

## Original Article

# Correlation Between Quality of Voice and Conventional Cigarette Smoking: Young Adult Male Perspective

Shamsa Kanwal<sup>1</sup>, Sadia Ijaz<sup>1</sup>, Sadia Akbar<sup>2</sup>, Ghazal Awais Butt<sup>3</sup>, Ezwah Khalid<sup>4</sup>, Shimza Saeed<sup>3</sup><sup>1</sup> Govt. Special Education Center of Excellence, Vehari, Pakistan<sup>2</sup> Doctors Hospital, Lahore, Pakistan<sup>3</sup> Armed Forces Institute of Rehabilitation Medicine, Rawalpindi, Pakistan<sup>4</sup> Govt. Children Hospital, Mandi Bahauddin, PakistanCorrespondence: [ghazalbutt.98@gmail.com](mailto:ghazalbutt.98@gmail.com)

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## ABSTRACT

*Background: Voice disorders can arise from various factors affecting the anatomical and functional integrity of the vocal tract, with smoking recognized as a significant risk factor contributing to vocal fold irritation and alterations in voice quality. Despite evidence linking tobacco use to voice disturbances, gaps remain regarding the specific correlation between smoking patterns and vocal symptoms in young adult males. Objective: To determine the correlation between quality of voice and conventional cigarette smoking among young adult males. Methods: A cross-sectional study was conducted at PSRD College of Rehabilitation Sciences, Lahore, Pakistan, from October 2022 to March 2023, involving 343 male participants aged 20–40 years. Data collection utilized a demographic questionnaire and the Vocal Tract Discomfort Scale (VTD), assessing both frequency and severity of symptoms. Statistical analysis was performed using SPSS version 23, employing ANOVA to compare VTD scores across groups defined by daily cigarette consumption and duration of smoking, with significance set at  $p < 0.05$ . Results: No significant differences were observed in total VTD scores or individual symptoms based on smoking duration ( $p > 0.05$ ). However, significant associations were identified between the number of cigarettes smoked per day and both frequency ( $p = 0.042$ ) and severity ( $p = 0.032$ ) of vocal symptoms, with highest scores among those who smoke fewer than 10 cigarettes daily. Conclusion: A significant relationship exists between the number of cigarettes smoked per day and vocal tract discomfort in young adult males, emphasizing the impact of even lower levels of daily smoking on vocal health.*

*Keywords: Quality of voice; Smoking; Smokers; Vocal tract discomfort; Voice disorders.*

## INTRODUCTION

Voice production relies on the intricate coordination of anatomical and physiological processes that ensure strength, quality, and smoothness of sound. Structural or functional alterations of the larynx can disrupt this balance, leading to voice disorders that significantly affect communication and quality of life. One of the most recognized external factors influencing vocal health is cigarette smoking, which contributes to drying of the vocal fold mucosa, irritation, and inflammatory changes, resulting in symptoms such as coughing, sputum production, and alterations in vocal quality (1). Beyond localized laryngeal effects, tobacco use is implicated in severe systemic consequences, including an estimated 480,000 annual deaths in adults, with worrying trends suggesting that approximately 1,600 adolescents aged 12 to 17 initiate smoking each day, placing around 5.6 million young individuals at risk of premature death from smoking-related illnesses (2). Although cessation before age 30 can mitigate much of this risk, smoking remains associated with both immediate and long-term health issues, establishing a pattern of disease development from adolescence into adulthood (3). Data from the Australian Burden of Illness Survey in 2015 indicated that tobacco use contributed to 3.4% of the disease burden among males aged 25 to 44 years and ranked among the top modifiable risk factors for morbidity in this population (4). In adults between 30 and 39 years, smoking has been linked predominantly with respiratory diseases, cardiovascular conditions, and musculoskeletal disorders, with cancer emerging as a significant concern in the following decade (5).

Extensive cross-sectional research has documented the diverse health consequences of smoking in younger populations, including heightened risks for asthma, cardiovascular disease, stroke, and metabolic disorders (5). Notably, differences have been observed between adolescents and adults in smoking withdrawal experiences, with adolescents often describing intense cravings even at low levels of use, suggesting a rapid establishment of nicotine dependence in younger smokers (6). Such dependence may extend beyond systemic health to impact vocal health, as young smokers report higher rates of voice-related problems compared to their non-smoking peers (6). Additionally, neuroimaging studies have shown abnormalities in frontostriatal circuits among young smokers, potentially contributing to both cognitive

control deficits and disruptions in neural networks associated with vocal function, thereby raising concerns about subtle neurological contributions to voice changes (7). Prior research has demonstrated that smoking can reduce fundamental frequency and speaking fundamental frequency, suggesting an adverse effect on vocal acoustic parameters (8). A study by Tuhanioglu and Erkan explored the impact of electronic versus conventional cigarette use on voice quality, finding that traditional smoking had a more pronounced negative effect on shimmer and harmonic-to-noise ratio values (8). Furthermore, Dogan and colleagues reported that in young male adults, subjective voice complaints often emerge earlier than measurable objective acoustic alterations, indicating that smokers may experience vocal discomfort even before significant physiological changes are detected (9). Despite accumulating evidence on smoking's harmful effects on voice, gaps remain regarding how different smoking patterns correlate specifically with vocal tract discomfort symptoms in young male adults. The current study was designed to address this knowledge gap by examining whether a significant correlation exists between the quality of voice, assessed via the Vocal Tract Discomfort Scale, and conventional cigarette smoking among young adult males. Clarifying this relationship is crucial for informing clinical counseling, early intervention, and preventive strategies tailored for younger populations at risk. Therefore, this study seeks to determine whether the frequency and severity of vocal tract discomfort symptoms differ according to the number of cigarettes smoked per day and the duration of smoking in young adult males (10).

## MATERIALS AND METHODS

This cross-sectional study was conducted at the PSRD College of Rehabilitation Sciences in Lahore, Pakistan, over a period of six months from 1st October 2022 to 31st March 2023, following approval from the institutional Research Ethical Committee under registration number PSRD/CRS/SK/REC/Letter-51 dated 20th September 2022 (11). The target population comprised young adult males aged between 20 and 40 years, drawn from a broader college community estimated at approximately 3,500 individuals. Inclusion criteria were male gender and an age range of 20 to 40 years, while exclusion criteria encompassed any history of diagnosed voice disorders unrelated to smoking, known respiratory diseases such as asthma or chronic obstructive pulmonary disease, prior laryngeal surgery, or significant occupational vocal strain unrelated to smoking. Participants were recruited through convenience sampling within the college campus, and written informed consent was obtained from all individuals prior to participation, ensuring voluntary engagement and confidentiality of personal data in compliance with ethical guidelines (11). The study aimed to examine the correlation between conventional cigarette smoking and vocal tract discomfort symptoms in young adult males. Data collection was carried out using two instruments: a demographic information sheet and the Vocal Tract Discomfort Scale (VTD). The demographic sheet captured participants' age, educational qualification, number of cigarettes smoked per day, and duration of smoking in years. The VTD, a validated and reliable tool for assessing subjective vocal symptoms, includes 16 items divided into two subscales: frequency and severity. Each subscale contains eight items evaluating symptoms such as burning, tightness, dryness, aching, tickling, soreness, irritability, and the sensation of a lump in the throat, scored on a Likert scale from 1 (never or none) to 6 (always or extreme) (12). Data collection was administered as supervised self-report questionnaires, ensuring consistency in completion and minimizing reporting errors.

The primary independent variables were the number of cigarettes smoked per day, categorized into four groups: fewer than 10 cigarettes, 10–15 cigarettes, 16–20 cigarettes, and more than 20 cigarettes, as well as the duration of smoking categorized into 0.5–1 year, 2–3 years, 4–5 years, and more than 5 years. The main outcome variables were the total VTD scores and individual symptom scores across the frequency and severity domains. Potential confounding variables, such as age and education level, were recorded but not adjusted for statistically due to the cross-sectional design and focus on smoking behavior as the primary exposure. Sample size was estimated using the Raosoft online calculator, yielding a minimum requirement of 347 participants based on a 5% margin of error, 95% confidence interval, and an assumed population of 3,500 young adult males. Ultimately, data from 343 participants were analyzed, as four individuals withdrew during the study without providing complete responses. Data were entered into and analyzed using the Statistical Package for the Social Sciences (SPSS), version 23. Descriptive statistics were computed as means and standard deviations for continuous variables and frequencies and percentages for categorical variables. One-way analysis of variance (ANOVA) was performed to compare mean VTD scores across categories of cigarette consumption and duration of smoking. Statistical significance was defined as a two-tailed *p*-value less than 0.05, with no imputation for missing data due to the low dropout rate. No additional subgroup analyses or multivariable adjustments were performed given the descriptive nature of the study. Procedures were implemented to ensure data integrity, including double-checking entries and maintaining secured electronic records accessible only to the research team (11,12).

## RESULTS

A total of 343 young adult males participated in the study, with a mean age of  $27.57 \pm 4$  years. Most participants ( $n=156$ , 45.5%) held graduate-level qualifications, while 118 (34.4%) were undergraduates and 69 (20.1%) were postgraduates. Regarding smoking behavior, the majority of individuals ( $n=212$ , 61.8%) reported smoking 10–15 cigarettes per day, whereas 76 (22.2%) smoked fewer than 10 cigarettes daily, 48 (14.0%) smoked 16–20 cigarettes, and 7 (2.0%) smoked more than 20 cigarettes daily. The most common duration of smoking was 4–5 years, reported by 149 participants (43.4%), followed by 2–3 years in 107 (31.2%), more than 5 years in 54 (15.7%), and 0.5–1 year in 33 (9.6%) (Table 1). The mean scores of symptoms on the Vocal Tract Discomfort Scale (VTD) are presented in Table 2. Within the frequency subscale, the highest mean score was recorded for aching ( $2.94 \pm 1.31$ ), whereas tickling exhibited the lowest mean score ( $2.33 \pm 1.18$ ). For the severity subscale, dryness demonstrated the highest mean score ( $3.27 \pm 1.39$ ), while aching recorded the lowest ( $2.45 \pm 1.19$ ). Analysis of variance (ANOVA) revealed a significant overall difference in total VTD scores based on the number of cigarettes smoked per day ( $p = 0.019$ ), with participants smoking fewer than 10 cigarettes daily exhibiting the highest mean total VTD score ( $40.95 \pm 7.70$ ), while those smoking more than 20 cigarettes daily reported the lowest mean score ( $35.43 \pm 18.37$ ). Similarly, significant differences were observed in the frequency domain ( $p = 0.042$ ) and the severity domain ( $p = 0.032$ ) across cigarette consumption categories (Table 3). However, no significant differences were found in mean scores for individual VTD symptoms across most categories of cigarette consumption, except for aching ( $p = 0.040$ ), sore throat ( $p = 0.028$ ), and irritability ( $p = 0.027$ ) in the frequency subscale, and

dryness ( $p = 0.009$ ) in the severity subscale. Conversely, ANOVA testing indicated no statistically significant differences in total VTD scores, frequency scores, severity scores, or individual symptom scores based on duration of smoking (all  $p > 0.05$ ) (Table 3).

Table 1. Socio-Demographic Characteristics of Participants (N = 343)

Variable	Group	Frequency (n)	Percentage (%)
Qualification	Undergraduate	118	34.4
	Graduate	156	45.5
	Postgraduate	69	20.1
Cigarettes per day	<10	76	22.2
	10–15	212	61.8
	16–20	48	14.0
	>20	7	2.0
Duration of smoking	0.5–1 year	33	9.6
	2–3 years	107	31.2
	4–5 years	149	43.4
	>5 years	54	15.7

Table 2. Mean Scores of Vocal Tract Discomfort Scale Symptoms (N = 343)

Subscale	Symptom	Mean $\pm$ SD
Frequency	Burning	2.40 $\pm$ 0.92
	Tightness	2.49 $\pm$ 1.01
	Dryness	2.70 $\pm$ 1.12
	Aching	2.94 $\pm$ 1.31
	Tickling	2.33 $\pm$ 1.18
	Soreness	2.68 $\pm$ 1.36
	Irritability	2.78 $\pm$ 1.29
Severity	Lump in throat	2.60 $\pm$ 1.41
	Burning	2.55 $\pm$ 1.02
	Tightness	2.60 $\pm$ 1.26
	Dryness	3.27 $\pm$ 1.39
	Aching	2.45 $\pm$ 1.19
	Tickling	2.52 $\pm$ 1.24
	Soreness	2.83 $\pm$ 1.23
	Irritability	2.62 $\pm$ 1.31
	Lump in throat	2.73 $\pm$ 1.43

Table 3. Comparison of VTD Scores Across Number of Cigarettes per Day and Duration of Smoking (N = 343)

Variable	Group	Frequency Mean $\pm$ SD	Severity Mean $\pm$ SD	Total VTD Mean $\pm$ SD	p-value
Cigarettes/day	<10	18.45 $\pm$ 3.97	22.50 $\pm$ 4.80	40.95 $\pm$ 7.70	0.019*
	10–15	18.44 $\pm$ 4.28	21.74 $\pm$ 5.45	40.17 $\pm$ 8.80	
	16–20	16.56 $\pm$ 4.39	19.90 $\pm$ 5.94	36.46 $\pm$ 9.15	
	>20	16.86 $\pm$ 8.51	18.57 $\pm$ 10.00	35.43 $\pm$ 18.37	
p-value (ANOVA)		0.042*	0.032*	0.019*	
Duration of smoking	0.5–1 year	18.55 $\pm$ 3.20	22.45 $\pm$ 5.83	41.00 $\pm$ 8.19	0.852
	2–3 years	18.09 $\pm$ 4.27	21.55 $\pm$ 5.26	39.64 $\pm$ 8.54	
	4–5 years	18.26 $\pm$ 4.57	21.22 $\pm$ 5.69	39.48 $\pm$ 9.36	
	>5 years	17.70 $\pm$ 4.74	22.11 $\pm$ 5.60	39.81 $\pm$ 9.36	
p-value (ANOVA)		0.819	0.587	0.852	

\*Significant at  $p < 0.05$

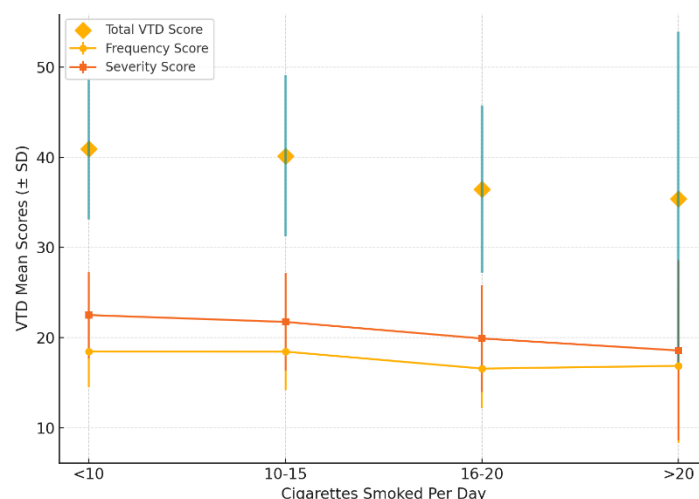


Figure 1 Vocal Tract Discomfort scores as per cigarettes smoked per day

The integrated visualization displays how frequency, severity, and total Vocal Tract Discomfort (VTD) scores vary according to the number of cigarettes smoked per day among young adult males. Both frequency and severity scores show a declining trend as cigarette consumption increases, with the highest scores observed in those who smoke fewer than 10 cigarettes daily (frequency mean  $18.45 \pm 3.97$ , severity mean  $22.50 \pm 4.80$ ), while the lowest values appear in the  $>20$  per day group (frequency mean  $16.86 \pm 8.51$ , severity mean  $18.57 \pm 10.00$ ). Total VTD scores, represented as distinct points with error bars, follow a similar decreasing trajectory: the group smoking fewer than 10 cigarettes per day reports the highest mean VTD ( $40.95 \pm 7.70$ ), with progressively lower scores in higher consumption groups, reaching  $35.43 \pm 18.37$  for those smoking more than 20 daily. This pattern indicates an unexpected inverse relationship, suggesting that lower daily cigarette intake is associated with greater perceived vocal tract discomfort, while heavier smokers report comparatively fewer symptoms. Error bars for all scores reflect wider variability in the highest consumption group, underscoring potential heterogeneity in symptom reporting or individual susceptibility at high exposure levels. The data collectively emphasize that, in this sample, daily smoking intensity may not predictably correspond to greater self-reported vocal tract discomfort, raising questions about adaptation, reporting bias, or underlying physiological mechanisms.

## DISCUSSION

This study aimed to explore the relationship between conventional cigarette smoking and vocal tract discomfort symptoms among young adult males, revealing nuanced findings that partially align with existing literature. Although prior research has demonstrated that cigarette smokers often report significantly greater vocal tract discomfort and altered phonatory function compared to non-smokers (13), the present study found no significant differences in total VTD scores or individual symptom scores based on the duration of smoking, suggesting that cumulative years of smoking may exert less influence on vocal discomfort among young adults than previously assumed. These results differ from findings by Bojana Vuković and colleagues, who reported progressive deterioration of voice quality with increasing smoking experience, implying a dose-dependent relationship over time (14).

Notably, the current results did demonstrate significant associations between the number of cigarettes smoked per day and both the frequency and severity of vocal tract discomfort symptoms. Individuals smoking fewer than ten cigarettes daily exhibited the highest mean total VTD scores, contrary to expectations that higher cigarette consumption would produce greater symptom burden. Similar trends were observed in specific symptoms such as aching, sore throat, and irritability within the frequency domain, and dryness in the severity domain, which reached statistical significance across smoking levels. This unexpected inverse relationship could reflect several possibilities, including heightened symptom awareness among lighter smokers, underreporting among heavier smokers due to habituation, or compensatory vocal behaviors that temporarily mask symptoms in individuals with higher tobacco consumption. Such observations echo earlier studies indicating that subjective symptoms of voice disturbance may emerge before objective acoustic changes become measurable in young adult smokers (15).

The predominance of dryness as the most severe symptom, consistent with prior reports linking tobacco exposure to dehydration of the vocal fold mucosa and increased laryngeal irritation, underscores the biological plausibility of smoking's impact on vocal health (16). However, the lack of significant associations with smoking duration might suggest that young adult smokers have not yet accumulated sufficient cumulative exposure for chronic structural changes to manifest as overt vocal dysfunction, as documented in older populations (13,17). Additionally, potential neurophysiological effects of smoking on brain networks governing vocal motor control, as suggested by imaging studies showing frontostriatal alterations in young smokers, could contribute to altered symptom perception rather than overt phonatory impairment (18). A meta-analysis by Byeon and Cha confirmed that smoking exerts moderate but significant effects on vocal parameters such as fundamental frequency, mean phonation time, and voice handicap index, emphasizing the importance of evaluating both subjective and objective measures when assessing vocal health in smokers (19). However, this study relied solely on subjective reporting through the VTD scale, which, while reliable and validated (12), might be insufficient to detect subtle physiological changes detectable through acoustic analysis or laryngoscopic examination. This limitation could explain why individual symptom differences were less pronounced across smoking durations, and why the highest symptom burden appeared among lighter smokers in daily consumption categories.

Further research should therefore integrate multidimensional assessments, combining subjective questionnaires with instrumental voice measures to clarify the clinical significance of these findings. Moreover, longitudinal designs are essential to determine whether subjective symptoms in lighter smokers signal early pathophysiological changes that may progress with continued smoking, or whether such reports reflect transient irritation without long-term consequences. The current study's limitations include its single-center setting, which restricts generalizability to other populations, and its focus solely on young adult males, precluding conclusions about females or older age groups. Nonetheless, the findings provide valuable insights suggesting that the quantity of daily cigarette consumption, rather than smoking history duration, may play a more immediate role in vocal discomfort among younger smokers. This information could inform clinical practice by emphasizing targeted screening and counseling for vocal health even among lighter smokers, who may represent an overlooked group experiencing significant subjective symptoms despite lower tobacco exposure.

## CONCLUSION

In conclusion, this study demonstrates a significant relationship between the number of cigarettes smoked per day and the frequency and severity of vocal tract discomfort symptoms in young adult males, with lighter smokers reporting higher subjective symptom scores than those consuming larger quantities daily. No significant associations were found between the duration of smoking and vocal tract discomfort scores, suggesting that daily smoking intensity may exert a more immediate influence on perceived vocal health than cumulative years of smoking in this population. These findings underscore the importance of recognizing vocal health concerns even among individuals with

lower levels of tobacco consumption and highlight the need for further research employing objective voice assessments and longitudinal designs to elucidate the mechanisms underlying these observations.

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