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# The Role of Sociodemographic and Psychosocial Predictors in Cancer Risk Perception and Preventive Behaviors among Tertiary Students in Punjab, India: A Multigroup Analysis across Gender and Districts

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## Abstract

**Background:** Risk perception is a well-established predictor of health-promoting behavior, yet its influence may vary significantly across sociodemographic groups. In the context of rising cancer prevalence in Punjab, understanding how identity and context shape the relationship between perceived cancer risk and preventive actions is essential for designing effective public health interventions.

**Objectives:** This study examined the moderating effects of gender, geographic district, and family history of cancer on the relationship between cancer risk perception and health-promoting behavior among tertiary students in six high-risk districts in Punjab, India.

**Methods:** A cross-sectional study was conducted among 601 students selected through multistage sampling. Standardized tools were used to measure risk perception (TRIRISK), cancer stigma, and preventive behavior (HPLP-II). Data were analyzed using MANOVA, interaction regression, and multigroup structural equation modeling (SEM) to test for moderating effects across gender, district, and family history subgroups.

**Results:** Risk perception significantly predicted health-promoting behavior ($\beta = .37$, $p < .001$), but this relationship was moderated by gender, district of residence, and family cancer history. Females showed a stronger association between perceived risk and preventive action ($\beta = .39$) than males ($\beta = .24$). Similarly, students from high-risk districts and those with a family history of cancer demonstrated heightened behavioral responses to perceived risk. Multigroup SEM confirmed significant moderation, and model fit indices indicated excellent structural validity (CFI = .958, RMSEA = .045).

**Conclusion:** The influence of cancer risk perception on health behavior is not uniform and is significantly shaped by demographic and contextual factors.

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Tailored health interventions that account for gender, place, and personal cancer history are critical to improving cancer prevention strategies among young adults in high-risk regions.

**Keywords:** Cancer risk perception, health behavior, moderation, multigroup SEM, gender differences, Punjab, India, cancer prevention, tertiary students, TRIRISK.

## Introduction

The rising cancer burden among young adults in India poses a serious public health challenge, especially in states like Punjab where environmental exposure and lifestyle transitions converge to increase population-level risk. Tertiary students, who represent a critical segment of the emerging adult population, often remain unaware or misinformed about cancer risk factors, early warning signs, and the preventive actions they can take. While cancer awareness interventions have grown in number, their behavioral effectiveness remains inconsistent, partly due to the complex role of individual differences such as gender, age, geographic location, and family health background.

Cancer risk perception is a key driver of preventive behavior, encompassing how individuals evaluate their susceptibility to cancer and the severity of its consequences. The tripartite model of risk perception—deliberative, affective, and experiential—provides a nuanced understanding of how people cognitively and emotionally process health risks (Ferrer et al., 2016). However, risk perception does not operate in isolation; its influence on health behavior may be amplified or attenuated by sociodemographic and psychosocial variables. For instance, gender differences in emotional risk responses and health-seeking behavior have been widely reported (Janz et al., 2003; Ferrer & Klein, 2015), with women often reporting greater risk sensitivity but men displaying lower engagement in preventive actions. Age is also a known moderator, as cognitive maturity and life experience shape how risk is internalized and acted upon (Weinstein et al., 2007).

Geographic location plays an equally crucial role. In cancer-prone areas like Patiala and Mansa, young adults may perceive cancer risk as more salient due to community exposure and local narratives. In contrast, students in less-affected regions may underappreciate their vulnerability, despite engaging in risky lifestyle behaviors. Research has shown that place-based beliefs and community health history can profoundly influence health perceptions (Katapodi et al., 2010; Niederdeppe et al., 2008). Similarly, having a family member with cancer has been associated with increased health vigilance, emotional salience of risk, and proactive health behavior, but the strength of these effects may vary across contexts and populations (Han et al., 2006; Umeh & Rogan-Gibson, 2001).

Despite a robust theoretical foundation, few empirical studies have examined how sociodemographic variables moderate the relationship between cancer risk

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perception and preventive health behavior among youth in South Asia. Even fewer have applied multigroup structural equation modeling or interaction-based analysis to test these effects rigorously. This gap limits the design of tailored interventions that account for individual and contextual diversity.

Therefore, this study aims to investigate the moderating role of gender, age group, district of residence, and family cancer history in the relationship between cancer risk perception and preventive health behaviors. We hypothesize that these sociodemographic and psychosocial factors will significantly differentiate the strength and direction of this relationship across subgroups. By employing multigroup CFA, MANOVA, and interaction regression techniques, the study seeks to uncover targeted pathways through which interventions can be designed to reach specific populations more effectively.

## Methods

### Study Design and Participants

This cross-sectional analytical study was conducted among 601 tertiary students drawn from six high-risk districts in Punjab, India: Patiala, Muktsar, Mansa, Sangrur, Gurdaspur, and Tarn Taran. Participants were selected through multistage sampling across institutions offering undergraduate and postgraduate programs. Inclusion criteria required that participants be enrolled as full-time students and provide informed consent.

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### Measures

Cancer Risk Perception was assessed using the TRIRISK model developed by Ferrer et al. (2016), which includes three subscales: deliberative (cognitive probability), affective (emotional concern), and experiential (gut feeling). Responses were recorded on a 5-point Likert scale, with higher scores indicating stronger perceived risk. The Cronbach's alpha for the overall scale in this study was 0.86.

Health-Promoting Behavior was measured using the Health-Promoting Lifestyle Profile-II (HPLP-II), which captures six dimensions of health behavior including physical activity, nutrition, stress management, and health responsibility. The scale showed strong internal consistency in this sample ($\alpha = 0.89$).

Sociodemographic Variables included gender (male, female), age group (17–20, 21–25, 26–30, 31–35), district of residence (six categories), and family history of cancer (yes/no). Financial status was also recorded as a control variable in regression models.

### Data Analysis

Preliminary analyses included descriptive statistics, scale reliability, and Pearson correlations among key variables. One-way ANOVA and MANOVA were used to test for mean differences in cancer risk perception and health behavior across gender, age groups, districts, and family history.

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To examine the moderating effects of gender, district, and family cancer history, we employed multigroup confirmatory factor analysis (CFA) and structural equation modeling (SEM). Groups were tested for measurement invariance before estimating moderation effects.

Additionally, interaction regression models were run using SPSS PROCESS macro (Model 1), with interaction terms computed between risk perception and each sociodemographic variable. Simple slopes analysis was used to interpret significant interactions.

Statistical significance was set at $p < .05$. Model fit was assessed using standard indices: CFI ≥ .90, TLI ≥ .90, RMSEA ≤ .06, and $\chi^2/df \leq 3$.

### Ethical Considerations

The study protocol received approval from the Institutional Review Board of the host university. Written informed consent was obtained from all participants. Anonymity and confidentiality were maintained throughout the research process.

## Results

### Participant Demographics

The study included a total of 601 tertiary-level students drawn from six high-risk cancer districts in Punjab. As shown in Table 1, the sample was predominantly male, with 324 participants (53.9%) identifying as male and 277 (46.1%) as female.

In terms of geographic representation, students were fairly distributed across districts: Patiala accounted for the highest proportion with 118 participants (19.6%), followed closely by Shri Muktsar Sahib (19.3%), Mansa (17.3%), Sangrur (15.5%), Gurdaspur (15.1%), and Tarn Taran (13.1%). This ensured a wide spatial coverage of students from both central and peripheral regions of Punjab's cancer belt.

Regarding personal cancer exposure, 174 students (28.9%) reported a family history of cancer, while 427 (71.1%) had no such history. This distinction was critical for testing the moderating role of familial exposure in risk perception.

With respect to economic background, 196 students (32.6%) identified as being from low-income households, 297 (49.4%) from middle-income households, and 108 (18.0%) from high-income backgrounds. This financial distribution allowed for additional stratification during regression and subgroup analysis.

These demographic characteristics provide a solid foundation for exploring how gender, geography, and psychosocial history interact with cancer risk perception and influence preventive health behavior in youth.

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**Table 1: Demographic Characteristics of Respondents (N = 601)**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Gender** | **Male** | **324** | **53.9%** |
| | **Female** | **277** | **46.1%** |
| **District** | **Patiala** | **118** | **19.6%** |
| | **Shri Muktsar Sahib** | **116** | **19.3%** |
| | **Mansa** | **104** | **17.3%** |
| | **Sangrur** | **93** | **15.5%** |
| | **Gurdaspur** | **91** | **15.1%** |
| | **Tarn Taran** | **79** | **13.1%** |
| **Family History of Cancer** | **Yes** | **174** | **28.9%** |
| | **No** | **427** | **71.1%** |
| **Financial Status** | **Low Income** | **196** | **32.6%** |
| | **Middle Income** | **297** | **49.4%** |
| | **High Income** | **108** | **18.0%** |

**Descriptive Statistics and Scale Reliability**

The descriptive statistics of key variables are presented in Table 1. Overall, participants reported moderate levels of risk perception and health-promoting behavior. Reliability analysis showed acceptable to high internal consistency for all scales used in the analysis.

**Table 2: Descriptive Statistics and Reliability of Key Variables (N = 601)**

| Variable | Mean | SD | Cronbach's α |
|---|---|---|---|
| Risk Perception (Total) | 3.26 | 0.76 | 0.86 |

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| | | | |
|---|---|---|---|
| - Deliberative | 3.22 | 0.78 | 0.79 |
| - Affective | 3.67 | 0.81 | 0.84 |
| - Experiential | 2.88 | 0.69 | 0.76 |
| Health-Promoting Behavior (HPLP-II) | 2.81 | 0.66 | 0.89 |

Students scored highest on affective risk perception and lowest on experiential risk. The HPLP-II scale showed strong internal consistency.

### Group Differences by Sociodemographic Factors

A one-way MANOVA was conducted to determine if gender, district, age, and family cancer history influenced perceived risk and preventive behavior. Significant multivariate effects were observed.

**Table 3: MANOVA Results by Gender and District**

| Factor | F | p-value | Partial $\eta^2$ | Interpretation |
|---|---|---|---|---|
| Gender | 8.42 | < .001 | .043 | Males and females differed significantly |
| District | 6.19 | < .001 | .081 | Location influenced both risk and behavior |
| Family History | 12.05 | < .001 | .051 | Those with history perceived higher risk |

Females reported significantly higher affective risk and better health behaviors than males ($p < .001$). Districts like Patiala and Muktsar showed elevated perception scores. Students with a family history of cancer had significantly higher total risk perception ($p < .001$).

### Moderation through Interaction Regression

Interaction regression models were used to test moderation effects of gender, district, and family history on the relationship between risk perception and behavior.

**Table 4: Regression Interaction Effects on Health-Promoting Behavior**

| Predictor | β | t | p-value | Interaction Effect |
|---|---|---|---|---|
| Risk Perception (RP) | .37 | 6.84 | < .001 | Strong predictor of behavior |

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|---|---|---|---|---|
| Gender (0 = Male, 1 = Female) | .12 | 2.33 | .020 | Females had stronger effect |
| RP × Gender | .19 | 3.72 | < .001 | Moderating effect confirmed |
| District Risk Level | .09 | 1.92 | .055 | Marginal |
| RP × District | .17 | 3.14 | .002 | Significant moderation by location |
| Family History | .14 | 2.67 | .008 | History predicts higher behavior |
| RP × Family History | .13 | 2.43 | .015 | Significant moderation effect |

Risk perception was a significant predictor of health behavior. Its influence was stronger among females and those with a family history of cancer. District also moderated the relationship, with students in high-risk districts like Mansa and Muktsar more likely to translate perceived risk into action.

**Multigroup SEM Analysis**

To confirm the moderation patterns, multigroup SEM was conducted for gender and district. The model achieved good fit for both groups.

**Table 5: Multigroup SEM Fit Indices**

| Group Comparison | $\chi^2$/df | CFI | TLI | RMSEA | Model Fit |
|---|---|---|---|---|---|
| Male vs Female | 2.11 | 0.952 | 0.937 | 0.046 | Good |
| High-risk vs Low-risk Districts | 2.02 | 0.958 | 0.942 | 0.045 | Excellent |

**Table 6: Standardized Path Coefficients by Group**

| Path | Male | Female | High-Risk District | Low-Risk District |
|---|---|---|---|---|
| RP → Behavior | 0.24 | 0.39 | 0.33 | 0.19 |
| RP → Stigma | -0.31 | -0.42 | -0.36 | -0.29 |
| Stigma → Behavior | -0.22 | -0.28 | -0.27 | -0.18 |

The effect of risk perception on behavior was significantly stronger among females and students from high-risk districts. Stigma also had a greater negative influence in these

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groups, confirming that contextual and identity variables moderate the behavioral impact of risk perception.

## Discussion

This study examined the moderating role of gender, district of residence, and family history of cancer in the relationship between risk perception and health-promoting behavior among tertiary students in Punjab. The findings offer important insights into how sociodemographic and psychosocial factors shape preventive health actions, particularly within high-burden cancer regions.

Consistent with previous literature, risk perception emerged as a significant predictor of health-promoting behavior, confirming that individuals who perceive themselves at risk are more likely to adopt preventive practices (Ferrer & Klein, 2015; Han et al., 2006). However, this effect was not uniform across all subgroups. Gender played a prominent moderating role, with females showing a significantly stronger relationship between perceived cancer risk and engagement in preventive behaviors. This aligns with existing research suggesting that women, especially young adults, tend to report higher emotional responses to health threats and are generally more proactive in engaging with preventive services (Janz et al., 2003; Umeh & Rogan-Gibson, 2001; Katapodi et al., 2010). Emotional salience may drive this behavior, particularly among females who have witnessed cancer in family members or communities.

District-based differences were also notable. Students from high-risk districts such as Patiala and Muktsar showed a stronger association between risk perception and preventive behavior than those from lower-risk districts. This could be due to heightened community awareness or frequent exposure to cancer cases within families and neighborhoods. Previous studies have emphasized that geographic context influences health behavior by shaping norms, shared experiences, and the perceived proximity of health threats (Niederdeppe et al., 2008; Sharma et al., 2021). The role of place-based beliefs and health narratives cannot be underestimated, especially in cancer-endemic regions where health threats are part of the collective experience.

Having a family history of cancer significantly strengthened the influence of risk perception on behavior, echoing findings from Ferrer et al. (2016) and Lannin et al. (1998), who demonstrated that personal experience with illness increases not only perceived susceptibility but also the motivation to act. In this study, participants with such histories were more engaged in health-promoting practices, likely due to both emotional resonance and observed consequences of delayed action. These results reinforce the theory that

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experiential knowledge of disease amplifies the affective dimension of risk and fosters more deliberate behavior (Loewenstein et al., 2001; Winterbottom et al., 2008).

The multigroup SEM further validated these interaction effects. Females and students from high-risk districts had stronger standardized path coefficients from risk perception to behavior than their male or low-risk counterparts. This suggests that interventions targeting these populations may have greater behavioral payoff when they focus on enhancing risk perception. Conversely, for groups with weaker associations, such as males and students from low-risk districts, other mechanisms—such as habit formation, peer influence, or structural barriers—may require greater emphasis in intervention designs.

These findings have critical implications for public health policy. First, cancer awareness and risk communication campaigns must be demographically and geographically tailored. Uniform messaging is unlikely to resonate equally with different groups. For example, emotional appeals and survivor stories may be particularly effective among female students, while visual cues or peer-led demonstrations may work better for males. Similarly, in high-burden districts, interventions can leverage community concern and recent local events, whereas in low-burden areas, strategies may need to address perceived invulnerability and build urgency through education.

Second, health promotion units in universities should incorporate cancer risk perception modules into their routine programming, paying attention to group-specific needs. Risk appraisal tools, interactive workshops, and culturally sensitive stigma-reduction campaigns can be used to personalize health information and strengthen perceived relevance. Faculty and student counselors should be trained to identify students with low health motivation or misinformation, especially among males or those from low-awareness regions.

Third, family history of cancer should be integrated into university health records and screening programs, with such students prioritized for personalized education and counseling. Early identification of psychosocial vulnerability due to familial cancer exposure can help institutions offer timely support and promote proactive engagement in preventive care.

Despite its contributions, this study is subject to limitations. The cross-sectional design precludes causal inferences, although statistical modeling indicates plausible directional effects. All data were self-reported, which may introduce bias due to social desirability or recall inaccuracies (Podsakoff et al., 2003). While the sample was geographically diverse, it included only tertiary students, limiting generalizability to non-student populations or youth in informal settings. Additionally, the analysis did not include psychosocial moderators such as fatalism, self-efficacy, or peer

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influence, which may also interact with risk perception to shape behavior.

Nevertheless, the use of multigroup SEM and interaction regression analysis strengthens the robustness of findings and underscores the value of personalized approaches to health communication. By illuminating how identity and context mediate behavioral responses to perceived risk, this study makes a strong case for moving beyond generalized campaigns toward precision health promotion in educational institutions.

## Conclusion

This study provides strong evidence that the relationship between cancer risk perception and health-promoting behavior among tertiary students is significantly influenced by sociodemographic and psychosocial factors, particularly gender, district of residence, and family history of cancer. While perceived risk consistently predicts preventive behavior, the strength and direction of this influence vary meaningfully across subgroups. Females, students from high-risk districts, and those with a family history of cancer are more likely to translate perceived vulnerability into proactive health actions. These findings underscore the need for demographically and geographically tailored health communication strategies that account for the diversity of student experiences and identities.

The results highlight that a one-size-fits-all approach to cancer prevention may limit effectiveness. Public health programs must be responsive to context and leverage psychosocial insights to enhance their impact. In academic settings, integrating targeted awareness initiatives, risk assessment tools, and support for emotionally affected groups can foster a culture of early prevention and health responsibility. Ultimately, to curb the rising burden of cancer in high-risk populations, health education must become more personalized, emotionally intelligent, and locally relevant.

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