Research Article

Spinal Pain Prevalence and Characteristics among Male Athletes with Disabilities

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ABSTRACT

Introduction: Chronic pain is a serious secondary problem for many individuals with disabilities.

Materials and Methods: A total of 231 disabled athletes invited to compete in a multi-sport national sports tournament for para-athletes in Ahvaz, Iran, participated in the study to be investigated whether spinal pain (SP) prevalence and characteristics are different among different sports and disabilities. Athletes' demographic information, SP prevalence, characteristics, and disability using the athlete disability index questionnaire were obtained. SP prevalence, characteristics, and factors affecting SP intensity and disability caused by low back pain (LBP) were determined as primary outcome measures before data collection.

Results: The mean (95% confidence intervals) disability percentage and LBP intensity score were 22.2% (19.2-25.3) and 2.14(1.84-2.47) of 10, respectively. The highest LBP intensity was among physical fitness participants and patients with spinal lesions. Weightlifting athletes and athletes with arm movement limitations had the highest disability. The mean (95% confidence intervals) neck pain intensity score was 2.16(1.80-2.54).

Conclusion: A high prevalence of SP was observed among most disabilities and sports. Although its intensity is rarely severe among a population of any disability or sports, it is undeniably disabling among the vulnerable population of para-athletes.

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1. Introduction

The existing research report that chronic pain is a serious secondary problem for many persons with disabilities [1]. When the pain locations were studied, the most common site was the low back [1]. the average low back pain (LBP) prevalence in the general population has been approximated between 12% and 45% [2]. However, LBP prevalence is not the same among people with disabilities. Ehde et al. reported that 71% of lower limb amputees had experienced back pain in the preceding four weeks [3].

Neck pain (NP) is defined as discomfort or more intense forms of pain localized to the cervical region. NP is a prevalent disorder with an overall prevalence of 23.1% among the general adult population [4]. The global burden of NP is also considerably high and increasing [5]. Disability-adjusted life years (DALY) of NP were estimated at 33.6 million in 2010, making the NP globally the fourth disability in years lived with disability ranking and 21st in the DALY ranking [5].

However, previous LBP studies in the population with disabilities only included acquired amputation, spinal cord injury, cerebral palsy, neuromuscular disease, multiple sclerosis, and post-polio syndrome [1, 6]. Also, the sample of those studies was obtained from the general population [1, 6]. The prevalence and characteristics of LBP have not been studied among professional athletes with disabilities or other types of disabilities and sports.

Besides LBP, few studies investigated NP's epidemiologic features among athletes or persons with disabilities, the prevalence numbers appear to be considerably different from the general population. The point prevalence of NP among athletes is 45.9% [7], which is significantly higher than 14.4% in the general population [4]. In the case of people with disabilities, there is scarce data regarding the prevalence of NP. Kovacs et al. reported a point prevalence of 55% in a cross-sectional study among wheelchair users with disabilities regardless of their physical activity [8].

A national multi-sport tournament for male athletes with disabilities was conducted in Ahvaz, Iran in 2018. The present study aimed to explore the prevalence and characteristics of SP among athletes with disabilities of different types of sports and with various disabilities to determine the influence of sport and disability-related factors on SP's features and intensity and disability caused by LBP.

2. Materials and Methods

This cross-sectional survey was conducted on 231 male athletes with disabilities participating in a national sports Olympiad in Ahvaz, Iran, in 2018. This study conforms to all STROBE guidelines and reports required information accordingly (see supplementary checklist). The questionnaire and methodology for this study were approved by the committee on research ethics of Tehran University of Medical Sciences before the start of the investigation.

The inclusion and exclusion criteria

Athletes with disabilities competing in the sports Olympiad were included. Participants not willing to participate in the study were excluded from the study.

Survey implementation

Each participant of the tournament signed an informed consent form and a paper-based survey (see questionnaire) with four parts. The surveys were collected after being completed during the tournament.

The survey dataset (Appendix 1) consisted of four sections: (1) Demographic information, (2) LBP prevalence and characteristics, (3) NP prevalence and characteristics, and (4) the athletes disability index (ADI) questionnaire for LBP. This questionnaire was designed based on an expert panel consultation method and previous studies of their lifetime [9-11].

Appendix 1:

Section 1: Demographic information

Age, height, weight, sport type, mean training hours per week, years of playing the sports at the competitive level, disability type, and years of disability were recorded and reported as Mean±SD.

Section 2: LBP prevalence and characteristics

LBP questions were adopted from Noormohamadpour et al.'s study [10]. LBP was defined as a pain in the lumbosacral region limiting the subject's athletic or daily activities for at least 24 hours. Chronic LBP was described as an accumulative LBP presence for more than three months during the last six months. Sciatica was defined as an LBP radiating to the buttocks and posterolateral side of the lower extremities.

Section 3: NP presence and characteristics

NP was defined as a pain in the cervical region that had restrained the subject's athletic or daily activities for 24 hours or more. Chronic NP was defined as an NP lasting for more than three months accumulatively during the last six months.

Section 4: Athletes' disability caused by LBP index questionnaire

Every participant, including those who answered "yes" to the question "Have you ever had low back pain?" fulfilled section 4 of the ADI Questionnaire to measure the athletes' disability caused by LBP. The Persian version of the ADI questionnaire was used. Good reliability and validity have been indicated for the Persian version of the ADI questionnaire [11].

Data analysis

Statistical analyses were executed using SPSS software, version 21 (IBM Corporation, Armonk, NY).

Low back pain and neck pain prevalence and characteristics

The obtained data from descriptive analyses were reported as the mean and 95% confidence intervals. Independent-sample t-tests were used to investigate SP's prevalence among athletes based on their sports and disability classification. Independent-sample t-tests were also used to examine the prevalence of medical care-seeking and absence from daily activities due to SP.

Low back pain and neck pain intensity

The average spinal pain intensity over the last 24 hours was measured on a 0-10 visual analog scale (VAS) for pain. Validity has been demonstrated for the VAS as a comparative scale measure for pain [12]. Independent-sample t-tests were used to investigate the LBP intensity score of the participants. An independent-sample t-test was used to examine the relationship between participants' obesity and LBP intensity.

A multivariate backward linear regression was performed to examine the possible factors correlating with LBP intensity. Univariate linear regression analysis was conducted before the multivariate regression analysis to determine which variables should be included in the multivariate regression analysis to reduce the possibility of selection and reporting bias. Variables with a $P<0.20$ in the univariate regression analysis were included in the multivariate regression analysis. A backward stepwise approach was conducted until only variables with a $P=0.05$ remained in the equation.

Low back pain disability

Independent-sample t-tests were used to investigate the participants' mean disability scores in different sports types and disability classifications. The disability caused by LBP was measured by adding the score of the 12 questions of section 4(0-3) and multiplying it by 100/36.

To explore the factors influencing the LBP-caused disability score, multivariate backward linear regression was utilized with selected variables by previous univariate regression analysis. The approach was explained in more detail in the prior section.

3. Results

Survey responses

Of 278 surveys distributed, 231 were returned completed. Thus, an 83% response rate (231/278) was achieved. All questionnaires were included in the final analysis. Athletes with disabilities competed in sitting volleyball, Ping-pong, swimming, wheelchair basketball, shooting, archery, weight lifting, futsal, soccer, chess, darts, physical fitness, bodybuilding, jogging, and running. Athletes with disabilities were classified as having arm amputation, reduced range of motion in the arm, leg amputation, reduced range of motion in the leg, vision loss, visual impairment, hearing loss, auditory impairment, neuropsychiatric diseases, and spinal lesions.

The results were reported for the total population, six sports with the greatest number of participants, and six disability types with the greatest number of athletes with disabilities. It was not feasible to include all sports and disabilities in the reporting tables. On the other hand, the small number of corresponding athletes would result in a large confidence interval for the reporting rates.

Participants characteristics

The Mean±SD of participants' age, height, weight, mean training hours per week, years of playing the sports at the competitive level, years of disability, years of sufferance from LBP, and years of sufferance from NP were 51.5±4.5 years, 176.1±7.0 cm, 85.1±11.8, kg 5.7±3.4, 15.2±9.2, 30.7±4.6, 17.7±27.3, 2.5±3.4, respectively. All participants were male since the competitive events were offered only to male athletes with disabilities. The six

Table 1. Spinal pain prevalence in the largest sub-populations

	Variables	Lifetime LBP	Sport Time LBP	Last Year LBP	LBP with Sciatica	Chronic LBP
	Total	57.7 (50.7-64.8)	50.2 (43.2-57.3)	46.0 (39-53.1)	28.6 (23-34.3)	15.0 (10.3-19.7)
By sport	Ping-pong	46.1 (30.0-61.7)	35.9 (21.2-51.1)	28.2 (14.2-43.5)	33.3 (19.0-47.8)	2.5 (0.0-8.8)
	Swimming	66.2 (56.3-76.7)	62.3 (51.7-72.5)	57.1 (46.6-68.3)	44.1 (33.3-55.0)	19.4 (10.9-28.4)
	Shooting	74.3 (60.0-87.5)	66.6 (50.0-80.4)	66.6 (51.2-80.4)	25.6 (12.2-40.0)	7.6 (0.0-17.5)
	Futsal	36.7 (24.3-51.1)	24.4 (13.5-37.5)	18.3 (8.4-30.9)	10.2 (2.3-19.6)	18.3 (7.6-30.1)
	Chess	67.5 (51.5-82.9)	59.4 (43.7-75.8)	64.8 (48.6-81.2)	35.1 (19.3-51.2)	21.6 (7.8-34.4)
	Dart	68.9 (51.7-85.7)	51.7 (32.4-70.9)	58.6 (38.2-77.7)	41.3 (23.8-60.5)	27.5 (11.1-44.1)
By disability type	Leg amputation	58.8 (33.3-83.3)	58.8 (33.3-83.3)	64.71 (40.0-88.2)	17.6 (0.0-38.4)	17.6 (0.0-38.4)
	Leg movement limitation	75.4 (64.4-86.5)	62.2 (49.1-75.5)	52.83 (38.4-66.0)	32.0 (20.3-45.6)	16.9 (7.8-27.9)
	Partial blindness	68.4 (45.8-89.9)	68.4 (44.4-88.8)	73.68 (52.1-92.8)	26.3 (5.8-47.0)	5.2 (0.0-18.1)
	Partial deafness	75.8 (58.0-92.0)	68.9 (51.7-86.6)	65.52 (47.6-83.8)	41.3 (24.0-60.8)	31.0 (15-47.9)
	Nervous problems	65.3 (52.9-78.4)	59.6 (46.6-73.0)	53.85 (40.0-67.3)	50.0 (36.3-63.0)	19.2 (9.2-29.6)
	Spinal lesions	78.7 (63.8-92.5)	69.7 (53.5-85.1)	57.58 (40.01-73.3)	51.5 (34.6-68.5)	18.1 (6.0-33.3)

LBP: Low back pain. Numbers are reported as percent (95% confidence intervals).

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sports with the most participants were swimming (n=83), futsal (n=53), chess (n=42), shooting (n=41), ping-pong (n=41), and darts (n=30). It is a common practice that many of these athletes engage in two or more competitive sports. The six most prevalent disabilities were leg movement limitation (n=54), nervous problems (n=54), spinal lesions (n=33), partial deafness (n=32), partial blindness (n=20), and leg amputation (n=17). Some of these athletes had more than one disability.

Spinal pain prevalence and characteristics

The prevalence of sport-time and chronic LBP among all athletes was 50.2% and 15%, respectively. Darts (64.2%)

Table 2. Neck pain prevalence in the largest sub-populations

	Variables	Lifetime NP	Sport Time NP	Last Year NP	Radiculopathy	NP with Headache	Chronic NP
	Total	50.9 (44.5-57.3)	42.7 (36.4-49.1)	41.8 (35.0-48.6)	27.3 (21.4-33.2)	16.4 (11.8-21.8)	17.7 (12.7-23.2)
By sport	Ping-pong	36.1 (20.6-51.8)	27.7 (13.8-43.5)	19.4 (6.2-32.5)	16.6 (5.2-28.9)	11.1 (2.5-22.5)	0.0 (0.0-0.0)
	Swimming	61.2 (50.0-71.7)	57.5 (46.5-68.9)	48.7 (38.4-60.2)	36.2 (25.6-48.0)	22.5 (13.7-32.8)	27.5 (18.2-38.4)
	Shooting	60.9 (45.0-76.3)	51.2 (35.4-67.5)	39.0 (24.0-55.1)	14.6 (4.6-26.8)	12.2 (2.5-23.4)	12.2 (2.8-24.3)
	Futsal	32.0 (20.4-44.0)	26.4 (15.7-38.6)	33.9 (21.5-46.9)	22.6 (12.7-34.6)	5.6 (0.0-12.7)	5.6 (0.0-12.7)
	Chess	56.1 (41.0-71.4)	48.7 (33.3-64.2)	60.9 (45.4-75.6)	43.9 (29.2-60.4)	26.8 (14.2-40.0)	26.8 (13.6-41.0)
	Dart	64.2 (45.1-81.8)	53.5 (35.4-72.0)	60.7 (41.9-79.1)	57.1 (37.5-76.0)	25.0 (10.3-41.3)	39.2 (21.2-58.3)
By disability type	Leg amputation	47.0 (21.4-70.5)	0.0 (0.0-0.0)	29.4 (8.3-52.9)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
	Leg movement limitation	50.0 (36.1-64.1)	40.0 (26.5-53.8)	38.0 (24.4-52.5)	24.0 (11.6-37.1)	14.0 (5.0-25.0)	12.0 (3.2-22.6)
	Partial blindness	58.8 (33.3-84.6)	47.0 (22.2-72.2)	41.1 (17.6-68.7)	11.7 (0.0-30.7)	17.6 (0.0-39.9)	17.6 (0.0-40)
	Partial deafness	64.5 (47.0-81.2)	61.2 (43.4-78.1)	35.4 (17.8-51.8)	35.4 (17.8-51.7)	19.3 (6.4-34.4)	35.4 (18.9-51.8)
	Nervous problems	52.8 (38.7-66.1)	52.8 (38.7-66.1)	50.9 (36.8-64.8)	43.4 (29.4-58.0)	20.7 (9.6-32.6)	30.1 (17.5-44.0)
	Spinal lesions	77.4 (61.3-91.4)	67.7 (48.7-83.8)	61.2 (43.3-77.4)	41.9 (24.1-59.9)	19.3 (6.6-35.2)	35.4 (19.3-53.3)

NP: Neck pain; Numbers are reported as percent (95% confidence intervals).

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and futsal (32.0%) athletes had the highest and lowest lifetime prevalence of NP, respectively. Swimming athletes had the highest (57.5%), and futsal players (26.4%) had the lowest sport-time NP. Participants with spinal lesions as a disability had the highest prevalence of lifetime NP (77.4%), sport-time NP (67.7%), last-year NP (61.2%), headache secondary to NP (19.3%), and chronic NP (35.4%). Participants suffering from leg amputation had the lowest prevalence of lifetime NP (47.0%), sport-time NP (0.0%), last-year NP (29.4%), NP radiculopathy (0.0%), headache secondary to NP (0.0%), and chronic NP (0.0%). Additional data on SP prevalence in the participants are presented in Tables 1 and 2.

The care-seeking behaviors due to SP in sports with the most participants and disability types with the highest prevalence are shown in Tables 3 and 4. Overall, 36.9% of the participants had seen a general practitioner complaining of their LBP. Darts players had the most prevalence of admission to a general practitioner (53.5%), admission to a specialist (46.4%), radiography examination (50.0%), and magnetic resonance imaging (MRI) examination (46.4%) due to NP among the athletes of all sports. Participants with spinal lesions as a disability had the most prevalence of admission to a general practitioner (41.9%), medication use (51.6%), radiography examination (35.4%), and MRI examination (32.2%) because of the NP among the disabilities. In addition, participants with leg amputation had the least prevalence of admission to a general practitioner (0.0%), admission to a medical specialist (0.0), radiography (0.0%), and MRI examination (0.0%).

Absence from social activities due to SP in sports with the most participants and disability types with the highest prevalence is demonstrated in Tables 5 and 6. Among all participants, 20.4% reported at least one absence period from work because of their LBP. Darts players had the most prevalence of absence from competitions (25.0%), the shooting athletes had the most prevalence of absence from training (19.5%), and the swimming athletes had the most prevalence of absence from work (21.2%) due to NP in the last year. Participants suffering from leg amputation had the highest prevalence of absence from competition (17.6%), and patients who have partial deafness had the highest prevalence of absence from training (25.8%) and work (29.0%) due to NP in the last year.

Table 3. Low back pain-induced care-seeking in the largest sub-populations

	Variables	Refer to GP	Refer to a Spine Specialist	Medication Use	Radiography	MRI
	Total	36.9 (31.1-43.5)	33.3 (27.1-39.1)	30.2 (24.4-36.9)	23.1 (17.8-28.9)	19.1 (14.2-24.4)
By sport	Ping-pong	10.2 (2.3-20.8)	17.9 (6.2-30.3)	2.5 (0.0-9.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
	Swimming	49.3 (38.8-60.5)	49.3 (37.9-59.7)	42.8 (31.6-54.5)	31.1 (20.9-41.7)	32.4 (22.2-42.6)
	Shooting	64.1 (48.5-79.4)	53.8 (38.4-68.8)	53.8 (37.5-70.0)	51.2 (35.1-68.0)	17.9 (6.4-30.2)
	Futsal	12.2 (3.9-22.6)	12.2 (3.9-22.4)	16.3 (6.6-28.5)	12.2 (3.9-22.4)	18.3 (6.5-32.7)
	Chess	56.7 (39.4-72.5)	35.1 (20.0-51.0)	37.8 (21.4-54.1)	27.0 (12.1-42.2)	24.3 (10.0-39.1)
	Darts	51.7 (33.3-70.0)	48.2 (30.0-66.6)	37.9 (20-56.2)	37.9 (20.6-57.1)	34.4 (17.8-54.1)
Leg amputation	By disability	58.8 (33.3-83.3)	11.7 (0.0-30.4)	41.1 (18.2-66.6)	41.1 (18.2-66.6)	5.8 (0.0-18.7)
	Leg movement limitation	32.0 (19.0-44.8)	45.2 (32.0-60.0)	30.1 (17.9-42.8)	35.8 (23.0-48.9)	30.1 (17.3-44.4)
	Partial blindness	73.6 (52.1-92.8)	42.1 (20.0-66.6)	36.8 (15.8-61.5)	26.3 (6.6-50.0)	26.3 (4.7-54.9)
	Partial deafness	55.1 (37.0-74.2)	65.5 (47.0-82.6)	48.2 (29.0-65.7)	24.1 (8.7-40.6)	20.6 (7.1-36.8)
	Nervous problems	44.2 (31.2-58.4)	42.3 (29.3-56.2)	42.3 (28.8-55.3)	32.6 (20.4-45.4)	28.8 (16.8-41.6)
	Spinal lesions	45.4 (27.7-61.2)	51.5 (34.3-67.8)	48.4 (30.7-64.7)	24.2 (9.3-40.7)	30.3 (14.7-46.4)

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Abbreviations: GP: General practitioner; MRI: Magnetic resonance imaging. Numbers are reported as percent (95% confidence intervals).

Table 4. Neck pain-induced care-seeking in the largest sub-populations

Variables		Refer to GP	Refer to a Spine Specialist	Medication Use	Radiography	MRI
	Total	27.9 (21.9-33.8)	20.5 (15.1-26.0)	28.3 (21.9-34.2)	21.0 (15.5-26.5)	20.5 (15.1-26.0)
By sport	Ping-pong	10.8 (2.3-22.2)	8.1 (0.0-18.1)	8.1 (0.0-17.9)	10.8 (2.3-22.2)	10.8 (2.3-22.2)
	Swimming	33.7 (22.9-44.4)	28.7 (18.3-39.1)	38.7 (27.6-49.3)	27.5 (18.0-37.8)	26.2 (16.8-36.1)
	Shooting	26.8 (13.5-40.5)	14.6 (4.6-27.0)	48.7 (33.3-63.6)	19.5 (7.8-33.3)	19.5 (7.8-33.3)
	Futsal	26.4 (15.7-38.4)	5.6 (0.0-12.5)	20.7 (10.6-31.5)	11.3 (3.6-20.4)	11.3 (3.6-20.4)
	Chess	34.1 (20.4-48.7)	31.7 (18.1-46.6)	29.2 (16.6-45.2)	29.2 (15.9-43.7)	29.2 (15.9-43.7)
	Darts	53.5 (33.3-72.7)	46.4 (28.5-64.2)	42.8 (23.8-61.2)	50.0 (30.4-68.5)	46.4 (28.0-64.1)
By disability	Leg amputation	0.0 (0.0-0.0)	0.0 (0.0-0.0)	29.4 (9.0-52.6)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
	Leg movement limitation	30.0 (16.3-43.4)	26.0 (13.7-39.0)	20.0 (9.0-32.0)	26.0 (14.0-39.2)	26.0 (14.0-39.2)
	Partial blindness	11.1 (0.0-27.7)	11.1 (0.0-27.7)	16.6 (0.0-37.4)	16.6 (0.0-36.3)	16.6 (0.0-36.3)
	Partial deafness	22.5 (8.3-38.4)	25.8 (9.0-41.6)	38.7 (21.2-55.8)	29.0 (12.5-45.4)	25.8 (10.0-40.7)
	Nervous problems	32.0 (19.6-45.2)	35.8 (23.0-48.9)	33.9 (21.4-46.6)	30.1 (17.3-43.4)	30.1 (17.3-43.4)
	Spinal lesions	41.9 (24.1-59.0)	25.8 (10.2-41.3)	51.6 (34.3-69.9)	35.4 (19.3-51.8)	32.2 (16.6-49.9)

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GP: General practitioner; MRI: Magnetic resonance imaging, Numbers are reported as percent (95% confidence intervals).

Table 5. Low back pain-included absence behavior in the largest sub-populations

Variables		Competition	Training	Work
	Total	16.4 (11.6-21.8)	22.7 (16.9-28.9)	20.4 (15.1-25.8)
By sport	Ping-pong	0.0 (0.0-0.0)	10.2 (2.2-20.8)	0.0 (0.0-0.0)
	Swimming	28.4 (19.0-38.4)	35.0 (24.6-46.7)	28.5 (18.9-38.1)
	Shooting	36.5 (22.2-52.5)	48.7 (32.2-64.8)	38.4 (21.8-54.2)
	Futsal	11.3 (3.6-20.4)	16.3 (6.6-27.9)	16.3 (6.1-27.7)
	Chess	9.5 (2.1-19.9)	13.5 (3.1-26.4)	18.9 (6.0-31.2)
	Darts	10.0 (0-22.2)	13.7 (2.8-27.2)	31.0 (14.2-48.4)
By disability	Leg amputation	41.1 (17.6-64.7)	47.0 (23.8-73.3)	47.0 (23.8-73.3)
	Leg movement limitation	28.3 (16.9-40.0)	30.1 (19.1-43.1)	13.2 (4.6-22.8)
	Partial blindness	45.0 (22.7-66.6)	42.1 (19.0-66.6)	26.3 (6.6-50.0)
	Partial deafness	25.0 (10.0-41.9)	41.3 (23.3-58.9)	44.8 (26.9-62.5)
	Nervous problems	3.7 (0.0-9.8)	17.3 (7.8-28.5)	36.5 (23.4-50.0)
	Spinal lesions	24.2 (10.0-39.2)	33.3 (17.4-51.3)	27.2 (12.5-43.2)

Numbers are reported as percent (95% confidence intervals).

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Table 6. Neck pain-included absence behavior in the largest sub-populations

Variables		Competition	Training	Work
	Total	13.7 (9.1-19.2)	10.0 (5.9-14.2)	10.0 (5.9-14.2)
By sport	Ping-pong	2.7 (0.0-9.6)	8.1 (0.0-18.1)	8.1 (0.0-18.1)
	Swimming	20.0 (11.4-28.9)	18.7 (10.6-27.7)	21.2 (12.5-30.6)
	Shooting	17.0 (7.1-30.0)	19.5 (9.3-31.9)	9.7 (2.3-19.9)
	Futsal	11.3 (3.6-20.4)	1.8 (0.0-6.4)	0.0 (0.0- 0.0)
	Chess	17.0 (6.9-30.0)	2.4 (0.0-7.8)	9.7 (2.2-19.9)
	Darts	25.0 (8.3-41.3)	7.1 (0.0-19.9)	17.8 (4.1-33.3)
By disability	Leg amputation	17.6 (0.0-37.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)
	Leg movement limitation	10.0 (2.2-19.1)	4.0 (0.0-10.6)	6.0 (0.0-14.0)
	Partial blindness	5.5 (0.0-18.7)	5.5 (0.0-18.7)	5.5 (0.0-18.7)
	Partial deafness	16.1 (3.5-30.4)	25.8 (11.1-42.4)	29.0 (13.7-45.8)
	Nervous problems	11.3 (3.8-20.8)	9.4 (2.0-18.3)	18.8 (8.9-29.7)
	Spinal lesions	16.1 (5.2-29.6)	12.9 (3.0-25.0)	9.6 (0.0-22.2)

Numbers are reported as percent (95% confidence intervals).

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Table 7. Athletes' disability index and 24 hour in spinal pain in the largest sub-populations

Variables		ADI	LVAS	NVAS
	Total	22.2 (19.2-25.3)	2.14 (1.84-2.47)	2.16 (1.80-2.54)
By sport	Ping-pong	16.0 (10.0-23.2)	1.25 (0.78-1.73)	1.10 (0.65-1.72)
	Swimming	30.2 (25.2-35.1)	2.70 (2.06-3.39)	2.23 (1.62-2.87)
	Shooting	27.2 (20.4-33.8)	2.44 (1.66-3.33)	2.03 (1.29-2.83)
	Futsal	11.9 (8.7-15.3)	1.40 (0.84-2.03)	1.47 (1.03-1.96)
	Chess	21.3 (14.9-28.2)	2.43 (1.66-3.23)	3.23 (2.28-4.26)
	Darts	28.7 (20.3-37.1)	3.0 (1.82-4.20)	3.90 (2.37-5.39)
By disability type	Leg amputation	32.4 (19.2-45.4)	2.2 (1.39-3.07)	0.95 (0.42-1.43)
	Leg movement limitation	24.5 (18.7-30.6)	2.24 (1.63-2.94)	1.88 (1.24-2.57)
	Partial blindness	26.6 (17.6-35.9)	2.65 (1.41-4.02)	1.44 (0.72-2.29)
	Partial deafness	31.0 (22.8-39.4)	3.17 (2.11-4.38)	2.58 (1.49-3.81)
	Nervous problems	28.4 (21.9-35.1)	3.15 (2.28-4.01)	3.28 (2.31-4.20)
	Spinal lesions	35.5 (27.6-42.9)	3.66 (2.61-4.68)	3.87 (2.84-5.00)

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Abbreviations: ADI: Athlete disability index; LVAS: Low back pain visual analog scale; NVAS: Neck pain visual analog scale.
Numbers are reported as percent (95% confidence intervals)

Spinal pain intensity

Athletes' LBP intensity during the last 24 hours divided by sports and disability types is presented in Table 7. An independent-sample t-test was conducted to compare the LBP intensity score for obese participation (BMI≥30 [13]) and non-obese participation conditions. There was a significant difference in the scores for obese participation (Mean±SD 0.84±1.01) and non-obese participation (Mean±SD 2.39±2.62) conditions, t(112.114)=5.641, P<0.0001.

A univariate linear regression analysis was performed to estimate the LBP disability score based the age, BMI, duration of disability, duration of LBP, duration of playing the sports at the competitive level, and mean training time per week.

Age (P=0.03), BMI (P=0.05), duration of LBP (P=0.01), duration of playing the sports at the competitive level (P=0.01), and mean training time per week (P=0.15) were the only variables that had a P<0.20 in the analysis. Therefore, they were incorporated into the multivariate regression analysis.

A backward linear regression was calculated to predict LBP intensity based on age, BMI, duration of LBP, duration of playing the sports at the competitive level, and mean training time per week. A significant regression equation was found ($F_{(1, 24)}$=7.003, P<0.14), with an R^2 of 0.475. Participants predicted pain intensity is equal to 1.871±0.133 (years of sufferance from LBP) years when pain intensity is measured in a score of 0-10. Participants' pain intensity increased by 0.133 for each year of suffering from LBP.

Athletes' NP intensity in the last 24 hours, according to the VAS in the most prevalent sports and disabilities, is presented in Table 7. Darts players (3.90 from 10) among athletes of all six sports and participants with spinal lesions (3.87 from 10) among the athletes with any of the six disabilities had the highest NP VAS scores.

Low back pain disability

Athletes' disability index divided by sports and disability types is presented in Table 7. A univariate linear regression analysis was executed to predict LBP disability score based on age, BMI, duration of disability, duration of LBP, duration of playing the sports at the competitive level, and the mean training time per week. Only age (P<0.01), duration of LBP (P=0.03), and mean training time per week (P=0.01) had a P<0.20 in the analysis. Hence, they were included in the multivariate regression analysis. A multivariate backward linear regression was calculated to predict ADI score based on age, duration of LBP, and mean training time per week of the participants. A significant association was shown ($F_{(2, 25)}$=14.926, P<0.0001), with an R^2 of 0.544.

Participants predicted disability=-100.490+2.372 (age) years+1.210 (years of suffering from LBP) years when disability is measured in percent.

Participants' disabilities increased by 2.372 for each year of age. Participants' disability increased by 1.210 for each year of suffering from LBP.

4. Discussion

In the present study, we aimed to investigate whether SP prevalence and characteristics are different among different sports and disabilities. The findings from this study indicate a high prevalence of lifetime, last-year, and sport-time SP among male athletes with disabilities. While the intensity of this troublesome morbidity and its consequent disability is lower than expected among the athletes of specific sports and athletes with particular disabilities, it is still undeniably high overall.

There is no study investigating LBP among athletes with disabilities quantitatively to the best of the author's knowledge. Furthermore, LBP is studied only among lower limb amputees of the population with disabilities. The present study's reported prevalence of lifetime LBP among non-athlete lower limb amputees (58.8%) was comparable to the obtained prevalence by Kulkarni et al. (63%) [14], which had a sample with a mean age (48 years old) similar to this study (51.5 years old). The current study sample's slightly lower prevalence might arise from the higher mean muscle strength in the participants since they were all professional athletes. However, the impact of exercise on LBP is not yet comprehensively explored among lower-limb amputees [15]. The same applies to another previous study, which delineates lifetime low back prevalence as 63% in a sample of 526 non-athlete lower limb amputees with a mean age of 52 years [16].

The study's novel finding is that lifetime LBP was prevalent among lower limb amputees and prevalent in other disability subtypes. These subtypes include leg movement limitation, partial blindness, partial deafness, nervous problems, and spinal lesions. The main contributor to LBP in subpopulations of leg movement limitations, nervous problems, and spinal lesions probably is biomechanical discrepancies and kinetic chain disturbances caused by the disability in these athletes [17]. A presumable cause of LBP in subpopulations of partial blindness and partial deafness disabilities could be higher psychosocial distress among athletes with disabilities, which is demonstrated to impact pains, including LBP significantly [6]. The proposed reason is already established as a significant predictor of LBP and its chronicity among healthy athletes [18].

Compared to healthy athletic subjects, the lifetime prevalence of LBP was slightly higher (66.2%) among swimmers with disabilities than among healthy swimmers (64%) [19], which might denote the additive effect of disability on LBP prevalence. However, the difference might be affected by the two studies' disparate age groups and female athletes' inclusion in Zaina et al.'s study [19]. Both mentioned parameters are well-established confounders of back pains among athletes [20].

Currently, there is no other single-sport study available for comparison of LBP prevalence. The first reason was their significant discrepancies of age and gender with our sample (e.g. sample gender consisted of merely young adult females, etc.). The second reason was their investigation of a sport other than the most participated sports in the present study (e.g. track and field, ice hockey, etc.). Furthermore, no appropriate multi-sport study was found for the comparison of the results. The reason was the significantly contrasted distribution of athletes in different sports between the two samples, making the comparison unrealistic because of significant inter-sport differences in spinal loads, which substantially impacts the prevalence and characteristics of LBP in each particular sport [20].

The current study demonstrated that the disability caused by LBP correlated with age and duration of LBP for the subject. Age is a well-known risk factor for developing LBP among the general population and non-disabled athletes [21]. However, no study was found to evaluate the predictors of disability caused by LBP among athletes with disabilities. On the other hand, LBP intensity correlated with obesity, age, and LBP duration, but surprisingly not with BMI. A similar study on back pain intensity among elite non-disabled athletes also demonstrated that LBP corresponds neither with age nor with BMI [22]. The discordance concerning LBP intensity with age between the two studies might arise from the considerable difference in the sample populations' age. The sample population in Schulz et al.'s study had a mean age of 21.4 [22], whereas the mean age of the present study's subjects is 51.5. Another surprising finding of the current paper is the disproportion between the intensity of LBP and disability caused by LBP. While the mean LBP intensity was only 2.14 of 10, the mean disability index was measured as high as 22.4%. This discrepancy may arise from the underreporting of pain intensity, including LBP intensity, among elite male athletes. This underreporting is an established finding among non-disabled male athletes [23]. To our knowledge, no study has evaluated the underreporting of pain intensity among male athletes with disabilities. However, the same reasons for underreporting among non-disabled male athletes may also be present for male athletes with disabilities including the social influence of peer athletes and trainers [24].

A strikingly high one-year prevalence of NP was found among athletes with disabilities. While a previous study indicated that the mean one-year prevalence of NP is only 25.8% among the general population [4], the mean one-year prevalence of NP was as high as 41.8% in our study. This finding is in good agreement with a previous study that suggested chronic NP as a shared experience after several disabilities, including, but not limited to, spinal lesions and limb amputations [1]. This finding is particularly important since the NP may result in even higher disability and fear of movement among this vulnerable population [25]. It correlates with more frequent reports of psychological dysfunctions such as depressive or anxiety symptoms [26]. However, compared to the mean one-year prevalence of NP in healthy athletes (45.9%), the difference does not seem considerable [7].

It was found that the prevalence of lifetime NP in lower limb amputees (47%) and persons with lower limb movement limitations (50%) were similar to a previous study investigating the NP among the wheelchair athletes participating in wheelchair games, reporting the prevalence of NP as high as 55% [27]. It could be hypothesized that individuals with lower-limb amputations or movement limitations cannot rely on their lower limb movements to have a 360° vision of their surroundings. This phenomenon leads to the overuse of neck movements to have a complete line of sight, in contrast to non-disabled individuals, which depend heavily on rapid and convenient lower limb movements for a 360° line of sight.

However, the NP intensity score during the past 24 hours, according to the VAS, was dramatically different. The mean score was 0.95 in lower limb amputees and 1.88 in persons with lower limb movement limitations, whereas Boninger et al. reported scores of 6.1 and 3.2 for the worst and the best-experienced NP in the last 24 hours [27]. A possible explanation is a difference in the sports types of the two samples. The sample of Boninger et al. may have included more athletes in sports with higher dependency on lateral sight and neck movements, resulting in higher NP intensities. Another possible explanation might be in the difference in the psychological state [28], cognitive factors such as catastrophizing [29], coping responses, religious beliefs, and social and environmental factors such as social support [6] between the two Iranian and American populations of wheelchair athletes.

The NP intensity results were also remarkably lower than a previous study concerning NP among permanent wheelchair users, which reported a pain severity score of 5 [8]. Besides the explanations above, this score difference may originate from athletes with disabilities' higher neck muscle strength, contributing to fewer NP reports. The other reason might be a moderate physical activity level among the athletes compared to probably low physical activity levels among non-athlete wheelchair users. This correlation in chronic NP had been suggested in a previous study [30].

The current study indicates that chronic NP prevalence in athletes with disabilities (17.7%) is slightly higher than in the general population [30, 31]. The difference may arise from the higher use of neck movements and more difficult administration to healthcare centers than the general population, resulting in less realization and NP follow-up.

The present study has several limitations. It was designed as a cross-sectional study. Therefore, we were unable to identify any causal relationship between SP and sport-related and disability-related factors. The data was gathered through self-report, which increases the chance of recall bias. Finally, no physical examination and paraclinical tests were performed to evaluate the athletes' SP. However, the current paper also has various strengths. SP's prevalence and characteristics were assessed in a large sample of athletes with different disabilities participating in different sports. Moreover, the ADI questionnaire was utilized to explore the disability caused by LBP among athletes with disabilities for the first time.

5. Conclusion

SP is a common problem among athletes with disabilities. Its high prevalence is observed among most disabilities and sports. There is a considerable disparity in SP characteristics among athletes with disabilities of different sports and disability subtypes. This discrepancy is also found in the patterns of care-seeking behaviors and absence due to SP. Although its intensity is rarely severe among a population of any disability or sports, it is undeniably disabling among the vulnerable population of athletes with disabilities. The implications of the findings of this study can contribute to better care guidelines and strategies for these athletes. Future research should investigate the causal relationships and their strength between disability subtypes and SP's prevalence and characteristics.

Ethical Considerations

Compliance with ethical guidelines

The ethics committee of Tehran University of Medical Sciences approved this study (Ethics approval number: IR.TUMS.NI.REC.1398.040). Informed consent was obtained from all individual participants included in the study.

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Authors' contributions

Conceptualization, supervision and Methodology: Farzin Farahbakhsh, Pardis Noormohammadpour, Mohsen Rostami, Bahar Hassanmirzaie, Ramin Kordi and Ataollah Shahbandi; Investigation, Writing – original draft, and Writing – review & editing: Ataollah Shahbandi, Farzin Farahbakhsh, Navid Moghadam, Pardis Noormohammadpour, Mohsen Rostami, Bahar Hassanmirzaie and Ramin Kordi; Data collection: Farzin Farahbakhsh; Data analysis: Ataollah Shahbandi, Mohsen Rostami and Navid Moghadam.

Conflict of interest

The authors declared no conflict of interest.

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Appendix 1

Section one of Appendix 1: Demographic information

Age: …years old

Height: … centimeters

Weight: … kilograms

Participated sport: Sitting volleyball / Ping-pong / Swimming / Wheelchair basketball / Shooting / Archery / Weight lifting / Boccia / Futsal / Soccer / Chess / Darts / Physical fitness / Bodybuilding / Jogging / Weight throw / Discus throw / Javelin throw / Running / Long jump / Other track and field events

Write down your participated sport if it is not written above: …

Average weekly practice hours: …

Years of competitive activities in the sport: …

Disability type (s): Arm amputation / Reduced range of motion in arm / Leg amputation / Reduced range of motion in leg / Mental retardation/Vision loss / Visual impairment / Hearing loss / Auditory impairment / Neuropsychiatric diseases / Spinal lesions

Write down your disability if it is not written above: …

Years lived with disability: …

Section two of Appendix 1: Low back pain

Have you ever had low back pain? Yes/No

Pain intensity during the last 24 hours: According to VAS, it should be a 10 cm solid line that begins at zero and ends at ten.

Low back pain duration: …years and … months and … days

Have you ever had low back pain during your athletically active years? Yes/No

Have you had low back pain during the last year? Yes/No

Have you seen a general practitioner for your low back pain during the last year? Yes/No

Have you seen a medical specialist for your low back pain during the last year? Yes/No

Have you taken any medications for your low back pain during the last year? Yes/No

Have you taken X-ray radiography for your low back pain during the last year? Yes/No

Have you done an MRI. for your low back pain during the last year? Yes/No

Have you missed any competitive sports events for your low back pain during the last year? Yes/No

Have you missed any athletic training sessions for your low back pain during the last year? Yes/No

Have you missed any workdays for your low back pain during the last year? Yes/No

Have you experienced concurrent pain or numbness in your leg (s) with your low back pain? Yes/No

Have you had at least 90 days of experiencing low back pain during the last six months? Yes/No

Section three of Appendix 1: Neck pain

Have you ever had neck pain? Yes/No

Pain intensity during the last 24 hours: According to VAS, it should be a 10 cm solid line that begins at zero and ends at ten.

neck pain duration: …years and … months and … days

Which item describe your neck pain more accurately? Single episode/Recurrent / Persistent

Have you ever had neck pain during your athletically active years? Yes/No

Have you had neck pain during the last year? Yes/No

Have you seen a general practitioner for your neck pain during the last year? Yes/No

Have you seen a medical specialist for your neck pain during the last year? Yes/No

Have you taken any medications for your neck pain during the last year? Yes/No

Have you taken X-ray radiography for your neck pain during the last year? Yes/No

Have you done an MRI. for your neck pain during the last year? Yes/No

Have you missed any competitive sports events for your neck pain during the last year? Yes/No

Have you missed any athletic training sessions for your neck pain during the last year? Yes/No

Have you missed any workdays for your neck pain during the last year? Yes/No

Have you experienced concurrent pain or numbness in your leg (s) with your neck pain? Yes/No

Have you had at least 90 days of experiencing neck pain during the last six months? Yes/No

Section four of Appendix 1: Athletes' disability index questionnaire

Appendix 1. STROBE Statement—a checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract ✓ (b) Provide in the abstract an informative and balanced summary of what was done and what was found ✓
		Introduction
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported ✓
Objectives	3	State-specific objectives, including any prespecified hypotheses ✓
		Methods
Study design	4	Present key elements of study design early in the paper ✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection ✓
Participants	6	(a) Cohort study—Give the eligibility criteria and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants ✓ (b) Cohort study—For matched studies, give matching criteria and the number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable ✓
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe the comparability of assessment methods if there is more than one group ✓
Bias	9	Describe any efforts to address potential sources of bias ✓
Study size	10	Explain how the study size was arrived at ✓
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why ✓
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding ✓ (b) Describe any methods used to examine subgroups and interactions ✓ (c) Explain how missing data were addressed ✓ (d) Cohort study—If applicable, explain how the loss to follow-up was addressed Case-control study—If applicable, explain how the matching of cases and controls was addressed Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy ✓ (e) Describe any sensitivity analyses ✓

		Results
Participants	13*	(a) Report numbers of individuals at each stage of study—eg. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed ✓ (b) Give reasons for non-participation at each stage ✓ (c) Consider the use of a flow diagram ☐
Descriptive data	14*	(a) Give characteristics of study participants (eg. demographic, clinical, social) and information on exposures and potential confounders ✓ (b) Indicate the number of participants with missing data for each variable of interest ✓ (c) Cohort study—Summarize follow-up time (eg. average and total amount)
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time Case-control study—Report numbers in each exposure category, or summary measures of exposure Cross-sectional study—Report numbers of outcome events or summary measures ✓
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg e.g. 95% confidence interval). Make clear which confounders were adjusted for and why they were included ✓ (b) Report category boundaries when continuous variables were categorized ✓ (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg e.g. analyses of subgroups and interactions, and sensitivity analyses ✓
		Discussion
Key results	18	Summarize key results with reference to study objectives ✓
Limitations	19	Discuss the limitations of the study, taking into account sources of potential bias or imprecision. Discuss both the direction and magnitude of any potential bias ✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, the multiplicity of analyses, results from similar studies, and other relevant evidence ✓
Generalizability	21	Discuss the generalizability (external validity) of the study results ✓
		Other information
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based ✓

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in the cohort and cross-sectional studies, Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

References

[1] Ehde DM, Jensen MP, Engel JM, Turner JA, Hoffman AJ, Cardenas DD. Chronic pain secondary to disability: A review. The Clinical Journal of Pain. 2003; 19(1):3-17. [DOI:10.1097/00002508-200301000-00002] [PMID]

[2] Hoy D, Brooks P, Blyth F, Buchbinder R. The epidemiology of low back pain. Best Practice & Research Clinical Rheumatology. 2010; 24(6):769-81. [DOI:10.1016/j.berh.2010.10.002] [PMID]

[3] Ehde DM, Smith DG, Czerniecki JM, Campbell KM, Malchow DM, Robinson LR. Back pain as a secondary disability in persons with lower limb amputations. Archives of Physical Medicine and Rehabilitation. 2001; 82(6):731-4. [DOI:10.1053/apmr.2001.21962] [PMID]

[4] Hoy DG, Protani M, De R, Buchbinder R. The epidemiology of neck pain. Best Practice & Research: Clinical Rheumatology. 2010; 24(6):783-92. [DOI:10.1016/j.berh.2011.01.019] [PMID]

[5] Hoy D, March L, Woolf A, Blyth F, Brooks P, Smith E, et al. The global burden of neck pain: Estimates from the global burden of disease 2010 study. Annals of the Rheumatic Diseases. 2014; 73(7):1309-15. [DOI:10.1136/annrheumdis-2013-204431] [PMID]

[6] Jensen MP, Moore MR, Bockow TB, Ehde DM, Engel JM. Psychosocial factors and adjustment to chronic pain in persons with physical disabilities: A systematic review. Archives of Physical Medicine and Rehabilitation. 2011; 92(1):146-60. [DOI:10.1016/j.apmr.2010.09.021] [PMID] [PMCID]

[7] Noormohammadpour P, Farahbakhsh F, Farahbakhsh F, Rostami M, Kordi R. Prevalence of neck pain among athletes: A systematic review. Asian Spine Journal. 2018; 12(6):1146. [DOI:10.31616/asj.2018.12.6.1146] [PMID] [PMCID]

[8] Kovacs FM, Seco J, Royuela A, Barriga A, Zamora J. Prevalence and factors associated with a higher risk of neck and back pain among permanent wheelchair users: A cross-sectional study. Spinal Cord. 2018; 56(4):392-405. [DOI:10.1038/s41393-017-0029-z] [PMID]

[9] Farahbakhsh F, Akbari-Fakhrabadi M, Shariat A, Cleland JA, Farahbakhsh F, Seif-Barghi T, et al. Neck pain and low back pain in relation to functional disability in different sport activities. Journal of Exercise Rehabilitation. 2018; 14(3):509. [DOI:10.12965/jer.1836220.110] [PMID] [PMCID]

[10] Noormohammadpour P, Rostami M, Mansournia MA, Farahbakhsh F, Pourgharib Shahi MH, Kordi R. Low back pain status of female university students in relation to different sport activities. European Spine Journal. 2016; 25(4):1196-203. [DOI:10.1007/s00586-015-4034-7] [PMID]

[11] Noormohammadpour P, Hosseini Khezri A, Farahbakhsh F, Mansournia M, Smuck M, Kordi R. Reliability and Validity of Athletes Disability Index Questionnaire. Clinical Journal of Sport Medicine. 2018; 28(2):159-167. [DOI:10.1097/JSM.0000000000000414] [PMID]

[12] Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain. 1983; 17(1):45-56. [DOI:10.1016/0304-3959(83)90126-4] [PMID]

[13] North American Association for the Study of Obesity, National Heart, Lung, Blood Institute, NHLBI Obesity Education Initiative. The practical guide: Identification, evaluation, and treatment of overweight and obesity in adults. Michigan: National Institutes of Health, National Heart, Lung, and Blood Institute, NHLBI Obesity Education Initiative, North American Association for the Study of Obesity; 2000. [Link]

[14] Kulkarni J, Gaine WJ, Buckley JG, Rankine JJ, Adams J. Chronic low back pain in traumatic lower limb amputees. Clinical Rehabilitation. 2005; 19(1):81-6. [DOI:10.1191/0269215505cr819oa] [PMID]

[15] Highsmith MJ, Goff LM, Lewandowski AL, Farrokhi S, Hendershot BD, Hill OT, et al. Low back pain in persons with lower extremity amputation: A systematic review of the literature. The Spine Journal. 2019; 19(3):552-63. [DOI:10.1016/j.spinee.2018.08.011] [PMID]

[16] Devan H, Hendrick P, Hale L, Carman A, Dillon MP, Ribeiro DC. Exploring factors influencing low back pain in people with nondysvascular lower limb amputation: A national survey. Physical Medicine and Rehabilitation 2017; 9(10):949-59. [DOI:10.1016/j.pmrj.2017.02.004] [PMID]

[17] O'Leary CB, Cahill CR, Robinson AW, Barnes MJ, Hong J. A systematic review: The effects of podiatrical deviations on nonspecific chronic low back pain. Journal of Back and Musculoskeletal Rehabilitation. 2013; 26(2):117-23. [DOI:10.3233/BMR-130367] [PMID]

[18] Heidari J, Mierswa T, Kleinert J, Ott I, Levenig C, Hasenbring M et al. Parameters of low back pain chronicity among athletes: Associations with physical and mental stress. Physical Therapy in Sport. 2016; 21:31-7. [DOI:10.1016/j.ptsp.2016.03.003] [PMID]

[19] Zaina F, Donzelli S, Lusini M, Minnella S, Negrini S. Swimming and spinal deformities: A cross-sectional study. The Journal of Pediatrics. 2015; 166(1):163-7. [DOI:10.1016/j.jpeds.2014.09.024] [PMID]

[20] Trompeter K, Fett D, Platen P. Prevalence of back pain in sports: A systematic review of the literature. Sports Medicine. 2017; 47:1183-207. [DOI:10.1007/s40279-016-0645-3] [PMID] [PMCID]

[21] Moradi V, Memari AH, ShayestehFar M, Kordi R. Low back pain in athletes is associated with general and sport specific risk factors: A comprehensive review of longitudinal studies. Rehabilitation Research and Practice. 2015; 2015:850184. [DOI:10.1155/2015/850184] [PMID] [PMCID]

[22] Schulz SS, Lenz K, Buttner-Janz K. Severe back pain in elite athletes: A cross-sectional study on 929 top athletes of Germany. European Spine Journal. 2016; 25(4):1204-10. [DOI:10.1007/s00586-015-4210-9] [PMID]

[23] Christopher S, Tadlock BA, Veroneau BJ, Harnish C, Perera NKP, Knab AM, et al. Epidemiological profile of pain and non-steroid anti-inflammatory drug use in collegiate athletes in the United States. BMC Musculoskelet Disord. 2020; 21(1):561. [DOI:10.1186/s12891-020-03581-y] [PMID] [PMCID]

[24] Nixon HL. A social network analysys of influences on athletes to play with pain and injuries. Journal of Sport and Social Issues. 1992; 16(2):127-35. [DOI:10.1177/019372359201600208]

[25] Cheung J, Kajaks T, Macdermid JC. The relationship between neck pain and physical activity. The Open Orthopaedics Journal. 2013; 7:521-9. [DOI:10.2174/1874325001307010521] [PMID] [PMCID]

[26] Strine TW, Hootman JM. US national prevalence and correlates of low back and neck pain among adults. Arthritis & Rheumatology. 2007; 57(4):656-65. [DOI:10.1002/art.22684] [PMID]

[27] Boninger ML, Cooper RA, Fitzgerald SG, Lin J, Cooper R, Dicianno B et al. Investigating neck pain in wheelchair users. American Journal of Physical Medicine & Rehabilitation. 2003; 82(3):197-202. [DOI:10.1097/01.PHM.0000054217.17816.DD] [PMID]

[28] Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J. Do psychological states associate with pain and disability in chronic neck pain patients? Journal of Back and Musculoskeletal Rehabilitation. 2015; 28(4):797-802. [DOI:10.3233/BMR-150587] [PMID]

[29] Thompson DP, Urmston M, Oldham JA, Woby SR. The association between cognitive factors, pain and disability in patients with idiopathic chronic neck pain. Disability and Rehabilitation. 2010; 32(21):1758-67. [DOI:10.3109/09638281003734342] [PMID]

[30] Noormohammadpour P, Mansournia MA, Koohpayehzadeh J, Asgari F, Rostami M, Rafei A et al. Prevalence of chronic neck pain, low back pain, and knee pain and their related factors in community-dwelling adults in Iran: A population-based national study. The Clinical Journal of Pain. 2017; 33(2):181-7. [DOI:10.1097/AJP.0000000000000396] [PMID]

[31] Nobari M, Arslan SA, Hadian MR, Ganji B. Effect of corrective exercises on cervicogenic headache in office workers with forward head posture. Journal of Modern Rehabilitation. 2017; 11(4):201-8. [Link]