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ORIGINAL ARTICLE

Effects of working years in cold environment on the musculoskeletal system and carpal tunnel symptoms

Soğuk ortamda çalışma yıllarının kas iskelet sistemi ve karpal tünel sendromu semptomları üzerine etkisi

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Summary

Objectives: Musculoskeletal disorders are the most common work-related health problems. The risk of musculoskeletal disorders is increased by working in a cold environment. The present study aims to investigate the effects of working years on the body.

Methods: We examined the effects of the working years on the musculoskeletal system and carpal tunnel syndrome symptoms of the individuals who were engaged in cutting, shredding, packaging, bagging and transportation operations at 9 degrees and lower ambient temperatures in a poultry factory in Turkey. Nordic Musculoskeletal Questionnaire (NMQ) was used to evaluate musculoskeletal symptoms of the individuals. Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) was used to investigate the carpal tunnel symptoms. Individuals grouped according to their total working years in a cold factory setting. Groups were formed as less than two years, between two and five years, between six and nine years, and ten years or more.

Results: This study showed that the increase in working years in a cold factory setting might lead to a feeling of pain and discomfort in various regions of the body, disrupt ordinary works due to the pain felt ($p<0.05$). This study also showed that the severity of the symptoms felt because carpal tunnel syndrome worsened, especially when an individual has been working for more than ten years in cold.

Conclusion: Working in the cold for a long time may result in long-term health effects on the human body.

Keywords: Cold temperature; cumulative trauma disorders; discomfort; pain; poultry sector.

Özet

Amaç: İşle ilgili sağlık sorunları arasında en yaygın olanı kas-iskelet sistemi hastalıklarıdır. Soğuk bir ortamda çalışmak kas-iskelet sistemi rahatsızlıkları riskini arttırmaktadır. Bu çalışmanın amacı, soğuk ortamda çalışma yıllarının vücut üzerindeki etkilerini araştırmaktı.

Gereç ve Yöntem: Çalışma yıllarının Türkiye'deki bir fabrikada 9 derece ve altında kanatlı hayvanlarda kesme, parçalama, paketleme, torbalama ve taşıma işlemleri yapan ve düşük ortam sıcaklıklarında çalışan bireylerin kas-iskelet sistemi ve karpal tünel sendromu semptomları üzerindeki etkisini inceledik. Bireylerin kas iskelet sistemi semptomlarını değerlendirmek için İskandinav Kas İskelet Sistemi Sorgusu kullanıldı. Karpal tünel semptomlarını araştırmak için Boston Karpal Tünel Sendromu Anketi kullanıldı. Bireyler toplam çalışma yıllarına göre gruplandırılmışlardır. Gruplar iki yıldan az, iki ila beş yıl, altı ila dokuz yıl ve on yıl veya daha fazla olarak kuruldu.

Bulgular: Bu çalışma soğuk bir fabrika ortamında çalışma yıllarındaki artışın, vücudun çeşitli bölgelerinde ağrı ve rahatsızlık hissinde artışa yol açabileceğini, hissedilen ağrı nedeniyle sıradan işlerin etkilenebileceğini göstermiştir ($p<0,05$). Ayrıca bu çalışma, karpal tünel sendromu nedeniyle hissedilen semptomların ciddiyetinin, özellikle on yıldan fazla bir süre soğukta çalışıldığında kötüleştiğini göstermiştir.

Sonuç: Uzun süre soğukta çalışmak, insan vücudunda sağlık problemlerine neden olmaktadır.

Anahtar sözcükler: Soğuk; kümülatif travma bozuklukları; rahatsızlık; ağrı; kanatlı hayvan sektörü.

Introduction

Musculoskeletal disorders are the most common work-related health problems. Generally, manual work, heavy physical work, working in inappropriate and static postures, continuous repetition of movements and vibration are the main factors that cause these disorders. Occupational disabilities and disorders are an important issue in developing countries,

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which account for 70% of the global workforce. Recent evaluations show that job-related health loss causes significant losses in total national production percentages.[1]

Most of the musculoskeletal disorders associated with work are cumulative, occurring in the long term by repeating low or high-intensity loads. Symptoms vary from discomfort and pain to reduced body function and disability. The extent to which these diseases originate from work life is not clear, but the effects on daily life are shown.[2] It can also interfere with activities that need to be done at work, reduce production, cause workers to obtain sick leave and increase chronic occupational insufficiency.[3]

Carpal tunnel syndrome (CTS) is a neuromuscular condition caused by compression neuropathy and constitutes 90% of all nerve compressions.[4] Commonly reported CTS symptoms include wrist and hand pain, paresthesia, muscle weakness and loss of dexterity.[5–7] Female gender, increased age, physical illness, repetitive hand use, and occupation are potential risk factors for CTS development.[4,7]

In many cross-sectional studies, low environmental temperature and routine work have been shown to increase the risk of musculoskeletal disorders.[8–10] It is accepted that the risk of CTS is high in professions where meat and fish were processed.[8,11,12]

Although the cold has been shown to adversely affect various parameters of muscle performance, such as strength, speed, and coordination, few studies have investigated the effects of cold on body functions.[13] This study aimed to investigate the effects of working years on the musculoskeletal system and especially on carpal tunnel syndrome symptoms.

Material and Methods

This study included 568 individuals who were engaged in cutting, shredding, packaging, bagging and transportation operations at 9 degrees and lower ambient temperatures in a poultry factory. Evaluations were made at the factory where the individuals worked. After the assessment forms were distributed to the workers, necessary explanations were made about the participation and questionnaires. Inclusion criteria were to work in a cold environment at least 9 degrees Celsius in the factory, to be able to understand and respond to survey, to be between the ages of 18–60, and to be a volunteer. The exclusion criteria were to be diagnosed with rheumatic disease, to have undergone surgery due to an orthopedic disorder, to have a history of trauma that still affects the person physically, and to receive treatment due to a discomfort requiring physical therapy. This descriptive study approved by Abant İzzet Baysal University Clinical Research and Ethics Committee, (Decision No. 121 on 26/05/2017. Resolution NO: 2017/37).

765 people were tested for convenience. 178 people were excluded from the study because they did not work in cold conditions and had a history of orthopedic surgery and 9 people refused to participate. During the study, 568 individuals were included in the evaluation criteria. Of those working in cold conditions, 506 were working at 5 degrees and below, and 62 at 9 degrees. Ambient temperature was measured by the factory measuring system. The individuals included in the study were informed about the study and their consent was obtained. Individuals grouped as less than 2 years (n=211), 2–4 years (n=140), 5–9 years (n=147) and 10 years or more (n=70) according to working years in cold.

Nordic Musculoskeletal Questionnaire

Symptoms of the musculoskeletal system were evaluated using the Nordic Musculoskeletal Questionnaire (NMQ) developed in 1987.[14] Kahraman et al.[15] adapted the NMQ to the Turkish language in 2016. The questionnaire has two parts. In the first part; name, surname, date of evaluation, gender, date of birth, how many years and months the current work was done, the average number of hours worked in a week, the weight, height and the dominant side were questioned. The second part is supported by a body map image to indicate that nine symptoms (neck, shoulder, back, elbow, waist circumference, wrist/hand, hip/thighs, knees and ankles/feet) are present. The participant can see the approximate positions of the body parts mentioned in the body diagramme of the questionnaire. The question of whether there are any problems (pain, discomfort) in the aforementioned 9 regions, whether or not a normal job (at home or outside the home) is caused by pain, and whether there is any pain during the last 7 days or not, is one of the questions in the format of yes/no in the questionnaire format.[15]

Table 1. Distribution of gender, dominant extremity and smoking status of working year groups

	Less than 2 years (n=211) n	2–5 years (n=140) n	5–10 years (n=147) n	Over 10 years (n=70) n	Total	χ^2	p
Sex							
Female	123	77	89	33	319	1.112	0.376
Male	88	63	61	37	249		
Dominant extremity							
Right	192	129	129	62	512	1.940	0.585
Left	19	11	18	8	56		
Smoking status							
Yes	88	56	52	28	224	1.499	0.683
No	123	84	95	42	344		

χ^2: Chi-square test; n: Number of individuals; p>0.05.

Boston Carpal Tunnel Syndrome Questionnaire

Symptoms of Carpal Tunnel Syndrome were evaluated using the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ). The BCTQ developed by Levine et al.[16] in 1993, later adapted to Turkish by Sezgin et al.[17] in 2006. BCTQ consists of two parts. The first part is called the Symptom Severity Scale (SSS). It has 11 questions. Questions the symptoms related to carpal tunnel syndrome. The second part, the Functional State Scale (FSS), reveals the level of difficulty experienced in the 8 activities designed. Scoring is generally calculated in 1–5 for each question and the increase in score indicates worsening of symptoms.[17]

Demographic Questionnaire

The questionnaire examined gender, date of birth, daily working hours in cold, working days in a week, body weight, length, dominant extremity, presence of chronic disease, use of painkillers, the level of pain felt while resting and working.

Statistical Analysis

The minimum number of individuals required for each group found as 67 by using the G*Power program with the settings of α<0.05 β=%80 power. Descriptive statistical methods used for demographic information. The chi-square test was used to compare NMQ scores to the work years. Since there was an equal distribution in the evaluation, the Anova test was used for comparing the groups' BCTQ scores. For the post-hoc analysis, the Bonferroni test was used. The statistical significance level of the data taken as p<0.05. SPSS 22 program was used for the analysis.

Results

Distribution of gender, dominant extremity and smoking status of working year groups

The mean age of the patients was 36,92±8,61 years, the mean weight was 71,47±13,10 kg, the mean height was 165,35±8,83 cm, body mass index was 26,12±4,23 kg/m^2.

319 (56.1%) of the participants were female and 249 (43.9%) were male. 512 (90.3%) of the individuals were right-handed and 56 (9.7%) were left-handed. There was a normal distribution in the gender, dominant extremity and smoking between groups (Table 1) (p>0.05).

Comparison between NMQ scores of working years groups

The effect of the cold working years on the scores of the NMQ was investigated. Answers for "Have you at any time during the last twelve months had trouble (such as ache, pain, discomfort, numbness)?"shown a significant difference between groups for hip and knee regions. Answers for"Have you at any time during the last twelve months been prevented from doing your daily activities (at home or away from home) because of the trouble?" shown significant difference between groups for hip and elbow regions. Answers for "Have you had trouble at any time during the last seven days?" question shown significant difference shoulder region (p<0.05). No significant change was observed for all three questions in other regions (p>0.05) (Tables 2, 3).

Table 2. Comparison between NMQ scores and working years of the neck and upper extremities

	Less than 2 years (n=211) n	2–5 years (n=140) n	5–10 years (n=147) n	Over 10 years (n=70) n	χ^2	p
Neck A						
Yes	140	88	94	38	3.333	0.343
No	71	52	53	32		
Neck B						
Yes	186	124	123	54	6.667	0.083
No	25	16	24	16		
Neck C						
Yes	149	101	106	42	3.993	0.262
No	62	39	41	20		
Shoulders A						
Yes	130	79	86	38	1.599	0.660
No	81	61	61	32		
Shoulders B						
Yes	182	124	129	55	4.402	0.221
No	29	16	18	15		
Shoulders C						
Yes	148	98	114	40	9.533	**0.023**
No	63	42	33	30		
Elbows A						
Yes	181	114	121	54	3.091	0.378
No	30	26	26	16		
Elbows B						
Yes	197	135	140	60	9.900	**0.019**
No	14	5	7	10		
Elbows C						
Yes	184	128	128	56	5.534	0.137
No	27	12	19	14		
Wrists/hands A						
Yes	111	71	80	27	5.234	0.115
No	100	69	67	43		
Wrists/hands B						
Yes	170	120	122	52	4.426	0.219
No	41	20	25	18		
Wrists/hands C						
Yes	134	104	105	45	5.742	0.125
No	77	36	42	25		

χ^2: Chi-square test; A: Have you at any time during the last 12 months had trouble (ache, pain, discomfort)?; B: Have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?; C: Have you had trouble at any time during the last 7 days? $p<0.05$.

Comparison between the BCTQ scores of working years groups

The effect of individuals' working years on the results of Boston carpal tunnel syndrome was examined. There was no statistical difference between the work year groups in the Boston FSS score (p=0.577), but it was found that Boston SSS (p=0.008) scores get higher as individual's working years increase (p<0.05) (Table 4).

Table 3. Comparison between NMQ scores and working years of the spine and lower extremities

	Less than 2 years (n=211) n	2–5 years (n=140) n	5–10 years (n=147) n	Over 10 years (n=70) n	χ^2	p
Upper back A						
Yes	134	76	89	38	3.830	0.280
No	77	64	58	32		
Upper back B						
Yes	183	121	128	54	4.607	0.203
No	28	19	19	16		
Upper back C						
Yes	141	104	112	47	4.958	0.175
No	70	36	35	23		
Low back A						
Yes	115	62	75	29	5.595	0.133
No	96	78	72	41		
Low back B						
Yes	174	111	121	51	3.556	0.314
No	37	29	26	19		
Low back C						
Yes	136	98	105	41	4.224	0.238
No	72	42	42	29		
Hips/tights A						
Yes	191	122	120	53	11.817	**0.008**
No	20	18	27	17		
Hips/tights B						
Yes	202	133	137	58	14.882	**0.002**
No	9	7	10	12		
Hips/tights C						
Yes	190	127	135	57	6.043	0.110
No	21	13	12	13		
Knees A						
Yes	154	96	90	34	15.629	**0.001**
No	57	44	57	36		
Knees B						
Yes	192	123	129	56	6.058	0.109
No	19	17	18	14		
Knees C						
Yes	167	111	115	49	2.884	0.410
No	44	29	32	21		
Ankles/feet A						
Yes	119	85	82	31	5.165	0.160
No	92	55	65	39		
Ankles/ feet B						
Yes	176	124	119	53	6.200	0.102
No	35	16	28	17		
Ankles/feet C						
Yes	144	101	104	42	3.546	0.315
No	67	39	43	28		

χ^2: Chi-square test; A: Have you at any time during the last 12 months had trouble (ache, pain, discomfort)?; B: Have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?; C: Have you had trouble at any time during the last 7 days? $p<0.05$.

Table 4. Comparison between the BCTQ scores (functional status scale and symptoms severity scale) of working years groups

	Less than 2 years (n=211) X±SD	2–5 years (n=140) X±SD	5–10 years (n=147)	Over 10 years (n=70)	f	df	p
Boston FSS	1.30±0.62	1.38±0.81	1.39±0.75	1.41±0.78	0.660	564	0.577
Boston SSS	1.74±0.80	1.70±0.89	1.74±0.74	2.11±1.18	3.968	564	**0.008**

f: One way anova; df: Degree of freedom; X: Average value; SD: Standard deviation; FSS: Functional state scale; p<0.05.

Table 5. Post-hoc evaluations of Boston SSS scores for working year groups

	Working years	Working years	Mean	SD	p
Boston SSS	Less than 2	2–5 years	0.04127	0.09469	1.000
		5–10 years	0.00048	0.09332	1.000
		Over 10 years	-0.36718	0.11982	**0.014**
	2–5 years	Less than 2	-0.04127	0.09469	1.000
		5–10 years	-0.04079	0.10258	1.000
		Over 10 years	-0.40844	0.12716	**0.008**
	5–10 years	Less than 2	-0.00048	0.09332	1.000
		2–5 years	0.04079	0.10258	1.000
		Over 10 years	-0.36766	0.12615	**0.022**
	Over 10 years	Less than 2	0.36718	0.11982	**0.014**
		2–5 years	0.40844	0.12716	**0.008**
		5–10 years	0.36766	0.12615	**0.022**

F: One way anova post hoc Bonferoni; SD: Standard deviation; p<0.05.

Post-hoc evaluations of Boston SSS scores

Post-hoc evaluations of the Boston SSS scores according to their working years are the work year was more than ten years, there was a statistically significant difference in scores compared to all other groups (p<0.05) (Table 5).

Discussion

Exposure to cold in the work environment may be due to cold weather/wind exposure, dipping into water or touching cold surfaces. According to standard guidelines and norms, cold work can be defined as a situation of cold or cold feeling in a working environment. Even in a light physical job with an ambient temperature below 10 degrees can create this sensation. According to other international standards, cold work is generally defined for jobs with an ambient temperature below 10–15 degrees.[18]

It is found that the pain felt on the shoulder in the last 7 days was related to the working years. Shoulder is a joint where the problems are common in the works where active use of the upper extremity is required. In cold conditions, these muscles cannot work properly, causing muscular pain and injury. Decrease in muscle temperature adversely affects all parameters such as endurance, power, speed, and coordination of muscle performance.[19]

The decrease in the performance of hypothermic skeletal muscle can also be attributed to a decrease in nerve conduction velocity.[20,21] Muscle function and co-ordination also deteriorate due to the suppression of agonist muscle activity and increased antagonist muscle activity in hypothermic muscle.[21,22] Fatigue occurs earlier with these changes and repetitive activities when muscle temperature falls.[21,23] These effects prepare the ground for overuse injuries.[24]

When muscle temperature drops, muscle spindle activity, and motor neuron activity decrease, therefore muscle tension reflex decreases. This prevents the muscle from releasing sufficient force.[13] It is re-

ported that the working year and the working hours were effective on shoulder problems in cashiers.[25]

In this study, the increase in the working year and the disruption of the ordinary works due to pain felt in the elbow in the last 12 mounts were found to be correlated. The elbow is an active joint in meat processing and packaging activities. Therefore it is susceptible to injuries and disabilities.

The incidence of epicondylitis was reported to be 11.3% in female sausage makers, 7% in female packers and 6.4% in male meat cutters. The temperature of the environment where the sausages are working is 20 degrees and the temperature of the women working in the package is 8–10 degrees. The incidence of these diseases is reported to be less than 1% in non-demanding workers.[8]

In this study, the problems experienced in the knee and hip in the last 12 months (pain, discomfort) and the disruption of the ordinary works due to the pain felt in the hip in the last 12 months were found to be related. In our opinion, there are 2 possible causes of pain in the hips and knees. The first is the effect of low ambient temperature on muscle performance. Secondly, it can be defined as muscular pain due to long term standing. It is reported that individuals exposed to severe cold (-10, -25 degrees) have been reported to have more musculoskeletal pain than those exposed to moderate cold (-5, 5 degrees) and MDs developed in individuals as a result of cumulative exposure to cold work environment and waist and knee symptoms were very common in individuals exposed to cold for 5 years or more.[26]

It has been proven that long term repetitive hand and wrist movements, uncomfortable hand placement and position, continuous pressure on wrist or hand are related to Carpal Tunnel Syndrome and complaints about Carpal Tunnel Syndrome are seen more frequently in people who carry out activities involving such risks.[27,28] Participants were exposed to several of these factors at the same time. These factors can be counted as cold, continuous and long term hand-wrist activities and continuous pressure due to cutting action. We think that the continuous work of our participants increased the risk of microtraumas. Moreover, the slowing of the nerve conduction speed and the decrease of muscle performance due to cold are also effective factors.[20, 21]

Our study has four main limitations. Firstly, employees could not be grouped according to their professions because there were many different jobs in the factory setting. Secondly, jobs were not normally distributed for gender groups. Women were mostly employed in cutting and packaging, where more men working in storage areas. Thirdly, tests used to diagnose carpal tunnel syndrome could not be used due to work intensity and lack of time. Fourthly, the absence of a control group of individuals who did not work in a cold environment made a possibly meaningful comparison impossible. Therefore, increased musculoskeletal problems may be due to the cold environment or increased years of work. Considering the shortcomings of this study, some suggestions can be given for further studies. The physical difficulty of the work performed and the postures taken to do the work can be properly classified. Nerve conduction tests for carpal tunnel syndrome can be included in the study. Working in populations where genders can normally be distributed can lead to more objective results.

Conclusions

The results of this study demonstrated that the increase in working years in a cold factory setting may lead to a feeling of pain and discomfort in various regions of the body, disrupt ordinary works due to the pain felt and worsen the symptoms for carpal tunnel syndrome. There was a correlation between the increased working year and the pain felt on the shoulder in the last 7 days was found. There was a correlation between the increasing work years and the disruption of the ordinary works due to the pain felt in the elbow and the hip. The problems (pain, discomfort) felt on the knees and hips in the last 12 months were related to the increasing work years. It was concluded that the increase in working years worsened the symptoms of carpal tunnel syndrome. Participants exhibited a worse picture both functionally and symptomatically.

Ethics Committee Approval: This descriptive study approved by Abant İzzet Baysal University Clinical Research and Ethics Committee, (Decision No. 121 on 26/05/2017. Resolution NO: 2017/37).

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