ORIGINAL ARTICLE

Occurrence and trends of musculoskeletal pain among ski instructors

Denis Čaušević[1ABCDE], Erol Kovačević[1ABD], Semir Mašić[1ABD], Siniša Kovač[1,2A], Seth Spicer[3D]

[1] *Faculty of Sport and Physical Education, University of Sarajevo, Bosnia and Hezegovina*
[2] *Ski Trainers and Ski Instructors Association in Bosnia and Hezegovina, Bosnia and Hezegovina*
[3] *Rowan University School of Osteopathic Medicine, USA*

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Abstract

Background and Study Aim: Musculoskeletal disorders (MSD) are incredibly common and are often related to work load. For any occupational or public health intervention, injury prevention is preferred to injury treatment. Occupational health and injury prevention research has the potential to help mitigate MSD in the workplace. The aim of this study was to determine how the work demands of ski instructors may affect the health of their musculoskeletal system.

Material and Methods: A cross-sectional study involved the participation of 87 ski instructors (age = 34.61 ±10.67) in Bosnia and Herzegovina (ATUS in Bosnia and Herzegovina). Observed variables were the prevalence of MSD measured using a modified Nordic questionnaire about injuries during the previous ski season (neck, shoulders, elbows, wrist, upper back, lower back, one or both hips, one or both knees, and ankle). Means and standard deviations for each of the variables were calculated, and differences between genders were examined using an independent sample t-test.

Results: Prevalence of MSDs in ski instructors was most common in neck (13.8%), shoulders (12.6%), elbows (4.6%), wrist (9.2%), upper back (10.3%), lower back (46.0%), one or both hips (9.2%), one or both knees (29.9%), and ankle (9.2%). The results showed statistically significant differences in MSD between genders in the neck (p=.034); shoulders (p=.017); upper back (p=.027); one or both knees (p=.003) and in the ankle joint (p=.011).

Conclusions: MSD's are common in ski instructors, especially in the low back and knees of female employees. Future research or injury prevention programs would benefit these populations.

Keywords: skiing, injuries, health issues, musculoskeletal disorders, occupation, kinesiology

Introduction

Injury prevention and safety is a core tenant of public health programs, especially in occupational contexts. Every work activity carries a certain degree of load and stress, which can be physical, mental, or emotional. The process of teaching and motor learning in kinesiology presents the teacher with the above-mentioned components of stress. The level of the teacher's workload is influenced by several factors, such as the complexity of the movement, the demonstration and explanation of the movement, the level of knowledge required, motivation, number of students, as well as the working environment in which the learning process takes place. Skiing is a very specific and demanding movement activity, which places significant physical and mental demands on the instructors. The process of ski instruction is composed of motor learning principles and hands on work by the teacher. Kinesiology as a science applies to the understanding of both facets of workload in the workplace and the optimization of motor learning. Kinesiology of work is part of general kinesiology, i.e. the science of movement, which integrates all knowledge from the field of kinesiology and adapts it to the specifics of different workplaces. The basic goal of occupational kinesiology is to contribute, as part of a multidisciplinary approach, to the preservation and the improvement of human health in the work process [1].

Considering the very specific working conditions of ski instructors, experience has shown that they, as well as other workers with increased physical loads, experience musculoskeletal disorders accompanied by painful conditions and a decrease in work ability. In the research conducted by Roberts [2] on ski instructors, the results showed that they have poor stability of the lumbar spine, knees, and shoulders. The author further stated that there are other potential factors that contribute to occupational injuries, such as the impact of mild hypoglycemia and dehydration on measures of psychomotor alertness. These included cognition, attention, and motor reaction time. The causes of musculoskeletal disorders and the occurrence of pain are multifactorial, from which endogenous-genetic and exogenous factors of external influence can be distinguished. For this study, exogenous factors are particularly interesting due to the unique nature of the burden of daily work activities involving ski instructors. It is possible to talk about the causes of musculoskeletal disorders

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from the aspect of quantity and quality of postural movement habits.

The quantity of work refers to the weight of the load that the worker handles, the number of repetitions of a work task, the speed at which the worker works, the amplitude of movement and the time of holding a certain position of the body, which can be the cause of some form of injury and pain [3]. The quantity of work refers to the total mechanical load of the musculoskeletal system due to performing work activities or taking irregular positions. From the position of a ski instructor, there is certainly the time spent on skis, the number of repetitions of movements such as bending down and/or lifting clients, time spent sitting on the lift, climatic conditions such as exposure to low temperatures, the hardness of the surface, and the choice of ski equipment. Ski instructors and patrollers are most exposed to the risk of injury and have one of the highest classifications of occupational injury rates of all industry sectors [2]. Their increased risk of injury, compared to other participants in winter sports, may be due to more hours and days spent on the track during the season [4]. Haddock [5] states that all factors that contribute to injuries should be considered, such as equipment (design, development and care), environment (weather, terrain, snow conditions), and people (attributes, attitudes, skills). Because occupational kinesiology is a relatively young scientific discipline, there is not much research that has determined the professional load or the frequency of musculoskeletal disorders among skiing instructors. The main goal of this study is to determine the prevalence of symptoms of musculoskeletal disorders among ski instructors. The intent of this study is to determine how the work demands of ski instructors may affect the health of their musculoskeletal system. Considering the impressive demands on ski instructors, insights gained from this study may elucidate possible target areas for future workplace injury preventative programs.

Material and Methods

Participants

A total of 145 mailing addresses of ski instructors who are members of the association in BiH were collected, and the results of 87 ski instructors (age = 34.61 ±10.67) were included in this research. Because this study did not take into account how acute trauma and the consequences of acute trauma affect the health of ski instructors, the processing and interpretation of data did not include subjects who declared that they were injured in a skiing or other accident.

Ethical considerations. Participation in the study was voluntary and anonymous. Participants were provided informed consent.

Study design

A cross-sectional study was conducted. The mailing list of ski instructors in Bosnia and Herzegovina (ATUS in Bosnia and Herzegovina) was obtained from the Management of ATUS. The main instrument in this study was the modified Nordic questionnaire. The respondents were asked the following: Have you at any time during the last ski season had trouble (neck, shoulders, elbows, wrist, upper back, lower back, one or both hips, one or both knees, and ankle) (Yes, No). Data were collected in 2022. An online survey with a cover letter was developed. The cover letter fully explained the purpose of the study and asked for voluntary participation. A survey questionnaire was used on the representation of symptoms of musculoskeletal disorders by self-assessment through a modified Nordic questionnaire (Eng. Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms) [6]. The questionnaire consists of two parts and the modifications related to the appearance of symptoms in the ski season (not in 12 months as in the original). The survey inquired about age, gender, years of ski instruction experience, average number of days of work during the season, time spent in ski training during one day, and questions about injuries during the previous ski season (neck, shoulders, elbows, wrist, upper back, lower back, one or both hips, one or both knees, and ankle). The survey and cover letter were mailed after the 2021/2022 ski season at the last lecture of the Association of Ski Trainers and Teachers in BiH (April 12, 2022).

Statistical analysis

Descriptive statistical analysis was carried out by computing the means and standard deviations for each of the variables of interest. Baseline differences were examined using an independent sample t-test. Data analysis was performed using IBM SPSS Statistics for Windows (Version 21.0. SPSS Inc. Chicago. IL. USA).

Results

The research included 87 instructors, of which 65 were men (74.71%) and 22 were women (25.29%). The average age of the treated group of ski instructors in Bosnia and Herzegovina was 34.61 years, and the average length of service as the instructors was 6.52 years. When it comes to the previous season, the instructors spent an average of 61.21 days (5.72 hours per day) on the mountain doing their instructor work (Table 1).

When it comes to the prevalence of symptoms of musculoskeletal disorders in the previous season, instructors reported symptoms in the following regions: neck (13.8%), shoulders (12.6%), elbows (4.6%), wrist (9.2%), upper back (10.3%), lower back (46.0%), one or both hips (9.2%), one or both knees (29.9%), and ankle (9.2%) (Table 2.).

Table 1. Characteristics of participants

Variables	Total			Male			Female		
	n	Mean	St.dev	n	Mean	St.dev	n	Mean	St.dev
Age	87	34.61	10.67	65	37.58	9.40	22	25.82	9.38
How long have you been working as a ski instructor?	87	6.52	4.14	65	7.23	3.95	22	4.41	4.04
How many days did you work as a ski instructor last season?	87	61.21	35.48	65	61.85	35.54	22	59.32	36.03
How much time do you spend on skis on average during the day?	87	5.72	1.25	65	5.46	1.07	22	6.50	1.40

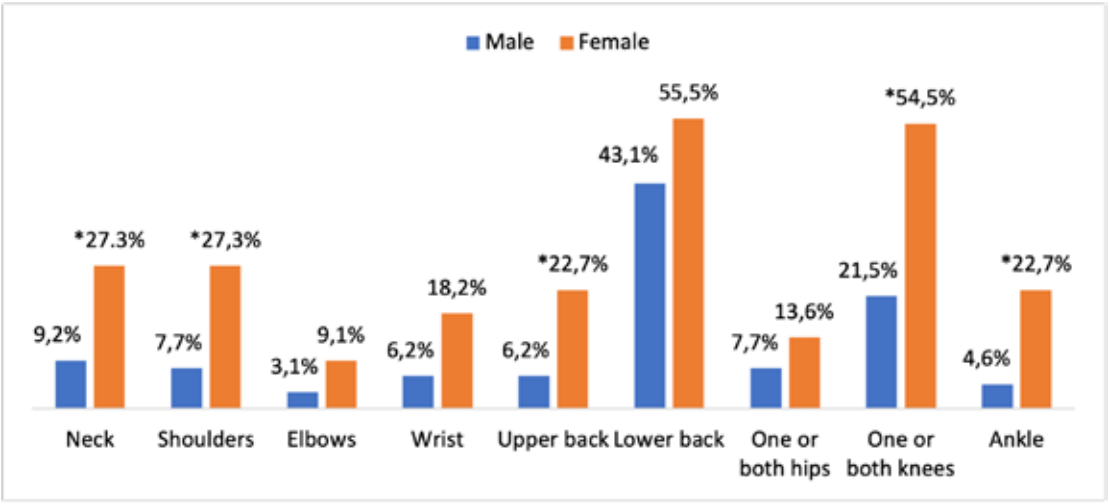

Figure 1. Percentage difference between MSD among male and female ski instructors. "*" Indicates a statistically significant difference.

Table 2. Musculoskeletal disorders among ski instructors

MSD		Total		Male		Female		T - test
		n	%	n	%	n	%	
Neck	**No**	75	86.2	59	90.8	16	72.7	.034*
	Yes	12	13.8	6	9.2	6	27.3	
Shoulders	**No**	76	87.4	60	92.3	16	72.7	.017*
	Yes	11	12.6	5	7.7	6	27.3	
Elbows	**No**	83	95.4	63	96.9	20	90.9	.249
	Yes	4	4.6	2	3.1	2	9.1	
Wrist joint	**No**	79	90.8	61	93.8	18	81.8	.094
	Yes	8	9.2	4	6.2	4	18.2	
Upper back	**No**	78	89.7	61	93.8	17	77.3	.027*
	Yes	9	10.3	4	6.2	5	22.7	
Lower back	**No**	47	54.0	37	56.9	10	45.5	.357
	Yes	40	46.0	28	43.1	12	55.5	
One or both hips	**No**	79	90.8	60	92.3	19	86.4	.410
	Yes	8	9.2	5	7.7	3	13.6	
One or both knees	**No**	61	70.1	51	78.5	10	45.5	.003*
	Yes	26	29.9	14	21.5	12	54.5	
Ankle joint	**No**	79	90.8	62	95.4	17	77.3	.011*
	Yes	8	9.2	3	4.6	5	22.7	

Legend: MSD - musculoskeletal disorders; * - $p \leq 0.05$

Discussion

The main purpose of this study was to determine how cumulative trauma caused by the work of ski instructors affects the prevalence of symptoms of musculoskeletal disorders in ski instructors with the intent to direct future injury prevention programs. The results showed that in the past ski season, the incidence of musculoskeletal disorders for certain body segments among ski instructors in Bosnia and Herzegovina was between 9.2% and 46% (Figure 1.). Although there is a very small number of studies that studied this problem, the stated results can be compared with some studies that determined the prevalence of musculoskeletal disorders or the onset of injuries among ski instructors. Thus [7] state that the majority of instructors (67%) experienced a serious injury while skiing or had problems with painful conditions. If we look at the highest incidence of painful conditions in a particular body region, low back pain at 46% is certainly and unequivocally the biggest problem among ski instructors in Bosnia and Herzegovina. No significant differences in frequency between men and women were found. The above data are in accordance with the research by Peacock et al. [8] who state that 75% of ski instructors reported a history of low back pain. These data fit with the results obtained in the general population and the population of working-age people. According to Eurostat [9], during 2013, 8% of the total EU population reported some form of musculoskeletal problems, while 55% of that population was absent from work because of them. Of the total percentage of reported diseases caused or related to work, 60% were related to musculoskeletal disorders and most often MSD was associated with the back. It is estimated that 80% of the population experiences pain in the low back at least once during their lifetime, which recurs in at least 50% of these patients. The problem of "back pain" most often occurs in the most productive period of a person's life, between thirty and fifty years of age, equally often in people of both sexes [10]. For these reasons, in 2020 it launched a campaign called "Healthy Workplaces Lighten the Load".

When talking about the causes of this phenomenon, it was determined that 90% of all low back pain is the so-called mechanical low back pain associated with biomechanical stress [11]. In this sense, Supej et al. [12], among other reasons, state that numerous studies have shown that exposure to vibration is associated with lower back pain. The results of their study showed that all forms of alpine skiing produce vibrations and such observations reveal that WBV (whole-body vibrations) is a significant risk factor for LBP (low back pain) in alpine skiers, and therefore in ski instructors.

The next most common problem among ski instructors is pain in one or both knees (29.9%), which is consistent with research (27% to 41%) [13, 14, 15]. It is interesting to note that there is a statistically significant difference in the incidence of knee pain in women (54.5%) compared to men (21.5%). The cause of this is likely related to anatomical differences between men and women such as an increased Q angle in women. Widening the pelvis reduces the angle between the neck and the trunk of the femur, which alters the kinetics at the knee and hip joints. Consequently, the anatomical position and movement of the lower extremities is slightly different [16]. In particular cases, there is "miserable malalignment syndrome". This represents a combination of three anatomical variations of the lower extremities (anteversion of the femur, external rotation of the tibia, and increased Q angle) that can present in women that likely predisposes them to instability, knee pain, and ultimately more frequent anterior cruciate ligament injury [17]. Rochman [18] states that research has shown that non-contact injuries of the anterior cruciate ligament are 2-3 times more common in female athletes than in male athletes. This syndrome, along with differences in neuromuscular reflex response, hormonal status (the influence of estrogen receptors on ligaments), and of course differences in training, causes up to 7 times higher frequency of anterior cruciate ligament injuries and higher frequency of patellofemoral syndrome in female athletes compared to male athletes [16].

It is interesting that in 5 out of 9 body regions (neck, shoulders, upper back, knee and ankle), women have a significantly higher frequency of painful conditions. There are explanations in the literature that refer to the higher frequency of injuries of women in sports with possible reasons for this. Simek et al. [19] state that women are exposed to a greater risk of injury in training and competition. The reason for this is the anthropological characteristics of women, such as a wider pelvis, less developed strength, greater mobility in the joints, etc. Thus, the ligamentous structures are more frequently put into disadvantageous positions and are more likely to be strained. These conclusions can be taken as relevant in the context of suggesting an explanation for the obtained results of this study. It is possible that female instructors have a greater biomechanical strain on the locomotor apparatus when performing the same tasks relative to men, which puts them in a disadvantageous position in the context of the occurrence of overload and the occurrence of musculoskeletal disorders. If this activity happens every day, overexertion syndrome occurs. Overexertion syndrome is chronic in nature, because repeated trauma over time overcomes the ability to regenerate tissues (tendons, bones, cartilage, mucous membranes or muscles) [20]. In addition, irregular movement patterns that cause

cumulative damage to anatomical structures caused by the continuous application of non-physiological positions and non-functional movements are most often cited as the causes of musculoskeletal disorders in the literature. When correcting irregular movement patterns, occupational kinesiology emphasizes intermuscular coordination and joint mobility. Muscle imbalance that occurs in 100% of low back pain can hardly be the cause of low back pain. It is necessary to determine the cause of the muscle imbalance, and then the back pain. The cause of muscle imbalance is improper posture and improper movement patterns. All of the above results in muscle imbalances, a breakdown of intermuscular coordination with a consequent general breakdown of the statics of the whole body, and changes in the relationships between anatomical structures over time. In other words, due to the continuous application of non-physiological positions and non-functional movements, i.e. mechanisms of cumulative trauma, structural and functional changes of anatomical structures occur over time. By correcting improper postural and movement habits, i.e. continuous application of physiological positions and functional movements, it is possible to stop the progression of structural changes in hard tissues [21]. This, combined with the findings, suggests that future workplace health programs or future research into injury prevention may be beneficial for this population.

Conclusions

The incidence of musculoskeletal disorders among ski instructors in the past ski season ranged between 9.2% and 46%. As expected, the largest number of respondents of both sexes stated that they had problems with lower back pain during the past ski season. Lumbar pain syndrome is one of the most common health problems today and the most common cause of absenteeism from work. In the context of occupational safety of ski instructors, it is important to pay attention to the quality of work, which refers to the way the body is held when performing daily work tasks. For example, when lifting clients from a sitting position to an upright position on skis, demonstrating techniques, etc. By determining the primary risk factors when performing professional activities, in this case ski instructors, stressors that lead to the appearance of painful conditions in the musculoskeletal system can be prevented or prepared for accordingly. Aside from the low back findings, it is possible to conclude that there is a statistically significant difference in the frequency of painful musculoskeletal disorders between woman and male ski instructors where women are more afflicted. Specifically, in 5 of the 9 body regions tested, painful conditions of the musculoskeletal system appeared more often in women.

Conflict of interest

No conflict of interest.

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Information about the authors:

Denis Čaušević; (Corresponding Author); https://orcid.org/0000-0003-2400-9352; denis.causevic@fasto.unsa.ba; Faculty of Sports and Physical Education, University of Sarajevo; Sarajevo, Bosnia and Hercegovina.

Erol Kovačević; https://orcid.org/0000-0003-4391-6070; erol.kovacevic@fasto.unsa.ba; Faculty of Sports and Physical Education, University of Sarajevo; Sarajevo, Bosnia and Hercegovina.

Semir Mašić; https://orcid.org/0000-0003-0042-5255; semir.masic@fasto.unsa.ba; Faculty of Sports and Physical Education, University of Sarajevo; Sarajevo, Bosnia and Hercegovina.

Siniša Kovač; https://orcid.org/0000-0003-3496-0272; sinisa.kovac@fasto.unsa.ba; Faculty of Sports and Physical Education, University of Sarajevo; Sarajevo, Bosnia and Hercegovina.

Seth Spicer; https://orcid.org/0000-0001-9309-5923; spicer39@rowan.edu; Rowan University School of Osteopathic Medicine, Stratford New Jersey, USA.

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