

Adiposity and dietary indicators in premenopausal and postmenopausal women attending a breast cancer screening service in Peru

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ABSTRACT

Background: Breast cancer is a leading cause of morbidity and mortality in Peru and worldwide. In addition to screening and early detection, lifestyle-related factors such as adiposity and dietary behaviors are relevant in cancer prevention. However, data describing these indicators in Latin American women attending screening services remain limited.

Objective: To compare anthropometric and dietary indicators between premenopausal and postmenopausal Peruvian women attending screening mammography, and to explore their distribution according to mammographic classification.

Materials and Methods: A cross-sectional study was conducted among 99 women attending the League Against Cancer in Arequipa, Peru. Anthropometric and dietary indicators potentially associated with breast cancer risk were assessed using food frequency questionnaires and standardized anthropometric measurements. Comparative and exploratory analyses were performed to examine differences according to menopausal status and to describe patterns of adiposity and lifestyle-related risk indicators.

Results: The median age was 50 years, 40.4% of participants were premenopausal and 59.6% were postmenopausal. Most participants had BI-RADS classifications ≤ 2 , limiting exploratory analyses of mammographic findings. A high prevalence of central and total adiposity was observed in the overall sample: 80.8% had a waist circumference ≥ 88 cm, 82.8% had

fat mass $\geq 33.8\%$, and 97.9% had relative fat mass $\geq 33.9\%$. Most participants reported low intake of red and processed meat, alcohol, and sugary beverages, while added sugar consumption was relatively frequent. Anthropometric and dietary indicators were similar between premenopausal and postmenopausal women.

Conclusion: In this screened population, central and total adiposity were highly prevalent despite relatively low self-reported intake of several selected dietary risk-related items. These findings are descriptive and highlight the need for larger prospective studies with validated instruments to examine how adiposity and lifestyle patterns relate to mammographic findings and breast cancer risk in Latin American women.

KEYWORDS

Breast Neoplasms; Body Composition; Adiposity; Waist-Height Ratio; Risk Factors; Peru (Source: MeSH NLM).

LIST OF ABBREVIATIONS

AICR: American Institute for Cancer Research.

aWC: Abdominal Waist Circumference.

BI-RADS: Breast Imaging Reporting and Data System.

BMI: Body Mass Index.

cWC: Crestal Waist Circumference.

FM: Fat Mass.

IQR: Interquartile Range.

ISAK: International Society for the Advancement of Kinanthropometry.

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RFM: Relative Fat Mass.

SD: Standard Deviation.

WC: Waist Circumference.

WHR: Waist-to-Hip Ratio.

WHtR: Waist-to-Height Ratio.

WCRF: World Cancer Research Fund.

INTRODUCTION

Breast cancer is one of the leading causes of cancer-related morbidity and mortality among women in Peru and world-wide¹. Early detection through mammographic screening can improve prevention and treatment, while primary prevention strategies include promoting healthy body weight, physical activity, and healthy dietary patterns^{2,3}. In this regard, evidence suggests that adopting a healthy dietary pattern, including plant-based, anti-inflammatory, mediterranean, and other favorable dietary patterns, which include whole grains, nuts, legumes, fruits, vegetables, fish, and dairy products, may help reduce the risk of cancer, especially breast cancer⁴.

In addition to dietary factors, women are exposed to other non-dietary risk factors, such as the frequent and prolonged use of hormonal contraceptives⁵ or the omission of annual screenings, despite their importance as a protective measure⁶. Another relevant factor is the body fatness, particularly the obesity, which has been linked more than 13 types of cancer in woman^{7,8}. Excess body fat is associated with a higher risk of developing between 10 and 26 types of cancer in countries like the United Kingdom and Spain, respectively^{9,10}.

Anthropometric assessment may help characterize adiposity patterns that are relevant to cancer prevention research and can complement the description of dietary and lifestyle-related exposures¹¹. The World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) recommends breast cancer prevention through controlling body fatness, physical activity, energy density, and plant-based diets, as well as the consumption of alcoholic drinks and processed meats, among other things^{12,13}.

The association between body fat, diet, and cancer risk highlights the importance of reassessing a healthy lifestyle as a preventive strategy. In this sense, measuring adiposity could be useful for understanding how higher levels of body fat may be associated with an increased risk of cancer development. However, the evidence linking these anthropometric indicators to breast cancer risk factors in Latin American women is limited.

Therefore, the aim of this study was to compare anthropometric and dietary indicators between premenopausal and postmenopausal Peruvian women attending screening mammography, and to explore their distribution according to mammographic classification.

METHODS

A cross-sectional descriptive study was conducted in August 2021 among women aged 18 years or older who attended the mammography unit of the League Against Cancer in Arequipa, Peru. Women were recruited at the time of their routine visit to the service. Pregnant and obese women were excluded. The study was carried out during the COVID-19 pandemic, a context that may have influenced healthcare-seeking behavior, lifestyle patterns, and service utilization. The sample size ($n=99$) was estimated using the number of mammograms performed in 2020 ($n=1435$), assuming a 95% confidence level, an expected proportion of 22.9%, and a margin of error of 8%.

Information was collected using a structured questionnaire that included sociodemographic characteristics, reproductive history, selected lifestyle factors, and mammographic findings. Menopausal status was classified based on self-report as premenopausal or postmenopausal. Additional variables included age at menarche, parity, age at first birth, history of hormonal contraceptive use, smoking status, physical activity, family history of cancer, and frequency of mammographic screening.

Dietary intake was assessed using a brief 17-item food frequency questionnaire designed to characterize the usual frequency of consumption of selected food groups and behaviors considered relevant in cancer prevention, based on recommendations from the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR)³. The questionnaire included items on red meat, processed meat, fried foods, fast foods, sugar-sweetened drinks, sugary foods, fruits, vegetables, legumes, olive oil, and timing of the last meal. This instrument was used to describe self-reported dietary behaviors rather than to quantify nutrient intake or overall diet quality. Mammographic findings were obtained from the clinical record and classified according to the Breast Imaging Reporting and Data System (BI-RADS)¹⁴.

Anthropometric measurements were conducted following standardized protocols of the International Society for the Advancement of Kinanthropometry (ISAK)¹⁵. The anthropometrists measured weight, height, circumferences (abdominal, waist, hip), skinfolds (biceps, triceps, subscapular, and suprailiac), and body diameters. From these measurements, Body Mass index (BMI), Waist-to-Hip Ratio (WHR), Waist-to-Height Ratio (WHtR), Conicity Index, Fat Mass (FM), and Relative Fat Mass (RFM) were derived using established equations. Cut-off points, based on previous studies, included $WHR \geq 0.85$ ¹⁶, FM and $RFM \geq 33.8\%$ ¹⁷, Waist Circumference (WC) > 88 cm¹⁸. FM was calculated according to Siri et al.¹⁹, from body density according to Durnin and Womersley²⁰; this was based on skinfold thicknesses. RFM was calculated following the equation proposed by Woolcott and Bergman²¹. To minimize measurement bias, calibrated instruments were used (Rosscraft Gaucho Kit, Slim Guide caliper, non-extensible

metal tape, OMRON scale). Measurements were replicated three times, with the mean value recorded.

Descriptive statistics were calculated using means and standard deviations or medians and interquartile ranges, depending on data distribution. Categorical variables were summarized using absolute and relative frequencies. All analyses were stratified by menopausal status (premenopausal and postmenopausal). Comparisons between groups were performed using Two sample t-test or Welch's t-test for continuous variables and Fisher's exact test for categorical variables. Correlations between anthropometric measurements and body composition indices were also explored to characterize adiposity.

A two-stage analytical approach was applied to identify variables associated with BI-RADS risk classification. In the initial phase, a Random Forest algorithm (comprising 500 trees) was employed to screen candidate variables and assess their relative importance through the mean decrease accuracy and mean decrease Gini metrics. This procedure enabled the selection of variables with elevated discriminative capacity for BI-RADS classification, incorporating RFM, physical activity, and age at menarche.

In the second stage, the selected variables were entered into a binomial regression model (Log-Binomial). A log-link function was employed to directly estimate Prevalence Ratios (PR) and their 95% Confidence Intervals (95% CI), an approach recommended for cross-sectional studies to avoid risk overestimation associated with odds ratios. To address the numerical instability of the log-link function and the reduced effective sample size ($n=63$), model estimation was performed using Firth's penalized maximum likelihood method (brglmFit). This methodological approach ensured convergence and minimized bias related to small sample sizes and potential data separation. The results were then summarized using the gtsummary package, with statistical significance set at $p < 0.05$.

All statistical analyses were conducted using R version 4.0.2 (GNU General Public License)²², employing the randomForest and brglm2 packages.

The study was approved by the Institutional Research Ethics Committee of Clínica Avendaño (Code: 012-2021-CIEI). Written informed consent was obtained from all participants prior to enrollment. Data were collected and processed confidentially and anonymously, in accordance with the principles of the Declaration of Helsinki.

RESULTS

A total of 99 women were included in the study. The median age was 50.0 years (IQR: 45.5 – 56.0), and 40.4% were classified as premenopausal and 59.6% as postmenopausal. As expected, postmenopausal women were older than premenopausal women (median 54.0 vs 44.5 years; $p < 0.001$).

Educational level also differed between groups; postmenopausal women reported a higher frequency of higher education and only primary education or no education (Table 1).

No clear differences were observed between menopausal groups in age at menarche, parity, age at first birth, hormonal contraceptive use, smoking status, screening frequency, or physical activity. In the overall sample, 13.1% were nulliparous, 50.5% had never used hormonal contraceptives, and 39.4% were classified as physically inactive. Most women had mammographic findings classified as BI-RADS 0 to 2, and only three participants were classified as BI-RADS ≥ 3 (Table 1). Only 8 (8.1%) women had a first- to third-degree relative with breast cancer, but 40 (40.4%) of the women had a close relative with cancer in general.

Regarding dietary factors, consumption of foods associated with higher breast cancer risk was generally low and similar between groups. More than 70% of participants reported consuming fewer than three servings of red meat per week and less than one daily serving of processed meat. Frequent consumption of fried foods, fast food, and sugar-sweetened drinks was also low and did not differ between pre- and postmenopausal women. The only dietary factor that differed between groups was timing of the last meal, with dinner before 22:00 hours being more frequent among postmenopausal women (89.8%) than premenopausal women (75.0%; $p=0.043$). Intake of fruits, vegetables, legumes, and olive oil was generally moderate, with no significant differences according to menopausal status (Table 2).

With respect to anthropometric indicators, the median of BMI was 26.4 kg/m² (IQR 24.4 – 27.5), with no differences between groups. A high prevalence of central and total adiposity was observed in the sample. Overall, 80.8% had a WC ≥ 88 cm and 94.9% a WHR ≥ 0.85 , with no significant differences by menopausal status. Likewise, 82.8% had FM $\geq 33.9\%$ and 98.0% had RFM $\geq 33.8\%$. Tricipital skinfold values and other indicators of subcutaneous adiposity were mostly within ranges considered normal, with no differences between groups (Table 3). The variables that demonstrated a Spearman correlation greater than 60 with FM were the suprailiac, subscapular, and biceps skinfold thicknesses, and average WC. Concurrently, RFM demonstrated a correlation only with BMI (Supplementary Figure 1).

Because only three women had BI-RADS classifications ≥ 3 , any analysis involving this outcome was severely limited by sparse data. The exploratory analysis using Random Forest identified RFM, physical activity, and age at menarche as the variables with the highest discriminative capacity for BI-RADS classification (≤ 2 vs ≥ 3). Notably, BMI was excluded from the final model in favor of RFM, as the latter provides a more precise estimation of abdominal adiposity and body composition. No statistically significant associations were observed in the adjusted model (Table 4). The RFM showed a PR of 1.26 (95%

Table 1. Sociodemographic characteristics and non-dietary factors by menopausal status

Variable	All women	Menopausal status		p value*
	(n=99)	Premenopausal (n=40)	Postmenopausal (n=59)	
Age (years) – Median (IQR)	50.00 (45.50; 56.00)	44.50 (42.00; 48.00)	54.00 (49.50; 60.00)	< 0.001
Educational level – n (%)				
None/Primary	19 (19.2)	3 (7.5)	16 (27.1)	0.041
Secondary	19 (19.2)	10 (25)	9 (15.3)	
Higher	61 (61.6)	27 (67.5)	34 (56.6)	
Age at menarche (years) – n (%)				
<12	20 (20.2)	11 (27.5)	9 (15.3)	0.202
≥12	79 (79.8)	29 (72.5)	50 (84.7)	
Parity – n (%)				
Nulliparity	13 (13.1)	5 (12.5)	8 (13.6)	0.582
Age at first birth < 30 years	71 (71.7)	27 (67.5)	44 (74.6)	
Age at first birth ≥ 30 years	15 (15.2)	8 (20.0)	7 (11.9)	
Hormonal contraception (years of use) – n (%)				
Never used	50 (50.5)	18 (45.0)	32 (54.2)	0.757
< 1	19 (19.2)	7 (17.5)	12 (20.3)	
< 5	15 (15.2)	7 (17.5)	8 (13.6)	
5 to 10	11 (11.1)	6 (15.0)	5 (8.5)	
> 10	4 (4.0)	2 (5.0)	2 (3.4)	
Screening mammography (number per year) – n (%)				
≥ 1	27 (27.3)	10 (25.0)	17 (28.8)	0.25
< 1	44 (44.4)	15 (37.5)	29 (49.2)	
First time	28 (28.3)	15 (37.5)	13 (22.0)	
Smoking – n (%)				
Never	90 (90.9)	34 (85.0)	56 (94.9)	0.086
Current	7 (7.1)	5 (12.5)	2 (3.4)	
Former (1 unit/day)	1 (1.0)	1 (2.5)	0 (0)	
Former (15 unit/day)	1 (1.0)	0 (0)	1 (1.7)	
Physical activity – n (%)				
Intense (1.5 hours/week)	16 (16.2)	8 (20.0)	8 (13.6)	0.73
Moderate (3 to 4 hours/week)	16 (16.2)	5 (12.5)	11 (18.6)	
Low (< 30 minutes/week)	28 (28.3)	12 (30.0)	16 (27.1)	
Inactive	39 (39.4)	15 (37.5)	24 (40.7)	
BI-RADS – n (%)				
0	25 (25.3)	12 (30.0)	13 (22.0)	0.57
1	36 (36.4)	12 (30.0)	24 (40.7)	
2	35 (35.4)	14 (35.0)	21 (35.6)	
3	2 (2.0)	1 (2.5)	1 (1.7)	
4	1 (1.0)	1 (2.5)	0 (0.0)	

* p values were from Fisher's exact test for categorical variables and Two-sample t-test for continuous variables. IQR: Interquartile range.

Table 2. Dietary factors associated with breast cancer by menopausal status

Variables	All women (n=99)	Menopausal status		p value*
		Premenopausal (n=40)	Postmenopausal (n=59)	
Red meats (3 portions equivalent to about 350 – 500 g/week) – n (%)				
<3	71 (71.7)	28 (70.0)	43 (72.9)	0.430
≥3	22 (22.2)	8 (20.0)	14 (23.7)	
Processed meats (slices or sausages/day) – n (%)				
<1	71 (71.7)	32 (80.0)	39 (66.1)	0.224
≥2	3 (3.0)	0 (0)	3 (5.1)	
High temperature meats (servings/week) – n (%)				
<1	68 (68.7)	26 (65.0)	42 (71.2)	0.616
1-2	20 (20.2)	8 (20.0)	12 (20.3)	
≥3	3 (3.0)	1 (2.5)	2 (3.4)	
Fried foods (servings/week) – n (%)				
≤1	60 (60.6)	25 (62.5)	35 (59.3)	0.751
≥2	33 (33.3)	12 (30.0)	21 (35.6)	
Fast foods (servings/week) – n (%)				
<1	43 (43.4)	18 (45.0)	25 (42.4)	0.799
1	10 (10.1)	3 (7.5)	7 (11.9)	
≥2	3 (3.0)	2 (5.0)	1 (1.7)	
Sugar added (teaspoons/day) – n (%)				
1-2	27 (27.3)	10 (25.0)	17 (28.8)	0.779
3-5	27 (27.3)	10 (25.0)	17 (28.8)	
≥6	24 (24.2)	11 (27.5)	13 (22.0)	
Monthly	2 (2.0)	0 (0)	2 (3.4)	
Sugary drinks (drinks/week) – n (%)				
1-2	27 (27.3)	11 (27.5)	16 (27.1)	0.773
7	4 (4.0)	1 (2.5)	3 (5.1)	
Monthly	32 (32.3)	15 (37.5)	17 (28.8)	
Sugary foods (portions/week) – n (%)				
1-3	36 (36.4)	14 (35.0)	22 (37.3)	0.650
>3	5 (5.1)	1 (2.5)	4 (6.8)	
Monthly	47 (47.5)	19 (47.5)	28 (47.5)	
Nighttime eating (hours) – n (%)				
<10:00 pm	83 (83.8)	30 (75.0)	53 (89.8)	0.043
>10:00 pm	1 (1.0)	0 (0)	1 (1.7)	
Egg (units/week) – n (%)				
<2	9 (9.1)	5 (12.5)	4 (6.8)	0.401
≥2	85 (85.9)	32 (80.0)	53 (89.8)	
Monthly	4 (4.0)	2 (5.0)	2 (3.4)	

* p values were from Fisher's exact test for categorical variables.

Table 2 continuation. Dietary factors associated with breast cancer by menopausal status

Variables	All women (n=99)	Menopausal status		p value*
		Premenopausal (n=40)	Postmenopausal (n=59)	
Fruits (portions/day) – n (%)				
<3	67 (67.7)	26 (65.0)	41 (69.5)	0.553
≥3	26 (26.3)	10 (25.0)	16 (27.1)	
Weekly	2 (2.0)	1 (2.5)	1 (1.7)	
Vegetables (portions/day) – n (%)				
<1	18 (18.2)	7 (17.5)	11 (18.6)	0.977
1	54 (54.5)	22 (55.0)	32 (54.2)	
≥2	18 (18.2)	8 (20.0)	10 (16.9)	
Legumes (portions/week) – n (%)				
1	59 (59.6)	20 (50.0)	39 (66.1)	0.251
≥2	2 (2.0)	1 (2.5)	1 (1.7)	
≥3	30 (30.3)	16 (40.0)	14 (23.7)	
Monthly	5 (5.1)	1 (2.5)	4 (6.8)	
Olive oil (Use type) – n (%)				
Crude	52 (52.5)	17 (42.5)	35 (59.3)	0.108
Fried	5 (5.1)	1 (2.5)	4 (6.8)	

* p values were from Fisher's exact test for categorical variables.

Table 3. Anthropometric characteristics of participants by menopausal status

Risk indicators	All women (n=99)	Premenopausal (n=40)	Postmenopausal (n=59)	p value*
BMI (Kg/m ²) – Median (IQR)	26.44 (24.38 – 27.45)	26.50 (24.45 – 27.40)	26.19 (24.38 – 27.60)	0.678
Conicity Index – Median (IQR)	1.34 (1.30 – 1.39)	1.31 (1.28 – 1.35)	1.38 (1.31 – 1.41)	0.012
aWC cut-off (cm) – n (%)				
< 88 (normal)	17 (17.17)	9 (52.94)	8 (47.06)	0.285
≥ 88 (high)	82 (82.83)	31 (37.80)	51 (62.20)	
cWC cut-off (cm) – n (%)				
< 88 (normal)	25 (25.25)	12 (48.00)	13 (52.00)	0.480
≥ 88 (high)	74 (74.75)	28 (37.84)	46 (62.16)	
WC cut-off (cm) – n (%)				
< 88 (normal)	19 (19.19)	11 (57.89)	8 (42.11)	0.118
≥ 88 (high)	80 (80.81)	29 (36.25)	51 (63.75)	
WHtR – Median (IQR)	0.60 (0.57 – 0.63)	0.59 (0.57 – 0.61)	0.61 (0.58 – 0.64)	0.006
WHR cut-off – n (%)				
< 0.85 (normal)	5 (5.1)	3 (60.0)	2 (40.0)	0.390
≥ 0.85 (high)	94 (94.9)	37 (39.84)	57 (60.6)	
FM cut-off (%) – n (%)				
< 33.9 (normal)	17 (17.17)	6 (35.29)	11 (64.71)	0.788
≥ 33.9 (high)	82 (82.83)	34 (41.46)	48 (58.54)	
RFM cut-off (%) – n (%)				
< 33.8 (normal)	2 (2.02)	2 (100.00)	0 (0)	0.161
≥ 33.8 (high)	97 (97.98)	38 (39.18)	59 (60.82)	

* p values were from the Two sample t-test or Welch's t-test for continuous variables and Fisher's exact test for categorical variables. Abbreviations: aWC, abdominal Waist Circumference; cWC, crestal Waist Circumference; WC, Waist Circumference (average); BMI, Body Mass Index; WHR, Waist-to-Hip Ratio; WHtR, Waist-to-Height Ratio; FM, Fat Mass; RFM, Relative Fat Mass; IQR, Interquartile Range. * p values were from the Two sample t-test or Welch's t-test for continuous variables and Fisher's exact test for categorical variables.

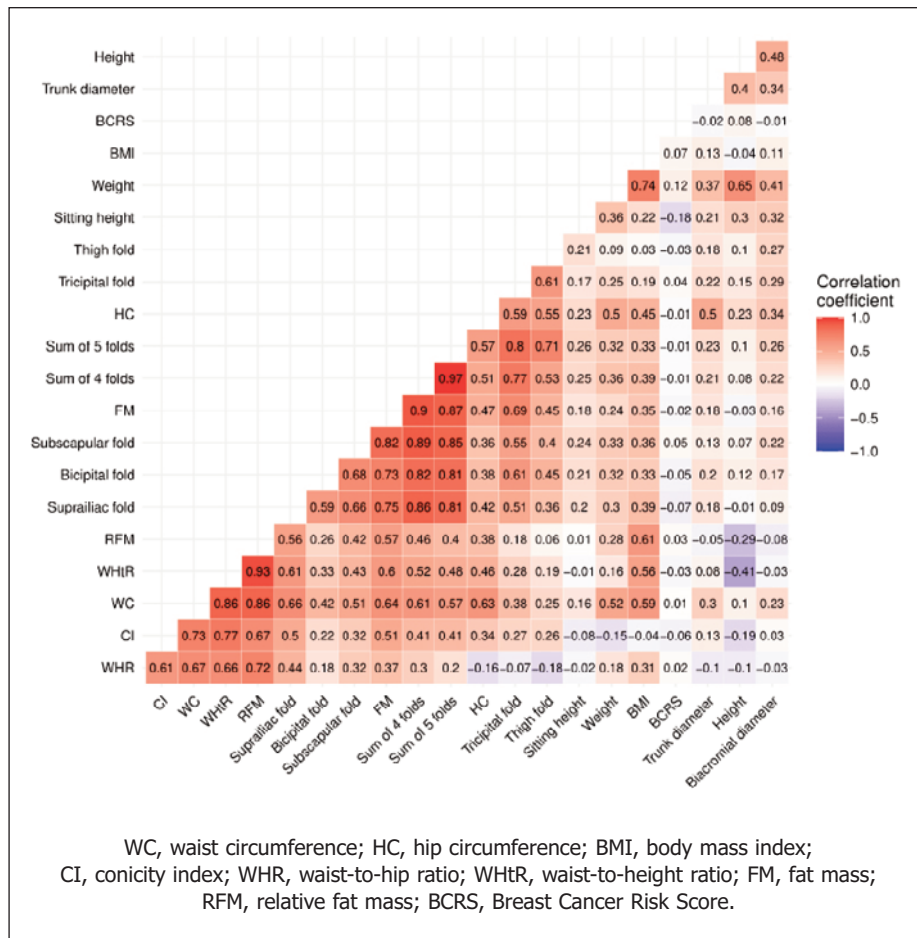


Figure 1. Correlation matrix of anthropometric data

Table 4. Factors associated with higher BI-RADS classification (≥ 3 vs ≤ 2)

Characteristic	PR (95% CI)	p-value
RFM (%)	1.26 (0.85 to 1.87)	0.3
Physical activity		
Intense (1.5 hours/week)	Ref.	
Moderate (3 to 4)	0.35 (0.02 to 6.44)	0.5
Low (< 30 minutes/week)	0.41 (0.05 to 3.59)	0.4
Inactive	0.55 (0.07 to 4.10)	0.6
Age at menarche (years)		
< 12	Ref.	
≥ 12	2.24 (0.45 to 11.2)	0.3

PR: Prevalence Ratio estimated from binomial regression models "brglmFit". 95% CI: 95% Confidence Interval. Ref.: Reference. BI-RADS classification was dichotomized (≤ 2 vs ≥ 3). Reference categories: Intense physical activity and age at menarche ≥ 12 years.

CI: 0.85–1.87; $p = 0.30$). Similarly, physical activity levels and age at menarche did not demonstrate consistent or significant associations with the BI-RADS classifications.

DISCUSSION

In this cross-sectional study of women attending a mammography service in southern Peru, we observed a high prevalence of central and total adiposity in both premenopausal and postmenopausal women, together with limited variability in most self-reported dietary indicators. Most participants had mammographic findings classified as BI-RADS 0 to 2, and only a very small number had BI-RADS ≥ 3 . These findings suggest that, in this population, excess adiposity coexists with relatively low exposure to several behavioral risk factors, highlighting the importance of contextualizing anthropometric risk within broader lifestyle and reproductive profiles.

Several established non-dietary risk factors for breast cancer include family history, menopausal status, nulliparity, high adiposity, prolonged use of hormonal contraceptives, smoking, high breast density, early age at menarche, and low screening practices^{9,23}. In this screened population, exposure to some of these factors was limited, including smoking and long-term hormonal contraceptive use. Regular mammographic screening remains a key protective strategy, as screening among women older than 40 years has been associated with reductions in breast-cancer mortality²³. Only 8.1% had a family history of breast cancer, 50.5% never used hormonal contraceptives, 79.8% had menarche after the age of 11 years, and 71.7% had their first child before the age of 30 years. Tobacco exposure is also relevant, given evidence linking long-term smoking to increased breast cancer risk²⁴. Although these exposures were infrequent in this population, they remain relevant for risk stratification in screening contexts.

After menopause, non-modifiable risk factors may interact with modifiable exposures such as adiposity and physical inactivity²⁵. Physical activity has been identified as a protective factor, with regular moderate-to-vigorous activity associated with lower lifetime breast cancer risk independent of adiposity and menopausal status^{26,27}. The persistence of physical inactivity in screened populations is therefore relevant from a

Table S1. Anthropometric data of participants

Variables	Mean	SD	Min	P25	P50	P75	Max
General Anthropometric data							
Age	51.24	7.96	40.00	45.50	50.00	56,00	77,00
Weight (Kg)	61.38	7.18	40.70	56.70	60.90	66,00	77,00
Height (m)	1.54	0.06	1.39	1.49	1.54	1,59	1,68
Sitting height (cm)	76.77	8.58	32.50	75.80	78.10	79.70	106.10
Circumferences							
aWC (cm)	92.85	6.82	72.47	89.20	92.80	97,05	107,90
cWC (cm)	91.21	6.81	71.45	88.00	91.10	96,30	106,35
WC (cm)	92.03	6.68	73.13	88.46	92.65	96,22	106,33
HC (cm)	97.86	5.33	82.55	94.30	97.47	101,15	109,90
Diameters							
Biacromial diameter (cm)	36.34	1.70	30.00	35.30	36.60	37,40	41,00
Trunk diameter (cm)	50.95	2.18	46.20	49.35	51.00	52.30	58.70
Folds							
Bicipital fold (mm)	11.25	3.66	1.75	8.62	11.00	13.75	21.00
Tricipital fold (mm)	18.34	4.48	5.00	15.88	18.00	21.67	29.75
Subscapular fold (mm)	24.07	6.67	6.75	20.38	23.50	29.38	41.00
Suprailiac fold (mm)	21.01	6.32	3.25	16.75	21.50	25.00	40.00
Thigh fold (mm)	20.16	5.94	5.50	16.00	20.50	23.27	41.75
Sum of 4 folds (mm)	74.68	17.78	17.00	62.41	74.00	85.88	113.00
Total sum of folds (mm)	94.84	21.51	22.50	80.38	95.00	109.88	138.17
Measurement of adiposity							
BMI (Kg/m ²)	25.88	2.31	19.26	24.38	26.44	27.45	29.84
CI	1.34	0.08	1.03	1.30	1.34	1.39	1.62
WHR	0.95	0.05	0.75	0.91	0.94	0.98	1.11
WHtR	0.60	0.05	0.45	0.58	0.60	0.63	0.70
Density (g/mL)	1.02	0.01	1.00	1.01	1.02	1.02	1.05
FM (%)	36.89	3.64	19.40	35.39	37.20	39.02	43.20
RFM (%)	42.38	2.74	31.42	41.28	42.62	44.12	47.27

aWC, abdominal waist circumference; cWC, crestal waist circumference; WC, waist circumference; HC, hip circumference; BMI, body mass index; CI, conicity index; WHR, waist-to-hip ratio; WHtR, waist-to-height ratio; FM, fat mass; RFM, relative fat mass; SD, standart deviation; Min, minimum; Q1, first quartile; Q2, second quartile; Q3, third quartile; Max, maximum.

prevention perspective, even in the absence of abnormal mammographic findings.

Dietary exposures in this population were broadly consistent with patterns considered compatible with cancer prevention. Alcohol intake was low, and higher levels of consumption have been consistently associated with increased breast cancer risk²⁸. Late-night eating patterns have also been proposed as a behavioral factor related to metabolic dysregulation and cancer risk²⁹, but this pattern was uncommon in the present sample. The available evidence on the relationship between the consumption of animal-based foods and plant-based

foods and the development of breast cancer is clearer¹³, whereas processed meat intake and low consumption of plant-based foods are more consistently associated with increased cancer risk¹². Also, cooking meat at high temperatures has been linked to exposure to heterocyclic amines associated with several cancers, including breast cancer^{30,31}. High intake of sugars and high-glycemic foods has also been linked to modest increases in breast cancer risk, with possible variation by menopausal and hormone-receptor status³² and dietary fat quality may further influence this relationship³³. Overall, dietary patterns in this screened population did not reflect high exposure to these risk-related dietary factors.

In contrast, anthropometric indicators revealed a consistent pattern of elevated adiposity. Excess body fat has been associated with increased risk of multiple cancers, including postmenopausal breast cancer¹³. Adiposity has been proposed as a potential contributor through hormonal, inflammatory, and metabolic pathways, and its impact may extend across menopausal stages¹⁸. Body-fat percentage thresholds proposed for women suggest that values above approximately one-third of body mass represent excess adiposity²¹, and higher FM in postmenopausal women has been associated with increased risk of invasive breast cancer^{17,25}. Evidence from European cohorts indicates that multiple adiposity indicators, including BMI, WC, WHR, and FM, are positively associated with postmenopausal breast cancer risk⁹. Moreover, reliance on BMI alone may underestimate risk in women with central adiposity, and direct or indirect measures of body composition may provide additional information¹⁷.

In Latin American populations, evidence regarding adiposity and breast cancer risk before menopause has been heterogeneous. Some studies have suggested inverse associations between general adiposity and premenopausal breast cancer, whereas central adiposity indicators such as WHR have shown positive associations in certain subgroups¹⁸. Additional studies in the region have reported inconsistent relationships between anthropometric indicators and breast cancer risk¹⁶. These findings highlight the complexity of interpreting adiposity patterns across menopausal stages and underscore the need for region-specific evidence.

This study has several strengths. Anthropometric measurements were obtained by certified anthropometrists following standardized ISAK protocols, with calibrated instruments and replicated measurements, which reduces measurement error and misclassification. The simultaneous assessment of multiple anthropometric indicators and adiposity estimators allowed a comprehensive characterization of body-composition patterns. The study also incorporated dietary and lifestyle variables aligned with international cancer-prevention recommendations¹³, enabling an integrated assessment of risk-related exposures in a Latin American screening context.

The limitations are important and should be emphasized. First, the cross-sectional design precludes causal inference and does not allow any assessment of breast cancer incidence or prognosis. Second, participants were recruited from a screening service, which may have introduced selection bias and limits generalizability to the broader population of Peruvian women. Third, the sample size was modest and not well suited for robust subgroup analyses or modelling of uncommon mammographic categories. Fourth, the dietary instrument was brief and not formally validated, which increases the likelihood of measurement error and misclassification. Finally, the study was conducted during the COVID-19 pandemic, a context that may have altered diet, physical activity, and healthcare utilization. Dietary intake was assessed using a frequency questionnaire not formally validated in Peruvian

populations, and self-reported lifestyle data may be affected by recall and social-desirability bias.

CONCLUSION

In this sample of Peruvian women attending a mammography service, a high prevalence of central and total adiposity was observed across both premenopausal and postmenopausal groups. In contrast, self-reported dietary indicators showed limited variability and did not consistently reflect a clearly favorable or unfavorable pattern. No clear differences were detected between menopausal groups in most anthropometric or dietary indicators. In addition, the very low frequency of BI-RADS ≥ 3 findings precluded meaningful evaluation of associations with mammographic classification. Prospective studies with larger samples, validated dietary instruments, and longitudinal follow-up are needed to clarify the contribution of adiposity and lifestyle patterns to breast cancer risk in Latin American populations and to determine whether these anthropometric indicators predict subsequent changes in mammographic risk or cancer incidence.

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