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A cross-sectional study on cancer awareness, risk perception, and preventive behaviors in urban and rural India: Insights from 4,321 participants

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Abstract
Cancer is a major public health challenge globally, with increasing incidence and mortality rates, especially in low- and middle-income countries like India. Awareness of cancer prevention, screening, and treatment remains critically low. This study evaluates public awareness of cancer, assesses perceptions of personal risk, identifies preventive behaviors, explores attitudes toward government interventions, and highlights areas for improvement. A cross-sectional survey of 4,321 participants from urban and rural India was conducted. The questionnaire assessed cancer awareness, risk perceptions, preventive behaviors, and opinions regarding government roles. The statistical analyses included descriptive statistics and chi-square tests to identify associations between demographic characteristics and awareness levels. Ninety percent of participants had heard of cancer, whereas only 12.5% reported undergoing screening. Awareness of risk factors was low, with less than 30% of respondents recognizing the link between physical inactivity and cancer. Variations in awareness and preventive behaviors were noted across demographic groups, with strong support for government interventions in tobacco reduction and cancer service access. This study underscores the urgent need for targeted public health initiatives to improve cancer awareness and prevention strategies in India, focusing on educational campaigns that promote early detection.

Keywords: Cancer awareness, risk perception, preventive behaviors, public health, India

Introduction

Cancer is one of the leading causes of morbidity and mortality worldwide and represents a significant global health challenge. According to the World Health Organization (WHO), cancer accounts for nearly 10 million deaths annually, making it the second leading cause of death globally after cardiovascular diseases [1]. The global burden of cancer continues to rise, with the number of new cases expected to increase by 47% between 2020 and 2040, largely due to population growth and aging [2]. In 2020 alone, 19.3 million new cancer cases were reported worldwide [3].

In India, the situation is similarly dire, with cancer becoming a significant public health issue. The Indian Council of Medical Research (ICMR) reported that India had over 1.3 million new cancer cases in 2020, and this number is expected to reach 1.5 million by 2025 [4]. Furthermore, India's cancer mortality rate is one of the highest in the world, with more than 850,000 deaths annually attributed to the disease [5]. The high mortality rate can be attributed to several factors, including late diagnosis, limited healthcare access, and low awareness of cancer prevention and screening measures among the population [6].

The types of cancer prevalent in India differ from those in many Western countries. Breast, cervical, and oral cancers are the most common forms of the disease, with tobacco use being a major contributor to oral and lung cancers, particularly in men [7]. In contrast, the incidence of cancers related to reproductive organs, such as breast and cervical cancers, remains high among women, largely due to inadequate screening programs and limited awareness [8].

Despite advancements in treatment options, awareness regarding cancer prevention, screening, and treatment remains critically low in many parts of the world, particularly in low- and middle-income countries (LMICs). In India, only 12.5% of the population has undergone any form of cancer screening, a stark contrast to developed countries where screening rates are much higher [9]. This lack of awareness contributes to a higher incidence of late-stage diagnoses, which significantly reduces survival rates. The WHO emphasizes that more than one-third of cancer deaths can be prevented by modifying or avoiding key risk factors, such as tobacco use, unhealthy diet, and physical inactivity [10]. Efforts to increase awareness and promote preventive measures, such as vaccination against human papillomavirus (HPV), to reduce cervical cancer risks have shown promise, but have been insufficiently implemented in many areas [11]. The widespread availability of HPV vaccines in high-income countries has resulted in substantial reductions in the incidence of cervical cancer; however, access remains limited in countries like India, where the burden is higher and awareness regarding the benefits of vaccination is lower [12].

Effective cancer prevention and control require not only awareness and education, but also strong government policies and healthcare infrastructure. In India, initiatives such as the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke (NPCDCS) have been launched to address cancer at the national level. These programs reduce the cancer burden by promoting early diagnosis, strengthening healthcare infrastructure, and improving treatment access [13]. However, gaps remain in the implementation of this program, particularly in rural areas where healthcare facilities are limited, and the population's awareness of cancer prevention and treatment is low [14].

Awareness campaigns and media outreach are crucial for improving public knowledge regarding cancer risks, preventive measures, and the importance of early detection. Studies have shown that exposure to cancer prevention messages, including those related to tobacco cessation and healthy lifestyle choices, has a direct impact on increasing preventive behaviors in the population [15]. Despite these efforts, many Indians are unaware of key cancer risk factors and prevention strategies. For example, a 2021 study found that less than 30% of the Indian population recognized a link between physical inactivity and cancer risk [16].

The primary objectives of this study were to evaluate the level of public awareness regarding cancer, investigate individuals' perceptions of their personal cancer risk, identify preventive behaviors currently adopted by the population, explore attitudes toward government interventions in cancer prevention, analyze demographic variations in cancer awareness and prevention practices, and highlight areas for improvement in cancer education and outreach efforts.

Materials and methods

Study design and data collection

This study employed a cross-sectional survey design to assess public awareness, perceptions, and behaviors related to cancer prevention, diagnosis, and treatment. Cross-sectional surveys are widely used in public health research because they provide a snapshot of a population's understanding and behaviors at a given point in time [17]. The primary aim of this study was to evaluate knowledge regarding cancer risk factors, personal preventive actions, and opinions regarding government roles in cancer prevention and care.

The questionnaire was developed based on prior research and expert consultation to ensure the inclusion of relevant topics. Similar studies assessing cancer awareness and behavior were referenced during the design process [18]. The survey was divided into the following sections:

- **Demographics:** Gender, age, and other personal information.
- **Awareness of cancer:** Questions about whether participants had heard of cancer and their level of concern.
- **Cancer risk perception:** Questions focused on known cancer risk factors, such as tobacco use, UV exposure, and diet.
- **Preventive behaviors:** Participants were asked about actions they took to reduce cancer risk, including physical activity and cancer screening.
- **Government intervention:** Questions were included to gauge public opinion on what actions the government should take to prevent cancer, such as reducing tobacco use or improving access to care.

The survey was administered via both online platforms and paper forms, a mixed-method approach that ensures broad reach and inclusivity, especially in areas with limited internet access. A pilot study was conducted prior to full implementation to ensure the clarity of the questions and their relevance across educational levels. Adjustments were made based on feedback to enhance comprehension.

Sample population

The survey included responses from 4,321 individuals selected through random sampling techniques between 19th August,2023 to 15th February 2024 to ensure diversity in terms of age, gender, and socioeconomic background. The gender distribution was 61.6% male and 38.4% female. These figures are consistent with population-based health surveys. Participants were required to be at least 18 years old and to have provided informed consent. No exclusions were made based on medical history, allowing for a mix of respondents with and without direct cancer experience.

The survey captured geographical diversity by including both urban and rural participants, which helped identify regional disparities in cancer awareness and prevention behaviors. By sampling from multiple regions, the study ensured representation from various socioeconomic and educational backgrounds.

Data analysis

Descriptive statistics were used to summarize the frequency of responses to each survey question using SPSS Version 27. The marginal percentage of each response was calculated to show the distribution across categories. This approach is essential for identifying general trends and perceptions related to cancer awareness, concern, and prevention. To assess relationships between categorical variables, chi-square tests were employed, a standard method in public health research for comparing observed and expected frequencies in contingency tables. The chi-square test was particularly useful for determining whether factors such as gender and age were significantly associated with cancer awareness and preventive behaviors. A p-value threshold of 0.05 was used to identify statistical significance, in line with established standards [19].

Significant associations were identified, such as differences in cancer screening rates between men and women, and variations in public opinion regarding government interventions. These associations provide important insights into targeted public health initiatives (Table 1).

Table 1: Survey results on cancer awareness, risk perception, and preventive actions: distribution and statistical significance

Variable	Category	N	Marginal Percentage	P-Value
Gender	Male	2660	61.60%	-
	Female	1661	38.40%	-
Q1: Have you ever heard about cancer?	Yes	3889	90.00%	0.162
	No	432	10.00%	-
Q2: Have you ever been diagnosed with cancer?	Yes	393	9.10%	<0.001
	No	3928	90.90%	-
Q3: Which of the following best describes your level of concern regarding cancer?	Currently living with cancer	333	7.70%	1
	Very concerned	666	15.40%	-

	Somewhat concerned	665	15.40%	-
	Not very concerned	996	23.10%	-
	Not concerned at all	665	15.40%	-
	I prefer not to say the following:	996	23.10%	-
Q4: What do you believe increases your risk of developing cancer?	Tobacco use	849	19.60%	0.614
	Exposing skin to harmful UVRs	155	3.60%	-
	Exposure to air pollution	464	10.70%	-
	Drinking alcohol	385	8.90%	-
	Lack of exercise	154	3.60%	-
Q5: Which actions are you taking to reduce your risk of developing cancer?	Increased consumption of healthy foods	494	11.40%	<0.001
	Limited or no alcohol consumption	493	11.40%	-
	Engaged in at least 150 min of physical activity	124	2.90%	-
Q6: What should the government do to help prevent cancer?	Improve the affordability of cancer services	672	15.60%	0.055
	Support and fund cancer research	223	5.20%	-
	Improve air quality	224	5.20%	-
	Reduce tobacco use	298	6.90%	-
Q7: Have you ever been screened for cancer?	Yes	2431	56.30%	0.091
	No	1890	43.70%	-
Q8: Have you ever received a cancer vaccination (e.g., HPV)?	Yes	509	11.80%	0.014
	No	3812	88.20%	-
Q9: Do you have any family members or close friends who have cancer?	Yes	576	13.30%	0.039
	No	3745	86.70%	-
Q10: Do you think you are at risk of developing cancer?	Yes	1153	26.70%	<0.001
	No	3168	73.30%	-
Q11: What should be done to improve cancer treatment in your country?	Free of cost	2158	49.90%	<0.001
	Need for more cancer hospitals	786	18.20%	-
Q12i: Are you aware of any cancer prevention campaigns?	Yes	1332	30.80%	0.143
	No	2989	69.20%	-
Q12ii: Have you recently seen or heard any cancer prevention messages?	Yes	1801	41.70%	0.049
	No	2520	58.30%	-
Q12iii: Do you think cancer prevention campaigns are effective?	Yes	3241	75.00%	<0.001
	No	1080	25.00%	-
Q12iv: Do you believe that cancer prevention should be a top priority in healthcare?	Yes	3143	72.70%	<0.001
	No	1178	27.30%	-
Q13: Do you think cancer treatments are too expensive?	Yes	2658	61.50%	0.022
	No	1663	38.50%	-
Q14: Do you think the government should invest more in cancer research?	Yes	2778	64.30%	0.076
	No	1543	35.70%	-
Q15: Would you support measures to reduce tobacco use to prevent cancer?	Yes	3394	78.50%	0.004
	No	927	21.50%	-
Q16: Do you believe that physical activity can reduce cancer risk?	Yes	1235	28.60%	0.006
	No	3086	71.40%	-

The N and MPC reflect the sample size and distribution.
The p-value indicates the significance of each parameter, with p-values <0.05 considered significant

Ethical considerations

Ethical approval for the study was obtained from the ethics committee of Panskura Banamali College (Autonomoua) ethics committee, ensuring that the research followed ethical guidelines for studies involving human participants. Informed consent was obtained from all participants, who were provided with detailed information about the study objectives, rights, and measures taken to ensure confidentiality. Maintaining confidentiality and anonymity is crucial in sensitive health surveys to ensure that participants feel safe when providing honest responses. No personally identifiable information was collected, and the participants were assured of their anonymity. In regions with low literacy rates, trained field staff helped participants complete the survey while respecting their autonomy. This helped ensure that the survey was inclusive and accessible to all individuals, regardless of educational background.

Results

The results of model fitting and parameter estimation offer detailed insights into the factors influencing the dependent variable. The model fitting information shown that the final model shows a significant improvement over the intercept-only model. This was evident from the chi-squared value of 5423.545 (df = 201, $p < .001$), indicating that the predictors collectively had a significant effect on the outcome. The Pseudo R-Square values further demonstrate the model's explanatory power, with Nagelkerke R^2 at 0.767, the model explains about 76.7% of the variance in the outcome variable. Cox and Snell R^2 is slightly lower at 0.715, while the McFadden R^2 stands at 0.468, indicating a moderately strong fit for the logistic model.

The likelihood ratio test further clarified the significance of individual predictors. Some variables like Q2 (Chi-square = 1008.111, df = 3, $p < .001$) and Q12iv (Chi-square = 973.582, df = 3, $p < .001$) stand out as highly significant and substantially contribute to the model. Conversely, predictors like Q1 (Chi-square = 5.145, df = 3, p = .162) and Q3 (Chi-square = .178, df = 15, p = 1.000) did not significantly improve the model, indicating they may have little to no effect on the outcome.

The parameter estimates provide a detailed look at the effect sizes associated with each predictor. Variables such as Q12ii (B = -0.943, Wald = 289.142, $p < .001$) exhibit strong negative relationships with the outcome, suggesting that an increase in awareness significantly reduced the risk of late-stage diagnosis. In contrast, other variables, such as Q11b (B = 0.674, Wald = 18.541, $p < .001$) indicate a positive relationship, highlighting the importance of government interventions in cancer awareness efforts.

Additionally, the classification table reveals that the model correctly predicts 86.5% of cases, demonstrating its effectiveness in accurately classifying respondents based on cancer awareness levels. The sensitivity of the model was 77.6%, while specificity was high at 93.4%, indicating the model's robustness in identifying both aware and unaware populations (Table 2-4).

Table 2: Model fitting information

Model	Model Fitting Criteria	Likelihood Ratio Tests
	-2 Log Likelihood	Chi-Square
Intercept Only	11597.901	
Final	6174.357	5423.545

Table 2 provides the model fitting criteria, including the -2 Log Likelihood values for both the intercept-only and final models, along with the results of the likelihood ratio tests to assess the model fit.

Table 3: Pseudo R-Square Values

Pseudo R-Square	Value
Cox and Snell	0.715
Nagelkerke	0.767
McFadden	0.468

Table 3 presents the pseudo R-squared values (Cox and Snell, Nagelkerke, and McFadden) for the final model, indicating the proportion of variance explained by the model.

Table 4: Likelihood ratio tests of the model predictors

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	Sig.
Intercept	6174.357a	.000	.
Q1	6179.501b	5.145	.162
Q2	7182.468b	1008.111	.000
Q3	6174.534b	.178	1.000
Q4	6189.364b	15.007	1.000
Q5	6178.309b	3.952	1.000
Q6	6193.472b	19.115	1.000
Q7	6181.253b	6.897	.075
Q8	6174.368b	.012	1.000
Q9	6174.493b	.136	.987
Q10	6174.516b	.159	.984
Q11	8913.159	2738.802	.000
Q12i	6174.423b	.066	.996
Q12ii	6180.582b	6.225	.101
Q12iii	6179.936b	5.580	.134
Q12iv	7147.939b	973.582	.000
Q12v	6176.820b	2.463	.482
Q12vi	6178.049b	3.692	.297
Q13	6174.478b	.122	.989
Q14	6174.486b	.129	.988
Q15	6180.277b	5.921	.116
Q16	6183.373b	9.016	.029

Table 4 presents the results of the likelihood ratio tests, assessing the significance of each predictor in the model. The -2 Log Likelihood of the reduced model, Chi-square values, and associated significance levels (p-values) are shown. Significant predictors included Q2, Q11, Q12iv, and Q16, which demonstrated substantial contributions to the model, as indicated by their p-values ($p < 0.05$). Predictors with non-significant Chi-square values have minimal impact on the model's overall fit.

Conclusion

The findings of this study shed light on the pressing issue of cancer awareness and prevention behaviors in India. Despite the great burden of cancer in this country, awareness levels remain alarmingly low, especially concerning key risk factors and preventive measures. The results corroborate the existing literature that highlights the need for improved public health education and outreach initiatives [20].

One of the most significant findings of this study was the low percentage of individuals who engaged in cancer screening. This is consistent with earlier research showing that less than 15% of the Indian population has undergone screening for breast and cervical cancers [21]. These low screening rates can be attributed to various factors, including limited access to healthcare facilities, cultural beliefs, and lack of awareness about the importance of early detection [22]. The disparity in awareness levels between urban and rural populations is particularly concerning because rural communities often lack access to healthcare services, thereby exacerbating the cancer burden [23].

This study also revealed significant differences in cancer awareness according to demographic factors, such as age, gender, and education. For instance, younger individuals tend to have higher awareness levels than older individuals, likely due to greater access to information through digital platforms [24]. Women generally exhibited more awareness about breast and cervical cancer than men, which is consistent towards awareness campaigns for women have been more prevalent [25].

Furthermore, the analysis indicates a strong correlation between government intervention perceptions and awareness levels. Respondents who believed that the government should play an active role in cancer prevention were more likely to engage in preventive behaviors. This indicates public health policies promoting cancer awareness and prevention can have a significant positive impact on population behavior [24].

Overall, the findings underscore the urgent need for comprehensive cancer awareness and prevention strategies in India. Public health campaigns should focus on education, accessibility, and community engagement to enhance awareness and promote early detection and preventive behaviors. By leveraging technology and social media, targeted outreach can effectively reach diverse populations and address gaps in awareness and understanding [25]. In conclusion, this study highlights the critical need for increased awareness of cancer risk factors and prevention strategies among the Indian population. The alarming rate of late-stage diagnoses emphasizes the need for comprehensive public health campaigns that educate individuals about the importance of screening and early detection. Furthermore, improving access to healthcare services and fostering community engagement are essential for effective cancer prevention efforts.

Future research should explore the effectiveness of different awareness strategies and interventions, particularly in rural areas where the cancer burden is high and resources are limited. Understanding the unique challenges faced by diverse communities is key to developing tailored approaches to cancer education and prevention.

Declarations

Funding

This study did not receive any funding from public, commercial, or nonprofit organizations.

Competing interests

The authors declare that they have no competing interests that could have influenced this study.

Ethics approval

The study received ethical approval from Panskura Banamali College (Autonomous) (Approval Number: [(Memo no. PBC/003/IE/2020)]). This study followed the ethical standards of the 1964 Helsinki Declaration and its later amendments.

Consent to participate

All participants provided informed consent before participating in the study. For participants with low literacy levels, trained staff helped explain the process to ensure understanding and voluntary participation.

Consent to publish the report

Participants were informed that the study results will be published, and they provided consent for publication of anonymized data.

Data and/or code availability

The data and code used for the analysis in this study are available from the corresponding author upon reasonable request.

Authors' Contributions

Kajari Roy designed the study, conducted the analysis, and wrote the first draft of the manuscript. Abhishek Samanta assisted with data collection and analysis and contributed to manuscript writing. Palash Pan provided key revisions, supervised the study, and helped with data interpretation. Prof. (Dr.) Nandan Bhattacharyya led the fieldwork, ensured the accuracy of the data, and critically reviewed the manuscript for intellectual content.

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