

Prevalence and Determinants of Red Flag Symptoms of Cancer among Adults in rural areas of Puducherry, India: A Community-Based Cross-Sectional Study

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Citation: Malar Ilango, Anlin Jenisha, NivedhithaThatshanamoorthy, Sindu Kanagalingam, Premkumar Ramasubramani. Prevalence and Determinants of Red Flag Symptoms of Cancer among Adults in rural areas of Puducherry, India: A Community-Based Cross-Sectional Study. Indian J Comm Health. 2026;38(3):Page Number 599 - 606 <https://doi.org/10.47203/IJCH.2026.v38i03.015>

Article cycle: Received: 12/05/2026; Accepted: 19/06/2026; Published: 30/06/2026

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Abstract

Background: Cancer is a leading cause of morbidity and mortality globally. Majority of cases in India are diagnosed in an advanced stage due to low awareness and lack of screening. Early identification of cancer at community level can facilitate early diagnosis and treatment. This study aimed to determine the prevalence of red flag symptoms of cancer among adults in rural Puducherry, and to examine its associated factors. **Material & Methods:** A community-based cross-sectional study was conducted among adults aged ≥30. A total of 418 participants were recruited using multistage random sampling. Data were collected through a validated semi-structured questionnaire, which captured sociodemographic details, cancer risk factors, and red flag cancer symptoms in the past two months. Prevalence was reported with 95% confidence interval (CI). Log-binomial regression was used to identify predictors of red flag symptoms. **Results:** The prevalence of at least one red flag symptom of cancer was 15.8% (95%CI: 12.4%-19.6%). Persistent unexplained pain (6.9%) and changes in bowel habits (6.5%) were the most frequently reported symptoms. Higher prevalence of red flag symptoms were seen in male compared to females (aPR: 1.63, 95%CI: 1.09-2.44), socioeconomic class III (aPR: 3.46, 95%CI: 1.90-6.30) and class IV (aPR: 2.22, 95%CI: 1.09-4.51) compared to class I and participants with a NCD risk of CBAC score >4 than those with lower risk (aPR: 3.06, 95% CI: 1.43-6.54). **Conclusion:** Nearly one-sixth of the rural adult population reported cancer-related red flag symptoms, highlighting the need for targeted community-level screening and awareness initiatives to facilitate early cancer detection.

Keywords: Red flag symptoms; Cancer screening; Rural health; Non-communicable diseases.

Introduction:

According to World Health Organization (WHO), cancer remains a major global public health challenge, accounting for 20 million new cases and 9.7 million deaths globally in 2022. The global burden is projected to reach 35 million new cases annually by 2050.[1] In the WHO South-East Asia Region, 2.37 million new cases and 1.53 million deaths were estimated due to cancer in 2022.[2]

As per GLOBOCAN Indian report, in 2022 an estimated 1.41 million new cancer cases and 9.17 lakh cancer deaths occurred.[3] Around 70% of cancer cases are diagnosed at

advanced stages, when curative treatment options are limited and cause financial hardships.[4] One of the critical contributors to delayed diagnosis in India is the lack of awareness of early warning signs of cancer, combined with the absence of routine screening at population level, especially in the rural regions and hard populations.[5] Screening for red-flag symptoms offers a feasible, low-cost strategy for detecting cancer at earlier and more treatable stages and thereby reducing cancer mortality. Comprehensive cancer prevention and management are essential to achieve the Sustainable Development Goal (SDG) target 3.4, which calls

for a one-third reduction in premature mortality from noncommunicable diseases (NCDs), including cancer by 2030.[6] Evidence suggests that screening strategies tailored to the primary healthcare level can enhance the identification of pre-cancerous lesions and early-stage malignancies.[7]

In India, this public health mandate was systematically structured under the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS), which has been officially renamed as the National Program for Prevention and control of Non-Communicable Diseases (NP-NCD).[8] Under this framework, the community Based Assessment Checklist (CBAC) was introduced for frontline workers to screen for risk factors associated with common malignancies (breast, cancer, and oral cancers).[9] While the NP-NCD framework targets risk factors for three specific cancers, it leaves an operational gap in capturing broader community-wide red-flag symptoms. Symptoms profiling complements this strategy by identifying early warning signs of other malignancies that standard checklists may miss.

However, rural populations face major barriers, including low awareness, social stigma, and poor healthcare access to healthcare.[10] Localized data on symptom prevalence and socio-demographic determinants are essential to optimize CBAC implementation and referral pathways.[11] Therefore, this study aimed to determine the prevalence of cancer red-flag symptoms and analyze their socio-demographic determinants among adults in rural Puducherry, South India.

Material & Methods:

Study design and setting A community-based cross-sectional study was carried out among the adults residing in the rural areas of Puducherry, a union territory in southern region of India. The study area includes eight villages falling under the service area of a tertiary care teaching hospital and medical college located within Puducherry.

Study participants: The study participants included adults aged ≥ 30 years who had resided in the study area for at least one year were eligible for inclusion. Data were collected over a three-month period. Individuals who had already been diagnosed with any type of cancers were excluded from the study.

Sample size

The sample size for this study was 416, calculated using the previous study which assessed the prevalence of red flag signs of cancer among the urban residents of Puducherry as 7.3% (at least one red flag signs of cancer).[12] We used OpenEpi software version 3.0 for the calculation of sample size using 7.3% proportion, 2.5% absolute precision, 80% power and 95% confidence interval.

Sampling technique

The participants were selected from the community using a multistage sampling approach. Initially, a proportionate sampling technique was adopted across all eight villages. Within each village participants were selected using the simple random sampling using the sample frame obtained from the family survey records maintained in our rural health centre of the hospital. The participants selection ensured that not more than one participant represented from the same household.

Study procedure

Adults aged above 30 years were contacted with the help of the family survey information and eligibility was assessed as per the selection criteria. Purpose and procedure involved in the study were explained before the administration of questionnaire. Participants were also assured regarding the confidentiality of the information. Eligible participants those who gave consent for the study were included in the study. All the participants were screened for all the cancers. Data collection was done by undergraduate and postgraduates medical students posted in rural centre over a period of two months. Those who were involved in the data collection were adequately trained to administer the question and elicit response and as well as measure the anthropometric parameters as per the standard procedure.

Study variables

A semi-structured questionnaire was administered to the participants which consisted of three sections. The questionnaire was validated with the subject expert for completeness and understandability as required for the research question of this study. The first section included questions related to sociodemographic factors such as age, gender, education, occupation, and income. The socioeconomic status was calculated according to modified BG Prasad scale using the per capita income of the household.[13] The second section included cancer specific symptoms focused on breast cancer, cervical cancer and oral cancer, and general cancer symptoms which included ten red flag symptoms of cancer that occurred within the last two months: persistent cough, persistent change in bowel or bladder habits, nonhealing ulcer, persistent difficulty swallowing, unexplained weight loss, unexplained lump, persistent unexplained pain, unexplained bleeding, and change in mole appearance. The third section was adopted from the community-based assessment checklist (CBAC) for the non-communicable disease, a tool developed under the National Programme for Non-Communicable Diseases (NP-NCD) to identify individuals aged 30 years and above who are at risk of non-communicable diseases. It includes risk factors such as age, tobacco and alcohol use, waist circumference,

physical inactivity, and family history of NCDs. As per the operational guidelines, the CBAC score of >4 considered as high risk and will be prioritized for attending the weekly NCD day.[14]

Statistical analysis

Data were entered into EpiCollect5 and analysis was done using IBM SPSS version [21]. Continuous variables such as age and waist circumference were transformed into categorical variables and summarized as frequency and percentage. The prevalence of at least one red flag symptom was reported in percentage with 95% confidence interval (CI). The predictors of the red flag signs were assessed using the log-binomial regression and the outcomes were reported as prevalence ratio (PR). The univariate regression was done first and those variables being significant more than 20% were taken for multivariate regression to obtain the adjusted PR. The point estimate was reported with 95% CI and the significance was kept as p-value of <0.05.

Ethical clearance

Approval from Institute Research Committee and Institute Ethics Committee was sought before commencement of the study. The Ethics certificate was provided numbered MGMCRI/2025/08/01/IHEC/93. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, ensuring the protection of participants' rights, safety, and well-being. Participants identified with one or more red flag symptoms during the survey were counselled regarding the importance of seeking timely medical evaluation and were referred to the nearest appropriate healthcare facility for further assessment and management, as required.

Results

We obtained the responses from 418 participants. Table 1 shows the characteristics of the study population.

Table 1: Sociodemographic characteristics of study participants in rural Puducherry, (n=418)

Characteristics	Frequency,(%)	Percentage, %
Age Category		
30-39 years	94	(22.5)
40-49 years	77	(18.5)
50-59 years	95	(22.8)
>60 years	151	(36.2)
Gender		
Female	233	(55.7)
Male	185	(44.3)
Education		
Primary	102	(24.4)
Secondary	75	(17.9)
Higher secondary	115	(27.5)
Graduate	42	(10.0)
Postgraduate	22	(5.3)
Diploma	62	(14.8)
Occupation		
Employed	219	(52.4)
Unemployed	199	(47.6)
Socioeconomic status*		
Class I	163	(39.0)
Class II	140	(33.5)
Class III	51	(12.2)
Class IV	53	(12.7)
Class V	11	(2.6)

*Socioeconomic status was classified using the Modified BG Prasad Scale (2024 revision),

Almost equal distribution of participants was in age group of 30-39years (22.5%), 40-49years (18.5%), 50-59 years (22.8%) and >60 years (36.2%) with each group comprising approximately one-third of the total. More representation was from females (55.7%) compared to male. Majority of the participants were educated till either primary education (24.4%)

or higher secondary education (27.5%). A slightly greater than half of the respondents (52.4%) were employed. In terms of socioeconomic status, the majority belonged to Class I (39%), followed by another third was classified as Class II (33.5%).

When examining cancer-specific symptoms the majority of respondents had not encountered any of the symptoms.

Table 2: Distribution of specific cancer symptoms of breast, cervical and oral cancers among study participants in rural Puducherry.

Cancer specific	Frequency(%)	Percentage, %
Breast cancer, (n = 233)		
Lump in the breast	7	(3.0)
Blood-stained discharge from the nipple	1	(0.4)
Change in shape or size of the breast	0	(0.0)
None of the above	225	(96.6)
Cervical Cancer, (n = 233)		
Bleeding between period	4	(1.7)
Bleeding after intercourse	4	(1.7)
Foul smelling vaginal discharge	5	(2.1)
None of the above	225	(94.4)
Oral Ulcer, (n = 418)		
Ulcer / patch / growth in the mouth not healing in two weeks	6	(1.4)
Change in tone of voice	3	(0.7)
None of the above	409	(97.8)

Note: Multiple responses were permitted. Percentages were calculated using the respective eligible population as the denominator and may not sum to 100%.

Table 2 shows the cancer specific symptoms among the study participants. For the breast cancer specific symptoms, a very few of individuals reported experiencing a breast lump (3%) and blood-stained nipple discharge (0.4%), while symptoms such as changes in breast contour were uncommon. Similarly, only 1.7% of women reported symptoms such as bleeding between periods and bleeding after intercourse and 2.1% of the women had foul-smelling discharge which were symptoms specific to cervical cancer. Oral cancer symptoms were reported by six participants (1.4%) who had a non-healing ulcer in the mouth and three participants (0.7%) reported a change in voice tone. The remaining individuals (nearly 98%) did not submit any of the above symptoms.

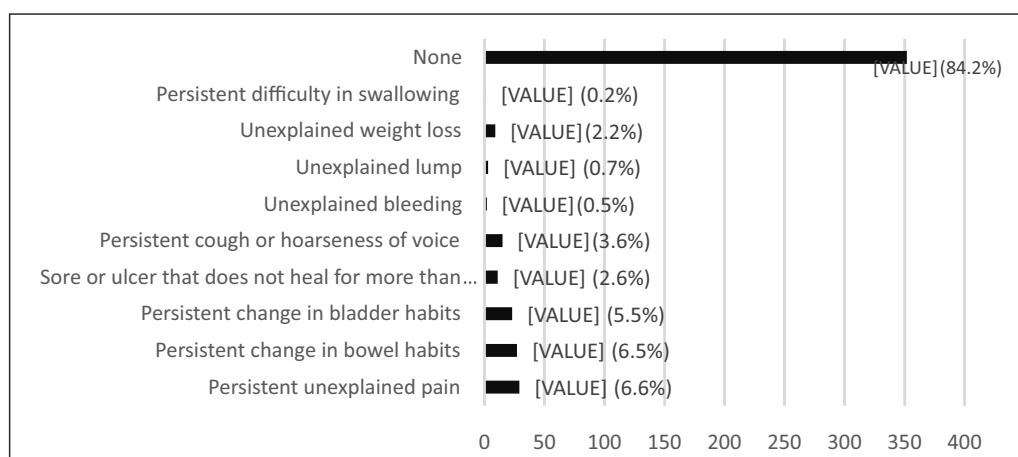


Figure 1: Distribution of Red Flag symptoms of cancer among study participants in rural Puducherry, (n=418)

Note: Participants could report more than one red flag symptom. Percentages were calculated using the total study population (n = 418) as the denominator; hence, percentages may not add up to 100%.

Prevalence of at least one red flag symptoms of the cancer among study population were 15.8% (95% CI: 12.4%-19.6%). Fig. 1 shows the distribution of the red flag symptoms of cancer among the study participants. Persistent, unexplained pain was the most frequently reported issue (6.9%), followed by bowel habits (6.5%) and altered bladder habits (5.5%). Only 15 (3.6%) participants had persistent cough or hoarseness of voice and 9 (2.2%) participants had unexplained weight loss. More than three-fourth (84.2%) of the participants had not encountered any of the red flag signs of cancers.

Table 3: Distribution of risk factors for Non-Communicable Diseases based on Community-Based Assessment Checklist (CBAC) among study participants in rural Puducherry, (n = 418)

Risk assessment	Frequency, n	Percentage, %
Age		
30-39 years	94	(22.5)
40-49 years	77	(18.5)
50-59 years	95	(22.8)
>60 years	151	(36.2)
Tobacco use		
Never	317	(75.8)
In past / Sometime now	72	(17.2)
Daily	29	(6.9)
Alcohol use		
Never	342	(81.8)
Daily	76	(18.2)
Waist circumference*		
Normal	368	(88.0)
At risk	34	(8.1)
Excess	16	(3.8)
Physical activity[†]		
Adequate	237	(56.7)
Not adequate	181	(43.3)
Family history of comorbidities[‡]		
None	232	(55.5)
Present	186	(44.5)

*Waist circumference: normal range for Men: Less than 90 cm (35.4 inches) and Women: Less than 80 cm (31.5 inches)

[†]Physical activity: Adequate for adults- At least 150-300 minutes of moderate-intensity aerobic activity per week or 75-150 minutes of vigorous-intensity aerobic activity per week.

[‡]Family history of comorbidities: Hypertension, type 2 diabetes mellitus, coronary artery disease, obesity, cancer, asthma & allergies

Table 3 show the distribution of the risk assessment for NCD using the CBAC checklist among the study participants. The majority of participants were aged over 60 years (36.2%). A large proportion reported never using tobacco (75.8%) and alcohol (81.8%). Most had normal waist circumference (88.0%) and reported adequate physical activity (56.7%). About 44.5% of the participants had a family history of comorbid conditions.

Table 4: Association of factors with red flag symptoms of cancer among study participants in rural Puducherry, (n=418)

Category	Red Flag - Present		Red Flag - Absent		Unadjusted prevalence ratio		Adjusted prevalence ratio		p value
	n	%	n	%	cPR	95%CI	aPR	95%CI	
Education									
Primary	16	(23.9)	86	(24.5)	2.26	(0.57-8.86)			
Secondary	12	(17.9)	63	(18.0)	2.20	(0.54-8.89)	-	-	-
Higher Secondary	18	(26.9)	97	(27.6)	1.72	(0.43-6.90)	-	-	-
Graduate	7	(10.4)	35	(10.0)	1.24	(0.28-5.53)	-	-	-
Postgraduate	4	(6.0)	18	(5.1)	1.05	(0.21-5.28)	-	-	-
Diploma	10	(14.9)	52	(14.8)	Ref		-	-	-
Occupation									
Unemployed	43	(19.6)	176	(80.4)	1.63	(1.03-2.58)	1.35	(0.84-2.19)	0.22
Employed	24	(12.1)	175	(87.9)	Ref		Ref		
Socioeconomic status									
Class I	16	(9.8)	147	(90.2)	Ref		Ref		
Class II	16	(11.4)	124	(88.6)	1.16	(0.60-2.24)	1.10	(0.56-2.14)	0.79
Class III	21	(41.2)	30	(58.8)	4.19	(2.37-7.41)	3.46	(1.90-6.30)	<0.001
Class IV	12	(24.5)	40	(75.5)	2.50	(1.29-4.85)	2.22	(1.09-4.51)	0.03
Class V	1	(9.1)	10	(90.9)	0.93	(0.13-6.35)	0.78	(0.11-5.39)	0.80
NCD risk*									
Low Risk (CBAC Score > 4)	7	(5.6)	117	(94.4)	Ref		Ref		
High Risk (CBAC Score >4)	60	(20.4)	234	(79.4)	3.62	(1.70-7.69)	3.06	(1.43-6.54)	<0.01

*CBAC: Community-Based Assessment Checklist is a screening tool developed under India's National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) to identify individuals aged ≥ 30 years at risk of non-communicable diseases. A score >4 indicates high

The association between participant characteristics and red flag symptoms is presented in Table 4. Variables including gender, education, occupation, socioeconomic status, and NCD risk status were assessed in the univariate analysis. Education was not significantly associated with red flag symptoms and was therefore excluded from the multivariable model. As shown in Table 5, male participants had a 63% higher prevalence of red flag symptoms compared to females (aPR: 1.63; 95% CI: 1.09-2.44). Participants belonging to socioeconomic Class III (aPR: 3.46; 95% CI: 1.90-6.30) and Class IV (aPR: 2.22; 95% CI: 1.09-4.51) had significantly higher prevalence of red flag symptoms compared to those in Class I. Similarly, participants with a high NCD risk (CBAC score >4) had approximately three times higher prevalence of red flag symptoms than those with a low NCD risk (aPR: 3.06; 95% CI: 1.43-6.54). Occupation was not significantly associated with red flag symptoms after adjustment.

Discussion

Our community based cross sectional study was conducted among adults aged 30 years and above in rural Puducherry has found that the prevalence of red-flag symptoms of cancer was 15.8% (95% CI: 12.4%-19.6%). Among the red-flag symptoms of cancer, persistent unexplained pain was the most frequently reported issue (6.9%) and a fewer percentage of individuals reported altered bladder habits (5.5%) or bowel habits (6.5%) in the study population. These findings were found similar to another study conducted in 2018 in urban parts of Puducherry, which showed the highest prevalence of persistent unexplained pain (2.9%) among the study population (n= 302), followed by persistent change in bladder habits (1.3%) and persistent change in bowel habits (1.3%), while the prevalence of other red flag symptoms was found to be less than 1%. [15] The relatively low prevalence observed in this study may be attributable to under recognition and underreporting of symptoms, particularly among rural populations with limited health literacy and delayed healthcare-seeking behaviour. The present study has found, the common symptoms of breast cancer specific symptoms as breast lump (3%) and blood-stained nipple discharge (0.4%) among the women study participants. These findings have been found similar with a study in England using national level data, on typical and atypical presentation of breast cancer, which showed breast lump as most common symptom of breast carcinoma. [16] The higher prevalence among males may reflect greater exposure to behavioral risk factors such as tobacco and alcohol use, which are known contributors to cancer risk and related symptom burden. In contrast to our findings, a study done by

Fritz et al., on red-flag signs and symptoms for earlier diagnosis of early-onset colorectal cancer have shown that there are no differential associations observed by gender for each red-flag signs or symptoms. [17] The socioeconomic status of the participants showed that individuals belonging to Class III and Class IV had significantly higher prevalence of red flag symptoms reported when compared to Class I. This may be attributed to greater exposure to risk factors and delayed healthcare seeking. This is supported by previous qualitative studies that have highlighted poorer symptom awareness, healthcare access barriers, and delays in presentation among socioeconomically disadvantaged populations. [18]

The NCD risk scores which helped to find out the high-risk individuals among the study subjects, has shown that individuals with the NCD risk with CBAC score of >4 had a significantly higher prevalence of red flag signs compared to those with no NCD risk with CBAC score of <4. Similarly, a study on the prevalence of multiple non-communicable diseases risk factors among self-reported healthy older adults living in community dwelling in India have found the prevalence of individuals at high-risk for NCDs defined as a CBAC score ≥ 4 was 55.20%. [19] This suggests that the CBAC tool, although primarily designed for NCD risk assessment, may also help identify individuals who warrant further evaluation for possible cancer symptoms during community-based screening activities.

Programmatic and Policy Implications

The significant association between higher CBAC scores and red flag symptoms suggests that routine CBAC-based NCD screening may provide an opportunity for early identification of individuals with potential cancer symptoms. Integrating symptom-based screening into existing NP-NCD activities at sub-centres and primary health centres could strengthen early cancer detection and referral, particularly among high-risk and socioeconomically vulnerable populations.

Strength

This study has several notable strengths. Firstly, being a community-based study with rigorous sampling technique the finding of the study has a better internal validity and allows generalized of the findings within the rural populations of India. Capturing the red flag symptoms and the cancer specific symptoms, the study provides a comprehensive perspective about the prevalence of symptoms suggestive of cancer in the rural communities. This also reflects the awareness and access to diagnostics services toward the cancer in the rural settings of India. Incorporating the CBAC for the NCD risk

assessment provides the burden of the NCD risk and the relation with the cancer symptoms, thus, enhancing the utility of the screening approach in integrated NCD care. Moreover, participants who screened positive for red flag symptoms were appropriately referred to a tertiary care center and followed up, demonstrating a commitment to ethical responsibility and facilitating early diagnostic intervention.

Limitations

The study relied on self-reported symptoms, which may be subject to recall bias and under- or over-reporting. As a symptom-based screening approach was used, asymptomatic cancers could not be identified. Also, some of the symptoms are non-specific to cancer alone, potentially leading to overestimation. Additionally, the cross-sectional design limits causal inference between the associated factors and red flag symptoms. Further the finding is restricted to the NCD risk scoring as per CBAC, yet there are various other independent parameters associated with red flag symptoms of cancer. Therefore, results should be considered with caution.

Conclusion

The study highlights the feasibility of community-based identification of cancer red flag symptoms among rural adults. Integrating symptom-based screening with existing NP-NCD activities, particularly among high-risk and socioeconomically vulnerable populations, may facilitate earlier detection and timely referral. Strengthening awareness, screening, and referral pathways at the primary healthcare level could contribute to improved cancer outcomes in rural settings.

Funding source:

No financial benefits have been received for any part related directly or indirectly to the subject of this study from any funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval:

The study was reviewed and approved by the Institute Ethics Committee of the Mahatma Gandhi Medical College and Research Institute (MGMCR/2025/08/01/IHEC/93). Adherence to the principal of Helsinki was integral to the execution of this study. Participants identity will be kept confidential in all circumstances.

Conflict of interest: None declared

Highlights

- 15.8% of rural adults reported at least one cancer red flag symptom
- Persistent pain, bowel, and bladder changes were the most common symptoms

- Male gender and lower socioeconomic class had higher symptom prevalence
- CBAC score >4 significantly predicted red flag symptom burden
- Community screening linked to referral supports early cancer detection

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