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RESEARCH ARTICLE

# Cognitive Exposure to Tobacco Marketing and Preventive Health Messages Among Adolescents: A School-Based Cross-Sectional Study

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## Abstract

**Background:** Adolescents are frequently exposed to tobacco-related environmental cues, yet limited evidence exists on how such exposure is cognitively processed, particularly in low- and middle-income settings. Understanding adolescents' psychological engagement with tobacco marketing and preventive messages is essential for effective prevention strategies. **Methods:** A school-based cross-sectional study was conducted among 1,017 adolescents. A structured, self-administered questionnaire assessed exposure to tobacco advertisements at points of sale, cognitive responses to health warnings on cigarette packages, and recall of school-based tobacco education. Gender-based differences were examined using chi-square tests. **Results:** Overall, 42.9% of adolescents reported exposure to tobacco advertisements at points of sale in the past 30 days, with significantly higher exposure among males ($p < 0.001$). Only 24.8% reported that health warnings prompted reflective thinking about quitting or not initiating tobacco use, while 40.6% did not notice warnings. Cognitive responses to health warnings differed significantly by gender ($p = 0.010$). Recall of school-based tobacco education was reported by 42.3% of participants, with no significant gender differences. **Conclusion:** Despite widespread exposure to tobacco control measures, meaningful cognitive engagement among adolescents remains limited. Strengthening tobacco prevention efforts requires adolescent-centered approaches that enhance psychological salience, reduce exposure to marketing cues, and improve the effectiveness of school-based education.

**Keywords:** Adolescents- Tobacco marketing exposure- Health warnings- Cognitive processing

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## Introduction

Tobacco use remains one of the leading preventable causes of morbidity and mortality worldwide, accounting for millions of premature deaths each year and imposing a substantial psychosocial and economic burden on societies [1]. While the biomedical consequences of tobacco exposure are well documented, increasing attention has been directed toward understanding tobacco and areca nut use as behaviorally acquired and psychologically reinforced habits, particularly when initiation occurs during adolescence [2].

Adolescence represents a critical developmental window characterized by heightened risk-taking behavior, identity exploration, increased susceptibility to peer influence, and evolving cognitive control mechanisms [3]. During this period, experimentation with psychoactive substances such as tobacco and areca nut is often driven not only by availability but also by psychological factors including curiosity, perceived social acceptance, stress coping, modeling of adult behavior, and misperception of harm [4]. Evidence suggests that behaviors adopted during adolescence frequently persist into adulthood, increasing the likelihood of long-term dependence and

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chronic disease [5].

In the Indian context, tobacco consumption patterns are particularly complex due to the coexistence of smoked products, smokeless tobacco, and areca nut preparations, many of which are culturally normalized and easily accessible to minors [6]. Areca nut, often perceived as a benign or socially acceptable substance, possesses psychoactive properties and is classified as a Group 1 carcinogen by the International Agency for Research on Cancer [7]. Despite this, its use among adolescents is frequently overlooked in prevention programs, partly due to low perceived risk and deep cultural embedding.

Recent school-based research conducted in North India has demonstrated that experimentation with tobacco and areca nut begins early in adolescence, with a notable male predominance in smoked products and a high prevalence of areca nut use across both sexes [8]. In a large cross-sectional study among school-going adolescents in Mathura city, India, Chakraborty reported that while current tobacco use was relatively infrequent, areca nut use was substantially more prevalent, highlighting a potential gateway behavior that may precede or coexist with tobacco initiation [8]. Importantly, the absence of observable oral mucosal lesions in this cohort suggests a critical preclinical window during which psychologically informed preventive interventions may be most effective.

From a psychological perspective, early substance experimentation particularly when reinforced by peer norms and low immediate adverse outcomes can normalize risk behaviors and weaken perceived susceptibility, thereby increasing the probability of escalation in later adolescence or young adulthood [9]. Understanding the behavioral patterns, initiation trajectories, and psychosocial correlates of tobacco and areca nut use among adolescents is therefore essential for designing effective, age-appropriate prevention strategies.

Given the limited literature integrating psychological determinants with epidemiological patterns of tobacco and areca nut use among Indian adolescents, the present study seeks to build upon existing evidence by examining substance use behaviors through a behavioral and cognitive framework. By contextualizing initiation and use patterns within adolescent psychosocial development, this research aims to inform more targeted school-based and policy-level interventions. The objectives of this study were to assess (i) adolescents' exposure to tobacco advertisements at points of sale, (ii) their cognitive responses to health warnings on cigarette packages, and (iii) recall of school-based tobacco education, with a focus on gender-based differences in psychological processing.

*Psychological Framework and Study Rationale*

The present study is grounded in established psychological models that explain how adolescents perceive, interpret, and respond to health-related environmental cues. Adolescence is marked by ongoing neurocognitive development, particularly in brain regions responsible for impulse control, risk evaluation, and future-oriented decision-making. As a result, adolescents are especially susceptible to external stimuli that shape attitudes and behavioral intentions, including substance-related cues encountered in everyday environments.

Social Cognitive Theory provides a useful framework for understanding how repeated exposure to tobacco-related cues such as advertisements at points of sale may influence adolescent cognition and behavior. According to this model, behaviors are learned not only through direct experience but also through observational learning and environmental reinforcement. Tobacco advertising visible in retail environments can function as a passive conditioning stimulus, reinforcing social normalization of tobacco use and reducing perceived harm, even among adolescents who have not initiated use. Such exposure may subtly influence outcome expectancies and weaken psychological resistance to experimentation.

The Health Belief Model further explains how adolescents process risk-related information, particularly in relation to health warnings on tobacco packaging. Health warnings are designed to increase perceived severity and susceptibility, thereby motivating protective cognitive responses. However, psychological research suggests that repeated exposure to warning messages can result in message fatigue or desensitization, leading to reduced emotional arousal and diminished cognitive engagement. Among adolescents, who may prioritize immediate social rewards over long-term health consequences, the effectiveness of health warnings depends not merely on exposure but on whether the message is actively processed and internalized.

School-based tobacco education represents a formal preventive learning mechanism intended to enhance knowledge, shape health beliefs, and promote adaptive decision-making skills. From a cognitive psychology perspective, the effectiveness of such education relies on attention, comprehension, retention, and recall. Inconsistent delivery, limited reinforcement, or low perceived relevance may impair cognitive encoding of preventive messages, resulting in poor recall or uncertainty regarding exposure to tobacco-related education. This gap between educational intent and psychological uptake may undermine the protective potential of school-based interventions.

Previous epidemiological research, including our own work among school-going adolescents in northern India, has documented early initiation of tobacco and areca nut use, gender differences in consumption patterns, and the absence of overt oral pathology during adolescence. These findings highlight a critical window during which substance-related behaviors may still be shaped by psychological and educational interventions. However, prevalence-focused studies do not adequately capture how adolescents cognitively engage with tobacco-related environmental cues and preventive messages.

Therefore, the present study adopts a psychological framework to examine adolescents' exposure to tobacco advertisements at points of sale, their cognitive responses to health warnings on cigarette packaging, and their recall of school-based tobacco education. By integrating these factors, the study aims to assess gaps in attentional

exposure, cognitive processing, and preventive learning that may contribute to continued vulnerability to tobacco initiation. Understanding these psychological dimensions is essential for informing more effective, developmentally appropriate tobacco control and prevention strategies targeting adolescents.

## Materials and Methods

*Study Design and Setting*

A school-based cross-sectional study was conducted among adolescent students enrolled in secondary and higher secondary schools. The study was designed to assess psychological exposure to tobacco-related environmental cues and preventive messages, rather than behavioral prevalence alone. Data were collected in a classroom setting using a structured, self-administered questionnaire.

*Study Population*

The study population comprised school-going adolescents within the typical adolescent age range, representing both male and female students across multiple grade levels. Students who were present on the day of data collection and provided assent were included in the study. Participation was voluntary, and no incentives were offered.

*Ethical Considerations*

Ethical approval for the study was obtained from the appropriate institutional ethics committee. Permission was secured from school authorities prior to data collection. Written informed assent was obtained from all participating students, and confidentiality and anonymity were strictly maintained. No personally identifiable information was collected.

*Data Collection Tool*

Data were collected using a structured questionnaire adapted from standardized youth tobacco surveillance instruments and modified to align with the psychological objectives of the study. The questionnaire was designed to assess adolescents' attentional exposure, cognitive processing, and preventive learning related to tobacco control measures.

The questionnaire included sections on:

- Demographic characteristics (age, gender, grade)
- Exposure to tobacco advertisements at points of sale
- Cognitive responses to health warnings on cigarette packages
- Recall of school-based tobacco education

To ensure comprehension, questions were phrased in simple language appropriate for adolescents. The questionnaire was administered under supervision to minimize discussion among participants.

*Psychological Variables and Operational Definitions*

*Exposure to Tobacco Advertisements at Points of Sale*

Attentional exposure to tobacco marketing was assessed by asking students whether they had seen advertisements or promotions for tobacco products at points of sale during the past 30 days. Responses were categorized to reflect exposure, non-exposure, or non-visit to retail environments.

*Cognitive Response to Health Warnings on Cigarette Packages*

Cognitive processing of health warnings was evaluated by asking students whether they had noticed health warnings on cigarette packages during the past 30 days and whether these warnings prompted reflective thinking, such as considering quitting or deciding not to initiate tobacco use. Responses were categorized to distinguish passive exposure from active cognitive engagement.

*School-Based Tobacco Education*

Preventive learning was assessed by asking students whether they had been taught about the dangers of tobacco use in any of their classes during the past 12 months. Responses included affirmative recall, absence of recall, or uncertainty, which was interpreted as limited cognitive encoding or retention of preventive messages.

*Statistical Analysis*

Data were entered and analyzed using standard statistical software. Descriptive statistics were used to summarize demographic characteristics and distributions of psychological exposure variables. Categorical variables were expressed as frequencies and percentages.

Associations between gender and key psychological variables exposure to tobacco advertisements, cognitive responses to health warnings, and recall of school-based tobacco education were examined using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

## Results

*Study Sample*

A total of 1,017 school-going adolescents participated in the study, comprising 573 males (56.3%) and 444

Table 1. Exposure to Tobacco Advertisements at Points of Sale by Gender (N = 1,017)

| Exposure to advertisements (past 30 days) | Male n (%) | Female n (%) | Total n (%) |
|---|---|---|---|
| Did not visit point of sale | 69 (12.0) | 103 (23.2) | 172 (16.9) |
| Yes | 264 (46.1) | 172 (38.7) | 436 (42.9) |
| No | 240 (41.9) | 169 (38.1) | 409 (40.2) |
| Total | 573 | 444 | 1,017 |

$\chi^2$ test: $p < 0.001$ (statistically significant)

Table 2. Cognitive Response to Health Warnings on Cigarette Packages by Gender

| Response to health warnings | Male n (%) | Female n (%) | Total n (%) |
|---|---|---|---|
| Saw but did not think much | 198 (34.6) | 154 (34.7) | 352 (34.6) |
| Thought about quitting / not starting | 161 (28.1) | 91 (20.5) | 252 (24.8) |
| Did not notice warnings | 214 (37.3) | 199 (44.8) | 413 (40.6) |
| Total | 573 | 444 | 1,017 |

$\chi^2$ test: p = 0.010 (statistically significant)

Table 3. Recall of School-Based Tobacco Education by Gender

| Tobacco education in past 12 months | Male n (%) | Female n (%) | Total n (%) |
|---|---|---|---|
| Yes | 241 (42.1) | 189 (42.6) | 430 (42.3) |
| No | 209 (36.5) | 170 (38.3) | 379 (37.3) |
| Don't know | 123 (21.5) | 85 (19.1) | 208 (20.5) |
| Total | 573 | 444 | 1,017 |

$\chi^2$ test: p = 0.639 (not significant)

females (43.7%). All responses were complete and included in the final analysis.

*Exposure to Tobacco Advertisements at Points of Sale*

Overall, 42.9% of adolescents reported seeing tobacco advertisements or promotions at points of sale in the past 30 days, while 40.2% reported not seeing such advertisements. Additionally, 16.9% indicated that they had not visited any points of sale during this period.

Gender-wise analysis showed a significant association between gender and exposure to tobacco advertisements ($\chi^2$, $p < 0.001$). A higher proportion of male students (46.1%) reported exposure compared to female students (38.7%). Conversely, a greater proportion of females reported not visiting points of sale.

These findings suggest differential environmental exposure to tobacco marketing cues between male and female adolescents.

*Cognitive Responses to Health Warnings on Cigarette Packages*

Regarding exposure to health warnings on cigarette packages during the past 30 days, 34.6% of participants reported noticing the warnings but experiencing minimal cognitive impact. Only 24.8% reported that health warnings led them to think about quitting smoking or not initiating tobacco use. Notably, 40.6% of adolescents reported not noticing health warnings at all.

Gender differences in cognitive response were statistically significant ($\chi^2$, $p = 0.010$). Female students were more likely to report not noticing health warnings (44.8%) compared to males (37.3%), whereas a higher proportion of males reported cognitive engagement with warnings.

*Recall of School-Based Tobacco Education*

When asked about exposure to school-based tobacco education in the past 12 months, 42.3% of participants reported receiving such education, while 37.3% reported no exposure. Additionally, 20.5% were uncertain whether tobacco-related topics had been covered in their classes.

Gender-wise comparison showed no statistically significant association between gender and recall of tobacco education ($\chi^2$, $p = 0.639$), indicating similar patterns of preventive learning and recall among male and female students (Table 1-3).

## Discussion

This study explored adolescents' psychological exposure to tobacco-related environmental cues and preventive messages, focusing on attentional exposure, cognitive processing, and recall of formal education rather than behavioral prevalence. The findings highlight important gaps in how adolescents perceive and cognitively engage with tobacco control measures.

A substantial proportion of adolescents reported exposure to tobacco advertisements at points of sale, despite existing regulations restricting tobacco promotion. From a psychological perspective, such exposure represents repeated environmental cueing that may normalize tobacco use and weaken perceived risk. The significantly higher exposure reported by male students suggests that boys may be more frequently present in retail environments or more attentive to promotional stimuli, potentially increasing their susceptibility to tobacco initiation through observational learning and social normalization mechanisms.

Although health warnings on cigarette packages were widely present, their psychological effectiveness appeared limited. Less than one-quarter of adolescents reported that these warnings prompted reflective thinking about quitting or avoiding tobacco initiation. This finding suggests that mere exposure to health warnings does not guarantee cognitive engagement. Repeated exposure may lead to desensitization or message fatigue, particularly among adolescents whose cognitive appraisal of long-term health risks is still developing. The significant gender differences observed further indicate that cognitive processing of risk messages may vary between male and female adolescents, emphasizing the need for more targeted and emotionally engaging warning strategies.

School-based tobacco education, a cornerstone of adolescent prevention, showed mixed effectiveness in terms of recall. While approximately two-fifths of students reported receiving education on tobacco hazards, a considerable proportion either denied exposure or were uncertain. From a cognitive psychology standpoint, uncertainty reflects weak encoding or poor retention of preventive messages. The absence of gender differences suggests that this limitation is systemic rather than gender-specific, possibly related to inconsistent curriculum delivery or insufficient reinforcement of key concepts.

Taken together, these findings indicate that current tobacco control strategies may insufficiently engage adolescents at a cognitive level. Environmental cues promoting tobacco remain visible, health warnings often fail to elicit active cognitive processing, and school-based education does not consistently translate into durable preventive learning. Addressing these gaps requires interventions that move beyond information dissemination and actively engage adolescents' attention, emotions, and decision-making processes.

In conclusion, this study highlights important gaps in how adolescents psychologically perceive and process tobacco-related environmental cues and preventive messages. Despite widespread exposure to tobacco advertisements at points of sale, particularly among male students, existing regulatory measures appear insufficient to shield adolescents from promotional stimuli that may normalize tobacco use. Moreover, although health warnings on cigarette packaging are commonly encountered, their ability to elicit meaningful cognitive engagement remains limited, with a substantial proportion of adolescents demonstrating passive exposure or complete non-recognition of warning messages.

School-based tobacco education, while present for a segment of students, showed inconsistent recall, suggesting challenges in the effective cognitive encoding and retention of preventive information. These findings underscore that adolescent vulnerability to tobacco initiation is shaped not only by availability or social influences but also by how environmental and educational messages are psychologically processed.

Strengthening tobacco control efforts requires a greater emphasis on adolescent-centered psychological engagement. Interventions should aim to reduce exposure to tobacco marketing cues, enhance the salience and emotional impact of health warnings, and improve the delivery and reinforcement of school-based preventive education. Addressing these psychological dimensions may improve adolescents' risk perception and decision-making, thereby contributing to more effective prevention of tobacco initiation during this critical developmental period.

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*Statement of Transparency and Principles*

• The authors declare no conflict of interest.

• The study was approved by the Research Ethics Committee of the authors' affiliated institution.

• The study data are available upon reasonable request.

• All authors contributed to the implementation of this research.

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