

The influence of competitive shooting on lower back pain: An empirical study

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Abstract

Background: In recent years, the attention of researchers has focused on myofascial pain and the contribution of fascial dysfunctions to lumbosacral troubles, in particular, their role in reoccurring low back pain (LBP). LBP disrupts proprioceptive abilities of the lower spine; it would be expected that competitive shooters experiencing LBP are less precise than fellow athletes who do not experience this ailment.

Aims: The main purpose of this study was to assess LBP prevalence and intensity among Polish competitive shooters using the revised Oswestry Disability Index (ODI). Additionally, the prevalence and types of aches and pains were assessed, as well as shooters' preferences regarding firearm types and training frequencies.

Material and methods: Group of 93 active competitive shooters (4 women, 89 men), affiliated with a shooting club completed the anonymous online questionnaire. The mean age of the group was 40.4 ± 10.1 (min. 19, max. 76 years). The obtained results were analyzed using Statistica 13.3 program with statistical tests: Shapiro-Wilk test and Mann-Whitney U test.

Results: Our study revealed that LBP has a 29% prevalence among competitive shooters (mean ODI score was 9.63 ± 7.07 points), and the average frequency of dry-fire training was higher (once a month) among shooters experiencing LBP when compared to shooters with no back pain (a few times a year).

Conclusion: LBP prevalence among Polish competitive shooters does not differ from LBP prevalence in the general population and is similar in other countries. Competitive shooting contributes to aches and pains in body parts exposed to firearm recoil.

Key words

LBP, ODI, recoil, online questionnaire, competitive shooting.

Introduction

Lower back pain (LBP) is an issue that has been widely reported in the scientific literature, particularly in medical and sociological literature. In recent years, researchers have focused on myofascial pain and the contribution of fascial dysfunctions to lumbosacral troubles, particularly their role in reoccurring LBP [1, 2]. In addition, the prevalence of 'sacral pain' in many socio-occupational groups has been described, and risk factors and possible causes have been identified [3–5]. However, one group appears to have been overlooked in Polish publications. This group is competitive shooters who are affiliated with shooting clubs and hold a Competitor's License from the Polish Shooting Sports Association (pol. Polski Związek Strzelectwa Sportowego, PZSS). The maintenance of which requires participation in at least: 4 competitions in a selected "leading" shooting discipline, two competitions in a second shooting discipline, and further two competitions in a third shooting discipline during the calendar year.

Firearms, including sports firearms, generate recoil when fired, a force vector with a direction identical to the bullet's path ejected from the barrel but with the opposite direction and directed towards the shooter. A study conducted by the US Army demonstrated that firing a long gun after 15 shots caused pain and bruising of the area known as the shoulder pocket and a reduction in shoulder joint abduction of approximately 5°. In addition, magnetic resonance imaging (MRI) revealed muscle edema (mainly the anterior part of the supraspinatus muscle, the proximal part of the biceps brachii muscle, and the pectoralis major muscle) and subcutaneous edema of the shoulder pocket region [6]. The following study investigated the impact of recoil on the musculoskeletal ailments of competitive shooters.

Individuals with discopathy and its associated pain tend to score lower on body balance tests and have reduced hip mobility (particularly on the more painful side). Postural stability is par-

ticularly important in competitive shooting as it directly affects shooting accuracy - untrained shooters with better initial balance parameters achieve greater long barrel gun stability and better results on target [7]. Knowing that LBP disrupts proprioceptive abilities of the lower spine, it would be expected that competitive shooters experiencing LBP are less precise than fellow athletes who do not experience this ailment.

Aims

The main aim of this study was to investigate the prevalence of LBP and its severity using the standardized Oswestry Disability Index (ODI) Questionnaire among active competitive shooters. The first additional objective was to determine the frequency and type of musculoskeletal ailments in the same study group using the original questionnaire and to indirectly determine whether competitive shooting fosters the occurrence of these ailments. The second additional objective was to estimate the preferences of Polish competitive shooters in terms of the type of firearms used and the frequency of shooting training. The collected data can provide a starting point for the rehabilitation planning of individuals involved in competitive shooting and help answer the question of whether competitive shooting can be a safe form of physical activity recommended to patients suffering from LBP.

Material and methods

Research materials

The research was conducted between February and March 2021 with the help of the shooting club. The study group consisted of 93 individuals: 4 women (4.3%) and 89 men (95.7%) from the club-affiliated competitive shooting community. The mean age of the subjects was 40.4 ± 10.1 years (min. 19, max. 76 years). The distribution of subjects' ages is non-normal (Shapiro-Wilk test,

$p=0.037$). The survey covered competitive shooters holding a PZSS Competitor's License, the maintenance of which requires active participation in shooting competitions approved by PZSS. In practice, this means that each participant actively practices competitive shooting in at least one of the three basic disciplines (pistol, rifle, smoothbore shotgun) at a frequency not less than that required to maintain a license.

Research methodology

The study was approved by the Bioethics Committee of the Medical University of Białystok, Poland (no.: APK.002.91.2021). Participants were provided with a hyperlink to the online questionnaire (Google Forms) form via email and an online discussion forum. Information about the purpose, subject, and anonymity of the survey was included in the questionnaire instructions, and at no stage of the survey was collected data allowing the subject to be identified. The form used in the study consisted of: (1) an introduction providing instructions for filling in the questionnaire and informing about the purpose of the survey, voluntary participation, and anonymity, (2) a self-administered personal questionnaire with items related to competitive shooting habits and preferences, (3) an original musculoskeletal ailment questionnaire, (4) Polish version of the standardized ODI Questionnaire. Ninety-three people responded to the questionnaire out of approximately 480 who received a hyperlink, giving a 19.4% completion rate. Statistica version 13.3 under an academic license was used to analyze the collected data statistically. Statistical tests used were Shapiro-Wilk and Mann-Whitney U tests.

Results

None of the 93 subjects reported problems with the temporomandibular joints, sternum, left pectoralis muscle and its area, left ribs, left forearm, abdominal muscles, hip joints, gluteal muscles, femurs, lower limbs, and feet. Out of 93 participants, 66 participants (71%) did not experience

LBP, with the remaining participants (27 participants) scoring an average of 9.63 on the ODI, which translates into a score of approximately 19.26%, that is, a minimal level of disability due to LBP [8, 9]. Also, 75 participants (81%) declared that they had never suffered any injury or strain due to using a firearm. Out of the remaining subjects: 6 individuals suffered a contusion in the area of the so-called "shoulder pocket" as a result of shooting with a long firearm (two subjects specified the type of firearm as a smoothbore rifle, two others as a Mosin rifle), two individuals suffered tennis elbow as a result of excessive training in shooting with a pistol, one individual complained about pain in the thoracic spine and three individuals did not specify what kind of strain/injury they suffered.

Out of 93 participants, 51 (54.8 %) declared that they never felt pain during or after shooting practice or competitions. For the rest, the vast majority felt pain occasionally (38 people, 41%), while three people (3.2%) felt pain frequently, and one (1.1%) felt pain every time. These findings suggest the need for further research focused on the causes of pain during shooting training and competition. **Figure 1** presents the map of ailments of sports shooters according to the author's questionnaire and ODI questionnaire. **Figure 2** shows the results of the ODI questionnaire in the group experiencing LBP.

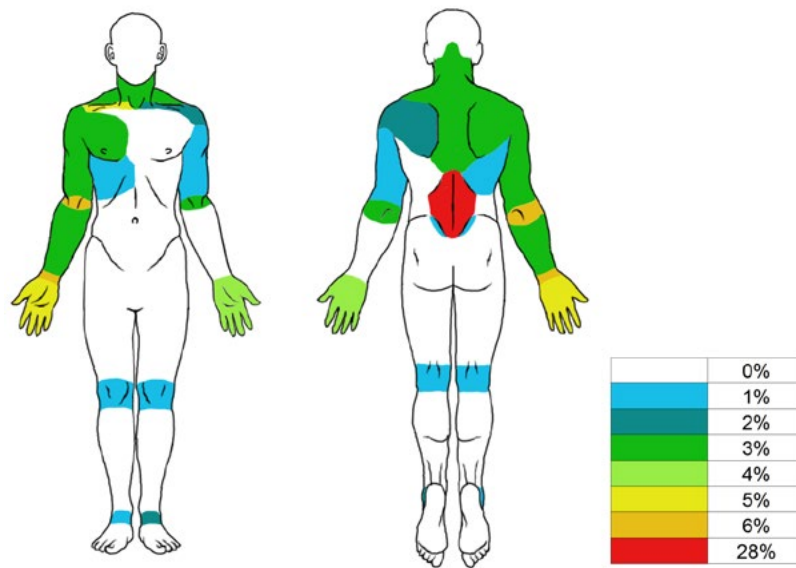


Figure 1. Map of ailments of sport shooters according to the author's questionnaire and ODI questionnaire.

Notes: Colors indicate ailment distribution of a particular region in study participants – LBP highlighted in red.

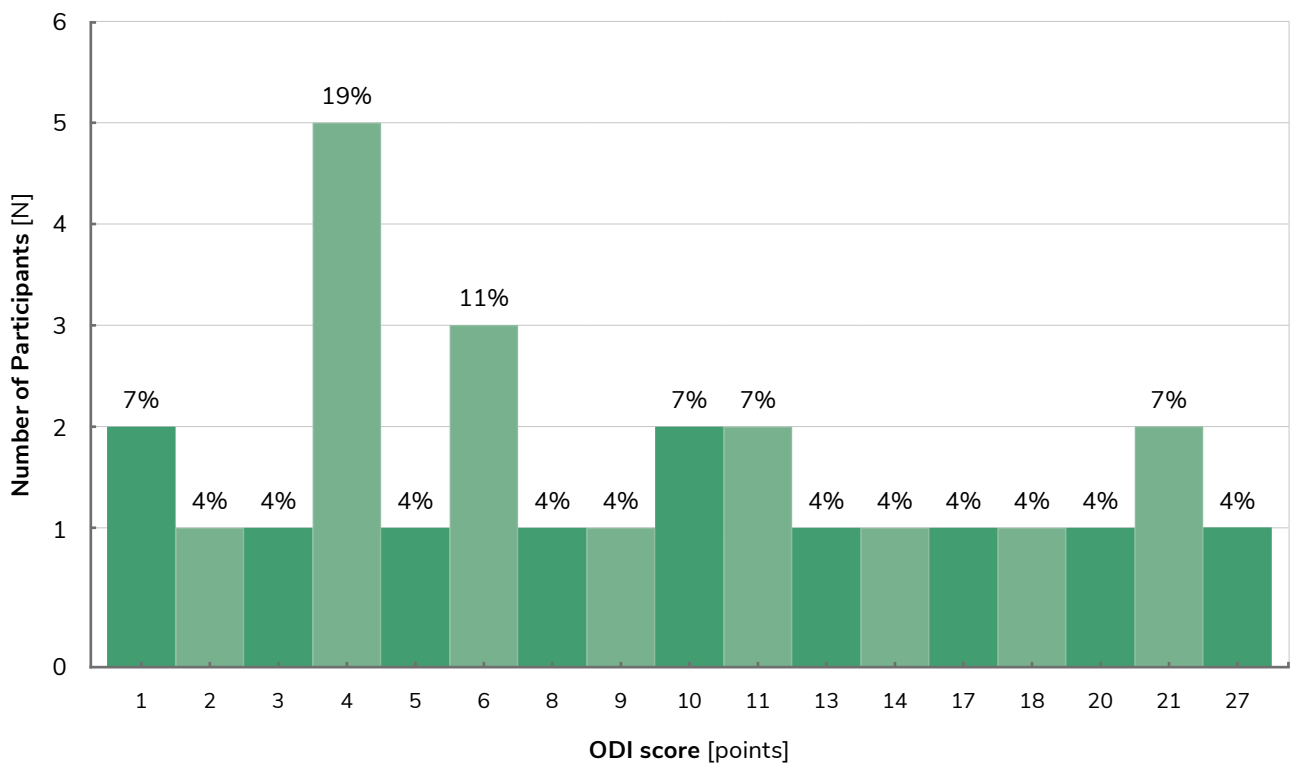


Figure 2. Results of the ODI questionnaire in the group experiencing LBP.

There was no statistically significant difference in terms of age between subjects experiencing LBP and those not experiencing LBP ($p>0.05$). However, the typical age in the "no pain" group was 40 years (mean age 40.2 ± 10.6 years), while in the "pain" group, it was 41 years (mean age 41.1 ± 9.2 years).

There was no statistically significant difference in terms of shooting 'seniority' (number of years for which a competition license has been held) between participants experiencing LBP and those without LBP ($p>0.05$). The lowest value was one month, while the highest (and an outlier) was 35 years. The typical 'seniority' value in both groups and among all respondents was the same, at three years. The average "seniority" of all subjects was 2.6 ± 4.1 years, in the "no pain" group – 2.8 ± 2.4 years, while in the "pain" group (after exclusion of one outlier), 3.1 ± 2.6 years.

The typical frequency of practicing target shooting (with live ammunition) was the same (once a month) in both groups, i.e., those experiencing and those not experiencing LBP. However, shooters suffering from LBP practiced at the range at least several times a year, while some of the 'no pain' participants trained once a year or less frequently.

The typical frequency of dry fire training in the group experiencing LBP is higher (once a month) than in the group not experiencing LBP (several times a year). By far, the dominant category of shooting discipline practiced by the subjects was the pistol (55.9%), that is, a short weapon held solely in the hands, without shoulder support and the so-called shoulder pocket. The second most common response was in two categories: pistol and rifle (25.8%). Next in order were: all three categories equally, i.e., pistol, rifle, and shotgun (8.6%), followed by rifle alone (7.5%), shotgun alone (1.1%), and pistol and shotgun (1.1%). There were no statistically significant differences ($p>0.05$) between the group experiencing LBP and those not experiencing LBP in terms of the preferred type of firearm used at the range, with pistol users making up the largest proportion in both cases.

Discussion

The original questionnaire on musculoskeletal ailments used in this study is a pilot study, an attempt to create a simple and clear questionnaire that will help the patient to describe problems unambiguously and help the doctor or physiotherapist point out areas worth paying attention to during diagnosis and therapy. Its main advantage is that it can be completed *online* by the patient, with no time or space restrictions. However, an inherent disadvantage of an anonymous survey conducted over the Internet is the lack of direct contact between the respondent and the researcher, which requires an extremely precise question formulation and possible given responses. In addition, the original questionnaire, in both electronic and paper form, is designed to allow automated decoding, which could, in future, allow the creation of an early detection program for potential strains or injuries before they progress to degeneration and irreversible structural changes.

Discomfort and objective tissue damage at risk of recoil were detected both in the aforementioned US Army study and in a case description by Cho et al. [10] in 2015, where a 27-year-old soldier experienced a reverse Bankart-type lesion with articular cartilage damage and instability in his left shoulder joint after target shooting training with a rifle. This injury occurred directly because of the repetitive action of the recoil on the subject's left shoulder [10]. This case demonstrates that shooting training using firearms with significant recoil energy can have a damaging effect on structures exposed to this energy. The results of the present study suggested that there is a positive correlation between regular exposure of tissues to firearm recoil and pain complaints of these tissues. All subjects who declared experiencing discomfort in the right shoulder joint shot with their right hand and most often used a long gun (two subjects used a rifle, one a shotgun). Given this study's results, it would seem reasonable to strive for the introduction of measures

to protect athletes from the damaging effects of recoil of firearms, for example, rubber cushioning pads on the rifle and shotgun butts, exhaust brakes, and shooting position training (so-called "assuming a proper stance"), which will allow the recoil energy to be distributed as efficiently as possible throughout the body [11, 12].

An additional argument in favor of such solutions is the proven negative effect of recoil on shot accuracy - in a study conducted by Frank Morelli et al. [13], it was shown that the higher the recoil energy, the poorer the shot focus on the target. It is worth highlighting that the vast majority of participants never felt pain during or after shooting practice or shooting competitions (54.8%), while the remaining 41% felt pain occasionally, and only one person felt pain every time. Given that the majority of people who declared that they had experienced injuries or strains in the past as a result of using firearms had suffered them as a consequence of firing a high-recoil weapon (mainly a Mosina rifle and a 12-calibre shotgun), it is reasonable to conclude that most of these ailments were caused by the recoil of the firearm.

In the present study, approximately 29% of the competitive shooters were found to experience LBP to some degree, which is similar to the prevalence of this condition in the general population, estimated at 25% per month [14, 15] and 15-30% at any given time [16]. This means that actively practicing shooting is unlikely to contribute to LBP or - that those experiencing LBP are less likely to take up competitive shooting. Noormohammadpour et al. [17] obtained a very similar result regarding the prevalence of LBP in a 2015 survey including 1,059 female university students practicing various sports. The highest percentage of back pain (experienced in the past year) was recorded in groups practicing basketball and karate (47.9% and 44%, respectively), while among shooters, LBP was experienced by 29.7% of respondents, which was the lowest of all sports covered in this research. Furthermore, the mean prevalence of LBP among all subjects was 39%,

and the mean "seniority" in the shooting group was 5.4 ± 4.3 years, which is higher than that obtained in the current study (2.6 ± 4.1 years), while the mean age of the subjects was lower due to the specific inclusion criteria (female university students): 23.8 ± 4 years, almost half the 40.4 ± 10.1 years obtained in the present research. These findings suggest that competitive shooting is not an activity predisposing to LBP - it may even be a factor in reducing the likelihood of experiencing it. Furthermore, an exceptionally comprehensive meta-analysis conducted by Farahbakhsh et al. [18], in 2018 revealed that competitive shooting is the sport with the lowest prevalence of LBP at any given time (10%), where the highest was detected among skiers (67%).

However, concerning preferred firearms, it is worth mentioning that in the 'no pain' group, not a single person declared frequent use of the shotgun alone, while more people in the 'pain' group preferred a combination of pistol disciplines with the other two. This may suggest that a greater variety of training reduces the likelihood of LBP, but further research is required on a larger sample.

In comparing the frequency of target shooting training, no significant differences were found between the group experiencing LBP and the 'no pain' group. A more pronounced difference only emerged when comparing the frequency of non-shooting ('dry fire') training, where those not experiencing LBP trained less frequently (several times a year) than those experiencing LBP (once a month). It may be that the participants who are more likely to train 'dry fire training' do not have an optimal movement pattern and strain the lumbar spine, which can only be verified by traditional functional testing.

Regarding the musculoskeletal ailments reported in the original questionnaire, represented graphically in **Figure 1**, the absence of reported ailments of the hips, gluteal, femurs, shank, and feet is particularly striking. Only one subject experienced discomfort in the knee joints, with the

second longest 'seniority' in competitive shooting (12 years). The same respondent also experienced discomfort in both ankle joints (in the left - the only individual). This participant was the 'record-holder' of the number of places where he experienced ailments - he marked 14 of them. In addition to this individual, one other respondent felt mild discomfort (tingling, pinching) in the right ankle joint. Thus, after excluding the 'record holder' as an extreme case, it is easy to observe that almost none of the examined shooters had problems with their lower limbs. Whether this is an effect of competitive shooting and, at the same time, an argument in favor of the preventive impact of this form of activity on lower limb structures or merely a correlation without causality - it is impossible to determine at the moment, although the existing association of efficient hip rotation movements with a lower LBP percentage combined with a lower ODI score among shooters than in the general population suggests the first hypothesis.

Regarding the upper limbs, it is worth indicating that, in the right scapula, right clavicle, right pectoral muscle, right ribs, right shoulder, right elbow, and right forearm, only subjects operating the trigger of the firearm with their right hand and resting the butt on the right shoulder pocket experienced discomfort. There were 80 'right-handed' individuals included in the sample (86% of the group, which is similar to the

percentage in the general population - 90%) [19]. After discarding the most "extreme" subject (the longest shooting experience and the second highest number of experienced musculoskeletal ailments), the list of painful body structures on the right-side present only in 'right-handed' shooters extends to include additional regions: the right wrist and right hand. In addition, only "right-handed" shooters with less than one year's experience felt discomfort in the right shoulder. These data suggest that competitive shooting can lead to strains and discomfort of tissues particularly exposed to firearm recoil, as seen in **Figure 1**. The present research is not able to unequivocally determine the causes of the pain experienced by the subjects; it is merely an attempt to establish the current state of a group hitherto overlooked in such Polish-language research.

Conclusions

Based on the results of this study, it can be concluded that the prevalence of LBP among Polish competitive shooters is not significantly different from the prevalence of LBP in the general population and is similar to the prevalence among competitive shooters from other countries. Data collected from the original musculoskeletal ailment questionnaire suggest that competitive shooting fosters pain in the upper limb rims and the upper limbs themselves, particularly on the side exposed to the recoil of the firearm.

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