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WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG PHYSIOTHERAPISTS AND PHYSIOTHERAPY STUDENTS IN CROATIA AND THEIR ASSOCIATION WITH PHYSICAL FITNESS

Z DELOM POVEZANE MIŠIČNO-SKELETNE MOTNJE FIZIOTERAPEVTOV IN ŠTUDENTOV FIZIOTERAPIJE NA HRVAŠKEM IN NJIHOVA POVEZANOST S TELESNO PRIPRAVLJENOSTJO

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ABSTRACT

Introduction: Among physiotherapists, work-related musculoskeletal disorders (WMSDs) are the most common health problem. This study aimed to provide evidence for planning evidence-based health promotion programmes for ensuring and maintaining adequate physical fitness (PF) to decrease WMSDs among physiotherapists which would have started already during the study.

Methods: A cross-sectional study involved the participation of a total of 100 physiotherapy students and 62 physiotherapists. Observed variables were prevalence of WMSDs in the last 12 months, lasting >3 days during physiotherapeutic activities and five PF components: body composition, cardiorespiratory and muscle endurance, muscle strength, and flexibility. A chi-square test and binary logistic regression were used as the main analytical methods.

Results: Prevalence of WMSDs in physiotherapists was 63.9% (the most common locations: lower back, shoulders, neck), while in physiotherapy students it was 46.5% (the most common locations: lower back, neck, upper back) (p=0.031). Among the PF components, the results showed statistically significantly worse flexibility among students compared to physiotherapists (about two thirds of students had poor or very poor results of flexibility testing) (p=0.002) in comparison to physiotherapists. A statistically significant positive association between WMSDs and PF was observed only between knee pain and poor cardiorespiratory endurance (OR=4.03 with 95% CI 1.12-14.58; p=0.033).

Conclusion: The study showed poor flexibility among students indicating that it is necessary to direct them to perform activities that will increase the extensibility of muscles. The awareness of this problem should be increased. A specific role should be played by staff involved in clinical practice.

Keywords:
musculoskeletal disorders,
physical fitness,
physiotherapists,
physiotherapy students

IZVLEČEK

Uvod: *Pri fizioterapevtih so z delom povezane motnje mišično-skeletnega sistema (ZDPMSM) najpogostejša zdravstvena težava. Namen te študije je bil zagotoviti dokaze za razvoj z dokazi podprtih programov promocije zdravja za zagotavljanje in vzdrževanje ustrezne telesne pripravljenosti (TP) fizioterapevtov za zmanjšanje ZDPMSM z začetkom že v času študija.*

Metode: *V presečni študiji je sodelovalo 100 študentov fizioterapije in 62 fizioterapevtov. Opazovane spremenljivke so bile prevalenca ZDPMSM v zadnjih 12 mesecih, ki so trajale >3 dni med fizioterapevtskimi aktivnostmi in pet komponent TP: telesna sestava, srčno-dihalna vzdržljivost, mišična vzdržljivost, mišična moč in prožnost. Glavni analitični metodi sta bili test hi-kvadrat in binarna logistična regresija.*

Rezultati: *Prevalenca ZDPMSM je bila v skupini fizioterapevtov 63,9-odstotna (najpogostejše lokacije: spodnji del hrbta, ramena, vrat), v skupini študentov fizioterapije pa 46,5-odstotna (najpogostejše lokacije: spodnji del hrbta, vrat, zgornji del hrbta) (p = 0,031). Med komponentami TP so rezultati pokazali statistično značilno slabšo fleksibilnost študentov v primerjavi s fizioterapevti (približno dve tretjini študentov je imelo slabe ali zelo slabe rezultate testiranja fleksibilnosti) v primerjavi s fizioterapevti (p = 0,002). Statistično značilna pozitivna povezanost med ZDPMSM in TP je bila zaznana le med bolečino v kolenu in slabo srčno-dihalno vzdržljivostjo (RO = 4,03 s 95-odstotnim IZ 1,12-14,58; p = 0,033).*

Zaključek: *Študija je pokazala slabo fleksibilnost študentov, kar kaže, da jih je treba usmerjati v dejavnosti, ki bodo povečale raztegljivost mišic. Ozaveščenost o tem problemu je treba povečati. To posebno vlogo mora imeti osebje, vključeno v klinično prakso.*

Ključne besede:
mišično-skeletne motnje, telesna pripravljenost, fizioterapevti, študenti fizioterapije

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1 INTRODUCTION

Musculoskeletal disorders (MSDs), cumulative damage/dysfunction of the musculoskeletal system caused by prolonged and repeated exposure to high- or low-intensity loads or as a result of acute trauma (1), are the most common cause of severe long-term pain/discomfort causing physical disability. Work-related MSDs (WMSDs) are MSDs in which the work environment and work contribute significantly to the condition and/or the condition worsens/persists longer due to work conditions (2). They are the most common work-related health problem in the European Union (EU), with an average prevalence of about 60% (3, 4), ranging from 40-79% in the Member States in 2015 (3). All occupations can be affected, but human health and social work occupations more so than others (3).

In physiotherapists, the WMSDs prevalence is higher than average. The 12-month prevalence is estimated at 58-91% (5-7). Moreover, Glover et al. determined that 42% of musculoskeletal symptoms persisted for >3 days within the past year (5). The leading cause of WMSDs among physiotherapists is the performance of repetitive movements or intense physical demands (lifting heavy patients, manual handling, patient handling, awkward positioning, prolonged constrained postures) (6-9). The most frequently affected areas are the lower back (6-9, 10-13), neck and upper back (8, 9), and thumb (6). To carry out the physically demanding work of a physiotherapist, it is necessary to ensure satisfactory physical fitness (PF).

PF is defined as the capacity for physical activity, which is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. It consists of five components: body composition, cardiorespiratory and muscle endurance, muscle strength and flexibility (14). The level of PF is partially genetically predetermined but is influenced by external factors, such as exercise. Although good PF is considered a protective factor for the occurrence of MSDs, research to date has not been able to show this statistically (15-17).

The latest available data show that the prevalence of WMSDs in Croatia is slightly higher than the average in the EU (2015: 62%) (4). Data on PF and the prevalence of WMSDs among physiotherapists/physiotherapy students in Croatia are very limited. Only recently, studies addressing this topic have emerged (18, 19). Sklempe Kokic et al. (2019) for example, estimated the last 12-months prevalence of MSDs among physiotherapy students at about 80% (18).

Aiming to provide evidence for the development of evidence-based health promotion programmes for maintaining adequate PF in physiotherapists to decrease their WMSDs starting in the years of studying, the objectives of this study were a) to assess the differences in self-rated WMSDs and PF components between physiotherapists and students of physiotherapy and b) to assess the association between WMSDs and PF components.

2 METHODS

2.1 Study design, setting and time frame

The presented cross-sectional study is a part of comprehensive research on WMSDs in physiotherapists in Croatia in relation to PF and physical activity. It was carried out during the 2017/18 academic year at the University of Applied Health Sciences Zagreb (UAHSZ) in collaboration with the Faculty of Kinesiology, University of Zagreb.

2.2 Subjects

The study involved two groups of subjects. The first consisted of physiotherapists involved in the UAHSZ study programme (e.g. conducting clinical teaching and clinical tutoring). The inclusion criterion was practising the profession in the Zagreb area, which was met by 71/80 physiotherapists. They were invited to participate in the study. The second group consisted of the Bachelor of Physiotherapy study programme of the UAHSZ students. The total population of the third year of 2017/18 (n=107) was invited to participate. There were no exclusion criteria.

2.3 Study course

Everyone who was invited to the research was first briefly introduced to the purpose and importance of the research and its course (filling in the questionnaire and PF testing). This was followed by completing a structured self-completion questionnaire designed by the first author. The questionnaire consisted of three sets of questions. The first set consisted of questions about WMSDs based on selected questions from the Nordic Musculoskeletal Questionnaire (NMQ) (20), supplemented by additional questions (e.g. questions about the history of symptoms and about possible treatment of symptoms). The second set consisted of questions of the long version of the International Physical Activity Questionnaire (21). The last set consisted of questions on socio-demographic data. The questionnaire was completed by all who decided to participate in this first part of the research. Afterwards, the first author demonstrated the performance of PF tests. This was followed by a short interview about the current self-reported state of health. All those whose current state of health did not allow them to perform PF tests were excluded from the study.

2.4 Observed variables and study instruments

2.4.1 Musculoskeletal variables

WMSDs status was assessed by questions about WMSDs based on selected similar NMQ questions (20). The

respondents were asked the following: Have you at any time during the last 12 months had trouble (ache, pain, discomfort) lasting >3 days during physiotherapeutic activities (0=no, 1=yes). If yes, they were asked about the locations: neck, shoulders, upper back, elbows and forearms, lower back, wrist and hands, thumb, hips and thighs, knees, and ankles and feet (all 0=no, 1=yes).

2.4.2 Physical fitness components variables

In the PF assessment, the battery of tests proposed by the American College of Sports Medicine was used (22). All measurements were performed by the study's first author. Body composition was assessed by body mass index (BMI) (23), which demonstrated high reliability (Cronbach=0.995) (24). Body mass was measured using a Seca 700 medical personal scale (Seca GmbH, Germany) and body height using a Seca 220 stadiometer (Seca GmbH, Germany). The original BMI values were transformed into standardized categories (1=BMI <18.5: underweight; 2=BMI 18.5-24.9: normal weight; 3=BMI 25.0-29.9: overweight; 4=BMI ≥30.0: obese) (25).

Cardiorespiratory endurance was assessed with the Harvard step test, which demonstrated acceptable reliability (Interclass Coefficient-ICC=0.63) (26). Respondents were stepping up and down on a step bench (men: 50 cm; women: 45 cm) for 5 min at the frequency of 30 times per minute until exhaustion or up to 5 minutes (27). At one, three, and five minutes after the test, pulse rate was recorded. The cardiorespiratory fitness index (CRI) was calculated using a standard procedure (28). The original CRI values were transformed into standardized categories (1=CRI <54(poor), 2=CRI 54-67(low average), 3=CRI 68-82(average), 4=CRI 83-96(good), 5=lCRI >96(excellent)) (29).

Muscle endurance was tested using a curl-up test for assessment of the dynamic capacity of the abdominal muscles, which demonstrated high reliability (ICC=0.91-0.96) (30). On the training mat on which two stripes 1 metre long separated by 10 centimetres were placed (UAHSZ, Croatia), the examinee performed the lifting of the torso from the lying position on the back, with the movement of the arms from the starting to the end marked position. The test was conducted for 1 minute in time with the metronome (mobile application "Metronome" version 1.21). The number of repetitions the subject was able to perform was recorded. Considering the sex and age of the participants, the number of repetitions was transformed into standardized categories (1=poor, 2=low-average, 3=average, 4=good, 5=excellent) (31).

For muscular strength, the handgrip strength test was used (21), which demonstrated high reliability (ICC=0.87) (26). Isometric force (kg) was measured with a Jamar handgrip dynamometer (Jamar 5030 J1; Sammons Preston Inc., USA). Measurements were taken in the seated position, with the arm supported leaning against the body, elbow bent at 90 degrees, the hand in a neutral position holding the dynamometer (22). The participants were instructed to squeeze the dynamometer as hard as they could (22). The subject performed 3 attempts, each hand alternately. The result was the average of the best measurements of both hands. Considering the sex and age of the participants, basic values were transformed into standardized categories (1=poor, 2=low-average, 3=average, 4=good, 5=excellent) (31).

As an assessment tool to evaluate posterior muscular chain flexibility, which simultaneously implies a requirement for balance, the Toe-Touch Test was applied (32), which demonstrated high reliability (r=0.97) (33). The respondents were standing on a flexometer – a raised platform (UAHSZ, Croatia), bending forward with straight knees, touching their toes, or reaching further. The distance (in cm) to/from the ground (point 0) at which the middle index finger reaches the lowest was recorded. Measured values were divided into seven categories (1=very poor, 2=poor, 3=fair, 4=average, 5=good, 6=excellent, 7=outstanding) (34).

2.4.3 Other variables

Along with health and PF variables, selected socio-demographic factors were observed: sex and physical workload according to the physiotherapeutic work during service or during the practical exercise (1=work in a hospital ward, 2=work in an outpatient clinic, 3=work of a mixed type) were observed.

2.5 Data processing and statistical analysis

Prior to analysis, the data were prepared so that they were suitable for public health purposes. In this procedure, the PF variables were dichotomised considering the physical workload of the participants in terms of what their PF should be in relation to their work as physiotherapists, except in body composition. For those working in hospital wards, or hospital wards and outpatient clinics, excellent and outstanding results were considered satisfactory PF achievements. For those working only in outpatient clinics good, excellent and outstanding results were considered satisfactory PF achievements. For students, already average results were considered satisfactory PF achievements. A new variable was created for each of them: poor cardiorespiratory endurance, poor muscle endurance, poor muscle strength and poor flexibility (all 0=no, 1=yes). A variable for poor body composition was also created (0=no (normal weight), 1=yes (underweight/overweight/obesity)).

First, differences in WMSDs and PF components between physiotherapists and physiotherapy students were analysed. The chi-square test was used as a principal method, while in the case of low expected frequencies,

Fisher exact (in case both variables had two categories) and likelihood-ratio tests (in case one variable had more than two categories) were used.

Afterwards, an assessment of the association between WMSDs and PF components was performed. Multiple binary logistic regression was used as a method of multivariate analysis. For each WMSD, a multivariate model was defined with the same independent variables: all five components of PF, the group of physiotherapy students/physiotherapists, and sex. As a method of assessing goodness-of-fit of models, the Hosmer-Lemeshow test was used.

In all statistical tests, $p \leq 0.05$ was considered significant. The software IBM SPSS for Windows Version 27.0 (SPSS Inc., Chicago, IL., USA) was used for computations.

3 RESULTS

3.1 Description of participants

Of the 71 invited physiotherapists, 9 declined to participate or had a health condition that did not allow the performance of PF tests (pregnancy, neck problems, knee problems, multiple sclerosis). Finally, 62 (87.3% of invitees) participated in the study. Of 107 physiotherapy students 100 agreed to participate in the study (response rate of 93.4%).

The group of students consisted of 31 (31.0%) males and 69 (69.0%) females. In the group of physiotherapists, the distribution by sex was very similar (males: 17, 27.4%; females: 45, 72.6%). The mean age of students was 21.7±1.1 years, while the mean age of physiotherapists was 42.4±9.0 years. Among the physiotherapists, 28 (45.2%) were working in hospital wards and the same number in outpatient clinics (28, 45.2%), while 6 of them (9.7%) were working in hospital wards and outpatient clinics.

3.2 Prevalence of WMSDs

The overall 12-month prevalence of WMSDs, lasting >3 days during physiotherapeutic activities regardless of location, was 53.1%. The results showed that the prevalence in physiotherapists was higher except in the lower back, and ankle and foot. Among the physiotherapists the prevalence was the highest in the lower back, shoulders and neck, while among physiotherapy students, it was highest in the lower back, upper back and neck (Table 1).

Table 1. The 12-month prevalence of pain lasting >3 days due to work-related musculoskeletal disorders.

Location of pain	Category	Physiotherapists (n=62)	Students (n=100)	p
		N_{cat}(%)	N_{cat}(%)	
Any location	No	22(36.1%)	53(53.5%)	0.031*
	Yes	39(63.9%)	46(46.5%)	
Neck	No	48(77.4%)	88(88.0%)	0.075*
	Yes	14(22.6%)	12(12.0%)	
Shoulder	No	47(75.8%)	91(91.0%)	0.008*
	Yes	15(24.2%)	9(9.0%)	
Upper back	No	49(79.0%)	88(88.0%)	0.125*
	Yes	13(21.0%)	12(12.0%)	
Elbow and forearm	No	55(88.7%)	97(97.0%)	0.033#
	Yes	7(11.3%)	3(3.0%)	
Lower back	No	43(69.4%)	67(67.0%)	0.775*
	Yes	19(30.6%)	33(33.0%)	
Wrist and hand	No	52(83.9%)	97(97.0%)	0.003#
	Yes	10(16.1%)	3(3.0%)	
Thumb	No	56(90.3%)	100(100.0%)	0.002#
	Yes	6(9.7%)	0(0.0%)	
Hip and thigh	No	57(91.9%)	98(98.0%)	0.065#
	Yes	5(8.1%)	2(2.0%)	
Knee	No	55(88.7%)	90(90.0%)	0.795*
	Yes	7(11.3%)	10(10.0%)	
Ankle and foot	No	61(98.4%)	94(94.0%)	0.182#
	Yes	1(1.6%)	6(6.0%)	

Legend: *=Chi-square test results, #=Fisher exact test results

3.3 Physical fitness analysis

Table 2 shows the results of the PF analysis in both observed groups, and a comparison between them. The results show that more physiotherapists are overweight, with poor cardiorespiratory endurance, poor muscular endurance, and low average muscular strength, than students, except in the case of flexibility.

3.4 Results of analysis of the association between WMSDs and PF

Due to the very low frequency, the multivariate analysis could not be performed for two pain locations – thumb, and ankle and foot. Other results of the analysis of the association between WMSDs and PF in physiotherapists and physiotherapy students are shown in Table 3.

Table 2. Physical fitness tests results.

Physical fitness component	Category	Physiotherapists (n=62)	Students (n=100)	p
Body composition	Underweight	0(0.0%)	4(4.0%)	<0.001#
	Normal weight	26(41.9%)	76(76.0%)	
	Overweight	31(50.0%)	17 17.0%)	
	Obese	5(8.1%)	3(3.0%)	
Cardiorespiratory endurance	Poor	30(48.4%)	20(20.0%)	0.003#
	Low average	0(0.0%)	1(1.0%)	
	Average	4(6.5%)	16(16.0%)	
	Good	16(25.8%)	38(38.0%)	
	Excellent	12(19.4%)	25(25.0%)	
Muscular endurance	Poor	31(50.0%)	11(11.0%)	<0.001#
	Low average	9(14.5%)	16(16.0%)	
	Average	8(12.9%)	15(15.0%)	
	Good	6(9.7%)	16(16.0%)	
	Excellent	8(12.9%)	42(42.0%)	
Muscular strength	Poor	7(11.3%)	5(15.0%)	0.421*
	Low average	22(35.5%)	25(25.0%)	
	Average	12(19.4%)	14(14.0%)	
	Good	13(21.0%)	28(28.0%)	
	Excellent	8(12.9%)	18(18.0%)	
Flexibility	Very poor	6(9.7%)	33(33.0%)	0.002#
	Poor	20(32.3%)	33(33.0%)	
	Fair	19(30.6%)	25(25.0%)	
	Average	10(16.1%)	7(7.0%)	
	Good	5(8.1%)	1(1.0%)	
	Excellent	1(1.6%)	1(1.0%)	
	Outstanding	1(1.6%)	0(0.0%)	

Legend: *=Chi-square test results, #=Likelihood-ratio test results

Table 3. Results of multiple binary logistic regression analysis of the association between pain associated with work-related musculoskeletal disorders, and physical fitness and socio-demographic factors.

Health outcomes	PF and socio-demographic factors	Category	OR(95% CI limits)	p_V	p_{HL}
Neck pain	Poor body composition	No	1.00		0.529
		Yes	0.76(0.28-2.09)	0.599	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	0.50(0.17-1.50)	0.218	
	Poor muscular endurance	No	1.00		
		Yes	2.30(0.77-6.86)	0.134	
	Poor muscular strength	No	1.00		
		Yes	0.55(0.17-1.83)	0.331	
	Poor flexibility	No	1.00		
		Yes	0.65(0.17-2.49)	0.531	
	Group	Students	1.00		
		Physiotherapists	3.16(0.80-12.41)	0.099	
	Sex	Males	1.00		
		Females	1.04(0.37-2.90)	0.938	
Shoulder pain	Poor body composition	No	1.00		0.706
		Yes	0.72(0.24-2.12)	0.554	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	0.27(0.08-0.90)	0.033	
	Poor muscular endurance	No	1.00		
		Yes	2.37(0.70-8.00)	0.164	
	Poor muscular strength	No	1.00		
		Yes	0.50(0.13-1.84)	0.297	
	Poor flexibility	No	1.00		
		Yes	1.02(0.18-5.65)	0.981	
	Group	Students	1.00		
		Physiotherapists	6.96(1.55-31.09)	0.011	
	Sex	Males	1.00		
		Females	2.41(0.68-8.54)	0.172	
Upper back pain	Poor body composition	No	1.00		0.851
		Yes	0.72(0.26-1.99)	0.531	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	0.79(0.27-2.32)	0.668	
	Poor muscular endurance	No	1.00		
		Yes	1.98(0.65-6.00)	0.227	
	Poor muscular strength	No	1.00		
		Yes	1.40(0.42-4.66)	0.581	
	Poor flexibility	No	1.00		
		Yes	1.30(0.25-6.90)	0.752	
	Group	Students	1.00		
		Physiotherapists	1.34(0.34-5.35)	0.678	
	Sex	Males	1.00		
		Females	1.65(0.54-5.03)	0.380	
Elbow and forearm pain	Poor body composition	No	1.00		0.822
		Yes	1.05(0.22-4.98)	0.953	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	0.63(0.10-3.60)	0.601	
	Poor muscular endurance	No	1.00		
		Yes	2.80(0.45-17.03)	0.265	
	Poor muscular strength	No	1.00		
		Yes	0.58(0.09-3.41)	0.547	
	Poor flexibility	No	1.00		
		Yes	0.17(0.03-0.92)	0.040	
	Group	Students	1.00		
		Physiotherapists	5.09(0.56-45.88)	0.147	
	Sex	Males	1.00		
		Females	0.59(0.12-2.84)	0.514	

Health outcomes	PF and socio-demographic factors	Category	OR(95% CI limits)	p_V	p_{HL}
Lower back pain	Poor body composition	No	1.00		0.441
		Yes	0.51(0.23-1.16)	0.109	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	1.21(0.52-2.81)	0.656	
	Poor muscular endurance	No	1.00		
		Yes	1.86(0.81-4.28)	0.141	
	Poor muscular strength	No	1.00		
		Yes	0.72(0.28-1.83)	0.486	
	Poor flexibility	No	1.00		
		Yes	0.97(0.31-2.96)	0.953	
	Group	Students	1.00		
		Physiotherapists	0.92(0.30-2.75)	0.877	
	Sex	Males	1.00		
		Females	0.59(0.28-1.30)	0.190	
Wrist and hand pain	Poor body composition	No	1.00		
		Yes	1.11(0.29-4.15)	0.874	0.272
	Poor cardiorespiratory endurance	No	1.00		
		Yes	1.62(0.37-6.98)	0.520	
	Poor muscular endurance	No	1.00		
		Yes	1.53(0.31-7.45)	0.599	
	Poor muscular strength	No	1.00		
		Yes	1.49(0.29-7.48)	0.627	
	Poor flexibility	No	1.00		
		Yes	0.75(0.12-4.52)	0.756	
	Group	Students	1.00		
		Physiotherapists	2.91(0.40-21.04)	0.291	
	Sex	Males	1.00		
		Females	0.89(0.22-3.54)	0.869	
Hip and thigh pain	Poor body composition	No	1.00		0.113
		Yes	0.76(0.10-5.69)	0.796	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	0.19(0.02-1.86)	0.157	
	Poor muscular endurance	No	1.00		
		Yes	0.59(0.08-4.03)	0.588	
	Poor muscular strength	No	1.00		
		Yes	2.69(0.28-26.14)	0.394	
	Poor flexibility	No	1.00		
		Yes	0.06(0.01-0.54)	0.013	
	Group	Students	1.00		
		Physiotherapists	7.23(0.50-103.64)	0.145	
	Sex	Males	1.00		
		Females	1.85(0.22-15.18)	0.567	
Knee pain	Poor body composition	No	1.00		0.377
		Yes	0.88(0.27-2.86)	0.833	
	Poor cardiorespiratory endurance	No	1.00		
		Yes	4.03(1.12-14.58)	0.033	
	Poor muscular endurance	No	1.00		
		Yes	0.66(0.19-2.35)	0.525	
	Poor muscular strength	No	1.00		
		Yes	0.44(0.10-1.97)	0.287	
	Poor flexibility	No	1.00		
		Yes	0.66(0.15-2.94)	0.583	
	Group	Students	1.00		
		Physiotherapists	1.19(0.23-6.14)	0.835	
	Sex	Males	1.00		
		Females	0.82(0.26-2.64)	0.742	

Legend: OR=odds ratio; CI=confidence interval; p_V=p-value of a variable; p_{HL}=p-value of the Hosmer-Lemeshow test

4 DISCUSSION

The study showed two unexpected results, both regarding physiotherapy students. First, they had pain in the lower back and knees essentially as often as physiotherapists; second, two thirds of them had poor/very poor flexibility. Regarding the prevalence, the results could only be compared with the results of the study of Glover et al. (5) in which the question about experiencing WMSDs was most similar to the question in our study (symptoms that lasted >3 days); the observed prevalence in their study was 42%. As the composition of the studied group was to a certain extent also similar (94% of the studied group consisted of physiotherapists and physiotherapy students, and 6% physiotherapy assistants), we can conclude that the problem in Croatia seems to be slightly greater than in the UK. Comparison with other studies was not possible due to differences in the question about WMSDs, which in our study focused only on WMSDs prevalence of longer duration (>3 days) in the previous 12 months, while other studies were focused on the previous 12-month prevalence of WMSDs without specifying the duration (7, 18), or lifetime prevalence of WMSDs (6, 9). A comparison regarding the location of the pain was less problematic. Studies in this area have shown that our results are very similar: the most common pain locations were the lower back, neck, and shoulders (5, 35, 36). For students, the location could also be compared to a recent study conducted in Croatia (18). The results were very similar: the highest prevalence was observed, as in our study, in the lower back, neck, and upper back. As expected, the prevalence of WMSDs in our study was higher in physiotherapists in comparison to students in general, as well as in many individual locations. Although the prevalence of low back pain between students and physiotherapists has not been significant, it is important to note that this finding in students is worrying, which may be related to an increased sedentary lifestyle, and it should be investigated further. Similar, though less pronounced, is the problem in two other locations – knees and upper back. The latter was revealed only by multivariate analysis.

The body composition of physiotherapy students was within the normal range, similarly to other recently published studies (15, 28, 36-38), and was statistically significantly better than in physiotherapists, although it was still within acceptable limits, which is consistent with the study of Ramanadi et al. (16). Cardiorespiratory endurance was also statistically significantly better in students than in physiotherapists, for whom it was surprisingly poor. The situation was similar in muscular endurance, which was scored as excellent for students. The results were similar to those of Juhkam et al. (37). The first PF component of concern in students was muscular strength. The isometric handgrip strength is one of the important components of PF, indicating the strength of the upper limb and, indirectly, the whole body (39). We expected students to do better than physiotherapists, but the two groups were quite similar. A similar result was shown by Juhkam et al. (37). It would make sense to direct students to a physical activity requiring more involvement of the upper limbs and handgrip. Unexpected was the result of the flexibility test in which as many as two thirds of students demonstrated poor or even very poor flexibility. Consequently, students should be directed to perform activities that will increase the extensibility of the dorsal muscle chain of the boot and hip (40). Again, a similar result was observed in another study (41).

There are few published studies on the relationship between WMSDs and PF, and comparison with other results is difficult. The only similar study by Mirza and collaborators showed very similar results - the association between PF and WMSDs could not be confirmed (15). A statistically significant positive association was observed only between knee pain and poor cardiorespiratory endurance, while other statistically significant results were debatable (in the shoulder, the elbow/forearm, and the hip/thigh pains). Poor cardiorespiratory endurance and poor flexibility in our study seemed to be protective factors for pain as a contradictory result; however, as previously stated, the available literature thus far has not shown a statistical relationship between PF and WMSDs.

The study has some limitations. First, the observed group was too small, which, given the low frequency of some observed WMSDs, did not allow for more in-depth analyses, although the size of the participants was estimated in accordance with the theory and was expected to be large enough (42). However, we still obtained some very important results. Representativeness was also not an issue, as all identified physiotherapists at the time of the study and all students in the academic year were invited, and the response rate was on average more than 90%. Next, there is a time mismatch of the variables in the multivariate models. However, as in similar studies, we asked about the symptoms of WMSDs in the previous 12 months, and this could be at any time during the past 12 months and quite distant in time, while in a cross-sectional design the PF measurements could only be performed at the time of the study. Next, one could argue that the original general NMQ, whose reliability proved to be moderate to high in the majority of questions with kappa coefficients above 0.50 (43), was not used. However, some parts have been used, although slightly modified or supplemented. First was the question on the occurrence of troubles at any time during the last 12 months, which was modified in the sense that the focus in our study was only on troubles lasting >3 days occurring during physiotherapeutic activities. All locations of troubles listed in the original NMQ were also used (in all yes or no regardless of the body side), while the thumb

location was added. Other parts of the original general NMQ were omitted. Next, one could also argue that the Physical Workload Questionnaire was not used in judging workplace workload. Finally, the applied fitness tests have rather low sensitivity. For each component of PF, it is possible to use several different tests, focusing more on the examination of the upper or lower part of the body. However, we believe that the application of other tests would not significantly contribute to a change in the obtained results of measuring the parameters of PF.

Nevertheless, the study has some important strengths. First, this is the first study showing the level of PF and the problem of WMSDs among physiotherapists in Croatia in relation to physiotherapy students. Next, one very important strength is that it is a study on a population with very high responsiveness. This allows a reliable estimate of prevalence. Finally, the results could be useful in other social environments as well, especially in those where the transition took place in a similar way and, consequently, the values of the younger generations of the population are subject to similar changes in values.

The results provide very important implications in terms of where to direct efforts to prepare future physiotherapists physically for their future profession. The educational institution should be actively involved, as should the physiotherapists from whom students receive practical training. It would make sense, for example, to direct students to organised physical exercise, which would be useful not only during their studies, but could also be performed in late adulthood to prevent frailty (44). An appropriate exercise, which is also popular among young people, could be yoga (45).

In the continuation of research in this field, it would first be necessary to increase the sample size, while choosing fitness tests appropriate for the individual location of WMSDs due to greater sensitivity. In addition, it would be sensible to construct a questionnaire that puts the phenomena in which we observed the relationship in the right place in terms of chronological order and simultaneity.

5 CONCLUSIONS

The study showed two important unfavourable results. The first is that physiotherapy students have pain in the lower back even more often than their older senior colleagues, and the second is that an extremely high percentage of physiotherapy students have poor flexibility. Both results are issues of great concern and indicate where action is needed – in promiting physical activity for the preservation and improvement of the health of physiotherapy students. UAHSZ should be more involved in introducing them to this problem. This role should be played by staff involved in clinical practice, who by their example, and work activities, can improve their attitude to PF and physical activity.

CONFLICT OF INTEREST

No conflict of interest.

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ETHICAL CONSIDERATIONS

Participation in the study was voluntary and anonymous. Participants were provided informed consent. The research protocol was approved by the UAHSZ Ethics Committee (KL:602-04/16-18/410, URBR:251-379-1-17-04; 8 November 2017).

REFERENCES

1. Podniece Z, van den Heuvel S, Blatter B. Work-related musculoskeletal disorders: prevention report. European Agency for Safety and Health at Work, 2008.
2. CDC. Work-related musculoskeletal disorders & ergonomics. Accessed May 3rd, 2022 at: https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/index.html.
3. Crawford JO, Davis A. Work-related musculoskeletal disorders: why are they still so prevalent? Evidence from a literature review. European risk observatory report. Luxembourg: Publications Office of the European Union, 2020.
4. de Kok J, Vroonhof P, Snijders J, Roullis G, Clarke M, Peereboom K, et al. Work-related musculoskeletal disorders: prevalence, costs and demographics in the EU. European risk observatory report. Luxembourg: Publications Office of the European Union, 2019.
5. Glover W, McGregor A, Sullivan C, Hague J. Work-related musculoskeletal disorders affecting members of the Chartered Society of Physiotherapy. Phys Ther. 2005;91(3):138-47. doi: 10.1016/j.physio.2005.06.001.
6. Cromie JE, Robertson VJ, Best MO. Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses. Phys Ther. 2000;80(4):336-51. doi: 10.1093/ptj/80.4.336.
7. Nordin NAM, Leonard JH, Thye NC. Work-related injuries among physiotherapists in public hospitals - a Southeast Asian picture. Clinics (Sao Paulo). 2011;66(3):373-8. doi: 10.1590/S1807-59322011000300002.
8. Liao JC, Ho CH, Chiu HY, Wang YL, Kuo LC, Liu C, et al. Physiotherapists working in clinics have increased risk for new-onset spine disorders: a 12-year population-based study. Medicine (Baltimore). 2016;95(32):e4405. doi: 10.1097/MD.0000000000004405.
9. Vieira ER, Schneider P, Guidera C, Gadotti IC, Brunt D. Work-related musculoskeletal disorders among physical therapists: a systematic review. J Back Musculoskelet Rehabil. 2016;29(3):417-28. doi: 10.3233/BMR-150649.
10. Hogan DAM, O'Sullivan LW, Nolan S, Greiner BA. Are Irish therapists at heightened risk for low back pain? Occup Med (Lond). 2016;66(5):351-7. doi: 10.1093/occmed/kqw020.
11. Molumphy M, Unger B, Jensen GM, Lopopolo RB. Incidence of work-related low back pain in physical therapists. Phys Ther. 1985;65(4):482-6. doi: 10.1093/ptj/65.4.482.

12. Truszczynska A, Scherer A, Drzał-Grabiec J. The occurrence of overload at work and musculoskeletal pain in young physiotherapists. Work. 2016;54(3):609-16. doi: 10.3233/WOR-162343.
13. Rugelj D. Low back pain and other work-related musculoskeletal problems among physiotherapists. Appl Ergon. 2003;34(6):635-9. doi: 10.1016/S0003-6870(03)00059-0.
14. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 1985;100(2):126-31.
15. Mirza FT, Roslan AS, Bahri AS. Work-related musculoskeletal disorders and its association with physical fitness among physiotherapy students attending public universities in Malaysia. Healthscope. 2019;(2):230-5.
16. Ramanandi VH, Desai AR. Association of working hours, job position, and BMI with work-related musculoskeletal disorders among the physiotherapists of Gujarat - an observational study. Bull Faculty Phys Ther. 2021;26(1):3. doi: 10.1186/s43161-021-00022-2.
17. Jensen JN, Holtermann A, Clausen T, Mortensen OS, Carneiro IG, Andersen LL. The greatest risk for low-back pain among newly educated female health care workers; body weight or physical work load? BMC Musculoskelet Disord. 2012;13:87. doi: 10.1186/1471-2474-13-87.
18. Sklempe Kokic I, Znika M, Brumnic V. Physical activity, health-related quality of life and musculoskeletal pain among students of physiotherapy and social sciences in Eastern Croatia - cross-sectional survey. Ann Agric Environ Med. 2019;26(1):182-90. doi: 10.26444/aaem/102723.
19. Butarić M. Job related musculoskeletal disorders in physiotheraphy: master thesis. Rijeka: Rijeka University, Faculty of Health Studies, 2020.
20. Kuorinka I, Andersson G. Standardised Nordic questionnaires for the analysis. Appl Ergon. 1987;18(3):233-7. doi: 10.1016/0003-6870(87)90010-X.
21. IPAQ. International Physical Activity Questionnaire (October 2002): long last 7 days self-administered format. Accessed May 24th, 2022 at: https://sites.google.com/site/theipaq/questionnaire_links.
22. Dwyer GB, Davis SE, editors. ACSM's health-related physical fitness assessment manual. Philadelphia: Lippincott Williams&Wilkins, 2008.
23. Keys A, Fidanza F, Karvonen MJ, Kimura N, Taylor HL. Indices of relative weight and obesity. J Chron Dis. 1972;25(6):329-43.
24. Hart PD. Test-retest stability of four common body composition assessments in college students. J Phy Fit Treatment&Sports. 2017;1(2):555561. doi: 10.19080/JPFMTS.2017.01.555561.
25. WHO. Body mass index - BMI. Accessed May 6th, 2022 at: https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi.
26. Burnstein BD, Steele RJ, Shrier I. Reliability of fitness tests using methods and time periods common in sport and occupational management. J Athl Train. 2011;46(5):505-13. doi: 10.4085/1062-6050-46.5.505.
27. Brouha L. The Step Test: a simple method of measuring physical fitness for muscular work in young men. Res Q Am Assoc Health Phys Educ Recreat. 1943;14(1):31-7. doi: 10.1080/10671188.1943.10621204.
28. Mahajan R, Rawat D. Determination of physical fitness index and its relation with body mass index among physiotherapy students. PJIAP. 2020;14:84-8. doi: 10.4103/PJIAP.PJIAP_25_19.
29. Fox EL, Billings CE, Bartels RL, Bason R, Mathews D. Fitness standards for male college students. Int Z Angew Physiol. 1973;31:231-6. doi: 10.1007/BF00697601.
30. Lubans DR, Morgan P, Callister R, Plotnikoff RC, Eather N, Riley N, et al. Test-retest reliability of a battery of field-based health-related fitness measures for adolescents. J Sports Sci. 2011;29(7):685-93. doi: 10.1080/02640414.2010.551215.
31. Jakovljević M, Knific T, Petrič M. Testiranje telesne pripravljenosti odraslih oseb: priročnik za preiskovalce. Ljubljana: NIJZ, 2017.
32. Kraus H, Eisenmenger-Weber S: Evaluation of posture based on structural and functional measurements. Phys Ther Rev. 1945;25:267-71.
33. Kippers V, Parker AW. Toe-touch test. A measure of its validity. Phys Ther. 1987;67(11):1680-4. doi: 10.1093/ptj/67.11.1680.
34. Health and Fitness Education (HFE): Toe touch test. Accessed April 1st, 2022 at: https://www.hfe.co.uk/resources/health-and-fitness-assessments/toe-touch-test/.
35. Adegoke BO, Akodu AK, Oyeyemi AL. Work-related musculoskeletal disorders among Nigerian physiotherapists. BMC Musculoskelet Disord. 2008:9:112. doi: 10.1186/1471-2474-9-112.
36. Meh J, Bizovičar N, Kos N, Jakovljević M. Work-related musculoskeletal disorders among Slovenian physiotherapists. J Health Sci. 2020;10(2):115-24. doi: 10.17532/jhsci.2020.880.
37. Juhkam E, Vaher I. Physical fitness of physiotherapy students. Acta Kinesiol. 2019;25:88-96. doi: 10.12697/akut.2019.25.07.
38. Pedišić Ž, Greblo Z, Phongsavan P, Milton K, Bauman AE. Are total, intensity- and domain-specific physical activity levels associated with life satisfaction among university students? PLoS One. 2015;10(2):e0118137. doi: 10.1371/journal.pone.0118137.
39. Adedoyin RA, Mbada CE, Farotimi AO, Johnson OE, Emechete AA. Endurance of low back musculature: normative data for adults. J Back Musculoskelet Rehabil. 2011;24(2):101-9. doi: 10.3233/BMR-2011-0282.
40. Zhang Q, Trama R, Fouré A, Hautier CA. The immediate effects of self-myofacial release on flexibility, jump performance and dynamic balance ability. J Hum Kinet. 2020;75:139-48. doi: 10.2478/hukin-2020-0043.
41. Bello AI, Bonney E, Opoku B. Physical fitness of Ghanaian physiotherapists and its correlation with age and exercise engagement: a pilot study. Arch Physiother. 2016;6(1):1-5. doi: 10.1186/s40945-016-0016-2.
42. Harrell FE. Predicting outcomes: applied survival analysis and logistic regression. Charlottesville: University of Virginia, 1999.
43. Rosecrance JC, Ketchen KJ, Merlino LA, Anton DC, Cook TM. Test-retest reliability of a self-administered musculoskeletal symptoms and job factors questionnaire used in ergonomics research. Appl Occup Environ Hyg. 2002;17(9):613-21. doi: 10.1080/10473220290095934.
44. Valevein Rodrigues E, Silveira Gomes AR, Pchevozniki Tanhoffer AI, Leite N. Effects of exercise on pain of musculoskeletal disorders: a systematic review. Acta Ortop Bras. 2014;22(6):334-8. doi: 10.1590/1413-78522014220601004.
45. Koneru S, Tanikonda R. Role of yoga and physical activity in work-related musculoskeletal disorders among dentists. J Int Soc Prev Community Dent. 2015;5(3):199-204. doi: 10.4103/2231-0762.159957.