

Tobacco Use in Sudan: Prevalence, Patterns, and Determinants – A Systematic Review

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Keywords

Smoking and tobacco · Prevalence · Determinants · Sudan

Abstract

Background: The aim of this review was to investigate the published papers about prevalence, patterns, and determinants of tobacco use in Sudan. **Methods:** Four scientific databases were searched for relevant articles published between 1900 and 2020. Applying the inclusion criteria, which were original articles published in peer-reviewed journals, conducted on Sudanese in Sudan and about tobacco prevalence, patterns of use, or determinants, in either English or Arabic languages, 20 articles were included in this review. **Results:** Two articles (10%) were among the general population, 8 (40%) among schoolchildren and adolescents, 4 (20%) among medical and health professions university students, 3 (15%) studies among non-health professions university students, and 3 studies among special groups (prisoners, diabetic patients and school workers). The reported prevalence ranged from 1% to 47.5%, with significant differences between males and females. All patterns of tobacco use are practiced in Sudan. Peer pressures, having more money, and

family tobacco user or friends were associated with tobacco use initiation. **Conclusion:** All patterns of tobacco utilization (cigarette smoking, Toombak dipping, and shisha) are practiced in Sudan as well as combined patterns. Tobacco prevalence ranges from 1–25% and 10–47.5% among adolescents and adults, respectively, indicating the need for intervention programs to enhance decreasing this high prevalence.

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Introduction

Tobacco use is a global public health problem with an estimated 7 million associated deaths in 2017 due to direct use of tobacco and the related diseases [1]. Since the tobacco use is a modifiable risk factor for a wide range of serious diseases [2], prevention activities should take place as stated by the Framework Convention on Tobacco Control [3]. The overall projected prevalence of tobacco use in the Eastern Mediterranean Region for 2020 is 18.6%, with 33.3% and 3.9% for males and females, respectively [4].

In Sudan, cigarettes smoking was rare before 1940 and became popular in the 1990s [5]. During the mid-1960s

to mid-1970s, Sudan and Somalia were the 2 countries in Africa to have increased consumption and the world's largest airlift of cigarettes takes place in Britain [6]. Sudanese use tobacco in forms of cigarettes, water pipe (Shisha), and smokeless type of tobacco locally known as Toombak, which is a moist form of fermented tobacco leaf mixed with sodium carbonate [7]. Because of the addictive effect of high nicotine tobacco products, considerable number of Sudanese smoke and use Toombak at the same time during their life [5, 8]. The main objective of this systematic review is to explore the published data about prevalence of tobacco use, patterns of use, and its determinants in Sudan.

Methodology

Pub-Med, Medline, Google Scholar, and Scopus databases were searched between the mid and end of December 2020 for articles published between 1900 and 2020, using the following keywords: tobacco, Toombak, smoking, and Shisha in Sudan. The search resulted in 491 published articles. The selection criteria for the articles included in the review were: original articles published in peer-reviewed journals, conducted on Sudanese in Sudan, about tobacco prevalence, patterns of use, or determinants in either English or Arabic language. The 2 researchers independently reviewed abstracts of all 491 articles. Based on inclusion criteria, only 20 (4.3%) articles were included in this review. Based on the study population, the articles were categorized as follows: 2 (10%) articles related to the general population, 8 (40%) articles about schoolchildren and adolescents, 4 articles were about medical field and healthcare professional students (20%), while 3 (15%) articles about non-health professions university students, and a similar number of studies were about special groups (prisoners) (Table 1).

Data Collection and Risk of Bias Assessment

Adhering to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines [9], independently the 2 investigators conducted screening by title and abstract, reviewed the full-text articles using a created form, and additionally data collected from each article were cross-checked by the other investigator. Discussion was used to resolve any disagreement and differences of opinions. To avoid the risk of bias, we used the assessment tool for observational cohort and cross-sectional studies which were published by the National Institutes of Health – National Heart, Lung, and Blood Institute [10] (Table 2).

Results

Four studies were conducted to study tobacco use behavior of medical students and health care professionals; 45% of participants from the College of Pharmacy in Yarmouk University were Toombak users [11]. The smoking prevalence among the first year and fifth-year medical

students in Ribat National University was 10% and 6.6% respectively, with overall smoking prevalence of 14.4% [12]. Almahdi et al. [13] revealed that 9.2% of the participants reported that they have ever used Toombak; among them, 69.5% were current users. Among health professional students of a private university, the prevalence of smoked tobacco was 19.6%, while the overall prevalence of ever other tobacco users and current other tobacco users was 30.9% and 10.7%, respectively [14]. Assessing tobacco use among adults in Northern state, a study revealed that using of Toombak dipping was higher than tobacco smoking as 27.5% were Toombak users while 20% were current smokers, 29.5% and 38% of participants had smoked tobacco and dipped Toombak, respectively, in their lifetime [15]. In Nile state, Idris and colleagues [5] reported 34% prevalence of Toombak and 12% of cigarette smoking among the population aged 18 years and above.

Three studies investigated tobacco use among non-medical university students. Osman et al. [16] reported prevalence of 13.7% among university students. While Ahmed and colleagues [17] reported 16.3% as current tobacco users among university students in Khartoum state, a higher prevalence was reported by Elmannan and colleagues [18] where prevalence of cigarettes, shisha, and Toombak was found to be 42%, 30.5%, and 14.9%, respectively (Table 2).

Eight studies investigated the tobacco use behavior among adolescents; Mohamed et al. [19] showed that 31% had used some tobacco products at some stage in their life, cigarettes were the most often tried tobacco products (13%), followed by herbal cigarettes (8%), shisha (6%), and Toombak (4%). Attari and colleagues [20] reported that 21.8% were ever cigarette users with prevalence of 13.1% and 6.5% among males and females, respectively, while current cigarette users were 4.9% males and 1.3% of females, and users of non-cigarette tobacco products were 6.8% for males and 6.1% for females. Another study assessed smoking prevalence among school adolescents in Khartoum State and found that the overall prevalence was 13.6% and students in public schools were more likely to be smokers (10.7%) compared with those in private schools (2.9%) [21]. A study to estimate the prevalence of shisha smoking among adolescents found that 13.4% was the overall prevalence of those who had ever smoked shisha and users were 16.8% males and 10.9% females [22]. Almahdi and colleagues [23] reported a prevalence of 10.9% for Toombak ever-users among students aged 13–16 years in Khartoum state and reported a similar Toombak prevalence among adolescents in Sudan in their

Table 1. Quality assessment for the reviewed articles

Article	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Ahmed [33]	1	1	1	1	1	-1	0	0	1	0	1	0	0	0
Idris et al. [5]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Almahdi et al. [13]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Mahmoud et al. [11]	1	1	1	1	-1	0	0	0	1	0	1	0	0	0
Dirar [14]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Elamin et al. [12]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Elmanna [18]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Osman et al. [16]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Ahmed et al. [17]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Almahdi et al. [24]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Mohamedet al. [19]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Othman et al. [22]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Almahdi et al. [23]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Elmosaad et al. [26]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Gadalla et al. [21]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
El-Amin et al. [25]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Atari [20]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Awooda and Shashati [29]	1	1	1	1	1	0	0	0	1	0	1	0	0	0
Awadalla et al. [28]	1	1	1	1	-1	0	0	0	1	0	1	0	0	0
Almahdi et al. [27]	1	1	1	1	1	0	0	0	1	0	1	0	0	0

Key

- A Was the research question or objective in this paper clearly stated?
- B Was the study population clearly specified and defined?
- C Was the participation rate of eligible persons at least 50%?
- D Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?
- E Was a sample size justification, power description, or variance and effect estimates provided?
- F For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?
- G Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?
- H For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?
- I Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?
- J Was the exposure (s) assessed more than once over time?
- K Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?
- L Were the outcome assessors blinded to the exposure status of participants?
- M Was loss to follow-up after baseline 20% or less?
- N Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

1 = yes, 0 = not applicable, -1 = no.

study, which assessed the association between Toombak advertisement and its use [24]. Investigating the prevalence of tobacco use in Nile state, Idris and colleagues [5] reported a range from 1% to 2% among children and adolescents with an abrupt increase of up to 25% in late adolescence. One study assessed the role of parents, friends, and teachers in adolescents' tobacco use in Sudan and found that the prevalence of current adolescent smokers was 3.8% and current Toombak users were 3.3% [25], while Elmosaad and colleagues [26] showed that the over-

all smoking prevalence among male students in secondary schools in Khartoum locality was 12.9%.

Prevalence in special groups was investigated by 3 studies. A study investigating knowledge, attitude, and practice of Toombak among school workers in Khartoum state reported that 9.6% school workers confirmed ever use of Toombak and the daily users were 64.7% [27]. The prevalence of tobacco smoking among diabetics was found to be 33.9% [28], while the prevalence of tobacco use among male prisoners in Khartoum was found to be

Table 2. Findings of included articles

Group	Article	Study type	Study population	Tobacco type	Prevalence, %
General population	Ahmed [33]	Cross-sectional	10–78 years with a mean of 34.12±1.3 years	Toombak	27.5
				Smoked tobacco	20
	Idris et al. [5]	Cross-sectional	Children and adolescents (4–17 years) 18 years and older	Toombak	2 Children 25 Late adolescents
				Toombak Cigarettes	47.5 12
Medical students and professionals	Almahdi et al. [13]	Cross-sectional	Health professions students (majority between 19–22 years)	Toombak	9.2
	Mahmoud et al. [11]	Cross-sectional	15–26 years (pharmacy students)	Toombak	45
	Dirar [14]	Cross-sectional	Health professions students of a private university	Smoked tobacco	19.6
				Current other tobacco user	10.7
	Elamin et al. [12]	Cross-sectional	Students in the first and fifth year in faculty of medicine	Cigarettes	6.6 first year 14.4 fifth year
Cigarettes				14.4 fifth year	
Nonmedical students	Elmanna et al. [18]	Cross-sectional	≥19 years ≥20–21 years ≥22 years	Cigarettes	42
				Shisha	30.5
				Toombak	14.9
	Osman et al. [16]	Cross-sectional	Nonmedical Universities' students	Tobacco	13.7
Ahmed et al. [17]	Cross-sectional	Nonmedical students Bahri University	Cigarettes	16.3 (overall)	
			Toombak	56 23	
Adolescents	Almahdi et al. [24]	Cross-sectional	13–15 years	Toombak	10.9
	Mohamed et al. [19]	Cross-sectional	School-aged adolescents (11–17 years)	Cigarettes	13
				Herbal cigarettes	8
				Shisha	6
				Toombak	4
	Othman et al. [22]	Cross-sectional	14–17 years	Shisha	16.8 (males) 10.9 (females)
	Almahdi et al. [23]	Cross-sectional	13–16 years	Toombak	10.9
	Elmosaad et al. [26]	Cross-sectional	16–19 years	Cigarettes	12.9
	Gadalla et al. [21]	Cross-sectional	11–17 years	Cigarettes	13.6
	El-Amin et al. [25]	Cross-sectional	11–17 years	Cigarettes	3.8
Toombak				3.3	
Atari [20]	Cross-sectional	School-aged adolescents (11–17 years)	Cigarettes Non-cigarette tobacco products	6.9 14.7	
Special groups	Awooda and Shashati et al. [29]	Cross-sectional	Male prisoners in Khartoum	Toombak	87
				Cigarettes	57
				Both toombak and cigarettes	30.9
				Water pipe	3.8
Awadalla et al. [28]	Cross-sectional	Sudanese diabetics smokers	Cigarettes	33.9	
Almahdi et al. [27]	Cross-sectional	Adult school workers	Toombak	9.6	

100%, of whom 78% were Toombak users, 57% cigarette smokers, 30.9% used both cigarette and Toombak, 0.6% used cigarette and water pipe while 3.2% used cigarette, Toombak and shisha together, and shisha users were 3.8% [29] (Table 2).

Regarding the duration of tobacco use, a study mentioned that a considerable number of users of tobacco products use it throughout their adulthood [30]. The study of Ahmed and colleagues [15] reported that 53% of Toombak dippers have used it for >11 years followed by 27% who used Toombak for <5 years.

In conclusion, all patterns of tobacco utilization (cigarette smoking, Toombak dipping, and shisha) and combined use of 2 or 3 patterns together is commonly practiced in Sudan. Smoking prevalence ranged from 1% to 25% among children and adolescents while it ranged from 10% to 47.5% among adults, indicating the need for early intervention during childhood and adulthood to decrease this high prevalence.

Sociodemographic Determinants of Tobacco Use

Significant gender difference in the prevalence of tobacco use in Sudan was reported [17, 30], except Shisha use in which the prevalence was almost similar for males and females [17]. A study among school-aged adolescents (11–17 years) documented the nonsignificant gender differences between users of non-cigarette tobacco products [20]. Among Sudanese diabetic patients, tobacco smoking was found to be associated with being a male [28], and 8% of female tobacco users were of old age, as reported by Idris et al. [5].

All the studies that included both genders reported a higher prevalence of tobacco use among males than females, indicating the significant gender differences in the prevalence of tobacco use in Sudan [5, 17, 20, 28]. Also the pattern of use widely differed specially for Toombak which is mainly associated with males [5, 31].

For the age of tobacco use onset, a study among university medical students showed that 38.9% started using tobacco during their secondary school and 61.1% during university [11], similar to the findings of another study which reported that most of the smokers started smoking before joining the university, but the frequency of tobacco use increased after being enrolled in the university [12]. Two studies investigated the age of tobacco onset among adolescents, wherein one reported the age of initiation as 11 years old and the other one reported that 54.5% of cigarettes smokers among male students in secondary schools in Khartoum locality started smoking during their primary school [21, 26].

Monthly income or allowance appears to be an important risk factor for using tobacco products among adolescents. The risk of becoming an ever cigarette user and current cigarette user was found to be increased by the increase in monthly allowances. It was found that 72.6% of students aged 11–17 years got their cigarette from school expenditure and only 5.6% and 4% got it directly from fathers and mothers, respectively [20], while another study found that 21%, 19.4%, and 5.6% of smokers got cigarettes from their fathers, mothers, and friends, respectively [21]. Ahmed and colleagues [17] showed the association between income and frequent tobacco use and their study revealed that most of families (78.2%) in the intervention group had low family income compared to the control group (59.6%) [18]. In a study among university students, it was found that 72% of the participants' family income was low and the association between income and excessive use of tobacco was insignificant [17], with no significant associations between fathers' and mothers' educational level and students' smoking [26].

Area of residence, rural or urban, and the effect on tobacco use was investigated by Idris et al. [5], who found that the prevalence of Toombak use among males 18 years and above was significantly higher in the rural than in the urban areas (35% vs. 24%), while cigarette smoking had a higher prevalence in urban areas (18% vs. 12%). The highest rates of Toombak use were found in rural areas among the male population with mean age of 46.6 with prevalence ranging from 45% to 47%.

Socio-Cognitive Determinants of Tobacco Use

Out of the 20 articles under review, only 5 studies investigated the related cognitive factors to tobacco use [11, 12, 17, 20, 21]. Smoking friends and peer pressure are on the top, followed by having smoking family members (father, mother, and siblings) who are tobacco users [11, 17, 20, 26]. Life and academic pressures were mentioned by 25% university students of tobacco users [12], while 71% and 73.4% adolescents thought that the smoking relieves depression and stress, respectively, and another study revealed that 34% of participants thought that smoking is a behavior of manhood and strength [21]. Imitating friends, independence, prestige, and curiosity were other factors too [17]. Other studies mentioned availability and easy access to tobacco, mainly smokeless [18, 23]. Almahdi et al. [23] showed that 81.6% reported a positive attitude toward its use and 60.7% had received information about its harmful effects. A total of 72.6% reported normative social influence toward using Toombak and 62.5% perceived a negative social image to its use. Most of the students (70.8%)

reported exposure to anti-Toombak information, 41.8% confirmed exposure to Toombak advertisement, and 87.5% reported indirect access to its sale. Individuals who perceived a positive social image of Toombak users and had past experience were more likely to intend to its use.

Awareness and risk perception in Sudan did not go unnoticed. The majority of smokers in the study of Gadalla and colleagues [21] were knowledgeable about lung cancer (55.6%) and 75.8% of them knew that smoking causes lung cancer, while 77.4% and 43.5% knew that smoking is related to lung and heart diseases, respectively. Mahmoud and colleagues [11] reported that all tobacco users in their study population were aware that Toombak use causes oral cancer, but none of them were aware that it causes central nervous system diseases and lung cancer. Another study by Elamin et al. [12] showed that students in grade 1 were less aware of health problems caused by tobacco than their colleagues in grade 5, and adolescents who think second-hand smoke is harmful were less likely to use tobacco products [12]. Ahmed and colleagues [17] concluded that there is a significant association between students' knowledge concerning the risks of using tobacco and health, social and economic risks, and using tobaccos products.

In summary, tobacco use is a male behavior in Sudan. Tobacco initiation is as early as primary school. The prevalence of Toombak is higher in rural than in urban areas, in reverse to cigarette smoking. Having higher family income, friends or family members who smoke, perceived high peer pressure and low-risk perceptions are the risk factors to initiate tobacco use.

Discussion

The aim of this review is to investigate the prevalence, patterns, and determinants of tobacco use in the published literature about Sudan and Sudanese. The reported prevalence in the reviewed articles ranged from 1% to 25% among children and adolescents [5] and 10% [12] to 47.5% [5] among adult males, and from 0.9% [5] to 10.9% [22] among adult females. In line with the findings of other reviews which investigated the prevalence adolescents, Almutairi [32] got similar high range of prevalence among adolescents in Saudi Arabia, which was reported by various studies under investigation as 20–29%. Exposure to Toombak advertisements at points of sale was found to be high and associated with increased Toombak use in Khartoum State, Sudan, in addition to increasing social acceptability to its use and perceived easy accessibility can be a factor influencing this prevalence [24]. Due to non-

enforcement of existing tobacco control policies in Sudan, the prevalence of Toombak dipping and smoking is increasing, particularly among the young population. Although the current data show that Toombak is more prevalent among adults, yet this might not indicate decreased use among younger population, but may contribute that most of Toombak dipper never quit [33]. Hence, the current law which bans selling tobacco product to minors and bans Toombak advertisement and promotion at points of sale, needs to be enforced [34].

The gender differences in tobacco use reported by various studies included in our review, support the findings of other studies in the region as Fouda and colleagues [35] found that males (38.1, 95% CI [36.8–39.4]) are much more likely to use tobacco than females (0.6, 95% CI [0.4–0.9]) in Egypt. Similarly, in Saudi Arabia a study among adolescents [36] showed this difference which might be due to the social stigma associated with smoking females as a documented study showed the differences among the females in Sudan, since 95% of Toombak users were males, supporting the explanation of the influence of the social norms [31]. Nevertheless, these differences can be due to the difficulties researchers face, to recruit females as participants in tobacco- and alcohol-related studies to participate in this survey [15].

Many socio-cognitive factors were mentioned in the reviewed articles as leading causes for smoking initiation in Sudan, for both adolescents and adults, whereas peer pressure and presence of smoking friends and family members were dominant among others [11, 12, 17, 20, 21]. The effect of these social influences – pressure, norms, and modeling – on smoking behavior is well documented in the international studies [37, 38], and also other factors related to beliefs were present in the studies of this review. Positive attitude toward nonusing tobacco and knowledge about the harmful effect of smoking and high risk perception proved to help in avoidance of smoking among the adolescents [12] in agreement with another study in the region [39]. As can be noticed, most of the published studies in Sudan only addressed attitude and social influence (pressure, norms, and modeling) as smoking determinants and neglected the other socio-cognitive determinants. Those other determinants are very well documented in the international literature and shaped many models to understand tobacco use behavior, such as the theory of planned behavior [40] which addressed attitude, social influence, and self-efficacy, and the integrated model for behavioral change (The I-Change Model) by De Vries and colleagues [41], which addressed attitude, social influence, self-efficacy, and intention. However, fu-

ture research in Sudan needs to consider those missing behavioral determinants.

Two of the reviewed articles showed that the majority of tobacco users use tobacco outside home and schools [24, 26]. This suggests the potential influence of environment other than home and school; students who spent most of their time outside home were prone to tobacco use. Additionally, exposure to family members who smoke expedite the process of behavior, copying consequently; this will influence individuals of same sex at household where the majority of male smokers have a male sibling who smokes [21].

In line with regional and international studies and reviews [42–44], some of the articles under review [12, 15, 17] found that lack of awareness about the hazards of tobacco use, among other factors, has contributed to smoking initiation among the Sudanese, indicating the need for health promotion and health education programs to tackle this.

One of the limitations of this review is that almost all studies included are cross-sectional analysis, which only described the association, but did not justify causality. Hence, there is a need for additional investigations with longitudinal and case-control studies to assess the real situation.

Conclusion

Most of the reviewed studies investigated the prevalence and the patterns of tobacco use very well, however; only few studies deeply analyzed the socio-cognitive factors. Those studies reported a relatively high prevalence of tobacco use in Sudan. Therefore, more research are recommended to investigate the determinants of tobacco use among adults and adolescents for both males and females to guide the recommended anti-tobacco interventions which should target prevention and cessation strategies. The concerned bodies in Sudan (tobacco control

program, ministry of education, and anti-tobacco non-governmental organizations) should adopt awareness campaigns using community and school settings. Lastly, enforcement of laws and policies regulating tobacco selling to minors should be strictly applied and put in place.

Statement of Ethics

The paper is exempted from the Ethical Committee approval, since it is a review of already published articles with no human substance. Informed consent was not needed and no personal identifiers were used. Trial registrations were not needed for this article since it is not a clinical trial.

Conflict of Interest Statement

All authors declare that there is no conflict of interest.

Funding Sources

This work received no fund neither from governmental nor private sectors.

Author Contributions

Dr. Hala Elnazeer Elgoni designed the study, searched the Pub Med, Medline, Google Scholar, and Scopus databases, extracted 491 articles and reviewed their abstracts, and also contributed to data collection, analysis and interpretation of findings, and writing the manuscript. Dr. Mutaz Mohammed participated in reviewing the 491 abstracts, data collection, analysis and interpretation of findings, and reviewed and approved the final version to be published.

Data Availability Statement

The data that support the findings of this study are openly available in different science data bases and can be directly accessed and cited from the related scientific data base.

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