Research Article

Awareness and Understanding of Breast Density and Its Implications Among Screening-Age Women

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Abstract

Breast density is an important factor influencing breast cancer risk and the accuracy of mammographic screening; however, awareness and understanding among women remain limited. This study aimed to assess the awareness, knowledge, and perception of breast density and its implications among screening-age women. This study employed a cross-sectional descriptive design using a closed-ended questionnaire distributed to women settling in rural and urban regions of Saudi Arabia. This study used the BDAUQ, a structured, self-administered questionnaire. This study involves 678 participants with a mean age of 55.15 ± 9 years. The findings revealed that awareness of breast density was generally low. Only 321 participants reported having heard of the term, while 375 had not. Similarly, fewer participants had been informed about their breast density by healthcare providers (313 vs. 365). Knowledge scores were moderate (mean = 5.01 ± 1.56), whereas awareness scores were low (mean = 2.42 ± 1.08). In contrast, perception scores were relatively higher (mean = 24.25 ± 3.97), indicating a generally positive attitude toward the importance of breast density despite limited understanding. Socio-demographic factors played a significant role in influencing awareness and knowledge. Statistical analysis showed significant associations between awareness and sources of information ($F = 21.5$, $p < 0.001$), education ($p = 0.004$), and income ($p < 0.001$). Knowledge was also significantly associated with sources of information ($p = 0.01$), education ($p = 0.01$), and income ($p = 0.03$). Perception was significantly associated with education and income but not with age. In conclusion, the study highlights a gap between women's perception and their actual awareness and knowledge of breast density.

Keywords: Breast density – Breast cancer – Mammography – Breast imaging – Saudi Arabia.

Introduction

Breast cancer remains the most frequently diagnosed malignancy and the leading cause of cancer-related mortality among women globally. In 2018, an estimated 2.1 million new cases and approximately 600,000 deaths were reported [1]. Consequently, early detection and timely treatment are critical for improving outcomes. Mammography, the primary screening modality, provides a rapid, accessible means of assessing breast density. On mammographic imaging, adipose tissue appears radiolucent (dark), whereas fibroglandular components—including fibroblasts, epithelial cells, and connective tissue—are radiopaque (white) [2].

Age-specific distribution indicates that the highest proportion of breast cancer cases occurs in women aged 40–49 years (30%), followed by those aged 50–59 years (24.9%) [3]. Data from the National Cancer Registry (2022) revealed that nearly 70% of cases are diagnosed at advanced stages (III–IV), where prognosis is poor and mortality is substantially elevated. Five-year mortality rates have been reported at 60.4% for stage III and 94.2% for stage IV disease [4].

Mammography is widely regarded as the gold standard for early breast cancer detection and has been associated with significant reductions in mortality [5]. For instance, screening has been shown to reduce mortality by approximately 30% in women aged 55–74 years and by 34% in those aged 75–79 years. However, its diagnostic performance is compromised in women with high breast density, as dense fibroglandular tissue can obscure malignant lesions, thereby reducing detectability. Evidence suggests that mammographic sensitivity declines from 89.2% in women with low breast density to 67.9% in those with high density [6].

Mammographic breast density, defined as the proportion of radiographically dense (white) fibroglandular tissue on a mammogram, is among the most significant and prevalent risk factors for breast cancer [3]. High breast density not only elevates cancer risk but also diminishes the sensitivity of mammography due to the "masking effect," where tumors and dense tissue appear similarly radiopaque. This increases the likelihood of interval cancers—those diagnosed between routine screenings—particularly in asymptomatic women [7].

While female sex is the primary risk factor, age is the most influential predictor of breast cancer risk and largely accounts for variations in breast density. Although breast density generally declines with advancing age, the overall risk of breast cancer increases. Thus, breast density relative to age may be a more meaningful risk indicator. However, clinical assessment is limited by the absence of standardized, age-adjusted measures of breast density [8]. Determining a woman's breast density percentile for her age could improve risk stratification, facilitate targeted preventive strategies, and support earlier screening interventions, particularly in younger women under 40 years of age [9].

Subjects and Methods

Design and study area

This study employed a cross-sectional descriptive design using a closed-ended questionnaire distributed to women settling in rural and urban regions of Saudi Arabia.

Sampling and population

Using a random sampling technique and by using the G Power sample size calculator with an error margin of 2.5% and a confidence interval of 95%, the total sample size is 678 women. The inclusion criteria were all women living in different regions of Saudi Arabia, of any age, more than 18 years old, and at least educated to an elementary level.

Instrumentation

This study utilized the BDAUQ form, which is a structured, self-administered questionnaire developed based on literature and existing breast cancer awareness tools [10-12].

It assesses women's awareness, knowledge, perceptions, and information sources related to breast density and its clinical implications.

It composed of five domains, the first domain is the sociodemographic and clinical characteristics (8 items), the second domain was about awareness of breast density (5 items), the third one about knowledge of breast density and its implications (10 items), the fourth domain was the perceptions and attitudes (8 items), and the fifth domain was the sources of information provided to these women (5 items).

Scoring System and its Interpretation

Awareness score: 0–5, Knowledge score: 0–10, and the Perception score: 8–40. Good knowledge: ≥75%, Moderate knowledge: 50–74%, and Poor knowledge: <50%

Content Validity

A panel of 3–5 experts (oncology, radiology, nursing, public health) was asked to assess the content validity using Content Validity Index (CVI), where the item-level CVI (I-CVI ≥ 0.78) is considered acceptable, and the scale-level CVI (S-CVI ≥ 0.90). As well as using Exploratory Factor Analysis (EFA) for the perception domain.

Reliability

The internal consistency of these questionnaire items was assessed using Cronbach's alpha, which was 0.94, and it is considered acceptable (≥ 0.70)

Ethical considerations

Besides the anonymity, the right of participants to withhold their names or any personal data, an IRB was obtained under number 3567-c-2026.

Statistical analysis

The Graphed Prism 11.0 program was used for performing statistical analysis for the study findings, and descriptive analyses, such as means and standard deviations, as well as frequencies and percentages, were carried out. Inferential analyses using one-way ANOVA and regression were also used to interpret the study variables. The study was considered significant at $p<0.05$.

Results

In this study, a total of 678 participants responded to the study questionnaire; their mean age was 55.15 (S.D =9) years old.

Distribution of participants by educational level (n = 678), with variation across categories (exact values not shown in the figure). This indicates that participants come from diverse educational backgrounds. Among 678 participants, 26.9% (n = 183) were married, 25.7% (n = 175) widowed, 24% (n = 163) divorced, and 23.1% (n = 157) single. Regarding employment, 51.6% (n = 351) were employed and 48.1% (n = 327) were unemployed. Income distribution was relatively balanced: 34.4% (n = 234) high, 33.4% (n = 227) middle, and 31.9% (n = 217) low (Fig.1, Table 1).

The proportion of participants reporting breast disease and undergoing mammography (specific numerical values not shown). It reflects variation in screening behavior and disease history among participants (Fig.2).

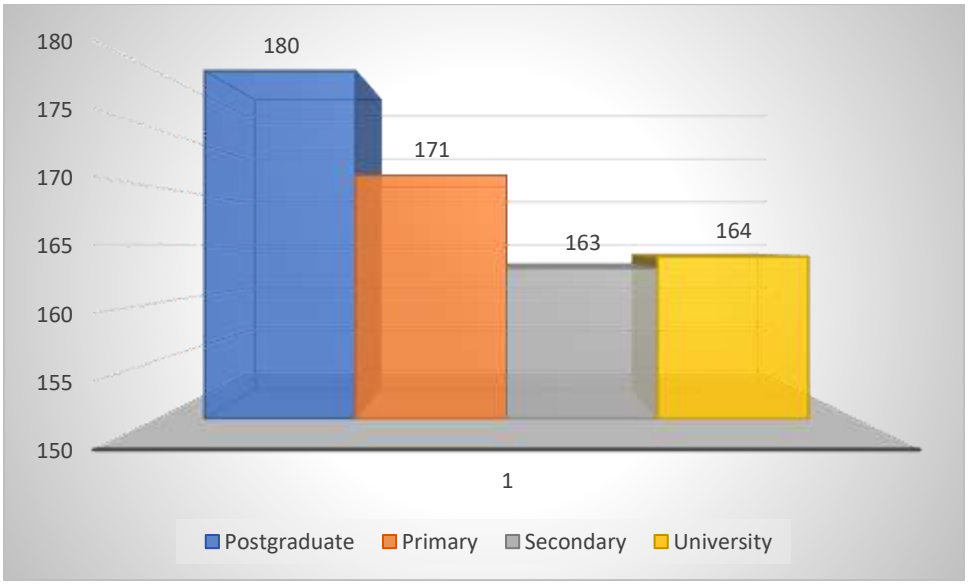


Figure 1 Educational level distribution among the study participants (n=)

Table 1 Marital, employment, and income statuses

		Frequency (n)	Percentage (%)
Marital status	Divorced	163	24
	Married	183	26.9
	Single	157	23.1
	Widowed	175	25.7
Employment status	Employed	351	51.6
	Unemployed	327	48.1
Income	High	234	34.4
	Low	217	31.9
	Middle	227	33.4
	Total	678	100

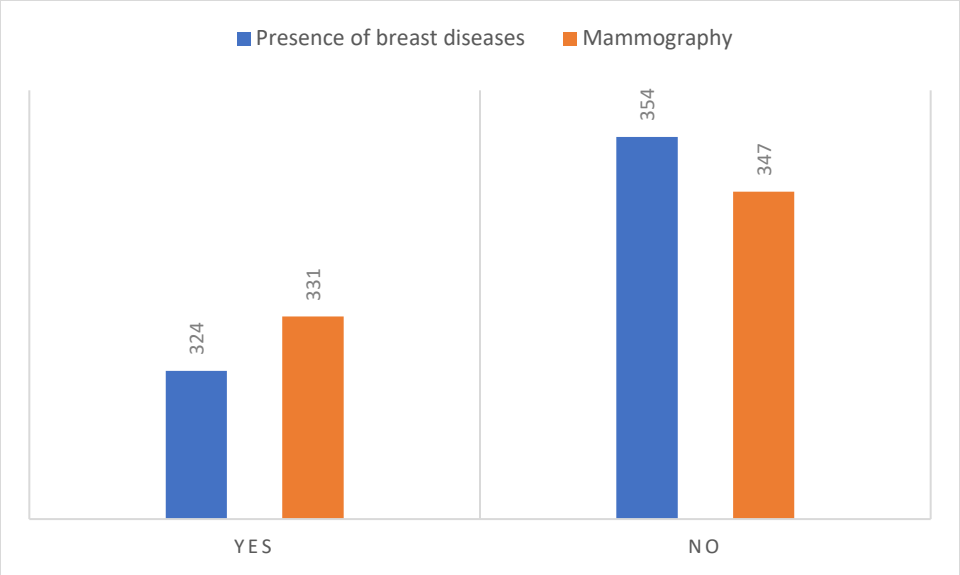


Figure 2 Breast diseases presence and mammography

Assessment of awareness, knowledge, and perception about breast density

The awareness, knowledge, and perception levels were measured and found to be 2.42 ± 1.08, 5.01 ± 1.56, and 24.25 ± 3.97, respectively.

Out of 678 participants, 321 answered "Yes" and 375 "No" to having heard of breast density. Similarly, 313 vs. 365 had been informed by healthcare providers, 323 vs. 355 knew that breast density varies, 350 vs. 328 were aware that it is reported in mammography, and 336 vs. 342 received written information. These results indicate that "No" responses slightly exceed "Yes" across most items (Table 2).

Responses varied across all categories. For example, for "knowing breast density is important," 153 agreed and 139 strongly agreed, compared to 116 strongly disagreed. Similarly, for seeking more information, 151 strongly agreed and 134 agreed. However, confidence in understanding shows dispersion (123 strongly disagree vs. 129 strongly agree) (Table 3).

Table 2 Awareness items and their level of occurrence

Awareness	Yes	No
Have you ever heard of the term "breast density"?	321	375
Have you ever been informed about your breast density by a healthcare provider?	313	365
Do you know that breast density can vary among women?	323	355
Are you aware that breast density is reported in mammography results?	350	328
Have you ever received written information about breast density?	336	342

Table 3 Perception items and their level of agreement

	Knowing my breast density is important for my health.	I am concerned about the risks associated with dense breasts.	I feel confident in understanding breast density information.	Healthcare providers adequately explain breast density.	Additional screening for dense breasts is necessary.	I would seek more information if told I have dense breasts.	Breast density information influences my screening decisions.	I trust the information provided by healthcare professionals.

Strongly disagree	116	153	123	128	130	133	122	128
Disagree	139	118	148	144	136	135	134	124
Neutral	131	147	148	140	142	125	151	125
Agree	153	134	130	138	123	134	146	137
Strongly agree	139	126	129	128	147	151	125	164

The categories of participants' awareness, knowledge, and perception were also detected as shown in Fig. 3-6.

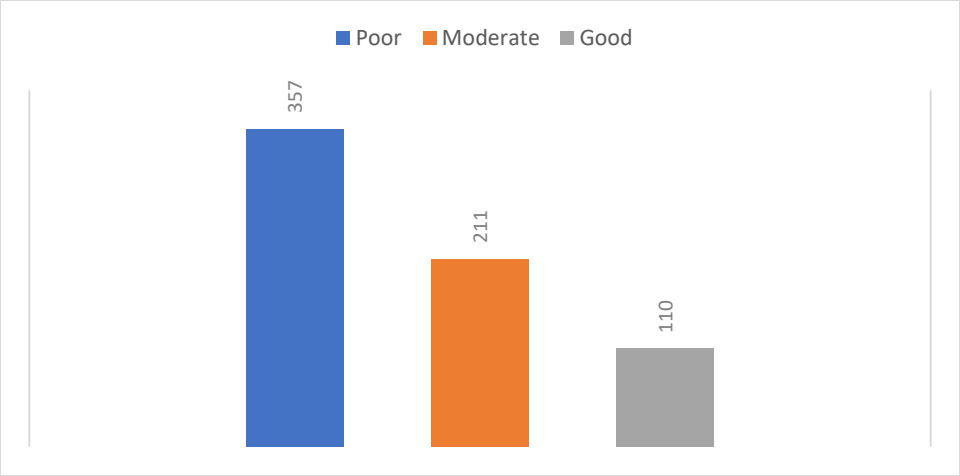


Figure 3 Awareness level distributed categories

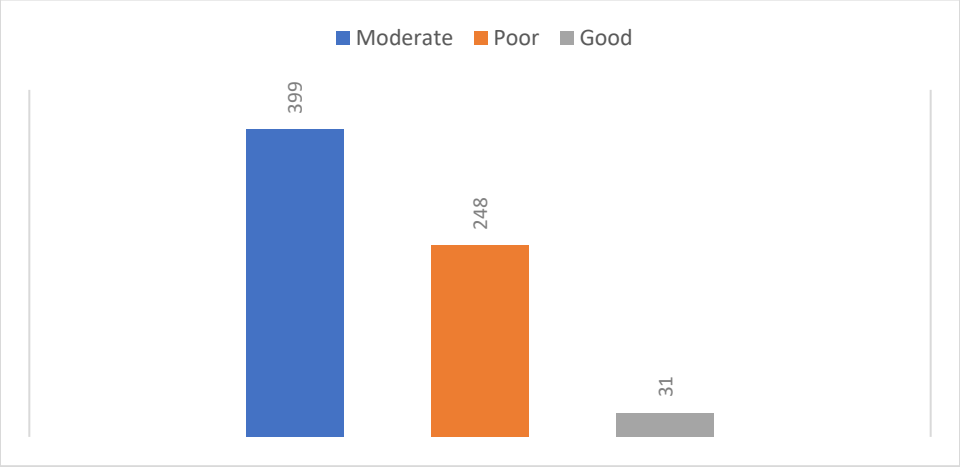


Figure 4 Knowledge level distributed categories

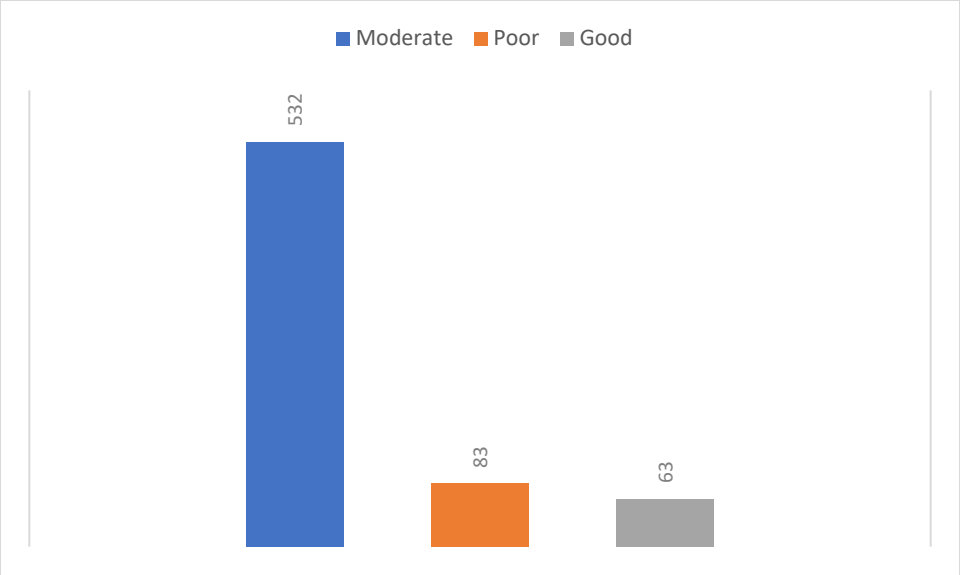


Figure 5 Perception level distributed categories

Sources of Information obtained about mammography and breast density

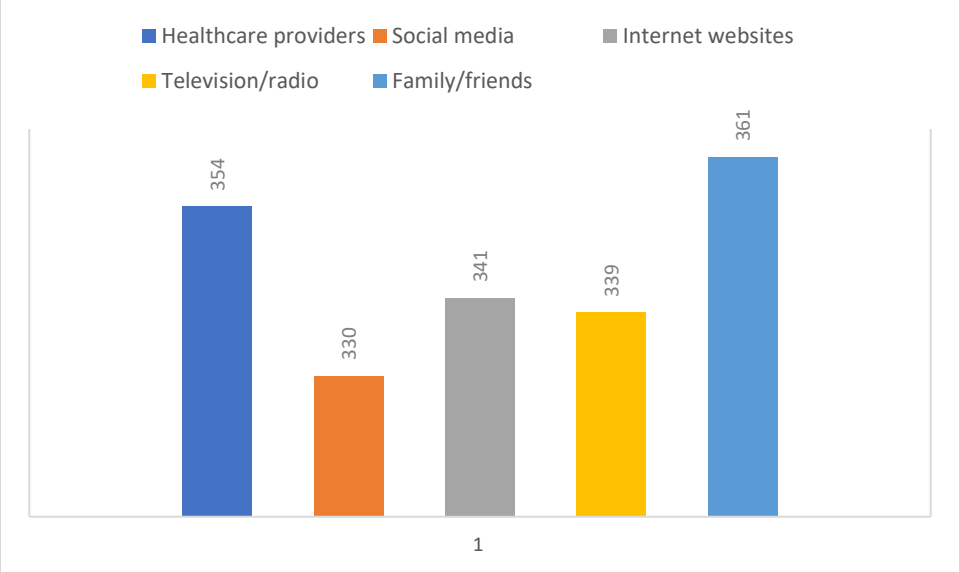


Figure 6 Sources of Information obtained about mammography and breast density

Significant associations were found between awareness and sources of information (F = 21.5, p = 0.00), education (t = 19.6, p = 0.004), and income (F = 17.9, p = 0.00). Knowledge was also significantly associated with sources of information (F = 21.6, p = 0.01), education (t = 37.9, p = 0.01), and income (F = 14.8, p = 0.03). Perception showed significant associations with education (t = 19.7, p = 0.00) and income (t = 24.8, p = 0.01), but not with age (Table 4).

Table 4 ANOVA results for the correlation between awareness, knowledge, perceptions to breast density and some demographic data

Variable	Demographic data	F/t value	p-value
Awareness about breast density	Sources of information	21.5	0.00
	Age	31.4	0.14
	Educational level	t=19.6	0.004
	Income	17.9	0.00

Knowledge about breast density	Sources of information	21.6	0.01
	Age	14.8	0.96
	Educational level	t=37.9	0.01
	Income	14.8	0.03
Perception towards screening	Sources of information	17.9	0.71
	Age	24.3	0.9
	Educational level	t=19.7	0.00
	Income	t=24.8	0.01

Discussion

Breast density is an important factor influencing breast cancer risk and the accuracy of mammographic screening; however, awareness and understanding among women remain limited. This study aimed to assess the awareness, knowledge, and perception of breast density and its implications among screening-age women. This study included 678 participants with a mean age of 55.15 ± 9 years, reflecting a screening-age population. The socio-demographic characteristics showed a relatively balanced distribution: 26.9% married (n = 183), 25.7% widowed (n = 175), 24% divorced (n = 163), and 23.1% single (n = 157). Employment status was nearly evenly divided between employed (51.6%, n = 351) and unemployed (48.1%, n = 327) individuals, while income levels were also comparable, with 34.4% high (n = 234), 33.4% middle (n = 227), and 31.9% low (n = 217). This balanced distribution enhances the representativeness of the sample and supports the reliability of examining associations between socio-demographic factors and breast density awareness [13].

Despite this diversity, awareness of breast density was found to be limited. Only 321 participants reported having heard of the term compared to 375 who had not, and similarly, fewer participants had been informed by healthcare providers (313 vs. 365). Knowledge about breast density variability (323 vs. 355) and its inclusion in mammography reports (350 vs. 328) showed marginal awareness, while receipt of written information was nearly equally divided (336 vs. 342). These findings indicate a consistent trend in which lack of awareness slightly outweighs awareness across all measured items, suggesting insufficient dissemination of information and highlighting gaps in patient education and provider communication [14]. While Santiago-Rivas et al.'s study reported that the majority of individuals (69.2%) indicated awareness of breast density, fewer than one-third (30.4%) were knowledgeable of their own breast density status [15].

From these findings and aligned results, the awareness of one's breast density, the belief that women should be informed about their breast density in mammography reports, and the perception of being adequately informed when receiving this information are correlated with the likelihood of completing a mammogram.

In terms of overall scores, the mean awareness level was relatively low (2.42 ± 1.08), while knowledge was moderate (5.01 ± 1.56), and perception scores were comparatively higher (24.25 ± 3.97). This pattern suggests that although participants may hold generally positive attitudes or perceptions toward breast density and its importance, their actual understanding and awareness remain inadequate. This discrepancy may reflect exposure to general health messaging without sufficient detail or structure [16].

The perception analysis further supports this interpretation, as responses were widely distributed across agreement levels. For instance, 153 participants agreed and 139 strongly agreed that knowing breast density is important, compared to 116 who strongly disagreed. Similarly, a high proportion expressed willingness to seek additional information (151 strongly agree and 134 agree), yet confidence in understanding breast density information varied considerably (123 strongly disagree vs. 129 strongly agree). This variability indicates that, while participants recognize the importance of breast density, they lack confidence and clarity in interpreting related information, suggesting inconsistencies in health communication [17]. Also, Gauci et al. found that breast density and its related hazards were inadequately understood (average scores between 2.80 and 3.34 out of 5), although supplemental screening was better recognized (3.65). The participants' knowledge and awareness corresponded with their age, occupation, and level of education. Leaflets (40%) and medical professionals (40%) were the preferred sources of information among respondents. The studied population in this study, along with previous reports, exhibits a deficiency in knowledge and awareness regarding breast density and its associated dangers. It is essential to furnish women with additional information regarding breast density. This information will enable women to pursue optimal care [18].

Screening behavior and prior exposure to breast health information, as illustrated in the figures, further emphasize variability among participants, likely influenced by personal health history and access to healthcare services. Additionally, the distribution of awareness, knowledge, and perception levels across categories suggests that most participants fall within low to moderate ranges, reinforcing the need for targeted educational interventions [19].

Importantly, the analysis of information sources highlights their critical role in shaping awareness and knowledge. This is further supported by the ANOVA results, which demonstrated statistically significant associations between awareness and sources of information ($F = 21.5$, $p = 0.00$), education ($t = 19.6$, $p = 0.004$), and income ($F = 17.9$, $p = 0.00$). Similarly, knowledge was significantly associated with sources of information ($F = 21.6$, $p = 0.01$), education ($t = 37.9$, $p = 0.01$), and income ($F = 14.8$, $p = 0.03$). Perception was also significantly linked to education ($t = 19.7$, $p = 0.00$) and income ($t = 24.8$, $p = 0.01$), although no significant association was observed with age. These findings confirm that socio-economic status and access to information are key determinants influencing women's understanding and attitudes toward breast density. Aloufi et al. reported that women possessing higher education and prior mammography experience exhibited markedly greater awareness (OR: 5.00, 95% CI: 2.18–11.45; $p<0.001$ and 1.81, 95% CI: 1.15–2.86; $p=0.010$, respectively). A significant majority (80%) indicated a desire to be educated about their breast density, and over half (56.3%) are prepared to incur costs for supplementary imaging if they own dense breast tissue [20]. Patel et al. discovered that, after adjusting for age, education, screening history, and language, awareness of breast density in mammograms was comparable between the two cohorts ($P = .83$). However, knowledge of breast density as a masking factor ($P = .03$) and as a risk factor ($P < .001$) was significantly greater among citizens [21].

Overall, the study highlights a critical gap between perception and actual knowledge of breast density among screening-age women. While many participants acknowledge its importance, insufficient awareness and inconsistent understanding persist, largely influenced by educational level, income, and information sources. These findings underscore the need for improved communication strategies, enhanced patient education, and more proactive involvement of healthcare providers in informing women about breast density and its implications for breast cancer screening.

Conclusion

The findings indicate that, despite a relatively diverse socio-demographic sample, awareness of breast density remains low, with a considerable proportion of participants lacking basic information about the concept and its clinical implications. Knowledge levels were moderate, while perception scores were higher, suggesting that many women recognize the importance of breast density but do not fully understand it.

Recommendations

It is recommended to implement targeted educational programs to improve women's awareness and understanding of breast density, particularly among those with lower educational and income levels. Healthcare providers should play a more active role in communicating breast density information during mammography consultations and provide clear, written educational materials. Public health campaigns utilizing media and community outreach can further enhance knowledge dissemination. Additionally, integrating breast density education into routine screening programs may improve patient engagement and informed decision-making. Future research should explore effective intervention strategies and evaluate their impact on awareness, knowledge, and screening behaviors among diverse populations.

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