World Journal of Public Health
2025, Vol. 10, No. 4, pp. 441-448
https://doi.org/10.11648/j.wjph.20251004.11

Research Article

Epidemiology of Common Low Back Pain in Soldiers in Senegal

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Abstract

Introduction: Musculoskeletal disorders are indicative of the physically demanding nature of occupational environments and constitute a significant public health concern. This study aimed to assess the prevalence and determinants of low back pain among Senegalese military personnel deployed in operational settings. *Methodology:* A cross-sectional analytical study was conducted from April 7 to June 5, 2023, in the region of Kolda. Data collection was based on a modified version of the 2000 INRS questionnaire (National Institute of Research and Security). Statistical analysis was performed using R software, and all ethical considerations were strictly observed. *Results*: A total of 164 soldiers were enrolled in the study, all of whom were male. The mean age was 34.9 years, with an average length of military service of 13.9 years. Participants reported an average of 43.1 working hours per week. Prolonged sitting was reported in 62.8% of cases. Personnel involved in escort and intervention missions represented 29.3% of the sample. The overall prevalence of low back pain was 37.8%. Several variables were significantly associated with the occurrence of low back pain ($p < 0.05$), including average monthly income, duration of military service, military rank/status, participation in escort and intervention missions, occupational stress, and the use of combat gear such as Kevlar helmets, flak jackets, and firearms. *Conclusion:* Low back pain is highly prevalent among military personnel deployed in operational settings and is linked to a variety of factors inherent to military service. Effective prevention should include targeted awareness and training programs focusing on proper posture and ergonomic practices. Moreover, a comprehensive review of organizational structures and management strategies is warranted to mitigate occupational risk and preserve operational readiness.

Keywords

Lower Back Pain, Military, Risk Factors, Senegal

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Received: 20 August 2025; **Accepted:** 23 September 2025; **Published:** 25 September 2025

1. Introduction

Low back pain is defined as an "unpleasant sensation indicating potential or actual damage to a structure located in the lower back" [1]. It is referred to as "common" when its origin is degenerative or mechanical in nature and when no clinical signs point toward inflammatory, infectious, traumatic, or neoplastic etiologies [2]. As a complex and multifactorial condition, low back pain involves mechanical stress on the lumbar spine, psychosocial influences, genetic predispositions, and lifestyle-related factors [3]. It represents a major occupational health issue, often resulting in substantial socio-professional consequences, including absenteeism and increased healthcare costs [4]. In Senegal, a study conducted among employees of a transport company identified low back pain as the leading cause of work-related absenteeism, with a reported prevalence of 39% [5]. The military is not an exception to the rule, which means that it is prevalent among combat and support units operating under strenuous conditions. In this context, the present study was initiated in response to the frequent occurrence of low back pain among Senegalese military personnel deployed in operational zones and the limited body of research available on the subject. The primary objective was to determine the prevalence and associated risk factors of low back pain within this population. Ultimately, the goal was to better understand the interplay between the unique occupational demands of military service and the development of low back pain, in order to inform the implementation of targeted prevention, strategies aimed at safeguarding the health, performance, and operational readiness of the armed forces.

2. Methodology

The study was conducted within a military camp located in Kolda, a region in the southern part of Senegal, situated in an operational zone and drenched by an ongoing armed conflict involving separatist groups opposing the Senegalese Republican Armed Forces. This was a cross-sectional, descriptive, and analytical study carried out over a two-month period, from April 7 to June 5, 2023. The study population consisted of military personnel stationed at the aforementioned camp, representing various specialties. Inclusion criteria encompassed all personnel present at the time of the survey who consented to participate. Exclusion criteria included:

1) Personnel absent during the data collection period,
2) Personnel with fewer than eight months of military service,
3) Eligible personnel (≥8 months of service) who declined to participate.

Data were collected using a modified version of the 2000 INRS questionnaire. The instrument included the following components:

1) Sociodemographic and anthropometric data: age, sex, marital status, weight, height, educational level, and lifestyle habits. Body Mass Index (BMI) was calculated as weight (kg) divided by height squared (m^2). A BMI between [20-25] kg/m^2 was considered normal; [25-30] kg/m^2 indicated overweight; and values above 30 kg/m^2 indicated obesity.
2) Occupational characteristics: military rank/status, contract type, specialty, length of service in the current post and within the armed forces, job versatility, work schedule regularity, number of hours worked per week, shift type (day/night), participation in escort and intervention missions, average monthly income (in $ US currency), and use of combat equipment (Kevlar helmet, bulletproof vest, firearm, and ranger boots).
3) Clinical data: presence of lower back pain or discomfort during the previous 12 months.
4) Psychosocial factors: job satisfaction, occupational stress, family-related issues, insomnia within the past 12 months, and addictive behaviors.
5) Biomechanical factors and work experience: work pace, task repetitiveness, and movement precision.

Data were collected using the KoboCollect software and subsequently analyzed with Microsoft Excel 2016. For descriptive statistics, qualitative variables were summarized using frequency distributions and visualized through bar and pie charts. Quantitative variables were described using measures of central tendency (mean) and dispersion (standard deviation and range). For bivariate analysis, associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value less than 0.05 was considered indicative of statistical significance.

Prior to enrolment, informed and voluntary consent was obtained from all participants. The anonymity and confidentiality of individual responses were strictly maintained throughout the study. Ethical clearance was further ensured through formal authorization granted by the commander of the military zone in which the study was conducted.

3. Results

3.1. Descriptive Results

Table 1. *Socio-professional characteristics of military personnel.*

Specialities	Workforce	Percentages (%)
Marital status		
Married	114	69.5
Single	50	30.5
Level of study		
Medium and secondary	113	68.9

Specialities	Workforce	Percentages (%)
University	27	16.5
Elementary	20	12.2
Not enrolled	4	2.4
Army contract		
Open-ended contract	140	85.4
Fixed-term contract for legal duration	24	14.6
Status in the army		
Enlisted personnel	108	65.8
Non-commissioned officers	50	30.5
Officers	6	3.7
Regular practice of sport		
Yes	156	95.1
No	8	4.9
Type of operation		
Day	98	59.8
Alternating day and night	66	40.2
Quarter shift (sentry guard)		
Yes	31	18.9
No	133	81.1
Working hours		
Regular	116	70.7
Irregular	48	29.3
Versatility in work		
Yes	70	42.7
No	94	57.3
Escort and intervention missions		
Yes	48	29.3
No	116	70.7
Wearing combat gear		
Bullet-proof vest/kevlar helmet/weapon	81	49.4
Ranger shoes	147	89.6

Socio-professional Characteristics

A total of 164 military personnel participated in the study. The mean age was 34.9 years, with a range spanning from 21 to 59 years. The average duration of military service was 13.9 years (range: 8 months to 35 years), while the average length of service in the current position was 3.21 years (range: 1 month to 17 years). Participants reported an average of 43.1 working hours per week, with values ranging from 15 to 96 hours and a standard deviation of 14.3 hours. The average monthly income was $534.58, with individual earnings ranging from $100 to $2500.

The infantry was the most represented speciality (46.3%). Other military personnel included a communicator, a painter, a bricklayer, a deminer and an engineer (see table 2).

Table 2. *Breakdown of military personnel by speciality.*

Specialities	Workforce	Percentages (%)
Infantry	76	46.3
Health	19	11.6
Music	15	9.1
Transmission	14	8.5
Mechanical engineering	6	3.7
Housekeeping	5	3
Driver	4	2.4
Sports instructor	3	1.8
Kitchen	3	1.8
Electrician	4	2.4
Cavalry	3	1.8
Artificer	2	1.2
Secretariat	2	1.2
Arming	3	1.8
Other	5	3
Grand total	164	100

Anthropometric Characteristics

A normal Body Mass Index (BMI) was observed in 62.2% of participants. Overweight was identified in 27.4% of cases. Among those surveyed, 7.3% were classified as obese, 0.6% as having morbid obesity, and 2.4% as underweight.

Psychosocial Factors

Several psychosocial factors were reported among the military personnel, including family-related issues and the use of sleep-inducing medications (see Figure 1).

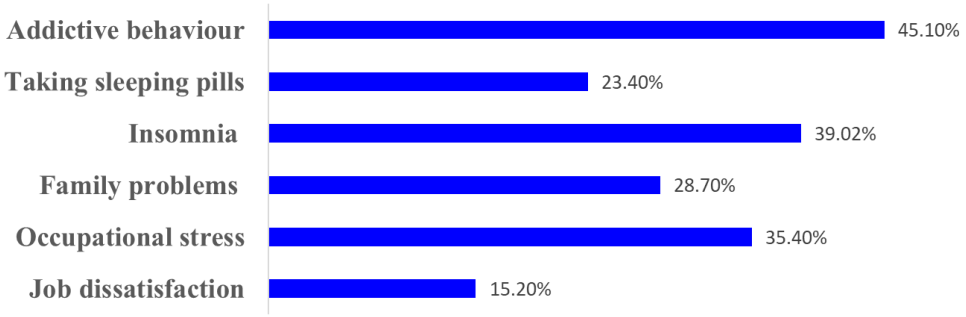

Figure 1. *Psychosocial factors identified among military personnel.*

The various addictive behaviours are listed in figure 2.

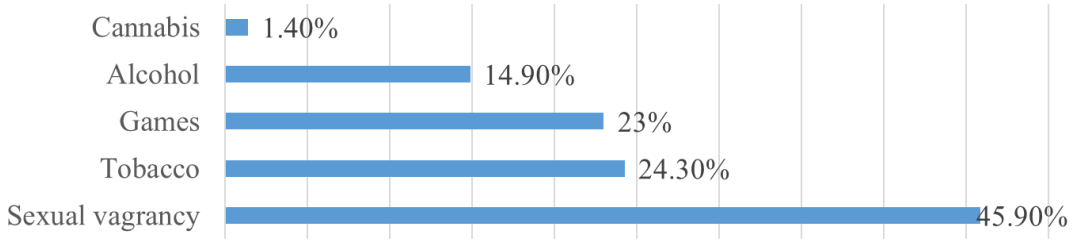

Figure 2. *Distribution of Military Personnel According to Addictive Behaviours.*

Use of Combat Gear

During the 4 to 12 months preceding the survey, military personnel routinely wore various types of combat equipment, with the following distribution:

1) 49.4% regularly wore bullet-proof vests in combination with Kevlar helmets;
2) 98.8% consistently carried weapons of war;
3) 89.6% wore military-issue ranger boots.

Work Experience and Biomechanical Factors

Military personnel reported exposure to prolonged sitting postures in 62.8% of cases. Movements during tasks were perceived as repetitive in 48.8%, and highly repetitive in 18.9% of participants, while 32.3% did not find the movements repetitive. The pace of work was reported as fast by 50% and very fast by 3% of participants, whereas 47% considered it to be slow.

High muscular effort was required in 32.3% of cases, with 2.4% reporting a very high level of exertion. Conversely, 65.2% described the physical effort required as low. Tasks required fine and precise movements in 53.7% of cases, and very precise actions in 18.3%. However, 28% of participants indicated that such precision was not necessary for their duties. Time constraints were reported as non-existent by 62.2% of respondents. They were described as tolerable by 34.8%, and as unbearable by 3% of participants.

Prevalence and Characteristics of Low Back Pain

The overall prevalence of low back pain among military personnel was 37.8%. Among those affected, 82% reported experiencing chronic low back pain (see figure 3).

During the study period, 44.8% of participants suffering from low back pain were receiving medical follow-up, with 53.8% of them being monitored by the unit's medical officer.

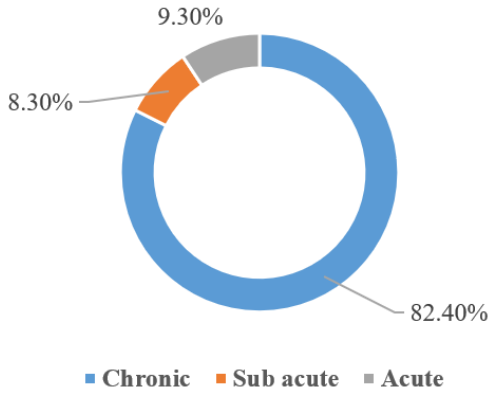

Figure 3. *Distribution of Low Back Pain Cases by Changes in Pain Intensity.*

3.2. Analytical Results

The analysis identified several factors significantly associated with the occurrence of low back pain among military personnel. These included monthly income, participation in escort missions, military rank/status, length of service in the army, use of bullet-proof vests, Kevlar helmets, and weapons, as well as occupational stress and insomnia (refer to Table 2).

Table 3. Association between low back pain and socio-professional characteristics.

Variables	Non low back pain sufferers		Low back pain		P Value
Average monthly income	*Percentages*	n	*Percentages*	n	
< $833.33	65.96%	93	34.04%	48	
$833.33 - $1666.66	40.00%	8	60.00%	12	0.035
> $1666.66	33.33%	1	66.67%	2	
Escort mission					
No	54.31%	63	45.69%	53	0.0012
Yes	81.25%	39	18.75%	9	
Status in the army					
Enlisted personnel	73.15%	79	26.85%	29	
Non-commissioned officers	42.00%	21	58.00%	29	0.0001
Officers	33.33%	2	66.67%	4	
Length of service in the army					
[0; 10]	79.30%	57	20.70%	14	
[10; 20]	61.3%	33	38.7%	20	0.0001194
[20; 30]	36.9%	7	63.1%	18	
[30; 40]	30.70%	5	69.30%	10	
Marital status					
single	80.00%	40	20.00%	10	0.001844
married	54.39%	62	45.61%	52	
Wearing bullet-proof waistcoats					
No	53.01%	44	46.99%	39	0.014
Yes	71.60%	58	28.40%	23	
Wearing a Kevlar helmet					
No	53.01%	44	46.99%	39	0.014
Yes	71.60%	58	28.40%	23	
Carrying weapons					
No	54.22%	45	45.78%	38	0.032
Yes	70.37%	57	29.63%	24	
Occupational stress					
No	69.81%	74	30.19%	32	0.0065
Yes	48.28%	28	51.72%	30	
Insomnia					
No	74.00%	74	26.00%	26	0.0001352
Yes	43.75%	28	56.25%	36	

4. Discussion

The primary limitations of this study were the absence of clinical and paraclinical evaluations, and the subjective nature of participants' responses. Some respondents were hesitant to provide certain information, questioning the true intent of the research despite receiving thorough briefings and reassurances regarding data confidentiality. Additionally, time constraints posed a significant challenge. Effective coordination with the military hierarchy was essential to allow participants to be excused from duty and attend the infirmary for data collection, which proved logistically demanding.

The average age of participants in our study was 34.9 years, reflecting the relative youth of the sample population. This is consistent with the operational demands of military missions in conflict zones, which requires deployment of younger, physically capable, and highly trained personnel. These findings align with the strategic preference for assigning younger soldiers to high-intensity operational areas. In comparison, a study conducted among hospital surgeons in Senegal reported a slightly higher mean age of 38.2 years [6], and a similar study by Awosan in Nigeria found an average age of 36.99 years [7].

All participants in our study were male, a finding that is also reported in Diédhiou's research on firefighters in south-eastern Senegal [8]. Although the integration of women into the Senegalese Armed Forces has progressed significantly, operational zones such as Kolda—marked by ongoing conflict with separatist groups from Casamance—pose considerable barriers to female deployment. Moreover, the living and working conditions in these remote and austere environments remain largely incompatible with the inclusion of women in field operations.

Despite the relatively young age of the study population, 69.5% of soldiers were married. This could be attributed to the strong sense of responsibility fostered within military culture, as well as the financial stability provided by military employment, which may encourage early family formation.

The military comprises a wide range of specialities, with infantry units being the most represented in this study due to the specific demands of the operational context. The average number of working hours per week was 43.1, ranging from 15 to 96 hours. As a 24/7 institution responsible for national defense and territorial integrity, the military operates on a continuous basis, often requiring personnel to maintain irregular schedules. In fact, 29.3% of respondents reported working up to 96 hours per week, and 40.2% worked alternating day and night shifts.

Moreover, 29.3% of military personnel were involved in escort and intervention missions, frequently carried out at irregular hours in response to operational demands. Finally, 81.1% of respondents did not reside with their families, largely due to the frequent redeployment and high mobility characteristic of combat units, both domestically and in international theatres.

Addictive behaviors were reported by 45.1% of military personnel, with half of those cases involving sexual vagrancy. This phenomenon may be partly explained by the socio-economic vulnerabilities of young women in the region, many of whom come from impoverished backgrounds. These individuals often form casual relationships with soldiers, who are perceived as figures of authority, security, and economic stability, making them particularly appealing partners. This dynamic contributes to a heightened prevalence of such behaviors within the military community.

Beyond sexual vagrancy, other forms of addictive behavior were also observed, including tobacco use, alcohol consumption, and online gambling (e.g., XBET). The elevated incidence of these behaviors is likely attributable to the psychological stress associated with deployment in conflict zones, where soldiers are regularly exposed to danger, uncertainty, and operational fatigue.

In terms of anthropometric data, 35.3% of the soldiers presented an abnormally high Body Mass Index (BMI). This finding is slightly lower than that reported by Fuentes, who identified 43% of soldiers with elevated BMI levels across four French military regiments [9]. Notably, nearly 95% of our study participants reported engaging in regular physical activity, with a frequency of at least two to three times per week. This apparent paradox—excess weight despite high physical activity—may be explained by specific dietary practices or by increased muscle mass resulting from rigorous training, especially among infantry units.

The prevalence of low back pain (LBP) among military personnel in our study was 37.8%, a rate consistent with that reported by Ledier (37.9%) [10]. However, higher prevalence rates have been documented in other professional sectors. For instance, Diatta observed a prevalence of 48.1% among health professionals in Senegal [11], while significantly higher rates were reported among public transport drivers in Benin (63.6%) by Gounongbé [12] and in Saudi Arabia (74.2%) by Bin Homaid [13]. The relatively lower prevalence of LBP in our sample may be attributed to the occupational versatility and regular physical activity practiced by military personnel.

Marital status appeared to be a significant determinant. The prevalence of LBP was notably higher among married soldiers (40%) compared to single soldiers (20%), a difference that was statistically significant ($p = 0.0018$). This may be linked to the additional family-related responsibilities and psychological strain associated with marital life, particularly in operational contexts marked by prolonged absences and family separation.

An analysis of rank revealed a positive correlation between hierarchical status and the prevalence of LBP. The condition was observed in 26.8% of enlisted personnel, 58% of non-commissioned officers, and 66.7% of officers, a statistically significant difference ($p = 0.0002$). Higher-ranking personnel tend to engage in more sedentary administrative tasks and are subject to increased psychological stress due to managerial responsibilities. Their duties often involve opera-

tional planning, coordination, and strategic decision-making—activities that are more cognitive in nature and less physically engaging.

The average length of service in our cohort was 13.9 years, substantially higher than the 5.5 years reported in a study involving French soldiers [9]. Our findings indicated a significant association between LBP and seniority in service ($p = 0.0001$). Furthermore, escort and intervention missions were also statistically associated with the occurrence of LBP ($p = 0.0012$), likely due to the combination of prolonged sitting in tactical vehicles, extended hours, and the routine use of heavy combat gear.

Additionally, monthly income was significantly associated with LBP ($p = 0.035$), with higher prevalence observed among personnel with greater income. This may be reflective of longer tenure, higher responsibilities, and elevated levels of occupational stress. Higher-ranked soldiers often face intense professional demands, where the consequences of operational errors are substantial, sometimes life-threatening, further compounding stress levels. In our study, 35.4% of participants reported occupational stress, which was significantly associated with LBP ($p = 0.0065$). The stress experienced by soldiers can be attributed to both the high-stakes operational environment and a command structure that limits subordinate input in decision-making. Military discipline mandates unquestioning compliance with orders, and any failure to perform may result in immediate disciplinary action.

The wearing of combat gear—excluding ranger shoes—was significantly associated with LBP. Specifically, this included the Kevlar helmet ($p = 0.014$), the 12-kg bulletproof vest ($p = 0.014$), and weapons weighing between 4 and 10 kg ($p = 0.032$). These items, while essential for operational safety, significantly increase the physical burden on soldiers and contribute to the development of musculoskeletal strain.

A considerable proportion (62.8%) of soldiers reported exposure to prolonged sitting, particularly among those in escort and intervention units (29.3%). Although this unit comprises physically fit and well-trained personnel, they spend extended periods seated in intervention vehicles, often traversing long distances. While the prevalence of LBP was higher among those exposed to prolonged sitting (40.78%) compared to those not exposed (32.79%), the difference was not statistically significant ($p > 0.05$).

Finally, a strong association was found between insomnia and LBP ($p = 0.0001$). The bidirectional relationship between psychosocial stressors and musculoskeletal disorders is well-established and has been described as a vicious cycle [14], whereby chronic stress exacerbates physical symptoms and vice versa.

5. Conclusion

Low back pain (LBP) is a prevalent and tangible health concern among soldiers deployed in operational environments. Its occurrence is closely associated with the inherent demands of military service, including physical strain, psychosocial stress, and the use of heavy protective equipment. The findings of this study highlight the critical need for comprehensive preventive strategies. These should include targeted education and training programs focused on ergonomics, emphasizing proper posture and safe movement techniques during operational tasks. Complementary measures such as the incorporation of recreational activities within military installations, the enforcement of regular leave, and the promotion of multi-skilling through task rotation are also essential to mitigate risk factors. Moreover, the periodic reassignment of personnel from escort and guard duties is recommended to prevent prolonged exposure to biomechanical stressors. Consideration should also be given to replacing standard-issue flak jackets and Kevlar helmets with lighter, ergonomically designed alternatives that are better adapted to field conditions. Finally, systematic screening for musculoskeletal disorders (MSDs), including low back pain, should be integrated into annual medical evaluations to ensure early detection and appropriate management. Such measures are imperative to preserve the operational effectiveness and long-term health of military personnel.

Abbreviations

LBP	Low Back Pain
MSDs	Musculoskeletal Disorders
BMI	Body Mass Index

Conflicts of Interest

The authors declare no conflicts of interest.

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