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Research Paper

The Association Between Hookah Smoking and Musculoskeletal Conditions: Results From a Cohort Study in Southern Iran

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ABSTRACT

Background: Smoking is known to have adverse effects on various human body systems. While previous studies have predominantly emphasized the harmful effects of smoking on other organs, the impact on the musculoskeletal system has been relatively understudied. This study aimed to survey the association between hookah smoking and musculoskeletal conditions.

Materials and Methods: This descriptive cross-sectional study was conducted on 4026 participants selected from baseline data of the Bandar-Kong non-communicable diseases (BKNCD) cohort study in southern Iran. Skeletal muscle injuries were identified through the medical questionnaire of the cohort based on the participants' history, where "yes" denoted the presence of injuries and "no" indicated their absence. Statistical analysis was performed by SPSS software, version 26 at a significance level of $P<0.05$.

Results: Among the 4026 participants, 2315(57.5%) were women and 1711(42.5%) were men. The mean age of participants was 48±9 years. Among 709 hookah users, 20(2.83%) and 40(5.64%) cases suffered from movement disorders and osteoporosis, respectively. Also, 108(15.23%) and 284(40.05%) hookah users experienced back pain and joint pain, respectively. The odds ratio (OR) of movement disorder was 2.38 times higher for hookah smokers than non-smokers (OR=2.38; P=0.002). There was no significant relationship between hookah smoking and other injuries (P>0.05).

Conclusion: The most common problem was joint pain. The mechanism of the effect of smoking on injuries was unknown. Further studies, with larger sample sizes, are necessary to evaluate the association between hookah smoking and musculoskeletal injuries.

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Introduction

Hookah smoking, also known as waterpipe smoking, is a prevalent form of tobacco use, particularly in the Middle East and South Asia [1]. While smoking is widely recognized for its adverse effects on the human body, including its association with high-mortality diseases such as cancers and cardiovascular and respiratory diseases [2], its impact on musculoskeletal health remains less understood and poorly documented. The relationship between hookah smoking and musculoskeletal conditions is still unclear. The musculoskeletal system, as one of the main human body systems, consists of bones, joints, muscles, cartilage, tendons, ligaments, and other connective nerves [3].

A healthy and efficient musculoskeletal system is essential for daily activities and high quality of life [4]. Some studies have explored the potential link between smoking, including hookah smoking, and musculoskeletal disorders. There is evidence suggesting that smoking, including hookah smoking, can have negative effects on bone health and increase the risk of musculoskeletal conditions [2]. However, more studies are needed to establish a direct link between hookah smoking and musculoskeletal health. Understanding this potential connection can guide public health interventions and enable individuals to make informed decisions about their tobacco use. Previous studies have observed a positive relationship between smoking and back pain [5, 6]. To delve deeper into this topic, we aim to investigate the potential relationship between hookah smoking and skeletal muscle injuries based on a comprehensive population investigation from the PERSIAN cohort study. The PERSIAN Cohort Study is a long-term, large-scale study conducted in Iran, offering a valuable opportunity to examine the health effects of hookah smoking in a diverse population [5]. The study will utilize self-reported data on hookah smoking, along with additional questionnaires on musculoskeletal health, to assess the prevalence of musculoskeletal conditions and their potential association with hookah smoking.

Materials and Methods

This descriptive cross-sectional study utilized baseline data from the Bandar-Kong non-communicable diseases (BKNCD) cohort study, comprising 4026 participants aged 35-70 years, located in the south of Iran. The BKNCD is part of the prospective epidemiological research studies in IRAN (PERSIAN) [7]. According to the BKNCD profile [8], the inclusion criteria were willingness to participate, age between 35 and 75 years, residency of at least one year and nine months annually, provision of written informed consent, and Iranian nationality. The exclusion criteria included incomplete smoking or musculoskeletal condition records.

Participants were categorized into hookah and non-smoker groups according to their smoking status. The process of subject selection is illustrated in Figure 1 Demographic information, including age, body mass index (BMI), education, gender, residence, marital status, socioeconomic status, and occupation was collected through interviews. Hookah smoking status was determined through a questionnaire querying hookah use within the last 30 days. Cigarette smoking status adhered to the current definition of the national health interview survey (NHIS), requiring smoking of more than 100 cigarettes over a lifetime [9]. Also, participants were queried about exposure to smoking at the workplace and whether any family members smoked at home. Alcohol consumption and drug abuse were also assessed. Physical activity levels were also assessed using a questionnaire employing metabolic equivalent rates (METs) [10]. Participants' daily activities were measured using the MET index, with a score below 40 considered insufficient and a score of 40 or higher deemed adequate.

Skeletal muscle injuries, such as walking problems, muscle weakness, movement disorders, numbness of hands or feet, recurring headaches, dizziness, history of fracture in the last 5 years, fractures due to falling, femoral issues, osteoporosis, back pain persisting for more than a week, back pain with morning stiffness for more than an hour, joint pain and joint pain with morning stiffness, were considered and checked in all participants. These injuries were identified in the medical questionnaire of the cohort based on the subjects' history, where 'Yes' indicated the presence of the disorder and 'No' indicated its absence [11].

Statistical analysis

Quantitative variables were reported as Mean±SD, and qualitative variables were expressed as number and percentage (%). The independent-samples t-test was used to compare the mean scores of the groups, and the chi-square test was employed to determine if there was a significant relationship between two categorical variables. The logistic regression model was used to investigate the relationship between hookah consumption and each of the variables. All statistical analyses were performed using SPSS software version 26, and a $P<0.05$ was considered statistically significant.

Results

Among the 4026 participants, 2315(57.5%) were women and 1711(42.5%) were men. The mean age of participants was 48±9 years. The majority of participants (84.7%) resided in urban areas. In terms of socio-economic status and physical activities, 1544(38.4%) and 2260(56.1%) cases were categorized as low, respectively. Additionally, 393(9.8%) males and 316(7.8%) females were hookah users. Among the 709 hookah users, 177 cases were cigarette smokers; 54 cases were drug users, and 79 cases were alcohol users. The demographic characteristics of participants are presented in Table 1.

The main musculoskeletal issues observed in participants are presented in Table 2. Among 709 hookah users, 20(2.83%) and 40(5.64%) cases suffered from movement disorders and osteoporosis, respectively. Additionally, 104(14.67%) cases had a history of fractures due to falling, while 108(15.23%) and 284(40.05%) cases reported back pain and joint pain, respectively. After adjusting for other variables, the odds of movement disorders were 2.38 times more for hookah users compared to non-users (odds ratio (OR)=2.38; P=0.002). There was no statistically significant relationship between hookah smoking and other diseases (P>0.05) (Table 3).

Discussion

The main observed musculoskeletal issues observed in hookah smokers were movement disorders (2.83%) and osteoporosis (5.64%). Additionally, 14.67% of them had a history of fractures due to falling. Also, 15.23% and 40.05% of hookah smokers experienced back pain and joint pain, respectively. The odds of movement disorders were 2.38 times higher for hookah users than non-smokers, and there was no statistically significant relationship between hookah smoking and other disorders.

Regarding osteoporosis, previous research has indicated potential interactions between smoking and osteoporosis in postmenopausal women [12] and between smoking and glutathione S-transferases polymorphism on bone quality index in young adult men [13]. Studies have also explored the prevalence of fractures in smokers, the relationship between smoking and fracture risk, fracture healing, the biological mechanisms of fractures in smokers, and the interaction of smoking with other fracture risks [2]. Fracture incidence was found to be higher in male smokers compared to male nonsmokers [14], with smoking increasing the likelihood of fractures. Current smoking was associated with a higher risk of osteoporotic fractures in elderly men [15], and former and current smoking in older women compared to nonsmokers increased the risk of fractures [16, 17]. Moreover, smoking has been significantly linked to unfavorable fracture outcomes such as nonunion [18-21], lower trabecular strength and toughness [22], and delayed mean

Table 1. Demographic characteristics of the participants

Characteristics		Mean±SD/No. (%)			P
		Total (n=4026)	Non-users (n=3317)	Hookah Users (n=709)	
Age (y)		48.24±9.4	47.70±9.1	50.8±10.2	<0.001[a]
Education (y)		5.82±4.81	6.10±4.9	4.45±4.1	<0.001[a]
BMI (kg/m^2)		26.90±5.11	27.00±5.07	26.46±5.27	0.011[a]
Gender	Male	1711(42.5)	1318(32.7)	393(9.8)	<0.001[b]
	Female	2315(57.5)	1999(49.7)	316(7.8)	
Residence	Urban	3411(84.7)	2832(70.3)	579(14.4)	0.016[b]
	Rural	615(15.3)	485(12.0)	130(3.2)	
Marital status	Single/Widowed/ Divorced	421(10.5)	320(7.9)	101(2.5)	<0.001[b]
	Married	3605(89.5)	2997(74.4)	608(15.1)	

Characteristics		Mean±SD/No. (%)			P
		Total (n=4026)	Non-users (n=3317)	Hookah Users (n=709)	
Socio-economic status	Low	1544(38.4)	1207(30.0)	337(8.4)	<0.001[b]
	Moderate	844(21.0)	708(17.6)	136(3.4)	
	High	1638(40.6)	1402(34.8)	236(5.8)	
Physical activity score (METs/day)	Insufficient (<40)	2260(56.1)	1850(46.0)	410(10.1)	0.338[b]
	Acceptable (≥40)	1766(43.9)	1467(36.5)	299(7.4)	
Job	No	2250(55.9)	1888(46.9)	362(9.0)	0.005[b]
	Yes	1776(44.1)	1429(35.5)	347(8.6)	
Have you smoked at least 100 cigarettes in your life?	No	3438(85.4)	2906(72.2)	532(13.2)	<0.001[b]
	Yes	588(14.6)	411(10.2)	177(4.4)	
Are you in contact with cigarette smoke at home?	No	3539(87.9)	2920(72.5)	619(15.4)	0.612[b]
	Yes	487(12.1)	397(9.9)	90(2.2)	
Are you in contact with cigarette smoke at your workplace?	No	1709(42.4)	1352(33.6)	357(8.8)	<0.001[b]
	Yes	202(5.1)	139(3.5)	63(1.6)	
	I do not work outside the home	2115(52.5)	1826(45.4)	289(7.1)	
Did anyone in your family smoke at home when you were a child?	No	3630(90.2)	2992(74.4)	638(15.8)	0.835[b]
	Yes	396(9.8)	325(8.0)	71(1.8)	
Drug Use	No	3851(95.7)	3196(79.4)	655(16.3)	<0.001[b]
	Yes	175(4.3)	121(3.0)	54(1.3)	
Alcohol consumption	No	3810(94.6)	3180(79.0)	630(15.6)	<0.001[b]
	Yes	216(5.4)	137(3.4)	79(2.0)	

[a]Independent-samples t-test, [b]Chi-square test.

healing time [23]. Compounds present in tobacco, such as nicotine and polycyclic aromatic hydrocarbons like Benzo[a]pyrene, inhibit bone formation and reduce bone mass [24]. Additionally, tobacco smoke's anti-estrogenic effects lead to decreased vitamin D3 levels and low calcium absorption [25, 26].

In our study, joint pain emerged as the most common issue. In a study, smokers were found to have a higher risk of medial and lateral tibiofemoral cartilage defects [27]. However, another study reported no association between smoking and tibiofemoral cartilage defects [28]. Moreover, smokers exhibited early meniscus repair failure [29], less improvement after autologous chondrocyte implantation surgery for knee defects [30], and a lower satisfaction rate after knee microfracture procedures [31] compared to non-smokers. Conversely, one study found no association between smoking and disc degeneration or low back pain [32]. Some studies reported an association between smoking and the risk of reoperation [33-35], higher infection rates [36, 37], increased morbidity risk [37], and greater use of analgesics [38, 39]. Additionally, some studies found a significant association between smoking and lower spinal fusion rates [36, 38, 40], while one study yielded conflicting results [41].

Several mechanisms, such as impaired bone healing [42], decreased function of osteoblasts and bone resorption, and increased systemic inflammation in smokers, may play an important role in the development of os-

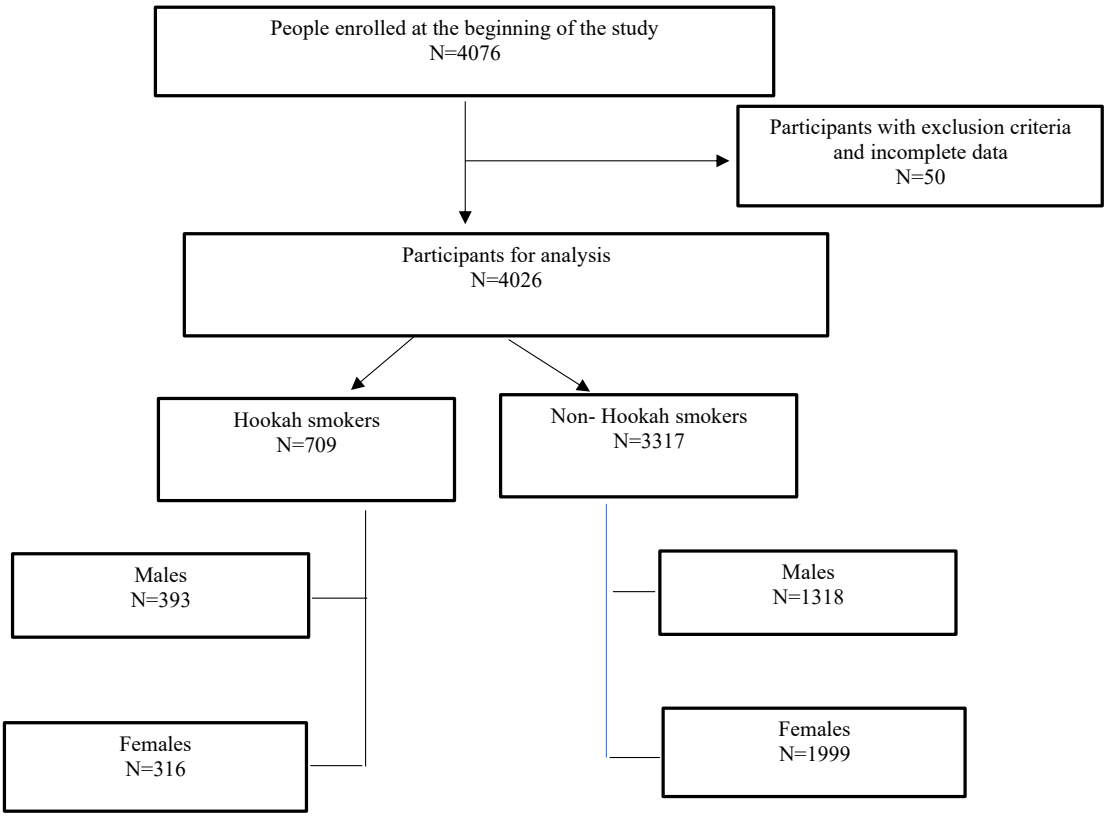

Figure 1. Sampling flowchart

Table 2. The main problems/injuries of participants'

Characteristics		No. (%)			P
		Total (n=4026)	Non-users (n=3317)	Hookah Users (n=709)	
Walking problem	No	4006(99.5)	3301(82.0)	705(17.5)	0.768
	Yes	20(0.5)	16(0.4)	4(0.1)	
Muscle weakness	No	3929(97.6)	3242(80.5)	687(17.1)	0.179
	Yes	97(2.4)	75(1.9)	22(0.5)	
Movement disorders	No	3966(98.5)	3277(81.4)	689(17.1)	0.003
	Yes	60(1.5)	40(1.0)	20(0.5)	
Numbness of hands or feet	No	3824(95.0)	3157(78.4)	667(16.6)	0.219
	Yes	202(5.0)	160(4.0)	42(1.0)	
Recurring headaches	No	3853(95.7)	3177(78.9)	676(16.8)	0.610
	Yes	173(4.3)	140(3.5)	33(0.8)	
Dizziness	No	3823(95.0)	3156(78.4)	667(16.6)	0.256
	Yes	203(5.0)	161(4.0)	42(1.0)	

Characteristics		No. (%)			P
		Total (n=4026)	Non-users (n=3317)	Hookah Users (n=709)	
History of fracture in the last 5 years	No	3784(94.0)	3128(77.7)	656(16.3)	0.081
	Yes	242(6.0)	189(4.7)	53(1.3)	
Fractures due to falling	No	3512(87.2)	2907(72.2)	605(15.0)	0.107
	Yes	514(12.8)	410(10.2)	104(2.6)	
Femoral issues	No	3990(99.1)	3287(81.6)	703(17.5)	>0.999
	Yes	36(0.9)	30(0.8)	6(0.1)	
Osteoporosis	No	3746(93.0)	3077(76.4)	669(16.6)	0.143
	Yes	280(7.0)	240(6.0)	40(1.0)	
Back pain for more than a week	No	3438(85.4)	2837(70.5)	601(14.9)	0.598
	Yes	588(14.6)	480(11.9)	108(2.7)	
Back pain with morning stiffness for more than an hour	No	3678(91.4)	3036(75.4)	642(16.0)	0.418
	Yes	348(8.6)	281(7.0)	67(1.6)	
Joint pain	No	2420(60.1)	1995(49.6)	425(10.5)	0.933
	Yes	1606(39.9)	1322(32.8)	284(7.1)	
Joint pain with morning stiffness	No	3740(92.9)	3090(76.8)	650(16.1)	0.097
	Yes	286(7.1)	227(5.6)	59(1.5)	

Table 3. The multivariate logistic regression to explore the relationship between hookah smoking and other variables

Problems	Odds Ratio (95% CI)	P
Walking problem	1.17 (0.39, 3.51)	0.779
Muscle weakness	1.38 (0.85, 2.24)	0.186
Movement disorders	2.38 (1.38, 4.09)	0.002
Numbness of hands or feet	1.24 (0.87, 1.76)	0.224
Recurring headaches	1.10 (0.75, 1.63)	0.605
Dizziness	1.23 (0.87, 1.75)	0.238
History of Fracture in the last 5 years	1.34 (0.97, 1.83)	0.072
Fractures due to falling	1.22 (0.96, 1.53)	0.095
Femoral issues	1.07 (0.44, 2.63)	0.881
Osteoporosis	1.31 (0.92, 1.85)	0.131
Back pain for more than a week	1.06 (0.84, 1.33)	0.602
Joint pain	1.13 (0.85, 1.49)	0.400

teoarthritis [43, 44]. Although numerous studies have investigated the relationship between smoking and skeletal disorders, the results remain controversial, and the mechanism by which smoking affects injuries is unclear. Therefore, additional studies with larger sample sizes are necessary to assess the association between hookah smoking and skeletal muscle injuries. Furthermore, the effects of smoking on musculoskeletal disorders may be influenced by various socioeconomic factors and comorbidities, which should be considered in future research.

Conclusion

Joint pain was the most common problem observed in our study, followed by back pain, a history of fractures, movement disorders, and osteoporosis. The odds of movement disorders were 2.38 times higher for hookah users than non-smokers, with no statistically significant relationship found between hookah smoking and other disorders. Since smoking is a significant public health concern, further research is essential to understand the mechanisms of smoking's effects on the musculoskeletal system and to raise awareness among healthcare providers and community members about the detrimental effects of smoking on the body's musculoskeletal system.

Ethical Considerations

Compliance with ethical guidelines

The Ethics Committee of the Hormozgan University of Medical Sciences approved this study (Code: IR.HUMS.REC.1402.369), which was conducted in compliance with the statements of the Declaration of Helsinki. Informed consent was obtained from all participants.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflicts of interests.

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