ORIGINAL RESEARCH

Impact of Smoking Status and Nicotine Dependence on Academic Performance of Health Sciences Students

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Background: Smoking behavior has been associated with poor academic performance among adult students worldwide. However, the detrimental effect of nicotine dependence on several students' academic achievement indicators is still unclear. This study aims to assess the impact of smoking status and nicotine dependence on grade point average (GPA), absenteeism rate and academic warnings among undergraduate health sciences students in Saudi Arabia.

Methods: A validated cross-sectional survey was conducted, in which, participants responded to questions evaluated cigarette consumption, urge to consume and dependency, learning performance, days of absentees, and academic warnings.

Results: A total of 501 students from different health specialties have completed the survey. Of whom, 66% were male, 95% ranging between the age of 18–30 years old, and 81% reported no health issues or chronic diseases. Current smokers estimated to be 30% of the respondents, of which 36% revealed smoking history of 2–3 years. The prevalence of nicotine dependency (high to extremely high) was 50%. Overall, smokers had significantly lower GPA, higher absenteeism rate, and higher number of academic warnings when compared to nonsmokers (p<0.001). Heavy smokers demonstrated significantly less GPA (p=0.036), higher days of absences (p=0.017), and more academic warnings (p=0.021) compared to light smokers. The linear regression model indicated a significant association between smoking history (increased pack-per-year) and poor GPA (p=0.01) and increased number of academic warning last semester (p=0.01), while increased cigarette consumption was substantially linked with higher academic warnings (p=0.002), lower GPA (p=0.01), and higher absenteeism rate for last semester (p=0.01).

Conclusion: Smoking status and nicotine dependence were predictive of worsening academic performance, including lower GPA, higher absenteeism rate and academic warnings. In addition, there is a substantial and unfavorable dose–response association between smoking history and cigarette consumption with impaired academic performance indicators.

Keywords: smoking, nicotine dependence, academic performance, health sciences, student

Introduction

Tobacco smoking is one of the greatest threats to public health and is defined as any habitual use of the tobacco plant leaf.[1] The use of tobacco is divided into combustible and non-combustible forms. Combustible tobacco products include cigarettes, cigars and water pipes, while electronic cigarettes and tobacco formulations developed for chewing or snuffing are classified as non-combustible tobacco products.[2] Cigarette smoking, the most common form of tobacco use

worldwide, is the leading cause of preventable death and illness, as it contains many harmful chemicals, one of which is nicotine.[3]

Despite the efforts that have been made to control nicotine-containing tobacco, the prevalence of cigarette smoking globally among adults and adolescents worldwide, and especially in Saudi Arabia, remains high. It has been shown that cigarette smoking is prevalent among adolescents in Arar (41%),[4] Jeddah (37%)[5] and Hail (20%), Saudi Arabia.[6] Cigarette smoking has also been reported to be prevalent among Saudi medical students at Qassim University (6%),[7] at King Fahad Medical City in Riyadh (18%),[8] as well as among Saudi dental students at King Abdulaziz University (25%).[9] More importantly, studies suggest that cigarette smoking can influence students' academic performance.[10–13]

Nicotine is the main addictive component in cigarettes. Nicotine dependence or addiction, commonly assessed using the Fagerstrom Tolerance Questionnaire,[14] can lead to both physiological and psychological effects. We have previously demonstrated that both extracts of cigarette smoke and e-cigarettes that contain nicotine can cause an imbalance between vasodilators and vasoconstrictors and induce inflammatory mediators in human pulmonary artery and airway cells,[15,16] respectively. This may eventually lead to several pulmonary diseases, including chronic obstructive pulmonary disease and pulmonary hypertension. These observations suggest that nicotine dependence can increase a person's risk of experiencing smoking-related morbidity and all-cause mortality.

Poor academic performance among college students can lead to a low cumulative grade point average (GPA), excessive absences or tardiness and an increased number of academic warning letters received. Previous studies have suggested an association between smoking behaviour and academic achievement among students. For instance, it has been demonstrated that cigarette smoking among both Saudi secondary school and medical students is associated with poor academic performance,[12,13] suggesting that students who smoke are likely to achieve less academically. In support of these findings, it has also been reported that smoking is also negatively associated with academic performance among Norwegian adolescents[11] and undergraduates at a public university in Islamabad, Pakistan.[10]

Although previous studies have suggested a high prevalence of cigarette smoking among medical students, the prevalence of cigarette smoking and nicotine dependence among other allied health sciences students (such as Anesthesia Technology, Biomedical Technology, Clinical Laboratory Sciences, Emergency Medical Services, Health Information Management, Respiratory Care, and Nursing professions) have not been assessed before in Saudi Arabia. In addition, the association between nicotine dependence as a result of cigarette smoking and academic performance indicators among health sciences students in the country is largely unknown. Therefore, this study aims to assess the impact of smoking status and nicotine dependence on GPA, absenteeism and academic warnings among undergraduate health sciences students in Saudi Arabia. We hypothesize that smoking has detrimental effects on health sciences students' academic performance.

Methods
Study Overview
This research was carried out at the Prince Sultan Military College of Health Sciences between March 2022 and July 2022. Institutional Review Board approval for the study was obtained from Prince Sultan Military College of Health Sciences (Ref. IRB-2022-RC-029). All respondents gave informed consent to participate in this research, and the study was in compliance with the Helsinki Declaration.

Design and Tools
A validated survey: Fagerström Test for Nicotine Dependence (FTND) was utilized to investigate the influence of smoking status and nicotine dependency on GPA, absenteeism, and academic warnings among Saudi undergraduate health sciences students.[14] We employed a non-probability convenience sampling strategy. To reach the target groups, the research team distributed the survey at the break time for each specialty. Those who were absent were also approached during the next classes' break time in order to reach additional students.

Inclusion and Exclusion Criteria

The inclusion criteria were being a student with a major in health science at the Prince Sultan Military College of Health Sciences. Health Sciences majors at the college were Anesthesia Technology, Biomedical Technology, Clinical Laboratory Sciences, Emergency Medical Services, Dental & Oral Health Care, Health Information Management, Respiratory Care, and Nursing professions). Students who majored in fields other than these or who refused to participate in the study were excluded.

Data Collection

We utilized Google forms to offer a self-administered questionnaire that took 10 minutes to complete. There are two elements to the survey: the socio-demographic sheet and the FTND questionnaire. Self-reported gender, age, specialty, current study year, smoking history, GPA, days of absentees, and academic warnings are included in the demographic section. The FTND is a standard tool for measuring the severity of physical nicotine addiction, providing an ordinal measure of nicotine dependency in relation to cigarette smoking.[14] It includes six measures that assess cigarette consumption, urge to consume, and dependency. The final score ranges from 0 to 10, depending on the total of the elements. More severe nicotine addiction is indicated by a higher overall FTND score. A current smoker was defined as someone who has smoked at least 100 cigarettes in their lifetime and is still smoking at the time of data collection. While a former smoker was defined as someone who had previously smoked at least 100 cigarettes but was no longer smoking at the time of data collection. In addition, a "light smoker" is a smoker who smokes between one and ten cigarettes per day; while 'heavy' smoker was defined as a smoker who reported smoking more than 30 cigarettes each day. Academic warning was defined as a GPA below 2 on a scale of 5 or failing in more than one course.

Power Calculation

The Prince Sultan Military College of Health Sciences is home to almost 1258 students majoring in different allied health sciences professions. Taking into consideration the total number of students and assuming a 50% response distribution, a 5% margin of error, and a 95% confidence interval, the minimum needed sample size was 295.

Statistical Analysis

The data was automatically captured by the hosting platform and then exported to an Excel file. The characteristics of respondents were analyzed using descriptive analysis (ie, absolute values and proportions). To compare groups (non-smokers versus smokers), we performed Chi square tests. We performed multivariate linear regression analysis to investigate which characteristics were associated to the dependent variables: smoking history and nicotine dependence. We included GPA, days absent and academic warnings as our independent variables as well as gender and socioeconomic status in these models. Those variables with no significant results in the univariate analysis were excluded from the model. Multicollinearity has been considered and verified with our regression models using the indicator of multi-collinearity: variance inflation factor (VIF). VIF <3, indicates low correlation among variables under ideal conditions and can be added to the regression model. SPSS version 28 was used to analyze the findings (IBM Corp. Armonk, New York, USA). A P value of <0.05 was used to determine statistical significance.

Results

Demographic Characteristics

A total of 501 students completely answered the survey. More than half of the participants were male (66%), and 473 (95%) of them were between the ages of 18 to 30. The students' area of specialization and academic level among all respondents was fairly distributed (Table 1). The majority of the students surveyed 430 (86%) were unemployed full-time students, about half of them had limited income 215 (43%).

The population mean for the Body Mass Index (BMI) was 25.14 where more than half of the participants 272 (54%) had healthy weight body mass index based on their self-reported height and weight. In addition, 407 (81%) of the

Table 1 Demographics Data and Characteristics of the Respondents (n=501)

Variable	N (%)
Gender	
Male	331 (66%)
Female	170 (34%)
What is your age range (year)	
18–30	473 (95%)
31–40	26 (5%)
Current study year:	
1st	87 (17%)
2nd	133 (27%)
3rd	118 (24%)
4th	103 (21%)
Internship	60 (12%)
Specialty	
Anesthesia Technology	58 (12%)
Biomedical Technology	62 (12%)
Clinical Laboratory Sciences	69 (14%)
Dental & Oral Health Care	22 (4%)
Emergency Medical Services	58 (12%)
Health Information Management	61 (12%)
Pre-clinical	80 (16%)
Respiratory Care	55 (11%)
Nursing	36 (7%)
Employment status	
No	430 (86%)
Yes	71 (14%)
Monthly income	
Less than 1000 SR	28 (6%)
1000 SR	187 (37%)
1000–2000 SR	170 (34%)
2000–3000 SR	61 (12%)
More than 3000 SR	55 (11%)

(*Continued*)

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Table 1 (Continued).

Variable	N (%)
BMI Category	
Population BMI	25.14 (14.08)
Underweight (below 18.5)	35 (7%)
Healthy weight (18.5 to 24.9)	272 (54%)
Overweight (25 to 29.9)	141 (28%)
Obese (30 to 39.9)	33 (7%)
Extremely obese (40 or higher)	20 (4%)
Health status	
Healthy	407 (81%)
Diabetes	25 (5%)
Asthma	20 (4%)
Depression	14 (3%)
Stomach disease	14 (3%)
Anaemia or other blood disease	9 (2%)
Cardiac disease	7 (1%)
High blood pressure	5 (1%)

participants reported no health issues or chronic diseases. Diabetes 25 (5%), asthma 20 (4%) were the highest prevalent comorbidities followed by depression 14 (3%) and Stomach disease 14 (3%).

Academic Performance, Smoking History and Nicotine Dependence Indicators

Half of the participants 248 (49.5%) reported a grade point average (GPA) ranging from 3.75 to 4.49 (Table 2). On the other hand, more than a third of participants 164 (33%) were reported absent during last semester for 1 to 2 days and about the third 131 (26%) with full attendance. Almost three-fifths of the participants 307 (61%) did not receive any academic warnings, while 123 (25%) received one academic warning.

More than half of the participants 275 (55%) never smoked, while 152 (30%) were currently smokers. As many as 32 (43%) of the former smokers smoked for more than five years, while 55 (36%) of the current smokers smoked for two to three years. 50% of current smokers had high to extremely high nicotine dependency on the Fagerstrom test Table 2).

Academic Performance Between Non-Smokers versus Smokers

Table 3 shows the academic performance for non-smokers and smokers, in which significant differences were observed regarding the GPA, absences days and the number of academic warnings. Smokers had lower GPA, more absent days and higher number of academic warnings.

Cigarettes Consumption Effect on Academic Performance

We also found a significant relationship between cigarettes consumption and academic performance where we noted that higher cigarettes smoked per a day impacted the GPA, absent days and number of academic warnings. None of the heavy smokers (smoked more than 30 cigarettes per a day) had GPA of 4.50–5.00. It was a significant difference when

Table 2 Academic Performance, Smoking History and Nicotine Dependence Indicators (n=501)

Indicator	Number (%) OR Mean ±SD
GPA	
Less than 2.00	2 (0.5%)
2.00–2.74	13 (3%)
2.75–3.74	61 (12%)
3.75–4.49	248 (49.5%)
4.50–5.00	177 (35%)
How many days were you absent from classes during last semester	
No absences	131 (26%)
1–2 days	164 (33%)
3–4 days	118 (24%)
5–6 days	45 (9%)
More than 6	43 (9%)
Academic warnings	
No warnings	307 (61%)
1 warning	123 (25%)
2 warnings	48 (10%)
3 warnings	23 (5%)
Smoking history	
Never smoke	275 (55%)
Former smoker	74 (15%)
Current smoker	152 (30%)
Pack per Year	7.5 ±8
Smoking duration for former smokers	
One year or less	10 (14%)
Two to Three years	16 (22%)
Four to five years	16 (22%)
More than five years	32 (43%)
Smoking duration for current smokers	
One year or less	10 (7%)
Two to Three years	55 (36%)
Four to five years	33 (22%)
Six to seven years	21 (14%)

(*Continued*)

Table 2 (Continued).

Indicator	Number (%) OR Mean ±SD
Eight to nine years	17 (11%)
More than 10 years	16 (11%)
Light Smokers (1–10 cigarettes per day)	41 (27%)
Heavy smokers (> 30 cigarettes per day)	46 (30%)
Fagerstrom scale for current smokers (Total Score)	
Very Low Dependence	28 (18%)
Low Dependence	32 (21%)
Medium Dependence	16 (11%)
High Dependence	45 (30%)
Very High Dependence	31 (20%)
Fagerstrom scale	5.14 ±2.6

Table 3 Non-Smokers versus Smokers Academic Performance (n=501)

Smoking Status and GPA						
GPA	Less than 2.00	2.00–2.74	2.75–3.74	3.75–4.49	4.50–5.00	P-value < 0.001
Non-smokers	1 (0.3%)	7 (2.0%)	32 (9.2%)	168 (48.1%)	141 (40.4%)	
Smokers	1 (0.7%)	6 (3.9%)	29 (19.1%)	80 (52.6%)	36 (23.7%)	
How many days were you absent from classes during last semester						
Absences days	No Absences	1–2 days	3–4 days	5–6 days	More than 6	P-value < 0.001
Non-smokers	109 (31.2%)	123 (35.2%)	65 (18.6%)	23 (6.6%)	29 (8.3%)	
Smokers	22 (14.5%)	41 (27.0%)	53 (34.9%)	22 (14.5%)	14 (9.2%)	
Have you received any academic warnings						
Number of academic warnings	No academic warnings	1	2	3	P-value < 0.001	
Non-smokers	237 (67.9%)	78 (22.3%)	24 (6.9%)	10 (2.9%)		
Smokers	70 (46.1%)	45 (29.6%)	24 (15.8%)	13 (8.6%)		

compared to light smokers (10 or less cigarettes per a day) that 24% of them had GPA of 4.50–5.00 (Figure 1). These percentages of higher academic achievement were significantly lower in smokers than non-smokers, in which 40% of non-smokers reported GPA of 4.50–5.00, P-value <0.001, Chisquare value = 19.25 (Table 3).

We found a significant increase of days of absences when we compare smoker students and non-smokers (P-value < 0.001, Chisquare value = 32.87). That led to study the amount of cigarettes consumption in relation to days of absences. Figure 2 shows the significant relation between days of absences and cigarettes smoked per a day (P-value: 0.017). Almost 50% of students who smoked 21 to 30 had 3–4 absences days last semester. Heavy smokers stand out by 40% (5–6 absences days) and 20% of them had more than 6 absent days. Compared to non-smokers, smokers received more academic
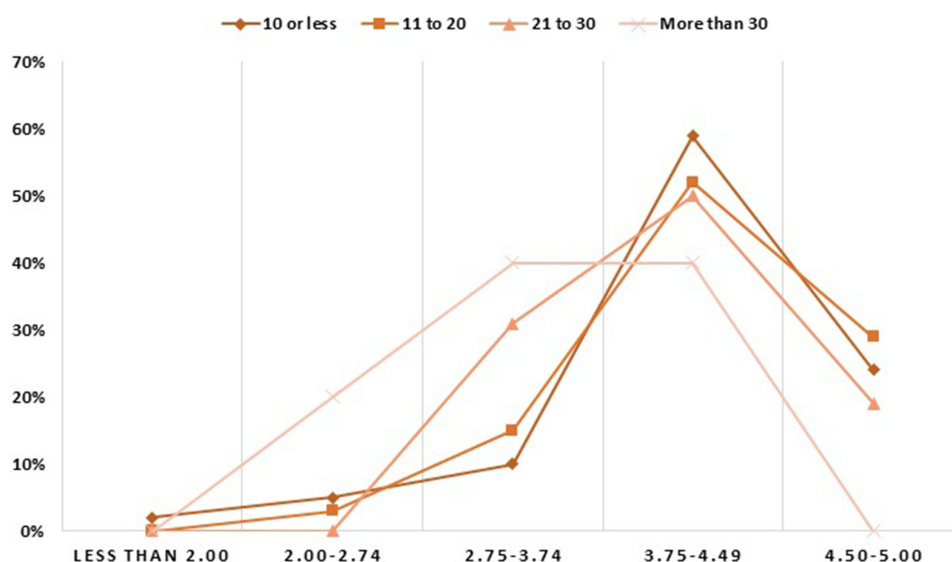
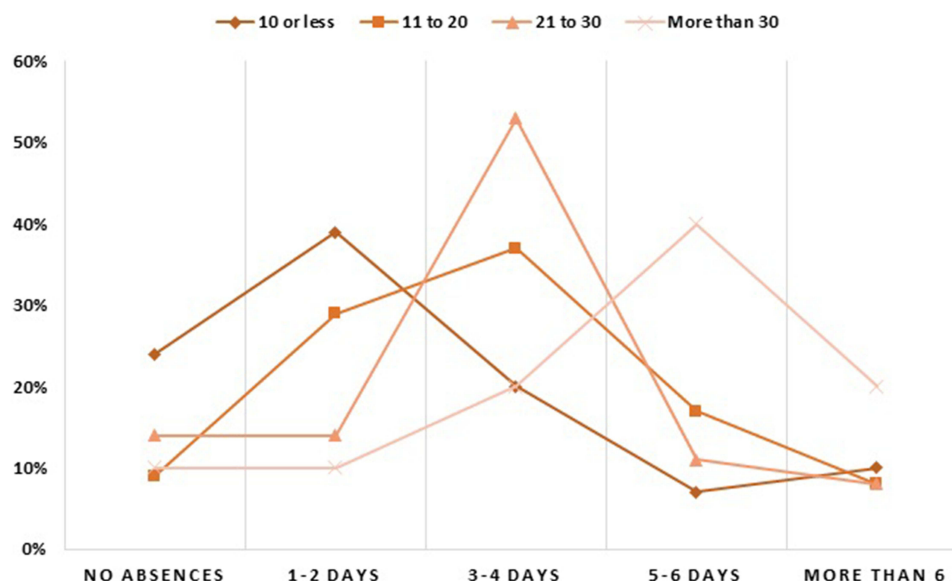**Figure 1** GPA by cigarettes smoked per day P-value: 0.036.

Figure 2 Days of absences by cigarettes smoked per day P-value: 0.017.

warnings, p value <0.001, Chisquare= 26.76. Heavy smokers were the highest to have academic warnings, in which 40% had two academic warnings and 30% had three academic warnings (Figure 3).

Association Between Smoking History, Cigarette Consumption and Academic Performance

We did liner regression to assess the association between smoking history and other factors including gender, socio-economic status, GPA, absent days and number of academic warnings. Gender and socioeconomic status were not statistically significant, p value >0.05. We found significant associations between GPA and academic warning, which higher pack per year was significantly associated with both poorer GPA and increased academic warning (see Table 4). Moreover, the total cigarette consumption was also associated with GPA, days absent last semester and academic warning (Table 4).
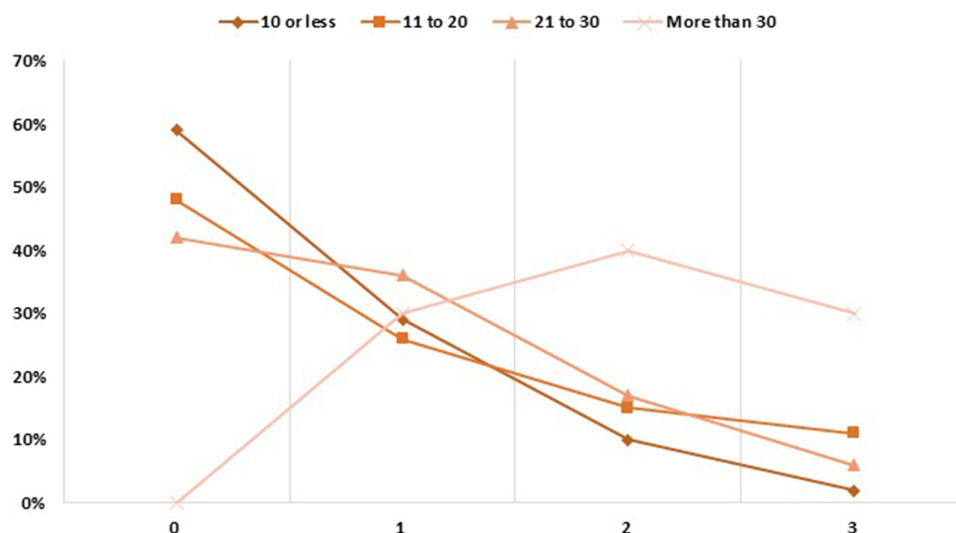
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Figure 3 Academic warnings by cigarettes smoked per day P-value: 0.021.

Discussion

This is the first study conducted in Saudi Arabia to look at the effects of smoking history and nicotine dependence on academic performance, absenteeism, and academic warning among health science students. The findings showed that smoking was prevalent at 30%, with 50% of current smokers classified as having high to extremely high nicotine dependency. In addition, we observed that smoking history had a detrimental impact on students' academic performance as measured by GPA, absence days, and the number of academic warnings. We also identified a substantial association between cigarette consumption and students' academic performance, noting that the quantity of cigarettes smoked each day negatively influenced GPA, absence days, and the number of academic warnings.

Smoking is a major risk for morbidity and mortality.[17] The prevalence of smoking is relatively high among Saudi adolescents. It affects the academic achievement of students, by decreasing attentiveness, cognitive, and memory functions.[18] In this study, we found that the prevalence of smoking is 30%. This finding is supported by previous studies demonstrating that smoking prevalence among Saudi secondary school students is 40.8% in Arar[4] and 37% in Jeddah, Saudi Arabia.[5] Inconsistent with our findings, lower prevalence rate (12.4%) has been reported among medical students at Jazan University, Saudi Arabia.[13] The discrepancies may be due to the differences in sample size (the sample size used in the other study is 354) and geographical

Table 4 Association of Smoking History and Cigarette Consumption with All the Academic Performance Parameters

Variables	Beta (95% CI)	p-value
Pack per year		
GPA	−1.96 (−3.5, −0.33)	0.01
Days absent last semester	0.47 (−0.70, 1.5)	0.45
Academic warnings received last semester	1.6 (0.29, 2.9)	0.01
Cigarette consumption		
GPA	−0.68 (−1.2, −0.15)	0.01
Days absent last semester	0.48 (0.11, 0.85)	0.01
Academic warning received last semester	0.68 (0.25, 1.11)	0.002

locations of the students studied,[13] considering the fact that the smoking prevalence is found to differ by the location of residence.[19] Another possible explanation is that, in the current study, we determined the smoking prevalence among health science students while in the other study only medical students were studied.[13]

We also found a significant relationship between cigarettes consumption and poor academic performance. This finding is in agreement with a study conducted in 1960s that found smokers among adolescents have lower grade compared with a nonsmoker.[20] Another study also showed a negative correlation between smoking and academic performance among school students.[21] In addition, our findings are supported by several studies showing that increased prevalence of smoking and nicotine dependence and that smoking is associated with lower academic achievement in African Americans,[22] and European students.[23] Interestingly, a cohort study confirmed that smoking in youth is associated with lower education attainment.[24] Our novel findings are further strengthened by a study conducted in Saudi medical students at Jazan University showing that inverse proportion between the prevalence of smoking and students GPA.[13] Moreover, all types of nicotine-containing products (including e-cigarettes) are found to be associated with poor academic achievement.[25] However, one study found that the low academic achievement depends on multi-factorial things and smoking may be one of these factors. The socioeconomic factor is also an important contributor.[26] Our study was in parallel to other studies that found an association between smoking and absenteeism among European adolescent school[27] and among workers,[28] but none of these conducted on health science students. According to the best of our knowledge, this is the first study conducted to measure the impact of smoking on undergrad health academic performance, class attendance, and academic warning.

Research and Practice Implications

Evidence of smoking's deleterious effects on college students majoring in health fields is provided in this research. There needs to be a long-term cohort research to determine whether or not smoking has a causal influence on students' academic success. As a result, it is crucial to evaluate the impact of smoking on long-term professional success and potential scientific accomplishments (such a graduate degree) in comparison to a nonsmoking group. Furthermore, further research is required to evaluate the association between smoking and drug abuse.

Practically, the findings of this study would help increase public health awareness of the detrimental effects of smoking on academic performance that may have far-reaching consequences on a person's future career and life trajectory. Psychoeducation is a powerful therapeutic technique, particularly for tobacco users. This technique would help students understand how smoking affects their health and academic performance, empowering them to change. This information may lead to a positive impact on the number of smokers who decide to give up their smoking habit. As a consequence, the burden of chronic obstructive pulmonary disease in Saudi Arabia would be reduced,[29] resulting in lower morbidity and death rates.

Limitations

Because it is a cross-sectional research, reverse causality biases are a potential issue. Multifactorial influences on students' academic performance mean that confounding might impact the findings. Therefore, our findings should be taken with caution.

Conclusion

We found that smoking status negatively affects students' grades, attendance, and academic warning. It is interesting to note that compared to non-smokers, students who smoke tend to do worse academically. We showed a strong and negative dose–response association between cigarette consumption and negative academic outcomes such as lower GPA, lower attendance rate, and worse grades.

Disclosure

The authors report no conflicts of interest in this work.

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