

Original Article

Health-risk knowledge of cigarette smoking and attitudes toward pack warning labels among adult smokers and nonsmokers in Punjab, Pakistan: a comparative cross-sectional study

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Abstract

Cigarette smoking is a leading preventable cause of death in Pakistan, yet adults' knowledge of its specific harms and attitudes toward pack warning labels are incompletely characterized. We conducted a comparative cross-sectional survey of 406 adults (260 smokers and 146 nonsmokers) in Ichhra, a densely populated locality of Lahore, Punjab. An interviewer-administered questionnaire adapted from a validated instrument captured sociodemographic characteristics, smoking behavior, a 14-item health-risk knowledge battery, and warning-label attitudes. Knowledge scores were classified by the modified Bloom cutoff, and internal consistency was assessed using the Kuder-Richardson 20 (KR-20) and Cronbach's alpha coefficients. Categorical characteristics were compared with the chi-square test, weight with the t test, and the knowledge score with the Mann-Whitney U test, applying a Bonferroni correction across the 14 item comparisons. Independent predictors were modeled with binary and ordinal logistic regression, and dimensionality (whether each scale measures one or more distinct constructs) was examined by exploratory factor analysis. The sample was predominantly male (97.8%); smokers consumed 7.6 (SD 3.9) cigarettes daily for 6.2 (SD 4.8) years, and 52.7% had attempted to quit. The knowledge and warning-label scales showed acceptable reliability (KR-20 = 0.71 and 0.72), and the quit-barrier scale had good reliability (Cronbach's alpha = 0.84). Nonsmokers knew more than smokers did; six items remained significant after the Bonferroni correction, all favoring nonsmokers. Good knowledge was more common among nonsmokers (72.6% versus 53.1%; $p = 0.001$). After adjustment, smoking (adjusted odds ratio [aOR] 0.42, 95% confidence interval 0.26 to 0.68), a rural background (0.45, 0.28 to 0.71) and lower personal income independently predicted poorer knowledge, whereas a graduate education level predicted being a smoker (3.48, 2.13 to 5.68). Among smokers, feeling concerned about smoking predicted quitting attempts (2.13, 1.26 to 3.60). Health messaging should prioritize smokers and people with a rural background and should address sex-specific harms.

Keywords

Cigarette smoking; Cross-sectional studies; Health knowledge; Nonsmokers; Pakistan; Smokers; Warning labels

1. Introduction

Tobacco use is among the greatest preventable causes of premature death world-wide, killing more than seven million people each year, including over 1.6 million non-smokers who are exposed to second-hand smoke [1]. The overwhelming majority of the world's tobacco users live in low- and middle-income countries, where health systems are least prepared to absorb the resulting burden of cardiovascular disease, chronic respiratory disease and cancer [1,2]. Cigarette smoke contains thousands of chemical constituents, and causal links between smoking and ischemic heart disease, chronic obstructive pulmonary disease, and cancers of the lung, larynx, pharynx, esophagus, oral cavity and stomach have been firmly established [2].

Pakistan bears a heavy and unequal share of this burden. National survey data indicate a high prevalence of smoking among men, a strong urban-rural gradient in household smoke exposure, and important sex differences in tobacco use and its determinants [3,4]. Recent Pakistani studies of smokers and the general population confirm that combustible cigarettes remain the dominant product and that knowledge, attitudes and practices vary widely across regions and social groups [5,6,7]. Understanding what people know about the specific harms of smoking is central to tobacco control because accurate risk perception underpins both the decision not to start smoking and the motivation to quit [8].

Health warnings on cigarette packaging are among the most cost-effective instruments available to communicate these harms, and Pakistan, as a party to the World Health Organization Framework Convention on Tobacco Control, has implemented pictorial and text warnings under the MPOWER package. A growing evidence base shows that stronger warnings increase perceived harm, quitting intentions and quitting attempts, especially when they are large and graphic [9,10]. However, the effect of warnings depends on how they are received, and public knowledge and the endorsement of warning content are rarely measured together in the same population, particularly among community-dwelling adults rather than students.

An earlier comparative study of university students in Pakistan applied a 14-item knowledge battery and the modified Bloom classification and revealed that knowledge did not differ between smokers and nonsmokers, that smoking was more common among rural students and that sex-specific harms were poorly understood; this study relied mainly on descriptive statistics, the chi-square test and the Mann-Whitney U test, and it did not report the reliability of its instrument, quantify effect sizes, adjust for confounding, or examine attitudes toward warning labels [8]. Whether its conclusions extend to the wider adult community, which differs from that of students in terms of age, education and occupation, is unknown. Comparable international work using knowledge indices has since shown that former smokers and more advantaged groups often know more than current smokers do and that knowledge is associated with concern about personal risk [11,12,13].

We therefore studied a community sample of adult smokers and nonsmokers in Punjab with three objectives: first, to quantify and compare health-risk knowledge between smokers and nonsmokers at the item level and overall; second, to establish the reliability and dimensionality of the knowledge, warning-label and quit-barrier scales; and third, to identify the independent sociodemographic determinants of knowledge, smoking status, and quit attempts using multivariable models. By adding reliability testing, effect sizes, correction for multiple comparisons and regression modeling to the earlier descriptive framework, the study aims to provide a more robust and policy-relevant account of what adults in this setting know and believe about cigarette smoking.

2. Methods

2.1. Study design and setting

This was a comparative, community-based cross-sectional study conducted over one month, from March 2025 to April 2025, in Ichhra, a densely populated residential and commercial locality of Lahore, Punjab, Pakistan. Ichhra is an old part of the city, with a mix of long-standing buildings and later flats, and is well known for Ichhra Bazaar, one of the more economical markets of Lahore. The locality houses both families who have lived there for generations and a large number of tenants who have moved from other parts of Pakistan and rent rooms or flats while working in the surrounding residential and commercial areas; this mix made Ichhra a practical setting in which to reach adults of varied backgrounds in a short period.

2.2. Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Review Committee of the Central Institute of Family Medicine (No. CIFM/ERC-25/0028). Written informed consent was obtained from every participant before data collection: literate participants signed the consent form, and participants who could not read or write gave a thumb impression after the form had been read and explained to them.

2.3. Sampling and participants

A door-to-door approach was used within Ichhra. A trained data-collection team visited households along successive residential streets and, within multioccupancy buildings, approached the individual flats and rented rooms in turn so that both long-term resident families and tenants who had settled in the area from various parts of Pakistan for work were represented. One eligible adult was interviewed per household or occupied unit; where more than one adult was present, the person available and willing at the time of the visit was enrolled. Sampling was therefore consecutive and convenience-based within the visited streets, and nonsmokers continued to be enrolled alongside smokers to preserve a workable comparison group.

Eligible participants were adults older than 18 years, whose age was confirmed against the date of birth on their Computerized National Identity Card (CNIC), who were residents of Ichhra at the time of the survey (as long-term residents or as tenants relocated for work), were able to provide informed consent and complete the interview in a single sitting and reported no chronic illness recognizable to a layperson as attributable to smoking, such as a known diagnosis of lung cancer or chronic obstructive pulmonary disease, so that personal illness experience would not inflate risk knowledge. People who could not understand and communicate in English or a local language (Urdu, Punjabi or Saraiki) and those who did not complete the core questionnaire were excluded.

Participants were classified by self-reported status as current cigarette smokers or nonsmokers, which is consistent with the smoking status classification used in the source study [8]; a current smoker was a person who reported smoking cigarettes at the time of the survey, whether daily or occasionally, and a nonsmoker was a person who reported not currently smoking.

2.4. Sample size

The required sample size was estimated for the primary comparison, the difference in the proportion with good knowledge between smokers and nonsmokers, using the standard formula for two independent proportions (Equation 1) [14]:

$$n = [z_{1-\alpha/2} \sqrt{2\bar{p}(1-\bar{p})} + z_{1-\beta} \sqrt{p_1(1-p_1) + p_2(1-p_2)}]^2 / (p_1-p_2)^2 \quad (1)$$

The anticipated proportion of smokers with good knowledge (p_1) was set at 0.54 on the basis of the 54.4% reported among smokers in the source study [8], and a difference of 20 percentage points ($p_2 = 0.74$ in nonsmokers) was taken as the smallest difference of practical importance. With a two-sided alpha of 0.05 ($z = 1.96$) and 80% power ($z = 0.84$), the calculation yielded 90 participants per group or 100 per group after allowing for 10% incomplete responses. The achieved sample of 260 smokers and 146 nonsmokers exceeds this requirement and provides adequate power for the primary comparison.

2.5. Instrument

Data were collected with a structured questionnaire adapted with minor modifications from a previously published instrument used in Pakistan [8], for which permission to adapt and use was obtained from the original authors. Because the participants ranged from highly educated to those with little or no formal schooling, the questionnaire was interviewer-administered: trained members of the data-collection team read each item aloud in the participant's preferred language and recorded the responses rather than leaving the respondents to complete it unaided. Before the main survey, the instrument was pilot tested on a small convenience sample of adults from the same setting to check the clarity and comprehensibility of the items, the appropriateness of the local-language wording, the average time to complete the interview, and the internal consistency of the scales; only minor wording adjustments followed, and the pilot responses were not included in the analysis. The questionnaire recorded sociodemographic characteristics (age group, sex, marital status, education, personal and family income band, source of income, district of origin and family system) and, for smokers, the number of cigarettes smoked per day, the duration of smoking in years, feelings about smoking and any previous quit attempt. Health-risk knowledge was assessed with 14 items covering ischemia and myocardial infarction, chronic obstructive lung disease, respiratory disorders, six cancers (esophagus, larynx, lung, oral cavity, pharynx and stomach), male impotence, pregnancy-related complications, the presence of toxic chemical constituents, and awareness of second-hand smoke and its dangers. Each correct answer was given one point, for a total of 0 to 14 points. Warning-label attitudes were captured by ten yes/no endorsement items, and for smokers who had attempted to quit, perceived barriers to quitting were rated on six five-point items covering fear of failure, irritability, difficulty concentrating, craving, loss of pleasure and weight gain.

2.6. Derived measures

Overall knowledge was classified by the modified Bloom cutoff as good (80% or more, that is, 12 to 14 correct), moderate (50 to 79%, that is, 7 to 11 correct) or poor (below 50%, that is, fewer than 7 correct) [8,15]. Age, personal income and family income were collected as ordered bands and were retained as categorical variables for description; in regression, they were entered as ordinal scores corresponding to the rank of the band. Education was dichotomized as graduate or higher versus up to intermediate. Because the sample combined long-term Lahore residents with tenants who had moved in from elsewhere, participants were classified by background as city-based when their district of origin was a metropolitan city and as having a rural background when their district of origin was a predominantly rural area. Body weight was recorded in whole kilograms and analyzed as a continuous variable, whereas height was recorded only in whole feet, which is too coarse for a valid body mass index; thus, body mass index was not computed.

A warning-label support score (0 to 10) and a quit-barrier score (6 to 30) were derived by summation.

2.7. Statistical analysis

Analyses were performed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA). Categorical variables, including age and income bands, are summarized as counts and percentages within each smoking group and were compared using the Pearson chi-square test or Fisher's exact test when a 2×2 table had an expected cell count below 5, with the Cramer V effect size. Weight, the only continuous characteristic, is summarized as the mean and standard deviation (SD) and was compared using the independent-samples *t* test with the Cohen *d* effect size. The overall knowledge score (0 to 14) is summarized as the median and interquartile range and compared using the Mann-Whitney U test, with the effect size *r* calculated as $Z/\sqrt{N}$ from the standardized test statistic. Across the 14 knowledge items, raw *p* values were multiplied by 14 (Bonferroni correction) because testing 14 items each at the 0.05 level carries an approximately 51% probability of at least one false-positive result; an item difference was considered significant only when its Bonferroni-adjusted *p* value was 0.05 or less. Internal consistency was quantified using the Kuder-Richardson 20 (KR-20) coefficient for dichotomous scales and the Cronbach's alpha coefficient for the Likert quit-barrier scale [16]. Dimensionality was examined by exploratory factor analysis with principal axis factoring and varimax rotation after confirming sampling adequacy with the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity. Associations between the knowledge score and other ordinal or continuous variables were assessed with Spearman's rank correlation. Independent predictors of good knowledge were estimated with binary logistic regression, and the ordered three-level knowledge outcome was estimated with proportional odds ordinal logistic regression; correlates of smoking status and, among smokers, of quit attempts were modeled with binary logistic regression, and model fit is reported as the Nagelkerke R^2 . The results are reported as adjusted odds ratios (aORs) with 95% confidence intervals. Sex was excluded from the knowledge models because only nine participants were women. A two-sided *p* value of 0.05 or less was considered significant.

3. Results

3.1. Sample characteristics

Among the 406 participants, 260 (64.0%) were smokers, 146 (36.0%) were nonsmokers, and 397 (97.8%) were men. The smokers consumed a mean of 7.6 (SD 3.9) cigarettes per day and had smoked for 6.2 (SD 4.8) years; 148 described themselves as contented with their smoking and 112 as concerned, and 137 of 260 (52.7%) had made at least one quitting attempt. Smoking status was associated with education, marital status, source of income, personal income, family income and weight but not with age, sex, background or family system (Table 1). Compared with nonsmokers, smokers were more often graduates and unmarried and less often held a private-sector job. Nonsmokers reported higher personal and family incomes and a higher mean body weight (73.3 kg versus 69.5 kg; $p = 0.001$).

Table 1. Sociodemographic and smoking characteristics by cigarette smoking status (N = 406).

Characteristic		Smokers (n = 260) n (%)	Nonsmokers (n = 146) n (%)	p Value	Effect Size
Sex	Male	254 (97.7)	143 (97.9)	> 0.99	V = 0.008
	Female	6 (2.3)	3 (2.1)		
Background	City-based	164 (63.1)	91 (62.3)	0.881	V = 0.007
	Rural background	96 (36.9)	55 (37.7)		
Family system	Joint	176 (67.7)	104 (71.2)	0.459	V = 0.037
	Nuclear	84 (32.3)	42 (28.8)		
Education	Graduate or higher	142 (54.6)	54 (37.0)	0.001	V = 0.169
	Up to intermediate	118 (45.4)	92 (63.0)		
Marital status	Married	165 (63.5)	113 (77.4)	0.004	V = 0.144
	Unmarried	95 (36.5)	33 (22.6)		
Source of income	Business	35 (14.7)	5 (3.8)	< 0.001	V = 0.211
	Government job	64 (26.9)	25 (18.8)		
	Private job	139 (58.4)	103 (77.4)		
Age group, years	Below 20	3 (1.2)	3 (2.1)	0.142	V = 0.130
	21 to 30	134 (51.5)	61 (41.8)		
	31 to 40	46 (17.7)	38 (26.0)		
	41 to 50	63 (24.2)	32 (21.9)		
	51 and above	14 (5.4)	12 (8.2)		
Personal income, PKR	Below 10 000	45 (18.9)	9 (6.8)	0.002	V = 0.226
	10 001 to 20 000	66 (27.7)	38 (28.6)		
	20 001 to 30 000	87 (36.6)	46 (34.6)		
	30 001 to 40 000	22 (9.2)	24 (18.0)		
	40 001 to 50 000	13 (5.5)	15 (11.3)		
	Above 50 000	5 (2.1)	1 (0.8)		
Family income, PKR	10 001 to 20 000	23 (8.8)	0 (0.0)	< 0.001	V = 0.234
	20 001 to 30 000	42 (16.2)	18 (12.3)		
	30 001 to 40 000	55 (21.2)	21 (14.4)		
	40 001 to 50 000	37 (14.2)	25 (17.1)		
	Above 50 000	103 (39.6)	82 (56.2)		
Weight, kg, mean (SD)		69.5 (10.2)	73.3 (11.3)	0.001	d = 0.351

Categorical variables were compared using the Pearson chi-square test or Fisher's exact test for sex because one expected cell count was less than 5 (effect size Cramer V), and weight was compared using the independent-samples t test (effect size Cohen d). $p \leq 0.05$ was considered to indicate statistical significance. Abbreviations: PKR, Pakistani rupees; SD, standard deviation; V, Cramer V. Sources of income and personal income were missing for 35 participants (22 smokers and 13 nonsmokers); percentages for these two variables are based on the 238 smokers and 133 nonsmokers with data.

3.2. Scale reliability

The 14-item knowledge scale and the 10-item warning-label support scale each showed acceptable internal consistency (KR-20 = 0.71 and 0.72, respectively). The six-item quit-barrier scale showed good internal consistency (Cronbach's alpha = 0.84, 95% confidence interval 0.79 to 0.88), supporting its use as a summary measure.

3.3. Item-level and overall knowledge

Nonsmokers answered most items correctly more often than smokers did. After the Bonferroni correction, six items remained significant, all of which favored nonsmokers: larynx, pharynx and stomach cancer; awareness of toxic chemical constituents; having

heard of second-hand smoke; and recognizing second-hand smoke as dangerous (Table 2). Four further items (chronic obstructive lung disease, esophageal cancer, lung cancer and pregnancy-related complications) differed at the unadjusted 0.05 level but not after correction. The two sex-specific items, male impotence and pregnancy-related complications, were among the least well known in both groups and did not differ significantly after correction. The median knowledge score was 12 of 14 in both groups, but the distribution shifted toward higher scores among nonsmokers (Mann–Whitney U test, $p = 0.001$; $r = 0.17$). Good knowledge was more common among nonsmokers than smokers, and poor knowledge was less common (Table 3; chi-square = 14.87, $p = 0.001$, $V = 0.191$).

Table 2. Correct responses to the 14 health-risk knowledge items by smoking status (N = 406).

Knowledge Item	Smokers n/N (%)	Nonsmokers n/N (%)	<i>p</i> Value	Bonferroni <i>p</i>	<i>V</i>
Ischemia and myocardial infarction	216/260 (83.1)	117/146 (80.1)	0.459	1.000	0.037
Chronic obstructive lung disease	213/260 (81.9)	131/146 (89.7)	0.036	0.503	0.104
Respiratory disorders	232/260 (89.2)	121/146 (82.9)	0.068	0.955	0.091
Esophageal cancer	204/260 (78.5)	127/146 (87.0)	0.034	0.471	0.105
Larynx cancer	197/260 (75.8)	137/146 (93.8)	< 0.001	< 0.001	0.227
Lung cancer	230/260 (88.5)	138/146 (94.5)	0.044	0.620	0.100
Oral cavity cancer	217/260 (83.5)	129/146 (88.4)	0.182	1.000	0.066
Pharynx cancer	212/260 (81.5)	142/146 (97.3)	< 0.001	< 0.001	0.226
Stomach cancer	193/260 (74.2)	130/146 (89.0)	< 0.001	0.005	0.176
Male impotence	174/260 (66.9)	90/146 (61.6)	0.284	1.000	0.053
Pregnancy-related complications	193/260 (74.2)	94/146 (64.4)	0.036	0.510	0.104
Contains toxic chemicals	192/260 (73.8)	132/146 (90.4)	< 0.001	0.001	0.198
Heard of second-hand smoke	200/260 (76.9)	138/146 (94.5)	< 0.001	< 0.001	0.226
Second-hand smoke as dangerous	187/260 (71.9)	130/146 (89.0)	< 0.001	0.001	0.199

Items were compared using the Pearson chi-square test (effect size Cramer *V*). *n*, number of correct answers; *N*, number of responses in that group. Bonferroni *p*, raw *p* value multiplied by the number of items (14) and capped at 1.000; an item difference was considered significant when the Bonferroni *p* was ≤ 0.05 . *V*, Cramer *V*.

Table 3. Overall knowledge level (modified Bloom classification) by smoking status (N = 406).

Knowledge Level	Smokers, <i>n</i> (%)	Nonsmokers, <i>n</i> (%)	<i>p</i> Value
Good (12 to 14)	138 (53.1)	106 (72.6)	0.001
Moderate (7 to 11)	107 (41.2)	35 (24.0)	
Poor (below 7)	15 (5.8)	5 (3.4)	

Comparisons were performed using the Pearson chi-square test (chi-square = 14.87, Cramer *V* = 0.191). $p \leq 0.05$ was considered to indicate statistical significance.

3.4. Independent predictors of good knowledge

In the multivariable binary logistic model, three variables independently predicted good knowledge after mutual adjustment (Table 4). Compared with nonsmokers, smokers had less than half the odds of having good knowledge (aOR 0.42, 95% confidence interval 0.26 to 0.68), and compared with city-based participants, participants with a rural background had similarly reduced odds (0.45, 0.28 to 0.71). Higher personal income was associated with modestly greater odds of good knowledge (1.24 per income band, 1.01 to 1.54, $p = 0.041$). Age, education, family system and marital status were not independently associated with knowledge. The proportional-odds ordinal model reproduced the same pattern for the two principal predictors, with aORs of 0.45 (0.28 to 0.73) for smoking and 0.45 (0.29 to 0.70) for a rural background, confirming that the associations were robust to model specification.

Table 4. Multivariable binary logistic regression for good knowledge (N = 371).

Predictor	aOR	95% CI	p Value
Smoker (versus nonsmoker)	0.42	0.26 to 0.68	< 0.001
Rural background (versus city-based)	0.45	0.28 to 0.71	0.001
Personal income (per band)	1.24	1.01 to 1.54	0.041
Age (per band)	1.04	0.81 to 1.34	0.738
Graduate or higher (versus lower)	0.97	0.59 to 1.59	0.892
Joint family (versus nuclear)	1.27	0.79 to 2.04	0.321
Married (versus unmarried)	1.36	0.80 to 2.31	0.264

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval. Age and personal income were entered as ordinal band scores (per band increase). $p \leq 0.05$ was considered to indicate statistical significance. Nagelkerke $R^2 = 0.13$.

3.5. Correlates of smoking status and quitting attempts

Modeling smoking status itself revealed a socioeconomic gradient (Table 5). Compared with less-educated participants, graduates had approximately three and a half times greater odds of being smokers (3.48, 2.13 to 5.68), whereas married participants (0.50, 0.28 to 0.86) and those with higher family income (0.58 per income band, 0.47 to 0.71) had lower odds. Age, sex, background and family system were not independently associated with smoking. Among smokers, feeling concerned rather than contented about smoking was the strongest predictor of having attempted to quit (aOR 2.13, 1.26 to 3.60; $p = 0.005$), whereas a longer smoking duration was associated with slightly lower odds of a quit attempt (0.92 per year; 0.85 to 1.00; $p = 0.046$) and a higher knowledge score with modestly lower odds (0.87 per point; 0.79 to 0.97; $p = 0.011$). The Nagelkerke R^2 for this model was 0.12.

Table 5. Multivariable binary logistic regression for being a smoker (N = 406).

Predictor	aOR	95% CI	p Value
Graduate or higher (versus lower)	3.48	2.13 to 5.68	< 0.001
Married (versus unmarried)	0.50	0.28 to 0.86	0.013
Family income (per band)	0.58	0.47 to 0.71	< 0.001
Age (per band)	1.08	0.84 to 1.39	0.537
Female (versus male)	0.78	0.17 to 3.55	0.752
Rural background (versus city-based)	0.68	0.42 to 1.09	0.107
Joint family (versus nuclear)	1.01	0.62 to 1.66	0.968

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval. Age and family income were entered as ordinal band scores (per band increase). $p \leq 0.05$ was considered to indicate statistical significance. Nagelkerke $R^2 = 0.17$.

3.6. Scale dimensionality and correlations

The quit-barrier scale was suitable for factor analysis (KMO = 0.76, Bartlett test $p < 0.001$) and resolved into two factors that together explained 61.1% of the variance, broadly separating affective and physical withdrawal from craving and irritability. For the 14 knowledge items (KMO = 0.69), the two sex-specific items, male impotence and pregnancy-related complications, loaded together on a distinct factor, indicating that knowledge of sex-specific risks behaves as a separate and systematically weaker dimension. The knowledge score correlated positively with warning-label support (Spearman $\rho = 0.33$, $p < 0.001$) and with the personal income band ($\rho = 0.18$, $p < 0.001$) but not with age, education or weight, indicating that more knowledgeable participants were also more supportive of stronger pack warnings.

4. Discussion

In this community sample of adults in Punjab, nonsmokers knew more about the health harms of cigarette smoking than smokers did, and this difference persisted after adjustment for age, education, background, family system, marital status and income. Current smoking status, a rural background and lower personal income independently predicted poor knowledge. These findings differ in an important way from those of the earlier Pakistani student study that used the same knowledge battery, which reported no difference in knowledge between smokers and nonsmokers and identified rural residence as a correlate of smoking rather than of knowledge [8]. This difference is unlikely to be an artifact of measurement because the present analysis confirmed the acceptable reliability of the instrument and used a Bonferroni correction and effect sizes rather than unadjusted tests alone. A more plausible explanation is that the community sample, which was older, more occupationally diverse and almost entirely male, captures a population in which the informational advantage of not smoking is more pronounced than among relatively homogeneous, health-aware university students.

The observation that current smokers know less than nonsmokers do is consistent with international work using knowledge indices, in which former smokers and nonsmokers tend to score higher than current smokers do, and greater knowledge is linked to greater concern about personal risk [11]. It also echoes an Iraqi study in which awareness of specific health harms was lower among smokers than among nonsmokers [12], and it aligns with evidence that disadvantaged groups often carry both a higher smoking burden and lower risk awareness [13]. The relocation of the rural signal from behavior to knowledge is noteworthy. In this sample, a rural background was not an independent correlate of smoking, but it strongly predicted poor knowledge, which points to the unequal reach of health information rather than a simple rural excess of smoking and suggests that communication channels serving people of rural origin deserve specific attention [3].

The socioeconomic pattern of smoking status was counterintuitive. Graduate education was associated with approximately three and a half times higher odds of being a smoker, while higher family income and being married were protective. That graduate education was associated with higher odds of smoking but not with better knowledge cautions against the assumption that formal schooling alone will curb tobacco use in this setting, and this pattern is compatible with reports that the direction of the socioeconomic gradient in smoking varies with a country's stage in the tobacco epidemic [4,6]. These relationships were most clearly seen after multivariable adjustment, underscoring the value of regression modeling alongside unadjusted comparisons in observational tobacco research.

Two applied findings stand out for messaging. First, the sex-specific harms of smoking (male impotence and pregnancy-related complications) were the least well-known items in both groups and formed their own factor in the knowledge structure, replicating a gap reported both in earlier student studies and in other populations and highlighting a concrete, targetable deficit for warning content [8,17]. Second, knowledge covaried with support for stronger pack warnings, and among smokers, those who felt concerned about their smoking were approximately twice as likely to have attempted to quit. These findings are consistent with evidence that stronger and more affective warnings increase perceived harm and quit intentions and attempts [9,10] and that complementary mass-media campaigns can further raise awareness and support cessation [18]. These findings suggest that messages that involve concern, rather than information alone, may be particularly effective, since risk perception and personal relevance shape how young adults respond to smoking information [19]. The modest inverse association between

knowledge score and having attempted to quit should be interpreted cautiously because in a cross-sectional design, it may reflect reverse causation, with smokers who struggle to quit becoming more informed over time.

This study has several limitations. The design is cross-sectional, so associations cannot be interpreted causally. The sample was recruited by convenience and was almost entirely male, which precludes analysis of sex differences and limits generalizability to women and to the wider community. Age and income were recorded as bands rather than exact values, background was classified operationally from the participant's district of origin, and height was too coarse to permit a valid body mass index. Finally, knowledge and attitudes were self-reported and may be subject to social desirability bias. Strengths include the community-based rather than student sampling frame, the explicit reliability and dimensionality assessment of the scales, the correction for multiple comparisons across the knowledge battery, and the use of both binary and ordinal multivariable models, which together provide a more rigorous basis for inference than descriptive comparison alone does.

5. Conclusions

Among adults in Punjab, current smokers, participants with a rural background and those with lower personal income had poorer knowledge of the health harms of cigarette smoking, sex-specific harms were poorly understood across the board, and knowledge was linked to support for stronger pack warnings. Graduate education was paradoxically associated with smoking, and concern about smoking predicted attempts to quit. Tobacco-control messaging in this setting should prioritize smokers and people with a rural background, for whom the reach of health information and the social determinants of smoking differ from those of long-term city residents [20], strengthen content on sex-specific harms, and engage the affective concern that appears to drive quitting attempts. Sustained implementation of pack warnings and broader tobacco-control measures remains essential, as national tobacco prevalence declines only slowly [21]. Longitudinal and more representative studies that include women are needed to confirm these associations and to guide the design of warning labels.

Abbreviations: aOR, Adjusted odds ratio; CI, Confidence interval; CNIC, Computerized National Identity Card; KMO, Kaiser–Meyer–Olkin; KR-20, Kuder–Richardson 20; MPOWER, Monitor, protect, offer, warn, enforce and raise; PKR, Pakistani rupees; SD, Standard deviation.

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Data availability: The data supporting this study's findings are available from the corresponding author, Muneeb Ghuman, upon reasonable request.

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