

Challenges in breast cancer prevention knowledge and training: identifying gaps among medical trainees

Paulina Kalman^{1*}, Jakub Czarny², Natalia Siwak³, Katarzyna Pietroniec⁴, Bartosz Wojewoda⁵, Zuzanna Granek⁶, Jan Krzakowski⁷, Weronika Borawska⁸, Barbara Radecka^{9,10}, Aleksandra Łacko¹¹, Piotr Wysocki¹², Joanna Kufel-Grabowska¹³, Michał Jarzab¹⁴, Bogusława Czaratorska-Arłukowicz¹⁵, Katarzyna Pogoda¹⁶

¹Maria Skłodowska-Curie National Research Institute of Oncology, Warsaw, Poland

²Poznan University of Medical Sciences, Poznan, Poland

³Medical University of Lublin, Lublin, Poland

⁴Medical University of Silesia, Katowice, Poland

⁵Jagiellonian University Medical College, Krakow, Poland

⁶Medical University of Lodz, Lodz, Poland

⁷Medical University of Gdansk, Gdansk, Poland

⁸Medical Faculty, *Collegium Medicum*, Cardinal Stefan Wyszyński University in Warsaw, Warsaw, Poland

⁹Department of Oncology, Institute of Medical Sciences, University of Opole, Opole, Poland

¹⁰Department of Clinical Oncology, Tadeusz Koszarowski Cancer Centre in Opole, Opole, Poland

¹¹Wroclaw Medical University, Wroclaw, Poland

¹²Jagiellonian University, Medical College Hospital, Krakow, Poland

¹³Clinic of Oncology and Radiotherapy, Medical University of Gdansk, Poland

¹⁴Breast Cancer Unit, Maria Skłodowska-Curie National Research Institute of Oncology, Gliwice Branch, Gliwice, Poland

¹⁵Maria Skłodowska-Curie Białystok Oncology Centre, Białystok, Poland

¹⁶Department of Breast Cancer and Reconstructive Surgery, Maria Skłodowska-Curie National Research Institute of Oncology, Warsaw, Poland

*Corresponding author:

Paulina Kalman MD
Maria Skłodowska-Curie
National Research
Institute of Oncology
5 W.K. Roentgena St.
02-781 Warsaw, Poland
E-mail: paulina.kalman@wp.pl

Submitted: 29 December 2025; **Accepted:** 14 July 2026

Online publication: 6 October 2026

Arch Med Sci 2026

DOI: <https://doi.org/10.5114/aoms/225927>

Copyright © 2026 Termedia & Banach

Abstract

Introduction: Breast cancer is the most common malignancy among women in Poland, yet participation in the national mammography screening programme remains low (approximately 30%). Medical trainees play a crucial role in promoting prevention, but their preparation in this area is insufficiently explored.

Material and methods: A cross-sectional online survey was conducted among students from 10 Polish medical universities and doctors-in-training (from November 2024 to February 2025). The questionnaire assessed knowledge of screening guidelines, exposure to curricular training, and self-reported competence in clinical breast examination (CBE). Descriptive statistics and χ^2 tests were used to analyse associations between categorical variables.

Results: A total of 1,245 participants were included. Nearly half (48.7%) had never been taught CBE, and only 4% had practised with patients. While most respondents recognised mammography as an effective screening tool (96.4%), only 24.1% correctly identified both the screening interval and eligible age group. Attendance at curricular classes was significantly associated with better knowledge, higher confidence in performing CBE independently ($p < 0.001$), and greater comfort discussing breast self-examination with patients (85% vs. 76%, $p < 0.001$).

Conclusions: This nationwide study highlights major gaps in breast cancer prevention education among Polish medical trainees. Although general awareness of mammography is high, understanding of programme details and practical CBE skills remains limited. Structured, competency-based curricula incorporating hands-on and simulation-based training are needed to strengthen preventive oncology education and support efforts to increase screening participation in Poland.

Key words: breast cancer, medical students, prevention.

Introduction

Breast cancer is the most common malignancy among women worldwide and one of the leading causes of cancer-related mortality [1]. In Poland, it is the most frequently diagnosed cancer and the second leading cause of cancer death among women [2]. The incidence continues to increase [3], which has been associated with lifestyle and environmental factors. Germline mutations account for approximately 5–10% of all breast cancer cases [4]. Despite therapeutic advances, prognosis is largely determined by early detection. This underscores the importance of both public and professional awareness of screening guidelines.

Population-based mammography screening has been proven to reduce breast cancer mortality [3, 5]. In Poland, the population-based national screening programme provides free-of-charge mammography every two years for women aged 45–74. However, participation remains far below the level required for effective prevention. According to the report of the National Health Fund, as of November 1, 2025, only about 33% of eligible women participated in the national breast cancer screening programme [6]. In comparison, participation rates in organised mammography screening programmes are considerably higher in many Western European countries. For example, uptake exceeds 70% in the Netherlands and Denmark, and over 80% in Sweden and Finland, according to Eurostat and national reports [7, 8].

Healthcare professionals are crucial in promoting screening and providing accurate information to patients. This responsibility extends to medical students and trainees, who should acquire sufficient knowledge and practical competence in breast cancer prevention and clinical breast examination (CBE) during their education. However, the extent and quality of teaching vary across curricula, and previous studies in other countries have shown significant gaps in knowledge, skills, and self-confidence among medical students [9, 10].

The present study aimed to evaluate knowledge of the national breast cancer screening programme, exposure to curricular teaching on breast cancer prevention, and self-reported competence in CBE among medical students from ten Polish universities. We further analysed whether

participation in curricular classes was associated with objective knowledge, perceived competence, and comfort in discussing breast self-examination with patients.

Material and methods

Study design

We conducted a cross-sectional online survey targeting students at 10 medical universities in Poland and doctors-in-training between November 2024 and February 2025. The online questionnaire was created using Microsoft Forms and distributed via social media platforms and university mailing lists. Participation was voluntary and anonymous. Each participant could complete the survey only once, as the system prevented multiple submissions from the same account.

Questionnaire development and structure

The study used an original questionnaire developed in Polish to assess knowledge, education, and attitudes related to breast cancer prevention among medical students. The tool consisted of four thematic sections with a total of 13 closed-ended questions (single- and multiple-choice). Section 1 collected demographic and academic information, including the field and year of study as well as the university. Section 2 assessed knowledge of the national breast cancer prevention programme in Poland (as of 2024). Section 3 explored practical training and self-assessed competence in performing clinical breast examination (CBE), while Section 4 addressed perceived barriers and comfort in communicating with patients about breast self-examination.

The questionnaire aimed to capture both objective knowledge and subjective attitudes toward preventive oncology education. The full version of the questionnaire (originally in Polish, translated into English for publication) is provided in Supplementary Material. However, no formal psychometric validation (e.g., reliability or construct validity assessment) was performed.

A convenience sampling strategy was used. The survey was distributed via student organisations, university mailing lists, and social media groups, which may have favoured students with a pre-existing interest in oncology or preventive medicine.

The questionnaire was developed by a team of medical students. Content validity was ensured through expert review, and the tool was piloted among 12 students to assess clarity and comprehensibility. Microsoft Forms' settings prevented duplicate submissions by restricting each participant to one response per account.

Statistical analysis

All collected data were subjected to descriptive statistics (absolute numbers and percentages). Associations between categorical variables (e.g., attendance at curricular classes vs. knowledge of screening programme guidelines, self-reported competence, and comfort in communication) were analysed using Pearson's χ^2 test. For two-by-two comparisons, p -values were calculated with one degree of freedom, and Cramer's V was reported as a measure of effect size. For larger contingency tables (e.g., three-level self-assessed competence or comfort categories), χ^2 tests with appropriate degrees of freedom were applied, and Cramer's V was used for effect size estimation.

A p -value < 0.05 was considered statistically significant. Statistical analyses were performed using Microsoft Excel with built-in formulas (COUNTIFS, CHISQ.DIST.RT) and cross-validated with Python (pandas, scipy) for consistency.

Results

Study population

A total of 1,245 students from 10 Polish medical universities participated in the survey, with the characteristics of the study population summarized in Tables I and II. The largest group comprised medical students (804; 64.6%), followed by nursing students (130, 10.4%), with midwifery and physiotherapy representing the next most common fields. Most respondents were in the middle years of study – predominantly the third year (23%) and fourth year (19%).

Training in clinical breast examination (CBE) and self-reported competence

Nearly half of the students (606, 48.7%) reported that they had never been taught CBE during their studies. Among those who had received CBE training, most attended theoretical courses only (447, 36%), while 123 (10%) had practical classes with models and 50 (4%) students were exposed to CBE with patients in a clinical setting (Figure 1). The most common courses during which students learned CBE included oncology (122, 9.8%), gynaecology and obstetrics (102, 8.2%), internal medicine (80, 6.4%), introduction to clinical courses (43, 3.5%), and family medicine (21, 1.7%).

Table I. Distribution of participants by field of study

Field of study	N	%
Medicine	804	64.58
Nursing	130	10.44
Physiotherapy	54	4.34
Midwifery	51	4.10
Medical analytics	38	3.05
Dentistry	27	2.17
Pharmacy	26	2.09
Dietetics	19	1.53
Electroradiology	17	1.37
Biotechnology	15	1.20
Paramedics	8	0.64
Cosmetology	8	0.64
Public health	7	0.56
Other	40	3.21

Table II. Distribution of participants by year of study

Year of study	N	%
I	201	16.14
II	222	17.83
III	290	23.29
IV	238	19.12
V	206	16.55
VI	66	5.30
Intern doctor	21	1.69

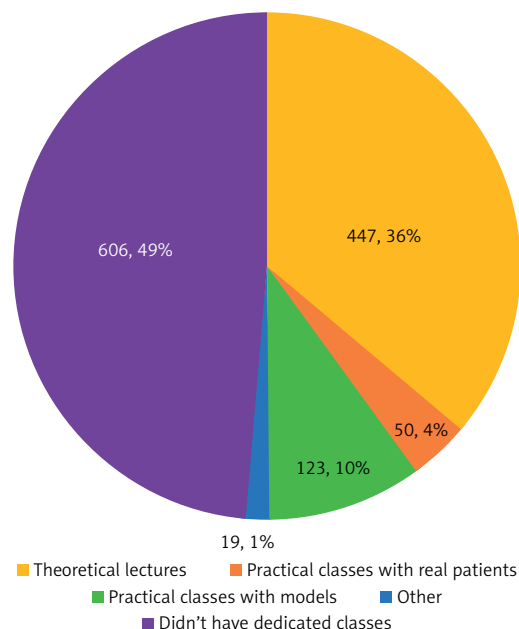


Figure 1. Self-reported attendance at CBE training sessions among participants

Self-reported competence in CBE was limited: 490 (39.4%) reported being unable to perform the examination, 417 (33.5%) could perform it under su-

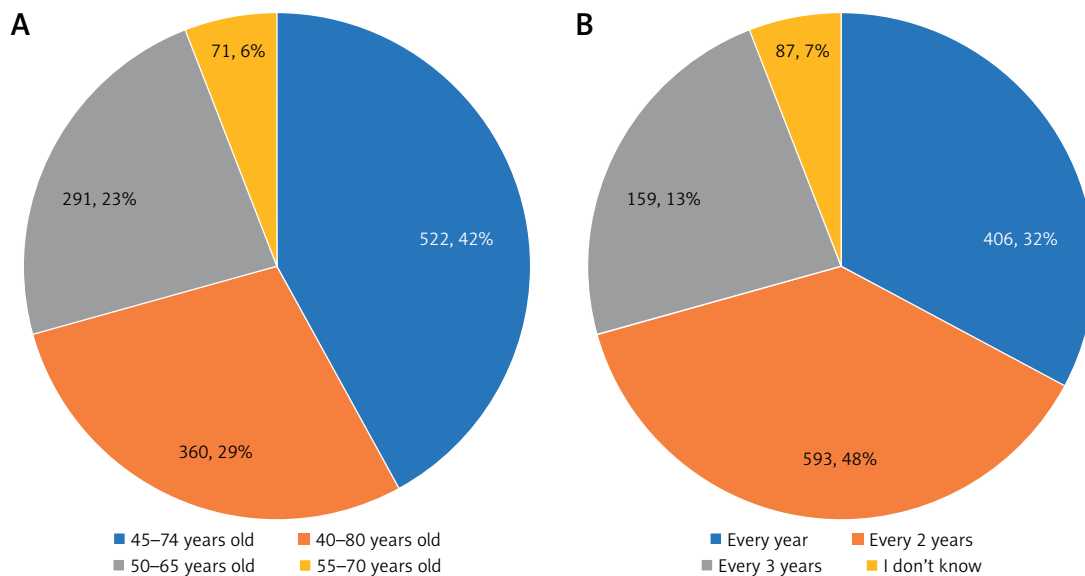


Figure 2. Knowledge about breast cancer screening program in Poland: **A** – recommended age range; **B** – recommended screening interval

pervision, and 338 (27.2%) reported full independence. Despite this, 1,013 (81.4%) students felt comfortable discussing breast self-examination with patients, while 191 (15.3%) did not.

Knowledge of the national breast cancer screening programme

Of the 1,245 surveyed students, 706 (56.7%) reported having attended classes on breast cancer prevention during their curricula, while 539 (43.3%) had not. The majority of respondents (57%, 705) reported knowing about the programme only at a basic level, 23% (285) admitted having no knowledge of it, and 20% (247) stated they were able to provide patients with complete information and referrals for mammography. When asked specifically about their knowledge of the screening guidelines, students demonstrated incomplete understanding. Almost all participants (96.4%, $n = 1,200$) correctly identified mammography as an effective screening method. However,

only 593 (47.6%) correctly recognized the recommended two-year screening interval, and 522 (41.9%) identified the correct eligible age group (Figure 2). Importantly, when combining both key elements of the programme – interval and age – only 300 students (24.1%) answered both correctly, whereas 945 (75.9%) did not.

Attendance at curricular classes on breast cancer prevention was associated with greater knowledge of the screening guidelines. Among medical students, 456 out of 804 (56.7%) reported having classes on breast cancer prevention, with the majority (341, 74.8%) attending them during the preclinical years (years I–III, corresponding to the preclinical stage of medical education in Poland). Among students of other health-related disciplines, a similar proportion declared participation in such classes. The organization and timing of these classes varied between universities, with classes most commonly included within oncology, gynaecology, or internal medicine courses. Students who had such classes more frequently identified the correct interval, the eligible age group, and both elements combined (all $p < 0.001$), whereas no difference was observed for knowledge about the effectiveness of mammography ($p = 0.76$) (Figure 3).

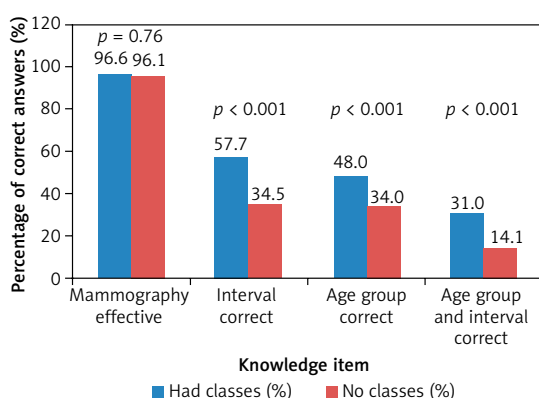


Figure 3. Knowledge of breast cancer screening by attendance at breast cancer prevention classes

Interactions between training, knowledge, and student perceptions

Practical training influenced perceived competence. Students who attended classes reported significantly greater ability to perform breast examination independently ($p < 0.001$) and more often felt comfortable discussing breast self-examination with patients ($p < 0.001$).

Objective knowledge correlated with subjective perceptions. Students who correctly answered questions about the screening interval and eligible age group more often rated the quality of university education higher (all $p < 0.001$). Similarly, self-assessed competence in CBE was associated with greater comfort in patient communication ($p < 0.001$) and with higher evaluation of the quality of education received in breast cancer prevention and clinical breast examination ($p < 0.001$). Moreover, students who rated the quality of their CBE-related and preventive oncology education more positively also reported greater comfort in discussing breast health with patients ($p < 0.001$).

Discussion

This nationwide study demonstrates significant deficiencies in breast cancer prevention education among Polish medical trainees. Although most respondents correctly identified mammography as an effective screening tool, detailed knowledge of the national programme – particularly the recommended screening interval and eligible age range – remained limited. Only one in four participants provided fully correct answers. This suggests a gap between general awareness and the guideline-based competence required for effective patient counselling.

Although the study included students from 10 medical universities, the sample was dominated by medical students and respondents from the middle years of training. Therefore, the findings should be interpreted as reflecting important educational trends rather than fully representative estimates for all health profession students in Poland. Our findings are consistent with earlier studies showing that students commonly recognise the importance of breast cancer screening but lack precise knowledge of national recommendations [10–12]. Similar observations were reported in a recent Hungarian analysis, where students were familiar with breast cancer symptoms yet demonstrated insufficient understanding of screening protocols [11]. Cross-country comparisons also confirm that deficits in preventive oncology education are widespread and reflect systemic issues within medical curricula [12, 13].

A further important observation was the discrepancy between communication confidence and technical competence. While the majority of respondents felt comfortable discussing breast self-examination, fewer than 30% reported confidence in performing CBE independently. Such discrepancies have been noted in previous research [14–16]. Evidence supports that practical exposure – through simulation models, standardized patients (trained actors simulating clinical cases), or hybrid formats – substantially improves both

technical and communication skills [15–19]. Integrating psychosocial and empathy-focused components into training may additionally enhance preparedness in patient interactions [20]. Peer-assisted learning and simulation-based approaches used in other clinical domains have also been shown to improve skill retention and performance [21, 22].

These results should be interpreted in the context of the persistently low participation in Poland's mammography screening programme, which remains at approximately 30% – significantly below the $\geq 70\%$ threshold recommended by European guidelines for population-level mortality reduction [6, 23]. In contrast, participation consistently exceeds 70–80% in several Western European countries. Limited emphasis on cancer prevention – particularly secondary prevention, including early detection and screening – during secondary and university education may weaken both public engagement and professional competence. Digital and mobile health tools, which have shown promise in supporting early detection behaviours, could serve as an additional component of preventive education [24].

Given that breast cancer remains the most common malignancy among women and a major cause of cancer-related death [2], strengthening preventive competencies among healthcare professionals is essential. Previous European studies have demonstrated that primary care physicians and nurses significantly influence women's decisions to undergo mammography [25, 26]. Ensuring that medical students, nursing students and allied health trainees receive adequate training in breast cancer prevention may therefore contribute to improved screening uptake.

Importantly, the gaps identified in our study are consistent with evidence from other preventive domains. A recent nationwide assessment revealed low awareness of the European Code Against Cancer among Polish students, further indicating that deficits in prevention-related knowledge extend beyond breast cancer [27–29]. This highlights the need for comprehensive, system-level reform of preventive oncology education.

This study has several limitations. First, the cross-sectional design limits causal interpretation of the observed associations. Second, the use of self-reported measures may lead to overestimation of skills and confidence, as no objective assessment of clinical breast examination performance was conducted.

An important limitation is the use of convenience sampling, which may introduce selection bias and limit the generalizability of the findings. Students with a greater interest in oncology or prevention may have been more likely to participate, potentially leading to overestimation of

knowledge and engagement compared to the broader student population.

Additionally, sex-specific analyses were not performed, although sex may influence knowledge, attitudes, and engagement in breast cancer prevention. This should be considered in future research.

Moreover, the study did not allow for detailed analysis of institutional-level differences in curricula across universities, which may influence both knowledge and practical training. Finally, long-term knowledge retention and real-world clinical performance were not assessed.

Therefore, the results should be interpreted with caution and considered indicative of broader educational trends rather than fully representative of all medical students in Poland. Future longitudinal and interventional studies are warranted to evaluate whether targeted educational interventions lead to sustained improvements in competence and screening participation.

In conclusion, our findings reveal persistent deficiencies in breast cancer screening education among Polish medical students, particularly in the application of guideline-based knowledge and practical examination skills. While general awareness is high, the ability to translate knowledge into clinical practice remains limited.

These findings highlight the need for targeted and structured educational interventions. Early integration of cancer prevention and screening into medical curricula, followed by reinforcement during clinical training, may help address these gaps. In particular, expanding practical training in clinical breast examination through simulation-based learning, standardized patients, and supervised clinical encounters appears essential.

Introducing simulation-based modules at the preclinical stage – alongside core clinical skills training such as cardiopulmonary resuscitation (CPR) – may provide a strong foundation for later clinical practice, helping to bridge the gap between theoretical knowledge and practical competence. In addition, preventive oncology should be more explicitly integrated into key clinical disciplines, including internal medicine, gynaecology, and family medicine.

Consideration should also be given to implementing mandatory competency-based training modules, including assessment of practical skills before graduation or during postgraduate internship, to ensure a minimum standard of preparedness among future healthcare professionals.

This approach is supported by evidence suggesting that simulation-based education improves skill retention, confidence, and readiness for clinical practice [30]. However, given the cross-sectional design of the present study, these findings should be interpreted as associations rather than causal relationships.

Further longitudinal and interventional studies are needed to determine whether enhanced educational strategies may translate into improved clinical competence and, potentially, contribute to increased participation in screening programmes and better cancer outcomes.

Funding

No external funding.

Ethical approval

Not applicable.

Conflict of interest

The authors declare no conflict of interest.

References

1. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2021; 71: 209-49.
2. Krajowy Rejestr Nowotworów 2023. [cited 2025 Dec 29] <https://onkologia.org.pl/pl>.
3. Jassem EJ, Krzakowski M, Jassem AJ, et al. Breast cancer. *Oncol Clin Pract* 2020; 16: 207-60.
4. Kufel-Grabowska J, Wasąg B. Diagnosis and treatment of patients with breast cancer and mutation in the BRCA1/2 genes. *Oncol Clin Pract* 2024; 20: 222-8.
5. Duffy SW, Tabár L, Yen AM, et al. Mammography screening reduces rates of advanced and fatal breast cancers: results in 549,091 women. *Cancer* 2020; 126: 2971-9.
6. Narodowy Fundusz Zdrowia; Raport: Realizacja Populacyjnego Programu Wczesnego Wykrywania Raka Piersi. 2025. [cited 2025 Dec 29]
7. Lagerlund M, Åkesson A, Zackrisson S. Population-based mammography screening attendance in Sweden 2017-2018: A cross-sectional register study to assess the impact of sociodemographic factors. *Breast* 2021; 59: 16-26.
8. Eurostat. Cancer screening statistics. 2023. [cited 2025 Dec 29]
9. Kann PE, Lane DS. Breast cancer screening knowledge and skills of students upon entering and exiting a medical school. *Acad Med* 1998; 73: 904-6.
10. Tomic M, Vescan ML, Ungureanu MI. Exploring female medical students' knowledge, attitudes, practices, and perceptions related to breast cancer screening: a scoping review. *J Med Life* 2023; 16: 1732-9.
11. Garai S, Törzsökné Márton J, Csima M, Sipos D. Understanding breast cancer: awareness, risk factors, and symptoms among female health science students in Hungary. *Healthcare (Basel)* 2025; 13: 1512.
12. Colman R, Kirkman A, Jackson J, Goldburn L, Ozaki A, Kotera Y. Breast cancer understanding among university students: a rapid review of cross-country comparisons. *Arch Breast Cancer* 2023; 10: 114-23.
13. Deandrea S, Molina-Barceló A, Uluturk A, et al. Presence, characteristics and equity of access to breast cancer screening programmes in 27 European countries in 2010 and 2014. Results from an international survey. *Prev Med* 2016; 91: 250-63.
14. Meani F, Kovacs T, Wandschneider W, Costa A, Pagani O. Multidisciplinary blended learning to build a breast

- cancer specialist career: survey on the perspective of the first 2 cohorts of the ESO-ULM Certificate of Competence in Breast cancer (CCB). *BMC Med Educ* 2022; 22: 344.
15. Özerdoğan N, Şahin BM, Kösgeroğlu N, et al. Educational study to increase breast cancer knowledge level and scanning participation among women working at a university. *Eur J Breast Health* 2017; 13: 113-6.
 16. Lind DS, Jasra B. Competency-based medical education and breast disease. *HCA Healthc J Med* 2021; 2: 137-41.
 17. Orsi TD, Valadares ALR, Orsi PME, Orsi IME, Moura AS. Simulation-based training for pelvic and breast physical examination: effect on the anxiety and self-confidence of medical students. *Rev Bras Ginecol Obstet* 2020; 42: 739-45.
 18. Nassif J, Sleiman AK, Nassar AH, Naamani S, Sharara-Chami R. Hybrid simulation in teaching clinical breast examination to medical students. *J Cancer Educ* 2019; 34: 194-200.
 19. Sharara-Chami R, Musharrafieh U, Nassar A, Lakissian Z, Nassif J. Hybrid simulation for teaching clinical breast examination (CBE) for physicians in training. *Health Edu Care* 2019; 4: 1-5.
 20. Bratborska A, Piotrowski I. The impact of yoga practice on cortisol levels in breast cancer patients – a comprehensive review. *Oncol Clin Pract* 2024; 20: 420-7.
 21. Zhang Y, Maconochie M. A meta-analysis of peer-assisted learning on examination performance in clinical knowledge and skills education. *BMC Med Educ* 2022; 22: 147.
 22. McCoy CE, Rahman A, Rendon JC, et al. Randomized controlled trial of simulation vs. standard training for teaching medical students high-quality cardiopulmonary resuscitation. *West J Emerg Med* 2019; 20: 15-22.
 23. European guidelines for quality assurance in breast cancer screening and diagnosis. European Commission; 2023. [cited 2025 Dec 29] <https://euref.org/download/european-guidelines-for-quality-assurance-in-breast-cancer-screening-and-diagnosis-pdf-2/>.
 24. Küçükkaya M, Demirezen E. Using information and communication technologies to improve awareness of early diagnosis of cancers in women. *Oncol Clin Pract* 2025; 22: e00526073.
 25. Bongaerts THG, Büchner FL, Nierkens V, Crone MR, Guicherit OR, Numans ME. Perceptions and beliefs of general practitioners on their role in the cancer screening programmes in the Netherlands: a mixed-methods study. *BMC Prim Care* 2024; 25: 129.
 26. Lemmo D, Martino ML, Donizzetti AR, Freda MF, Caso D. The relationship between healthcare providers and preventive practices: narratives on access to cancer screening. *Int J Environ Res Public Health* 2022; 19: 10942.
 27. Leżanko M, Pilch BA, Czechowska A, Sigorski D, Sobczuk P, Nawrocki S. Knowledge about the European Code Against Cancer, and adherence to the principles of a healthy lifestyle among students in Poland. *Nowotwory* 2025; 75: 10-8.
 28. Espina C, Yared W, Ritchie D, et al. Sustainability and monitoring of the European Code Against Cancer: recommendations. *Cancer Epidemiol* 2021; 72: 101933.
 29. Karasiewicz M, Chawłowska E, Lipiak A, Więckowska B. How to improve cancer prevention knowledge? A way to identify gaps and tackle the limited availability of health education services in primary health care using the European Code Against Cancer. *Front Public Health* 2022; 10: 878703.
 30. Elendu C, Amaechi DC, Okatta AU, et al. The impact of simulation-based training in medical education: a review. *Medicine (Baltimore)* 2024; 103: e38813.