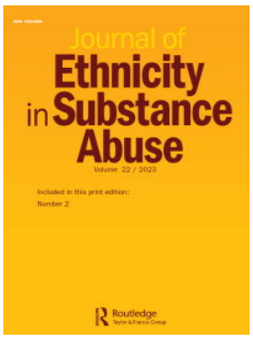

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The associations between cigarette smoking behavior and the use of heated tobacco products among Arab cigarette smokers: Findings from Saudi Arabia, Egypt, Kuwait, and Yemen

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ABSTRACT

As the availability of tobacco forms has evolved, emerging products known as heated tobacco products (HTPs) are increasingly being consumed worldwide and are claimed to be less harmful than tobacco cigarette smoking. To date, it is unknown whether Arab cigarette smokers are using or susceptible to HTPs. Therefore, this study aimed to assess the association between cigarette smoking behavior and the use of and susceptibility to HTPs in the Eastern Mediterranean region. Arab cigarette smokers ($n=628$) from Saudi Arabia, Egypt, Kuwait, and Yemen were recruited using a convenience sampling technique. A cross-sectional survey comprised questions related to sociodemographic characteristics, cigarette smoking behavior characteristics (quitting attempts and desire to quit cigarette smoking, nicotine dependence, and consideration of switching to nicotine products with reduced health risks), and awareness of, use of, and susceptibility to use of HTPs. Descriptive and logistic regression models were used for analysis. The participants indicated a high frequency of past quitting attempts and a desire to quit smoking cigarettes. They were also considering switching to a nicotine product with reduced health risks. However, their awareness of HTPs was relatively low (24.2%), and the proportion of participants who had ever used HTPs or were currently using them was quite low as well (10.7% and 5.0%, respectively). A history of quit attempts was associated with more likely lifetime use of HTPs (adjusted odds ratio [AOR] = 2.63, 95% confidence interval [CI] [1.21–5.71]). Nicotine-dependent cigarette

KEYWORDS

Arab country; Eastern Mediterranean region; cigarette smoking; heated tobacco products; harm reduction; smoking cessation

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smokers were more likely to be susceptible to HTP use (AOR = 1.12, 95% CI [1.01–1.24]). Moreover, those who would consider switching to a product that provided nicotine and could reduce health risks by 99% were more likely to be susceptible to using HTPs (AOR = 2.17, 95% CI [1.05–4.51]). Awareness of HTPs is relatively low among Arab cigarette smokers. Attempts to quit cigarette smoking, nicotine dependence, and the consideration of switching to a product that delivers nicotine with reduced health risks were significantly associated with using HTPs. The findings of this study provide potential for evidence-based treatment for smokers and will help prevent the use of tobacco industry tactics in marketing HTPs.

Introduction

Tobacco cigarette smoking is a major public health concern worldwide (Samet, 2013). The Eastern Mediterranean region (EMR) is not exempt, because cigarette smoking is prevalent among Arabs (World Health Organization [WHO], 2021a). For instance, the adult daily smoking prevalence in 2019 was 21% in Egypt, 17% in Kuwait, 14% in Yemen, and 11% in Saudi Arabia (WHO, 2021a). Despite the advancement in tobacco control to slow the uptake of cigarette smoking (WHO, 2021a), the availability of tobacco forms is evolving over time as emerging products are increasingly consumed worldwide, including cigars, hookahs, e-cigarettes, and heated tobacco products (HTPs; Cruz et al., 2019). However, tobacco smokers are usually eager to quit but face difficulties owing to nicotine addiction. Those who succeeded in quitting tobacco usually made several attempts before being able to quit (Hughes et al., 2008). In their quest to quit tobacco, especially when they tried but did not succeed, smokers may consider other tobacco products that are safer (or are perceived to be safer) than combustible tobacco, such as e-cigarettes, smokeless tobacco, and HTPs. By switching to these products, they aim to reduce the harm induced by smoking tobacco, a concept that is usually described in the theory of harm reduction. Harm reduction of tobacco refers to moving to a less toxic nicotine product for those who are unable to avoid using nicotine or smoking (Warner, 2019). The popularity of this concept is due to the concern that smokers either do not want to quit smoking or feel they are unable to stop smoking (Hatsukami et al., 2004).

HTPs are usually promoted by manufacturers as an alternative and less harmful method of nicotine delivery (Mallock et al., 2019). HTPs have been developed with the concept “heat-not-burn” tobacco cigarettes (Jankowski et al., 2019). HTPs deliver nicotine through the method of heating tobacco leaves, in comparison to smoking cigarettes, which relies on burning tobacco, thus avoiding combustion by-products (Jankowski et al., 2019). HTPs were first introduced in Japan and Italy in 2014; subsequently, sales have been increasing and have extended to being marketed

in more than 50 countries (Jankowski et al., 2019). For example, the prevalence of HTP use among Korean adults is 4.4% (7.8% among males and 0.9% among females; Kim & Cho, 2020). HTPs are marketed under several trade names, such as IQOS by Philip Morris International, glo by British American Tobacco, and Ploom TECH by Japan Tobacco International (McNeill et al., 2018). Recently, HTPs have been legally introduced into several Arab nations. For instance, Saudi Arabia approved the use of HTPs in 2019, and Egypt legalized the use of HTPs in 2022 (Market, 2020; WHO, 2021a). HTPs have, however, been illegally promoted in social media, supermarkets, and malls in middle- and low-income countries such as Armenia, Cyprus, Palestine, and Malaysia (WHO, 2020).

Although tobacco manufacturers claim that hazardous compounds are considerably reduced with HTP use compared to smoking cigarettes, U.S. legislation requires solid scientific evidence for such claims (Lempert & Glantz, 2018). Studies examining the cytotoxicity of HTPs revealed that harmful nitrosamine emissions are lower in HTPs relative to smoking cigarettes, indicating that switching entirely to HTPs could be advantageous for smokers (Leigh et al., 2018; Simonavicius et al., 2019). In contrast, literature indicates that exposure to HTPs negatively affects the function of human mitochondria, leading to higher risks of airway inflammation and lung cancer (Znyk et al., 2021). The ultimate goal of smoking cessation is to reduce the risk of adverse health effects, and complete abstinence is the best approach to achieve this goal. Therefore, the decision to switch from smoking cigarettes to using HTPs remains questionable because harm reduction alone does not align with the ultimate goal of smoking cessation.

In the EMR region, there is limited information available about cigarette smokers' desire to quit, the approaches used in quit attempts, and the use of HTPs. It is also unknown whether characteristics related to cigarette smoking behavior, such as the desire to quit smoking, nicotine dependence, and switching to other products, are associated with the use of HTPs or susceptibility to use among Arab smokers. Therefore, this study aimed to assess the association between cigarette smoking behavior and the use of HTPs among cigarette smokers from four Arab countries: Saudi Arabia, Egypt, Kuwait, and Yemen. The future goal of this study is to inform prevention and treatment programs for tobacco use about new emerging products (HTPs) and provide evidence to support efforts to curb tobacco use in Arab nations.

Materials and method

Participants

This study used a cross-sectional survey design. A convenience sample of 628 Arab adults (Saudi Arabia = 430, Egypt = 92, Kuwait = 66, and

Yemen = 40) aged ≥18 years who smoked tobacco cigarettes was recruited through word of mouth. To achieve a 5% margin of error and 95% confidence level with a reference population of over 20,000 adults, the minimum required sample size was determined to be 377 Arab adults who smoke tobacco cigarettes. The included countries were selected based on the feasibility of administering this study's instruments to each country's citizens. Participants were considered tobacco cigarette smokers if they had smoked tobacco cigarettes (even one cigarette) in the last 30 days (Camenga et al., 2014; Saddleson et al., 2016). An electronic self-administered questionnaire comprising informed consent and closed-ended questions was used to answer author-constructed and other questions that were adapted from previous studies and published scales (Heatherton et al., 1991; Heavner et al., 2009). The questions were translated from English to Arabic in two steps. First, forward–backward translations of linguistics were obtained to ensure the translation accuracy of the item content. Second, cultural adaptation of the items was used to pilot-test the questionnaire by reviewing it with Arab adults who smoked tobacco cigarettes to assess the clarity of each item. After the pilot test, no questions on the original scale were excluded or modified. The study was approved by the Institutional Review Board of the King Abdullah International Medical Research Center (SP21R/223/05). This study was conducted from June 2021 to May 2022.

Measures

Sociodemographic characteristics

Sociodemographic characteristics were collected from participants, including country of residence (Saudi Arabia, Egypt, Kuwait, or Yemen), age (in years), sex (female or male), educational attainment (high school or lower, diploma degree, bachelor's degree, or higher education), occupational status (unemployed, student, or employed), and perceived income (weak, middle, or high). Because the included countries in this study vary in terms of currency and income economy, with Saudi Arabia and Kuwait being high-income countries, Egypt being a lower-middle-income country, and Yemen being a low-income country, we asked participants to provide their perceived income rank instead of their monetary income, ranging from weak to high.

Cigarette smoking behavior characteristics

To assess cigarette smoking behavior characteristics among Arab smokers, we used different author-constructed items that included historical quit attempts ("Have you ever tried to quit tobacco cigarettes in the past?"; no = 0, yes = 1), previous month's quit attempts ("Have you tried to quit

tobacco cigarettes in the past 30 days?"; no = 0, yes = 1), medicinal nicotine product use ("Have you used medicinal nicotine products [such as nicotine patches and nicotine gum]?"; no = 0, yes = 1), desire to quit tobacco cigarettes (from 1 = *least desire* to 10 = *highest desire*), and nicotine dependence by administering the Fagerstrom Test for Nicotine Dependence scale (range 0 = *least dependence* to 10 = *highest dependence*; Heatherton et al., 1991). In addition, we assessed current multiple tobacco product (MTP) use by asking, "Do you currently use waterpipe (shesha, shisha, hookah) and/or electronic nicotine delivery system (ENDS; e-cigarettes or e-hookah)?" Then a dichotomous variable was created (no = 0, or yes =1).

Furthermore, we assessed the use of hypothetical reduced-harm nicotine products by asking the participants the following: first, "If a new product provided nicotine in a way that was almost as satisfying as smoking, it could be used without anyone noticing that you were using it, and reduced your health risks by 50%, would you consider switching to this product?" The possible answers were no = 0, or yes = 1. Second, "If a new product provided nicotine in a way that was almost as satisfying as smoking, could be used without anyone noticing that you were using it, and reduced your health risks by 99%, would you consider switching to this product?" The possible answers were no = 0 or yes = 1. These two questions were adapted from a survey of Edmonton-area smokers' opinions about tobacco and nicotine products (Heavner et al., 2009).

Awareness and use of HTPs

We assessed different items that reflected the awareness of, susceptibility to use, lifetime use, and current use of HTPs. First, participants were asked via author-constructed items about their awareness of HTPs ("Have you ever heard of heated tobacco products?"; no = 0, yes =1) and how they heard of HTPs ("How did you hear about heated tobacco products?") with possible multiple selection answers "from friends," "I saw others using it in public places," "from smoking shops and stores," and "ads on social media."

We assessed participants' susceptibility to HTP use as either *not susceptible* = 0 or *susceptible* = 1. Participants' susceptibility to using HTPs was assessed using a validated questionnaire that included three items ("Would you try heated tobacco products if one of your best friends offered it to you?"; "Do you think you would use heated tobacco products in the next six months?"; and "Are you curious about using heated tobacco products?"). Response options included "definitely not," "probably not," "probably yes," and "definitely yes." Participants who responded "definitely not" to all three questions were classified as not susceptible. Those who responded "probably not," "probably yes," or "definitely yes" to any question were classified as susceptible (Pierce et al., 1996; Strong et al., 2015). Lifetime use of HTPs

was assessed by asking, "Have you ever used heated tobacco products?" Current use of HTPs was assessed by asking, "Do you currently use heated tobacco products?" Possible answers for lifetime and current use of HTPs were no = 0 or yes = 1. Finally, we asked those who answered yes to lifetime and current use of HTPs about the reasons for using them by asking, "What was/were the reason(s) for using heated tobacco products?" The possible multiple selection answers were "alternatives to ENDS," "by recommendation," "curiosity," "safety to my health," and "quitting tobacco cigarettes."

Data analysis

Descriptive statistics of percentages and means are reported to represent the participant characteristics in the univariate analysis. An analysis of variance was conducted to reveal sample characteristics across countries. Finally, logistic regression was used to examine the association between cigarette smoking behavioral characteristics and the use of HTPs, controlling for sociodemographic characteristics (country of residence, age, sex, educational attainment, occupational status, and perceived income). The selection of covariates in the model was based on previous research. Only covariates that were considered to be conceptually relevant as confounders were included in the analysis. SPSS v26 (IBM Corp, 2019) was used for all analyses. Statistical significance was set at $p < .05$.

Results

As shown in Table 1, there were significant between-group differences for all sociodemographic characteristics. The mean age of the total sample was 32.5 years; participants from Kuwait were oldest (mean [*SD*] = 39.2 [12.7]), and the youngest participants were from Saudi Arabia (mean [*SD*] = 30.7 [10.8]). Males comprised most of the sample, especially from Egypt and Yemen. Most participants held bachelor's degrees, were employed, and perceived their income to be mid-level.

With respect to cigarette smoking behavioral characteristics, as depicted in Table 2, most participants had quit tobacco cigarette smoking in the past; however, they had not tried to quit smoking in the past month, nor had they used medicinal nicotine products in the past. In addition, most participants reported a high desire to quit tobacco cigarette smoking, especially among those from Yemen, and they were less dependent on nicotine, except those from Egypt, who were more nicotine-dependent smokers. Concerning MTP use by waterpipes and ENDS with cigarette smoking, most participants were not currently using tobacco products other than cigarettes. When asked whether they would switch to a product that could reduce health risks, most participants indicated that they would

Table 1. Sociodemographic characteristics.

Variable	Total $N=628$ % (*n*)	Saudi Arabia $n=430$ % (*n*)	Egypt $n=92$ % (*n*)	Kuwait $n=66$ % (*n*)	Yemen $n=40$ % (*n*)	*F* ratio	*p* Value
Age (years)							
Mean (*SD*)	32.5 (11.0)	30.7 (10.8)	34.3 (9.0)	39.2 (12.7)	36.3 (8.9)	14.8	<.001
Sex							
Female	17.5 (109)	20.8 (88)	4.4 (4)	22.7 (15)	5.0 (2)	6.6	<.001
Male	82.5 (514)	79.2 (336)	95.6 (87)	77.3 (51)	95.0 (38)		
Educational attainment							
High school or lower	28.7 (180)	33.9 (145)	15.4 (14)	22.7 (15)	12.5 (5)	5.1	.002
Diploma	13.9 (87)	12.1 (52)	20.9 (19)	13.6 (9)	17.5 (7)		
Bachelor's degree	48.3 (303)	46.5 (199)	54.9 (50)	48.5 (32)	55.0 (22)		
Higher education	9.1 (57)	7.5 (32)	8.8 (8)	15.2 (10)	15.0 (6)		
Occupational status							
Unemployed	17.3 (108)	18.0 (77)	20.9 (19)	4.7 (3)	22.5 (9)	6.7	<.001
Student	22.6 (141)	27.9 (119)	9.9 (9)	9.4 (6)	15.0 (6)		
Employed	60.1 (375)	54.1 (231)	69.2 (63)	85.9 (55)	62.5 (25)		
Perceived income							
Weak	10.8 (68)	9.3 (40)	16.3 (15)	1.5 (1)	30.0 (12)	7.0	<.001
Middle	71.3 (448)	70.6 (303)	75.0 (69)	78.5 (51)	60.0 (24)		
High	17.8 (112)	20.1 (86)	8.7 (8)	20.0 (13)	10.0 (4)		

Table 2. Cigarette smoking behavior characteristics.

Variable	Total $N=628$ % (*n*)	Saudi Arabia $n=430$ % (*n*)	Egypt $n=92$ % (*n*)	Kuwait $n=66$ % (*n*)	Yemen $n=40$ % (*n*)	*F* ratio	*p* Value
Have you ever tried to quit tobacco cigarettes in the past?							
No	31.3 (196)	36.1 (154)	22.0 (20)	24.2 (16)	12.5 (5)	5.5	<.001
Yes	68.7 (430)	63.9 (273)	78.0 (71)	75.8 (50)	87.5 (35)		
Have you tried to quit tobacco cigarettes in the past 30 days?							
No	74.4 (462)	77.0 (329)	66.7 (60)	71.9 (46)	65.8 (25)	2.0	.108
Yes	25.6 (159)	23.0 (98)	33.3 (30)	28.1 (18)	34.2 (13)		
Have you used medicinal nicotine products (this includes nicotine patches and nicotine gum)?							
No	84.9 (529)	83.1 (355)	88.9 (80)	83.2 (55)	97.4 (37)	2.3	.076
Yes	15.1 (94)	16.9 (72)	11.1 (10)	16.7 (11)	2.6 (1)		
			Desire to quit tobacco cigarettes (range, 1–10)				
Mean (*SD*)	7.4 (2.8)	7.3 (2.8)	7.8 (2.7)	6.6 (3.0)	8.2 (2.7)	3.8	.010
Fagerstrom Test for Nicotine Dependence (range, 0–10)							
Mean (*SD*)	4.6 (2.5)	4.3 (2.4)	6.0 (2.3)	4.9 (2.7)	3.6 (2.7)	12.9	<.001
Current MTP use (waterpipe and/or ENDS)							
No	54.2 (341)	59.1 (223)	64.1 (59)	53.0 (35)	60.0 (24)	1.73	.160
Yes	45.8 (287)	48.1 (207)	35.9 (33)	47.0 (31)	40.0 (16)		
If a new product provided nicotine in a way that was almost as satisfying as smoking, could be used without anyone noticing that you were using it, and reduced your health risks by 50%, would you consider switching to this product?							
No	25.3 (157)	26.2 (112)	15.7 (14)	28.8 (19)	29.7 (11)	1.7	.150
Yes	74.7 (464)	73.8 (315)	84.3 (75)	71.2 (47)	70.3 (26)		
If a new product provided nicotine in a way that was almost as satisfying as smoking, could be used without anyone noticing that you were using it, and reduced your health risks by 99%, would you consider switching to this product?							
No	15.6 (97)	15.7 (67)	8.9 (8)	22.7 (15)	16.2 (6)	1.8	.129
Yes	84.4 (525)	84.3 (360)	91.1 (82)	77.3 (51)	83.8 (31)		

switch if the product could reduce health risks by 50%. The percentage of those who would switch increased if the product could reduce health risks by 99%. Finally, previous attempts to quit tobacco cigarette smoking,

Table 3. Characteristics of HTP use.

Variable	Total $N=628$ % (*n*)	Saudi Arabia $n=430$ % (*n*)	Egypt $n=92$ % (*n*)	Kuwait $n=66$ % (*n*)	Yemen $n=40$ % (*n*)	*F* ratio	*p* Value
Have you ever heard of HTPs?							
No	75.8 (470)	78.5 (333)	67.0 (61)	66.7 (42)	80.0 (32)	2.9	.032
Yes	24.2 (150)	21.2 (91)	33.0 (30)	33.3 (21)	20.0 (8)		
How did you hear about HTPs? (multiple selections)							
From friends	59.1 (110)	64.0 (73)	30.3 (10)	70.4 (19)	66.7 (8)	4.7	.003
I saw others used it in public places	15.1 (28)	10.5 (12)	30.3 (10)	22.2 (6)	0 (0)		
From smoking shops and stores	10.8 (20)	12.3 (14)	9.1 (3)	7.4 (2)	8.3 (1)		
Ads on social media	15.1 (28)	13.2 (15)	30.3 (10)	0 (0)	25.0 (3)		
Susceptibility to use of HTPs							
Not susceptible	19.2 (110)	19.2 (75)	14.1 (12)	18.6 (11)	28.9 (11)	1.2	.289
Susceptible	80.8 (464)	80.8 (315)	85.9 (73)	81.4 (48)	71.1 (27)		
Lifetime use of HTPs							
No	89.3 (561)	90.0 (386)	82.6 (76)	90.9 (60)	95.0 (38)	2.0	.109
Yes	10.7 (67)	10.0 (43)	17.4 (16)	9.1 (6)	5.0 (2)		
Current use of HTPs							
No	95.0 (597)	96.5 (415)	89.1 (82)	92.4 (61)	97.5 (39)	3.4	.016
Yes	5.0 (31)	3.5 (15)	10.9 (10)	7.6 (5)	2.5 (1)		
Reasons for using HTPs (multiple selections)							
Alternative to ENDS	9.9 (20)	11.2 (15)	0 (0)	14.8 (4)	11.1 (1)	3.1	.026
By recommendation	15.3 (31)	20.9 (28)	0 (0)	7.4 (2)	11.1 (1)		
Curiosity	32.5 (66)	32.8 (44)	45.5 (15)	18.5 (5)	22.2 (2)		
Safer for my health	16.7 (34)	12.7 (17)	27.3 (9)	25.9 (7)	11.1 (1)		
To quit tobacco cigarettes	25.6 (52)	22.4 (30)	27.3 (9)	33.3 (9)	44.4 (4)		

a desire to quit tobacco cigarettes, and nicotine dependence were the only variables that were statistically significant in between-group differences.

As shown in Table 3, most participants were not aware of HTPs, and those who were aware of HTPs had heard about them mostly from friends, followed by seeing it in public places, ads on social media, and from smoking shops and stores. Most participants were susceptible to HTP use but had not previously or currently used HTPs. Among lifetime and current users, the reasons for using HTPs varied; however, the most common were curiosity and a desire to quit tobacco cigarettes. All variables showed statistically significance between-group differences, except for susceptibility to use and lifetime use of HTPs.

Lastly, Table 4 reveals the associations between cigarette smoking behavior characteristics and the use of HTPs, controlling for sociodemographic characteristics. Arab cigarette smokers who had tried to quit in the past were more likely to have used HTPs in their lifetime (adjusted odds ratio [AOR] = 2.63, 95% confidence interval [CI] [1.21–5.71]). However, those who tried to quit in the past month were less likely to be susceptible to HTP use (AOR = 0.51, 95% CI [0.28–0.92]). Alternatively, those who were more nicotine-dependent cigarette smokers were more likely to be susceptible to HTP use (AOR = 1.12, 95% CI [1.01–1.24]). In addition, those who were currently MTP users were more likely to have used HTPs in

Table 4. Associations between cigarette smoking behavior characteristics and the use of HTPs.

	Susceptibility to use		Lifetime use		Current use	
Variable	AOR	95% CI	AOR	95% CI	AOR	95% CI
Have you ever tried to quit tobacco cigarettes in the past?						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.17	[0.64–2.13]	2.63	[1.21–5.71]	1.77	[0.63–4.91]
Have you tried to quit tobacco cigarettes in the past 30 days?						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.51	[0.28–0.92]	0.68	[0.32–1.41]	0.72	[0.24–2.13]
Have you used medicinal nicotine products (this includes nicotine patches and nicotine gum)?						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.10	[0.50–2.41]	0.61	[0.25–1.44]	0.37	[0.07–1.75]
Desire to quit tobacco cigarettes						
	0.94	[0.85–1.04]	0.96	[0.85–1.07]	0.91	[0.78–1.06]
Fagerstrom Test for Nicotine Dependence						
	1.12	[1.01–1.24]	1.11	[0.98–1.25]	1.09	[0.92–1.28]
Current MTP use						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.27	[0.76–2.12]	2.87	[1.57–5.24]	1.90	[0.81–4.43]
If a new product provided nicotine in a way that was almost as satisfying as smoking, could be used without anyone noticing that you were using it, and reduced your health risks by 50%, would you consider switching to this product?						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.74	[0.92–3.29]	1.59	[0.59–4.25]	2.21	[0.51–9.53]
If a new product provided nicotine in a way that was almost as satisfying as smoking, could be used without anyone noticing that you were using it, and reduced your health risks by 99%, would you consider switching to this product?						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	2.17	[1.05–4.51]	1.30	[0.39–4.33]	0.66	[0.13–3.30]

Note. Controlled for country of residence, age, sex, educational attainment, occupational status, and perceived income.

their lifetime (AOR = 2.87, 95% CI [1.57–5.24]). Finally, those who would consider switching to a product that provided nicotine and could reduce health risks by 99% were more likely to be susceptible to HTP use (AOR = 2.17, 95% CI [1.05–4.51]). No cigarette smoking behavior characteristics were associated with the current use of HTPs.

Discussion

This study provides insights into two crucial cigarette smoking behaviors among adult Arab smokers in four countries in the EMR region. A desire to quit smoking, followed by awareness, susceptibility, and other factors, was associated with the use of HTPs. Such findings are important for providing evidence-based treatment in the region and for preventing the use of tobacco industry tactics in marketing HTPs.

Overall, results echo the common finding of a high frequency of quit attempts among tobacco cigarette smokers, accompanied by a high desire to quit. This finding was consistent across all four countries included in this study. Notably, the use of medicinal nicotine products (for example, nicotine patches and gum) was very low in the sample despite a desire to quit, which shows the potential for offering evidence-based treatment

to smokers wanting to quit. Additionally, the use of medicinal nicotine products was lower in Egypt and Yemen than in the other two countries, which could be related to the differences in individual income levels, as well as the health care services, health policies, and availability and affordability of medicinal nicotine products.

The present study's sample of smokers exhibited a higher level of awareness compared to the general population. For instance, in Saudi Arabia, 21.2% of participants were aware of HTPs, whereas the national estimate of awareness in the general population is 8.4% (WHO, 2019). This is in line with existing studies showing a higher awareness among smokers (Ratajczak et al., 2020). Similarly, results show a relatively higher prevalence of current and lifetime use of HTPs than among the general population (5.0% and 10.7%, respectively, compared to the national estimates of 0.1% and 0.5%, respectively; WHO, 2019). Although the prevalence in the present study is similar to that in other studies (Nyman et al., 2018), there is a wide variation between regions due to several potential reasons, including marketing, regulations, and availability of tobacco products (Ratajczak et al., 2020). Results show a high susceptibility to use of HTPs among the sample of smokers, which could be explained by the current perception of lower risk associated with HTPs and smokers' intention to reduce their risk of diseases (El-Toukhy et al., 2018; Xu et al., 2020). This was also demonstrated by our finding that those who had a greater desire to quit were more likely to be susceptible to the use of HTPs. A major factor in experimenting with HTPs, reducing the risk imposed by combustible tobacco products, was found in a qualitative study in the United Kingdom, where HTPs were perceived as a healthier alternative (Tompkins et al., 2021).

With the same rationale, those who tried to quit in the past were more likely to try HTPs. Additionally, those who had greater nicotine dependence were more susceptible to trying HTPs, demonstrating their struggle to quit using combustible tobacco. Furthermore, this study revealed that the attempt to quit smoking among participants was associated with susceptibility to initiating the use of HTPs. Consistent with this finding, smokers reported that they were able to quit smoking when they used HTPs (Tattan-Birch et al., 2022). However, these studies did not find statistically significant differences in the risk of adverse events between HTP users and tobacco cigarette smokers (Tattan-Birch et al., 2022). These studies were sponsored by the tobacco industry (Tattan-Birch et al., 2022). Therefore, the findings of current and previous studies may encourage future researchers to support independent research that examines the effectiveness of HTP use for smoking cessation among those who are willing to quit smoking.

These findings highlight the importance of offering accessible evidence-based treatment to current smokers to augment their attempts to

quit tobacco. Along with improving accessibility to evidence-based treatment, health education messaging for current smokers may need to highlight the availability of safe medicinal nicotine replacement and clarify the risks associated with HTPs. In addition, stricter regulations to limit the availability of HTPs to nonsmoking youth, who may experiment with HTP use under a false impression that it is harmless and consequently become addicted to nicotine, are necessary.

The study observed that individuals were more susceptible to starting the use of HTPs when they considered switching to a product that contained nicotine and had the potential to reduce the health risks associated with smoking. Consistent with this result, a previous study conducted in 28 countries found that one of the most common reasons for using HTPs was the perception that HTPs are less dangerous than conventional tobacco products (Laverty et al., 2021). This finding could be interpreted in terms of the role of the tobacco industry in marketing HTPs. Although independent researchers have shown that HTPs have a negative impact on human health (Znyk et al., 2021), studies funded by the tobacco industry have found that HTPs are less toxic than combustible tobacco products (Znyk et al., 2021). The tobacco industry has begun to promote HTPs using the concept of tobacco harm reduction (Bialous & Glantz, 2018). This claim made by the tobacco industry may be intended to soften the social and regulatory aspects of tobacco use (Bialous & Glantz, 2018). In addition, this claim could be considered misleading, because there are limited independent studies that have examined the long-term impact of HTP use on current tobacco users and those who have never used tobacco (Tactics, 2022). Considering the historical influence of the tobacco industry in the Middle East and the limited implementation of tobacco control policies in most of the EMR countries (White & Hammond, 2001), active monitoring of the tobacco industry's marketing activities in the region is a fundamental step in combating misleading information related to HTPs.

The present study has some limitations. First, the small number of participants may have limited the analyses, interpretation, and generalizability of the findings in these countries. Second, the data are based on self-report, which may introduce social desirability bias and misclassification in the outcome and exposure variables. Third, the cross-sectional nature of the study precludes inferring longitudinal relationships between variables. Finally, the sample of smokers in this study was recruited via word of mouth, which could introduce a selection bias. Representative and random sampling with a longitudinal assessment is highly recommended for future research.

Conclusions

This study is one of the first to assess awareness, susceptibility, and associated factors in HTP use among adult Arab smokers in the EMR region. Our findings revealed that awareness of HTPs is relatively low among adult Arab smokers, and attempts to quit tobacco cigarettes, nicotine dependence, and switching to a product that delivers nicotine with reduced health risks were significant factors in HTPs use among adult Arab smokers. The findings of this study provide potential for evidence-based treatment in the region and may help prevent the use of tobacco industry tactics in marketing of HTPs.

Authors' contributions

AMA, SSM, and AHA: conceptualization, analysis, article writing; NSA, AAA, WMB, SAA, MAA, SNH, and WSA: data curation and collection; TFA, SAA, HYA, MMA, and TTI: article writing and editing.

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References

Bialous, S. A., & Glantz, S. A. (2018). Heated tobacco products: Another tobacco industry global strategy to slow progress in tobacco control. *Tobacco Control*, *27*(Suppl 1), s111–s117. https://doi.org/10.1136/tobaccocontrol-2018-054340

Camenga, D. R., Kong, G., Cavallo, D. A., Liss, A., Hyland, A., Delmerico, J., Cummings, K. M., & Krishnan-Sarin, S. (2014). Alternate tobacco product and drug use among adolescents who use electronic cigarettes, cigarettes only, and never smokers. *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine*, *55*(4), 588–591. https://doi.org/10.1016/j.jadohealth.2014.06.016

Cruz, T. B., McConnell, R., Low, B. W., Unger, J. B., Pentz, M. A., Urman, R., Berhane, K., Chou, C. P., Liu, F., & Barrington-Trimis, J. L. (2019). Tobacco marketing and subsequent use of cigarettes, e-cigarettes, and hookah in adolescents. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, *21*(7), 926–932. https://doi.org/10.1093/ntr/nty107

El-Toukhy, S., Baig, S. A., Jeong, M., Byron, M. J., Ribisl, K. M., & Brewer, N. T. (2018). Impact of modified risk tobacco product claims on beliefs of US adults and adolescents. *Tobacco Control*, *27*(Suppl 1), s62–s69. https://doi.org/10.1136/tobaccocontrol-2018-054315

Hatsukami, D. K., Henningfield, J. E., & Kotlyar, M. (2004). Harm reduction approaches to reducing tobbacco-related mortality. *Annual Review of Public Health*, *25*, 377–395. https://doi.org/10.1146/annurev.publhealth.25.102802.124406

Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerstrom, K. O. (1991). The Fagerström test for nicotine dependence: A revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addiction*, *86*(9), 1119–1127. https://doi.org/10.1111/j.1360-0443.1991.tb01879.x

Heavner, K. K., Rosenberg, Z., & Phillips, C. V. (2009). Survey of smokers' reasons for not switching to safer sources of nicotine and their willingness to do so in the future. *Harm Reduction Journal*, *6*(1), 1–8. https://doi.org/10.1186/1477-7517-6-14

Hughes, J. R., Peters, E. N., & Naud, S. (2008). Relapse to smoking after 1 year of abstinence: A meta-analysis. *Addictive Behaviors*, *33*(12), 1516–1520. https://doi.org/10.1016/j.addbeh.2008.05.012

IBM Corp. Released (2019). IBM SPSS Statistics for Macintosh, Version 26.0 Armonk, NY: IBM Corp.

Jankowski, M., Brożek, G. M., Lawson, J., Skoczyński, S., Majek, P., & Zejda, J. E. (2019). New ideas, old problems? Heated tobacco products–A systematic review. *International Journal of Occupational Medicine and Environmental Health*, *32*(5), 595–634. https://doi.org/10.13075/ijomeh.1896.01433

Kim, S. H., & Cho, H.-J. (2020). Prevalence and correlates of current use of heated tobacco products among a nationally representative sample of Korean adults: Results from a cross-sectional study. *Tobacco Induced Diseases*, *18*(August), 66. https://doi.org/10.18332/tid/125232

Laverty, A. A., Vardavas, C. I., & Filippidis, F. T. (2021). Prevalence and reasons for use of heated tobacco products (HTP) in Europe: An analysis of Eurobarometer data in 28 countries. *The Lancet Regional Health. Europe*, *8*, 100159. https://doi.org/10.1016/j.lanepe.2021.100159

Leigh, N. J., Tran, P. L., O'Connor, R. J., & Goniewicz, M. L. (2018). Cytotoxic effects of heated tobacco products (HTP) on human bronchial epithelial cells. *Tobacco Control*, *27*(Suppl 1), s26–s29. https://doi.org/10.1136/tobaccocontrol-2018-054317

Lempert, L. K., & Glantz, S. A. (2018). Heated tobacco product regulation under US law and the FCTC. *Tobacco Control*, *27*(Suppl 1), s118–s125. https://doi.org/10.1136/tobaccocontrol-2018-054560

Mallock, N., Pieper, E., Hutzler, C., Henkler-Stephani, F., & Luch, A. (2019). Heated tobacco products: A review of current knowledge and initial assessments. *Frontiers in Public Health*, *7*, 287. https://doi.org/10.3389/fpubh.2019.00287

Market, R. A. (2020). *Regulatory Report: Saudi Arabia - Heated Tobacco*. Retrieved August 2022, from, https://www.researchandmarkets.com/reports/5238200/regulatory-report-saudi-arabia-heated-tobacco?utm_source=BW&utm_medium=PressRelease&utm_code=5m5tv9&utm_campaign=1495716+-+Saudi+Arabia+Heated+Tobacco+Regulatory+Report+2020&utm_exec=chdo54prd

McNeill, A., Brose, L. S., Calder, R., Bauld, L., & Robson, D. (2018). Evidence review of e-cigarettes and heated tobacco products 2018. A report commissioned by public health England. Public Health England. 6.

Nyman, A. L., Weaver, S. R., Popova, L., Pechacek, T. F., Huang, J., Ashley, D. L., & Eriksen, M. P. (2018). Awareness and use of heated tobacco products among US adults, 2016–2017. *Tobacco Control*, *27*(Suppl 1), s55–s61. https://doi.org/10.1136/tobaccocontrol-2018-054323

Pierce, J. P., Choi, W. S., Gilpin, E. A., Farkas, A. J., & Merritt, R. K. (1996). Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, *15*(5), 355–361. https://doi.org/10.1037//0278-6133.15.5.355

Ratajczak, A., Jankowski, P., Strus, P., & Feleszko, W. (2020). Heat not burn tobacco product—A new global trend: Impact of heat-not-burn tobacco products on public health, a systematic review. *International Journal of Environmental Research and Public Health*, *17*(2), 409. https://doi.org/10.3390/ijerph17020409

Saddleson, M., Kozlowski, L., Giovino, G., Homish, G., Mahoney, M., & Goniewicz, M. (2016). Assessing 30-day quantity-frequency of US adolescent cigarette smoking as a predictor of adult smoking 14 years later. *Drug and Alcohol Dependence*, *162*, 92–98. https://doi.org/10.1016/j.drugalcdep.2016.02.043

Samet, J. M. (2013). Tobacco smoking: The leading cause of preventable disease worldwide. *Thoracic Surgery Clinics*, *23*(2), 103–112. https://doi.org/10.1016/j.thorsurg.2013.01.009

Simonavicius, E., McNeill, A., Shahab, L., & Brose, L. S. (2019). Heat-not-burn tobacco products: A systematic literature review. *Tobacco Control*, *28*(5), 582–594. https://doi.org/10.1136/tobaccocontrol-2018-054419

Strong, D. R., Hartman, S. J., Nodora, J., Messer, K., James, L., White, M., Portnoy, D. B., Choiniere, C. J., Vullo, G. C., & Pierce, J. (2015). Predictive validity of the expanded susceptibility to smoke index. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, *17*(7), 862–869. https://doi.org/10.1093/ntr/ntu254

Tactics, T. (2022). *Harm Reduction*. Retrieved 10 August, from https://tobaccotactics.org/wiki/harm-reduction/

Tattan-Birch, H., Hartmann-Boyce, J., Kock, L., Simonavicius, E., Brose, L., Jackson, S., Shahab, L., & Brown, J. (2022). Heated tobacco products for smoking cessation and reducing smoking prevalence. *The Cochrane Database of Systematic Reviews*, *1*(1), CD013790. https://doi.org/10.1002/14651858.CD013790.pub2

Tompkins, C. N., Burnley, A., McNeill, A., & Hitchman, S. C. (2021). Factors that influence smokers' and ex-smokers' use of IQOS: A qualitative study of IQOS users and ex-users in the UK. *Tobacco Control*, *30*(1), 16–23. https://doi.org/10.1136/tobaccocontrol-2019-055306

Warner, K. E. (2019). How to think—not feel—about tobacco harm reduction. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, *21*(10), 1299–1309. https://doi.org/10.1093/ntr/nty084

White, C., & Hammond, R. (2001). *Voices of truth, Vol. 1: Multinational tobacco industry activity in the Middle East: A review of internal industry documents*.

World Health Organization. (2019). Global adult tobacco survey, kingdom of Saudi Arabia, fact sheet 2. https://cdn.who.int/media/docs/default-source/ncds/ncd-surveillance/data-reporting/saudi-arabia/ksa_gats_2019_factsheet_rev_4feb2021-508.pdf?sfvrsn=c349a97a_1&download=true

World Health Organization. (2020). *Heated tobacco products: Information sheet* – (2nd ed.) https://www.who.int/publications/i/item/WHO-HEP-HPR-2020.2

World Health Organization. (2021a). *EGYPT - Tobacco industry interference index*. https://globaltobaccoindex.org/upload/assets/dhYj7RmBllEfxQdUEBAKTzbenJXYWghlMyoV9XVizT8NkdeFiI.pdf

Xu, S. S., Meng, G., Yan, M., Gravely, S., Quah, A. C. K., Ouimet, J., O'Connor, R. J., Sutanto, E., Yoshimi, I., Mochizuki, Y., Tabuchi, T., & Fong, G. T. (2020). Reasons for regularly using heated tobacco products among adult current and former smokers in Japan: Finding from 2018 ITC Japan Survey. *International Journal of Environmental Research and Public Health*, *17*(21), 8030. https://doi.org/10.3390/ijerph17218030

Znyk, M., Jurewicz, J., & Kaleta, D. (2021). Exposure to heated tobacco products and adverse health effects, a systematic review. *International Journal of Environmental Research and Public Health*, *18*(12), 6651. https://doi.org/10.3390/ijerph18126651