Comparative Risk Analysis of Low Back Pain among Professional Football, Ice Hockey, and Floorball Athletes

Magdaléna Hagovská, Alena Buková, Peter Takáč, Viliam Knap, Perla Ondová, Katarína Oravcová, Anna Kubincová

Background: Low back pain (LBP) is a common concern among professional athletes, potentially hindering performance and career longevity. However, comparative assessments of LBP prevalence and severity across various sports remain scarce. This study aimed to evaluate the factors associated with LBP in 388 professional athletes, including football, ice hockey, and floorball players.

Material/Methods: Conducted from June 2021 to September 2022, this cross-sectional study incorporated 388 athletes from national elite clubs, including football (n=148), ice hockey (n=179), and floorball (n=61). The Oswestry Disability Index (ODI), comprising sections like pain intensity, self-care, lifting, walking, sitting, standing, sleeping, sexual life, social life, and traveling, was employed to evaluate spinal pain and disability.

Results: The study found no significant disparities in the LBP assessment among the groups. The relative risk (OR) of LBP and disability varied among the sports: football players displayed a lower risk (OR=0.49; 95% CI 0.32-0.74, \(P \leq 0.001\)), while ice hockey players had a higher risk (OR=2.18; 95% CI 1.45-3.29, \(P \leq 0.001\)) compared to the others. In contrast, the risk for floorball players (OR=0.82; 95% CI 0.47-1.41) did not significantly deviate from that of the other two sports.

Conclusions: LBP prevalence stood at 42.6% for football players, 60.1% for ice hockey players, and 49.2% for floorball players. Among these, ice hockey players exhibited a 2.18-fold increased risk of developing LBP and associated disability when compared to their football and floorball counterparts.

Keywords: Prevalence • Acute Pain • Spine

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Background

Lower back pain (LBP) is of musculoskeletal origin in the area defined by the lowest rib within the upper border and the gluteal groove within the lower border, with the possibility of radiating pain to the thigh (without extending to the knee joint) [1]. Furthermore, the prevalence and risk factors of LBP in athletes are not sufficiently researched [2].

Some studies have shown that up to 18% to 23% of the world’s adults have LBP. Women have a higher prevalence of LBP than men, at rates of 19.8% and 15.9%, respectively. However, when stratified by sex and age, men show a higher prevalence (13.8%) among young adults aged 18 to 27 years than do women (12.5%) [3].

Our systematic review of the prevalence of LBP in athletes generated 4379 records. LBP in athletes was shown to have a point prevalence ranging from 10% to 67%, a 1-year prevalence ranging from 17% to 94%, and a lifetime prevalence ranging from 33% to 84%. The highest prevalence of LBP was found among skiers, floorball players, and rowers, while the lowest was found in shooters, golfers, and triathletes. As in the general population, LBP is quite prevalent among athletes [4].

The prevalence of lumbar pain in young athletes ranges from 5% to 66%. Compared with that of the general population, the pain is largely the same. In a recent study, back pain was reported in 12% of children and adolescents who participate in sports. The pain was greater in girls than in boys [5].

Pain in various segments of the spine is a common problem in athletes. Some sports pose a greater risk of pain than others. Measurement tools for pain assessment also differ. Lumbar spine pain occurs in 67% of gymnasts, 53% of football players, 89% of hockey players and divers, and 50% of tennis players. More specifically, it relates to a large load on the spinal segments and intervertebral discs. The prevalence of cervical spine pain in athletes is 21%, and it is most often seen in connection with disc herniation [2].

The 3 most common causes of back pain are mechanical, degenerative, and inflammatory. Mechanical pain is commonly due to injury to the spine, intervertebral discs, or soft tissues. Disc herniation is a common cause of mechanical back pain. Degenerative pain is caused by osteoarthritis of the spine, including facet joint osteoarthritis, sacroiliac joint osteoarthritis, spinal stenosis, and degenerative disc disease. Inflammatory pain is caused by inflammatory spondyloarthropathies. Sacroiliitis is also commonly seen.

Diagnosis of spinal pain consists of patient history and physical examination. The presence of red flags requires further investigation. Indeed, magnetic resonance imaging (MRI) can be necessary to evaluate soft tissue lesions, nerve root/cord compression from a bulging disc, malignancy, and inflammatory conditions of the spine and surrounding tissues.

The management of LBP is based on etiology, age, and chronicity of pain. For radicular LBP, nonpharmacologic interventions consist of specific exercise, traction, and mobilization of the spine. Nevertheless, there is relatively weak evidence to support such treatments. For non-radicular chronic LBP, there is moderate evidence to support physical therapy, the McKenzie method, and acupuncture [6].

Lumbar spine pain often occurs with sharp, jerky spinal movements or when the person jumps, from rotation in extension to rotation in flexion. Concerning athletes, Wilkerson [7] found that the cause of back pain is reduced activation of deep muscles. Jonasson et al [8] monitored the occurrence of joint and spine pain in 90 elite athletes (the sports monitored included wrestling, gymnastics, ice hockey, and fitness) and in a control group of 20 nonathletes. No significant differences were found in the prevalence of pain in the cervical part of the spine and large joints in the group of athletes and nonathletes. Similarly, Tunås [9] monitored the prevalence of lumbar spine pain in 277 professional football (soccer) players, 190 handball players, and 167 nonathletes. He discovered no significant differences in the prevalence of pain between professional athletes and nonathletes. Todd [10] investigated the prevalence of back and hip pain in young elite skiers, using the Oswestry Disability Index (ODI) and EuroQol to evaluate general health, activity level, and back and hip pain prevalence. Young elite skiers were also shown not to have increased lifetime prevalence of back pain compared with a non-athletic control group.

However, the methodological weaknesses of these studies does not allow a detailed comparison between different sports or with the general population. The issue of monitoring back pain in athletes thus requires further research [11]. Therefore, our study differs from its predecessors in that it monitors pain and disability in the most frequently performed types of collective sports with the simple and complex ODI. Football, hockey, and floorball are collective and similar at first glance, but they all differ due to several risk factors. Risk factors include flexed body posture, swinging rotational movement with hockey sticks, the hardness of the terrain, and cold weather. Currently, the literature is lacking in its comparisons of frequent types of collective sports regarding the occurrence of pain and disability in the lumbar region of the spine.

Consequently, in this study, we aimed to evaluate the prevalence, severity, and risk factors associated with LBP in 388 professional athletes, including football, ice hockey, and floorball players.
Material and Methods

This cross-sectional study was conducted from June 2021 to September 2022. Before being included in the study, all enrolled participants signed informed consent forms and were informed about the study’s aims. The research was approved by the Institutional Ethics Committee of the Pavol Jozef Šafárik University, Slovakia (17/02/2020).

The inclusion criteria were men aged 18 to 35 years old, included in the first- or second-highest league in team sports, with a training duration of 90 min or more 4 times per week and training experience of 4 years or more.

The exclusion criteria were irregular participation in training fewer than 4 times a week, surgical treatment of the spine, not answering all questions, refusing to participate in the study, and a current interruption in the sport career lasting more than 2 months.

Sample Size

Currently, the literature has shown that back pain in athletes reaches a prevalence of 30% to 80% [8,9]. The average prevalence of such problems is 50%. We therefore performed a power analysis according to Daniel [12], while the sample size was determined according to the average prevalence of 50%. The minimum sample size was calculated using the following equation: 

\[ n = \frac{Z^2(1-P)P}{d^2} \]

\( Z = 1.96 \) for the 95% confidence level; \( P = 0.5 \) for the expected sample of 50%, and \( d = 0.05 \) for a 5% margin of error. According to this calculation, a minimum of 384 athletes in team sports was needed. We expected a 20% loss, so we included 469 potential participants.

Data Collection

Among collective sports, all clubs at the national level were approached. We focused on athletes playing in the 2 highest leagues. We also chose the 3 most popular sports in the extra league and the first league: football, floorball, and ice hockey. The number of registered athletes in football, hockey, and floorball at the required level was 1875. From this calculation, the minimum sample size was calculated using the following equation: 

\[ n = \frac{Z^2(1-P)P}{d^2} \]

\( Z = 1.96 \) for the 95% confidence level; \( P = 0.5 \) for the expected sample of 50%, and \( d = 0.05 \) for a 5% margin of error. According to this calculation, a minimum of 388 athletes in team sports was needed. We expected a 20% loss, so we included 469 potential participants.

Randomized (I:4) n=469

Included sportman n=388

Excluded sportman n=81

Currently interrupted sporting career n=13

Refuse to participated n=36

Insufficiency completed questionnaires n=32

Figure 1. Enrolment flow diagram.

Oswestry Disability Index

The ODI was used to assess pain and disability of the spine and contains 10 sections: 1: pain intensity, 2: self-care, 3: lifting, 4: walking, 5: sitting, 6: standing, 7: sleep, 8: sexual life, 9: social life, and 10: travel. The degree of disability ranges from a score of 0 to 5, with higher numbers characterizing higher disability [13,15]. During the evaluation, the numbers from all sections were added together. We divided the sum by 50 (the maximum possible value obtained from the sections) and multiplied the result obtained by 100. The result represents the level of difficulty on a scale from 0% to 100%. Rating (maximum possible total sum from sections): 50×100=0% ODI=index.

Interpretation: 0% to 20%=minimal pain and disability, 21% to 40%=moderate disability, 41% to 60%=severe disability, 61% to 80%=very severe disability, and 80% to 100%=bedridden.

ODI+ means an ODI index value greater than 0.

Statistical Processing

Descriptive and analytical statistics were used, and data are presented as means and standard deviations. Data normality was verified by the Shapiro-Wilk test in SPSS. Additionally, data were normally distributed; \( P \) values were obtained through an ANOVA analysis; and Bonferroni correction for post hoc was also used, with a significance level of \( P < 0.05 \) (ANOVA was used in Tables 1, 2).

Percentages were evaluated to assess the occurrence and prevalence of pain and disability in the observed group. Logistic regression analysis was used to determine the estimate of risk...
The independent variables were the 3 types of sports – football, hockey, and floorball – that have an impact on spinal pain and disability. The dependent variables were the results of the ODI and individual sections. Calculations were performed in IBM SPSS Statistics for Macintosh (Version 28, IBM Corp., Armonk, NY, USA).

Table 1. Demographics: Mean values and statistical comparison of total sample and of football, ice hockey, floorball players.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total Sample (x±SD)</th>
<th>Football N=148 (x±SD)</th>
<th>Ice Hockey N=179 (x±SD)</th>
<th>Floorball N=61 (x±SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>27.26±4.69</td>
<td>26.87±5.58</td>
<td>28.24±3.85</td>
<td>25.31±3.83</td>
<td>0.07</td>
</tr>
<tr>
<td>Weight</td>
<td>81.04±9.44</td>
<td>77.88±7.81</td>
<td>84.88±8.99</td>
<td>77.46±7.81</td>
<td>0.08</td>
</tr>
<tr>
<td>Height</td>
<td>181.27±6.93</td>
<td>181.35±7.57</td>
<td>181.59±6.48</td>
<td>180.16±6.57</td>
<td>0.44</td>
</tr>
<tr>
<td>BMI – body mass index</td>
<td>24.66±2.45</td>
<td>23.73±2.29</td>
<td>25.72±2.18</td>
<td>23.80±2.32</td>
<td>0.51</td>
</tr>
<tr>
<td>Years of doing sports</td>
<td>17.01±6.04</td>
<td>17.23±5.62</td>
<td>17.00±6.10</td>
<td>16.81±4.57</td>
<td>0.88</td>
</tr>
<tr>
<td>Days of doing sports</td>
<td>4.12±1.42</td>
<td>4.23±2.39</td>
<td>4.02±1.22</td>
<td>4.11±0.66</td>
<td>0.90</td>
</tr>
<tr>
<td>Minutes of doing sports</td>
<td>96.79±11.01</td>
<td>97.84±10.87</td>
<td>95.70±11.31</td>
<td>96.83±10.86</td>
<td>0.09</td>
</tr>
<tr>
<td>ODI index</td>
<td>4.37±6.13</td>
<td>3.59±5.84</td>
<td>5.31±6.62</td>
<td>3.48±4.91</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 2. Mean values and statistical comparison of ODI index and ODI sections of football, ice hockey, and floorball players.

<table>
<thead>
<tr>
<th>ODI index</th>
<th>Football N=148 (x±SD)</th>
<th>Ice Hockey N=179 (x±SD)</th>
<th>Floorball N=61 (x±SD)</th>
<th>P</th>
<th>P</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>0.46±0.91</td>
<td>0.54±0.68</td>
<td>0.48±0.74</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Self-care</td>
<td>0.18±0.70</td>
<td>0.05±0.26</td>
<td>0.03±0.18</td>
<td>0.03</td>
<td>0.03</td>
<td>0.11</td>
</tr>
<tr>
<td>Lifting</td>
<td>0.45±0.92</td>
<td>0.48±0.72</td>
<td>0.33±0.50</td>
<td>0.88</td>
<td>0.56</td>
<td>0.88</td>
</tr>
<tr>
<td>Walking</td>
<td>0.02±0.14</td>
<td>0.08±0.27</td>
<td>0.00±0.00</td>
<td>0.02</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Sitting</td>
<td>0.23±0.72</td>
<td>0.34±0.69</td>
<td>0.26±0.60</td>
<td>1.00</td>
<td>0.44</td>
<td>0.44</td>
</tr>
<tr>
<td>Standing</td>
<td>0.16±0.54</td>
<td>0.49±0.69</td>
<td>0.18±0.50</td>
<td>0.02</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Sleep</td>
<td>0.11±0.46</td>
<td>0.34±0.50</td>
<td>0.18±0.38</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Sex</td>
<td>0.01±0.11</td>
<td>0.03±0.16</td>
<td>0.05±0.21</td>
<td>0.08</td>
<td>0.42</td>
<td>0.08</td>
</tr>
<tr>
<td>Social life</td>
<td>0.03±0.16</td>
<td>0.16±0.37</td>
<td>0.05±0.28</td>
<td>0.01</td>
<td>0.45</td>
<td>0.01</td>
</tr>
<tr>
<td>Traveling</td>
<td>0.15±0.63</td>
<td>0.15±0.43</td>
<td>0.18±0.50</td>
<td>0.86</td>
<td>0.61</td>
<td>0.35</td>
</tr>
<tr>
<td>ODI index</td>
<td>3.59±5.84</td>
<td>3.51±6.62</td>
<td>3.48±4.91</td>
<td>0.12</td>
<td>0.52</td>
<td>0.07</td>
</tr>
</tbody>
</table>

(1 – football; 2 – ice hockey; 3 – floorball; P values: ANOVA – Bonferroni correction for post hoc; x – mean; SD – standard deviation; P(1-2) football/ice hockey; P(1-3) football/floorball; P(2-3) ice hockey/floorball; ODI – Oswestry Disability Index.)

(odds ratio [OR]) with a 95% CI (logistic regression analysis was used in Table 3).

Results

Demographic Characteristics

In our study, we had young athletes with an average age of 27 years. They were engaged in 3 kinds of sports: football, ice hockey, and floorball. The groups were homogeneous in regard to age, weight, height, and body mass index. There were also no significant differences between the groups in the evaluation of years of practicing sports, days per week, or minutes per
Comparison of the ODI in Individual Sections

In the intensity of pain, lifting, traveling, sitting, and sexual life sections, there were no significant differences between the groups.

In the self-care section, significant differences were found, with greater pain in the group of football players. In this section, there were no differences between ice hockey players or football players.

In the walking section, significant differences were found between all groups. Ice hockey players had the greatest pain, while football players had no pain.

In the standing section, significant differences were found between all groups, while the greatest pain was recorded in hockey players. By contrast, football players and floorball players had significantly less pain.

In the sleeping section, significant differences were found between all groups.

In the social life section, significant differences were found; the greatest pain was noted in ice hockey players. Football players and floorball players had significantly less pain (Table 2).

Risk of Back Pain

Football players had an OR of 0.49, which means a 0.49-times lower risk of developing LBP than ice hockey and floorball players. However, football players still had a prevalence of pain of 42.6%.

Additionally, ice hockey players had an OR of 2.18, giving them a 2.18-times higher risk of developing LBP than football and floorball players. Their prevalence of pain was 63.7%.

Floorball players had an OR of 0.82, which means that they did not have an increased or decreased risk of LBP in comparison with football and ice hockey players. Their prevalence of pain was 49.2% (Table 3).

Discussion

This study aimed to evaluate the prevalence, severity, and risk factors associated with LBP in 388 professional athletes, including football, ice hockey, and floorball players.

There were no significant differences among the groups in the assessment of LBP in the overall ODI score. In the intensity of pain, lifting, traveling, sitting, and sexual life sections, there were no significant differences among the groups. We believe that this is due to the similar intensity of training in the respective sports.

We found significant differences in the walking, standing, sleeping, and social life sections among all groups, with ice hockey players having the greatest pain. We believe that this is due to the action of several risk factors during the sport, for example, heavy equipment, cold temperatures, flexion and rotation of the trunk when holding the hockey stick, and jerking the trunk from rotation to flexion when moving with the hockey stick.

Regarding the estimated relative risk of back pain development, football players had a 0.49-times lower risk of LBP development than ice hockey and floorball players. The prevalence of pain in football players was 42.6%. Ice hockey players had a 2.18-times greater risk of developing LBP than football and floorball players. The prevalence of pain in ice hockey players was 63.7%. Floorball players did not have an increased or decreased risk of developing LBP compared with football and ice hockey players, with a prevalence of pain of 49.2%. Therefore, we would recommend that hockey players...
wear thermal clothing and practice counter-movements, ie, extension exercises, before every training session.

All of the aforementioned sports are collective and similar at first glance, but they all differ due to several risk factors. A flexed posture during hockey, extension and rotation with subsequent flexion and rotation of the spine during movement with a hockey stick, and cold temperatures can contribute to the occurrence of more frequent lumbar spine pain in hockey players. Indeed, football players do not flex their bodies while playing sports; they train on soft terrain without the influence of cold. However, floorball players have a flexed posture while playing the sport, and they train on hard terrain.

Ice hockey players are therefore affected by more risk factors than are football and floorball players, which explains their increased risk of back pain.

Several authors have addressed the prevalence of LBP. Tunås et al [9] compared the prevalence of LBP between elite football players (n=277) and handball players (n=190) and a control group from the general population (n=167) in a cross-sectional study. The Nordic Questionnaire for Musculoskeletal Symptoms was used to assess the prevalence of LBP. They found that 57% of football players, 59% of handball players (women), and 60% of people in the control group had experienced LBP in the previous year. There were no significant differences in the prevalence of LBP for the previous year and week among groups. In the present study, ice hockey players had the highest percentage of LBP (63.7%), and football players the lowest (42.6%). However, we used the ODI, so our results are slightly different from the previous study.

Bahr et al [14] monitored the prevalence of LBP during the previous 12 months in several athletes and control participants. He used a self-reported questionnaire on LBP adapted for sports, based on standardized Nordic questionnaires for musculoskeletal symptoms. Athletes reported more LBP during periods in which the training and competition loads were higher. LBP therefore appears to be somewhat more common in endurance sports that specifically stress the lower back during training and competitions. The prevalence of LBP in the aforementioned study was similar to our own, despite their use of a different questionnaire.

Trompeter et al [2] summarized the prevalence of pain in the cervical, thoracic, and lumbar regions of the spine in athletes for different time periods. The prevalence of pain depended on the type of sport discipline, although some sport disciplines are not well researched. It is therefore important to evaluate the frequency, duration, and intensity of pain [20-22].

Few studies have examined a large group of elite athletes from a variety of sport disciplines. Muller et al [21] reported an average prevalence of back pain of 8% in a large group of young elite athletes (n=2116; mean age: 13.3 years), whereas Schulz et al [23] reported an average prevalence of back pain of 55% in older elite athletes (n=929; mean age: 21.4 years).

Fett et al [19] identified the prevalence of back pain in German elite athletes, in addition to examining the influence of age, sex, sports discipline, and training volume, they compared elite athletes with a physically active control group. The authors used a standardized and validated online back pain questionnaire that was sent by the German Olympic Sports Confederation to approximately 4000 German national and international elite athletes, as well as a control group of 253 physically active but non-elite sports students. In elite athletes, the lifetime prevalence of back pain was 88.5%, the 12-month prevalence was 81.1%, the 3-month prevalence was 68.3%, and the point prevalence was 49.0%, compared with 80.7%, 69.9%, and 59.0% in the control group, respectively. A high training volume in elite athletes and a low training volume in physically active individuals might thus increase prevalence rates.

In our study, the prevalence of pain was 42.6% in football players, 63.7% in ice hockey players, and 49.2% in floorball players. This corresponds to the prevalence point from previous studies.

Moradi [20] used a systematic review to explore the available evidence of athletes’ LBP risk factors. Seven longitudinal studies were included, 4 of which had high methodological quality. Results showed that previous LBP, decreased lumbar flexion, and decreased lumbar extension are positively associated with LBP. There was moderate evidence for hip flexor tightness and high body weight as a risk factor. They found insufficient evidence for an association between forward bending, previous injury, amount of training per week, active years, age, and sex with LBP.

Back pain can be caused by training for extended periods of time, high training volume, and training with immense weight. Risk factors also include intermittent or continuous hyperflexion and rotation of the lumbar spine region.

Regarding localization, LBP is the most common ailment of all sports and in the general population. Pain can be localized but it can also radiate. If there is no pressure on the nerve roots, the pain can radiate to the hip joints, sacroiliac joint capsule, coccyx, or knees. If nerve root pressure is present, pain can radiate below the knee and be localized in the dermatoome; sensory symptoms can also be present [20-24].

Pain in the back and the musculoskeletal system as a whole cannot be completely prevented. The most common cause of pain is stretching of the muscles and protrusion of the intervertebral disc. Lower back muscle strain is often the cause of back pain. It often occurs in hockey players as a result of...
flexion and rotation while playing the sport, which leads to the abnormal stretching or tearing of muscle fibers, causing pain and limiting mobility. Excessive flexion and rotation can also cause protrusion of the intervertebral disc. The prevention of these conditions consists of extension exercises after consultation with a physiotherapist, observing correct ergonomics and regular stretching [16-18].

Further research should investigate specific back pain prevention programs, especially in high-risk sports. Further research should also explore the differences in pain management techniques used by athletes in different sports, or assess the impact of specific preventive programs. Indeed, it would be appropriate to use and compare other tests for pain in the lumbar region of the spine.

**Limitations of the Study**

This study had some limitations. A questionnaire method was used to determine spinal pain and disability, no test batteries were used to assess the stabilizing function of the spine, and pain was not determined according to the prevailing directional preference of individual types of movements. The prevalence of LBP was evaluated during the past year, neglecting to evaluate the prevalence in the past month or week. We also did not evaluate pain intensity separately. We decided to use the ODI; however, compared with other tests, such as the Roland Morris Questionnaire, the ODI is comprehensive in its evaluation.

**Conclusions**

According to the ODI, the prevalence of LBP was 42.6% in football players, 60.1% in ice hockey players, and 49.2% in floorball players. Ice hockey players also had a 2.18-times greater risk of developing LBP and disability compared with football and floorball players.

Therefore, it would be appropriate to implement back pain prevention programs into daily training routines for elite sports categories, where a high incidence of back pain has been found. Doctors, physiotherapists, and coaches should develop new effective and progressive specific preventive programs for athletes. Intervventional movement programs against back pain should also be part of elite athletes’ daily training.

Back pain has a negative impact on the performance and careers of athletes, but also on their personal life. Accordingly, it is necessary to pay sufficient attention to this issue.

**Acknowledgments**

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**Department and Institution Where Work Was Done**

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**Declaration of Figures’ Authenticity**

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**References:**