

Research Paper

Investigating the Association Between Waterpipe/
Cigarette Smoking and Incidence of Musculoskeletal
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ABSTRACT

Background: Tobacco smoking is an essential factor that affects people's quality of life. Numerous studies have suggested that tobacco smoking has considerable harmful effects on the musculoskeletal system. In addition, it has a high prevalence in Hormozgan Province, Iran. Accordingly, this research investigates the consumption of tobacco products and its relationship with the prevalence of symptoms of musculoskeletal disorders in service workers of Bandar Abbas City, Iran.

Materials and Methods: This was a descriptive-analytical epidemiological study with cross-sectional data. The population comprised 351 urban service workers employed in Bandar Abbas City, Iran. In the present research, musculoskeletal disorders over the past 12 months were investigated using the Nordic questionnaire in each of the nine body parts.

Results: The mean age of the participants was 37.66±7.9 years. More than half of the studied population (52%) smoked tobacco, and all of them experienced more musculoskeletal problems compared to the other group. Musculoskeletal disorders in tobacco smokers showed a significant difference in four parts of the body, including the elbow, lower back, hip, and knees, with P<0.05 when compared to individuals who did not smoke tobacco.

Conclusion: Individuals who smoked tobacco experienced higher pain in their muscles and bones compared to the other group, which can arise from the adverse effects of tobacco products on muscles, tendons, cartilage, and ligaments. Hence, suitable policies and plans are required to prevent and reduce tobacco consumption in the province, especially in occupations that are susceptible to musculoskeletal disorders.

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Introduction

Cigarette smoking is one of the most important and preventable causes of mortality worldwide. According to the [World Health Organization \(WHO\)](#), the consumption of tobacco products causes 6 million deaths annually on average and is predicted to reach 8.4 million people by 2030 [1, 2]. WHO evaluation reports show that one-third of individuals above 15 years consume tobacco products, with developing countries claiming more than 70% of the share of these individuals [3-5]. In addition, WHO has maintained that around 80% of the mortality resulting from tobacco products occurs in developing countries [2, 6]. More than 7 million of these mortalities result from direct consumption of tobacco, and the rest are related to non-smokers, regarded as secondhand smoke, and subjects who get exposed to cigarette smoke [7]. The disability-adjusted life years for cigarettes in developed and developing countries are 4% and 13%, respectively. It is still among the top five causes of increased disability-adjusted life years in 109 countries [8]. According to research conducted in 2016 on the prevalence of tobacco smoking in Iranian adults, from among the 30 provinces of the country, Hormozgan Province, Iran, claimed the fifth rank and showed a slight difference from the first province [9]. This highlights the necessity of conducting further research in this province.

Smoking cigarettes is a significant risk factor jeopardizing the longevity and quality of life. Numerous clinical and experimental studies indicate that cigarette smoking has harmful effects on the musculoskeletal system and is a prognosis for many orthopedic disorders [10]. Numerous epidemiological studies have confirmed the impact of cigarettes on bone mineral content (BMC). According to an epidemiological investigation conducted on 14 000 randomly chosen individuals, there was an inverse relationship between the amount of cotinine (an index for exposure to tobacco) and BMC in both genders [11].

A five-year study examined the bone density of 833 young men (18 to 20 years) using a high-resolution peripheral device. The computational tomography indicated that many smokers had a considerable reduction in BMC of the hip and femur neck compared to non-smokers, which led to the development of musculoskeletal disorders [12].

Another epidemiological investigation on postmenopausal women indicated that cigarette smokers lose considerably higher cortical bones compared to their

non-smoker counterparts [13]. A cross-sectional study of bone density measurement in the vertebral column and femur neck on 41 tween women, incompatible with cigarette habits, showed that women who smoked one pack of cigarettes per day during adulthood had 5% to 10% lower bone density on average until menopause, which would significantly predispose them to different types of fracture [14]. Passive smoking for those who are not smokers and are exposed to the cigarette smoke of smokers also has weak yet evident effects on bone mineral density. Kim et al. indicated a positive and significant relationship between exposure to tobacco smoke and osteoporosis of the backbone and femur neck in 925 Caribbean postmenopausal women who never smoked tobacco [15]. Cigarette increases the risk of vertebral fracture in men and women by 32% and 13%, in addition to hip fracture by 40% and 31%, respectively. Also, cigarette smoking cessation would reduce the risk of hip fracture in men after five years, while this time is longer for women [16].

Hence, according to epidemiological studies, cigarettes are essential in establishing bone resorption across all skeletal points. The loss of bone has a positive association with the number of cigarettes smoked daily and the years of exposure to it. It is independent of gender, age, weight, body mass index, and several unhealthy habits and lifestyles that are often seen in smokers (such as the lack of physical activity and exposure to sunlight, low calcium consumption, and consumption of alcohol and caffeine) [17].

The present study investigates the association between tobacco smoking (including cigarettes and waterpipe) and the prevalence of symptoms of musculoskeletal disorders in service workers of Bandar Abbas City, Iran.

Materials and Methods

This was a descriptive-analytical epidemiological study with cross-sectional data. The inclusion criteria were having at least one year of working background and absence of any musculoskeletal disorder before employment. Meanwhile, the exclusion criteria were the lack of willingness to cooperate in the study or having the disease in other body systems, including neurological, rheumatological diseases, malignancies, and joint replacements.

The study's sample size consisted of 351 male workers employed in the wharf. The measurement instruments in this research included the following items: 1) A researcher-made questionnaire in which personal charac-

teristics, including gender, age, marital status, education, and items about cigarette and waterpipe smoking were captured; 2) The general Nordic questionnaire to measure the extent of the prevalence of musculoskeletal disorders. The Nordic questionnaire is a self-report instrument that records musculoskeletal disorders in nine body regions (neck, shoulder, upper back, lower back, elbow, hand/wrists, thighs, knees, and legs/ankles) within one year.

The Nordic general questionnaire includes 27 items to examine the entire body, in which the symptoms of disorders throughout the whole body can be recorded. This questionnaire can measure the results of epidemiological studies regarding musculoskeletal disorders and characterize the injury frequency in the studied domain. This questionnaire is one of the most widely used for examining musculoskeletal disorders, designed by Kurinka et al. in 1987 [18]. The Nordic questionnaire is utilized for measuring the results of epidemiological studies in musculoskeletal disorders and can determine the extent of damage frequency. Regarding the results obtained from the reliability and validity of the Persian version of this questionnaire, the internal consistency was reported at 0.8, and replicability in frequencies was reported at Kappa >0.7 with P<0.00 [19]. The Nordic questionnaire investigates the body as nine regions (three regions related to the upper limbs, three regions of the vertebral area, and three regions of the lower limbs): Neck, shoulder, upper back area, lower back area, wrist, and hand, elbow, hip and thigh, knee, feet, and ankles. This questionnaire asks the subject about pain or numbness in one of the nine regions over the past 12 months. In this research, the individuals were assigned into two groups: 1) Individuals with musculoskeletal disorders over the past 12 months in

each of the nine body regions separately and 2) Individuals without disorders. They were then analyzed. The demographic and Nordic questionnaires were distributed among the workers to conduct the research. To observe the ethical principles, they were assured about the confidentiality of the information. The respondents participated voluntarily in this research, and if they did not consent at any moment of the study, they could withdraw. After collecting the questionnaires, the SPSS software, version 25 was used for data analysis. The significance level was considered at 0.05. For the relationship of the qualitative variables, The chi-square test was used.

Results

The findings indicated that the mean age of the participants in the study was 37.66±7.9 years, within the age range of 23-67 years. Their mean working background was 13.9±8.7 years. Further, 21.9% of the participants were single, and 67.5% had a diploma or lower level of education. All participants were male.

Table 1 indicates the prevalence of musculoskeletal disorders in different regions of the body in terms of cigarette smoking. Accordingly, in seven parts (shoulder, elbow, upper and lower areas of the back, hip and thigh, knee, feet, and ankles), out of the nine examined areas of the body, the prevalence of symptoms of musculoskeletal disorders was more significant in smokers compared to non-smokers. Nevertheless, a significant difference was observed between smokers and non-smokers only in the elbow region. Meanwhile, 77% of the workers were non-smokers, and only 23% smoked cigarettes.

Table 1. Prevalence of musculoskeletal disorders in different areas of the body in terms of cigarette smoking

Areas	No. (%)		P
	Non-smokers	Smokers	
Neck	158(85.5)	53(65.3)	0.265
Shoulder	181(67.0)	61(75.3)	0.158
Elbow	98(36.3)	41(50.6)	0.021
Hand and wrist	107(39.6)	32(39.5)	0.984
Upper back	190(70.4)	59(72.8)	0.668
Lower back	204(75.6)	66(81.5)	0.267
Hip	126(46.7)	50(61.7)	0.017
Knee	183(67.8)	58(71.6)	0.515
Feet/ankles	135(50.0)	39(48.1)	0.770

Table 2. Prevalence and frequency of musculoskeletal disorders in different areas of the body in terms of waterpipe smoking

Areas	No. (%)		P
	No Waterpipe Smoking (n=217)	Positive Waterpipe Smoking (n=134)	
Neck	122(56.2)	89(66.4)	0.037
Shoulder	144(66.4)	98(73.1)	0.183
Elbow	78(35.9)	61(45.5)	0.048
Hand and wrist	87(40.1)	52(38.8)	0.811
Upper back	147(67.7)	102(76.1)	0.093
Lower back	156(71.9)	114(85.1)	0.004
Hip	103(47.5)	73(54.5)	0.202
Knee	138(63.6)	103(76.9)	0.009
Feet/ankles	106(48.8)	68(50.7)	0.730

Table 2 reports the prevalence of musculoskeletal disorders in different body regions based on waterpipe use. Accordingly, the prevalence of symptoms of musculoskeletal disorders is higher among waterpipe smokers compared to non-smokers in seven areas (neck, shoulder, elbow, upper and lower areas of the back, hip and thigh, knee, feet, and ankle) out of the nine examined areas. Considering the waterpipe consumption, four body regions, including the neck, elbow, lower back, and knees, showed significant differences between waterpipe smokers and non-smokers, thereby highlighting the role of waterpipe consumption in the incidence

of musculoskeletal disorders. Furthermore, among the workers, 61% did not consume waterpipe, while 39% of the workers consumed waterpipe, claiming a more significant number compared to cigarette smokers.

Table 3 presents the prevalence of musculoskeletal disorders in different areas of the body in terms of tobacco consumption (cigarette or waterpipe). Accordingly, the prevalence of symptoms of musculoskeletal disorders was higher in tobacco product consumers compared to the other groups in all of the nine examined areas. More than half of the examined personnel (about 52%) used

Table 3. Prevalence and frequency of musculoskeletal disorders in different areas of the body in terms of tobacco product consumption

Areas	No. (%)		P
	No Tobacco Smoking (n=169)	Tobacco Smoking (n=182)	
Neck	94(55.6)	117(64.3)	0.098
Shoulder	111(65.7)	131(72.0)	0.203
Elbow	58(34.3)	81(44.5)	0.033
Hand and wrist	65(38.5)	74(40.7)	0.674
Upper back	113(66.9)	136(74.7)	0.105
Lower back	119(70.4)	151(83.0)	0.005
Hip	75(44.4)	101(55.5)	0.037
Knee	108(63.9)	133(73.1)	0.041
Feet/Ankles	85(50.3)	89(48.9)	0.794

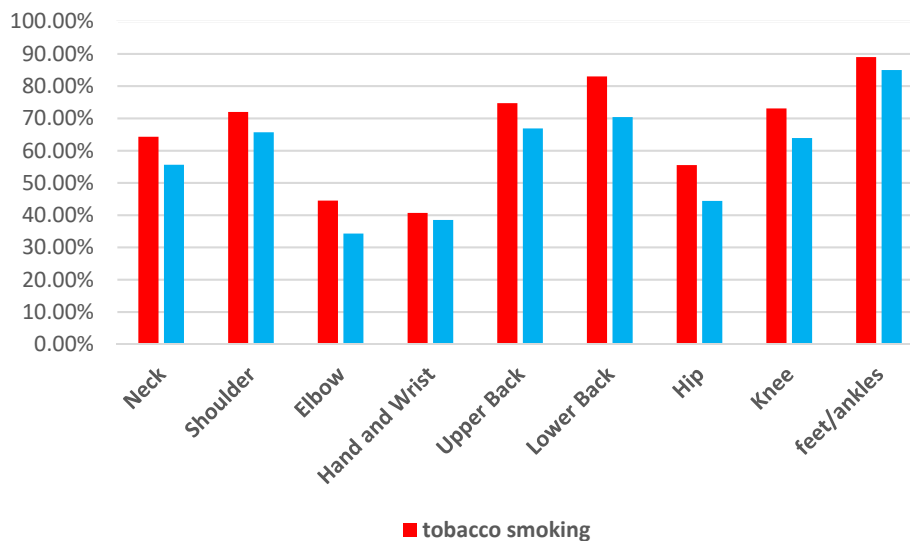


Figure 1. Prevalence and frequency of musculoskeletal disorders in different areas of the body in terms of tobacco smoking

tobacco products, and the musculoskeletal disorders showed a significant difference between tobacco consumers and non-consumers in four regions of the body, including elbow, lower back, hip, and knee.

Figure 1 displays the prevalence of musculoskeletal disorders in different areas of the body regarding tobacco consumption (cigarette or waterpipe). Accordingly, all individuals who smoke tobacco experienced more musculoskeletal problems in all of the examined areas. Regarding the frequency and prevalence, the order of regions was as follows: Lower and upper areas of the back, knee, shoulder, neck, hip, feet and ankle, elbow, wrist, and hand.

Discussion

The results of this research indicated that cigarette smoking has caused aggravation and increase in pain in more than 75% of the examined points. Nevertheless, only one region showed a significant difference compared to non-smokers. One of the reasons could be that most smokers in the present research did not have a long history of cigarette smoking. Similar studies have concluded that cigarette smoking has a positive effect on increasing pain in musculoskeletal regions. In a study conducted to investigate the impact of cigarette smoking on musculoskeletal disorders across a 21 000 subject population in Britain, cigarette smokers experienced higher bodily pain in all nine areas of the musculoskeletal system [20]. In another study performed in Norway, regardless of the site of pain, the logistic regression model was developed, which indicated that cigarette smoking was significantly associated with pain and impaired musculoskeletal system function [21]. The findings of the present study also suggest that

cigarette smokers experience pain and musculoskeletal disorders far more than their non-smokers counterparts. In another study performed in Sweden, they concluded that cigarette smokers, compared to non-smokers, experienced more significant pain in their muscles and bones, where pain and discomfort had a direct association with the extent of cigarettes smoked [22]. In another study, there was some evidence of adverse effects of cigarettes on muscles, tendons, cartilages, and ligaments [23, 24]. This can be attributed to the fact that based on experimental observations, the most established explanations for the association between smoking and musculoskeletal problems involve the adverse effects of nicotine on organs, increasing collagen degradation, as well as reducing blood and oxygenation resulting from vascular damage or vascular contraction [10].

In this research, it was observed that waterpipe smoking, regardless of concurrent cigarette smoking, introduced more impairments in the musculoskeletal system, and the waterpipe smokers experienced higher pain. It was especially true for four body regions, including neck, elbow, lower back, and knee, whereby a significant difference was observed between waterpipe smokers and non-smokers. Studies have demonstrated that waterpipe has more harmful effects compared to cigarettes; therefore, we would observe a more intense impact on the prevalence and frequency of musculoskeletal disorders [23]. In the present research, the percentage of individuals who used waterpipes was higher than that of cigarette smokers. This highlights the necessity of conducting further research in South Iran about the possible risks of waterpipe smoking and internalizing the culture of reducing its consumption.

Regarding tobacco smoking, in the present research, in all of the examined areas, individuals who smoked tobacco products had more prevalent and frequent pain and other problems compared to the other group. Nevertheless, in the elbow, lower back, hip, and knees, a significant difference with $P < 0.05$ was observed compared to the group not smoking tobacco. Tobacco smoking has harmful effects on the musculoskeletal system. The critical established negative implications are the loss of the BMC and increasing fracture incidence. The pathogenesis of these effects is complex due to the direct toxic effects of nicotine on the activity of osteoblasts/osteoclasts, along with the indirect effects, including influence on sexual hormones and adrenal cortex, vitamin D resorption, the lack of intestinal calcium absorption, negative impact on vessels, and oxygenation [24]. Tobacco products may contribute to the initiation or aggravation of the progression of rheumatoid arthritis and back pain. Adverse effects have also been observed on muscles and tendons [10].

Conclusion

Tobacco smoking delays bone and tendon healing in fractures and is also associated with short-term postoperative complications, causing prolongation of hospital stay and incurrance of higher costs. Thus, tobacco cessation is highly recommended for the prevention of musculoskeletal disorders [10]. In research, the positive long-term effects of tobacco consumption on the metabolism of bones have been demonstrated. Cessation of tobacco smoking has shown a significant association with increased bone mineral content at different sites as well as with lowered incidence of fracture. More evident results can be observed from the cessation of tobacco products in patients undergoing orthopedic surgery within the short term; with a reduction of tobacco smoking, a decrease in the frequency of complications and shortening of hospital stay have been observed [24].

Ethical Considerations

Compliance with ethical guidelines

The survey was approved by the Research Ethics Committee of the [Research Center for Social Factors of Health Promotion, Hormozgan University of Medical Sciences](#) (Code: IR.HUMS.REC.1402.249).

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Authors' contributions

Data curation: Marzieh Kazempour, Amin Ghanbarnejad; Data validation: Marzieh kazempour, Abdolhamid Tajvar; Writing—original draft: Marzieh kazempour, Abdolhamid Tajvar, Amin Ghanbarnejad; Writing—review and editing: Marzieh Kazempour, Abdolhamid Tajvar.

Conflict of interest

The authors declared no conflict of interest.

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