors influence prevention, early detection and treatment service which are suitable for developing breast cancer. The following sections provide an integrated analysis of socio-demographic patterns, lifestyle factors contribution, reproductive health characteristics and familial factors.

2.1 Socio-demographic Factors

A study based on Serbia's 2019 National Health Survey revealed that women aged 65 and older had the highest participation in breast cancer screening, women with secondary education were significantly more likely to undergo voluntary screening compared to those with higher education showing a moderate level of significance, and wealthier women, regardless of marital status, were highly significantly more likely to self-initiate mammography than lower-income groups, highlighting the substantial influence of socioeconomic factors on screening behavior and reinforcing the importance of targeted, affordable early detection strategies (25).

A hospital-based unmatched case-control study in Iraq involving 100 breast cancer cases and 200 controls examined various determinant factors including socioeconomic status, smoking, reproductive history, contraceptive use, education level, and family history of breast cancer, finding that low socioeconomic status and late menopause were associated with a moderate level of significance, regular contraceptive use showed low significance, and a positive family history of breast cancer demonstrated a high level of significance in increasing breast cancer risk, while smoking showed a weak, non-significant association, and education level and age at menarche were not significantly linked to breast cancer risk(26) .

A study of 813 women with breast cancer in Gaziantep, Turkey, found that many were premenopausal with an average age of 48.8 years, and advanced-stage diagnoses were more prevalent among illiterate, low-income, or rural residents, underscoring the substantial influence of socioeconomic and cultural factors on breast cancer prognosis and outcomes (27).

Community based study using Demographic and health survey data from Burkina Faso, Ivory Coast, Kenya, and Namibia show that a low prevalence of breast cancer screening 12.9% among women aged 15-49, with higher educational level, older age, and greater socioeconomic status significantly associated with increased screening uptake; for example, women with secondary or higher education had an Adjusted Odds Ratio (AOR) of 2.5 (95% CI: 1.8–3.5, $P < 0.001$) for undergoing screening compared to those with no education, highlighting substantial disparities in access, while the study emphasized that mammography, common in high-income countries, is often not feasible in low-resource settings due to financial and infrastructural barriers, underscoring the need for alternative strategies such as clinical breast examinations and community-based interventions to improve early detection and reduce breast cancer morbidity and mortality in sub-Saharan Africa (28).

Retrospective study conducted in Egypt among 1,953 breast cancer patients showed that 43.8% were diagnosed at advanced stages, with rural residence and high KI-67 scores showing a high level of significance, unemployment showing a moderate level of significance, and tumor subtype and grade also influencing stage at diagnosis, highlighting the urgent need for increased public awareness and early detection efforts (29).

A multilevel analysis by Lemma Seifu et al. (2024) identified key determinants of breast cancer screening among reproductive-age women in Sub-Saharan Africa, revealing that women with higher education were significantly more likely to undergo screening compared to those with no formal education, showing a high level of significance; older age, greater wealth, and recent healthcare visits were also highly significant positive predictors of screening uptake, while media exposure, contraceptive use, higher parity, breastfeeding, and recent pregnancy were associated with moderate levels of significance, and low education and rural residence were highly significant negative predictors of screening participation, underscoring the critical roles of education, economic status, and access to health information and services in shaping screening behaviors across the region (30).

A cross-sectional study conducted at two cancer referral hospitals, Gondar and Felege Hiwot hospitals found that 75.7% of 371 women delayed seeking breast cancer care for more than 90 days, leading to advanced-stage diagnoses in 71.2% of cases; rural residence, low literacy, absence of breast pain, and travel time longer than 5 hours were all significantly associated with the delay, with low literacy showing a high level of significance and the others showing moderate levels of significance (31).

A prospective study at Black Lion Specialized Hospital reported that breast cancer was the most common cancer (14.8%), predominantly affecting women aged 25–49, with significant associations found for contraceptive use and frequent raw red meat consumption, both showing moderate to high significance, underscoring the urgent need for early detection programs, public awareness campaigns, and targeted prevention strategies in Ethiopia (21).

2.2 Lifestyle Factors

The International Agency for Research on Cancer (IARC) estimates that approximately 25% of global breast cancer cases are attributable to obesity and sedentary lifestyles, with regular physical activity of 3–4 hours per week being associated with a moderate level of significance in reducing breast cancer risk by 30–40%, while obesity shows a high level of significance in increasing postmenopausal breast cancer risk by up to 2.5 times, and moderate alcohol consumption demonstrates a low to moderate level of significance in elevating risk, although dietary patterns remain inconclusive due to limited and inconsistent evidence, as these risk factors are believed to act primarily through hormonal mechanisms such as increased estrogen and insulin levels, highlighting the urgent need for globally scaled, lifestyle-focused interventions to combat rising obesity and inactivity trends (32).

The American Cancer Society recommends population-based strategies to reduce breast cancer risk by promoting evidence-based lifestyle interventions, including maintaining a healthy weight particularly after menopause which is associated with a high level of significance in reducing risk, engaging in regular physical activity with moderate to high significance, adopting a predominantly plant-based diet, and avoiding alcohol and tobacco use, both showing low to moderate levels of significance; these measures have demonstrated effectiveness in lowering breast cancer risk across diverse populations and age groups, supporting their broad implementation through public health and clinical counseling initiatives (33).

A pilot study conducted by Diana Web in Umbria investigates that lifestyle changes particularly adherence to a Mediterranean diet and regular exercise can improve breast cancer outcomes by engaging patients through an interactive online platform to track health and adopt sustainable habits, aiming to address the underrepresentation of lifestyle factors in oncology care while contributing valuable evidence on the role of diet and physical activity in prognosis and quality of life (34).

The Diet, Exercise, and Vitamin D to Reduce Breast Cancer Recurrence (DEDiCa) trial demonstrated that a 12-month lifestyle intervention including a Mediterranean diet, exercise, and vitamin D significantly improved health-related quality of life in 227 breast cancer survivors, with participants reporting better physical, social, and emotional functioning, reduced fatigue and side effects, improved body image, and outcomes positively associated with lower BMI and higher vitamin D levels, highlighting the critical role of healthy lifestyle changes in supporting recovery and long-term prognosis (35).

2.3 Reproductive History Factors

A large population-based case-control study in China, which included 3,792 breast cancer patients and 4,182 age-matched controls aged 20–70, examined reproductive risk factors by breast cancer subtype and addressed the research gap often focused on older women, finding that having more children was linked to a lower risk of developing luminal A and B subtypes across all age groups, with women of higher parity being less likely to develop these subtypes than those with fewer or no children, while having a first child at a later age appeared to reduce the risk of luminal A breast cancer among younger women (aged 40 and below) but increased it in older women, and breastfeeding for 12 months or more provided notable protection against both luminal B and triple-negative breast cancer (TNBC), especially among women aged 40 or younger, emphasizing that early childbirth and extended breastfeeding can offer subtype-specific protective effects, particularly in younger women (36).

A case-control study involving 1,256 breast cancer patients and 1,416 controls in East Asia found that women with higher body mass index (BMI) were more likely to develop both luminal and triple-negative breast cancer subtypes compared to those with lower BMI, while having a first live birth at a later age and experiencing menopause after age 55 were linked to increased risk across all subtypes, in contrast to late menarche at age 15 or older, which appeared to offer protection against luminal tumors, whereas early menarche before age 12, having no children, and not breastfeeding were associated with a notably higher likelihood of developing breast cancer, particularly of the luminal subtypes, highlighting the consistent and subtype-specific influence of BMI, reproductive timing, and breastfeeding practices on breast cancer risk across different menopausal statuses (37).

A case-control study in the Central African Republic involving 174 breast cancer cases and 348 age-matched controls identified several reproductive and socio-demographic factors associated with breast cancer risk, showing that women with low education, those who were married, those with a history of abortion, and those who had never given birth were more likely to develop breast cancer compared to their counterparts, while protective factors included being employed, living in urban areas, experiencing late menarche, having regular menstrual cycles, having at least one term pregnancy, and using hormonal contraceptives, aligning these findings with global breast cancer risk patterns and supporting targeted prevention strategies in Bangui (38).

A 2018 case-control study at Muhim Bili National Hospital in Tanzania assessed reproductive, hormonal, lifestyle, and nutritional factors influencing breast cancer risk among women and found that older age at menopause significantly increased risk with an adjusted odds ratio (AOR) of 2.6 (95%CI: 1.3–5.2; $P = 0.006$), while factors such as adolescent obesity, family history, smoking, alcohol intake, and rural residency showed elevated but statistically non-significant associations, highlighting older age at menopause as a key risk factor and emphasizing the need for further research into modifiable lifestyle factors for effective prevention strategies (39).

2.4 Family History Factors

A population-based study in Santiago de Compostela, Spain, involving 645 women with operable invasive breast cancer found that about one in five had hormone receptor-negative tumors, while the majority had hormone receptor-positive tumors, with women under 50 and those with a family history being more than twice as likely to develop the more aggressive hormone receptor-negative subtype compared to older women and those without such a history, indicating a strong link between family history and aggressive tumor types in younger patients (40).

A retrospective case-control study in Afghanistan involving 201 breast cancer cases and 201 controls identified that women with late menarche, early first childbirth, illiteracy, smoking habits, and a family history of cancer were significantly more likely to develop breast cancer compared to those without these factors, while marital status, BMI, contraceptive use, breastfeeding, and physical activity showed no significant association; similarly, a hospital-based study in Iraq found that women with low socioeconomic status, late menopause, a positive family history, and contraceptive use had a greater likelihood of breast cancer than their counterparts, whereas smoking, education level, and age at menarche showed no meaningful difference, underscoring the role of socioeconomic and reproductive characteristics in influencing breast cancer risk across these populations (26,41).

An unmatched case-control study conducted in Addis Ababa among 348 women revealed that those living in rural areas, consuming processed foods, being obese, experiencing early menarche, having fewer children, and possessing a family history of breast cancer were more likely to develop the disease compared to their counterparts, while contraceptive use showed no meaningful difference and abortion was only linked in unadjusted analysis, highlighting the need to focus on modifiable risk factors and encourage further context-specific investigations in Ethiopia (42).

A 2023 hospital-based case-control study in Hawassa City, Ethiopia, involving 300 participants (75 cases and 225 controls), identified postmenopausal status, family history of cancer, oral contraceptive use, overweight/obesity, and consumption of solid oil as significant breast cancer risk factors, highlighting the importance of healthier lifestyles and the critical role of early detection and regular screening in reducing breast cancer risk (43).

2.5 Conceptual framework

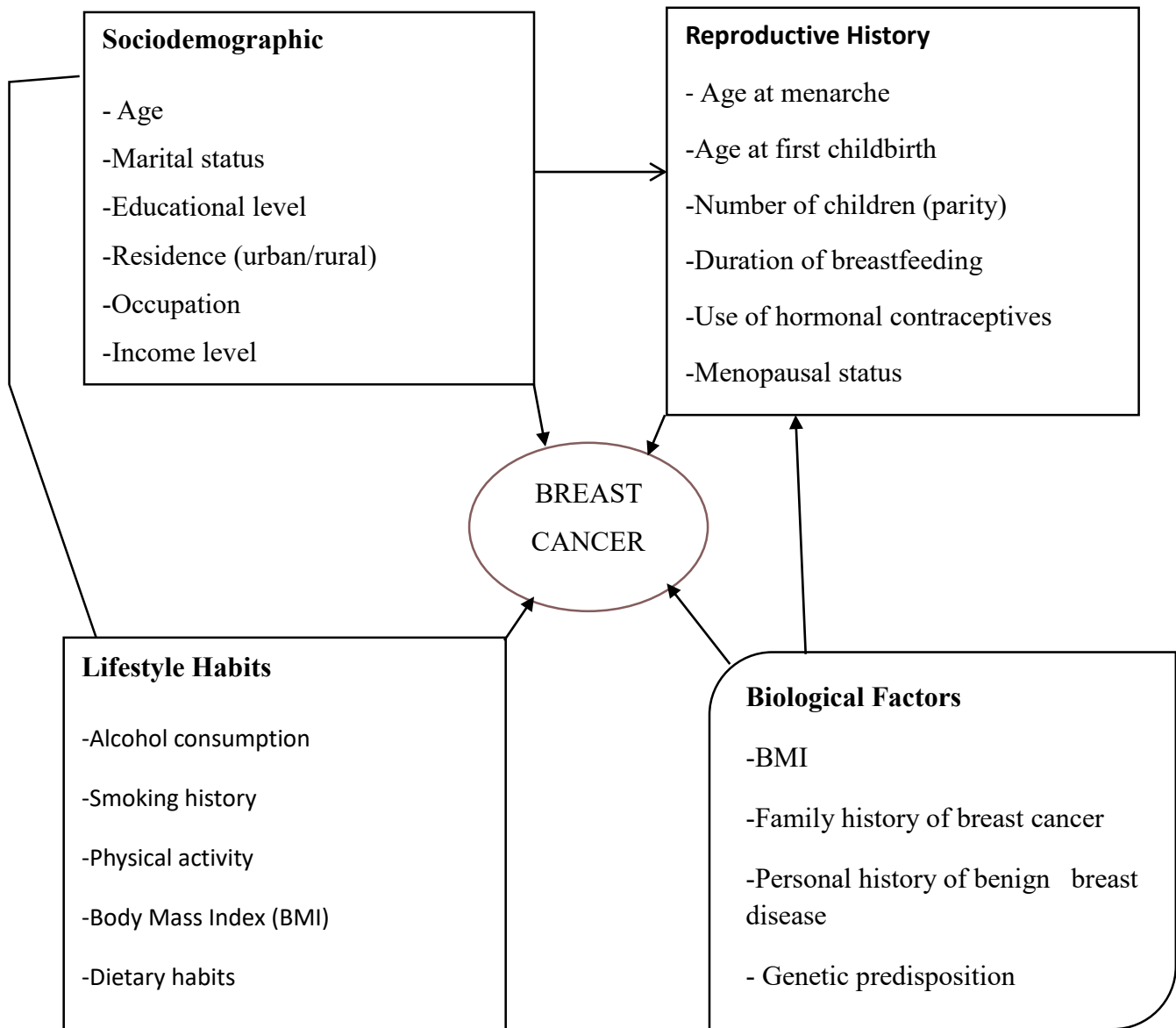


Figure 1 *Conceptual Framework for Determinants of Breast Cancer* (44)

3. Objectives of the Study

General Objectives:

To identify the determinants of breast cancer among women attending Asella Referral and Teaching Hospital between September and October, 2025

Specific objectives:

To assess the association between determinant factors and the occurrence of breast cancer among women attending Asella Referral and Teaching Hospital from September 01 to October 31, 2025.

4. Methodology

4.1. Study Area and Period

4.1.1 Study Area

Asella town, in Arsi University Asella Referral and Teaching Hospital, in southeast Ethiopia, was the site of the study. Asella was located 175 kilometers southeast from Addis Abeba, in Arsi Zone, Ormia region.

The Arsi University Asella Referral and Teaching Hospital in Asella, a town in southeast Ethiopia, was the site of this investigation. Asella was located roughly 175 kilometers southeast of Addis Ababa in the Arsi Zone of The Oromia Region. The town is situated on high plateau west of CHilalo Mount, overlooking Lake Ziway. The town was connected to Adama in northern with major commercial and transportation center.

Asella was affiliated with Arsi University and Asella Referral and Teaching Hospital which served as clinical training for medical and health science students, with full medical services to a wide range of patients in the surrounding area. Emergency care, obstetric and gynecology, surgery, internal medicine, and pediatric care were among the main departments of the hospital.

Asella Referral and Teaching Hospital serves predominantly rural communities, many of whom are women of childbearing age, and plays a key role in maternal and child health service including cervical and breast cancer screening and prenatal care. With its skilled professionals and commitment to quality of care, the hospital

Arsi University Asella Referral and Teaching Hospital serves predominantly rural patients, many of whom are women of childbearing age, and plays a key role in maternal and child health services, including breast and cervical cancer screening and prenatal care. With its skilled professionals and commitment to quality care, the hospital is accessible for research on identifying determinants of breast cancer among women at oncologic unit.

4.1.2. Study Period

The study was conducted from September to October, 2025.

4.2. Study Design

A Health facility–based unmatched case-control study was conducted, employing clear and standardized definitions for cases and controls based on internationally accepted diagnostic criteria.

4.3. Population

4.3.1 Source of Population

All Women aged 15 and above who presented at Asella Referral and Teaching Hospital constitute the source of population.

4.3.2 Study Population

This study was conducted among women aged 15 and above who attended Asella Referral and Teaching Hospital during the data collection period.

4.3.3 Case Definition

Cases were women with confirmed diagnosis of breast cancer; verified patient medical record documents, histo-patological examination document, clinical and imaging evaluations consistent with WHO breast cancer diagnosis criteria. Women whose diagnosis was confirmed breast cancer and who had not yet initiated chemotherapy, hormonal therapy or surgeries were counted as cases irrespective of treatment status. This ensured the cases identification was accurate and avoid selection bias.

4.3.4 Control Definition

Controls were cancer free women selected from outpatient department including internal medicine, surgery and gynecology OPDs and frequency-matched to by age (± 5 years) to ensure comparability. Eligible controls were who attended the hospital for non cancer medical conditions and with no current diagnosis of breast cancer. Controls were selected with systematic random sampling method to represent the same source of population.

Triangulated verification was used to minimize misclassification bias; medical record review to confirm if any documented breast cancer history, a symptom based screening, and clinical breast examination was performed by trained health care providers to identify any sign and/or symptom of breast cancer.

Women with any signs suggestive of Breast Cancer (e.g, breast lump, nipple discharge, skin dimpling) or with a previous history of breast cancer were excluded from the control group. To strengthen the internal validity of the study and accurate case-control selection using this approach was crucial in resource limited settings for the diagnosis delays.

4.3.5 Inclusion and Exclusion Criteria

Inclusion Criteria

Women aged 15 years and above with a histologically or clinically confirmed diagnosis of breast cancer, who attended Asella Referral and Teaching Hospital during the study period, regardless of their treatment status, was counted as cases.

Women aged 15 years and above who attended the hospital for non-cancer medical conditions during the study period and were confirmed to be free of breast cancer based on WHO criteria through medical records, absence of clinical symptoms, and clinical breast examination (CBE), when feasible were included as controls.

Exclusion Criteria

Women who can not respond to the interview and can not provide informed consent, which was critically ill and mentally incomplete, were excluded from the study. Controls with any sign and symptom suggestive of breast cancer were also excluded from the study

4.4 Sample Size Determination

The sample size was calculated for this unmatched case-control study, using Epi Info™ version 7 stat.Calc, based on the assumptions: 95% confidence interval, 80% statistical power, 1:4 a case-control ratio, an expected proportion of 30.6% among cases and 16% among controls, with women a family history of breast cancer. These inputs were derived from a case control study on determinants of breast cancer conducted in Hawassa (43).

Based on these inputs the total estimated sample was 345 (69 cases and 276 controls). After adding 10% of non-response rate the final sample size was adjusted to 384 participants (77 cases and 307 controls were participated.) The sample size was provided adequate statistical power to detect meaningful difference in exposure between cases and controls, and identifies association between key determinant factors and breast cancer among women attending Asella Referral and Teaching Hospital.

4.5 Sampling Technique and Procedures

This study utilized an unmatched case-control design with a 1:4 case-to-control ratio, involving both consecutive sampling for cases and systematic random sampling with proportional allocation for controls. To meet the sample size, all eligible breast cancer cases were selected due to low incidence rate during the data collection period (September to October, 2025). This approach minimizes the selection bias by ensuring that all available and consenting cases were selected and maximize statistical power. There was a potential of recall bias in case-control study; efforts were made to reduce this through the use of standardized tool, pretested questionnaires and trained data collectors.

Systematic random sampling Technique was applied for controls group. A pre assessment was conducted in each OPD to estimate the daily patient volume, which guided the sampling frame and proportional allocation. Every kth eligible woman was selected where k was calculated by dividing the estimated number of eligible daily attendees by the number of controls required from each department. To ensure randomness, the first participant was selected at random from the first k individuals. This approach minimizes selection bias and ensured that the control group accurately represented the source population, from which the cases originated.

4.6 Study variables

4.6.1 Dependent variable

Breast Cancer

4.6.2 Independent variables

The study assessed a range of independent variables grouped into four major categories to identify their association with breast cancer.

Socio-demographic factors: residence, educational status, income level, marital status, and occupation.

Lifestyle factors: Vegetable consumption, alcohol consumption, physical activity, body mass index (BMI), and tobacco use.

Reproductive history: Age at menarche, age at first childbirth, number of children, breastfeeding history, menopausal status, oral contraceptive use and breast infection/trauma

Familial factors: family history of breast cancer and cancer related disease.

4.7 Data Collection Tools and Procedures

4.7.1 Data Collection Tool

The data collection instrument was a structured questionnaire, initially developed in English based on an extensive review of relevant literature and validated tools from previous studies (45,46). After finalization, the questionnaire was programmed into the Kobo Toolbox platform for digital data collection.

To ensure linguistic and contextual relevance, the questionnaire was translated into the local languages, Afan Oromo and Amharic, by professional language experts. The translated versions were back-translated into English by a separate translator who was not involved in the original translation process to maintain semantic equivalency and ensure translation accuracy. To promote consistency and clarity during data collection, the final version of the questionnaire displayed both the local language and English side by side.

4.7.2 Data Collection Procedures

Prior to data collection, one day training was given for data collectors and supervisor, covering study objectives, ethical considerations, informed consent procedures, interviewing techniques, questionnaire content and Kobo tool platform usage. Data were collected by six trained nurses and midwives.

Interviewers administered the questionnaire to ensure response accuracy and completeness. Digital data collection allowed, for real-time entry, minimized errors, and enhanced data security.

The data collection tool was designed to gather detailed information in several important areas. Socio-demographic factors included respondents' age, residence, marital status, level of education, employment status, and household income. Lifestyle factors such as body mass index (BMI), vegetable intake, physical activity level, alcohol consumption, and cigarette smoking were also collected. Reproductive history factors including age at menarche, age at first childbirth, number of children, breastfeeding habits, menopausal status, and use of hormonal contraceptives. Additionally, any family history of Breast cancer, particularly among first-degree relatives, was recorded.

To ensure accuracy and consistency, a standardized checklist was used to extract clinical data for cases, including diagnostic and treatment details, from medical records. For controls, the same checklist was applied to verify the absence of breast cancer based on diagnostic notes, clinical evaluations, and available screening results. This standardized and systematic approach enhanced data reliability and supported the study's objective of identifying diverse factors associated with breast cancer risk.

A pre-test was conducted at bokoji hospital involving 5% of the total sample (19 participants) to assess the functionality of the Kobo Toolbox, as well as the logical flow, cultural appropriateness, and clarity of the questionnaire. Revisions were made based on the findings from the pre-test.

4.8 Data Quality Assurance

Data quality was ensured via carefully translated and back translated questionnaire before data collection to preserve linguistic consistency and cultural appropriateness and the result of pre test was guide the final modification.

Training on study objectives, procedures and tool use was provided to the supervisor and all data collectors. Daily supervision was conducted during data collection to check completeness and accuracy. Any issues that arose were addressed promptly to maintain the validity and reliability of the data.

4.9 Data Processing and Analysis

Data were collected using Kobo Toolbox and exported excel document the exported SPSS version 26 for analysis; before analysis any incompelet data were checked and cleaned.

Descriptive statistics were used to summarize the data. Categorical variables were presented as frequencies and percentages, whereas means and standard deviations (SD) were used to describe continuous variables.

The association between the independent variables (exposures) and the dependent variable (breast cancer) was examined using binary logistic regression analysis. Initially, bivariate logistic regression was conducted to identify potential predictors. Variables with a p-value < 0.25 in the bivariate analysis were included in the multivariable logistic regression model to control for potential confounding factors.

Before performing multivariable logistic regression, all continuous variables were tested for normality and found to be within acceptable limits (skewness between -1 and +1; kurtosis between -3 and +3). The strength and direction of associations were expressed as Adjusted Odds Ratios (AORs) with their corresponding 95% Confidence Intervals (CIs). In the final model, a p-value < 0.05 was considered statistically significant.

Model adequacy was assessed using the Hosmer–Lemeshow goodness-of-fit test, where a non-significant result ($p > 0.05$) indicated a good model fit. Variance Inflation Factors (VIFs) were examined to detect multicollinearity, and all values were below 5, confirming that multicollinearity was not a concern and that the estimated coefficients were both stable and reliable

4.10 Operational Definitions

Breast Cancer (BC): A malignant tumor originating from breast tissue, confirmed through histological examination (22).

Case: Women with histologically confirmed breast cancer attending the oncology unit of the selected hospital (43).

Control: Women attending gynecological outpatient departments (OPDs) in the selected hospitals for non-cancer-related conditions (43).

Body Mass Index (BMI): A measure of body fat based on weight in kilograms divided by the square of height in meters (kg/m^2) (37).

BMI Categories: Underweight: <18.5 , Normal weight: $18.5\text{--}24.9$, Overweight: $25\text{--}29.9$, Obese: ≥ 30 (37).

Active Smoking: The use of tobacco by smoking or having smoked within the last six months, including both current and recent former smokers (47).

Passive Smoking: Exposure to secondhand tobacco smoke for more than 15 minutes at least once per week, despite not being an active smoker (41).

Luminal A: Hormone receptor-positive (estrogen and/or progesterone), HER2-negative, and low Ki-67 expression. Typically, low grade, slow-growing, and less aggressive; Treated mainly with hormone therapy, with or without chemotherapy (42).

Luminal B: Hormone receptor-positive but either HER2-positive or with high Ki-67 expression. Generally higher grade, more aggressive, and associated with poor prognosis; Treatment often includes hormone therapy, chemotherapy, and HER2-targeted therapy if indicated (42).

4.11 Ethical Consideration

Ethical clearance of the study was obtained from the institutional review board (IRB) of college of health science of Arsi University with (Approval No. CoHS/R/210/2025) and supportive letter was provided to the Asella Referral and Teaching Hospital.

Informed consent was taken for all eligible participants and comprehensive information was provided about the study's objectives, procedures, potential risks, and anticipated benefits.

To maintain ethical Standards, participant confidentiality was strictly safeguarded by anonymizing all data and coding personal identifiers. Participants were also informed of their right to decline participation or withdraw from the study at any point without any penalty or loss of access to healthcare services.

4.12 Dissemination Plan

The study finding will be shared with Arsi University, College of Health science, Department of public Health and Other relevant institutional stakeholders.

Furthermore, the result will be submitted for publication in peer-reviewed scientific journals and presented at academic and professional conferences to inform public health policy and future research initiatives.

5. Results

5.1 Socio-demographic Characteristics

A total of 384 women (cases=77 and controls=307) participated, with a 100% response rate. The mean and standard deviation ($\pm$ SD) was 44.0 ± 12.1 years among cases and 31.9 ± 11.6 years among controls with ranging 20-75 and 15-70 respectively. Forty (51.9%) of the cases and 10(3.2%) of the controls were aged ≥ 55 years.

From the total of cases 45 (58.4%) were rural residencies, compared to 80(26.1%) of the controls, while urban residence was more common among controls 227(73.9%) than cases 32(41.6 %). The majority of both groups were married (83.1% of cases and 82.1% of controls).

Regarding marital status more than of the cases 64(83.1%) and 252(82.1%) of the controls were married and few participant were single, divorced and widowed in both groups. Twenty seven (35%) of the cases and 92(30%) of the controls were engaged in universities, while 20(26%) of the cases and 42(13.6%) the controls could not read and write. 57% of the cases and 45.3% of the controls were housewives, followed by government employees, and self employed women. Thirty three (42.9%) of the cases and 108(35.2%) of the controls' husband were engaged collage and above whereas 4(5.2%) and 11(3.6) were unable to read or write respectively (Table1).

Table 1: Socio-Demographic Characteristics of Study Participants at Asella Referral and Teaching Hospital, Arsi, Asella Town, Oromia, Ethiopia, 2025.

Variables	Category	Cases (Number %)	Controls Number %)
Places of residency	Rural	45(58.4%)	80(26.05%)
	Urban	32(41.6%)	227(73.95%)
Ages of respondents	15-24	2(2.6%)	70(22.8%)
	25-44	18(23.3%)	203(66.1%)
	45-54	17(22.1%)	24(7.8%)
	≥55	40(51.9%)	10(3.2%)
Marital status	Married	64(83.1%)	252(82.1%)
	Single	3(3.9%)	43(14%)
	Divorced	4(5.2%)	7(2.3%)
	Widowed	6(7.8%)	5(1.6%)
Educational status	Can't read and write	20(26%)	42(13.6%)
	Can read and write	495.2%)	54(17.6%)
	Primary & secondary school	7(9%)	65(21.2%)
	Collage	19(24.6%)	54(17.5%)
	University completed	27(35%)	92(30%)
Occupational status	House wife	44(57.1%)	139(45.3%)
	Government employ	13(16.9%)	68(22.1%)
	Self-employ	8(10.4%)	57(18.6%)
	Trader	1(1.3%)	18(5.9%)
	Daily labor	8(10.4%)	5(1.6%)
	No job	3(3.9%)	20(6.5%)
Educational level of husbands	Can't read and write	4(5.2%)	11(3.6%)
	Can read and write	19(24.7%)	54(17.6%)
	Primary & secondary school	26(33.8%)	87(28.3%)
	Collage	20(26.0%)	43(14.0%)
	University completed	7(9.1%)	65(21.2%)

5.2 Lifestyle Characteristics of the Study Participants

More than half 49 (63.6%) cases and 98(31.9%) of the controls were reported no engagement in physical exercise practice. and reported no engagement in physical exercise, compared to 98 (31.9%) of controls, this indicates lower overall physical activity among the cases compared to the controls group.

Regarding Physical intensity 18(23.9%) of cases and 58((18.9) of the controls were engaged in light physical activity. 134(43.6%) of the controls engaged in moderate physical activities and few of the cases 7(9.1%) were engaged.

Concerning fruit and vegetable intake, more than half of the cases 40(51.9) and 129(42%) of the controls were consumed 1-2 days per week. Twenty Eight (36.4%) the cases and 144(46.9%) of the controls were consumed 3-4 days per week, followed by 9(11.7%) of the cases and 34 (11.1%) of the controls were 5-6 days consumer per week.

Regarding consumption of unhealthy dietary habits, such as, Smoked meat 12(15.6%) cases and 9(2.9%) and consumption of processed food were among cases 10(13%) and 24(7.8%) controls, respectively. It shows there is higher rate of unhealthy practice among cases. Preventive measures, such as breast self-examination and mammographic screening, were very low in both groups with 16(20.8%) among cases and 76(25%) of the controls practicing breast self-examination and 2(2.6) cases and 2(0.7%) of the controls screened with mammogram.

Concerning Body mass index, Normal weight (18.5-24.9kg/m²) predominated among controls 251(81.8%) and overweight (25-29.9%), 32(41.6%) were more common among cases, followed by underweight (<18.5kg/m²) and obese (>30kg/m²) with 12(15.6%) and 2(2.6%) among cases respectively.

History of smoking was higher among cases, 19(24.7%) reported ever smoking compared to only 1(0.32%) of the control. While smoking status 12(15.6%) of the cases and only 1(0.3%) of the controls reported with Active smoking, and 7(9%) of the cases and 5(1.6%) of the controls reported with Passive smoking status respectively ([Table 2](#)).

Table 2: Lifestyle Factors of the study participants at Asella Referral and Teaching Hospital Arsi, Asella Town, Oromia, Ethiopia, 2025

Variables	Categories	Cases (Number %)	Controls (Number %)
Physical activity of respondents	Yes	28(36.4%)	209(68.1%)
	No	49(63.6%)	98(31.9%)
Physical intensity of respondents	Light	18(23.9%)	58(18.9%)
	Moderate	7(9.1%)	134(43.6%)
	Heavy	3(3.9%)	17(5.5%)
Vegetable consumptions of respondents	1-2 days per week	40(51.9%)	129(42%)
	3-4 days per week	28(36.4%)	144(46.9%)
	5-6 days per week	9(11.7%)	34(11.1%)
Consumption of smoked meat	Yes	12(15.6%)	9(2.9%)
	No	65(84.4%)	298(97.1%)
Consumption of packed food	Yes	10(13.0%)	24(7.8%)
	No	67(87.0%)	283(92.2%)
Mammogram screening	Yes	2(2.6%)	2(0.7%)
	No	75(97.4%)	305(99.3%)
Breast self-examination practice	Yes	16(20.8%)	76(24.8%)
	No	61(79.2%)	231(75.2%)
BMI category	<18.5kg/m ²	12(15.6%)	29(9.4%)
	18.5-24.9kg/m ²	31(40.3%)	251(81.8%)
	25-29.9kg/m ²	32(41.6%)	23(7.5%)
	≥30kg/m ²	2(2.6%)	4(1.3%)
History of smoking	Yes	19(24.7%)	1(0.32%)
	No	58(75.3%)	306(99.68%)
Smoking status	Active	12(15.6%)	1(0.3%)
	Passive	7(9.1%)	5(1.6%)

BMI, Body Mass Index

5.3 Reproductive Health characteristics of Study Participants

From the total of cases 41(53.2%), and 26(8.5%) of the controls were postmenopausal, while more than half of the controls 281(91.5%) of the controls and 36(46.8%) the cases were premenopausal status.

Concerning age at menopause, 19(24.7%) of the cases reached menopause at 46-54 years followed by 12(15.6%) with ≤ 45 years, and 5(6.5%) at ≥ 55 years. While the controls group 14(4.6%) of reached between 46-54 years followed by 12(3.9%) experience menopausal age at ≤ 45 years.

Regarding history of abortion 53(68.8%) of the cases and 90(29.3%) of the controls were reported, whereas most of study participants of the controls 217(70.7%) and 24(31.2%) of the cases had no such history.

In terms of age at menarche 21(27.3%) of the cases and 44(14.3%) of the controls experienced menarche at $t \leq 12$ years, 55(71.4%) of the cases and 263(85.7%) of the controls between 13-15 years, and 1.3% of the cases reported at ≥ 16 years. whereas the regularity of menstrual period 23(29.9%) of the cases and 151(49.2%) of the controls had regular menstrual cycle, while more than half of the case 54(70.1%) and 156(50.8%) the controls reported with irregular cycles.

Regarding Oral contraceptive usage 46(59.7%) of the cases and 96(31.3%) of the controls were used oral contraceptive method, while 31(40.3%) of the cases and 211(68.7%) of the controls had never used this. With respect duration 12(15.6%) of the cases and 75(24.4%) of the controls used oral contraceptives for < 4 years, whereas 34(44.2%) of the cases and 21(6.8%) of the controls used them for ≥ 4 years.

Breastfeeding practice of the study participant was reported by 41(56.2%) of the cases and 150(60%) of the controls practiced. With respect to age at first childbirth, 43(55.8%) of the cases and 97(31.6%) of the controls gave birth at ≤ 20 years, 23 (29.9%) of the cases and 144 (46.9%) between 21–29 years, and 7 (9.1%) of the cases and 2 (0.7%) of the controls at ≥ 30 years.

A history of breast trauma and breast infection was found among cases 44(57.2%) and 49(63.6%) respectively. whereas among controls 9(2.9%) and 30(9.8%) of the controls had history of breast trauma and breast infection respectively ([Table 3](#)).

Table 3: Reproductive health characteristics of the study participants at Asella referral and Teaching hospital, Arsi, Asella town, Oromia, Ethiopia, 2025

Variables	Categories	Cases	Controls
		Number (%)	Number (%)
Menopausal status	Premenopausal	36(46.8%)	281(91.5%)
	Postmenopausal	41(53.2%)	26(8.5%)
Menopausal Age (years)	≤45 years	12(15.6%)	12(3.9%)
	46-54 years	19(24.7%)	14(4.6%)
	≥55	5(6.5%)	
History of Abortion	Yes	53(68.8%)	90(29.3%)
	No	24(31.2%)	217(70.7%)
Menstrual Regularity	Regular	23(29.9%)	151(49.2%)
	Irregular	54(70.1%)	156(50.8%)
Age at Menarche (years)	≤12	21(27.3%)	44(14.3%)
	13-15	55(71.4%)	263(85.7%)
	≥16	1(1.3%)	
Ever Used Oral Contraceptives	Yes	46(59.7%)	96(31.3%)
	No	31(40.3%)	211(68.7%)
Duration of Oral Contraceptive Use (years)	<4 years	12(15.6%)	75(24.4%)
	≥4 years	34(44.2%)	21(6.8%)
Age at First Childbirth (years)	≤20 years	43(55.8%)	97(31.6%)
	21-29 years	23(29.9%)	144(46.9%)
	≥30	7(9.1%)	2(0.7%)
Breastfeeding History	Yes	41(56.2%)	150(60%)
	No	32(43.8%)	88(40%)
Breast Trauma History	Yes	44(57.2%)	9(2.9%)
	No	33(42.8%)	298(97.1%)
Breast Infection History	Yes	49(63.6%)	30(9.8%)
	No	28(36.4%)	277(90.2%)

5.4 Family History of Study Participants

A family history study participants with any cancer related disease among their closed blood relatives such as mother, father, sister, or aunt, were reported 24(31.2%) among cases and 22(7.2%) of them among controls. This shows that any cancer related disease among closed relatives were more common among cases than reported among controls.

Specifically focusing on History of breast cancer among their closed boold relatives, 18(23.4%) of the cases and only 9(3%) of the controls had a positive history. This indicates that a family history of breast cancer was more frequently reported among the cases compared to the controls (Table 4).

Table 4: Family History Characteristics of the study participants at Asella Referral and Teaching Hospital Arsi Asella Town, Oromia, Ethiopia, 2025

Variables	Categories	Cases (Number %)	Controls (Number %)
The family history of the respondent includes cancer-related diseases among close relatives such as their mother, sister, or aunt	Yes	24(31.2%)	22(7.2%)
	No	53(68.8%)	285(92.8%)
The respondent has a family history of breast cancer among close female blood relatives, such as theirs mother and sister	Yes	18(23.4%)	9(3%)
	No	59(76.6%)	298(97%)

5.5 Determinants Factors Associated with Breast Cancer

The Bivariate Logistic regression analysis shows that several determinant factors such as socio-demographic, lifestyle, reproductive and family history factors were significantly associated with breast cancer. These included place of residence, Age, occupational status, educational status, physical activity engagement, body mass index, vegetable consumption, menopausal status, history of abortion, regularity of menstrual period, use and duration of oral contraceptive, consumption of smoked and processed foods, preventive measures such as breast self-examination and mammographic screening plus breast feeding practice, age at menopause, age at menarche, history of breast trauma/infection and family history of any cancer related, and specifically breast cancer were significant.

After controlling potential confounding variables, several variables were remained independently associated with BC, with Multivariable logistic regression analysis. Women living in rural areas were more likely to develop breast cancer than those living in urban setting (AOR=2.64; 95%CI: 1.39–5.01; $p=0.0048$). As the age of women increased the risk of BC also progressively increase; women aged 45–54 years had 1.39 times higher odds (AOR = 1.39; 95% CI: 1.20–3.18; $p = 0.045$), and those aged 55 years and above had 3.59 times higher odds compared to the youngest age group (AOR = 3.59; 95% CI: 1.30–8.03; $p=0.041$).

Women with low fruit and vegetable intake (3–4) days per week were 1.88 times more likely to develop BC than consuming fruits and vegetables (5–6) days per week (AOR=1.88; 95%CI: 1.08, 4.34; $p=0.009$). Regarding women who did not engage in physical activities had three times risk of developing BC compared to those who engaged in regular physical exercise (AOR=2.95; 95%CI: 0.93–9.35; $P=0.003$). Women with BMI (25–29.9 kg/m²) were more than six as likely to develop breast cancer as women BMI (18.5–24.9 kg/m²), AOR (6.34; 95%CI: 2.17–13.7; $P=0.0001$). Whereas women with BMI <18.5 kg/m² were 2.78 times risk to develop BC than those with BMI 18.5–24.9 kg/m² (AOR=2.78; 95%CL: 0.94–9.48; $P=0.0008$).

Reproductive, hormonal and breast health factors were also highly significantly associated with BC. Postmenopausal women had 1.25 times odds of developing BC compared to premenopausal women (AOR=1.25; 95%CI: 1.04-3.28; P=0.025). Regarding history of abortion; women with history of abortion had four times higher odds of developing BC (AOR =4.01; 95%CI: 1.65–9.74; p=0.002). Similarly women with long term usage of oral contraceptive for four years and above were 2.51 times as likely to develop BC than no-users (AOR = 2.51(95%CI: 1.06–5.94) p=0.003). Women who had never breastfed had 1.21 times higher odds compared to those who had breastfed (AOR =1.21; 95%CI: 1.08–5.11; p= 0.010).

Women with history of breast trauma had more than fourfold increased odds of BC (AOR = 4.34; 95%CI: 2.06–8.38; p=0.017), and those with a previous breast infection had a 4.18-fold higher likelihood (AOR = 4.18; 95%CI: 1.71–10.21; p = 0.014). Family history factors were among the most significant determinants of BC. Women with a family history of any type of cancer had over three-fold higher odds of BC (AOR = 3.26; 95%CI: 1.93–11.50; p = 0.0027), whereas those with specifically breast cancer like a first-degree relative diagnosed with breast cancer were nearly six times more likely to develop the disease (AOR = 5.75; 95%CI: 2.41–13.54; p = 0.0019) (Table 5).

Table 5: Bivariate and multivariate logistic regression analyses of determinant factors associated with breast cancer among women attending Asella Referral and Teaching Hospital, Arsi, Asella Town, Oromia, Ethiopia, 2025

Variables	Categories	Case	Controls	COR (95%CI)	AOR (95%CI)	P-value
		N (%)	N (%)			
Places of residency	Rural	45(58.4%)	80(26.1%)	3.99(1.49,4.2)	2.64(1.39,5.01)	0.0048*
	Urban	32(41.6%)	227(73.9%)	1		
Ages of respondents	15-24	2(2.6%)	70(22.8%)	1.068(0.8,10.52)	1.07(1.01,2.87)	0.71
	25-44	18(23.3%)	203(66.1%)	1.26(0.350,4.57)	1.05(1.03,2.89)	0.16
	45-54	17(22.1%)	24(7.8%)	3.51(1.15,10.66)	1.390(1.2,3.18)	0.045*
	≥55	40(51.9%)	10(3.2%)	5.465(1.73,17.3)	3.59(1.3,8.028)	0.041*
Engagement in	Yes	28(36.4%)	157(52.3%)	1		
Regular Physical Activity	No	49(63.6%)	150(47.7%)	0.54(0.459, 1.52)	2.95(0.93,9.35)	0.003*
BMI category	<18.5kg/m2	12(15.6%)	29(9.4%)	3.35(1.5,7.24)	2.78(0.94,9.48)	0.008*
	18.5-24.9kg/m2	31(40.3%)	251(81.8%)	1		
	25-29.9kg/m2	32(41.6%)	23(7.5%)	11.27(5.8,21.68)	6.34(2.17,13.7)	0.001*
	≥30kg/m2	2(2.6%)	4(1.3%)	4.0 (0.71,12.51)	2.56(1.2, 4.92)	0.736
Fruit & Vegetable Intake (Times per Week)	1-2 days	40(51.9%)	129(42%)	0.85 (0.34,2.27)	1.27(1.06,3.46)	0.0032*
	3-4 days	28(36.4%)	144(46.9%)	1.36(0.78,3.30)	1.48(1.08,4.34)	0.009*
	5-6 days	9(11.7%)	34(11.1%)	1		
Current Menopause Status	Premenopausal	36(46.8%)	181(91.5%)	1		
	Postmenopausal	41(53.2%)	126(8.5%)	0.61(0.058,2.92)	1.25(1.04,3.28)	0.025*
Abortion History	Yes	53(68.8%)	90(29.3%)	5.35(3.09,9.148)	4.01(1.65,9.74)	0.002**
	No	24(31.2%)	217(70.7%)	1		
Breastfeeding History	Yes	41(56.2%)	150(60%)	1		
	No	32(43.8%)	88(40%)	0.75(0.62,1.6)	1.21(1.08,5.11)	0.01**
Breast Trauma History	Yes	44(57.2%)	59(19.2%)	5.60(2.13,10.48)	4.34(2.06,8.38)	0.017**
	No	33(42.8%)	248(80.8%)	1		
Breast Infection History	Yes	49(63.6%)	30(9.8%)	16.158(2.8,32.3)	4.18(1.71,10.2)	0.014**
	No	28(36.4%)	277(90.2%)	1		

The family history of the respondent includes cancer-related diseases among close relatives such as their mother, sister, or aunt	Yes	24(31.2%)	22(7.2%)	5.86(3.067,11.2)	3.26(1.93,11.5)	0.0027**
	No	53(68.8%)	285(92.8%)	1		
The respondent has a family history of breast cancer among close female blood relatives, such as theirs mother, Sister.	Yes	18(23.4%)	9(3%)	10.11(4.3,23.57)	5.75(2.41,13.5)	0.0019**
	No	59(76.6%)	298(97%)	1		

**significant at p-value <0.01 and *significant at p-value <0.05. BMI, Body Mass Index; COR, crude odds ratio; AOR, adjusted odds ratio; COR=1 indicated no significance. Bolded Numbers were significantly associated with Breast Cancer (BC).

6. Discussion

This Health facility-based case-control study identified several determinant factors associated with breast cancer (BC) among women attending Asella Referral and Teaching Hospital in the Oromia Region, Ethiopia. Place of residence, age, physical activity, body mass index (BMI), fruit and vegetable intake, menopause status, abortion history, breastfeeding history, breast trauma, breast infection, family history of any cancer-related disease, and family history specifically breast cancer were independently associated with BC.

This study shows that women living in rural areas had 2.64 times higher odds of developing BC than urban residents. This is due to lower awareness, limited resource to screening and late stage diagnosis in rural setting. This study aligns with similar findings reported in Turkey, Egypt, and Ethiopia, where rural residence was linked to delayed care and late stage diagnosis (27,29,31). This suggests that strengthening rural health education and community based screening services and lifestyle promotions could improve early detection and outcomes among rural women (25,28,30).

Age was also a significant determinant of BC, with women aged 55 years and above at greater risk than younger women. This may be due to the prolonged hormonal imbalance and reduced immune function. Similar findings were observed in Addis Ababa, Malaysia, and Serbia, where older age was linked to higher BC incidence and screening participation (25,27,39). These findings highlight the importance of prioritizing regular screening and health education for women aged 40 years and above (28,33).

Low engagement in physical activities was found to increase BC risk nearly three times than women with regular physical activity practice, while women with BMI (25-29.9 kg/m²) (Overweight) were 6.34 times higher odds of developing BC compared to those of normal weight (BMI=18.5-24.9 kg/m²). This suggests that lifestyle factors contribute to overweight and/or obesity, hormonal imbalance, and insulin resistance, which may promote carcinogenesis. This finding is consistent with East Asia and Tanzania where elevated BMI increased BC risk across all molecular subtypes (37,39). The likely mechanism involves excess adipose tissue increasing estrogen and inflammatory cytokine levels.

Maintaining a healthy weight through dietary modification and physical exercise remains essential in BC prevention (32,33,35). This study align with the International Agency for Research on Cancer (IARC) report indicating that regular physical activity reduces BC risk by up to 30%-40% (32), and with the DEDiCa trial showing improved outcomes through lifestyle interventions (35). Promoting physical exercise at the community level is thus a low-cost and effective preventive measure against BC (32,33,34).

Low fruit and vegetable consumption was also significantly associated with BC. Women consuming vegetables and fruits less frequently were at higher risk of developing BC, suggesting that reduced intake of antioxidants and fiber may increase oxidative stress and hormonal deregulation. This agrees with findings from the Diana Web and DEDiCa trials, which showed improved outcomes among women adhering to plant-based diets (34,35). Encouraging consumption of fruits and vegetables supports both national nutrition goals and cancer prevention strategies (33).

Postmenopausal women had 1.25 times greater risk of developing BC, than premenopausal women. This may be due to hormonal disturbance, reduced estrogen clearance and higher body fat accumulation after menopause. Similar studies were reported in Malaysia, Tanzania, and Iraq (26,27,39). Targeted interventions for postmenopausal women focusing on hormonal monitoring and weight management could help mitigate this risk (30,33).

Previous history of abortion also significantly associated with BC, women with history of abortion had four times greater odds of developing BC compared to women who had not such history. This result aligns with studies from the Central African Republic and Ethiopia (38,42). The increased risk may be due to interrupted breast cell maturation, leaving tissue more vulnerable to carcinogenic changes. Strengthening reproductive health education and post-abortion counseling could reduce potential long-term health consequences (38,42).

Women who had never breastfed their child were more likely to develop breast cancer. This protective association aligns with findings from China and East Asia, where longer breastfeeding durations were linked to lower risk, especially for luminal and triple-negative BC subtypes (36,37). Breastfeeding reduces lifetime estrogen exposure and enhances breast tissue differentiation, underscoring its importance as a natural preventive factor (33,36).

Previous history of breast trauma and/or infection also had significant factors in developing BC. Women with a history of breast trauma had higher risk of developing BC, than those who had not such traumatic history. Similarly women with history of breast infection had 4.18 times greater odds of developing BC compared to women without such history. Those findings align with studies in Ethiopia, though direct causality remains debated (31,42). Improving awareness and ensuring timely treatment of breast injuries and infections could reduce the risk of developing BC.

Finally women with family history of any cancer-related disease and specifically breast cancer were highly significant in developing BC. Women with family history of any cancer-related disease had 3.26 times higher odds of developing BC. Similarly women with history of breast cancer specifically had 5.75 times greater odds of developing BC, than those without such history. This indicates that the hereditary components of breast cancer, potentially involving BRCA1/2 and other gene mutations. These findings align with studies from Spain, Afghanistan, Iraq, and Addis Ababa (26,40,41,42). This emphasizes the need for genetic counseling, family-based screening, and risk reduction programs to identify high-risk women early (40,43).

6.1 Conclusion and Recommendations

6.1.1 Conclusion

This health facility-based case-control study identified several determinants of breast cancer among women attending Asella Referral and Teaching Hospital in Oromia Region, Ethiopia. The findings demonstrate that determinants of breast cancer are shaped by interplay of socio-demographic, reproductive health, lifestyle, and familial factors. Women living in rural areas, those aged 55 years and above, low physical activity engagement, elevated body mass index and low fruit and vegetable consumption were more significantly increase the risk to develop breast cancer. Postmenopausal status, history of abortion, and history of breast trauma/infection were also associated with increased risk, while breastfeeding exerted a protective effect. Furthermore, women with family history of any cancer, particularly breast cancer, had markedly higher odds of developing the disease.

Prevention strategies and comprehensive health promotion service are essential, in emphasizing lifestyle modification through regular physical exercise, body weight management, and balanced diets rich fruits and vegetables. Context specific prevention also play a great role particularly regarding the benefits of breastfeeding practice and contraceptive use, should integrate into women's health service. Expanding access to rural communities by decentralizing BC screening and diagnostic services can improve early detection and diagnosis. Implementing these targeted, evidence-based interventions has the potential to substantially reduce breast cancer incidence, enhance timely diagnosis, and ultimately lessen the national disease burden.

6.1.2 Recommendations

For Public Health Practice

The Federal Ministry of Health (FMoH), with regional health bureaus and local media, should implement sustained community awareness campaigns emphasizing the role of regular physical activity, balanced diets, weight control, and avoidance of tobacco use in preventing breast cancer.

Primary health care and hospital professionals should encourage women especially those aged 55 years and above with family history of cancer to undergo routine clinical breast examinations, and, where available, mammographic screening.

The FMoH and maternal-child health programs should integrate education on the protective role of breastfeeding and safe contraceptive use into reproductive health services.

Regional health bureaus, Zone health office, NGOs and community health workers, should establish outreach and support programs to improve access to breast cancer prevention, screening, and diagnostic services for rural and low-income.

For Health Policy Makers

Policy makers should implement national guidelines that include risk stratification based on family history, reproductive patterns, and lifestyle behaviors to guide prevention and screening efforts.

Governmental and development partners should allocate sustainable funding for mobile clinics, diagnostic equipment, and laboratory capacity to expand early detection and treatment accessibility in rural settings.

The Ethiopian Public Health Institute (EPHI) should strengthen national cancer registries and surveillance systems to capture data on risk factors, incidence, stage at diagnosis, and treatment outcomes, supporting evidence-based decision-making.

For Further Research

Academic and biomedical research institutions should investigate the molecular, hormonal, and genetic profiles of breast cancer patients to clarify hereditary and subtype-specific risks in the Ethiopian population.

Social science and public health researchers should explore cultural, economic, and psychological barriers that hinder women's participation in screening and early diagnosis programs, particularly in rural and pastoralist communities.

Strengths and Limitations of the Study

Strengths

The study design was appropriate for identifying and quantifying associations between multiple potential determinant factors and breast cancer.

This design enabled the comparison of women with breast cancer and women without breast cancer under similar healthcare previous exposure

The study identifies several socio-demographic, reproductive, lifestyle, and familial variables, providing a holistic understanding of breast cancer determinants among women.

The study was conducted in a regional referral and teaching hospital, this reflects the real-world clinical and demographic diversity of women in the Oromia region, making the findings applicable to similar low-resource settings in Ethiopia

Limitations

As data were collected through intervened questionnaires, participants may have under- or over-reported certain exposures, leading to recall-bias.

Since the study participants were selected from a hospital setting, they may not fully represent the general population.

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9. ANNEXES

Annex 1: English version Information Sheet and Consent Form

Hello, Good morning/afternoon. My name is Tafes Dejen Mersha. I am inviting you to participate in a study we are conducting in this hospital. I would like to ask you some questions about breast cancer.

The aim of this study is to assess the determinants of breast cancer among oncologic women attending the oncologic unit at Asella Referral and Teaching Hospital. The information you provide will help in understanding and improving breast cancer care and awareness.

Your participation in this study is entirely voluntary. You can choose not to participate or to withdraw at any point without any consequences to your care or services at the hospital.

The purpose of this study is to examine the changing factors (determinants) associated with breast cancer among women currently receiving oncologic care. The data will be used to help inform better health services, increase awareness, and guide future interventions related to breast cancer.

Data will be collected through a face-to-face interview.

The interview will take approximately 30 minutes.

There are no physical risks involved, though you may experience minor discomfort from discussing sensitive topics.

There are no direct benefits or compensation to you for participating.

However, your participation may contribute to improved understanding and services for breast cancer patients in the future.

All the information you provide will be kept strictly confidential.

Your name will not be used in any reports or presentations.

Instead, a study number will be used, known only to the study team and yourself.

All personal and medical information will be securely stored and will not be shared without your permission.

If you have any questions at any time regarding this study, please contact:

☐ Study Contact Numbers:

+251-924-543-964 or +251-708-543-964

☐ Principal Investigator:

Tafes Dejen Mersha (Arsi University, Collage of Health Sciences, Department of public Health)

Tel: +251-924-543-964

Participant Consent:

I have been asked to participate in this study. I have received information regarding the procedures, risks, rights as a participant, and the purpose of the study.

I understand that:

Participation is voluntary.

I may withdraw at any time.

This consent form does not waive my legal rights or relieve the investigators of any responsibility.

I freely agree to participate in this research study.

Name of Participant: _____

Date and Signature: _____

Study Number: _____

Annex 2: English version of Questionnaire

Section 1: Sociodemographic characteristics		
SN	Question	Response
101	Ages of respondents	15-24
		25-44
		45-54
		≥55
102	Marital status	1. Single 2. Married 3. Divorced 4. Widowed
103	Place of residence	1. Urban, 2. Rural

104	Education status	1. Cannot read and write 2. Read and write. 3. Primary school Secondary school 4. Collage and above
105	Occupational	1. House wife 2. Government employ 3. Self employe 4. Trader 5. Daily labored 6. No job
106	Religion	1. Orthodox 2. Muslim 3. Protestant
107	Ethnicity	1) Oromo 2) Amhara 3) Tigre 4) Specify if other-----
108	Level of education of your husband	1. Cannot read and write 2. Read and write. 3. Primary school Secondary school 4. Collage and above 5. College or university
109	What is your Monthly Family income?	Ethiopian Birr per month
Section 2: Life Style Factors		
201	Do you engage in regular physical activity?	1. Yes, 2. No
202	If yes, what is the intensity of your physical activity?	1) Light, 2) Moderate, 3) Heavy

203	How many times per week do you eat fruits or vegetables?	1. 1-2days/week, 2. 3-4 days/week 3. 5-6 days/week
204	Do you regularly consume smoked meat?	1. Yes, 2. No
205	Do you frequently consume packed/processed foods?	1. Yes, 2. No
206	Have you ever undergone a mammogram screening?	1. Yes, 2. No
207	Do you practice regular breast self-examination?	1. Yes, 2. No
208	What is your height and weight	1. Height..... 2. Weight.....
209	Your current Body Mass Index (BMI)?	1) Underweight, 2) Normal weight, 3) Overweight/Obese
210	Have you ever smoked cigarettes?	
211	If yes, are you a current or former smoker?	1) Active smoker, 2) Passive smoker
212	For how many years have you smoked?	__ years)
213	On average, how many cigarettes do you smoke per day?	: __ cigarettes/day)
Section 3 Reproductive History Factors		
301	What is your current menopausal status?	1) Premenopausal, 2) Menopausal
302	If menopausal, at what age did you reach menopause?	1. ≤ 45 years, 2. 46–54 years, 3. ≥ 55 years
303	Have you ever had an abortion?	1) Yes 2) No
304	Are your menstrual periods regular?	1) Yes 2) No

305	At what age did you have your first menstrual period?	1) ≤ 12 years, 2) 13–16 years, 3) ≥ 16 years
306	Have you ever used oral contraceptives?	1) Yes, 2) No
307	How long have you used contraceptives (in years)?	1) ≤ 4 years, 2) > 4 years
308	At what age did you give birth to your first child?	1. ≤ 20 years, 2. 21–29 years, ≥ 30 years
309	Have you ever breastfed your children?	1) Yes 2) No
310	Have you ever experienced any trauma/injury to the breast?	1) Yes 2) No
311	Have you ever had an infection in your breast(s)?	1) Yes 2) No
Section 4 Family History Factors		
401	Has any of your close blood relatives (e.g., mother, sister, aunt) ever been diagnosed with any type of cancer?	1) Yes 2) No
402	If yes, please specify the relative(s) and the type(s) of cancer (if known):	specify →
403	Has any of your close blood relatives ever been diagnosed specifically with breast cancer?	1) Yes 2) No
404	If yes, please indicate who (e.g., mother, sister, aunt):	specify-----

Annex 3: Afaan Oromo (local language) version information sheet and consent form

Akkam jirtu, бага nagaan dhuftan. Maqaan koo _____. Qorannoo kana keessatti hirmaachuuf si affeerra. Gaaffiiwwan muraasa kan akka kaansarii harmaa (Breast cancer) irratti sitti dhiyeessa.

Kaayyoon qorannoo kanaa, sababaalee fi haala kaansarii harma kan dubartoota yaala kaansarii fidan, Hospitaala Gargaarsa fi Barnoota Asallaatti argamanii qorachuu dha. Odeeffannoo ati kennitu kun, yaala kaansarii saalaa fi beekumsa irratti gargaarsa guddaa fiduuf ni tajaajila.

Hirmaannaan kee qorannoo kana keessatti fedhii kee irratti hunda'aa dha. yeroo kamiyyuu addaan kutuun ni danda'ama, kunis yaala ykn tajaajila hospitaala keessatti rakkoo tokko illee hin fidu.

Kaayyoon qorannoo kanaa, sababaalee fi haala kaansarii saalaa yeroo ammaa yaala argatan dubartoota irratti qorachuun jijjiiramaa fi bu'uuraalee gosa kaansarii saalaa irratti ibsa guutuu dhiyeessuudha. Odeeffannoo argannu kun, tajaajiloota fayyaa fooyyessuuf, beekumsa dabaluuf, fi yaada furmaataa kaansarii saalaa ilaalchisee deeggarsa kennuuf ni tajaajila.

Odeeffannoon, haala marii fuula dura kallatii irratti qoratama.

Marii kunis daqiiqaa 30 fudhata.

Rakkoo qaama irratti hin jiru, garuu dhimma kaansarii saalaa irratti yaada gahaa fi balaa xiqqaa hubachuu danda'ama.

Hirmaannaa keessan irraa bu'aa itti fufaa fi gatii tokko hin jiru, garuu hirmaannaan keessan kan si'a booda kaansarii saalaa irratti yaada fi tajaajila fooyyessuuf gumaacha guddaa gochuu danda'a.

Odeeffannoo ati kennitu hunda guutummaatti tajaajilamaa fi eyyama malee hin raawwatamu.

Maqaan kee qorannoo fi gabaasa irratti hin fayyadama, lakkoofsa qorannoo tokko kan ittiin beekamu malee.

Odeeffannoon hunda, kan ati kenitee fi garee qorannoo qofa beekamu, kunis haala amma qunnamtii keessa jiru irraa garaa garummaan eyyama malee hin raawwatamu.

Hojii qorannoo kanaa ilaalchisee yeroo kamiyyuu gaaffii yoo qabaatte nu quunnamii:

☐ Lakkoofsa Hirmaannaa Qorannoo:

Tel: +251-924-543-964 ykn +251-708-543-964

☐ Qorataa Duraanii:

Taaffas Dajan Marshaa (Yuunivarsitii Arsi, Kollejjii Saayinsii Fayyaa, Kutaa Fayyaa Hawaasaa)

Tel: +251-924-543-964

Mallattoo Hirmaataa:

Ani qorannoo kana keessatti hirmaachuuf affeeramee jira. Odeeffannoo hojii qorannoo, balaa fi mirga kootti kan hirmaataa ta'eefi kaayyoo qorannoo irratti argameera.

Nan hubadha:

Hirmaannaan koo fedhii kiyya irratti hunda'aa dha.

Yeroo kamiyyuu ni bahuu danda'a.

Mallattoo kana mallatteessuun mirga koo seeraa ni dhoowwu.

Qorannoo kana keessatti hirmaachuuf wal-hubannoo fi fedhii koo ni eeyyama.

Maqaa Hirmaataa: _____

Guyyaa fi Mallattoo: _____

Lakkoofsa Qorannoo: _____

Annex 4: Afaan Oromoo (local language) version questionnaire

Kutaa Iffaa: Amaloota Hawaasummaa fi Namummaa (Sociodemographic Characteristics)		
Lakkoofsa	Gaaffii	Filannoowwan (Options)
101	Umrii	15-24
		25-44
		45-54
		≥55
102	Haala gaa'ellaa	1.hin heerumne/ hin funee 2. Heerumte/fudhee 3. Wal- hikan 4. Jala du'ee
103	Bakka Jireenyaa	1. Magaalaa 2. Baadiyyaa
104	Sadarkaa Barnootaa	1. Dubbisuu fi barreessuu hin danda'u 2. Dubbisuu fi barreessuu danda'a 3. Sadarkaa tokkoffaa/lammataa

		4. Kollejji fi isaa ol 5. Yuunivarsiitii fixee
105	Hojii	1. Haadha manaa 2. Hojjetaa mootummaa 3. Ofiin hojjetaa 4. Daldalaa 5. Hojii guyyaa guyyaa 6. Hojii hin qabu 7. Ibsi yoo ka biroo ta'e:
106	Amantii	1. Ortodoksii 2. Musliimaa 3. Pirootestaantii 4. Ibsi yoo ka biroo:
107	Saba	1. Oromoo 2. Amaaraa 3. Tigree 4. Ibsi yoo ka biroo:
108	Barnoota Abbaa Warraa	1. Dubbisuu fi barreessuu hin danda'u 2. Dubbisuu fi barreessuu danda'a 3. Sadarkaa tokkoffaa/lammataa 4. Kollejji fi ol 5. Yuunivarsiitii fixee
109	Galii maatii baatii tokko keessatti	_____ Birrii Itoophiyaa
Kutaa 2ffaa: Haala Jiraachuu fi Soorata (Lifestyle Factors)		
Lakkoofsa	Gaaffii	Filannoowwan (Options)
201	Sochii qaamaa yeroo yerootti raawwatta?	1. Eeyyee 2. Lakki
202	Jabina sochii keetii?	1. Laafaa 2. Giddu galeessa 3. Cimaan

203	Torbanitti yeroo meeqa muduraa nyaatta?	1. 1-2 yeroo/torbani 2. 3-4 yeroo/torbani 3.5-6 yeroo/torbani
204	Foon arraan gubatee yeroo hunda nyaatta?	1. Eeyyee 2. Lakki
205	Nyaata ashagammaa yeroo hunda nyaatta?	1. Eeyyee 2. Lakki
206	Miidhaa harma siirra ga'ee jira?	1. Eeyyee 2. Lakki
207	Xinxala harmaa (mammogram) goote?	1. Eeyyee 2. Lakki
208	Harma ofii yeroo yeroon harka ofiin shukkumun ni ilaaltu?	1. Eeyyee 2. Lakki
209	Dheeraa fi ulfaatina kee	1. Dheeraa: _____ 2. Ulfaatina: _____
210	BMI kee amma	1. Salphaa 2. Sirrii 3. Cima/Buqqee
211	Sigaraa arsaa turte?	1. Eeyyee 2. Lakki
212	Yoo eeyyee, amma moo dur?	1. Amma urgaaftuu 2. Dur turte
213	Waggaa meeqaaf sigaraa fayyadamte?	_____ waggaa
214	Guyyaa tokkoti sigaraa meeqa urgaaftu?	_____ sigaraa/guyyaa
Kutaa 3ffaa: Seenaa Hirmaannaa Dubartummaa (Reproductive History)		
Lakkoofsa	Gaaffii	Filannoowwan (Options)
301	Haala ulfina keeti amma	1. Dura ulfina 2. Ulfina
302	Waggaa meeqa irratti ulfina dhaabu geesse?	1. ≤ 45 2. 46–54

		3. ≥ 55	
303	Ulfaa cabsuu/addan kutee goote?	1. Eeyyee 2. Lakki	
304	Yeroo lagu dhiigaa asiin duraa sirriidha?	1. Eeyyee 2. Lakki	
305	Yeroo jalqaba lagu dhiigaa argitte?	1. ≤ 12 2. 13–16 3. ≥ 16	
306	Qoricha ittisa ulfaa nifayyadamta?	1. Eeyyee 2. Lakki	
307	Waggaa meeqaaf fayyadamte?	1. ≤ 4 2. > 4	
308	Yeroo jalqabaaf deessu umriin meqaa?	1. ≤ 20 2. 21–29 3. ≥ 30	
309	Ilmaan kee harma sirnaan hosiiftee?	1. Eeyyee 2. Lakki	
310	Miidhaan harma kee irratti si mudate beekka?	1. Eeyyee 2. Lakki	
311	Dhukkuba harmaa si mudate?	1. Eeyyee 2. Lakki	
Kutaa 4ffaa: Seenaa Maatii Dhukkubaa (Family History)			
Lakk	Gaaffii	Filannoowwan (Options)	
401	Maatiin dhiiga si waliin qabu dhukkuba kansarii qabamee?	1. Eeyyee 2. Lakki	
402	Eyyeen yoo ta'e, kamsarii goosa kami?	-----	
403	Maatiin dhukkuba kansarii harmaatiin qabamee jira?	1. Eeyyee 2. Lakki	
404	Eyyen yoo ta'e eenyuun?	-----	

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Annex 6: Amharic (local language) version questionnaire

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103	□□□□□ □□	1. □□□ 2. □□□
104	□□□□□□ □□□	1. □□□□ □□□□□ 2. □□□□ □□□□ 3. □□□□□□ □□□ 4. □□□□ □□□ 5. □□□□ □□□ □□□

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106	□□□□□	1. □□□□□□ 2. □□□□ 3. □□□□□□□
107	□□□□□	1. □□□ 2. □□□ 3. □□□
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203	□□□□□ □□□ □□□□ □□□□□ □□□ □□□□□□□ □□□□□?	1. 1-2 □□ 2.3-4 □□ 3.5-6 □□
204	□□□□□□□ □□□ □□□ □□□□□□□?	1. □□ 2. □□
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210	□□□□ □□□□ □□□ (BMI)	1. □□□□ □□□ 2. □□□□ 3. □□□□ □□□/□□□□
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302	□□□ □□□□□ □□□ □□ □□□□□ □□□□□ □□□ □□ □□?	1. ≤ 45 □□□ 2. 46–54 □□□ 3. ≥ 55 □□□
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307	□□□□ □□□□□□□□ □□□ □□□ □□ □□□□□□?	1. ≤ 4 □□□ 2. > 4 □□□
308	□□□□□□ □□□□ □□□□□ □□□ □□ □□□□□?	1. ≤ 20 2. 21–29 3. ≥ 30
309	□□□□□□ □□ □□□□?	1. □□ 2. □□
310	□□□□ □□ □□□□□□ □□□□ / □□□□ □□□□□□ □□□□?	1. □□ 2. □□
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404	□□ □□□.....	

Declaration of Investigator

I, the undersigned student of the Master of Public Health program, declare that this thesis is my original work, submitted in partial fulfillment of the requirement for the degree of Master of Public Health in General Public Health, to the best of my knowledge.

Name of investigator: Tafes Dejen Mersha

Signature: _____

Date: December 12, 2025.

Declaration of Advisors

We, the undersigned, hereby declare that we have carefully reviewed this thesis and provided guidance for its preparation. We confirm that this thesis is ready for defense with our approval as the university advisor(s), and to the best of our knowledge, the work presented meets the academic standards and is in partial fulfillment of the requirements for the degree of Master of Public Health in General Public Health.

1. Name of Principal Advisor: Dr. Solomon Tejineh (PHD)

Signature: _____

Date: December 11, 2025.

2. Name of Co-Advisor: Dr. Gebi Hussien (PHD)

Signature: _____

Date: December 11, 2025.

Examiners' Declaration

We, the undersigned examiners, hereby declare that we have thoroughly examined the thesis presented for the degree of Master of Public Health in General Public Health. After careful review and defense of the thesis, we confirm that it meets the academic standards and requirements of the university. We hereby approve the thesis and consent to the student proceeding with the next steps toward completing the full thesis, which is required for the award of the degree.

Name of Examiner 1: _____

Signature: _____

Date: _____

Name of Examiner 2: _____

Signature: _____

Date: _____