Journal of Kerman University of Medical Sciences
2021; 28(4): 358-366
http://jkmu.kmu.ac.ir/
10.22062/JKMU.2021.91716
Original Article

The Prevalence of Musculoskeletal Pain Syndrome in 15-80 years old Population of Kerman: The Role of Smart Phone Use and its Related Factors

Hamid Najafipour[1], Mohammad Sadeghi[2], Zeinab Kordestani[3], Ahmad Naghibzadeh-Tahami[4], Marjan Ghavipisheh[5*], Mitra Shadkam Farokhi[6]

1. Cardiovascular Research Center, Institute of Basic and Clinical Physiology Sciences, and Department of Physiology and Pharmacology, Afzalipour Mediacl Faculty, Kerman University of Medical Sciences, Kerman, Iran
2. Physiology Research Center, Institute of Neuropharmacology and Department of Physiotherapy, Allied College, Kerman University of Medical Sciences, Kerman, Iran
3. Gastroenterology and Hepatology Research Center, Institute of Basic and Clinical Physiology Sciences, Kerman University of Medical Sciences, Kerman, Iran
4. Endocrinology and Metabolism Research Center, Kerman University of Medical Sciences, Kerman, Iran
5. Tarbiat Modares University, Tehran, Iran
6. Physiology Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran

ABSTRACT

Background: Musculoskeletal pain syndromes (MSPS) are among the most common disorders of societies today. Excessive use and inappropriate posture when using mobile phones seem to play a role in MSPS. In this study, the relationship between mobile phones use and MSPS and its predictive factors in southeastern Iran, Kerman, was investigated.

Method: This cross-sectional community-based study was performed on 1,135 people aged 15-80 years. A questionnaire containing demographic information, risk factors, musculoskeletal pain (types and symptoms), cell phone models, and the duration and how to use mobile phone in the preceding year, was completed.

Results: 51.1% of the participants were male. The overall prevalence of MSP was 71.30%, which was higher in female subjects (86.5%) than male subjects (56.7%). The risk of MSPS in people who used a smartphone was 45% higher than those who did not use a smartphone (Adjusted Odds Ratio (AOR) = 1.45, 95% CI: 0.98-3.1). The AOR was 2.02 (1.36-3.01) in female subjects relative to male subjects and reached 2.38 (1.50-3.76) in the age group over 55 years. The AOR was 1.98 (95% CI: 1.05-3.73) in diabetic and depressed individuals, 1.65 (1.22-2.23) in obese people, 1.63 (1.12-2.36) in hypertensive individuals, 1.55 (1.23-1.96) in anxious individuals, 1.94 (1.1-3.35) in employed people, 3.08 (1.53-6.22) in housewives, and 0.68 (0.47-0.98) in people with high physical activity.

Conclusion: 71% of the sample population of Kerman suffered from MSPS. The use of smartphones has contributed to this syndrome, and female gender, age, obesity, diabetes, hypertension, anxiety, depression, low physical activity, and being employed have exacerbated the disease. Taking educational measures regarding the rate of use and body position when using mobile phones is necessary.

Keywords: Musculoskeletal pain, Prevalence, Smartphone, Related factors, Kerman

Citation: Najafipour H, Sadeghi M, Kordestani Z, Naghibzadeh Tahamy A, Ghavipisheh M, Shadkam Farokhi M. The Prevalence of Musculoskeletal Pain Syndrome in 15-80 years old Population of Kerman: The Role of Smart Phone Use and its Related Factors. *Journal of Kerman University of Medical Sciences* 2021; 28(4): 358-366. doi: 10.22062/JKMU.2021.91716
Received: 26.12. 2020
Accepted: 26.05. 2021
***Correspondence** Marjan Ghavipisheh; Email: kerman.physiology@gmail.com

Published by Kerman University of Medical Sciences

Introduction

Musculoskeletal pain syndromes (MSPS) are common causes of occupational injury and disability in developing countries and mainly include a wide range of inflammatory and degenerative conditions affecting muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels (1). Clinical symptoms of MSPS include tendonitis (tenosynovitis, epicondylitis), bursitis, and neurological disorders such as carpal tunnel syndrome, sciatica, and osteoarthritis. The most common sites of pain are the spine, back, neck, forearms, and hands (2, 3). In the meantime, the damages and complications caused by repetitive movements such as data entry jobs have been widespread (4). Lack of proper diagnosis and treatment of MSPS in adolescence leads to significant disabilities in adulthood. Therefore, targeted screening programs can be a great help in detecting cases of orthopedic disorders that have not been previously diagnosed. This leads to the prevention of chronic and syndromic pain in young people (5, 6). In Iran, limited research has been conducted in this field. According to the report of the Medical Commission of the Social Security Organization of Tehran Province (2009), 14.4% of various causes of disabilities were attributed to musculoskeletal diseases. Low back pain was the second leading cause of absenteeism from work, the third leading cause of hospital admissions, and the fifth leading cause of hospitalization (7). Today, mobile phones are the most important technology of the century. Mobile features, multimedia capabilities such as audio, video, photography, internet, and satellite connectivity, and compatibility with computers and various applications make its use inevitable. According to the report of the International Telecommunication Union (ITU), of the world's 7 billion people, about 5 billion are mobile phone users, and this is growing more rapidly in developing countries (8). There are now 53 to 55 million mobile phone users in Iran (8). As the use of mobile phones expands, there is a growing concern about the excessive and harmful use of this technology. Excessive use of this tool can be associated with great physical and psychological damages (9, 10). Somatic disorders caused by its use include headache, fatigue, memory impairment, sleep disturbance, hearing problems, and a feeling of warmth in the back. The most common clinical signs associated with cell phone use are sleep disturbance (23%), hearing impairment (38%), and memory impairment (40%) while there is a clear relationship between these symptoms and the duration of cell phone use (11). Improper use of a mobile phone for a long time can cause the elbow joint to bend and lead to cubital tunnel syndrome. The disease can be presented as elbow pain with numbness in the fingers, especially the little finger. Also, excessive typing with thumbs and frequent taps to the mobile keyboard can cause pain, swelling, and tingling in the thumbs. Excessive texting and sending a large number of text messages can also cause tenosynovitis due to the small size of the phone and its buttons, resulting in wrist pain (12). In general, complaints such as fatigue, stress, anxiety, and sleep disturbance are more common in people who regularly use a cell phone than those who use it less (13, 11). In a study conducted 3 years ago on 1,700 people in Kerman, the prevalence of MSPS was 65%, which increased from 38% in the age group of 15-20 years to 79% in the ages over than 65 years (14). Its prevalence was positively related to gender, diabetes, obesity, depression, and anxiety, but its relationship with mobile phone use was not investigated. Given that the use of smartphones and the variety of applications have greatly popularized in recent years, it seems that the high use of this device may play a role in creating MSPS. Since no study has been done in this regard in Kerman, so, the present study aimed to investigate the possible role of mobile phone use in MSPS and its predictors such as age, sex, occupational status, physical activity, diabetes, obesity, hypertension, anxiety, and depression. Health officials can use these informations to make people aware of the causes of MSPS, to reduce harm, and make a healthier society, and also reduce the economic costs of these disorders in future years.

Material and Methods

The study population was a group of 15 to 80-year-old Kerman residents who had participated in the Kerman Coronary Artery Diseases Risk Factors study (KERCADRS) phase 2 (Et hical code IRKMU.REC.1397.354). People under 15 and over 80 years old and those living in Kerman for less than one year were excluded from the study. 250 postal codes were randomly selected among the postal codes of Kerman city and the social interface coordinators of the project referred to the home related to the postal code

and invited eligible people in the home and its right side neighboring's in the alley to reach five individuals in each postal code. All the individuals signed a consent form to participate in the study and scheduled an appointment. On the appointed day, after 10-12 hours of overnight fasting, 5 ml of the blood was taken to measure blood glucose, and a questionnaire containing demographic questions, medical history of diabetes and hypertension, taking medication to treat diabetes and hypertension, and other risk factors was completed and blood pressure was measured twice by a general practitioner. Height and weight were measured and questionnaires containing information on physical activity, anxiety, and depression were completed by trained interviewers. Detailed information on the method and defining variables was given in the previously published article (15). A researcher-made questionnaire containing 27 questions, 12 of which were about the presence of musculoskeletal pain and most painful body regions, and 15 questions about the type of cell phone (ordinary form or smartphone), the average daily use, body position, and method of usage in the past year was completed by face-to-face interviews. The reliability of the questionnaire was assessed by consulting experts in the field and calculating Cronbach's alpha coefficient. The obtained coefficient of 0.85 indicates its high reliability. The cell phones that are used only for phone calls and sending SMS are defined as ordinary phones, and those that are connected to the internet and are used for surfing the Internet, playing mobile games, watching films, and visiting social network services are called as smartphones. Anyone who was previously diagnosed with diabetes or had insulin or oral anti-diabetic medication, or had a fasting blood glucose level equal to or greater than 126 mg/dL was considered as a patient with diabetes (15). Hypertension was defined by a systolic blood pressure of 140 mm Hg or more, or diastolic blood pressure of 90 mmHg or more (average of two measurements at 30 min), or taking anti-hypertensive drugs. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2) with the ranges of: Underweight (<18.5), normal weight (18.5 to 24.9), overweight (25 to 29.9), and obese (30 or more) (15). The number of underweight people in the study was very low and they were combined with the normal weight group in analysis. The level of physical activity was determined using the Global Health Activity Questionnaire (GPAQ) and is defined as any activity of the body that is caused by the contraction and relaxation of the skeletal muscles that requires energy expenditure. To measure the intensity of physical activity, the metabolic equivalent of task (MET) scale was used. MET is equivalent to the consumption of 3.5 ml of oxygen per kilogram of body mass per minute while he/she is sitting quietly. Low physical activity was considered as less than four times, moderate physical activity as 4-8 times, and high physical activity as more than 8 times that of resting energy consumption (15). Anxiety and depression were assessed using the Beck anxiety inventory (BAI) and the Beck depression inventory (BDI) questionnaires, respectively (15). The BAI scores were classified as normal (0-7), mild (8-15), moderate (16-25), and severe (26-63) anxiety, and BDI scores as none (0-15), mild (16-30), moderate (31-46), and severe (47-63) depression. In this study, the pain was used as an indicator of the musculoskeletal disorders because pain is the main manifestation of these disorders.

Sample size calculation

Using the formula for calculating the sample size and considering the prevalence of 65% of musculoskeletal pain in the population (14) and using the formula $n = z^2pq/d^2$ based on q=0.35, p=0.65, z=2, and d=0.1p, the sample size was calculated as 1000 that 1,136 people entered the study to increase the power of the study.

Data analysis

The results of quantitative variables were reported as Mean ± SD, and qualitative and ranked variables were reported as percentages. Data were analyzed using SPSS version 11.5. 2016 census data of Kerman were used to standardize age- and sex- related prevalence. Chi-square test (χ^2) was used to assess the relationship between musculoskeletal pain and other factors in the objectives. Univariate and multivariate logistic regression tests were used to determine the relationship between the predicting factors of the role of cell phone use on musculoskeletal pain. Moreover, only the variables with P-value less than 0.2 in the univariate analysis were added to the final multivariate models. Adjusted odds ratio (AOR) was also used to show the strength of the association. P-value less than or equal to 0.05 was considered as a statistical significant level.

Results

The study included 1,136 people aged 15 to 80 years. The average age of the participants was 45.8 years with a standard deviation of 14.9 years. The number of male participants (51.1%) was slightly higher than female participants. The standardized age- and sex-related prevalence of musculoskeletal pain are given in Table 1. Accordingly, the overall prevalence of musculoskeletal pain in the study population was 71.3%, which was significantly higher in female participants (86.5%) than that in male participants (56.7%).

Also, the prevalence of musculoskeletal pain increased with age from 53.7% in the age group of 15-34 years to 81.2% in the age group of over 55 years. The lowest prevalence of MSPS was reported in the unemployed people and increased in the employed people, retirees, and housewives. Obesity, diabetes, depression, and anxiety were also factors which increased MSPS, but having high physical activity reduced it (Table 1).

Table 1. The standardized prevalence (95% confidence interval, CI) of the presence of musculoskeletal pain syndromes (A community-based study, n = 1136, Kerman, Iran, 2018)

Subgroups	N (%)	Standardized Prevalence (95% CI)	P-value
Overall	1136(100)	71.3(68.5-73.8)	
Gender			
Male	556(48.94)	56.7(52.7-60.6)	<0.001
Female	580(51.06)	86.5(68.9-74.8)	
Age group (years)			
15-34	294(25.90)	53.7(48.0-59.3)	<0.001
35-54	478(42.11)	74.4(70.0-78.1)	
≥55	363(31.98)	81.2(76.0-84.9)	
Obesity			
Normal	394(34.68)	59.6(54.7-64.3)	<0.001
Overweight & obese	742(65.32)	77.4(74.3-80.3)	
Diabetes			
No	1,025(90.23)	69.5 (66.6-72.3)	0.002
Yes	111(9.77)	87.3(79.7-92.4)	
Hypertension			
No	846(74.47)	67.4(642.2-70.5)	<0.001
Yes	290(25.53)	82(77.5-86.3)	
Depression			
No	966(85.04)	68(65.4-71.2)	<0.001
Yes	170(14.96)	87.6(81.7-91.8)	
Anxiety			
No	945(83.19)	67.8(64.7-70.0)	<0.001
Yes	191(16.81)	80.4(83.1-92.3)	
Occupational status			
Unemployed	91(8.01)	35.1(26.0-45.5)	
Employed	420(36.97)	60.0(55.2-64.5)	<0.001
Retired	177(15.58)	72.3(65.2-78.4)	
Housewife	448(39.44)	88.8(85.5-91.4)	
Physical activity			
Low	453(39.88)	75.2(71.0-79.0)	
Moderate	402(35.39)	75.8(71.4-79.8)	<0.001
High	281(24.74)	58.3(52.4-64.0)	

Of 1,136 participants, 1,084 (95.4%) had a mobile phone, of which 593 (54.7%) had an ordinary cell phone and 45.3% had a smartphone. Of those who used a smartphone, 19.2% spent more than two hours a day using it. In response to the question of whether you feel musculoskeletal pain during or immediately after using the phone, 14.7% of the smartphone users and 4.5% of the ordinary phone users answered in the affirmative. In those who felt pain when using the smartphone, the highest prevalence of the source of pain was head and neck (36.5%), the wrist (31.7%), shoulder and arm (26.9%), and elbow and forearm (14.4%), respectively. All of these symptoms were more prevalent in women than in men. Regarding the relationship between musculoskeletal pain and using mobile phones, the results of the analysis showed that people who used mobile phones were 45% more likely to develop musculoskeletal pain than those who did not use these devices (AOR = 1.45, 95% CI: 0.98-3.1).

Predictors of the effect of mobile phone use on MSPS

Factors affecting the role of cell phone use on musculoskeletal pain are shown in Table 2. One of these effective factors is gender (AOR = 2.02, 95% CI: 1.36-3.01). The AOR of the impact of mobile phones use on MSPS in women is double compared to that in men. Another factor was age. In this way, in the age group over 55 years compared to the age group of 15-24 years, this odds reached 2.38 (95% CI: 1.50-3.76). Occupational status seems to be another predictor of the impact of smartphone use on musculoskeletal pain. Having a job and being a housewife compared to being an unemployed person increased this odds to 1.94 (95% CI: 1.1-3.35) and 3.08 (95% CI: 1.53-6.22), respectively. The corresponding AORs were 1.98 (95% CI: 1.05-3.73) in diabetic and depressed individuals, 1.65 (95% CI: 1.22-2.23) in obese people, 1.63 (95% CI: 1.12-2.36) in hypertensive participants, 1.55 (95% CI: 1.23-1.96) in anxious persons, and 0.68 (95% CI: 0.47-0.98) in high physically active individuals (Table 2).

Table 2. Crude and adjusted odds ratio (OR) and 95% confidence interval (CI), for different predictors of the relationship between mobile phone use and MSPS (n=1135, Kerman, Iran, 2018)

Subgroups	Crude OR (95% CI)	Adjusted OR (95% CI)
Gender		
Male	1	1
Female	4.89(3.64 -6.56)	2.02(1.36-3.01)
Age group (years)		
15-34	1	1
35-54	2.51(1.84-3.41)	1.84(1.28- 2.63)
≥55	3.73(2.63-5.29)	2.38(1.50-3.76)
Obesity		
Normal	1	1
Overweight & Obese	2.32(1.78-3.03)	1.65(1.22-2.23)
Diabetes		
No	1	1
Yes	3.03(1.70-5.39)	1.98(1.05-3.73)
Hypertension		
No	1	1
Yes	2.25(1.61-3.15)	1.63(1.12-2.36)
Depression		
No	1	1
Yes	3.27(2.03-5.27)	1.98(1.14-3.44)
Anxiety		
No	1	1
Yes	1.96(1.61-2.39)	1.55(1.23-1.96)
Occupational status		
Unemployed	1	1
Employed	2.76(1.72-4.43)	1.94(1.1-3.35)
Retired	4.18(2.80-4.27)	1.81(0.89-3.69)
Housewife	14.67(8.71-24.71)	3.08(1.53-6.22)
Physical activity		
Low	1	1
Moderate	1.03(0.75-1.41)	0. 91(0. 64-1.30)
High	0.46(0. 33-0. 63)	0.68(0.47-0.98)

Adjusted OR; controlling for demographic and CAD risk factors.

Discussion

The aim of the present study was to investigate the possible role of cell phone use on the musculoskeletal pain in people aged 15 to 80 years in Kerman and determine the predictors of this role. The results showed that the prevalence of musculoskeletal pain in people aged over 15 years was 71%, which indicates the high prevalence of these disorders in the study population. Walker-Bone et al. (2004) reported a 52% increase in the prevalence of upper limb musculoskeletal disorders in the general population in Southampton, England (16). Important parts of the skeletal-muscular system include muscles and joints that following skeletal-muscular disorders, their movement as their most important output is impaired, resulting in pain and disability (17). It seems that lowering the head and bending the upper torso can cause pain in the head and neck areas, which was the most painful area for mobile smartphone users in this study. In this regard, cross-sectional studies have shown that the use of tablets and mobile phones leads to musculoskeletal symptoms,

mainly in the neck and shoulders, and their prevalence was reported to be between 26.3% and 60% (17-20), which is somewhat higher than the prevalence rate reported in the present study. Xie et al. (2016) showed that after 10 minutes of using a smartphone in a sitting position, discomfort develops in the neck area (19). Chiang and Liu (2016) reported that following tablet use in students, the prevalence of musculoskeletal symptoms in the neck and shoulder areas was 37.5% and 30%, respectively (20), which is consistent with the results of the present study conducted in the general population. Sommerich et al. (2007) showed that at least 50% of high school students had discomfort in the neck, back, and upper part of spinal column due to tablet use (21).

The present study showed a higher prevalence of musculoskeletal disorders and a higher impact of mobile phone use on these disorders in women and in housewives compared to other occupations. Studies have shown that the prevalence of musculoskeletal pain in most anatomical areas of the body especially in the wrist area is higher in women than in men (22, 23). In men, however, the complications are more of job disability types. Pain in the wrist, which has been attributed to the being a typist and being a secretary for women, may also be related to greater rate of mobile phone use among them.

The present study showed that the prevalence of musculoskeletal pain increased with age. Similarly, Andersson et al. (1993) reported that the prevalence of musculoskeletal pain increases in both sexes by the age of 60 years (24). Aging induces changes in the musculoskeletal system and degeneration occurs commonly after the age of 50 years. Muscles as the main supporting elements of joints are weaken, and destruction of joint structures, including articular cartilage, occurs (24). Although older people are less likely to use a smartphone, the present study showed that they are more exposed to the damage caused by smartphone use than young people.

The results of this study showed a significant positive association between diabetes and the prevalence of musculoskeletal pain. Changes in glucose and protein metabolism, damage to small blood vessels and peripheral nerves (diabetic neuropathy), and the accumulation of collagen in the skin and around the joints are some of the mechanisms involved in diabetes that cause musculoskeletal pain (25). The weakening of the muscles around the joints causes movements such as typing and repeated tapping of the fingertips on the mobile keyboard, put more pressure on the joint cause pain, swelling, and tingling in these areas. In diabetic people, the prevalence of pain and mobility limitations in shoulder joint has been reported to be 10 to 20% and the prevalence of carpal tunnel syndrome has been reported to be 12 to 30% (26). In a study in Kerman, the prevalence of carpal tunnel syndrome in diabetic individuals was 24.2%, which was significantly higher in female patients (30.6%) than in male patients (16.2%) (27).

According to the results of the present study, obesity is another factor related to musculoskeletal disorders and increased the impact of mobile phone use in these disorders. De Sá Pinto et al. (2006) reported that obesity had a negative effect on bone and joint health and caused biomechanical changes in the spine and lower limbs (28). Wearing et al. (2006) reported that obesity can have a significant effect on soft tissues such as tendons and fascia. Although the mechanism is unclear, but structural and functional limitations due to high weight lead to changes in the body's natural biomechanics during motor activity. These cause abnormal stresses on the connective tissues and causes musculoskeletal damages (29, 30). According to our recent research in Kerman, the rate of low physical activity has increased from 42% to 47% over the past 5 years, and this is more prevalent in the age group of 15-24 years (31). A sedentary lifestyle is one of the most important causes of obesity, and surfing social networks is probably one of the causes of sedentary lifestyle, especially in adolescents.

The results of the present study showed that physical activity played a protective role on the effect of mobile phone use on musculoskeletal pain and it can be concluded that young people are more at risk of the harmful impacts of mobile phones because they use mobile phones more frequently and the prevalence of their sedentary lifestyle is increasing rapidly (31). Another problem is that the adolescents are more at risk of mobile phone addiction and this has been shown to increase the risk of poor sleep quality in this age group (32).

Another finding of this study is that people with anxiety and depression were more likely to develop musculoskeletal pain and the intensifying effect of cell phone use was more in the participants with these disorders (Tables 1

and 2). However, their causal relationship cannot be determined because it has been shown that people with pain are at higher risk of depression and anxiety, and depressed and anxious people experience pain more intensely. The pain perception is more severe in patients with depression and causes a higher rate of disability and dysfunction (33). Anxiety and depression are also triggers of sympathetic nerve activity, and it has been shown that the activity of sympathetic nerves reduces joint blood flow (34).

One of the limitations of this study is that pain was used as an indicator of the musculoskeletal disorders, and there was no clinical examination facilities and para-clinical confirmation tools for MSPS assessment at the study site. However, since pain is the main manifestation of musculoskeletal disorders (17), it can be used as an acceptable indicator of this type of disorders.

Conclusion

According to the results of the present study, 70% of the population over the age of 15 years in Kerman suffered from musculoskeletal pain (MSPS). The use of smartphones has contributed to this syndrome; and obesity, diabetes, anxiety and depression, having a job, and being a housewife are exacerbating factors, while high physical activity was an ameliorative factor in reducing the impact of this device on MSPS. It is necessary to take educational measures to alarm the risk of overuse, inappropriate postural position when using this device, and the associated risk factors to reduce the burden of health care costs of MSPS in coming years in the community.

Conflict of interests

The authors declare that they have no conflict of interests.

Authors' contributions

HN participated in the design and coordination of the study, drafting and critically reviewing the manuscript. MS and MG participated in the design and drafting of the manuscript and interpretation of the data. AN performed the statistical analysis and helped the interpretation of the data. ZK and MSF participated in data collection and drafting of the manuscript. All authors read and approved the final manuscript.

Acknowledgments

The authors are grateful to Kerman University of Medical Sciences for funding of the study (Grant No. KMU.REC.97/362, for M. Sadeghi). They profoundly thank the people who were generous with their time and participation in the study. And special thanks to all employees of the Physiology Research Center of Kerman University of Medical Sciences for their help in performing the study.

References

1. Hayes M, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. Int J Dent Hyg 2009; 7(3):159-65. doi: 10.1111/j.1601-5037.2009.00395.x.
2. National Research Council, The Institute of Medicine. Musculoskeletal disorders and the workplace. Washington, DC: National Academy Press; 2001.
3. Bozkurt S, Demirsoy N, Günendi Z. Risk factors associated with work-related musculoskeletal disorders in dentistry. Clin Invest Med 2016; 39(6):27527.
4. National Research Council. Work-Related Musculoskeletal Disorders: A Review of the Evidence. Washington, DC: National Academy Press; 1998. doi: https://doi.org/10.17226/6309.
5. Nussinovitch M, Finkelstein Y, Amir J, Greenbaum E, Volovitz B. Adolescent screening for orthopedic problems in high school. Public Health 2002; 116(1):30-2. doi: 10.1038/sj/ph/1900812.
6. O'Donnell JL, Smyth D, Frampton C. Prioritizing health-care funding. Intern Med J 2005; 35(7):409-12. doi: 10.1111/j.1445-5994.2005.00839.x.
7. Mehrdad R, Seifmanesh S, Chavoshi F, Aminian O, Izadi N. Epidemiology of occupational accidents in iran based on social security organization database. Iran Red Crescent Med J 2014; 16(1):e10359. doi: 10.5812/ircmj.10359.
8. Goodarzi M, Ebrahimzadeh I, Rabi A, Saedipoor B, Asghari Jafarabadi M. Impact of distance education via mobile phone text messaging on knowledge, attitude practice and self-efficacy of patients with type 2 diabetes

mellitus in Iran. J Diabetes Metab Disord 2012; 11(1):10. doi: 10.1186/2251-6581-11-10.

9. Bianchi A, Phillips JG. Psychological predictors of problem mobile phone use. Cyberpsychol Behav. 2005; 8(1):39-51. doi: 10.1089/cpb.2005.8.39.

10. Sayah Bargard M. Olapour Alireza, hoseini Ahangari SA, Mashi SF, Heidari A. Examine the Relationship Between Mobile Phone Usage and Psychological Health and Academic Success among Medical Students. Educational Development of Jundishapur 2016; 7(1):57-63 [in Persian].

11. Khan MM. Adverse effects of excessive mobile phone use. Int J Occup Med Environ Health 2008; 21(4):289-93. doi: 10.2478/v10001-008-0028-6.

12. Ghiasian M, Khazaei M, Daneshyar S, Mazaheri S, Seyed Gheybi SM. Epidemiological survey of patients with a carpal tunnel syndrome referred to Sina Hospital in Hamedan during 2014- 2016. FEYZ 2017; 21(5):498-505. [In Persian].

13. Razavizadeh S, Parandeh A, Rahmati-Najarkolaei F. Pathology of mobile phone use in military university students from the views of media and communications professionals: a thematic analysis. Journal of Military Medicine 2018; 19(6):595-606. [In Persian].

14. Najafipour H, Sadeghigoghari M, Kordestani Z, Naghibzadeh Tahamy A, Ghavipisheh M. The prevalence of musculoskeletal pain syndromes and its associated factors in people between 15 and 80 years in Kerman: a population-based study on 1,700 individuals. Iranian Red Crescent Medical Journal 2017; 19(4). doi: 10.5812/ircmj.45084.

15. Najafipour H, Mirzazadeh A, Haghdoost AA, Shadkam M, Afshari M, Moazenzadeh M, et al. Coronary artery disease risk factors in an urban and peri-urban setting, Kerman, southeastern Iran (KERCADR study): methodology and preliminary report. Iran J Public Health 2012; 41(9):86-92.

16. Walker-Bone K, Palmer KT, Reading I, Coggon D, Cooper C. Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. Arthritis Rheum 2004; 51(4):642-51. doi: 10.1002/art.20535.

17. Sahrmann S, Azevedo DC, Dillen LV. Diagnosis and treatment of movement system impairment syndromes. Braz J Phys Ther 2017; 21(6):391-9. doi: 10.1016/j.bjpt.2017.08.001.

18. Kim HJ, Kim JS. The relationship between smartphone use and subjective musculoskeletal symptoms and university students. J Phys Ther Sci 2015; 27(3):575-9. doi: 10.1589/jpts.27.575.

19. Xie Y, Szeto GP, Dai J, Madeleine P. A comparison of muscle activity in using touchscreen smartphone among young people with and without chronic neck-shoulder pain. Ergonomics 2016; 59(1):61-72. doi: 10.1080/00140139.2015.1056237.

20. Chiang HY, Liu CH. Exploration of the associations of touch-screen tablet computer usage and musculoskeletal discomfort. Work 2016; 53(4):917-25. doi: 10.3233/WOR-162274.

21. Sommerich CM, Ward R, Sikdar K, Payne J, Herman L. A survey of high school students with ubiquitous access to tablet PCs. Ergonomics 2007; 50(5):706-27. doi. 10.1080/00140130701194793.

22. Wijnhoven HA, de Vet HC, Picavet HS. Prevalence of musculoskeletal disorders is systematically higher in women than in men. Clin J Pain 2006; 22(8):717-24. doi: 10.1097/01.ajp.0000210912.95664.53.

23. Wijnhoven HA, de Vet HC, Picavet HS. Explaining sex differences in chronic musculoskeletal pain in a general population. Pain 2006; 124(1-2):158-66. doi: 10.1016/j.pain.2006.04.012.

24. Andersson HI, Ejlertsson G, Leden I, Rosenberg C. Chronic pain in a geographically defined general population: studies of differences in age, gender, social class, and pain localization. Clin J Pain 1993; 9(3):174-82. doi: 10.1097/00002508-199309000-00004.

25. Kim RP, Edelman SV, Kim DD. Musculoskeletal complications of diabetes mellitus. Clinical Diabetes 2001; 19(3):132-35. doi: 10.2337/diaclin.19.3.132.

26. Smith LL, Burnet SP, McNeil JD. Musculoskeletal manifestations of diabetes mellitus. Br J Sports Med 2003; 37(1):30-5. doi: 10.1136/bjsm.37.1.30.

27. Foroozanfar Z, Ebrahimi H, Khanjani N, Bahrampour A, Najafipour H. Prevalence of carpal tunnel syndrome in diabetic patients with and without metabolic syndrome. Journal of Endocrinology and Diabetes Mellitus 2016; 4(1):10-6. doi: 10.12970/2310-9971.2016.04.01.2.

28. de Sá Pinto AL, de Barros Holanda PM, Radu AS, Villares SM, Lima FR. Musculoskeletal findings in obese children. J Paediatr Child Health 2006; 42(6):341-4. doi: 10.1111/j.1440-1754.2006.00869.x.

29. Wearing SC, Hennig EM, Byrne NM, Steele JR, Hills AP. Musculoskeletal disorders associated with obesity: a biomechanical perspective. Obes Rev 2006; 7(3):239-50. doi: 10.1111/j.1467-789X.2006.00251.x.

30. Vincent HK, Raiser SN, Vincent KR. The aging musculoskeletal system and obesity-related considerations with exercise. Ageing Res Rev 2012; 11(3):361-73. doi: 10.1016/j.arr.2012.03.002.

31. Najafipour H, Kahnooji M, Baneshi MR, Yeganeh M, Ahmadi Gohari M, Shadkam Farokhi M, et al. The prevalence and 5-year incidence rate of low physical activity in an urban population of 10,000 in Southeastern Iran: Relationship with other cardiovascular risk factors. J Phys Act Health 2020; 17(4):435-42. doi: 10.1123/jpah.2019-0426.

32. Lee JE, Jang SI, Ju YJ, Kim W, Lee HJ, Park EC. relationship between mobile phone addiction and the incidence of poor and short sleep among Korean adolescents: a longitudinal study of the Korean children & youth panel survey. J Korean Med Sci 2017; 32(7):1166-72. doi: 10.3346/jkms.2017.32.7.1166.

33. Poleshuck EL, Bair MJ, Kroenke K, Damush TM, Tu W, Wu J, et al. Psychosocial stress and anxiety in musculoskeletal pain patients with and without depression. Gen Hosp Psychiatry 2009; 31(2):116-22. doi: 10.1016/j.genhosppsych.2008.10.003.

34. Najafipour H, Ferrell WR. Sympathetic innervation and α-adrenoceptor profile of blood vessels in the posterior region of the rabbit knee joint. Br J Pharmacol 1993; 108(1):79-84. doi: 10.1111/j.1476-5381.1993.tb13443.x.