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Assessment of Knowledge, Attitudes, and Practices Toward Nicotine Addiction Among Health Care Workers in Sudan

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Abstract: ***Nicotine dependence is a major preventable contributor to global morbidity and mortality. Health care workers play a critical role in tobacco control through screening, counseling, and cessation support, yet discrepancies between knowledge and personal smoking behavior may reduce intervention effectiveness. This cross-sectional analytical study assessed knowledge, attitudes, and practices related to nicotine addiction among 380 health care workers in tertiary hospitals in Khartoum State, Sudan. Data were collected using a structured self-administered questionnaire and analyzed using descriptive statistics, chi square tests, and multivariate logistic regression. Current smoking prevalence was 27.1 percent. Although 62.9 percent demonstrated good knowledge and 68.4 percent reported positive attitudes, only 54.2 percent showed good cessation practice. Smoking status independently predicted poor cessation practice (adjusted odds ratio 2.41, p less than 0.001). A knowledge behavior gap was observed, with 15 percent of participants possessing high knowledge yet continuing to smoke. These findings highlight the need for integrated educational, behavioral, and institutional interventions to strengthen tobacco control efforts within healthcare settings.***

Keywords: Nicotine addiction; Health care workers; Smoking cessation; Knowledge–behavior gap; Sudan

1. Introduction

It is a major preventable cause of illness and premature mortality around the globe, with quite an extensive variation in smoking prevalence across countries, gender, and age curricula. The Global Burden of Disease (GBD) Study 2019 global modelling reveals that smoking remains a significant contributor to preventable morbidity and mortality and the importance of enhancing, context-based tobacco control in all of the regions, including low- and middle-income countries (LMICs) [1]. This nicotine dependence is at the biological level mediated by interplay of neuropharmacological actions triggered by nicotinic acetylcholine receptors in the reward and aversion systems that reinforce the recurring use and prevents cessation even in highly informed individuals [2]. This aids in explaining why smoking is not just a habit but a relapsing chronic addiction which in most cases remains even when the harm is known.

Health care workers (HCWs) play the leading role in tobacco control since they are supposed to deliver brief cessation intervention, encourage nicotine dependence treatment, and serve as role models in evaluating healthy behavior. Nevertheless, the tobacco consumption among HCWs remains an issue of concern. There is evidence that the adoption and sustenance of cessation programs in routine practice can be affected by clinician and organizational factors, which implies that knowledge is insufficient to ensure consistent provision of cessation care [3]. Moreover, tobacco use by HCWs weakens cessation promotion, lowers the level of credibility in cessation counseling experiences, and can even cause normalization of tobacco use in clinical and community practices.

Cigarette smoking as well as smokeless tobacco like toombak is a part of tobacco consumption in Sudan. The prevalence of toombak use and cigarette smoking has been documented using population based evidence in the Nile State which contributes to the importance of tobacco dependence as a community health issue and urgency of prevention and cessation program [4]. Meanwhile, HCWs are not any less vulnerable to tobacco usage; on a global scale, evidence indicates that the prevalence of tobacco usage among HCWs is also significant in most of the settings including LMICs with significant differences by occupation and gender [5]. This poses a life-threatening knowledge-behavior gap in which professional responsibility and awareness of the harm of tobacco does not always translate to personal abstinence or secondary cessation.

Thus, by measuring the knowledge, attitudes, and practices (KAP) of HCWs in relation to nicotine addiction along with the personal tobacco use, it is possible to determine the adjustable barriers, training requirements, and institutional opportunities. This proposed cross-sectional study in Sudan seeks to estimate KAP of HCWs on nicotine dependence and

to identify how these factors are correlated to tobacco use status and will be used to inform specific training, workplace policy and cessation support intervention.

2. Methodology

2.1 Study Design and Setting

The study used an analytical cross-sectional design to determine the knowledge, attitudes and practices (KAP) of nicotine addiction among health care workers (HCWs) in Sudan and to identify the correlation between professional knowledge and individual smoking habits. The cross-sectional method was suitable for measuring the prevalence and association between variables in a defined population at a specific time period [6]. The research was carried out in selected tertiary hospitals in Khartoum State, Sudan (public and private hospitals) to provide variability in professional duties and working conditions. The hospitals were selected based on the availability of multidisciplinary healthcare staff, tertiary care services, and administrative permission to conduct the study.

2.2 Population and Sampling of the Study

Physicians, nurses, pharmacists, dentists, and medical interns working in the selected hospitals with at least six months of professional experience constituted the study population. Healthcare workers who were administrative staff or those on long-term leave during the study period were excluded. The required sample size, the single population proportion formula was used by assuming a 30% prevalence of tobacco use among HCWs, a 95% confidence level, and a 5% margin of error, which resulted in a minimum sample size of 323 participants. After adjusting for a possible non-response rate of 15%, the final sample size was increased to 380 participants. A stratified random sampling method was applied to ensure that different categories of healthcare professionals were proportionally represented. In each hospital, administrative departments provided lists of eligible HCWs, and participants were selected using computer-generated random numbers. Stratified sampling improves representativeness and reduces sampling bias in heterogeneous populations such as healthcare institutions [7].

2.3 Data Collection Instrument

Data were collected using a structured self-administered questionnaire adapted from previously published tools assessing KAP related to tobacco control behavior among medical personnel [8], [9]. The questionnaire consisted of four sections: sociodemographic characteristics, knowledge regarding nicotine addiction, attitudes toward tobacco cessation, and clinical practices related to tobacco cessation interventions. The knowledge section contained multiple-choice and true/false questions regarding nicotine pharmacology, withdrawal symptoms, effectiveness and safety of nicotine replacement therapy (NRT), and guideline-based cessation strategies. The attitude section used a five-point Likert scale ranging from strongly agree to strongly disagree to assess perceptions of professional responsibility, role-model influence, and tobacco control. The practice section assessed implementation of the 5A model (Ask, Advise, Assess, Assist, Arrange), documentation habits, and cessation pharmacotherapy prescription. To ensure clarity and cultural relevance, the questionnaire was pilot tested among 10% of the estimated sample in a comparable hospital that was not included in the final study. Content validity was reviewed by two public health specialists and one clinical pharmacologist. Internal consistency reliability of the attitude and practice sections was evaluated using Cronbach's alpha, and values of 0.70 or above were considered acceptable [10]

2.4 Data Collection Procedure

Eligible participants were approached at their workplaces after obtaining ethical approval from the relevant institutional review board. Written informed consent was obtained from all participants before participation. The survey was conducted anonymously to encourage honest reporting of smoking behavior and reduce response bias. Completed questionnaires were returned in sealed envelopes and collected through designated boxes to maintain confidentiality

2.5 Variables and Measurement

Smoking status was the primary outcome variable and was classified as current smoker, former smoker, or never smoker. Knowledge scores were calculated by assigning one point for each correct response and summing the total score. Based on percentage cut-offs, knowledge levels were categorized as poor, moderate, or good. Attitude and practice scores were calculated using standardized scoring methods described in previous tobacco cessation research [8]. In addition, a knowledge–behavior gap variable was created to identify participants who had high knowledge scores but were current smokers.

2.6 Statistical Analysis

The SPSS version 26 was used to input and analyze the data. The means, standard deviations, frequencies and percentages were used as descriptive statistics to summarize demographic characteristics and KAP scores. The smoking rate in healthcare workers was estimated at 95 0 of confidence interval. The chi-square test was used in the evaluation of associations between categorical variables. A one-way ANOVA or independent t-tests were used to compare means of knowledge and practice scores of different groups of smokers. Bivariate analyses revealed variables with p-values below 0.20 to be included in a multivariate logistic regression model in order to determine independent predictors of smoking status and effective cessation practice. The assumptions that logistic regression makes like no multicollinearity and good fit to the model have been confirmed before the analysis. The adjusted odds ratios were presented together with 95 % confidence intervals. The Hosmer- Lemeshow test was used to test model goodness-of-fit. The statistical significance was set at p<|human|>The statistical significance was set at $p<0.05$.

2.7 Ethical Approval and Data Availability

Ethical approval for the study was obtained from the Khartoum State Health Research Ethics Committee

(Approval No.: KSHREC-2024-118). Participation was voluntary, and confidentiality of all participants was maintained throughout the study. The datasets generated and analyzed during the study are available from the corresponding author upon reasonable request.

3. Results

The study respondents were 380 health care workers, resulting in a response rate of 94.5 %. The average age of the respondents was 34.6 ± 8.7 years (22-58 years). Most of the respondents were women (58.2), and men formed 41.8% of the sample. The highest professional group (40.0%) was physicians, followed by pharmacists (10.0%), dentists (10.0%), interns (10.0%), and nurses (10.0%). Overview of these demographic features is described in Table 1. On the topic of tobacco use, 27.1 percent of respondents were current smokers, 12.4 percent were former smokers and 60.5 percent had never smoked. Those who received formal training in tobacco cessation were 37.4 percent and the respondents who had not undergone formal training were 62.6 percent. Table 1 shows the prevalence of smoking and training exposure.

Table 1: Sociodemographic Characteristics and Smoking Status of Participants (n = 380)

Variable	Frequency (n)	Percentage (%)
Age (years)		
<30	124	32.6
30–39	156	41.1
≥40	100	26.3
Gender		
Male	159	41.8
Female	221	58.2
Profession		
Physicians	114	30
Nurses	152	40
Pharmacists	38	10
Dentists	38	10
Interns	38	10
Smoking Status		
Current smoker	103	27.1
Former smoker	47	12.4
Never smoker	230	60.5
Received formal cessation training		
Yes	142	37.4
No	238	62.6

3.1 Nicotine Addiction Knowledge

The average level of knowledge was 11.8 with a standard deviation of 2.4 out of the possible 15. All in all, good knowledge (score 75 % and above) was exhibited by 62.9 percent of participants, moderate knowledge (50-75 percent) was demonstrated by 24.5 percent of participants and poor knowledge (less than 50 percent) was displayed by 12.6 percent of participants. The majority of the respondents knew the drug nicotine was an addictive drug and knew about the withdrawal symptoms, but misconceptions about the relative harmfulness of the nicotine replacement therapy (NRT) prevailed, and about 29% of respondents mistakenly thought that NRT is as dangerous as smoking cigarettes. In comparing the level of knowledge to the smoking status a statistically significant association was found. Table 2 indicates a good level of knowledge of 50.5% of the current smokers versus 69.8% of the non-smokers ($p = 0.002$). This implies that despite the fact that a good number of smokers had sufficient knowledge, their level of knowledge was very low compared to those of non-smokers.

Table 2: Association Between Smoking Status and Knowledge, Attitude, and Practice Levels

Variable	Current Smokers n (%)	Non-Smokers n (%)	p-value
Good Knowledge	52 (50.5%)	187 (69.8%)	0.002
Positive Attitude	60 (58.3%)	200 (74.6%)	0.004
Good Practice (5A's ≥70%)	38 (36.9%)	168 (62.7%)	<0.001
Prescribed NRT	29 (28.1%)	141 (52.6%)	<0.001
Received Training	24 (23.3%)	118 (44.0%)	0.001

3.2 Perception of Nicotine Addiction and Nicotine Cessation

In total, 68.4 percent of respondents showed good attitudes to nicotine addiction management by agreeing with the statement that smoking was a chronic illness and that health care workers played a professional role to encourage quitting. Nevertheless, 21.1% had a neutral attitude and 10.5% portrayed negative perceptions especially on the level of their responsibility in offering cessation counseling. The attitude scores were significantly different between smokers and non-smokers. Table 2 shows that positive attitudes were found in 58.3% of current smokers and 74.6% of non-smokers ($p = 0.004$). This result indicates that individual smoking attitude can affect the professional attitudes of tobacco control duties.

3.3 Smoking Cessation Practices

With regard to clinical practice, participants (78.2% of those interviewed) reported regularly assessing patients with regard to smoking, and 71.5% reported giving smoking cessation advice. Nevertheless, a smaller number of participants indicated that they have conducted the more advanced items of the 5A model: 54.2% of them typically assesed readiness to quit, 47.9% of them helped patients with cessation plans, and only 39.5% of them made follow-up appointments. In general, the percentage of participants who scored as good practice (≥70%) was 54.2. There was a high significant association between smoking status and cessation practices. The proportion of current smokers who proceeded to be of good practice was only 36.9 percent in relation to 62.7 percent of non-smokers ($p < 0.001$) as indicated in Table 2. Moreover, the prescription of NRT was considerably less in smokers (28.1) as compared with non-smokers (52.6) ($p < 0.001$). Formal training had a strong relationship with improved practice outcomes. Out of those who had undergone structured training in tobacco cessation, 67.6% of those who received training were good practitioners as opposed to 45.0% of those who were not trained ($p = 0.001$).

3.4 Prevalence of Smoking by Type of Professional

There was a difference in smoking prevalence among the professional groups and this is depicted in Figure 1. The highest prevalence was shown by the physicians (31.6%), then Interns (29.0%), pharmacists (28.9%), dentists (26.3%), and nurses (24.3%). These variations were not significant at 0.05 level ($p = 0.083$), but the trend indicates that there is occupational variation in the use of tobacco.

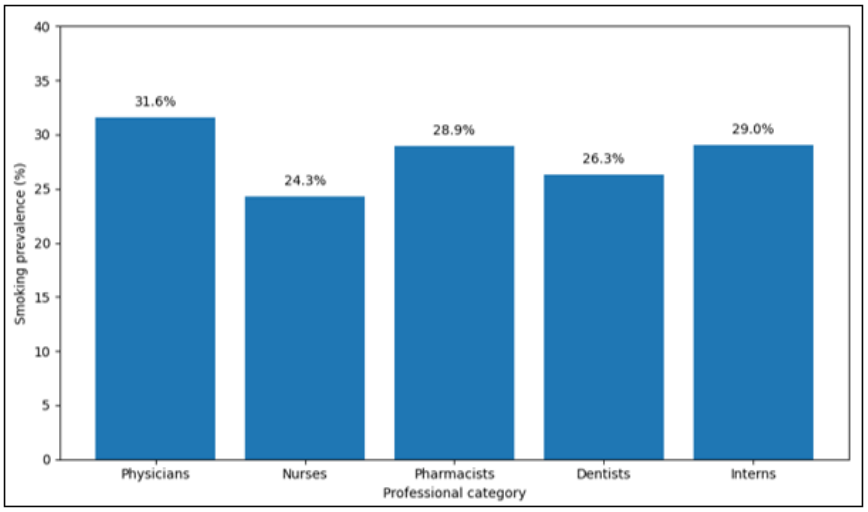

Figure 1: Prevalence of Smoking by Professional Category Among Health Care Workers in Sudan (n = 380).

3.5 Knowledge–Behavior Gap

To further investigate the relation between professional knowledge and personal smoking behavior, the participants were divided into four groups depending on the level of knowledge level and smoking status. Figure 2 illustrates that 48 percent of the participants were non-smokers and had high knowledge which is the perfect professional profile. Nonetheless, 15 percent of the people showed high level of knowledge and were still smokers. This sub group is the gap of knowledge and behavior identified. Also, 12% of the subjects had low or moderate knowledge and were smokers, 25% had low or moderate knowledge and were non-smokers. The challenge between professional-level awareness and individual conduct is indicated by the existence of a large percentage of high-knowledge smokers.

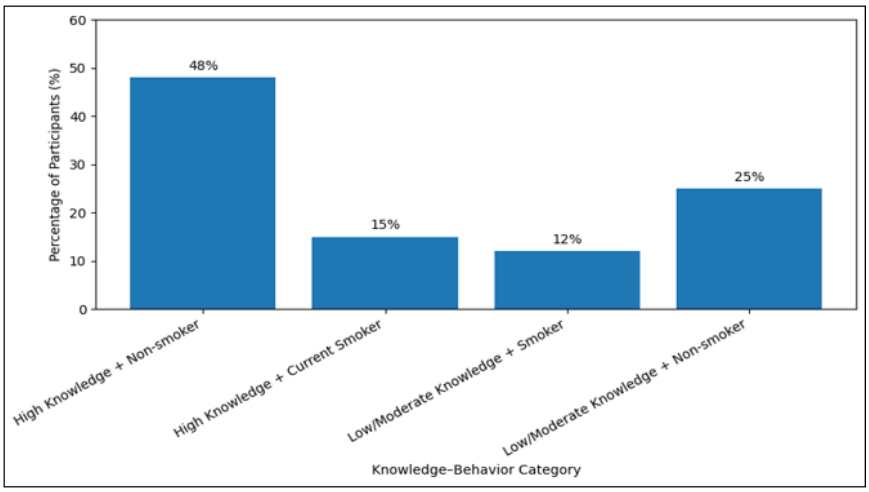

Figure 2: Knowledge–Behavior Gap Among Health Care Workers in Sudan (n = 380).

3.6 Multivariate Analysis

The multivariate logistic regression analysis was done and led to the results of independent predictors of good cessation practice. The variables that were incorporated into the model were knowledge level, attitude level, smoking status, profession, years of experience, and received formal training. Following the adjustment, the non-smoking status was also a major predictor of good practice (Adjusted Odds Ratio [AOR] = 2.41; 95% CI: 1.52381; $p < 0.001$). Good practice was also independently related with formal training (AOR = 1.89; 95% CI: 1.21 2.94; $p = 0.005$). The good practice had positive correlation with high level of knowledge (AOR = 1.74; 95% CI: 1.092.77; $p = 0.019$), whereas positive attitude had borderline significant relationship ($p = 0.058$).

The research shows that smoking is rather common among health care workers in Sudan (27.1%), and the prevalence differs among professional groups (Figure 1). Although most of the participants were well versed in terms of knowledge and positive attitudes, the clinical application of holistic cessation practices was not optimal. Notably, smoking status was largely related to reduced knowledge, unfavorable attitudes and worse cessation behaviors (Table 2). The fact that a 15 percent high-knowledge subgroup of smokers (Figure 2) is identified highlights that knowledge-behavior paradox is a reality in the healthcare work force. These results imply that knowledge will be not enough to transform personal behavior and professional practice. To close the identified gap, there may be a need to conduct institutional training and specific interventions aimed at behavioral determinant changes.

4. Discussion

The present study proves that smoking remains one of the significant problems in the health care workforce (HCWs) in Sudan, with a prevalence rate of 27.1%. Though the level of knowledge and attitude to the management of nicotine addiction was rather high and overall positive, a clear knowledge and behavior gap was observed. About 15 per cent of the respondents who had the highest knowledge levels were still smoking. Such observation supports universal research reports that familiarity with the negative impact of tobacco does not always project to individual quitting, or a regular professional participation in tobacco prevention [11].

The prevalence rates of smoking in this paper are according to the results identified in other low- and middle-income countries (LMICs), where the tendency of tobacco use among HCWs is alarming although there is a greater understanding of smoking health risks [12]. Stress at the workplace, low access to cessation programs, and poor adherence to smoke-free policies are some of the issues that make healthcare professionals in many LMICs remain tobacco users [13]. Such contextual factors could be one of the reasons to believe that knowledge without some other interventions was not sufficient to eliminate smoking behavior in the sample under consideration. The only factor that was significantly related to low scores on cessation practice was smoking status. The non-smokers had almost twice the amount of reporting good cessation practices as compared to smokers. This observation is in line with the past referring to the fact that smoking clinicians are less inclined to offer cessation counseling or pharmacotherapy to patients [14]. This may be affected by cognitive dissonance whereby healthcare providers that smoke is less confident or are less motivated to engage in achieving tobacco cessation [15].

The general level of knowledge was high, but the misunderstandings in the concept of nicotine replacement therapy (NRT) still existed. Other cases of such misconceptions are also reported in the literature, in which medical practitioners are usually overestimating the dangers of nicotine compared to those of combustible tobacco [16]. It is important to counter such misconceptions, and evidence-based pharmacotherapy with behavioral counseling is one of the best interventions in tobacco cessation [17]. Also, the full implementation of the 5A model was not done in most instances, especially the Assist and Arrange features. The same trend has been observed in other medical facilities where doctors tend to start cessation conversations but do not follow up thoroughly because they are either poorly trained or lack time to do that [18]. Training developed as a much-needed predictor of good cessation practice. The respondents with organized training on tobacco cessation and those who did not have the training reported more frequent use of evidence-based interventions. This result is in line with the systematic evidence that shows that educational interventions focused on developing healthcare providers competence and provision of cessation programs [19]. Nevertheless, knowledge-behavior gap might not be adequately filled by the education alone. There is also the need to have institutional interventions like smoke-free hospital policies, leadership by example, and easy access to cessation programmes among healthcare professionals to facilitate behavioural change among healthcare professionals [20]. The discovery of a quantifiable knowledge-religious behavior gap among Sudanese HCWs supports the need to implement multifaceted interventions. It is important to work on the reinforcement of educational programmes and the further development of the professionals, yet simultaneous attention should be paid to helping smoking HCWs. They can offer confidential counseling services, cessation programmes at the workplace, and access to pharmacotherapy as ways of reducing prevalence of smoking among the healthcare professionals and strengthening their reputation as role models in the field of public health.

5. Conclusion

This study demonstrates that smoking remains prevalent among healthcare workers in Sudan despite generally adequate knowledge and positive attitudes toward nicotine dependence management. A measurable knowledge behavior gap was identified, with smoking status significantly associated with poorer cessation practices. These findings indicate that knowledge alone is insufficient to ensure effective tobacco control engagement. Strengthening structured cessation training, enforcing institutional smoke free policies, and providing accessible support programs for healthcare workers are essential to enhance professional credibility and improve tobacco control outcomes in healthcare settings.

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