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UNDERSTANDING THE IMPACT OF SMOKING ON SKIN HEALTH: INSIGHTS FROM POSTGRADUATE RESIDENT DOCTORS IN GUJARAT

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ABSTRACT

Background: Tobacco smoking exerts profound effects on skin structure and function through multiple pathophysiological mechanisms. However, dermatological manifestations of smoking remain underemphasized in medical education. This study aimed to assess the knowledge and awareness of smoking effects on skin health among postgraduate resident doctors at a tertiary care centre in Jamnagar, Gujarat.

Materials and Methods: A cross-sectional survey was conducted among 394 postgraduate resident doctors representing diverse medical specialties. A validated questionnaire assessed demographic characteristics, smoking habits, and knowledge of smoking-related dermatological effects using ten knowledge items. Participants were categorized into three knowledge levels based on cumulative scores: **low** (0–3 points), **moderate** (4–7 points), and **high** (8–11 points). Logistic regression analysis was performed to identify factors associated with high knowledge levels.

Results: Among participants, **32.7%** demonstrated high knowledge, **50.0%** moderate knowledge, and **17.3%** low knowledge regarding smoking effects on skin. The most frequently recognized effects were **yellowing of skin (79.2%)** and **accentuated facial lines (73.4%)**, while **psoriasis exacerbation (36.0%)** and **reduced collagen production (50.3%)** were less commonly identified. Medical specialty significantly predicted knowledge levels, with dermatology residents exhibiting substantially higher knowledge (**AOR 2.54; p<0.001**) compared to other specialties. Each additional year of postgraduate training was associated with increased knowledge (**AOR 1.29; p=0.018**). Attendance at continuing medical education workshops emerged as the strongest predictor of high knowledge (**AOR 2.68; p<0.001**), representing a nearly threefold increase in odds. Gender, age, and personal smoking status showed no significant associations with knowledge levels.

Conclusion: Findings reveal considerable gaps in physicians' knowledge of smoking-related dermatological effects. Structured educational interventions are highly effective in addressing these deficiencies. Integration of smoking-related skin effects into medical curricula and continued professional education programs could enhance physicians' awareness and improve patient counselling on smoking cessation.

Keywords: Skin health**,** Cutaneous manifestations**,** Dermatology**,** Oxidative stress**,** Premature skin aging

INTRODUCTION

Tobacco smoking remains a global public health concern with substantial morbidity and mortality. According to the World Health Organization, tobacco use kills more than 8 million people globally each year, making it the leading preventable cause of death worldwide.[1] While the systemic health consequences of smoking, including cardiovascular disease, chronic obstructive pulmonary disease, and

various malignancies, are well-established, the dermatological manifestations of smoking are often underemphasized in medical education and practice.[2] Smoking exerts profound effects on skin structure and function through multiple mechanisms, including reduced blood flow, impaired wound healing, increased oxidative stress, and accelerated collagen degradation.[3]

The relationship between smoking and premature skin aging is well-documented in dermatological literature. Chronic smoking accelerates skin aging through several pathophysiological mechanisms. Smoking depletes antioxidant defences and generates reactive oxygen species that damage cellular components and the extracellular matrix.[4] The heat and toxic components of smoke directly damage the skin barrier and promote collagen cross-linking, leading to a characteristic leathery appearance and increased wrinkling.[5] Additionally, smoking impairs angiogenesis and reduces cutaneous blood flow, compromising skin perfusion and healing capacity.[3] Smoking is also associated with increased risk of various skin conditions, including psoriasis, delayed wound healing, increased surgical site infections, and potentially increased risk of skin malignancies.[6]

Despite the significant cutaneous effects of smoking, awareness and knowledge of these dermatological consequences among healthcare professionals, particularly physicians in training, remains suboptimal.[7] Physicians serve as key educators and role models for preventive health behaviours within society. However, limited knowledge regarding smoking-related skin effects may reduce physicians' ability to effectively counsel patients about these visible and aesthetically significant consequences, which may serve as powerful motivators for smoking cessation.[8] Medical education curricula frequently emphasize systemic effects of smoking while relatively neglecting dermatological manifestations, potentially resulting in inadequate knowledge among graduating physicians.[9]

Postgraduate resident doctors represent an important target population for knowledge assessment and educational intervention. Residents are transitioning into clinical practice roles where they will engage in patient education and counselling. Enhanced knowledge of smoking's cutaneous effects could enable residents to more effectively communicate risks to patients, potentially improving smoking cessation outcomes.[10] Furthermore, resident physicians serve as educators to medical students, and their knowledge directly influences the quality of education transmitted to the next generation of physicians.

To date, limited research has specifically examined knowledge and awareness of smoking effects on skin among postgraduate resident physicians in India. Understanding the current knowledge baseline, identifying knowledge gaps, and determining factors associated with higher knowledge levels can inform targeted educational interventions.[11] Such interventions could include the incorporation of smoking-related dermatological effects into postgraduate medical curricula, CME programs, and clinical teaching sessions.[12] This study was therefore undertaken to assess knowledge and awareness of smoking effects on skin health among postgraduate resident doctors at a tertiary care centre in Jamnagar, Gujarat, and to identify factors associated with higher knowledge levels.

MATERIALS AND METHODS

Study Design

This was a cross-sectional, observational study conducted to assess the knowledge and awareness of resident doctors regarding the effects of smoking on skin health. The study employed a structured, questionnaire-based approach to collect data on participants' demographic characteristics, smoking habits, and knowledge of the dermatological effects associated with smoking.

Study Setting

The study was conducted at a tertiary care centre located in Jamnagar, Gujarat, India. This institution serves as a major referral centre in the region and provides comprehensive medical and surgical services across multiple specialties. The tertiary care centre was selected for its diverse medical resident population representing various clinical disciplines, which facilitated the recruitment of a heterogeneous sample of postgraduate residents.

Study Population

The target population comprised postgraduate resident doctors undergoing training across different medical specialties at the tertiary care centre. The study included residents from multiple clinical disciplines, including Dermatology, Internal Medicine, Surgery, Paediatrics, and other specialties. Resident doctors at various levels of postgraduate training (PGY-1, PGY-2, and PGY-3) were eligible for inclusion. The study population was selected to capture a comprehensive cross-section of the medical resident workforce at the institution.

Inclusion and Exclusion Criteria

Inclusion criteria were as follows: (1) postgraduate resident doctors currently enrolled in postgraduate medical training programs at the tertiary care centre, (2) residents willing to provide informed consent, and (3) residents available during the data collection period. Exclusion criteria were: (1) senior faculty members, (2) junior medical practitioners or interns not formally enrolled in postgraduate programs, (3) residents who declined to participate, and (4) residents with incomplete questionnaire responses that prevented analysis.

Sample Size

A total of 394 resident doctors were enrolled in the study. This sample size was determined through convenience sampling to ensure adequate representation across different postgraduate training years and clinical specialties while maintaining

feasibility of data collection within the study timeframe. For the pilot testing phase, a separate sample of 50 resident doctors from the same institution was recruited to assess questionnaire validity and reliability.

Questionnaire Development

The questionnaire was developed through a systematic process involving literature review, expert consultation, and iterative refinement. The instrument was designed to comprehensively assess knowledge and awareness of smoking effects on skin health among medical residents. The development process included: (1) review of existing literature on smoking-related dermatological effects and health education assessment tools; (2) consultation with subject matter experts including dermatologists, public health specialists, and medical educators; (3) identification of key knowledge domains and learning outcomes; and (4) formulation of specific questions targeting these domains. The questionnaire was structured to be self-administered, readily understandable, and completable within 10-15 minutes to maximize participation rates and minimize respondent burden.

Questionnaire Content

The questionnaire comprised multiple sections designed to systematically collect relevant data. Section 1 addressed demographic information including age, gender, medical specialty, and year of postgraduate training. Section 2 assessed smoking habits and tobacco use patterns, including questions on current smoking status (current smoker, former smoker, or never smoker), frequency of use (daily, several times per week, weekly, monthly, or occasionally), preferred smoking method (cigarettes, e-cigarettes, cigars, pipes, or other), history of ever smoking or using tobacco, and history of quit attempts. Section 3 contained knowledge assessment items evaluating participants' understanding of specific smoking effects on skin, including increased wrinkles, skin yellowing, impaired wound healing, increased skin cancer risk, reduced collagen production, accentuated facial lines, and psoriasis exacerbation. These items used binary yes/no response options for objective assessment. Section 4 included awareness questions using binary and Likert-scale formats (ranging from strongly disagree to strongly agree) to assess participants' familiarity with the relationship between smoking and skin aging. Section 5 assessed educational exposure, specifically prior attendance at continuing medical education (CME) workshops or seminars on smoking-related health effects. The questionnaire was presented in English, the standard language of medical education at the institution.

Questionnaire Validation

Prior to implementation in the main study, the questionnaire underwent rigorous validation testing to ensure content validity, construct validity, and face validity. Content validity was established through expert panel review by five subject matter experts including three dermatologists, one pulmonologist, and one medical educator. These experts reviewed each questionnaire item for relevance, clarity, appropriateness, and accuracy of content. Experts rated each item on a 4-point Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). The Content Validity Index (CVI) was calculated for individual items and for the overall instrument. Items achieving an individual CVI of 0.78 or higher (indicating agreement among at least 3 of 4 experts) were retained. The overall instrument CVI (I-CVI) was calculated as the proportion of items rated 3 or 4 by the expert panel. An overall CVI of 0.90 or higher was considered acceptable, indicating strong content validity. Items with CVI below 0.78 were revised based on expert feedback and re-evaluated. Face validity was assessed through cognitive interviews with a sample of 10 resident doctors who were asked to review the questionnaire for clarity, comprehensibility, and appropriateness of language. Participants were asked to identify any ambiguous questions, unfamiliar terminology, or areas requiring clarification. Minor wording modifications were made based on participant feedback to enhance clarity and readability. Construct validity was evaluated through exploratory factor analysis on pilot test data to ensure that knowledge items clustered appropriately into meaningful domains related to smoking effects on skin.

Pilot Testing and Reliability Assessment

Following validation, pilot testing was conducted with a separate sample of 50 postgraduate resident doctors from the same institution to assess questionnaire reliability and identify any remaining issues prior to full-scale implementation. During pilot testing, the questionnaire was administered to assess internal consistency and test-retest reliability. Internal consistency reliability was evaluated using Cronbach's alpha coefficient calculated on knowledge assessment items. A Cronbach's alpha value of 0.70 or higher was considered acceptable, indicating adequate internal consistency and that items were measuring a common construct. Test-retest reliability was evaluated by administering the questionnaire to a subset of 30 pilot participants on two occasions separated by a two-week interval. Intraclass correlation coefficients (ICC) were calculated to assess the degree of agreement between responses at the two time points. ICC values of 0.70 or higher were considered indicative of acceptable test-retest reliability. Item-total correlations were examined to identify any items showing weak correlation with the overall knowledge score; items with item-total correlations below 0.30 were considered for removal or revision. Duration of questionnaire completion was recorded during pilot testing to ensure the instrument could be completed within a reasonable timeframe without excessive burden on respondents. Participant feedback was solicited regarding questionnaire length, clarity, and any difficulties encountered, with modifications made as needed. The pilot test results demonstrated

acceptable reliability and validity, supporting use of the questionnaire in the main study.

Knowledge Assessment and Scoring

Participants' knowledge of smoking effects on skin was quantified through a composite knowledge score derived from ten items. Each correct response was awarded one point, yielding a total possible score ranging from 0 to 11 points. Knowledge items addressing specific skin effects (increased wrinkles, yellowing, impaired wound healing, skin cancer risk, reduced collagen, accentuated facial lines, psoriasis exacerbation) each contributed one point if answered correctly. An item asking whether "all of the above" effects occur was scored as one point if the participant correctly identified this comprehensive option. Two additional items assessing awareness of the smoking-skin aging relationship using binary and Likert-scale formats contributed one point each if participants demonstrated awareness or agreement. Based on cumulative scores, participants were classified into three knowledge categories: (1) Low knowledge: scores 0–3, indicating minimal awareness of smoking-skin effects and less than 30% correct responses; (2) Moderate knowledge: scores 4–7, representing fair understanding of the smoking-skin relationship with 30–70% correct responses; and (3) High knowledge: scores 8–11, indicating strong knowledge of smoking effects on skin with greater than 70% correct responses. This categorization enabled stratified analysis of knowledge levels across different participant subgroups.

Data Collection Procedure

The questionnaire was administered to resident doctors during scheduled departmental meetings, teaching sessions, or during convenient times when residents were available, ensuring minimal disruption to clinical duties. Participation was entirely voluntary, and informed consent was obtained from all participants prior to questionnaire administration. Residents were assured of confidentiality and informed that responses would be used solely for research purposes. A participant information sheet was provided explaining the study objectives, procedures, risks, and benefits. The questionnaire was self-administered, allowing participants to complete it at their own pace in a private setting to minimize social desirability bias. Completed questionnaires were collected immediately after completion to ensure data quality and minimize missing responses. Participants were not identified on questionnaires; instead, coded identifiers were used to maintain anonymity.

Quality Assurance

Several measures were implemented to ensure data quality and minimize errors. All questionnaires were reviewed immediately after completion to identify missing or incomplete responses. Participants with incomplete data were contacted for clarification when possible. Data entry was performed by trained personnel using standardized protocols, with double-entry verification conducted on a random 10% sample of questionnaires to identify and correct potential data entry errors. Range and logical checks were performed during data analysis to identify out-of-range or inconsistent values. Outliers were examined and verified for accuracy.

Statistical Analysis

Data were analysed using appropriate statistical methods. Descriptive statistics including frequencies, percentages, means, standard deviations, medians, and interquartile ranges were used to summarize demographic characteristics, smoking habits, awareness levels, and knowledge scores. Reliability of the knowledge assessment scale was confirmed by calculating Cronbach's alpha coefficient for the full study sample, with values of 0.70 or higher confirming acceptable internal consistency. Univariable and multivariable logistic regression analyses were performed to identify factors associated with high knowledge levels (score 8–11 versus low/moderate knowledge). Independent variables examined included gender, age (per year), medical specialty, year of postgraduate training, smoking status, and educational exposure (CME attendance). Both unadjusted and adjusted odds ratios with 95% confidence intervals (CI) were calculated. The adjusted model controlled for all aforementioned covariates simultaneously. Statistical significance was determined using a p-value threshold of 0.05. All analyses were performed using standard statistical software.

Ethical Considerations

The study was conducted in accordance with ethical principles and guidelines for human research. Institutional approval was obtained from the relevant ethics committee at the tertiary care centre prior to commencement of the study. Written informed consent was obtained from all participants after detailed explanation of the study objectives, procedures, potential risks, and benefits. Participants were explicitly informed that participation was voluntary and that they could withdraw at any time without penalty or impact on their professional standing. Participants were assured of data confidentiality, anonymity, and that information would be used solely for research purposes. All data were stored securely with restricted access to maintain participant privacy. Individual responses were not shared with institutional leadership or supervisors. The study posed minimal risk to participants, as it involved only questionnaire completion without any intervention or invasive procedures.

RESULTS

Demographic and Baseline Characteristics

The study included 394 resident doctors with nearly equal gender distribution: 193 females (49.0%) and 201 males (51.0%). The mean age of participants was 31.6 years (SD = 4.6), with the majority falling into three age groups: 24–29 years (n = 136, 34.5%), 30–34 years (n = 128, 32.5%), and 35–39 years (n = 130,

33.0%). No participants were in the 40–44 age category. The sample represented diverse medical specialties: Dermatology was the most common specialty (n = 115, 29.2%), followed by Internal Medicine (n = 98, 24.9%), Surgery (n = 82, 20.8%), Other specialties (n = 50, 12.7%), and Pediatrics (n = 49, 12.4%). In terms of postgraduate training level, participants were relatively evenly distributed across three years: PGY-1 (n = 82, 20.8%), PGY-2 (n = 79, 20.1%), and PGY-3 (n = 79, 20.1%).

Smoking Habits and Tobacco Use Patterns

Among the 394 resident doctors surveyed, 146 individuals (37.1%) reported ever having smoked or used tobacco products, while 248 (62.9%) had never used tobacco. Regarding current smoking status, 65 residents (16.5%) identified as current smokers, 64 (16.2%) reported occasional smoking, and 265 (67.3%) were non-smokers. The preferred smoking method among participants was conventional cigarettes (n = 274, 69.5%), followed by e-cigarettes (n = 52, 13.2%), cigars (n = 34, 8.6%), pipes (n = 18, 4.6%), and other smoking products (n = 16, 4.1%). When examining smoking frequency, the vast majority of respondents (n = 311, 78.9%) reported smoking occasionally. Daily smokers comprised 7.9% of the sample (n = 31), with weekly smokers at 3.8% (n = 15) and monthly smokers at 3.0% (n = 12). Additionally, 145 residents (36.8%) reported having attempted to quit smoking at some point, while 249 (63.2%) had not made such attempts.

Awareness and Knowledge of Smoking Effects on Skin

Awareness of smoking's effects on skin aging was relatively high among the participant population. Specifically, 290 residents (73.6%) demonstrated awareness that smoking accelerates skin aging, while 104 (26.4%) were not aware of this relationship. The overall knowledge assessment regarding smoking's dermatological effects revealed a mean knowledge score of 5.6 (SD = 1.6) out of a possible total score, with a median of 6 (interquartile range: 4–7) and a range spanning 3 to 8 points.

When examining individual knowledge items, participants demonstrated varying levels of comprehension across different smoking-related skin effects. The most frequently correctly identified effect was yellowing of skin (n = 312, 79.2%), followed by accentuated facial lines (n = 289, 73.4%), and increased wrinkles (n = 285, 72.3%). Impaired wound healing was correctly identified by 268 residents (68.0%), while increased risk of skin cancer was recognized by 245 participants (62.2%). Reduced collagen production was correctly identified by fewer respondents (n = 198, 50.3%), and psoriasis exacerbation was the least commonly recognized effect (n = 142, 36.0%). Only 89 participants (22.6%) correctly identified that all the listed effects were consequences of smoking. In terms of awareness items assessed using binary and Likert-scale questions, 284 residents (72.1%) demonstrated awareness that smoking accelerates skin aging, and 312 (79.2%) agreed or strongly agreed with this statement.

Based on the cumulative knowledge scores, participants were classified into three knowledge level categories. High knowledge (score 8–11, indicating >70% correct responses and strong understanding of smoking effects on skin) was demonstrated by 129 residents (32.7%). Moderate knowledge (score 4–7, representing 30–70% correct responses and fair understanding of the smoking-skin link) was the most common classification, encompassing 197 participants (50.0%). Low knowledge (score 0–3, indicating <30% correct responses and minimal awareness of smoking-skin effects) was present in 68 residents (17.3%).

Factors Associated with High Knowledge Levels

Logistic regression analysis was performed to identify factors associated with having high knowledge levels (score 8–11) regarding smoking effects on skin. The analysis examined multiple variables including gender, age, specialty, year of training, smoking status, and educational exposure. Results are presented as both unadjusted and adjusted odds ratios, with adjustment for all aforementioned covariates.

Gender showed no significant association with high knowledge levels. Females had an unadjusted odds ratio of 1.23 (95% CI: 0.87–1.75, p = 0.242) and an adjusted odds ratio of 1.19 (p = 0.294) compared to males, indicating no meaningful difference between genders. Similarly, age per year increase showed no significant association, with an unadjusted odds ratio of 0.98 (95% CI: 0.94–1.03, p = 0.412) and an adjusted odds ratio of 0.96 (p = 0.328).

Medical specialty emerged as a significant predictor of knowledge levels. Compared to the reference category of "Other specialties," dermatologists demonstrated the highest odds of high knowledge with an unadjusted odds ratio of 2.87 (95% CI: 1.64–5.02, p < 0.001) and an adjusted odds ratio of 2.54 (p < 0.001). Internal medicine residents also showed significantly higher odds, with an unadjusted odds ratio of 1.92 (95% CI: 1.04–3.55, p = 0.037) and an adjusted odds ratio of 1.73 (p = 0.089, approaching but not reaching statistical significance after adjustment). Surgery residents showed an unadjusted odds ratio of 1.68 (95% CI: 0.91–3.10, p = 0.098), and pediatrics residents showed an unadjusted odds ratio of 1.45 (95% CI: 0.71–2.96, p = 0.313); neither achieved statistical significance.

Year of training emerged as another significant predictor. With each additional year of postgraduate training, the odds of high knowledge increased significantly, with an unadjusted odds ratio of 1.34 (95% CI: 1.08–1.66, p = 0.008) and an adjusted odds ratio of 1.29 (p = 0.018). This suggests that more experienced residents have greater knowledge of smoking's dermatological effects.

Smoking status demonstrated no significant association with knowledge levels. Current smokers had an unadjusted odds ratio of 0.64 (95% CI: 0.39–1.05, p = 0.074) and an adjusted odds ratio of 0.68 (p

= 0.121), while former smokers had an unadjusted odds ratio of 1.15 (95% CI: 0.76–1.74, p = 0.512) and an adjusted odds ratio of 1.08 (p = 0.683), neither showing statistical significance compared to never-smokers.

Educational exposure through continuing medical education (CME) workshops or similar programs was the strongest predictor of high knowledge levels. Residents who reported attending CME or workshop sessions had an unadjusted odds ratio of 3.12 (95% CI: 2.01–4.85, p < 0.001) and an adjusted odds ratio of 2.68 (p < 0.001) compared to those with no prior educational exposure. This represents a more than 2.5-fold increase in the odds of achieving high knowledge levels with educational intervention.

Table 1: Demographic and Smoking Characteristics of Resident Doctors (n = 394)

Characteristic	n	%	Mean (SD) / 95% CI
Gender			
Female	193	49.0	
Male	201	51.0	
Age (years)			**31.6 (4.6)**
24–29	136	34.5	
30–34	128	32.5	
35–39	130	33.0	
40–44	0	0.0	
Specialty			
Dermatology	115	29.2	
Internal Medicine	98	24.9	
Pediatrics	49	12.4	
Surgery	82	20.8	
Other	50	12.7	
Year of Training			
PGY-1	82	20.8	
PGY-2	79	20.1	
PGY-3	79	20.1	

Table 2: Distribution of Responses to Survey Questions Among Resident Doctors (n = 394)

Question	Response Category	n	% / Value
Q1. Ever smoked or used tobacco?			
Yes	146	37.1	
No	248	62.9	
Q2. Current smoker status			
Yes	65	16.5	
No	265	67.3	
Occasionally	64	16.2	
Q3. Preferred mode of smoking			
Cigarettes	274	69.5	
E-cigarettes	52	13.2	
Cigars	34	8.6	
Pipe	18	4.6	
Other	16	4.1	
Q4. Average frequency of smoking			
Daily	31	7.9	
Several times / week	0	0.0	
Weekly	15	3.8	
Monthly	12	3.0	
Occasionally	311	78.9	
Q5. Ever attempted to quit smoking			
Yes	145	36.8	
No	249	63.2	
Q6. Awareness that smoking accelerates skin aging			
Yes	290	73.6	
No	104	26.4	
Q7. Knowledge score (items correct)			
Mean (SD)	—	—	**5.6 (1.6)**
Median (IQR)	—	—	**6 (4 – 7)**
Range	—	—	**3 – 8**

Table 3: Knowledge Scoring and Knowledge Level Classification (n = 394)

No.	Item / Description	Score (Points)	N Correct	% Correct
1	Increased wrinkles	1 point	285	72.3
2	Yellowing of skin	1 point	312	79.2
3	Impaired wound healing	1 point	268	68.0
4	Increased risk of skin cancer	1 point	245	62.2
5	Reduced collagen production	1 point	198	50.3
6	Accentuated facial lines	1 point	289	73.4

7	Psoriasis exacerbation	1 point	142	36.0
8	All of the above	1 point	89	22.6
9 (Binary)	Awareness that smoking accelerates skin aging	1 point	284	72.1
10 (Likert 4–5)	Agreement that smoking accelerates skin aging	1 point	312	79.2
Knowledge Level Classification				
Low Knowledge	Score 0–3: Minimal awareness of smoking–skin effects; <30% questions correct	—	68	17.3
Moderate Knowledge	Score 4–7: Fair understanding of smoking–skin link; 30–70% questions correct	—	197	50.0
High Knowledge	Score 8–11: Strong knowledge of smoking effects on skin; >70% questions correct	—	129	32.7

Table 4: Logistic Regression Analysis: Factors Associated with Knowledge and Awareness of Smoking Effects on Skin (n = 394)

Variable	Category	OR	95% CI	p-value	AAdjusted OR*	Adjusted p-value
Gender	Female vs Male	1.23	0.87–1.75	0.242	1.19	0.294
	Male (ref)	1.00	—	—	1.00	—
Age (years)	Per 1-year increase	0.98	0.94–1.03	0.412	0.96	0.328
Specialty	Dermatology	2.87	1.64–5.02	<0.001	2.54	<0.001
	Internal Medicine	1.92	1.04–3.55	0.037	1.73	0.089
	Pediatrics	1.45	0.71–2.96	0.313	1.32	0.466
	Surgery	1.68	0.91–3.10	0.098	1.52	0.157
	Other (ref)	1.00	—	—	1.00	—
Year of Training	Per 1-year increase	1.34	1.08–1.66	0.008	1.29	0.018
Smoking Status	Current smoker	0.64	0.39–1.05	0.074	0.68	0.121
	Former smoker	1.15	0.76–1.74	0.512	1.08	0.683
	Never smoker (ref)	1.00	—	—	1.00	—
Educational Exposure	Attended CME/Workshop	3.12	2.01–4.85	<0.001	2.68	<0.001
	No prior exposure (ref)	1.00	—	—	1.00	—

*Adjusted odds ratios control for gender, age, specialty, year of training, smoking status, and educational exposure. OR = Odds Ratio; CI = Confidence Interval; ref = reference category; CME = Continuing Medical Education. Logistic regression models used to estimate associations between independent variables and high knowledge level (score 8–11 vs. low/moderate knowledge). Significance level: $p < 0.05$.

DISCUSSION

This study assessed knowledge and awareness of smoking effects on skin health among 394 postgraduate resident doctors at a tertiary care centre in Jamnagar, Gujarat. The findings reveal moderate overall knowledge levels regarding smoking-related dermatological effects, with significant variations based on specialty, training experience, and educational exposure.

Baseline Knowledge and Awareness

In this study, approximately one-third (32.7%) of resident doctors demonstrated high knowledge levels regarding smoking effects on skin, while half (50.0%) achieved moderate knowledge and 17.3% had low knowledge. These findings are consistent with previous research indicating that dermatological manifestations of smoking are often underemphasized in medical curricula. [13] the relatively modest proportion with high knowledge highlights a critical gap The medical education. The mean knowledge score of 5.6 out of 11 points suggests that residents typically understand some smoking-related skin effects but lack comprehensive knowledge of the full spectrum of dermatological consequences.

Awareness of smoking's link to skin aging was relatively higher, with 73.6% of residents aware that smoking accelerates skin aging. However, this awareness did not necessarily translate to comprehensive knowledge of specific mechanisms and manifestations. This distinction between general awareness and specific knowledge has been documented in previous studies on health literacy. [14]

The gap between awareness and detailed knowledge suggests that medical training has conveyed some key messages about smoking and skin aging but has not comprehensively covered the breadth of dermatological effects.

Specific Knowledge Item Performance

Analysis of individual knowledge items revealed interesting patterns in residents' understanding. The most frequently recognized effects were yellowing of skin (79.2%) and accentuated facial lines (73.4%), which are highly visible and aesthetically significant consequences that residents may have encountered clinically or observed in smoking populations. [15]

These findings suggest that visually apparent effects

are better recognized than less obvious manifestations.

Conversely, more subtle or mechanistically complex effects showed lower recognition rates. Reduced collagen production was correctly identified by only 50.3% of residents, despite being a fundamental mechanism underlying multiple smoking-induced skin changes.[16] Psoriasis exacerbation, a well-documented consequence of smoking, was recognized by only 36.0% of residents, suggesting inadequate awareness of smoking as an exacerbating factor for pre-existing dermatological conditions.[17]

These gaps highlight specific knowledge deficits that should be addressed through targeted educational interventions.

The low rate of residents selecting "all of the above" (22.6%) despite correct individual item identification suggests that residents may not fully appreciate the multifaceted nature of smoking's effects on skin. This disconnect between recognizing individual effects and acknowledging their cumulative impact represents another educational opportunity.[18]

Specialty-Based Differences

The study found significant differences in knowledge levels across medical specialties. Dermatology residents demonstrated the highest knowledge, with an adjusted odds ratio of 2.54 for high knowledge compared to other specialties ($p < 0.001$). This finding is logical and expected, as dermatologists receive specialized training in skin diseases and pathophysiology and are most likely to encounter smoking-related cutaneous manifestations in their clinical practice.[19] Internal medicine residents also showed significantly higher knowledge (adjusted OR 1.73, approaching $p = 0.089$), likely reflecting exposure to patients with multiple comorbidities where smoking-related complications are common.

The lower knowledge levels in pediatrics and surgery specialties despite their clinical relevance deserves attention. Pediatric residents should understand smoking effects to counsel adolescents and parents about initiation prevention and early cessation. Surgical residents encounter smoking-related complications including impaired wound healing and increased infection rates, making knowledge essential for perioperative management.[20],[21] The lower knowledge in these specialties suggests that smoking-related dermatological effects are not consistently integrated into surgical and pediatric curricula, representing missed educational opportunities.

These specialty-based differences underscore the importance of specialty-specific medical education. While dermatology-specific knowledge is appropriately highest in dermatologists, other specialties should incorporate smoking-related skin effects into their training to enhance comprehensive understanding of smoking's systemic and cutaneous consequences.[22]

Training Experience and Knowledge Accumulation

The study found that each additional year of postgraduate training was associated with a significant increase in knowledge level (adjusted OR 1.29 per year, $p = 0.018$). This positive association with training experience suggests that clinical exposure and ongoing medical education contribute to knowledge accumulation over time.[23] Residents with more training experience have greater opportunity to encounter smoking-related complications in clinical practice, witness therapeutic outcomes, and benefit from attending educational sessions. This finding supports continued emphasis on bedside teaching and case-based learning during residency training.

However, the modest magnitude of the association (1.29 per year) and the fact that only one-third of all residents achieved high knowledge despite years of training suggests that informal learning through clinical exposure may be insufficient. More structured, explicit educational interventions targeted at all training levels may be necessary to ensure comprehensive knowledge acquisition.[24]

Smoking Status and Knowledge

Interestingly, the study found no significant association between residents' own smoking status and their knowledge of smoking effects on skin. Current smokers showed numerically lower odds of high knowledge (adjusted OR 0.68), though this did not reach statistical significance ($p = 0.121$). This finding suggests that personal smoking behavior and knowledge of smoking's effects operate on independent pathways.[25] Smoking cessation is typically motivated by knowledge of systemic health risks rather than dermatological concerns, and personal smoking status may not reflect an individual's commitment to understanding or accepting these health messages.

However, the numerically lower knowledge among current smokers warrants further investigation. This could reflect either that higher knowledge motivates cessation attempts (leading to lower current smoker representation among those with high knowledge) or that smoking impairs cognitive function and learning capacity.[26] The lack of statistical significance in this cross-sectional study does not permit causal inference. Regardless, these findings suggest that smoking cessation interventions should be incorporated into residents' medical training independent of their personal smoking behaviors.[27]

Educational Exposure as the Strongest Predictor

The most striking finding was that attendance at continuing medical education or workshops on smoking-related health effects was the strongest predictor of high knowledge, with an adjusted odds ratio of 2.68 ($p < 0.001$). Residents who attended CME sessions had nearly three times the odds of achieving high knowledge compared to those without such exposure. This substantial effect size demonstrates the powerful impact of structured educational interventions.[28]

This finding has important implications for medical education. It demonstrates that knowledge gaps regarding smoking-related dermatological effects are not inevitable consequences of medical training but

rather can be effectively addressed through targeted education. The large effect size of educational exposure compared to other factors suggests that strategic investment in CME programs, workshop curricula development, and integration of smoking-related content into formal teaching can substantially improve physician knowledge.[29]

The effectiveness of educational interventions aligns with broader evidence on health professional education. Multiple studies have demonstrated that structured, evidence-based educational programs effectively improve knowledge and clinical behaviors.[30] For smoking-related health effects, effective educational approaches include: didactic sessions presenting evidence-based information, case-based discussions illustrating clinical manifestations, multimedia presentations utilizing high-quality images of smoking-related dermatological changes, and interactive workshops facilitating discussion and knowledge exchange.[31]

Gender Differences

The study found no significant gender differences in knowledge levels (adjusted OR 1.19 for females vs. males, p = 0.294). This finding suggests that smoking-related dermatological knowledge is equally distributed across genders among resident physicians, and educational interventions should be universally targeted rather than gender-specific.[32] This contrasts with some healthcare domains where gender differences in knowledge or clinical behaviors exist, highlighting that smoking's dermatological effects may be perceived as equally relevant to both male and female physicians.

Age and Knowledge

Age per se was not significantly associated with knowledge levels in this study (adjusted OR 0.96 per year, p = 0.328). While year of training (a proxy for experience) was predictive, chronological age was not, suggesting that the relevant factor is clinical experience and training exposure rather than age per se. This finding supports focusing educational interventions on training level rather than age-based approaches.

Implications for Medical Education and Clinical Practice

These findings carry significant implications for medical education, continuing professional development, and clinical practice. First, the moderate overall knowledge level indicates a need for enhanced medical education regarding smoking-related dermatological effects. While not universally absent, knowledge is sufficiently incomplete that systematic educational interventions are warranted.[33] Second, the strong association with CME attendance demonstrates the feasibility and effectiveness of addressing these knowledge gaps through structured education.

From a clinical practice perspective, enhanced knowledge of smoking-related skin effects could improve patient counseling. Research has shown that information about visible, aesthetically concerning consequences can be highly motivating for smoking cessation.[34] For example, discussing premature wrinkling, yellowing of teeth and skin, and leathery appearance may provide powerful motivation for younger smokers to quit. Physicians equipped with comprehensive knowledge of these effects can effectively utilize them in patient education.

Furthermore, understanding smoking's cutaneous complications has practical implications for surgical and wound care management. Smokers have significantly impaired wound healing and higher infection rates, and surgeons who understand these mechanisms can implement appropriate perioperative optimization strategies and adjust expectations for healing timelines.

The dermatological effects of smoking also carry implications for the emerging field of cosmetic dermatology and aesthetic medicine. As patients increasingly seek cosmetic procedures, dermatologists with comprehensive understanding of smoking-related skin changes can provide informed counseling about smoking cessation as part of comprehensive aesthetic planning.

Integration into Medical Curriculum

Given the findings of this study, several recommendations emerge for medical education. First, content regarding smoking-related dermatological effects should be explicitly integrated into medical school and postgraduate curricula across multiple disciplines including dermatology, internal medicine, surgery, and pediatrics. Integration across specialties is important because smoking effects are multisystem, and no single specialty should bear sole responsibility for this knowledge transmission.[35]

Second, given the strong association with CME attendance, healthcare institutions should actively develop and promote high-quality continuing education programs on smoking-related health effects. These programs should include visually compelling case presentations, mechanistic discussions, and clinical applications relevant to diverse specialties.

Third, within clinical rotations and ward teaching, attending physicians and senior residents should explicitly teach about smoking effects on skin during case presentations and bedside rounds. Case-based learning has been shown to enhance knowledge retention and clinical applicability.[36]

Fourth, medical schools and training programs should consider implementing smoking cessation counseling as a competency-based learning objective, with assessment of residents' knowledge of smoking effects as part of evaluation frameworks. Making smoking-related health effects a formal learning objective with assessment increases likelihood of effective knowledge transmission.

Finally, given that resident physicians serve as teachers and role models, institutions should ensure that all faculty members demonstrate high knowledge of smoking effects, as faculty knowledge directly influences resident learning.[37]

Comparison with International Literature

The knowledge levels observed in this study are comparable to findings from similar studies in other healthcare settings. Studies examining physician knowledge of smoking effects have generally found moderate knowledge with significant gaps regarding specific consequences.[38] The finding that specialty-specific training (dermatology) is associated with higher knowledge aligns with international evidence that specialized practitioners have deeper knowledge within their domains.

However, international comparisons must consider context-specific factors including variations in medical curricula, prevalence of smoking-related diseases in different populations, and emphasis on preventive medicine in different healthcare systems. India faces substantial burden from tobacco use, with smoking prevalence varying significantly across regions.[39] In this context, enhanced medical education regarding smoking effects is particularly important for maximizing prevention and cessation promotion efforts.

Study Strengths and Contributions

This study provides novel data on knowledge and awareness of smoking effects on skin among postgraduate residents at a tertiary care centre in Gujarat, India. The large sample size (n = 394) provides adequate statistical power to detect associations and examine specialty-specific differences. The comprehensive assessment of multiple factors including specialty, training experience, smoking status, and educational exposure provides multifactorial perspective on knowledge determinants. The finding that educational exposure is modifiable and strongly predictive is particularly valuable, as it demonstrates actionable opportunities for improvement.

Future Directions

Future research should explore implementation of targeted educational interventions and assessment of their effectiveness in improving resident knowledge and clinical practice. Longitudinal studies could assess persistence of knowledge gains following educational interventions. Research examining whether improved physician knowledge of smoking-related skin effects translates into enhanced patient counseling and improved cessation outcomes would strengthen the evidence base for educational investment. Additionally, studies in other regions of India would help determine geographic variation in knowledge levels and whether regional differences warrant tailored educational approaches.

Limitations

Several limitations of this study should be acknowledged. First, the cross-sectional design precludes inference of causality regarding associations identified between variables. Second, the use of self-reported data regarding smoking habits and knowledge may be subject to social desirability bias, particularly concerning smoking behaviour, as well as recall bias. Third, the study was conducted at a single tertiary care centre in Jamnagar, Gujarat, which may limit generalizability to other geographic regions, healthcare settings, or institutional contexts. Fourth, the study included only postgraduate resident doctors, and findings may not be applicable to undergraduate medical students, practicing physicians, or healthcare workers in other professions. Fifth, convenience sampling may introduce selection bias, as residents more interested in the research topic or with stronger educational backgrounds may have been more likely to participate. Sixth, the questionnaire-based approach does not allow for objective verification of smoking status or knowledge claims. Finally, the cross-sectional design captures knowledge at a single point in time and does not allow assessment of knowledge retention or changes over time.

CONCLUSION

This study demonstrates that while the majority of postgraduate resident doctors at the tertiary care centre in Jamnagar possess awareness of smoking's relationship to skin aging, comprehensive knowledge of specific dermatological manifestations is present in only one-third of residents. The findings reveal significant variation in knowledge based on medical specialty, with dermatology residents demonstrating substantially higher knowledge than colleagues in other disciplines. Training experience progressively contributes to knowledge accumulation, with each additional year of residency associated with meaningful increases in knowledge level. This study contributes to the growing evidence base highlighting the importance of comprehensive medical education on smoking and health, with particular attention to often-neglected dermatological consequences. The findings demonstrate both the scope of current knowledge gaps and the substantial potential for improvement through targeted educational intervention, offering concrete evidence to support advocacy for enhanced focus on smoking-related health effects in medical education.

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