

RESEARCH ARTICLE

Editorial Process: Submission:08/12/2024 Acceptance:04/13/2025

A Cross-Sectional Study of the Knowledge, Attitudes and Behaviours Associated with Smoking among University Students in Yemen

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Abstract

Background: Tobacco smoking is a global concern, and tobacco use is increasing among youth in Arab countries, such as Yemen, particularly among university students. The aim of this study was initially to explore smoking behaviours, attitudes and smoking-related knowledge among students in Yemen in various colleges/ departments. **Methods:** A cross-sectional descriptive study was conducted in urban and rural areas from March-May 2019. The data were collected from the faculties of Hodeidah University, as well as from the departments of Community College. The questionnaire was adapted from the Global Health Professionals Survey and Global Youth Tobacco Survey. A total of 760 students were randomly selected. **Results:** In the present study, 53 (27.3%) smokers who scored very high were considered vulnerable to high smoking dependency based on the FTND. Linear regression analysis revealed that students' smoking-related knowledge was strongly statistically associated with age, residence, smoking status, and geographic area ($P<0.001$). Sex, marital status, and school-year level were also significant predictors of smoking-related knowledge ($P<0.05$). The analysis revealed that age, family income, marital status, and school-year level were strongly associated with students' attitudes and beliefs concerning smoking ($P<0.001$). However, the analysis revealed that age >24 years and second and fourth school years were strongly associated with smoking behaviour ($P<0.001$). Students who obtained high attitude scores had low scores for smoking dependence ($P<0.05$). The attitudes and beliefs of smokers toward smoking were more significantly favourable than those of nonsmokers, and nonsmokers had significantly greater smoking-related knowledge than smokers did ($P<0.001$). The difference in knowledge levels about the negative effects of smoking and toxic tobacco substances from cigarettes among students from different departments and colleges was highly significant ($P<0.001$). **Conclusions:** This study found a high level of smoking dependency among smokers, as indicated by FTND scores. Fourth-year students exhibited stronger smoking attitudes, greater knowledge, and lower dependency. Smokers had more positive attitudes toward smoking, while nonsmokers showed better awareness of its harmful effects. Significant differences in smoking-related knowledge were noted across different departments and colleges, emphasizing the need for targeted anti-smoking programs and enhanced education on the consequences of smoking.

Keywords: Smoking- related Knowledge- attitudes- behaviours- students- Yemen

Asian Pac J Cancer Prev, 26 (4), 1233-1241

Introduction

Tobacco smoking is a global concern, and tobacco use is increasing among youth in Arab countries, such as Yemen, particularly among university students. Yemen has become more open over time. However, substantial increases in the number of young Arabs and teenagers of both genders who smoke have recently been observed, particularly among university students.

Tobacco smoking is one of the most worrisome problems facing global health; it kills nearly 6 million people every year and is associated with high health-care

costs and low productivity [1]. Approximately 80% of smokers in middle- and low-income countries die due to tobacco-related illness [2]. In developing countries, tobacco consumption is expected to increase at a rate of 3.4% annually [3]. A recent survey on the prognosis of tobacco use revealed a worsening of tobacco epidemics in the eastern Mediterranean and African countries where health systems are fragile [4].

The negative effects of smoking cigarettes can be classified as slow, gradual, or accumulative effects. The hazards of smoking are well known; however, the number of smokers among adult students is still high. Many

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factors can influence people's smoking habits, such as socioeconomic status; having parents, siblings and friends who smoke; and the social environment around the person [5]. The long-term consequences of tobacco smoking can be easier to ignore because young people feel that they are impervious to these dangers [6]. As such, some surveys have been conducted on the prevalence of smoking, most of which have shown that smoking is common in Yemen, especially among university students [7, 8].

However, medical organizations such as the American Society of Clinical Oncology (ASCO) [9] and the World Health Organization (WHO) [10] warn young people not to smoke any type of substances, as these substances are dangerous to them as well as to society. Therefore, identifying knowledge and beliefs related to smoking dependency would be useful for the Yemeni student population, as no studies have been conducted in this country to measure various knowledge, beliefs and other factors among university students in this country.

Materials and Methods

After obtaining approval from the university board of the rural and urban areas of Hodeidah and Hajja provinces (Hodeidah University and Community College), this cross-sectional descriptive study was carried out among university students during the summer semester of the 2019/3 academic year. A self-administered, anonymous questionnaire about smoking behaviour, habits, attitudes and smoking-related knowledge was completed by students in three different faculties at Hodeidah University (Commerce and Economics, Engineering and Medicine and Health Sciences) and from Community College at Hajja. These data were collected from three departments (the Nursing, Laboratory, and Assistant Doctor Departments), Yemen, from March 1st to May 30th, 2019. This study was approved by the study ethics committee of the Community College and Hodeidah University - Yemen. We defined smoking according to the WHO criteria for smoking status, which were adopted from the criteria set by Maziak et al. for waterpipe smoking [11, 12].

Study Sample

The cohort studies consisted of 805 full-time students enrolled in rural and urban areas; 805 students were selected using stratified randomization and were invited to participate in the study. Of the 805 students approached, 790 agreed to participate and complete the questionnaire; 30 questionnaires were discarded because they were incorrectly completed. A total of 760 students were enrolled in the survey (overall response average of 94.41%).

Sample size calculation: The sample size was estimated using the following formula for the cross-sectional survey: $N = Z^2 \cdot \alpha / 2p(1-p) / d^2$, where " α " is usually set as 0.05, the corresponding " $Z_{1-\alpha/2}$ " is 1.96, and " p " is the expected incidence of a certain disease. In this study, " p " refers to the smoking rate. According to previous research in India, the percentage of smokers was 9% among undergraduates and 7.1% among postgraduate medical students [13, 14]. The prevalence of smokers in Palestine was 27% among

youth [15]. Because the larger " $p(1-p)$ " is, the larger the sample size is, the greater the final " p " value is 27%. The variable " d^2 " is the allowable deviation error, and the value of " d " in this study is 0.05. The calculated result is $N=303$. According to the loss to follow-up rate of 10%, the expected sample size was 334. In the actual survey, 760 students were eventually surveyed, which was sufficient to meet the sample size requirements.

Questionnaire used in the Study

The questionnaire was in the Arabic language and was derived from models used for the assessment of tobacco use; it included the Global Health Professionals Survey and the Global Youth Tobacco Survey [16, 17]. The average time needed to answer the questionnaire was quarterly.

The first 9 items (sociodemographic profile) and smoking status (both cigarette and waterpipe) were collected. Smoking cessation: Patients may quit smoking, and they are willing to quit smoking). Additionally, smokers answered 8 questions about attitudes and beliefs concerning smoking among students and 6 questions about smoking behaviour and smoking habits (their first smoking attempt, amount, type and duration of smoking, smoking expenses, previous attempts to quit smoking and the longest abstinence time from smoking). Overall student knowledge of and attitudes toward the effect of smoking on health were measured by 12 questions about the adverse effects of cigarette smoking (lung cancer, emphysema, aging, throat cancer, stroke, ischemic heart disease, mouth cancer, tuberculosis, gastric ulcer, diabetes mellitus, arthritis, and cataract). Overall student knowledge of the effect of smoking on health was measured by 6 questions about the toxic chemicals from cigarettes that could harm smokers (nicotine, tar, carbon dioxide, carbon monoxide, hydrogen cyanide, and nitrogen oxide).

Statistical analysis

The IBM-SPSS statistics computer package version 24 was used for all analyses. Logistic regression and linear logistic regression were used for the data analysis, and chi-square tests (χ^2 test) were performed to determine the significance and association between smoking and related factors such as sex, age, marital status, study level, residence, income, department/college and area. One-way ANOVA and pairwise t tests were used to analyse smoking-related knowledge between departments/colleges. All the results were considered to be statistically significant at the 5% level.

The Fagerstrom test for nicotine dependence (FTND) has been used to measure the level of smoking behaviour dependence among college students according to the classification of dependence and smoking behaviour dependence types. The FTND consists of 6 items, and the score for each item may differ from question to question. The multiple-choice items are scored from 1 to 4. The items are summed to yield a total score of 6-22. The FTND score ranges from 6 to 22. The cut-off score for the FTND was calculated as follows: low for ($6 \leq \text{score} \leq 10$), moderate for ($11 \leq \text{score} \leq 14$), high for ($15 \leq \text{score} \leq 18$) and very high for ($19 \leq \text{score} \leq 22$).

Smokers who score 6 to 14, considered low to moderate smoking dependency, have to consider quitting smoking because they are vulnerable to high smoking dependency. Smokers who score 15 to 18 and 19 to 20 points are considered vulnerable to high smoking dependency and need treatment immediately (Fagerstrom) [18]. Tobacco smoking dependency in participants in the present study was considered to occur in those who scored 19 to 22 and above on the FTND.

Results

The study included a total of 760 students, 471 (62.0%) males and 289 (38.0%) females (66.8% of whom were between 18 and 24 years old). In the present study, 53 (27.3%) smokers who scored very high were considered vulnerable to high smoking dependency based on the FTND.

Smoking-related knowledge among college/departments in urban and rural areas

The difference in students' knowledge levels about some adverse effects and toxic chemicals from cigarettes among students from different departments and colleges was highly significant ($P<0.001$) (Table 1).

Pairwise comparison results between different departments and colleges on students' level of knowledge about the harmful effects and toxic chemicals of smoking.

First, the knowledge levels of students from different departments and colleges about the negative effects of cigarette smoking were assessed. The difference in knowledge level between students from the College of Commerce and those from the Department of Nursing and Assistants was highly significant ($P<0.001$). Students from the College of Commerce had significantly greater knowledge about the adverse effects of cigarettes than did the students from the Department of Nursing and Assistants. Students from the College of Engineering exhibited a significantly greater knowledge level than did the students from the College of Medicine and the Department of Laboratory ($P<0.05$).

Students from the College of Engineering had significantly greater knowledge levels than did the students from the Department of Nursing and Assistants ($P<0.001$). Students from the College of Medicine had significantly greater knowledge levels than did those from the Nursing and Assistant Department ($P<0.001$). Students from the Department of Laboratory had significantly greater knowledge levels than did those from the College of Nursing ($P<0.001$). Students from the Laboratory Department had significantly greater knowledge levels than did those from the Assistant Department ($P<0.001$).

Second, the students' knowledge level about the toxic chemical substances in cigarettes was assessed. The difference in knowledge level between students from the College of Commerce and those from the Nursing and Assistants Department was significant ($P<0.001$). Students from the College of Commerce had higher knowledge levels than did those from the Nursing and Assistant Department. Students from the College of Engineering had significantly greater knowledge levels

than did those from the College of Commerce ($P<0.05$).

Students from the College of Engineering had higher knowledge levels than did those from the Nursing and Assistant Department ($P<0.001$), as did those from the College of Medicine and Department of Laboratory ($P<0.05$).

Students from the College of Medicine exhibited a significantly greater knowledge level than did those from the Nursing and Assistant Department ($P<0.001$ and $P<0.05$, respectively). Students from the Department of Laboratory had a significantly greater knowledge level than did those from the Nursing and Assistant Department ($P<0.001$ and $P<0.001$, respectively).

Third, the overall level of smoking-related knowledge among students from different colleges and departments was assessed. Students from the College of Commerce had significantly greater knowledge levels than did those from the Nursing and Assistants Department ($P<0.001$), but they had significantly lower knowledge levels than did those from the College of Engineering ($P<0.05$).

Students from the College of Engineering exhibited significantly greater knowledge levels than did those from the College of Medicine and Nursing and Assistant Department ($P<0.001$) and those from the Department of Laboratory ($P<0.05$). Students from the College of Medicine had significantly greater knowledge levels than did those from the Nursing and Assistant Department ($P<0.001$). Students from the Department of Laboratory Science had significantly greater knowledge levels than did those from the Nursing and Assistant Department ($P<0.001$) (Table 1).

Smoking-related knowledge and its influence on smokers

Linear regression analysis revealed that students' smoking-related knowledge was strongly statistically associated with age, residence, smoking status, and geographic area ($P<0.001$). Sex, marital status, and school-year level were also significant predictors of smoking-related knowledge ($P<0.05$). Family income and department or college affiliation were not significantly associated with smoking-related knowledge ($P>0.05$) (Table 2).

Attitudes and beliefs concerning smoking and their influence on smokers

The influence of factors on the students' attitudes and beliefs concerning smoking was determined (Table 3). Age and school-year level were strongly significantly associated with students' attitudes and beliefs concerning smoking ($P<0.001$). Marital status, family income, and geographic area were also significant predictors of attitudes and beliefs concerning smoking ($P<0.05$).

Linear regression analysis revealed that age, family income, marital status, and school year were strongly associated with students' attitudes and beliefs concerning smoking ($P<0.001$). However, sex, residence, department and college affiliation, and area had no significant associations with attitudes or beliefs concerning smoking ($P>0.05$) (Table 4).

Associations between Knowledge, Attitudes, and

Table 1. Knowledge among University Students about Some of the Adverse Effects Caused by Cigarette Smoking and Toxic Chemicals from Cigarettes that Could Harm Smokers (n=760)

| One-way ANOVA results | | | | | | Pairwise comparison t test (results between colleges) | | | | |
|---|----------------------------------|------------|-----------------------|------------|---------|---|--------------------|-----------------|----------------|--------|
| Colleges/ departments | Frequency/Percent N0 (%) | Mean | Standard deviation | F value | P value | Comparison Among colleges | Mean difference | 95% CI | P value | |
| Urban and Rural areas | Knowledge about some ill effects | | | | | 1 - 2 | -1.564 | (-3.160 0.031) | 0.055 | |
| | Commerce | 140 (18.4) | 13.886 | 6.812 | 12.805 | <0.001 | 1 - 3 | 0.552 | (-1.043 2.148) | 0.497 |
| | | | | | | | 1 - 4 | 3.361 | (1.886 4.837) | <0.001 |
| | | | | | | | 1 - 5 | 0.479 | (-1.106 2.064) | 0.553 |
| | | | | | | | 1 - 6 | 4.015 | (2.299 5.730) | <0.001 |
| | | | | | | | 2 - 3 | 2.117 | (0.461 3.772) | 0.012 |
| | | | | | | | 2 - 4 | 4.926 | (3.385 6.466) | <0.001 |
| | | | | | | | 2 - 5 | 2.044 | (0.398 3.689) | 0.015 |
| | | | | | | | 2 - 6 | 5.579 | (3.807 7.351) | <0.001 |
| | | | | | | | 3 - 4 | 2.809 | (1.268 4.350) | <0.001 |
| | | | | | | | 3 - 5 | -0.073 | (-1.719 1.572) | 0.93 |
| | Medicine | 120 (15.8) | 13.333 | 6.618 | 3 - 6 | 3.462 | (1.691 5.234) | <0.001 | | |
| | Nursing | 164 (21.6) | 10.524 | 6.403 | 4 - 5 | -2.882 | (-4.412 -1.352) | <0.001 | | |
| | Laboratory | 123 (16.2) | 13.407 | 6.68 | 4 - 6 | 0.653 | (-1.011 2.318) | 0.441 | | |
| | Assistants | 93 (12.2) | 9.871 | 6.263 | 5 - 6 | 3.536 | (1.773 5.298) | <0.001 | | |
| Students' knowledge about some toxic chemicals from cigarette | | | | | 1 - 2 | -1.236 | (-2.256 -0.216) | 0.018 | | |
| Urban and Rural areas | Commerce | 140 (18.4) | 7.164 | 4.21 | 13.733 | <0.001 | 1 - 3 | 0.364 | (-0.656 1.384) | 0.483 |
| | | | | | | | 1 - 4 | 2.256 | (1.312 3.199) | <0.001 |
| | | | | | | | 1 - 5 | -0.055 | (-1.069 0.958) | 0.915 |
| | | | | | | | 1 - 6 | 2.186 | (1.089 3.283) | <0.001 |
| | | | | | | | 2 - 3 | 1.6 | (0.542 2.659) | 0.003 |
| | | | | | | | 2 - 4 | 3.491 | (2.507 4.476) | <0.001 |
| | | | | | | | 2 - 5 | 1.18 | (0.129 2.233) | 0.028 |
| | | | | | | | 2 - 6 | 3.422 | (2.289 4.554) | <0.001 |
| | | | | | | | 3 - 4 | 1.891 | (0.907 2.876) | <0.001 |
| | | | | | | | 3 - 5 | -0.42 | (-1.472 0.633) | 0.434 |
| | Medicine | 120 (15.8) | 6.8 | 4.22 | 3 - 6 | 1.822 | (0.689 2.954) | 0.002 | | |
| | Nursing | 164 (21.6) | 4.909 | 4.556 | 4 - 5 | -2.311 | (-3.289 -1.333) | <0.001 | | |
| | Laboratory | 123 (16.2) | 7.22 | 3.714 | 4 - 6 | -0.07 | (-1.134 0.994) | 0.897 | | |
| | Assistants | 93 (12.2) | 4.979 | 4.423 | 5 - 6 | 2.241 | (1.114 3.368) | <0.001 | | |
| | Total-related knowledge | | | | | 1 - 2 | -2.8 | (-4.998 -0.603) | 0.013 | |
| Urban and rural areas | Commerce | 140 (18.4) | 21.05 | 9.456 | 18.543 | <0.001 | 1 - 3 | 0.917 | (-1.281 3.114) | 0.413 |
| | | | | | | | 1 - 4 | 5.617 | (3.585 7.650) | <0.001 |
| | | | | | | | 1 - 5 | 0.424 | (-1.759 2.607) | 0.703 |
| | | | | | | | 1 - 6 | 6.201 | (3.838 8.564) | <0.001 |
| | | | | | | | 2 - 3 | 3.717 | (1.436 5.997) | 0.001 |
| | | | | | | | 2 - 4 | 8.417 | (6.295 10.539) | <0.001 |
| | | | | | | | 2 - 5 | 3.224 | (0.957 5.491) | 0.005 |
| | | | | | | | 2 - 6 | 9.001 | (6.560 11.441) | 0 |
| | | | | | | | 3 - 4 | 4.7 | (2.578 6.822) | 0 |
| | | | | | | | 3 - 5 | -0.493 | (-2.759 1.774) | 0.67 |
| | Medicine | 120 (15.8) | 20.133 | 10.093 | 3 - 6 | 5.284 | (2.844 7.724) | <0.001 | | |
| | Nursing | 164 (21.6) | 15.433 | 7.792 | 4 - 5 | -5.193 | (-7.300 -3.086) | <0.001 | | |
| | Laboratory | 123 (16.2) | 20.626 | 8.41 | 4 - 6 | 0.583 | (-1.710 2.877) | 0.618 | | |
| | Assistants | 93 (12.2) | 14.85 | 9.445 | 5 - 6 | 5.777 | (3.349 8.204) | <0.001 | | |

1, Commerce College; 2, Engineering College; 3, Medicine College; 4, Nursing Department; 5, Laboratory Department; 6, Assistant Department

Table 2. Linear Regression Analysis of Smoking-Related Knowledge (n=760)

| Factors/Variable | β | SE | Wald- χ^2 | P value |
|--------------------|---------|-------|----------------|----------|
| Sex | -1.636 | 0.712 | -2.297 | 0.022* |
| Age | 2.556 | 0.594 | 4.304 | <0.001** |
| Marital status | -1.883 | 0.829 | -2.272 | 0.023* |
| Study level | 1.151 | 0.424 | 2.716 | 0.007 |
| Residence | -2.56 | 0.756 | -3.386 | <0.001** |
| Family income | -0.006 | 0.464 | -0.012 | 0.99 |
| Department/College | 0.226 | 0.405 | 0.558 | 0.577 |
| Smoking | 4.906 | 0.803 | 6.108 | <0.001** |
| Area | 5.107 | 1.458 | 3.502 | <0.001** |

estimated coefficient; SE, standard error; **P value is highly statistically significant; *P value is statistically significant

Behaviors Concerning Smoking (n=194)

Smoking attitude scores were the dependent variable, whereas smoking knowledge scores were the independent

variable (Table 5). Linear regression analysis revealed that participants in the 18–24 and >24 years age categories and fourth-year students had more favourable attitudes

Table 3. Influence Factors on Attitudes and Beliefs Concerning Smoking (n=760)

| Factors | Scores (Mean \pm SD) | one-way analysis of variance (ANOVA) | P value |
|------------------------------|------------------------|--------------------------------------|----------|
| Sex | | | |
| Male | 7.86 \pm 1.428 | -1.003 | 0.316 |
| Female | 7.96 \pm 1.477 | -1.003 | 0.316 |
| Age | | | |
| <18years | 7.75 \pm 1.205 | 30.429 | <0.001** |
| 18-24years | 7.69 \pm 1.318 | 30.429 | <0.001** |
| Over 24years | 8.70 \pm 1.733 | 30.429 | <0.001** |
| Marital status | | | |
| Married | 7.83 \pm 1.406 | 8.749 | 0.003* |
| Single | 8.20 \pm 1.563 | 8.749 | 0.003* |
| Department/College | | | |
| Nursing | 8.05 \pm 1.061 | 1.771 | 0.116 |
| Laboratory | 8.06 \pm 1.002 | 1.771 | 0.116 |
| Assistant Doctor | 7.89 \pm 0.866 | 1.771 | 0.116 |
| Commerce and Economic | 7.93 \pm 1.883 | 1.771 | 0.116 |
| Engineering college | 7.60 \pm 1.741 | 1.771 | 0.116 |
| Medicine and Health Sciences | 7.81 \pm 1.697 | 1.771 | 0.116 |
| Study level | | | |
| First-year | 7.94 \pm 1.386 | 10.743 | <0.001** |
| Second-year | 7.55 \pm 1.513 | 10.743 | <0.001** |
| Third-year | 8.14 \pm 1.411 | 10.743 | <0.001** |
| Fourth year | 9.13 \pm 1.296 | 10.743 | <0.001** |
| Residence | | | |
| With family | 7.88 \pm 1.391 | 0.232 | 0.630 |
| Dormitory | 7.93 \pm 1.559 | 0.232 | 0.630 |
| Family income (per month) | | | |
| Low | 8.00 \pm 1.544 | 3.022 | 0.049* |
| Average | 7.81 \pm 1.396 | 3.022 | 0.049* |
| High | 7.65 \pm 1.061 | 3.022 | 0.049* |
| Area | | | |
| Urban area | 7.78 \pm 1.781 | 50117 | 0.024* |
| Rural area | 8.01 \pm 0.997 | 50117 | 0.024* |

**P value is highly statistically significant; *P value is statistically significant

Table 4. Linear Regression Analysis of the Factors Influencing Attitudes and Beliefs Concerning Smoking (n=760)

| Factors/Variable | β | SE | t | P value |
|--------------------|---------|-------|--------|----------|
| Sex | 0.146 | 0.112 | 1.304 | 0.193 |
| Age | 0.548 | 0.093 | 5.871 | <0.001** |
| Marital status | 0.269 | 0.13 | 2.077 | 0.038* |
| Study level | 0.152 | 0.066 | 2.319 | 0.021* |
| Residence | 0.039 | 0.119 | 0.33 | 0.742 |
| Family income | -0.259 | 0.072 | -3.575 | <0.001** |
| Department/College | 0.017 | 0.064 | 0.265 | 0.791 |
| Area | -0.363 | 0.207 | -1.758 | 0.079 |

β , estimated coefficient; SE, standard error; **P value is highly statistically significant; *P value is statistically significant

Table 5. Linear Regression Analysis of the Associations between Smoking Attitudes and Smoking-Related Knowledge (n=194)

| Factors/Variable | β | SE | T | P value |
|------------------|---------|-------|--------|----------|
| Age | | | | |
| 18-24years | 0.138 | 0.063 | 2.18 | 0.031* |
| >24years | 0.137 | 0.061 | 2.246 | 0.026* |
| Marital status | | | | |
| Single | -0.039 | 0.041 | -0.971 | 0.333 |
| Study level | | | | |
| Second-year | -0.081 | 0.048 | -1.684 | 0.094 |
| Third-year | -0.022 | 0.061 | -0.367 | 0.714 |
| Fourth-year | -0.207 | 0.06 | -3.442 | 0.001** |
| Residence | | | | |
| Dormitory | 0.019 | 0.048 | 0.395 | 0.693 |
| Family income | | | | |
| Average | 0.004 | 0.04 | 0.089 | 0.929 |
| High | -0.031 | 0.073 | -0.423 | 0.673 |
| Area | | | | |
| Rural | -0.05 | 0.045 | -1.116 | 0.266 |
| Knowledge score | 0.426 | 0.094 | 4.528 | <0.001** |

β , estimated coefficient; SE, standard error; **P value is highly statistically significant; *P value is statistically significant.

toward smoking ($P < 0.05$). Fourth-year students indicated more favourable attitudes toward smoking than first-year students did. Students who obtained high knowledge scores presented favourable attitudes toward smoking ($P < 0.05$).

The attitudes and beliefs about smoking were compared between smokers and nonsmokers (Table 6). The attitudes and beliefs of smokers toward smoking were more significantly favourable than those of nonsmokers

($P < 0.001$).

Smoking-related knowledge concerning smoking was compared between smokers and nonsmokers (Table 6). Compared with smokers, nonsmokers had significantly greater smoking-related knowledge ($P < 0.001$).

Smoking behaviour scores were the dependent variables, whereas smoking-related knowledge and attitude scores were the independent variables (Table 7). Linear regression analysis revealed that age >24 years and

Table 6. Attitudes and Beliefs Concerning Smoking and Smoking-Related Knowledge between Smokers and Nonsmokers (n=760)

| | Smoking | Scores (Mean \pm SD) | T test | P value |
|---|------------|------------------------|---------|----------|
| Attitudes and beliefs concerning smoking between smokers and nonsmokers | Smokers | 9.70 \pm 1.477 | -29.332 | <0.001** |
| Attitudes and beliefs concerning smoking between smokers and nonsmokers | Nonsmokers | 7.28 \pm 0.757 | -29.332 | <0.001** |
| Smoking-related knowledge between smokers and nonsmokers | Smokers | 6.49 \pm 3.982 | 5.157 | <0.001** |
| Smoking-related knowledge between smokers and nonsmokers | Nonsmokers | 8.27 \pm 4.174 | 5.157 | <0.001** |

*P value is highly statistically significant

Table 7. Linear Regressions Used for Associations between Smoking-Related Knowledge and Attitudes and Behavior (n=194)

| Factors/Variable | β | SE | T | P value |
|------------------|---------|-------|--------|----------|
| Age | | | | |
| 18-24years | 0.069 | 0.039 | 1.784 | 0.076 |
| >24years | 0.145 | 0.037 | 3.876 | <0.001** |
| Marital status | | | | |
| Single | -0.017 | 0.025 | -0.69 | 0.491 |
| Study level | | | | |
| Second-year | -0.077 | 0.029 | -2.616 | 0.010* |
| Third-year | 0.022 | 0.037 | 0.598 | 0.551 |
| Fourth-year | -0.119 | 0.038 | -3.162 | 0.002* |
| Residence | | | | |
| Dormitory | 0.04 | 0.029 | 1.371 | 0.172 |
| Family income | | | | |
| Average | -0.026 | 0.024 | -1.063 | 0.289 |
| High | -0.043 | 0.044 | -0.958 | 0.339 |
| Area | | | | |
| Urban | -0.04 | 0.027 | -1.466 | 0.144 |
| Knowledge score | -0.046 | 0.06 | -0.764 | 0.446 |
| Attitude score | -0.107 | 0.045 | -2.369 | 0.019* |

β , estimated coefficient; SE, standard error; **P value is highly statistically significant; *P value is statistically significant

second and fourth school years were strongly associated with smoking behaviour ($P < 0.001$). Students who obtained high attitude scores had low scores for smoking dependence ($P < 0.05$). The knowledge score was not significantly associated with smoking behaviour ($P > 0.05$).

Discussion

This study was conducted to determine the prevalence of smoking and differences in knowledge and beliefs among students in rural and urban areas of Yemen. The response rate to the present study was 94.4%, indicating that the students were willing to participate in this study. Among the participants, 62.0% were males and 38.0% were females. The FTND test results revealed a high smoking dependency among smokers, and students (27.3%) were considered vulnerable. Our findings are high compared with those of a previous study in the United Arab Emirates (UAE) (16.3%) based on the FTND [19].

A highly obvious disparity was found among students from the different colleges with regard to the level of knowledge about the harmful effects of smoking ($P < 0.001$) and the presence of toxic substances in tobacco ($P < 0.001$). In general, there was significant variation in the level of smoking-related knowledge among students from different departments and colleges ($P < 0.001$). The results of the assessment of the level of smoking-related knowledge were in accordance with those of a previous study conducted among Yemeni students in 2019 [8].

A lack of knowledge of the associated harmful health effects of smoking was observed among students, especially among students who smoke waterpipes from urban and rural areas. This result suggested that the prevalence of smoking must be addressed and that

minimized and proactive health education should be effectively implemented through various means, such as through mass media, community campaigns, and even in the students' own homes, to support and encourage the community to participate in reducing the high prevalence of smoking [20].

Our results revealed that smoking attitudes were more common among smokers than among nonsmokers, while smoking-related knowledge was more common among nonsmokers than among smokers ($P < 0.001$). These results may provide a basis for tobacco control strategies among university students in urban and rural areas. The inadequate or poor knowledge of the students about the health hazards of smoking may be a result of their irrational beliefs, lack of smoking cessation programs (information on tobacco control policies must be more widely disseminated), and favourable cultural behavior and beliefs toward smoking. Furthermore, Yemeni students face great psychological, economic, and social pressure because Yemen is economically undeveloped and has been devastated by civil war since 2011. Yemen was originally closed. Generally, smoking is one of the most persistent habits that may increase smoking prevalence among students.

Finally, the knowledge of smoking must be improved, and irrational beliefs must be modified, as the students analysed in the present study possess inadequate knowledge about the consequences of smoking. Regulatory frameworks for tobacco smoking should be developed and enforced, including tobacco use-specific health warning labels that describe the harmful effects of waterpipe smoking.

The reasons for smoking identified in this study may provide a strong basis and suggestions for the application

of antismoking programs, which could increase the effectiveness of these programs and influence the attitudes and behaviors of smokers. This study has implications for policymakers. The Ministry of Education and Higher Education should apply for anti-smoking programmes at all universities. Programs to educate the community about the health consequences of smoking need to be established, and they should involve teenagers and youths. Educators should be supplied with dependent and suitable information. In addition, anti-smoking messages through the media can assist in controlling smoking and encourage the whole population in Yemen to participate.

According to the results of this study, smoking-related knowledge was better among nonsmokers than smokers. However, attitudes concerning smoking among smokers were better than those among nonsmokers. These results may provide a basis for tobacco control strategies among university students in urban and rural areas. In addition, the results can contribute greatly to the country's tobacco control strategy and improve smoking behaviour, attitudes and smoking-related knowledge among students towards smoking control.

Limitations

This study has a number of limitations. First, the reported findings might be affected by reporting bias, and the data may also reflect respondents' subjective perceptions. Second, since the data used in the study were based on a large number of college students, the applicability of the results to other areas may be limited. The study was limited to only two provinces due to civil war in the country. Third, the effects of cigarette and waterpipe smoking in urban and rural areas were not examined in this study. Hence, further studies are needed to determine the effects of all kinds of smoking in the rural areas of Yemen. There are several difficulties in clarifying the logical relationship in the comparison between knowledge, practice, and attitudes and linking the three concepts, including the interaction between influencing factors in the model of the three.

In conclusion, in the present study. A high smoking dependency was detected among smokers based on the FTND score. A significant association was observed between student age and the tendency to smoke; fourth-year students displayed a strong association with smoking attitudes, and those students attained higher knowledge and attitude scores, along with a lower dependence on smoking behaviours. Second-year and fourth-year students were strongly associated with smoking behaviours.

The attitudes of smokers toward smoking were better than those of nonsmokers, and smoking-related knowledge among nonsmokers was better than that among smokers. The difference in knowledge level concerning the harmful effects of smoking and toxic tobacco substances from cigarettes among students from different departments and colleges was highly significant. The results urge policymakers to initiate anti-smoking programs. University students in Yemen should receive health education and counselling to reduce smoking habits in higher education institutions.

Abbreviations

ASCO: American Society of Clinical Oncology
FTND: Fagerström test for nicotine dependence
WHO: World Health Organization
SPSS: Statistical Package for the Social Sciences
UAE: United Arab Emirates

Author Contribution Statement

AMAN, solely designed the study, analyzed the data, and drafted the manuscript. He also provided sponsorship for the manuscript and contributed to the study design and data interpretation. All aspects of the manuscript, including revisions and the final version, were completed independently.

Acknowledgements

First, we would like to thank the almighty God for making everything possible. We would like to thank the School of Medicine and Health Management of Huazhong University, China. We also thank the Health Service Management and Hospitals, Gulf Colleges, Saudi Arabia, which supported this work. We express our sincere gratitude to all my friends for directing and supporting this research.

Availability of Data

Data sets generated or analysed in this study are available from the relevant author upon reasonable request.

Conflicts of interest

The author declares no conflicts of interest related to this work. This work is part of an approved doctoral thesis submitted to Tonji Medical College in partial fulfilment of the requirements for the Ph.D. degree in Health Management.

Endnotes

****KAP Model and Public Health****

The KAP model provides a structured framework to assess health behaviors and design interventions based on observed knowledge, attitudes, and practices.

****FTND Test****

The Fagerström Test for Nicotine Dependence (FTND) is a validated tool used to measure smoking dependency among individuals. Its results are widely referenced in studies comparing dependency levels across different demographics.

****Cultural Context in KAP Studies****

Understanding cultural influences is crucial when designing and interpreting KAP studies to ensure that findings reflect true behaviors rather than socially desirable responses.

****Sampling Bias Limitations****

Sampling bias can occur when the population sampled is not representative of the general population, limiting the applicability of the findings.

****Cross-Sectional Study Limitations****

Cross-sectional studies can reveal associations but

not causations. They often require follow-up longitudinal studies to confirm the observed relationships.

****Role of Policymakers****

Effective implementation of findings from KAP studies depends on the involvement of policymakers to design and promote targeted public health interventions.

****Social Desirability Bias****

This bias occurs when participants provide answers they believe are more acceptable rather than truthful, potentially affecting the reliability of self-reported data.

****Quantitative and Qualitative Methods****

Combining both methods ensures a more comprehensive understanding of behaviors and attitudes, providing actionable insights for interventions.

****Limitations of Study Regions****

Limiting studies to specific regions, such as the two provinces in Yemen due to conflict, can restrict the generalizability of findings to broader populations.

****Recommendations for Further Studies****

Future studies should explore longitudinal designs and incorporate diverse regions to address gaps in cross-sectional studies and enhance the reliability of the findings.

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