J Arch Mil Med. 2015 November; 3(4): e30876. doi: 10.5812/jamm.30876

Published online 2015 November 10. **Research Article**

Deployment and Risk Factors of Low Back Pain Among Iranian Soldiers

Farzad Najafipour,[1] Farshad Najafipour,[2,*] Ahura Ahmadi,[3] and Milad Darejeh[4]

[1]Department of Physical Therapy, Research Committee, Semnan University of Medical Sciences, Semnan, IR Iran
[2]Department of Epidemiology, AJA University of Medical Sciences, Tehran, IR Iran
[3]Department of Community Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran
[4]Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, IR Iran

**Corresponding author*: Farshad Najafipour, Department of Epidemiology, AJA University of Medical Sciences, Tehran, IR Iran. Tel: +98-2166733608, Fax: +98-2166726909, E-mail: drnajafipour2002@yahoo.com

Received 2015 June 24; **Revised** 2015 September 1; **Accepted** 2015 September 4.

Abstract

Background: Risk factors for low back pain (LBP) among the deployed forces are still under shadow, while the consequences of LBP are already clarified.

Objectives: This study aimed to identify the LBP risk factors associated with deployment-related exposures.

Patients and Methods: This study was conducted as a questionnaire-based cohort study, in which 3862 Iranian soldiers participated.

Results: Of the 1360 respondents, 350 (26%) reported LBP. The potential of nonresponse bias for the population of respondents was adjusted and the relationships between explanatory variables and LBP were analyzed using models of ordinal logistic regression. After the adjustment of all other variables, older age (P = 0.016), support from leaders (odds ratio (OR) = 1.69, P = 0.019), psychological stress (OR = 1.71, P = 0.009), working in depots or storehouses (OR = 2.60, P = 0.041), and awkward working positions (OR = 1.98, P = 0.001) were found to be associated with LBP. Maneuver and traffic accidents, sport or exposure to work, and lifestyle were not associated with LBP in this study, which was the result of the actual deployment only.

Conclusions: In this study older age, lack of support from leaders, psychological stress, awkward working positions, and working in depots or storehouses were significantly associated with LBP after the adjustment of all other variables. Preventive measures should include predeployment preparation of leaders to cope with LBP and other musculoskeletal troubles among their subordinates and involve trained medical staff and specialized physiotherapists, advising soldiers of different military occupational specialties on how to optimize ergonomics at work.

Keywords: Low Back Pain, Risk Factors

1. Background

In a recent review article, the burden of spinal pain in military was outlined (1). A common, painful condition affecting the lower portion of the spine is known as low back pain (LBP). Spinal pain is the most common complaint among soldiers in both operational and nonoperational environments. LBP is the primary condition, accounting for approximately 75% of spinal pain syndromes in military personnel (1). There is evidence of increased risk for spinal pain in an operational setting (2) and LBP is one of the principal reasons for soldiers seeking medical attention, including physical therapy in theaters of operations (3, 4). Furthermore, spinal pain was the fifth leading cause of medical evacuation out of theater in one operation, accounting for 2445 of a total of 34 006 evacuations (7%), and notably, the condition was associated with a low rate of return to duty (5). Therefore, spinal pain contributes considerably to difficulties in keeping the fighting force intact during deployments. The knowledge about risk factors for LBP among the deployed forces is lesser compared to the knowledge about the consequences of spinal pain and LBP during deployments. Soldiers working in some military occupations are more at risk of incurring LBP than others during deployment. A recent study found the highest occurrence of LBP among deployed noninfantry occupations such as service/supply and repair/maintenance (6). These occupations often require driving vehicles or continuous heavy lifting of supplies and the personnel are at risk of workplace accidents and prone to remain in awkward positions for extended periods. A survey of 263 soldiers in a Brigade Maneuver Team during their third month of deployment identified lifting tasks and wearing heavy loads as risk factors for musculoskeletal injuries, including LBP (7). A very recent prospective cohort study of demographic and physical risk factors for new-onset LBP among deployed forces identified the following risk factors for LBP: age, wearing body armor, the time spent on walking patrol, and the weight of equipment worn (8). Studies conducted in nonmilitary cohorts have found that psychosocial factors at work might contribute to the occurrence of LBP, but the evidence is still incomplete (9). High rates of psychiatric comorbidity found in veterans and service members with persistent back pain suggest a related etiology, (1) but there is no other research investigating the effect of psychosocial factors on LBP among deployed soldiers. This study was based on data obtained from an occupational medical health surveillance program, initiated by the Iranian Armed Forces Health Service in 2004. The background population for the study consisted of soldiers; they were asked to fill in questionnaires focused on exposures in the deployment area and health outcomes during deployment. This study added to the current knowledge by assessing not only self-reported work-related physical exposures, but also psychosocial exposures and their impacts on LBP complaints during the year in which the deployment took place.

2. Objectives

The purpose of the study was to identify any deployment-related explanatory variables associated with LBP.

3. Patients and Methods

3.1. Study Design and Study Population

The study was designed as a retrospective cohort study and data came from responses to postdeployment questionnaires with emphasis placed on using standardized and validated questions. A total of 3862 military service personnel (study population) were involved in this study. The deployments took place in the period between June 2004 and February 2006. From the defense personnel management system, age, gender, and military rank data for the total study population could be obtained. A questionnaire and a letter providing information about the study were given to all the personnel in the study population. All the participants were asked to give informed consents and answer the questionnaire according to the health surveillance program for the military deployments. Among those eligible for participation, 1506 soldiers filled the questionnaires, giving an average response rate of 37.7%. Because of insufficient completion or missing personal information, 66 questionnaires were excluded. In addition, 30 participants were excluded because of self-disinterest, leaving 1360 participants in the study.

3.2. Covariate Measures

The questionnaire used in the study was based on a questionnaire previously employed in one study (10). It consisted of several sections with questions; the parts pertinent to this study were (1) demographic and personal characteristics (confounders) including age, gender, military rank, partner status (single vs. married), time spent in deployment and self-reported height, and weight; (2) predeployment lifestyle and health; (3) unit affiliation, work-related factors, and factors concerning social support from leaders and colleagues during deployment; (4) exposures potentially associated with LBP during deployment; and (5) health outcomes. The self-reported exposures were assessed on a four-level categorical scale, from "No exposure" to "exposed more than 30 days during the deployment"; the social support variables were assessed on a four-level scale ranging from "never" to "often." The four-level scale used for assessing exposures was transformed to a binary variable by merging the two lowest values to the value of "exposure < six days" and the two highest to the value "exposure" 6 days. A similar transformation was applied in the case of social support variables.

3.3. Case Definition

The health outcomes part included the standardized Nordic questionnaire (SNQ) for the analysis of musculoskeletal symptoms (11) and this was used to assess the presence of LBP in this study. The outcome LBP was constructed as a categorical variable with an ordered three-value scale based on the following four questions from the SNQ:

(1) What is the total time that you have had LBP during the last 12 months?

(2) Has LBP caused you to reduce your activity during the last 12 months?

(3) What is the total time that LBP has prevented you from doing your normal work during the last 12 months?

(4) Have you been visited by a doctor, physiotherapist, or other such persons because of LBP during the last 12 months? Answer possibilities for (1) and (3) were "0 days", "1 - 7 days", "8 - 30 days", and "more than 30 days", and for (2) and (4) they were "No" and "Yes". The scores for the outcome variable LBPs were 0, 1, and 2. The value 0 was assigned if the answers to questions 1 to 4 were either "0 days" or "No". The value 1 was assigned if the answer to question 1 was "1 - 7 days", "8 - 30 days" or "more than 30 days", and the answers to question 2 to 4 were either "0 days" or "No". The value 2 was assigned if the answer to question 1 was "1 - 7 days", "8 - 30 days" or "more than 30 days", and at least 1 of the answers to question 2 to 4 were not "0 days" or "No". The ordinal scale was constructed to indicate severity, the value 0 meant "no LBP", 1 meant "LBP with no consequences", and 2 meant "LBP with consequences". The consequences were defined as reduced physical activity, reduced capacity for work, or need for treatment.

3.4. Statistical Analysis

As the composition of the study population in terms of age, gender, and military rank was known from the defense personnel management system, it was possible to adjust the population of respondents for potential nonresponse bias by post-stratification (12). The study group was younger with lower ranks compared to the background population of all the soldiers (Table 1). Using age categories and rank as post-stratification variables, a nonresponsive weighting scheme was constructed. In case of a missing value for either age or rank in the study group, only the non-missing variable was applied. In case the participants had filled in neither age nor rank, they were assigned the weight (1). The resulting sampling weights were included in all the statistical models thereby adjusting these for no response. The statistical analyses were performed using odds (ologit command in STATA). Potential confounders and covariates were identified in a priori c2 tests of contingency tables with the explanatory variables in the rows and LBP in the columns. In these initial c2 analyses of associations of covariates with LBP, a binary (not three-valued) categorical LBP variable was used, indicating the presence of LBP (case values 1 or 2) or not (noncase value 0) during the past year. The method of selecting variables for further analysis in OLR models was an adjusted manual strategy based on the method described by Janwantanakul et al. (13) with a cutoff value of P = 0.2 in the c2 tests. All the selected covariates were subsequently analyzed in univariate OLR models adjusted for significant confounders. Finally, all the covariates with P values = 0.2 in the univariate models were analyzed in a multivariate OLS model, where backward elimination was performed until every covariate still in the model had a Wald test P value = 0.2. The level of significance was chosen to be P = 0.05.

Table 1. Demographic Characteristics of the Study Group Compared With the Background Population

Characteristic	Study Population (n = 1360)	Background Population (n = 3862)
Age Group, y[a]		
< 25	528 (40.6)	1302 (33.7)
25 - 29	370 (28.4)	1114 (28.9)
30 - 39	246 (18.9)	960 (24.9)
> 39	158 (12.1)	486 (12.5)
Missing[b]	58	
Military Rank[a]		
Private	534 (66.9)	2398 (62.1)
NCO/officer	264 (33.1)	1464 (37.9)
Missing[b]	562	

[a] Values are presented as No. (%).
[b] Missing values are not included in the calculation of percentage.

4. Results

Among the 1360 participants, 350 reported LBP during the past 12 months and were defined as cases; 200 (57.1%) reported LBP for 1 - 7 days, 100 (28.6%) for 8 - 30 days, and 50 (14.3%) for more than 30 days. Of the cases, 112 (32%) reported reduced physical activity, 104 (29.7%) reported sick leave, and 88 (25.1%) reported treatment by doctor or physiotherapist during the past 12 months because of LBP. On the severity scale, 218 (62.3%) were assigned the value 1 (LBP without consequences) and 132 (37.7%) were assigned the value 2 (LBP with consequences). Table 2 shows LBP associations with demographic and individual confounders, i.e. age, rank, marriage, weight, height and body mass index (BMI), and predeployment covariates, i.e. total time spent in previous deployments, back pain in the past (more than one year ago), and smoking history. The following variables were most strongly associated with LBP (cutoff P = 0.20): Age, marriage, height, weight, and BMI. These were included in the subsequent regression models. Table 3 is similar to Table 2, but shows the associations of recorded deployment-related covariates and exposures with LBP. The following deployment-related variables were most associated with LBP (P = 0.20): the duration of deployment, unit affiliation, support from leaders, job satisfaction, psychological stress, poor psychosocial working environment, average length of sleep during the deployment, and change of exercise habits. The following exposures during deployment were most associated with LBP (P = 0.20): whole-body vibrations, heavy lifting, awkward working postures, driving in wheeled armored personnel carrier vehicles, office work, working in depots and storage facilities, and maneuver. There were neither associations between LBP and time spent on physical exercise in the deployment, nor between LBP and accidents because of sport, traffic, or work. Table 4 shows the results of univariate and multivariate analyses. As mentioned above, the outcome variable LBP in these analyses was an ordinal variable, constructed of four central questions on LBP in the SNQ. Cronbach's alpha for the LBP variable was calculated as 0.76, which was sufficient evidence for the internal consistency of the measure. In the univariate analyses, the following covariates were found to be significantly associated with LBP: age, support from leaders, psychological stress, poor psychosocial working environment, whole-body vibrations, heavy lifting, awkward working positions, working in depots or storehouses, and maneuver exposure. In a final multivariate model, after back-ward elimination, only age, support from leaders, psychological stress, exposure for awkward working positions, and working in depots or storehouses remained significantly associated with LBP.

Table 2. Demographic and Individual Confounders and Predeployment Covariates to Low Back Pain Stratified by Outcome[a]

Covariate	No LBP	LBP	P Value
Age group, y[b]			0.017
< 25	420 (79.6)	108 (20.4)	
25 - 29	268 (72.4)	102 (27.6)	
30 - 39	172 (69.9)	74 (30.1)	
> 39	100 (63.3)	58 (36.7)	
Military rank[b]			0.269
Private	400 (74.9)	134 (25.1)	
NCO/officer	184 (69.7)	80 (30.3)	
Cohabitation[b]			0.061
Married	400 (69.7)	174 (30.3)	
Single	540 (76.3)	168 (23.7)	
Total time deployed, y[b]			0.321
< 5	544 (75.1)	180 (24.9)	
5 ≤ 10	252 (73.6)	126 (26.4)	
10 ≤ 15	72 (65.5)	38 (34.5)	
15 ≤ 20	42 (87.5)	6 (12.5)	
Back pain in the past[b]			0.805
No	608 (74.3)	210 (25.7)	
Yes	334 (75.2)	110 (24.8)	
History of smoking[b]			0.570
Never smoked	356 (74.2)	124 (25.8)	
Ex-smoker	82 (68.3)	38 (31.7)	
Smoker	150 (70.6)	104 (29.4)	
Weight, kg[c]	82.5 ± 12.7	83.4 ± 11.8	0.420
Height, cm[c]	181.7 ± 7.4	180.5 ± 7.6	0.060
BMI, kg/m2[c]	25.0 ± 3.2	25.6 ± 3.1	0.030

[a]Abbreviations: OLR = ordinal logistic regression.
[b]Values are presented as No. (%).
[c]Values are presented as mean ± SD.

Table 3. Deployment-Related Covariates of Low Back Pain (LBP) Stratified by Outcome Including Administrative, Psychosocial and Physical Activity and Work-Associated Exposure Variables[a]

Covariate	No LBP	LBP	P Value
Duration of deployment, y[b]	10 ± 0.15	11 ± 0.15	0.100
Unit affiliation[c]			0.128
Infantry	464 (76.6)	142 (23.4)	
Engineer/CIS	84 (71.2)	34 (28.8)	
Logistics/medical	144 (75.8)	46 (24.2)	
Staff/administration	66 (60.0)	44 (40.0)	
Supply/maintenance	252 (75.0)	84 (25.0)	
Social support from colleagues[c]			0.798
Often/sometimes	796 (73.0)	294 (27.0)	
Rarely/never	144 (74.2)	50 (25.8)	
Colleagues willing to listen to your problems[c]			0.902
Often/sometimes	846 (73.3)	308 (26.7)	
Rarely/never	90 (72.6)	34 (27.4)	
Social support from leaders[c]			0.023
Often/sometimes	692 (75.9)	220 (24.1)	
Rarely/never	244 (67.0)	120 (33.0)	
Leaders willing to listen to your problems[c]			0.027
Often/sometimes	796 (75.2)	254 (24.8)	
Rarely/never	162 (65.3)	86 (34.7)	
Job satisfaction[c]			0.146
Very satisfied	250 (74.0)	88 (26.0)	
Satisfied	640 (74.3)	222 (25.7)	
Unsatisfied/very unsatisfied	48 (60.0)	32 (40.0)	
Exposure for psychological stress[c]			0.000

No	602 (79.2)	158 (20.8)	
Yes	334 (64.2)	186 (35.8)	
Exposure for poor psychosocial working environment[c]			0.005
No	828 (75.4)	270 (24.6)	
Yes	98 (60.5)	64 (39.5)	
Average length of sleep per night during the deployment, h[c]			0.090
6	336 (69.4)	148 (30.6)	
> 6	576 (75.6)	186 (24.4)	
Change of exercise habits during the deployment[c]			0.188
Same as before deployment	380 (74.2)	132 (25.8)	
Less exercise	210 (67.3)	102 (32.7)	
More exercise	324 (75.4)	106 (24.6)	
Hours spent on exercise per week during deployment, h[c]			0.346
1 - 2	322 (70.9)	132 (29.1)	
None	74 (74.0)	26 (26.0)	
3 - 4	214 (68.6)	98 (31.4)	
> 4	286 (76.9)	86 (23.1)	
Accidents because of sport during the deployment[c]			0.747
None	910 (74.0)	320 (26.0)	
1 accident	88 (75.9)	28 (24.1)	
> 1 accident	12 (85.7)	2 (14.3)	
Accidents because of work during the deployment[c]			0.493
None	888 (75.0)	296 (25.0)	
1 accident	90 (70.3)	38 (29.7)	
> 1 accident	32 (66.7)	16 (33.3)	
Accidents because of traffic during the deployment[c]			0.690
None	950 (74.1)	332 (25.9)	
1 accident	46 (74.2)	16 (25.8)	
> 1 accident	14 (87.5)	2 (12.5)	
Exposure for whole-body vibrations[c]			0.018
No	550 (77.0)	164 (23.0)	
Yes	396 (68.8)	180 (31.2)	
Exposure for heavy lifting[c]			0.090
No	568 (76.1)	188 (23.9)	
Yes	376 (70.2)	160 (29.8)	
Exposure for awkward working positions[c]			0.001
No	632 (77.8)	180 (22.2)	
Yes	312 (65.8)	162 (34.2)	
Exposure for driving tracked armored personnel carrier vehicles[c]			0.656
No	548 (72.7)	206 (27.3)	
Yes	198 (74.2)	138 (25.8)	
Exposure for driving wheeled armored personnel carrier vehicles[c]			0.007
No	136 (86.1)	22 (13.9)	
Yes	808 (71.9)	316 (28.1)	
Exposure for office work in staffs[c]			0.003
No	630 (77.0)	188 (23.0)	
Yes	296 (66.2)	150 (33.8)	
Exposure for working in depots or storehouses[c]			0.003
No	886 (74.0)	312 (26.0)	
Yes	26 (48.1)	28 (51.9)	
Exposure for repair/maintenance in garage [c]			0.531
No	628 (73.9)	222 (26.1)	
Yes	286 (71.5)	114 (28.5)	
Exposure for maneuver[c]			0.014
No	692 (75.7)	222 (24.3)	
Yes	220 (65.9)	114 (34.1)	

[a]Abbreviation: LBP, low back pain.
[b]Values are presented as median ± SD.
[c]Values are presented as No. (%).

Table 4. Univariate and Multivariate Ordinal Logistic Regression (OLR) Models With Low Back Pain as a Dependent Variable

Covariate[a]	Univariate Models Where Covariates Are Adjusted for Confounders		Multivariate Model With All Selected Covariates From the Univariate Analysis		Final Multivariate Model
	OR (CI)[b]	P Value	OR (CI)	P Value	OR (CI)
Age group, y[c]		0.033 [d]		0.164[d]	
< 25	1 (base)		1 (base)		1 (base)
25 - 29	1.40 (0.88 - 2.22)	0.156	1.19 (0.69 - 2.05)	0.529	1.33 (0.80 - 2.25)
30 - 39	1.72[e] (1.05-2.82)	0.032	1.30 (0.68 - 2.47)	0.425	1.56 (0.88 - 2.78)
> 39	2.11[e] (1.18 - 3.78)	0.011	1.87 (0.82 - 4.24)	0.135	2.36[e] (1.19 - 4.67)
Cohabitation					
Married	1 (base)		1 (base)		1 (base)
Single	0.73 (0.51 - 1.06)	0.097	1.03 (0.65 - 1.64)	0.879	1.03 (0.67 - 1.60)
Height	0.98 (0.96 - 1.00)	0.099	0.99 (0.96 - 1.01)	0.224	0.99 (0.96 - 1.01)
Duration of deployment	1.48 (0.45 - 4.85)	0.517	Not included	Not included	Not included
Unit affiliation		0.999[d]	Not included	Not Included	Not included
Infantry	1 (base)				
Engineer/CIS	1.14 (0.56 - 2.33)	0.710			
Logistics/medical	0.83 (0.46 - 1.51)	0.541			
Staff/administration	1.41 (0.68 - 2.91)	0.353			
Supply/maintenance	0.97 (0.59 - 1.60)	0.905			
BMI	1.04 (0.98 - 1.11)	0.147	1.04 (0.98 - 1.11)	0.213	1.04 (0.98 - 1.11)
Social support from leaders[c]					
Often/sometimes	1 (base)		1 (base)		1 (base)
Rarely/never	1.70[e] (1.12 - 2.57)	0.013	1.70 (0.87 - 3.33)	0.120	1.69[e] (1.09 - 2.63)
Leaders willing to listen to your problems					Not included
Often/sometimes	1 (base)		1 (base)		
Rarely/sever	1.84[e] (1.13 - 2.98)	0.014	0.97 (0.44 - 2.15)	0.935	
Job satisfaction		0.334[d]	Not included	Not included	Not included
Very satisfied	1 (base)				
Satisfied	1.09 (0.69 - 1.71)	0.711			
Unsatisfied/very unsatisfied	1.69 (0.72 - 3.94)	0.224			
Exposure for psychological stress[c]					
No	1 (base)		1 (base)		1 (base)
Yes	2.11[f] (1.44 - 3.10)	0.000	1.44 (0.90 - 2.31)	0.127	1.71[g] (1.14 - 2.56)
Exposure for poor psychosocial working environment					Not included
No	1 (base)		1 (base)		
Yes	2.08[g] (1.25 - 3.47)	0.005	1.15 (0.63 - 2.11)	0.648	
Average length of sleep Per night, h			Not included	Not included	Not included
6	1 (base)				
> 6	0.87 (0.59 - 1.30)	0.507			
Change of exercise habits		0.268[d]	Not included		Not included
Same as before deployment	1 (base)				
Less exercise	1.51 (0.94 - 2.42)	0.089			
More exercise	0.75 (0.47 - 1.19)	0.221			
Exposure for whole-body vibrations					Not included
No	1 (base)		1 (base)		
Yes	1.77[g] (1.20-2.61)	0.004	1.26 (0.76 - 2.09)	0.361	

Exposure for heavy lifting					Not included
Yes	1 (base)		1 (base)		
No	1.70[g] (1.15 - 2.52)	0.008	0.84 (0.51 – 1.41)	0.515	
Exposure for awkward working positions[c]					
No	1 (base)		1 (base)		1 (base)
Yes	2.42[f] (1.63 - 3.59)	0.000	1.97[g] (1.19 - 3.26)	0.008	1.98[g] (1.31 - 2.99)
Exposure for driving wheeled armored personnel carrier vehicles					Not included
No	1 (base)		1 (base)		
Yes	2.05 (0.94 – 4.48)	0.071	1.50 (0.59 – 3.83)	0.395	
Exposure for office work					Not included
No	1 (base)		1 (base)		
Yes	1.40 (0.90 – 2.19)	0.137	1.27 (0.77 – 2.07)	0.351	
Exposure for working in depots or storehouses [c]					
No	1 (base)		1 (base)		1 (base)
Yes	3.53[g] (1.48 - 8.41)	0.004	2.79[e] (1.02 - 7.61)	0.045	2.60[e] (1.04 - 6.53)
Exposure for maneuver					Not included
No	1 (base)		1 (base)		
Yes	1.60[e] (1.06 - 2.40)	0.025	1.13 (0.71 – 1.77)	0.611	

[a]Confounders: age group, cohabitation, height, BMI, and gap time.
[b]CI, confidence interval.
[c]Covariates that are significant in the final model are marked with bold types.
[d]P value for the variable as a whole (all categories).
[e]0.01 = P < 0.05.
[f]P < 0.001.
[g]0.001 = P < 0.01.

5. Discussion

One of the main findings of this study was that risk factors for LBP in a civilian occupational environment were also important in a military operational setting. However, it turned out that a history of LBP was not a risk factor for the condition. It should be stressed that this finding is contradicted by other researches including military and civilian cohorts (14, 15). The increased risk of maneuver and no maneuver injuries in a theater of maneuver did not seem to contribute essentially to the occurrence of LBP in this cohort, i.e. there were no associations with exposure to accidents during the deployment. Exposure to maneuver was associated with LBP in the initial screening of explanatory variables, but after the adjustment for other variables, the association disappeared. The pattern of operations of the Iranian maneuver group was characterized by mounted patrols and not so much strenuous duty involving dismounted maneuver activities, walking patrols, and load carriage. This could explain the stronger influence of no maneuver exposures on LBP. The main physical factors univariate associated with LBP in the study group were whole body vibrations, heavy lifting, awkward working positions, and working in depots or storehouses, with only the two latter variables remaining in the final multivariate model. The findings are in concordance with the findings of MacGregor et al. who demonstrated a higher risk of post-deployment LBP in service supply and maintenance military occupational specialties (MOS) than in infantry in a large cohort of US marines (6). Evidence of the LBP risk of working in an awkward posture was summarized in a systematic review, reporting conflicting evidence for an association with LBP (16). A more recent longitudinal study supported the hypothesis that exposure to awkward positions of the body during work or leisure time was a causal factor of LBP (17). In spite of MOS, soldiers often work with the body bent, twisted or in other awkward postures. It was found that those reporting doing that most and those working in depots had the highest risks of LBP. These findings indicate a role of ergonomics in prevention measures.

In a general population cohort, a positive association between age and LBP was established, but only in males (18). This corresponds well with the results of this study and the study by Roy et al. (8) where older age was found to be a risk factor. The majority of study participants in both studies were males. The psychosocial risk factors of LBP have been studied intensely in civilian cohorts. There are a variety of methodological issues making it difficult to compare results and conclusions from these studies, e.g. the definition of psychosocial variables, reliability, and reproducibility of measurements as well as the definition of outcome. Another study (19) found an effect of low job satisfaction and low workplace social support after reviewing 11 cohort and case-control studies. However, the authors noted that slight chances in the rating system they used could have resulted in a different conclusion. Sterud and Tynes (20) concluded that studies of better quality appeared to associate with low job satisfaction and job stress more consistently with the development of LBP. In this study, low job satisfaction was not a risk factor. A later review study assessing both level of evidence and strength of associations came to the conclusion that there was moderate evidence for no association between social support at work and LBP (9). In this study, there was no effect of social support from colleagues, but perceived lack of support by leaders increased the risk of LBP (adjusted OR = 1.69). In a very recent large prospective study, a low level of supportive leadership was not a significant predictor of LBP (21). The study cohort consisted of a general working population with many different civilian occupations. The results of this study indicated that military leaders could have a role in prevention of LBP. A moderate association between reporting of psychological stress during deployment and LBP was found (adjusted OR = 1.71). In many studies in civilian cohorts, there has been a strong association between self-reported stress and LBP, but in general, the evidence for a causal association has been deemed insufficient (9). In civilian studies, the association between LBP and contaminated drinking water has been documented very well, prolonged consumption of water with 4 ppm fluoride ion and above associated with LBP (22). In another study, drinking excessive black tea and green tea containing significant amounts of fluoride was recognized as a risk factor for LBP (23). Unfortunately, there have been no other military studies directly evaluating this issue. However, there is evidence indicating that mood and anxiety disorders and other psychiatric comorbidity increases the risk of spine pain in military populations (1).

The study group was a self-selected cohort that volunteered to participate in the health surveillance program and the response rate was low. This implied the risk of selection bias. To compensate for this, nonresponse weights were used in the statistical analyses (post-stratification). Because of the low response rate, the study did not try to estimate the incidence or prevalence of LBP in the study group, but with the pos-stratification adjustments, the analyses of associations were found to be valid. Recall bias was possible. The study design did not allow detailed assessment of all the activities of the deployed soldiers. As exposures were evaluated by analyzing the responses to selected questions, there may be risk factors that could have been overlooked. Examples were wearing body armor and weight of equipment worn, which have been identified as risk factors (8). If these factors had been registered and included in the statistical calculations, it would probably have influenced the results. Some limitations of using pain as an outcome must be mentioned. The lack of a standardized approach to measuring severity and frequency of LBP made it difficult to compare studies on the subject. Subjective measures as pain tend to be less reliable in distinguishing between categories such as cases and non-cases. The SNQ instrument is acknowledged as one of the best for evaluating musculoskeletal pain. By using SNQ in this study, it was possible to define cases explicitly and examine associations with risk factors, including psychosocial factors potentially affecting the perception of pain. Another issue pertinent to the case definition was the time of exposures. A participant reported one or more episodes of LBP in the past 12 months (recorded when filling in the questionnaire). Exposures, though, were only registered for the actual deployment time, implying the possibility that relevant exposures in the immediate pre- and post-deployment periods could be missed. To be deployed, the soldiers had to be medically fit and would not go to the theater with significant back pain, and the period after the end of deployment was characterized by vacation and light duties. Therefore, it was assumed that the influences of exposures before and after deployment were limited, but it cannot be ignored.

Risk factors known to be associated with LBP in a civilian occupational environment are also important factors associated with LBP in a military operational setting. In the studied cohort of Iranian soldiers, older age, lack of support from leaders, psychological stress, awkward working positions, and working in depots or storehouses were significantly associated with LBP after adjustment of all other variables. Maneuver and exposure to work, sport, or traffic accidents were not associated with LBP in this study, which was attributed to the characteristics of the actual deployment. Preventive measures should include pre-deployment preparation of leaders to cope with LBP and other musculoskeletal troubles among their subordinates and involve medical personnel, especially deployed physiotherapists, by giving advice to soldiers of different MOS on how to optimize ergonomics at work. Other measures to be considered are pre-habilitation, i.e. strength training, aiming to prevent injuries before the actual occurrence, and physiotherapist-guided, pre-deployment low back training, mimicking the demands of deployment in a given functional role.

Acknowledgments

We thank Dr. Alireza Khoshdel for helping us in publishing this paper.

Footnote

Authors' Contribution: Farzad Najafipour proposed the idea and supervised the research, Ahura Ahmadi did the statistical analyses, Milad Darejeh wrote the manuscript.

References

1. Cohen SP, Gallagher RM, Davis SA, Griffith SR, Carragee EJ. Spine-area pain in military personnel: a review of epidemiology, etiology, diagnosis, and treatment. *Spine J.* 2012;**12**(9):833–42. doi: 10.1016/j.spinee.2011.10.010. [PubMed: 22100208]
2. Nevin RL, Means GE. Pain and discomfort in deployed helicopter aviators wearing body armor. *Aviat Space Environ Med.* 2009;**80**(9):807–10. [PubMed: 19750878]
3. Roy TC. Diagnoses and mechanisms of musculoskeletal injuries in an infantry brigade combat team deployed to Afghanistan evaluated by the brigade physical therapist. *Mil Med.* 2011;**176**(8):903–8. [PubMed: 21882780]
4. White RL, Cohen SP. Return-to-duty rates among coalition forces treated in a forward-deployed pain treatment center: a prospective observational study. *Anesthesiology.* 2007;**107**(6):1003–8. doi: 10.1097/01.anes.0000290605.55736.e1. [PubMed: 18043069]
5. Cohen SP, Brown C, Kurihara C, Plunkett A, Nguyen C, Strassels SA. Diagnoses and factors associated with medical evacuation and return to duty for service members participating in Operation Iraqi Freedom or Operation Enduring Freedom: a prospective cohort study. *Lancet.* 2010;**375**(9711):301–9. doi: 10.1016/S0140-6736(09)61797-9. [PubMed: 20109957]
6. MacGregor AJ, Dougherty AL, Mayo JA, Rauh MJ, Galarneau MR. Occupational correlates of low back pain among U.S. Marines following combat deployment. *Mil Med.* 2012;**177**(7):845–9. [PubMed: 22808893]
7. Roy TC, Ritland BM, Knapik JJ, Sharp MA. Lifting tasks are associated with injuries during the early portion of a deployment to Afghanistan. *Mil Med.* 2012;**177**(6):716–22. [PubMed: 22730849]
8. Roy TC, Lopez HP, Piva SR. Loads worn by soldiers predict episodes of low back pain during deployment to Afghanistan. *Spine (Phila Pa 1976).* 2013;**38**(15):1310–7. doi: 10.1097/BRS.0b013e31829265c4. [PubMed: 23532119]
9. Hartvigsen J, Lings S, Leboeuf-Yde C, Bakketeig L. Psychosocial factors at work in relation to low back pain and consequences of low back pain; a systematic, critical review of prospective cohort studies. *Occup Environ Med.* 2004;**61**(1):e2. [PubMed: 14691283]
10. Ishoy T, Suadicani P, Guldager B, Appleyard M, Hein HO, Gyntelberg F. State of health after deployment in the Persian Gulf. The Danish Gulf War Study. *Dan Med Bull.* 1999;**46**(5):416–9. [PubMed: 10605620]
11. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon.* 1987;**18**(3):233–7. [PubMed: 15676628]
12. Bursac Z, Gauss CH, Williams DK, Hosmer DW. Purposeful selection of variables in logistic regression. *Source Code Biol Med.* 2008;**3**:17. doi: 10.1186/1751-0473-3-17. [PubMed: 19087314]
13. Janwantanakul P, Sitthipornvorakul E, Paksaichol A. Risk factors for the onset of nonspecific low back pain in office workers: a systematic review of prospective cohort studies. *J Manipulative Physiol Ther.* 2012;**35**(7):568–77. doi: 10.1016/j.jmpt.2012.07.008. [PubMed: 22926018]
14. Matsudaira K, Konishi H, Miyoshi K, Isomura T, Takeshita K, Hara N, et al. Potential risk factors for new onset of back pain disability in Japanese workers: findings from the Japan epidemiological research of occupation-related back pain study. *Spine (Phila Pa 1976).* 2012;**37**(15):1324–33. doi: 10.1097/BRS.0b013e3182498382. [PubMed: 22246538]
15. Roffey DM, Wai EK, Bishop P, Kwon BK, Dagenais S. Causal assessment of awkward occupational postures and low back pain: results of a systematic review. *Spine J.* 2010;**10**(1):89–99. doi: 10.1016/j.spinee.2009.09.003. [PubMed: 19910263]
16. van Oostrom SH, Verschuren M, de Vet HC, Boshuizen HC, Picavet HS. Longitudinal associations between physical load and chronic low back pain in the general population: the Doetinchem Cohort Study. *Spine (Phila Pa 1976).* 2012;**37**(9):788–96. doi: 10.1097/BRS.0b013e31823239d1. [PubMed: 21897339]
17. Kopec JA, Sayre EC, Esdaile JM. Predictors of back pain in a general population cohort. *Spine (Phila Pa 1976).* 2004;**29**(1):70–7. doi: 10.1097/01.BRS.0000103942.81227.7F. [PubMed: 14699279]
18. Hoogendoorn WE, Bongers PM, de Vet HC, Houtman IL, Ariens GA, van Mechelen W, et al. Psychosocial work characteristics and psychological strain in relation to low-back pain. *Scand J Work Environ Health.* 2001;**27**(4):258–67. [PubMed: 11560340]
19. Davis KG, Heaney CA. The relationship between psychosocial work characteristics and low back pain: underlying methodological issues. *Clin Biomech (Bristol, Avon).* 2000;**15**(6):389–406. [PubMed: 10771118]
20. Sterud T, Tynes T. Work-related psychosocial and mechanical risk factors for low back pain: a 3-year follow-up study of the general working population in Norway. *Occup Environ Med.* 2013;**70**(5):296–302. doi: 10.1136/oemed-2012-101116. [PubMed: 23322920]
21. Schierhout GH, Myers JE. Is self-reported pain an appropriate outcome measure in ergonomic-epidemiologic studies of work-related musculoskeletal disorders? *Am J Ind Med.* 1996;**30**(1):93–8. doi: 10.1002/(SICI)1097-0274(199607)30:1<93::AID-AJIM16>3.0.CO;2-3. [PubMed: 8837690]
22. Meklau Z, Haimanot RT, Shifera G, editors. Prevalence of low back pain in an agro-industrial community in the rift valley.; 2nd International Workshop on Fluorosis Prevention and Defluoridation of Water.; 1997; pp. 44–7.
23. Whyte MP, Totty WG, Lim VT, Whitford GM. Skeletal fluorosis from instant tea. *J Bone Miner Res.* 2008;**23**(5):759–69. doi: 10.1359/jbmr.080101. [PubMed: 18179362]