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Relationships between Physical Activity and Musculoskeletal Disorders in Former Athletes

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A B S T R A C T

The purpose of the study was to determine the prevalence and risks for musculoskeletal disorders (MSD) in relation to previous athletic status and current physical activity level in former athletes. Main anthropometric data, sports history, current physical activity and MSD were estimated using a questionnaire in 219 (148 males, 71 females) former athletes (35–75 years old) and 79 controls (33 males, 46 females). According to the previous participation in top-level sports, former athletes were divided into three groups: a) endurance, n=120 (76 males, 44 females); b) speed-power, n=57 (43 males, 14 females); c) team sports, n=42 (29 males, 13 females). The most prevalent MSD among the male and female ex-athletes were back and knee pain. The endurance ex-athletes group (both males and females) had significantly higher risk for the knee problems than the control group (Odds ratio – OR 5.9, 95% CI 1.7–20.00, p<0.05). Team sports athletes (males and females) showed significantly higher risk for Achilles' tendon injuries (OR 3.19 95% CI 1.19–8.5, p<0.05) as compared to controls. Back pain did not show any significant associations with previous physical activity and current physical activity level. Current physical activity was significantly associated with a lower risk for the knee and hip pain. Body mass index was positively associated with knee problems. In conclusion, our study results revealed that previous participation in enduranve sports events is associated with a significantly higher risk for knee problems. At the same time current regular physical exercise 6–11 times per month is associated with a lower prevalence of knee and hip problems as compared to those who exercised less than 6 times per month.

Key words: *former athletes, exercise, musculoskeletal disorders, overweight*

Introduction

Moderate regular physical activity is recommended for the prevention of musculoskeletal disorders[1,2]. There is evidence that moderate training helps to sustain the function of muscles as well as improve the function of joints[1,2]. Data have shown that physically active endurance veteran athletes have lower injury prevalence of lower limbs[3]. Review data demonstrate that recreational jogging over 60 or more years of age does not increase the risk for the development of osteoarthritis[4].

The relation of former participation in high-level sports and MSD in later life is one of great interest. Long-term engagement in high-level competitive sports has been shown to be associated with a higher risk for some musculoskeletal disorders, especially in the knee and hip region[5–7], however there has been demonstrated some controversial data from prospective studies. A higher risk for osteoarthritis in ex-athletes is mediated by different mechanisms, including previous injuries and overloading[5,6,8]. Thus, excessive participation in high level sports can increase the risk of developing osteoarthritis[9]. The continous physical stress on the joints can result in microtrauma and degeneration of the articular cartilage. There is evidence, that the onset of osteoarthritis appears to depend on the frequency, intensity and duration of physical activity[9]. Otherwise, high levels of physical activity have been shown to be associated with osteoarthritis among men under 50 years, but not in women[10].

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However, there is not enough data on how the musculoskeletal disorders are related to the current physical activity level and other risk factors, including overweight. There is practically no data available about the health risks related to musculoskeletal problems in former female athletes.

The purpose of the study was to determine the prevalence and risks for musculoskeletal disorders in relation to previous athletic status and current physical activity level in former athletes. In addition, present study examines the associations between overweight and musculoskeletal disorders.

Materials and Methods

A cross-sectional study was performed in 219 (148 males, 71 females) former athletes (35–75 years old) and 79 controls (33 males, 46 females) (Table 1). An inclusion criterion for the former athletes was their previous participation in national or international level sports. According to the previous participation in top-level sports, former athletes were divided into three groups: a) endurance, n=120 (76 males, 44 females), (swimming, cross-country skiing, rowing, long-distance running, etc.); b) speed-power, n=57 (43 males, 14 females), (weight lifting, boxing, track and field: throwing, jumping, sprint events, etc.); c) team sports, n=42 (29 males, 13 females), (basketball, volleyball, etc.). The subjects of the control group (n=79, 33 males and 46 females) were persons matched by age and sex mainly including fellow-workers of the ex-athletes and had no athletic history. Initially, a questionnaire by Fogelholm et al.[11] was sent to 280 former athletes and 100 controls. The overall response rate was 78.4% (78.2% for former athletes and 79.0% for the controls). In the questionnaire, the subjects' anthropometric data (body mass, height), physical activity, occupational physical activity, musculoskeletal disorders was asked. Based on their self-reports of weight and height, body mass index (BMI) (weight (kg)/height (m)^2), was calculated. The subjects recorded their mean current physical activity level (during their top-level athletic years) and mean current physical activity during the past 12 months in detail (mode, weekly frequency, mean duration of the session). The intensity of the physical activity was recorded as low intensity, medium intensity, high intensity or very high intensity. Mean durations of competing at an elite level and current physical activity are presented in Table 1. Current physical activity was divided into three categories: a) less than 6 times per month; b) 6–11 times per month and c) over 11 times per month (Table 1). Occupational physical activity was categorized into four groups: very low – a predominantly sedentary workload; low – moderate physical workload without dyspnea; moderate – moderate physical workload with acceleration of the heart rate and breathing; high – heavy physical workload (data not shown).

Musculoskeletal disorders were reported as sports-related injuries, physician-diagnosed osteoarthrosis (OA), or repeated pain syndrome by anatomical region (knee-, back-, hip-, shoulder- ankle- and Achilles' tendon region).

TABLE 1
MAIN CHARACTERISTICS OF THE SUBJECTS ($\bar{X}$±SD, %, n=298)

	Endurance (n=120)	Speed/ power (n=57)	Team (n=42)	Controls (n=79)
Male:female ratio (n)	76:44	43:14	29:13	33:46
Age (yrs)	51.5±10.6	50.1±11.0	48.8±10.2	51.8±13.3
Mean duration of sports career (yrs)	11.5±6.2	11.5±6.2	14.2±7.2	–
Males				
Age (yrs)	53.1±11.1	51.1±9.8	49.7±11.1	49.1±12.7
Body mass (kg)	82.2±13.2	85.8±12.6	87.6±11.8	81.7±10.2
Body height (cm)	180.3±7.1	178.1±6.9	183.8±5.4**	179.0±6.1
BMI (kg/m^2)	25.2±3.2	26.9±3.3*	25.8±2.7*	25.4±2.5
PA 6–11 times *per* month (%)	26.3*	23.3	48.3*	9.1
PA ≥11 times *per* month (%)	30.3*	46.5*	20.7	15.2
PA less than 6 times *per* months (%)	43.4	30.2	31.0	75.7
Females				
Age (yrs)	48.7±8.9	46.9±13.9	46.9±7.8	53.7±13.5
Body mass (kg)	68.7±10.6	61.1±7.6*	67.9±10.8*	70.3±11.3
Body height (cm)	167.8±5.9*	169.1±6.4*	172.4±8.6*	164.3±6.5
BMI (kg/m^2)	24.3±3.6	21.5±2.7**	22.9±3.5**	26.0±4.0
PA 6–11 times *per* month (%)	31.8	21.4	23.1	17.4
PA ≥11 times *per* month (%)	20.5	35.7*	23.1	8.7
PA less than 6 times *per* months (%)	47.7	42.9	53.8	73.9

Note: BMI – body mass index, PA – physical activity; *p<0.05; **p<0.01 in comparison with controls

All the musculoskeletal disorders were scored as »yes« or »no«. In addition, the occurrence of musculoskeletal problems were recorded as »<45 yrs of age« or »≥45 yrs of age«. Since sports-related injuries overlapped with the physician-diagnosed OA or repeated pain syndrome, they were handled as one case in the analysis.

Statistical analysis was performed using SPSS software package, version 11.0 (SPSS Inc., Chicago, IL, USA). The mean values ($\overline{X}$) and standard deviations (SD) were calculated. Group differences were analyzed using ANOVA and Tukey post-hoc comparison. The Kruskall-Wallis test was used for nonparametric analysis. The χ^2-test was used to determine the between-group differences in physical activity level and musculoskeletal disorders. The Pearson product moment or Spearman correlations were used to determine the relationships between variables. Odds ratios (ORs) and their 95% confidence intervals (95% CI) for different musculoskeletal disorders were analyzed using logistic regression models. Age, body mass and occupational activity level were used as confounding factors in the analysis. Statistical significance was defined as $p<0.05$.

Results

Descriptive data

The proportions of athletes with different physical activity levels are presented in Table 1. Among males, all three groups of ex-athletes showed a significantly higher prevalence of physical activity than the controls. Among females, only the power-speed group presented significantly higher engagement in physical exercise in comparison with controls. In total, 63.0% of male ex-athletes, and 52.0% of female ex-athletes were engaged in physical exercise 6 or more times *per* month.

Descriptive data of the main musculoskeletal disorders by anatomical region are shown in Table 2. The most prevalent musculoskeletal disorders among male and female groups of ex-athletes as well as in controls were back and knee pain. The prevalence of reported sports-related injuries was 13.6% and 10.1 % among the ex-athletes group and controls, respectively, and they were not related to permanent disability.

Frequency analysis showed that in 65% of the males' and in 50 % of the females' knee problems occurred for the first time before 45 years of age. Problems in hip and shoulder regions mainly occured after 45 years of age. Most of the Achilles' tendon injuries (82% in males, and 70% in females) occurred before 45 years of age, and were related to previous sports exercise intensity characteristics ($r=0.194$, $p<0.05$).

Univariate analysis

Correlation analysis showed significant relationship between age and hip problems ($n=298$, $r=0.270$, $p<0.01$), whereas associations were found both in males and females. Knee disorders were related to the age factor only in females ($n=117$, $r=0.291$, $p<0.001$). No siginficant correlations were detected between age and other musculoskeletal disorders. BMI was positively associated only with knee problems ($n=298$, $r=0.211$, $p<0.05$).

Current physical activity (PA≥6 times per month) was significantly related to the lower risk for knee problems ($n=298$, $r=0.234$, $p<0.01$), whereas the strongest correlation was detected in females ($n=117$, $r=0.298$, $p<0.001$).

TABLE 2
DESCRIPTIVE DATA OF THE MAIN MUSCULOSKELETAL DISORDERS (n=298)

	Endurance		Speed/ power		Team		Controls	
	Males n=76	Females n=44	Males n=43	Females n=14	Males n=29	Females n=13	Males n=33	Females n=46
Sport-related injuries, in total (n, %)	8 (10.5)	4 (9.1)	10 (23.3)	2 (14.3)	4 (13.8)	2 (15.4)	7 (21.1)	1 (2.2)
Physician-diagnosed OA (n, %)								
Knee	18 (23.7)	5 (11.4)	11 (25.6)	1 (7.1)	9 (31.0)	1 (7.7)	5 (15.2)	9 (19.6)
Hip	6 (7.9)	4 (9.1)	6 (14.0)	2 (14.3)	3 (10.3)	1 (7.7)	5 (15.2)	7 (15.2)
Shoulder	14 (18.4)	6 (13.6)	10 (23.3)	1 (7.1)	6 (20.7)	1 (7.7)	8 (24.2)	11 (23.9)
Repeated pain syndrome (n, %)								
Knee	29 (38.3)	16 (36.4)	22 (51.2)	7 (50.0)	15 (51.7)	8 (61.5)	9 (27.3)	23 (50.0)
Back	57 (75.0)	14 (31.8)	38 (88.4)	9 (64.3)	21 (72.4)	8 (61.7)	24 (72.7)	26 (56.5)
Hip	15 (19.7)	8 (18.2)	10 (23.3)	2 (14.3)	5 (17.2)	4 (30.8)	7 (21.2)	14 (30.4)
Shoulder	28 (36.8)	11 (25.0)	14 (32.6)	2 (14.3)	9 (31.0)	4 (30.8)	12 (36.4)	18 (39.1)
Ankle	2 (2.6)	1 (2.3)	4 (9.1)	1 (7.1)	1 (3.5)	1 (7.7)	0 (0)	3 (6.5)
Achilles' tendon	20 (26.3)	2 (4.6)	16 (37.2)*	5 (35.7)*	13 (44.8)*	5 (38.5)*	2 (6.1)	2 (4.4)

Note: OA – osteoarthritis; *$p<0.05$ in comparison with controls

Multivariate analysis

Table 3 presents the ORs for the different anatomical regions in groups of ex-athletes and in different PA level groups (total in males and females).

Logistic regression analysis revealed that the group of endurance ex-athletes had a significantly higher risk for knee problems than control group. No significant associations were found between the previous sports engagement (groups of ex-athletes), current physical activity level, and back problems. A significantly higher OR for the back problems was only detected among females in team sports groups in comparison with the controls (OR 8.5; 95% CI 1.75–20.70, $p<0.05$). A tendency for the higher risk of hip problems existed in all groups of ex-athletes in comparison with the controls, but the risk ratios remained nonsignificant. Current physical activity level 6–11 times per month revealed a significantly lower risk for hip problems if compared to those who exercised less than 6 times per months. There were no significantly higher risk ratios for shoulder problems in ex-athletes and different PA level groups in comparison with the corresponding controls. A significantly higher risk for ankle problems was not detected in groups of ex-athletes in comparison with the controls. Regular physical activity level 6–11 times per month was associated with a higher risk for ankle problems in comparison with the group exercising less than 6 times *per* months. Our results revealed that the team sports group showed a significantly higher risk for the Achilles' tendon problems in comparison with the controls.

Discussion

Our study compared the differences in musculoskeletal disorders among former top-level athletes in comparison with controls and evaluated the relationships between current physical activity level, overweight and musculoskeletal disorders. We observed that previous participation in endurance sports was significantly related to higher risk for knee problems. At the same time, post-competitive regular physical activity level showed significant associations with a lower risk for knee and hip problems.

Studies in former ex-athletes have shown a higher risk for lower-limb osteoarthritis[12,13]. Osteoarthritis and pain in the knee region are clearly related to the previous injuries in the same region[8]. Data of the previous studies demonstrate that soccer players and weight lifters have a higher prevalence of sports-related knee injuries[5,7,12]. It has been hypothesized that running does not accelerate the degeneration process as much as heavy weight training[8,12]. Thus, there is no clear evidence regarding higher knee problem prevalence and long-distance running. Our cross-sectional study showed significant associations be-

TABLE 3
AGE-, WEIGHT-, AND OCCUPATIONAL ACTIVITY ADJUSTED OR-s (95% CI) FOR THE DIFFERENT ANATOMICAL REGIONS IN EX-ATHLETES GROUPS AND IN DIFFERENT PHYSICAL ACTIVITY (PA) LEVEL GROUPS IN COMPARISON WITH REFRENCE VALUES (CONTROLS; PA LEVEL <6 TIMES PER MONTH)

	Knee	Back	Hips	Shoulder	Ankle	Achilleus' tendon
Endurance sports						
OR	5.90**	0.58	3.01	1.57	4.13	2.42
95% CI	1.70–20.00	0.24–1.41	0.15–17.65	0.56–4.41	0.72–8.23	0.94–6.26
Speed-power sports						
OR	1.78	0.63	1.40	1.17	6.84	1.16
95% CI	0.81–3.85	0.27–1.45	0.28–7.00	0.43–3.21	0.63–15.81	0.46–2.96
Team sports						
OR	1.15	0.85	3.40	1.39	7.59	3.19*
95% CI	0.48–2.77	0.33–2.20	0.63–18.30	0.46–4.17	0.33–20.01	1.19–8.54
Controls						
OR	1.0	1.0	1.0	1.0	1.0	1.0
PA 6–11 times *per* month						
OR	0.49*	0.78	0.19**	0.78	7.66*	0.65
95% CI	0.24–0.98	0.42–1.43	0.05–0.67	0.34–1.81	1.01–30.10	0.28–1.48
PA>11 times *per* month						
OR	0.28*	1.28	0.36	1.11	7.29	0.91
95% CI	0.10–0.80	0.48–3.44	0.08–1.53	0.38–3.20	0.73–50.61	0.33–2.51
PA<6 times *per* month						
OR	1.0	1.0	1.0	1.0	1.0	1.0

Note: PA – physical activity; *$p<0.05$; **$p<0.01$, significantly different from controls

tween previous endurance sports engagement and knee problems (OR 5.9). In our study, we did not calculate the relative risks for the group of long-distance runners separately because of the small sample size. On the other hand, there is evidence that regular physical exercise, especially jogging, improves the function of the knee[5,13]. This is in accordance with our study results: those who exercise regularly over 6 times *per* month have lower risk for knee problems. However, the causal relationship of the regular exercise is not clear, because there is always possibility that serious trauma during active sports career may result in a subsequent sedenary lifestyle. In our study, none of the ex-athletes reported permanent or serious disability due to sports-related injuries.

Inconsistent results have been reported concerning the associations of obesity, overweight and osteoarthritis[14]. It has been shown that overweight or obesity may be a factor, which may influence the risk of knee osteoarthritis[8]. Our results support these findings showing that BMI was positively related to the prevalence of knee problems.

Unfortunately we didn't find any significant associations between BMI and other MSD. In addition, the intensity of the previous sports engagement was also associated with knee problems.

Studies in athletes have shown that back pain is prevalent among the weight lifters and soccer players in comparison with shooters[7]. Long-distance runners are also described by higher prevalence of back pain during intensive training periods[7]. On the other hand, Videman et al.[16] demonstrated that long-term vigorous running is not deleterious to the spine. In general, the higher risk for back problems is prevalent at 55 to 64 years of age[7]. Our cross-sectional data revealed that there were no significant associations between previous sports participation and back pain, but a slightly higher risk for back problems was observed in the female team sports group in comparison with controls.

Other determinants (current PA, age, intensity or duration of sports sessions) did not show relationships with the back pain.

Data are scanty in the assessment of the risk for hip arthrosis in relation to sports engagement. There are some data available that team sportsmen as well as long-distance runners are prone to an increased risk of hip pain or arthrosis[5,7,13,17]. On the other hand, Kettunen et al.[18] showed that in athletes and the subgroup of endurance sportsmen, there exists a significantly lower prevalence of hip problems in comparison with referents. In our study, there was a tendency for a higher risk for hip problems in all groups of ex-athletes, but the risk ratios were not significant. Our study groups were relatively small, and this may explain the fact that we did not find significant associations between the previous sports participation and hip problems. Our study results also revealed that current physical activity 6–11 times per week was significantly related to a lower risk for hip problems as compared to those who exercised less than 6 times per months. Age was a significant factor contributing to hip problems.

Studies have shown that the Achilles´ tendon is the most commonly injured tendon in running sports[19]. Surprisingly, our study data revealed that significant associations existed between the Achilles' tendon problems and previous engagement in team sports. Previous participation was not significantly related to ankle problems, but current physical exercise 6–11 times per month increased the risk for ankle injuries. However, ankle injuries seem to be temporary rather permanent disabilities[20].

Conclusions

In conclusion, our study results revealed that previous participation in endurance sports events is associated with a higher risk for knee problems. Current regular physical exercise 6–11 times per month is associated with a lower prevalence of knee and hip problems.

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ODNOS FIZIČKE AKTIVNOSTI, PREKOMJERNE TEŽINE I MIŠIĆNO-KOŠTANIH OBOLJENJA KOD BIVŠIH SPORTAŠA

S A Ž E T A K

Cilj ove studije bio je utvrditi prevalenciju i rizik od mišićno-koštanih oboljenja kod bivših sportaša, s obzirom na sadašnju razinu njihove fizičke aktivnosti. Osnovi antropometrijski podaci, povijest sporta kojim se bave, trenutna fizička aktivnost i rizik od mišićno-koštanih oboljenja, procijenjeni su upitnikom na uzorku od 219 (148 muških i 71 ženskih) bivših sportaša (u rasponu godina od 35 do 75) i 79 ispitanika u kontrolnoj skupini. S obzirom na prijašnje bavljenje vrhunskim sportovima, bivši sportaši su podijeljeni u tri skupine: a) izdržljivost, n=120 (76 muških, 44 ženska ispitanika), b) brzina, n=57 (43 muška i 14 ženskih ispitanika), c) grupni sportovi, n=42 (29 muških i 13 ženskih ispitanika). Najučestalija mišićno-koštana oboljenja kod ispitanika oba spola bila su bolovi u leđima i koljenima. Skupina bivših sportaša iz sportova izdržljivosti (oba spola) je imala značajno viši rizik od problema s koljenima nego kontrolna skupina (OR 5,9, 95% CI 1,7–20,00, $p<0,05$). Skupina bivših sportaša iz grupnih sportova (oba spola) je pokazala značajno veći rizik od ozljeda Ahilove tetive (OR 3,19, 95% CI 19–8,5, $p<0,05$) u usporedbi s kontrolama. Za bol u leđima nije ustanovljena značajna povezanost s nekadašnjom i trenutnom razinom fizičke aktivnosti. Trenutna razina fizičke aktivnosti je značajno povezana sa sniženim rizikom od bolova u koljenu i kukovima. Indeks tjelesne mase je u pozitivnoj korelaciji s problemima koljena. Kao zaključak se može reći da rezultati naše studije otkrivaju kako je intenzivno bavljenje sportom u prošlosti povezano s znatno višim rizikom od oboljenja koljena., a u isto je vrijeme trenutna fizička aktivnost 6–11 puta mjesečno povezana s nižom prevalencijom za probleme koljena i kukova, u usporedbi s onima koji se bave fizičkom aktivnosti manje od 6 puta mjesečno.