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Closing the Belief–Behaviour Gap in Cancer Screening: Evidence from a Population-Based Study in Two Polish Voivodeships

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Abstract

Introduction

: Cancer remains a major public health challenge in Poland, and participation in organised cancer screening remains below the desired level. This study examined screening-related beliefs, information engagement, intentions to participate in screening, and self-reported screening-related examination uptake in two Polish voivodeships in 2025.

Material and methods

A cross-sectional study using computer-assisted telephone interviews (CATI) was conducted in July 2025 among 2,207 adults from Dolnośląskie and Świętokrzyskie voivodeships. The questionnaire assessed beliefs about cancer screening and early detection, information engagement, communication with primary care physicians, intentions to undergo screening, and self-reported preventive examinations. Principal component analysis with varimax rotation was used to explore the structure of screening-related items and to construct two exploratory indices. Reliability was assessed using Cronbach's alpha. Because index distributions were non-normal, group differences were analysed using Mann–Whitney U and Kruskal–Wallis tests.

Results

More than 90% of respondents endorsed the importance of early cancer detection, whereas awareness of specific screening programmes was substantially lower. The Beliefs About Cancer Screening index showed good internal consistency (Cronbach's alpha = 0.829), while the Information Engagement and Screening Intentions index showed moderate internal consistency (Cronbach's alpha = 0.633) and should be interpreted as exploratory. Women, respondents with higher educational attainment, and those reporting cancer in their family or close circle had higher scores on both indices.

Conclusions

The findings indicate a substantial gap between favourable beliefs about early detection and actual screening-related behaviour. Improving general awareness alone is unlikely to be sufficient. Clearer communication about eligibility and access pathways, stronger involvement of primary care, active reminder systems and tailored interventions for groups with lower engagement may help increase participation in cancer prevention.

1. Introduction

Cancer remains one of the leading public health challenges in Poland. Malignant neoplasms are the second most common cause of death, and the burden of disease remains high despite advances in diagnostics and treatment. In 2021, approximately 171.5 thousand new cancer cases and 93.7 thousand cancer deaths were recorded in Poland. Lung, colorectal and breast cancers remain among the most important contributors to cancer mortality [1–3].

Organised population-based screening programmes for breast and cervical cancer, as well as colorectal cancer screening pathways, are available free of charge in Poland, although participation remains unsatisfactory. At the time of this 2025 survey, lung cancer screening was being developed through pilot and implementation initiatives rather than functioning as a stable nationwide population screening programme. Cervical screening uptake illustrates the gap between self-reported and administrative data: survey-based estimates and opportunistic testing may suggest much higher use of cytology than national programme records. A similar discrepancy is seen for breast cancer screening. To improve population health outcomes, the eligible age ranges for breast and cervical cancer screening were widened in November 2023: mammography is offered to women aged 45–74, and cervical screening to women aged 25–64. Colorectal cancer screening is aimed primarily at people aged 50–65, including selected individuals aged 40–49 at increased risk [4–6].

The persistence of this gap suggests that screening-related behaviour is shaped by several mechanisms operating at the same time: beliefs about the benefits of early detection, practical awareness of available programmes, clarity of access pathways, active engagement with information sources, and communication with healthcare professionals. These mechanisms may vary by sex, age, education, family history of cancer and regional context, which has direct implications for the design of effective cancer prevention strategies in Poland.

2. Objectives

The aim of this study was to evaluate cancer screening-related beliefs, information engagement, intentions to participate in screening, and self-reported screening-related examination uptake among adults from two Polish voivodeships: Dolnośląskie and Świętokrzyskie. The study also examined whether these outcomes differed according to sex, age, education, family history of cancer and region.

Research questions:

1. (a) Screening-related beliefs: What beliefs about cancer screening and early detection are commonly held among respondents, and do these beliefs differ by age, education, sex, family history of cancer or voivodeship?
2. (b) Information engagement and screening intentions: What is the level of respondents' information engagement and intention to participate in cancer screening, and do these levels differ by age, education, sex, family history of cancer or voivodeship?
3. (c) Self-reported screening-related examination uptake: What proportion of eligible respondents report having undergone selected preventive examinations, and does self-reported uptake differ by

voivodeship?

3. Materials and methods

This cross-sectional study was conducted in July 2025 using computer-assisted telephone interviews (CATI) with a standardised 43-item questionnaire prepared by the authors.

No previously published questionnaire fully addressed the objectives of the present study, which simultaneously evaluated awareness, beliefs, perceived barriers, and participation in breast, cervical, and colorectal cancer screening within the Polish population. Therefore, an original questionnaire was developed by integrating and adapting thematic domains and selected items from several validated questionnaires and published studies. Questions assessing general cancer awareness, recognition of cancer warning signs, anticipated help-seeking behaviour, and perceived barriers to medical consultation were adapted from the Cancer Awareness Measure (CAM) [7]. Items concerning breast cancer awareness, including knowledge of risk factors and symptoms, attitudes towards prevention, perceived barriers to screening, and preventive health behaviours, were adapted from the Breast Cancer Awareness Scale (B-CAS) [8]. Questions addressing colorectal cancer knowledge, awareness of risk factors and warning signs, attitudes towards screening, and screening intentions were adapted from the questionnaire described by Wang et al. [9]. The conceptual framework for colorectal cancer awareness and screening participation was additionally informed by the review conducted by Akanbi et al. [10].

The selected items were critically reviewed by the research team, harmonised to ensure consistency of wording and response formats across questionnaire sections, supplemented where necessary with study-specific questions, and adapted to reflect the organisation of cancer screening programmes within the Polish healthcare system. In particular, new items were developed to capture features unique to the Polish context, including eligibility criteria for population-based screening programmes, invitation and referral pathways, previous participation in organised screening programmes, reasons for non-participation, and selected organisational and healthcare system factors that were not addressed by existing instruments. The final questionnaire therefore represents an original, integrated instrument specifically designed to achieve the objectives of the present study.

The sample included 2,207 adult respondents aged 18 years or older from two Polish voivodeships: Dolnośląskie (N = 1,104) and Świętokrzyskie (N = 1,103). Dolnośląskie Voivodeship is in south-western Poland and is one of the most urbanised regions in the country, with a population of approximately 3 million inhabitants. In contrast, Świętokrzyskie Voivodeship is in south-central Poland and has a population of approximately 1.2 million inhabitants. It is characterised by a lower level of urbanisation, a relatively high proportion of rural municipalities, population ageing, and ongoing depopulation. The socioeconomic profile of the region is shaped by smaller urban centres and by sectors such as industry, mining, tourism, and agriculture. The level of urbanisation is substantially lower in Świętokrzyskie Voivodeship, at approximately 35%, compared with approximately 69% in Dolnośląskie Voivodeship [11].

Participants were selected from a sampling frame based on population registers of adult residents in the two voivodeships. The target sample included adults without a prior cancer diagnosis or history of oncological treatment who provided informed consent to participate. A stratified sampling procedure was used to approximate the age and sex structure of the adult population in each voivodeship. Questions about breast and cervical cancer screening were asked only of women, and the question about prostate cancer screening was asked only of men. Results concerning self-reported screening-related examinations were restricted to respondents in age groups eligible for the relevant programme: cervical cancer screening, 25–64 years; breast cancer screening, 45–74 years; and colorectal cancer screening, 50–65 years, with inclusion of individuals aged 40–49 from risk groups where applicable [12].

Statistical analysis

Questionnaire development and quality control based on the literature review and based on the pilot on 10 patients. The analysed outcomes covered three domains: (1) beliefs about cancer screening and early detection, (2) information engagement and intentions to participate in screening, and (3) self-reported screening-related examination uptake. The term “uptake” in this manuscript refers to respondent-reported preventive examinations and should not be interpreted as verified participation in organised screening programmes unless confirmed by administrative data.

Principal component analysis was performed to identify the latent structure of screening-related items and to construct exploratory indices. Sampling adequacy was excellent (KMO = 0.887), and Bartlett’s test of sphericity was significant, chi-square (91) = 8154.03, $p < .001$, indicating that the correlation matrix was suitable for factor extraction. Based on Kaiser’s criterion (eigenvalues > 1) and inspection of the scree plot, a two-component solution was retained. The two components explained 45.21% of the total variance, including 32.07% for component 1 (eigenvalue = 4.49) and 13.15% for component 2 (eigenvalue = 1.84). Loadings of approximately > = 0.50, low cross-loadings and conceptual fit were used to retain items for scale construction. Internal consistency was evaluated using Cronbach’s alpha. Because the index scores did not meet assumptions of normality, group differences were assessed using Mann–Whitney U tests for two-group comparisons and Kruskal–Wallis tests for comparisons across more than two groups. Statistical analyses were performed using IBM SPSS Statistics.

Beliefs About Cancer Screening

This component captured cognitive beliefs about early detection and screening, including perceived effectiveness, importance and legitimacy of screening. To ensure a conceptually coherent and parsimonious structure, only items with the clearest conceptual fit and the strongest loadings were retained for scale construction. Index 1 was constructed as the sum of eight retained items, with an observed scale range of 8–40. These items showed consistently strong loadings on component 1 and represented a coherent domain of pro-screening beliefs and perceived benefits. The scale demonstrated good internal consistency (Cronbach’s alpha = 0.829).

- **Q1.1** (Regular checks help detect cancer early)

- **Q1.2** (Would attend the screening if knowing where to go)
- **Q1.3** (Importance of knowing recommended screening tests)
- **Q1.4** (Early stage cancer is easier to treat)
- **Q1.5** (Colonoscopy enables early detection)
- **Q1.6** (Early diagnosis/treatment can prolong life)
- **Q1.7** (Screening should be available to everyone)
- **Q1.8** (Mammography enables early detection)

Information Engagement and Screening Intentions

This component reflected active engagement and readiness for screening, including information seeking, communication with a primary care physician and intention to undergo screening. Because the three retained items measure related but not identical aspects of behaviour and system contact, this index should be interpreted as an exploratory engagement/intention measure rather than a fully validated psychometric scale. Items retained were:

- **Q2.1** (Often searches for information about prevention/early detection)
- **Q2.2** (The primary care physician provides screening information)
- **Q2.3** (Plans to undergo screening soon)

The internal consistency of the second component, Information Engagement and Screening Intentions, was moderate (Cronbach's alpha = 0.633 across 3 items). Given the small number of items and the exploratory character of the index, this value was considered sufficient for descriptive and comparative analyses but should be interpreted cautiously.

The selection of items for index construction was based on a combination of statistical and conceptual criteria, including factor loadings, minimisation of cross-loadings and theoretical coherence with the underlying constructs.

Local availability of screening was treated as a contextual/accessibility item rather than a core belief or engagement indicator. Information clarity was conceptually adjacent to engagement but loaded more strongly on Component 1, indicating potential cross-domain interpretation.

Population characteristics

The sociodemographic structure of the sample was broadly comparable between the two regions, although the manuscript requires final verification of exact denominators and sex distribution. Approximately one third of respondents were aged 60 years or older, and the distribution across the remaining age categories was relatively even. Educational attainment was also similar across regions, with the largest groups reporting vocational secondary or general secondary education, followed by higher education.

A chi-square test of independence indicated a significant association between voivodeship and education level (Pearson's χ^2 (6, N = 2207) = 16.65, p = .011, with small effect Cramér's V = .087). Respondents from Świętokrzyskie were more likely to live in rural areas (49.3%) and less likely to reside in large cities, whereas respondents from Dolnośląskie were more urban, including a substantial share from cities with > 200,000 residents (24.7%) (χ^2(3, N = 2207) = 331.26, p < .001, with a moderate effect size (Cramér's V = .387) (more in Appendix 1).

4. Results

Beliefs about cancer screening, information engagement, and screening intentions

The first index captured cognitive beliefs about early detection and screening. Overall, respondents showed strong endorsement of early detection and the value of preventive examinations. More than 90% agreed that lifestyle influences cancer risk and that early detection improves the chances of recovery. At the same time, practical awareness of specific screening programmes was substantially lower, indicating a gap between general support for prevention and detailed knowledge about available services. The Beliefs About Cancer Screening index demonstrated good internal consistency (Cronbach's alpha = 0.829). Figure 1 presents all statements included in the index together with the distribution of respondents' responses.

The second index reflected behavioural engagement, including seeking information about prevention, receiving information from a primary care physician and planning to undergo screening in the near future. It was based on three retained items with the highest loadings on component 2; the observed score range was 3–15. Internal consistency for this exploratory scale was moderate (Cronbach's alpha = 0.633). All statements included in this index and the distribution of respondents' responses are presented in Fig. 2. Together, the two indices suggest that positive attitudes toward screening are more common than active information engagement and concrete readiness to participate.

Differences by sex, age, education, and family history of cancer

Gender. Gender differences were observed in both screening-related indices across the two voivodeships. In Świętokrzyskie, women scored higher than men on both Index 1 and Index 2. For Index 1, the median score was 33.0 [32.0–36.0] among women and 32.0 [30.0–34.0] among men, and the difference was statistically significant, U = 189,053.50, z = 7.03, p < .001, r = .21. For Index 2, women also had higher scores than men, with medians of 8.0 [7.0–10.0] and 7.0 [6.0–9.0], respectively, U = 187,470.00, z = 6.75, p < .001, r = .20.

A similar pattern was found in Dolnośląskie. Women had higher Index 1 scores than men, with median values of 34.0 [32.0–37.0] and 32.0 [30.0–34.0], respectively, (U = 210,811.50, z = 11.25, p < .001, r = .34). For Index 2, women again scored higher than men, with medians of 8.0 [6.0–10.0] and 7.0 [5.0–9.25], respectively, U = 175,177.00, z = 4.49, p< .001, r = .14. Overall, women reported stronger pro-screening

beliefs and greater information engagement and screening intentions than men, although effect sizes ranged from small to moderate (see Table 1 and Fig. 3).

Table 1
Gender differences in Index 1 and Index 2

Index	Gender	n	Median [Q1–Q3]	IQR	Test results
Świętokrzyskie					
Index 1	**Men**	542	32.0 [30.0–34.0]	4.0	Mann–Whitney U = 189,053.50, z = 7.03, p < .001, r = .21
Index 1	**Women**	561	33.0 [32.0–36.0]	4.0	
Index 2	**Men**	542	7.0 [6.0–9.0]	3.0	Mann–Whitney U = 187,470.00, z = 6.75, p < .001, r = .20
Index 2	**Women**	561	8.0 [7.0–10.0]	3.0	
Dolnośląskie					
Index 1	**Men**	514	32.0 [30.0–34.0]	4.0	Mann–Whitney U = 210,811.50, z = 11.25, p < .001, r = .34
	Women	590	34.0 [32.0–37.0]	5.0	
Index 2	**Men**	514	7.0 [5.0–9.25]	4.25	Mann–Whitney U = 175,177.00, z = 4.49, p< .001, r = .14
	Women	590	8.0 [6.0–10.0]	4.0	

*Values are presented as median [Q1–Q3] using weighted average percentiles.

Age. Age-group differences were observed for both indices in both voivodeships. In Świętokrzyskie, Index 1 differed significantly across age groups, $H(4) = 29.77$, $p < .001$, $\varepsilon^2 = .023$, as did Index 2, $H(4) = 20.53$, $p < .001$, $\varepsilon^2 = .015$. In Dolnośląskie, significant age-group differences were also found for Index 1, $H(4) = 15.85$, $p = .003$, $\varepsilon^2 = .011$, and Index 2, $H(4) = 51.91$, $p < .001$, $\varepsilon^2 = .044$. Overall, the youngest respondents tended to have the lowest scores, particularly for Index 2, while middle-aged and older groups generally reported higher pro-screening beliefs and engagement. Effect sizes were small (see Table 2).

Table 2
Age-group differences in Index 1 and Index 2 by voivodeship

Index	Age group	N	Median [Q1–Q3]	IQR	Test results
Świętokrzyskie					
Index 1	18–29	171	32.0 [30.0–34.0]	4	Kruskal–Wallis H(4) = 29.77*
	30–39	184	33.0 [31.0–35.0]	4	**ε²=**.023
	40–49	202	33.0 [31.0–36.0]	5	p< .001
	50–59	169	33.0 [31.0–35.0]	4	
	60+	377	33.0 [30.0–36.0]	6	
Index 2	18–29	171	7.0 [5.0–9.0]	4	Kruskal–Wallis H(4) = 20.53
	30–39	184	8.0 [6.0–10.0]	4	**ε²=** .015
	40–49	202	8.0 [6.0–10.0]	4	p< .001
	50–59	169	8.0 [6.0–10.0]	4	
	60+	377	8.0 [6.0–10.0]	4	
Dolnośląskie					
Index 1	18–29	159	32.0 [31.0–34.0]	3	Kruskal–Wallis H(4) = 15.85
	30–39	208	33.0 [31.0–35.0]	4	**ε²=**.011
	40–49	220	33.0 [31.0–37.0]	6	P=.003
	50–59	165	33.0 [31.0–37.0]	6	
	60+	352	33.0 [31.0–36.0]	5	
Index 2	18–29	159	6.0 [5.0–8.0]	3	Kruskal–Wallis H(4) = 51.91
	30–39	208	7.0 [6.0–9.75]	3.75	p< .001
	40–49	220	8.0 [6.0–10.0]	4	**ε²=**.044
	50–59	165	8.0 [7.0–10.0]	3	
	60+	352	7.0 [6.0–10.0]	4	

***Values are presented as median [Q1–Q3] using weighted average percentiles. Effect size is reported as epsilon squared (ε²).

Education. Educational attainment was significantly associated with both indices in both voivodeships. Detailed results are presented in Table 3. Overall, respondents with higher educational attainment tended

to report stronger pro-screening beliefs and greater information engagement/screening intentions than those with lower educational attainment. Detailed results are presented in Table 3.

Table 3
Education-level differences in Index 1 and Index 2 by voivodeship*

Index	Education level	n	Median [Q1–Q3]	IQR	Test results
Świętokrzyskie					
Index 1	No education	1			Kruskal–Wallis H(6)** = 88.80
	Primary	33	30.0 [25.0–34.0]	9	**ε²=**.076
	Lower secondary	26	28.0 [26.75–29.0]	2.25	P < .001
	Vocational secondary	297	32.0 [30.0–35.0]	5	
	General secondary	298	33.0 [31.0–35.0]	4	
	Post-secondary/college	201	33.0 [32.0–35.0]	3	
	Higher education	247	34.0 [32.0–37.0]	5	
Index 2	No education	1			Kruskal–Wallis H(6) = 103.97
	Primary	33	5.0 [4.0–8.0]	4	**ε²=**.089
	Lower secondary	26	5.5 [4.0–7.0]	3	P < .001
	Vocational secondary	297	7.0 [5.0–9.0]	4	
	General secondary	298	8.0 [6.0–9.0]	3	
	Post-secondary/college	201	9.0 [8.0–10.0]	2	
	Higher education	247	8.0 [6.0–10.0]	4	
Dolnośląskie					
Index 1	No education	10	28.0 [25.75–33.0]	7.25	Kruskal–Wallis H(6) = 125.21
	Primary	31	29.0 [28.0–32.0]	4	**ε²=**.109
	Lower secondary	15	29.0 [26.0–32.0]	6	P < .001
	Vocational secondary	282	32.0 [30.0–34.0]	4	
	General secondary	261	33.0 [31.0–35.0]	4	
	Post-secondary/college	224	33.0 [32.0–36.0]	4	
	Higher education	281	35.0 [32.0–38.0]	6	

Index	Education level	n	Median [Q1–Q3]	IQR	Test results
Świętokrzyskie					
Index 2	No education	10	5.5 [5.0–7.0]	2	Kruskal–Wallis H(6) = 88.22 **ε²=**.075 P < .001
	Primary	31	5.0 [4.0–7.0]	3	
	Lower secondary	15	7.0 [4.0–7.0]	3	
	Vocational secondary	282	6.5 [5.0–9.0]	4	
	General secondary	261	7.0 [6.0–10.0]	4	
	Post-secondary/college	224	8.0 [7.0–10.0]	3	
	Higher education	281	8.0 [6.0–10.0]	4	

*Values are presented as median [Q1–Q3] using weighted average percentiles. The “no education” category in Świętokrzyskie included only one respondent and was therefore not reported descriptively. Effect size is reported as epsilon squared (ε²).

Cancer in the family. Respondents reporting a family or close-circle history of cancer had significantly higher scores on both indices in both voivodeships. In Świętokrzyskie, family cancer history was associated with higher Index 1 scores, U = 149,432.50, z = 7.43, p < .001, r = .24, and higher Index 2 scores, U = 139,712.00, z = 5.21, p < .001, r = .17. The same pattern was observed in Dolnośląskie for Index 1, U = 151,120.50, z = 6.84, p < .001, r = .22, and Index 2, U = 143,208.00, z = 5.07, p < .001, r = .16. Detailed results are presented in Table 4. Overall, respondents with personal proximity to cancer reported stronger pro-screening beliefs and greater information engagement/screening intentions than those without such experience. Because the study was cross-sectional, these findings should be interpreted as associations rather than evidence of causality.

Table 4
Family history of cancer and Index 1 / Index 2 by voivodeship

Voivodeship	Index	Family history of cancer	N	Median [Q1–Q3]	Test results
Świętokrzyskie	Index 1	No	457	32.0 [31.0–34.0]	**Mann–Whitney U** = 149,432.50, z = 7.43, p < .001, r = .24
		Yes	513	34.0 [32.0–37.0]	
	Index 2	No	457	7.0 [6.0–9.0]	**Mann–Whitney U =** 139,712.00, z = 5.21, p < .001, r = .17
		Yes	513	8.0 [6.0–10.0]	
Dolnośląskie	Index 1	No	454	32.0 [31.0–34.0]	**Mann–Whitney U**U = 151,120.50, z = 6.84, p < .001, r = .22,
		Yes	532	34.0 [32.0–37.0]	
	Index 2	No	454	7.0 [6.0–9.0]	**Mann–Whitney U** = 143,208.00, z = 5.07, p < .001, r = .16.
		Yes	532	8.0 [6.0–10.0]	

Note. Values are presented as median [Q1–Q3] using weighted average percentiles. Effect size is reported as *r* for Mann–Whitney U tests.

Participation in preventive examinations. Approximately one half of respondents reported having undergone at least one preventive examination, although self-reported uptake varied substantially by test and region. Self-reported uptake of women's screening-related examinations was higher in Dolnośląskie than in Świętokrzyskie. Among eligible women, 76% in Dolnośląskie and 57% in Świętokrzyskie reported breast screening-related examination uptake. For cervical screening-related examinations, the corresponding proportions were 58% and 48%, respectively. For colorectal cancer screening, self-reported uptake was low and similar in both regions, at approximately 14% and 13%, respectively (see Fig. 4).

Taken together, these results suggest that broad endorsement of early detection does not automatically translate into self-reported screening-related examination uptake. The gap appears particularly

pronounced for colorectal cancer screening-related examinations, whereas regional differences are most visible for breast and cervical screening-related examinations.

Discussion

The present study showed that although respondents expressed strong declarative support for early cancer detection and screening, this was not reflected in equally high participation in preventive screening programmes. This points to a clear belief–behaviour gap. More than 90% of respondents acknowledged the importance of early detection, yet awareness of specific screening programmes was substantially lower, and participation in selected tests particularly colorectal cancer screening, remained limited. In addition, screening-related beliefs and information engagement differed significantly according to sex, age, educational attainment, family history of cancer, and region.

These findings are consistent with previous evidence suggesting that positive attitudes towards prevention do not automatically lead to actual participation in screening. Similar observations were reported in the 2022 study *How Poles Take Care of Their Health*, conducted by the Institute for Health, which showed that women were more likely than men to declare taking care of the health of family members and loved ones, and that declared participation in preventive behaviours tended to exceed actual uptake. Taken together, these findings suggest that declarative support for prevention should not be interpreted as a proxy for real engagement in screening programmes. A higher level of awareness regarding these risk factors is strongly associated in other studies also with being female, having higher education, being occupationally active, and having a history of chronic diseases [13].

From a practical perspective, the results indicate that improving general awareness alone is unlikely to substantially increase screening uptake. Effective preventive strategies should therefore address not only knowledge deficits, but also behavioural, informational and organisational barriers that hinder participation. The observed differences across demographic groups suggest that communication should be better tailored to sex, age and educational level, with clearer information on eligibility criteria, access pathways and the practical steps required to undergo screening.

These findings can also be interpreted in light of established behavioural models. Evidence from a systematic review and meta-analysis based on the Health Belief Model [14] suggests that participation in cervical cancer screening is associated with perceived susceptibility, perceived benefits of screening and self-efficacy [15, 16]. In other words, individuals are more likely to engage in screening when they believe they are personally at risk, recognise the value of early detection and feel capable of managing the medical and organisational steps involved. Immediate cues to action are also important, including physician recommendation, family encouragement, media campaigns or positive experiences reported by peers. Similarly, the Integrated Behavioural Model [17] suggests that intention alone is insufficient if individuals face practical barriers, such as difficulties navigating the healthcare system, limited access to transport, financial constraints or inconvenient clinic hours. The human behaviour is often assumed to be largely driven by a practical cost-benefit analysis. A person will only act if the perceived benefits (e.g.,

the effectiveness of a cancer prevention, or a vaccine prevention) clearly outweigh the perceived barriers (the psychological, physical, or financial costs of the action). However, emotions and cultural perceptions also play a significant role and should be taken into account in design of interventions. This may help explain why strong endorsement of screening in the present study did not translate into higher actual uptake [18].

In conversations with patients, physicians often assume that the basic rationale for screening is self-evident and therefore fail to communicate it explicitly. As a result, even when individuals are formally informed about screening, their understanding of its purpose, process, and implications may remain limited. Unrecognized misunderstandings or misconceptions about cancer screening can contribute to low participation rates. Addressing this gap is challenging, but greater clarity in communication may significantly improve acceptance of screening tests [19].

According to other studies on implementing preventive programs in Poland, the main patient-related reasons for low screening attendance include: low awareness of cancer screening and its benefits (64%), fear of being diagnosed with cancer (63%), lack of care for one's health (49%), lack of knowledge about opportunities to participate (43%), fear of undergoing a medical procedure (33%), and embarrassment before the examination (24%) [20]. Young people in Poland often overestimate genetic factors—frequently identifying them as the main cause of cancer—while underestimating the impact of lifestyle factors such as a poor diet, lack of physical activity, or viral/bacterial infections. There is also a noticeable divide based on the field of study: medical students exhibit a significantly higher understanding of cancer risk factors and the oncological consequences of HPV infection compared to non-medical students [21].

While Polish women generally have good theoretical knowledge about the existence of tests like mammography and cytology (Pap smears), detailed knowledge and screening participation remain unsatisfactory. A decade-apart study on young Polish female students showed a concerning decrease in awareness of cytological examinations, dropping from 91.2% in 2012 to 81.9% in 2022 [22]. The most common psychological barriers preventing women from undergoing screenings include fear of an unfavourable diagnosis, fear of pain and radiation, shame or embarrassment during the physical examination, and a lack of detailed information regarding the screening's purpose.

Digital tools could support communication with the society especially as in Poland, the use of the internet to search for health information and access health records has increased and is now comparable to the EU average. However, a pronounced digital divide persists by age and socioeconomic status. Adults aged 25–64 years are substantially more likely to seek health information online than those aged 65–74 years, and individuals with higher educational attainment are much more likely to use digital tools than those with lower levels of education. These inequalities are likely to influence access to screening information and navigation of prevention pathways, and should therefore be considered when designing interventions [23].

At the system level, the findings support strengthening the role of primary healthcare physicians as a trusted and proactive source of information about cancer prevention and screening. Another important issue concerns inequalities in screening-related engagement. In both voivodeships, beliefs and engagement varied by age and educational attainment, suggesting that universal communication approaches may be less effective than targeted strategies. Younger and less educated groups may require different communication channels, message framing and support mechanisms than older or better educated respondents. This is particularly relevant in the context of increasing digitalisation of health information and services. The regional differences observed for self-reported breast and cervical cancer screening may indicate that local implementation and communication strategies influence participation. By contrast, the consistently low uptake of colorectal cancer screening in both voivodeships points to a broader systemic challenge rather than a purely regional one. Potential barriers may include limited knowledge of the programme, uncertainty about how to access screening, reluctance towards the procedure itself, or insufficient active outreach from healthcare providers [24].

More active invitation and reminder systems, including SMS, e-mail and primary care–based recall mechanisms, could help reduce missed opportunities for participation. In addition, prevention campaigns should be tailored not only regionally, but also demographically, in order to address disparities in beliefs, information engagement and actual preventive behaviour.

An important limitation of this study is the reliance on self-reported screening participation, which likely overestimates actual uptake compared with administrative data in Poland, where mammography coverage is typically around 30–40%. This discrepancy may reflect recall bias, social desirability bias, and difficulties in distinguishing organised screening from opportunistic or diagnostic testing. Consequently, the belief–behaviour gap may be greater than indicated. Future studies should incorporate objective measures or linkage with administrative data. Second, the study was conducted in two voivodships, which may limit the generalisability of the findings to the entire Polish population. Regional differences in healthcare access, socioeconomic factors, and organisation of screening programmes may influence awareness and participation. Therefore, the results should be interpreted with caution and primarily reflect patterns observed in the studied regions.

Third, the cross-sectional design does not allow causal conclusions regarding determinants of screening uptake. Finally, although the composite indices helped capture beliefs and engagement, measurement error cannot be excluded, and the second index showed only moderate internal consistency.

Overall, the study highlights a substantial gap between favourable beliefs about early cancer detection and actual participation in screening. This suggests that awareness-raising alone is insufficient and should be complemented by tailored communication, easier navigation of screening pathways and more active support for participation. Stronger involvement of primary care and structured reminder systems may improve uptake, particularly in groups with lower engagement. Self-efficacy as the confidence how successfully navigating the healthcare system and completing the procedure. Further longitudinal and

population-based studies are needed to monitor changes over time and to evaluate the effectiveness of targeted interventions.

5. Conclusions

Overall, the study highlights a substantial gap between favourable beliefs about early cancer detection and self-reported screening-related behaviour. Awareness-raising alone is insufficient and should be complemented by tailored communication, easier navigation of screening pathways and more active support for participation. Stronger involvement of primary care and structured reminder systems may improve uptake, particularly in groups with lower engagement. Future interventions should also strengthen screening-related self-efficacy, understood as individuals' confidence in their ability to navigate the healthcare system and complete the recommended screening procedure. Further longitudinal and population-based studies are needed to monitor changes over time and to evaluate the effectiveness of targeted interventions.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and approved by the Bioethics Committee of the Lower Silesian Medical Chamber in Wrocław, Poland (Resolution No. 06/BNBO/2025 of 14 May 2025).

Consent for publication

Not applicable (the manuscript reports anonymised, aggregated survey data and contains no identifiable personal information).

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Competing interests

The authors declare that they have no competing interests.

Author Contribution

Conceptualisation: MW, ML, JT, PZ; Methodology: Data collection: MW; Formal analysis: JT; Writing—original draft: JT, MW, ML, LS; Writing—review and editing: AM, MW, JT, RM, BCS and all authors; Supervision: MW, BCS. All authors reviewed manuscript.

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Data Availability

The datasets generated and/or analysed during the current study are not publicly available due to data protection requirements and project governance restrictions. The data are available from the corresponding author upon reasonable request and subject to the necessary approvals.

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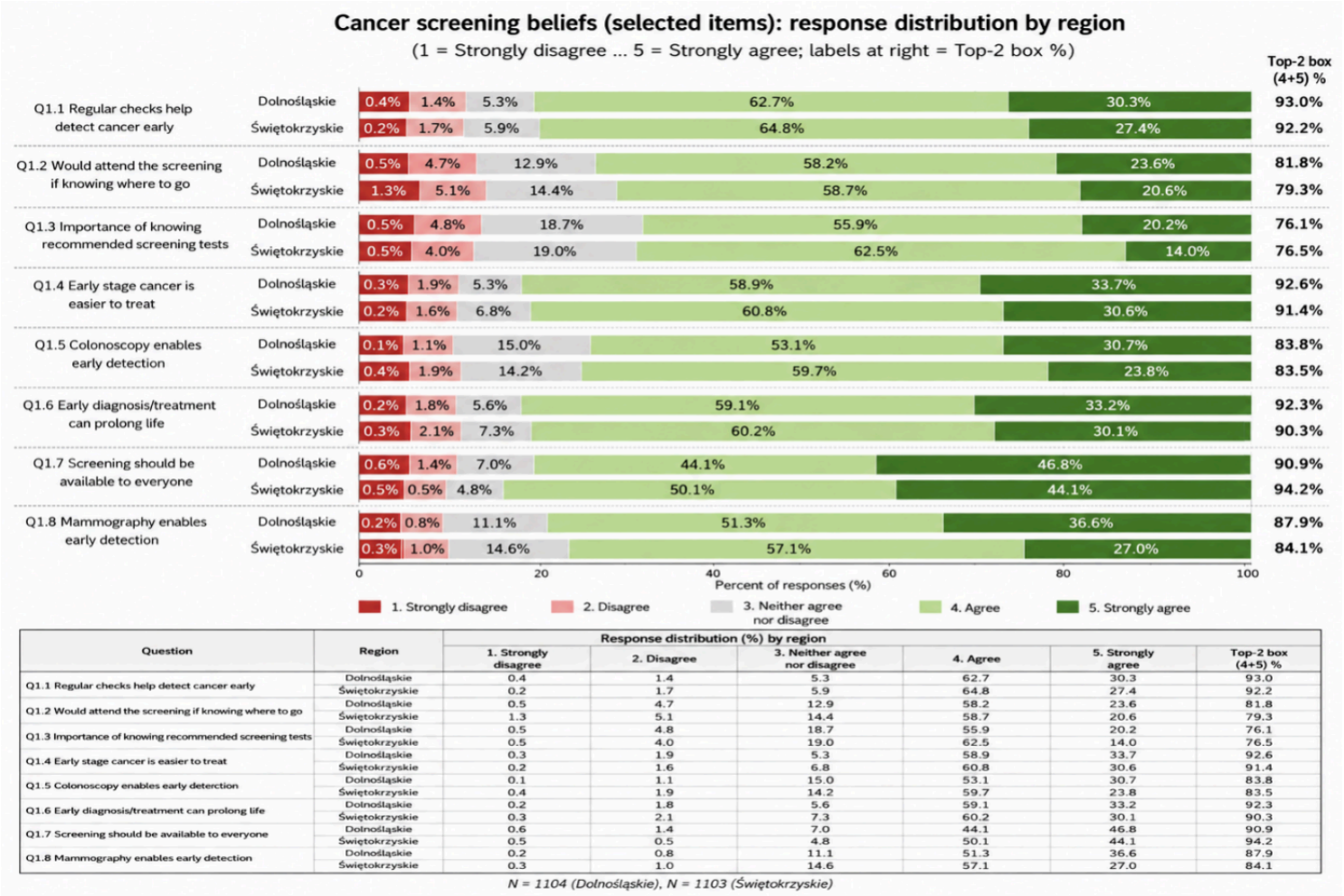
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Figures

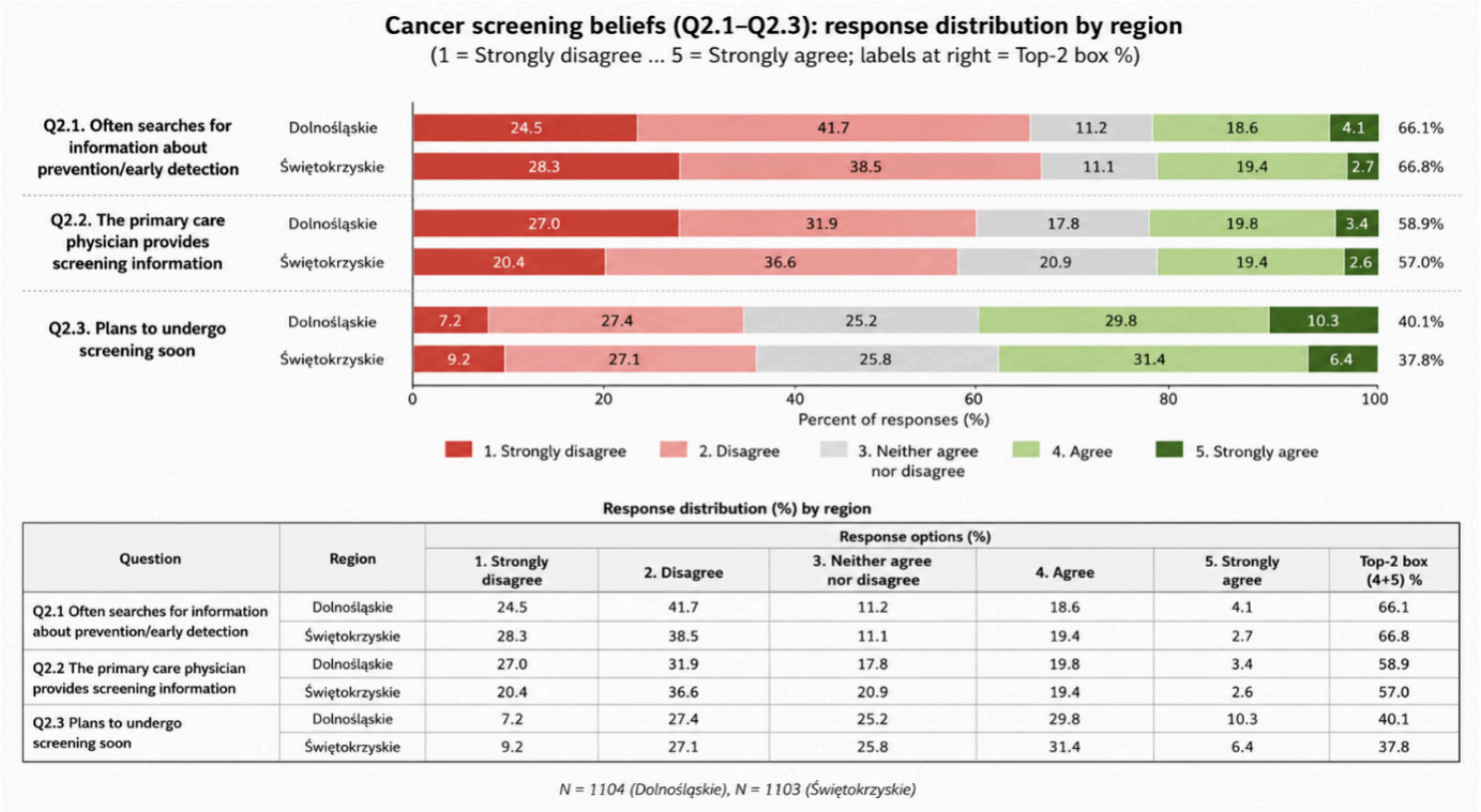


Question	Region	Response distribution (%) by region					
		1. Strongly disagree	2. Disagree	3. Neither agree nor disagree	4. Agree	5. Strongly agree	Top-2 box (4+5) %
Q1.1 Regular checks help detect cancer early	Dolnośląskie	0.4	1.4	5.3	62.7	30.3	93.0
	Świętokrzyskie	0.2	1.7	5.9	64.8	27.4	92.2
Q1.2 Would attend the screening if knowing where to go	Dolnośląskie	0.5	4.7	12.9	58.2	23.6	81.8
	Świętokrzyskie	1.3	5.1	14.4	58.7	20.6	79.3
Q1.3 Importance of knowing recommended screening tests	Dolnośląskie	0.5	4.8	18.7	55.9	20.2	76.1
	Świętokrzyskie	0.5	4.0	19.0	62.5	14.0	76.5
Q1.4 Early stage cancer is easier to treat	Dolnośląskie	0.3	1.9	5.3	58.9	33.7	92.6
	Świętokrzyskie	0.2	1.6	6.8	60.8	30.6	91.4
Q1.5 Colonoscopy enables early detection	Dolnośląskie	0.1	1.1	15.0	53.1	30.7	83.8
	Świętokrzyskie	0.4	1.9	14.2	59.7	23.8	83.5
Q1.6 Early diagnosis/treatment can prolong life	Dolnośląskie	0.2	1.8	5.6	59.1	33.2	92.3
	Świętokrzyskie	0.3	2.1	7.3	60.2	30.1	90.3
Q1.7 Screening should be available to everyone	Dolnośląskie	0.6	1.4	7.0	44.1	46.8	90.9
	Świętokrzyskie	0.5	0.5	4.8	50.1	44.1	94.2
Q1.8 Mammography enables early detection	Dolnośląskie	0.2	0.8	11.1	51.3	36.6	87.9
	Świętokrzyskie	0.3	1.0	14.6	57.1	27.0	84.1

N = 1104 (Dolnośląskie), N = 1103 (Świętokrzyskie)

Figure 1

Agreement with the statements on the beliefs about cancer screening



Response distribution (%) by region

Question	Region	Response options (%)					
		1. Strongly disagree	2. Disagree	3. Neither agree nor disagree	4. Agree	5. Strongly agree	Top-2 box (4+5) %
Q2.1 Often searches for information about prevention/early detection	Dolnośląskie	24.5	41.7	11.2	18.6	4.1	66.1
	Świętokrzyskie	28.3	38.5	11.1	19.4	2.7	66.8
Q2.2 The primary care physician provides screening information	Dolnośląskie	27.0	31.9	17.8	19.8	3.4	58.9
	Świętokrzyskie	20.4	36.6	20.9	19.4	2.6	57.0
Q2.3 Plans to undergo screening soon	Dolnośląskie	7.2	27.4	25.2	29.8	10.3	40.1
	Świętokrzyskie	9.2	27.1	25.8	31.4	6.4	37.8

N = 1104 (Dolnośląskie), N = 1103 (Świętokrzyskie)

Figure 2

Agreement with the statements on the Information Engagement and Screening Intentions

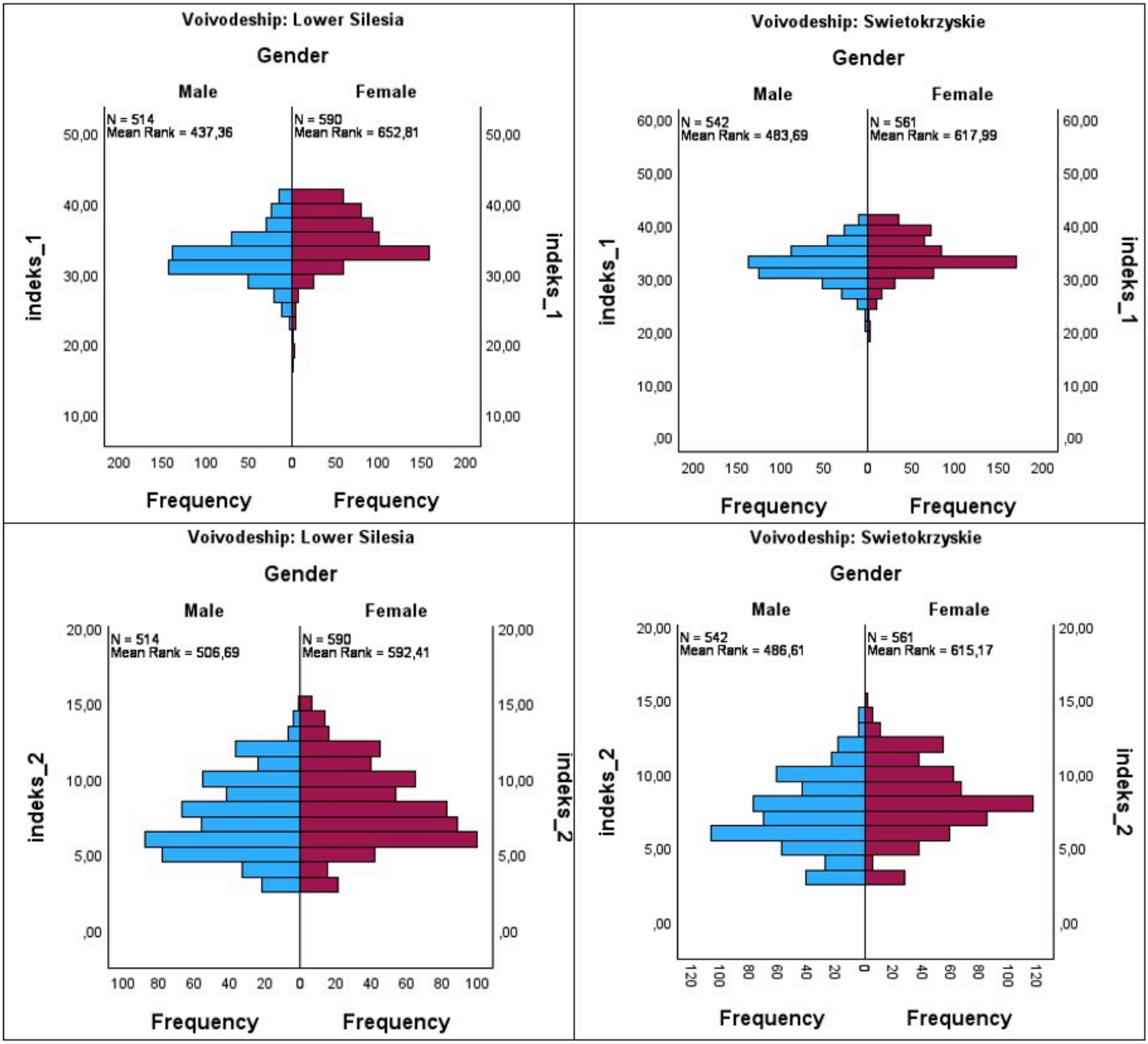


Figure 3

Mann-Whitney U Test for Independent Samples – gender as grouping sample (A. Dolnośląskie - index 1; B. Świętokrzyskie - index 1; C. Dolnośląskie – index 2; D. Świętokrzyskie - index 2)

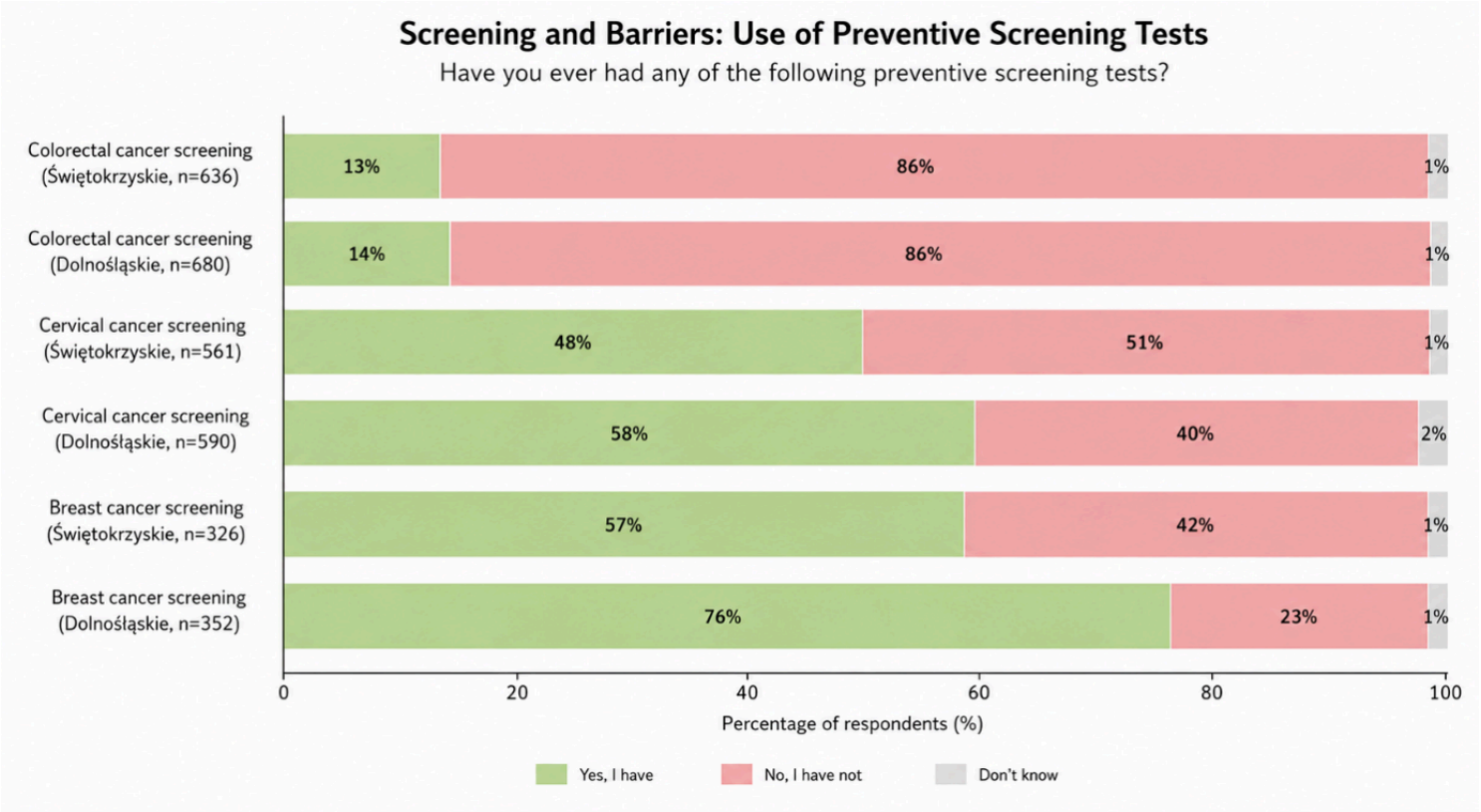


Figure 4

Percentage of individuals participating in preventive screenings by sex and age

Supplementary Files

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- Appendices.docx