

# HIGH PREVALENCE OF ANKLE, KNEE AND LOW BACK PROBLEMS IN HIGHLY TRAINED ADOLESCENT BASKETBALL PLAYERS AT THE BEGINNING OF THEIR COMPETITIVE SEASON

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## ABSTRACT

**Background:** Adolescent team sport athletes with high training volume and overscheduling have increased incidences of injuries (Osgood-Schlatter disease, low-back pain etc.) compared to their less active counterparts. These overuse injuries may begin to negatively affect young athletes' attitudes towards physical activity. The aim of this study was to investigate the prevalence of low back, knee and ankle problems in young male basketball players.

**Methods:** The Oslo Sports Trauma Research Centre Overuse Injury Questionnaire (OSTRC) was distributed weekly to 16 adolescent athletes who regularly participated in basketball training and who volunteered to participate in the study (age  $15 \pm 1.2$  years; body weight  $72.1 \pm 11.8$  kg; height  $183.5 \pm 8.2$  cm; BMI  $21.1 \pm 2.5$ ; training experience  $7.4 \pm 1.2$  years; training hours per week  $6.6 \pm 3.8$ ) for 12 weeks at the start of their season.

**Results:** The response rate to the weekly OSTRC questionnaire was 96.4%. A total of 94 overuse conditions were identified, affecting 15 athletes (94% of the cohort). 93.8% of the athletes in this group reported having had knee problems, while low back and ankle problems were reported by 43.8% and 31.3% respectively.

**Conclusions:** Knee and low back problems seem to be very common in adolescent basketball players and should be the focus of regular injury prevention programmes. Problems in these areas were more prevalent at the start of the study indicating the need for better pre-season physical preparation. Also, the weekly questionnaire helps to better regulate training loads and, therefore, is a good monitoring system for coaches and physiotherapists to prevent overuse problems.

**Key words:** *injury; adolescent; surveillance; lower extremity*

## INTRODUCTION

Participating in sports has great health benefits for adolescents [23], yet it seems that highly trained young athletes have increased incidences of injuries (e.g. Osgood-Schlatter disease, low back pain, etc.) compared to their less active counterparts. In young athletes, it is believed that growth increase occurring as the athlete matures during intensive training periods is related to increased risk of injury due to factors like increased musculotendinous strain, decreased epiphyseal strength and decline in bone mineralization [4, 5]. These injuries may affect young athletes' daily activities producing a negative attitude towards physical activity. Thus, the growing problem of overuse injuries in this population deserves closer attention [16, 20].

Previously, overuse injuries have been associated with endurance sports that require monotonous and repetitive actions like distance running, cycling, swimming, rowing, etc. However, recent research has additionally revealed high numbers of overuse injuries in team sport athletes [17, 24]. By definition, overuse injuries are the result of a cumulative process of tissue damage, often due to insufficient recovery time between high intensity training sessions. The tissues are not given enough time to recover from previous training sessions before the next period of physical load. Thus, eventually, tissue adaptation has not occurred, and the possible result is tissue injury [15]. Furthermore, elite athletes often continue to train and compete despite the presence of overuse injuries due to a relatively high threshold for ceasing the sports activity [3].

The onset of overuse-related problems and disability is gradual and the point at which they can be called an "injury" is blurred. Traditionally used injury surveillance systems [9] might not be best suited for studying overuse injuries, since they rely on a clearly identifiable onset of trauma along with the amount of time lost from the sport as the sole means of measuring injury severity [3]. To improve our knowledge about overuse problems in sport, Clarsen et al. have developed a new approach to recording the extent of overuse injuries, the Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire [6]. This tool is distributed to athletes at regular intervals (e.g. weekly) with primary outcome measures based on the prevalence of subjectively reported overuse problems compared to a traumatic injury incident as used in traditional systems.

The purpose of this study was to measure the prevalence of overuse-related problems in the ankle, knee and low back areas of adolescent basketball players using the OSTRC Overuse Injury Questionnaire and to compare this to the standard injury surveillance method.

## METHODS

### Participants

After contacting basketball coaches from one of the biggest Estonian basketball academies, 16 adolescent male athletes volunteered to participate in the study (age  $15 \pm 1.2$  years; body weight  $72.1 \pm 11.8$  kg; height  $183.5 \pm 8.2$  cm; BMI  $21.1 \pm 2.5$ ; training experience  $7.4 \pm 1.2$  years; training hours per week  $6.6 \pm 3.8$ ). The athletes took part in regular basketball trainings and competed at the highest level of the Estonian U-16 boys' championship league.

The purpose and procedures were explained to the coaches, players and their parents at the beginning of the study. Study procedures and protocols were approved by the Ethics Committee of the University of Tartu (Tartu, Estonia) and conformed to the Declaration of Helsinki. All testing procedures and related risks were described before acquiring written informed consent to participate in the study.

### Procedures

The OSTRC Overuse Injury Questionnaire [6] was distributed weekly to all athletes participating in the study during a 12-week period from November 2014 to February 2015 using online Google Forms software (Mountain View, CA, USA). Non-responders and their coach received a reminder on the second and third day if necessary. In the case of failure to fill out the questionnaire for longer than three days, the participant was contacted via telephone and asked to fill out the questionnaire. To minimize the learning effect, the subjects had two weeks of trial during which time the participants had the chance to get more closely acquainted with the questionnaire. These data were excluded from the final analysis.

The questionnaire focused on three anatomical areas – ankle, knee and low back region. There were four questions about each anatomical area [6], which meant a total of 12 questions. Each of the four questions had a numerical value from 0 to 25, where the score of 0 represented no problem and 25 represented the maximum problem level. In this case, the athlete could not participate in his sport. The summarized values were equal to a severity score ranging from 0 to 100 for each overuse problem. Participants answered subjectively with the questionnaire not intending to give a specific diagnosis but rather pointing out the most frequent problem areas which could be followed up if necessary.

Fuller et al [12] state that a minimal injury causes an absence of 1–3 days; a mild injury causes an absence of 4–7 days; a moderate injury causes an absence

of 8–28 days and a severe injury causes an absence of 29 or more days. To compare the OSTRC overuse injury weekly questionnaire to the standard injury surveillance method [12], extra questions were added to the online questionnaire to measure the time loss from regular trainings.

The prevalence of overuse problems was calculated for each anatomical area each week of the study by dividing the number of athletes who reported any problem (i.e., anything but the minimum value in any of the four questions) by the number of questionnaire respondents. Weekly prevalence trends were calculated to identify the trends over the course of 12 weeks and the average weekly prevalence of overuse problems was calculated for each anatomical area. Average values and standard deviations were calculated for the severity scores and the duration of cases.

## **RESULTS**

All 16 players who participated in this study were followed through the 12-week testing period. Fourteen players (87.5% of the cohort) completed all 12 questionnaires. The overall response rate to the weekly OSTRC Overuse Injury Questionnaire was 96.4%.

Using the traditional injury severity classification method, a total of 10 injuries in 15 athletes were registered, nine minimal injuries and one mild injury (Table 1). The results of the OSTRC overuse questionnaire indicated that overuse problems in the knee and lower back were the most frequently reported (93.8% and 43.8%, respectively). Ankle problems were reported by 31.1% of the subjects. Moderate or severe problems according to the OSTRC severity score, which prevented the players from participating in the trainings, were not common; two players could not participate in trainings due to severe knee pain for one week and one player reported severe low back pain and could not train for one and a half weeks.

The results of the standard injury surveillance method are summarized in Table 1.

**Table 1.** Number of time-loss injuries identified by standard injury surveillance methods.

Time-loss injuries in the lower limb during 12 weeks of study	No.
Minimal (1–3 days)	9
Mild (4–7 days)	1
Moderate (8–28 days)	0
Severe (> 28 days)	0

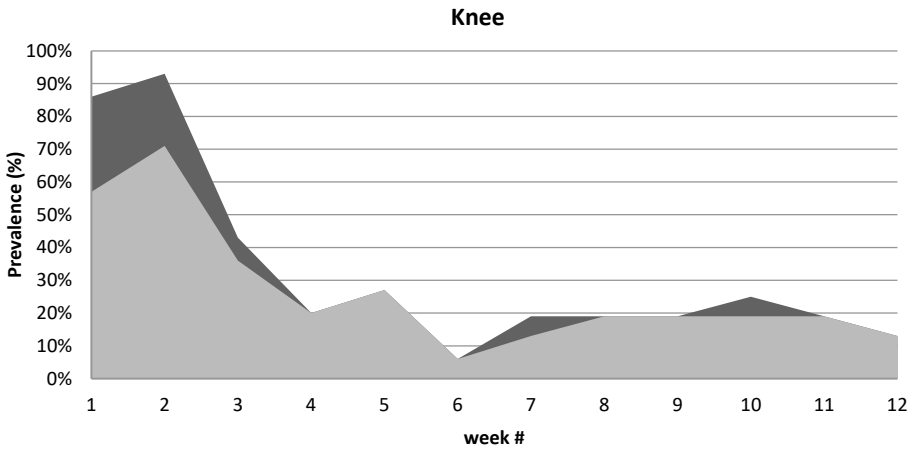
Table 2 represents the results of the weekly OSTRC Overuse Injury Questionnaire, the prevalence of all overuse problems and substantial overuse problems, average weekly severity score and average duration of cases. A total of 94 overuse conditions were identified, affecting 15 athletes (94% of the cohort). In the present study group, only three subjects out of 16 missed trainings due to injury.

**Table 2.** Prevalence of all overuse problems and substantial overuse problems, average weekly severity score and average duration of cases.

	ankle (13 cases)	knee (57 cases)	low back (24 cases)
Average weekly prevalence (all problems)	1	5	2
Average weekly prevalence (substantial problems*)	1	2	2
Average weekly severity score ( $\pm$ SD)	0.9 $\pm$ 1.1	9.4 $\pm$ 7.5	4.5 $\pm$ 4.4
Average duration of cases (weeks) ( $\pm$ SD)	0.8 $\pm$ 1.1	3.6 $\pm$ 2.3	1.6 $\pm$ 2.4

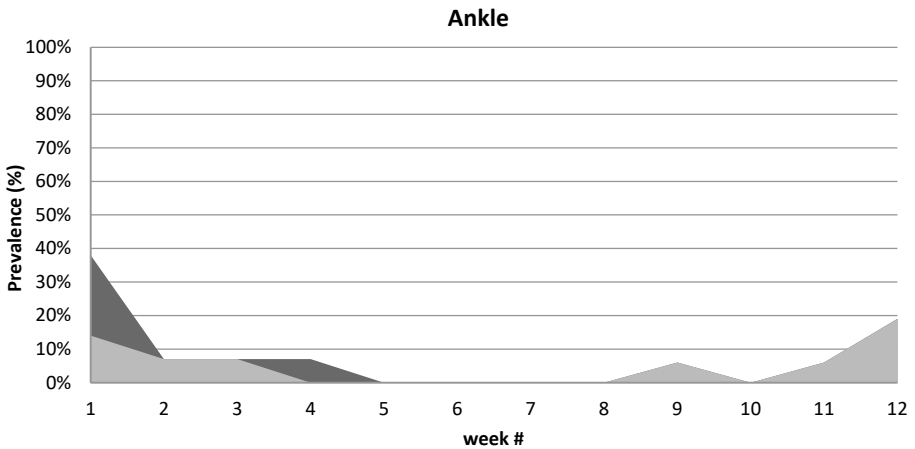
\* Substantial problems: overuse problem causing moderate/severe reductions in training volume or sports performance or complete inability to participate in training or competition.

Figure 1 represents the prevalence of all problems and substantial problems in the knee during the 12 weeks in 16 male adolescent basketball players. The highest average weekly severity score in knee problems was 9.4  $\pm$  7.5 points.



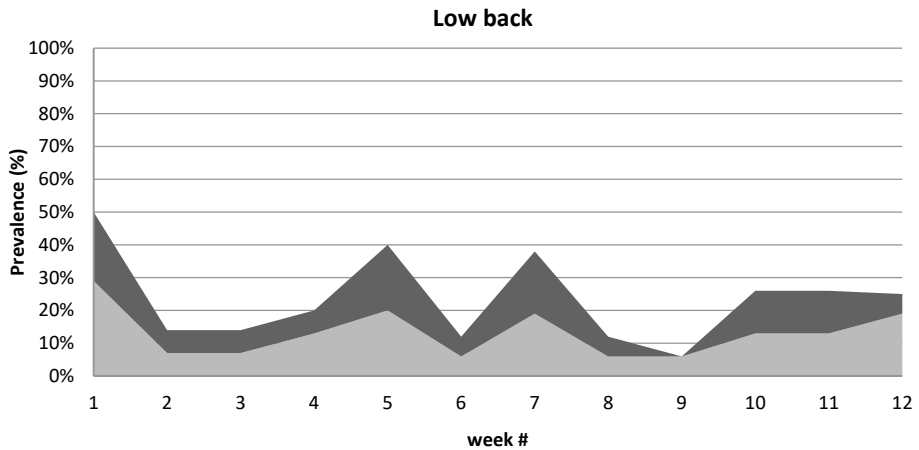
**Figure 1.** Prevalence of all overuse problems (dark grey) and substantial overuse problems (light grey) around the knee area in basketball players (n = 16) during a 12-week period.

Figure 2 points out the prevalence of all and substantial ankle area problems during the 12 weeks in 16 male adolescent basketball players. The highest average weekly severity score in ankle was low –  $0.9 \pm 1.1$  points.



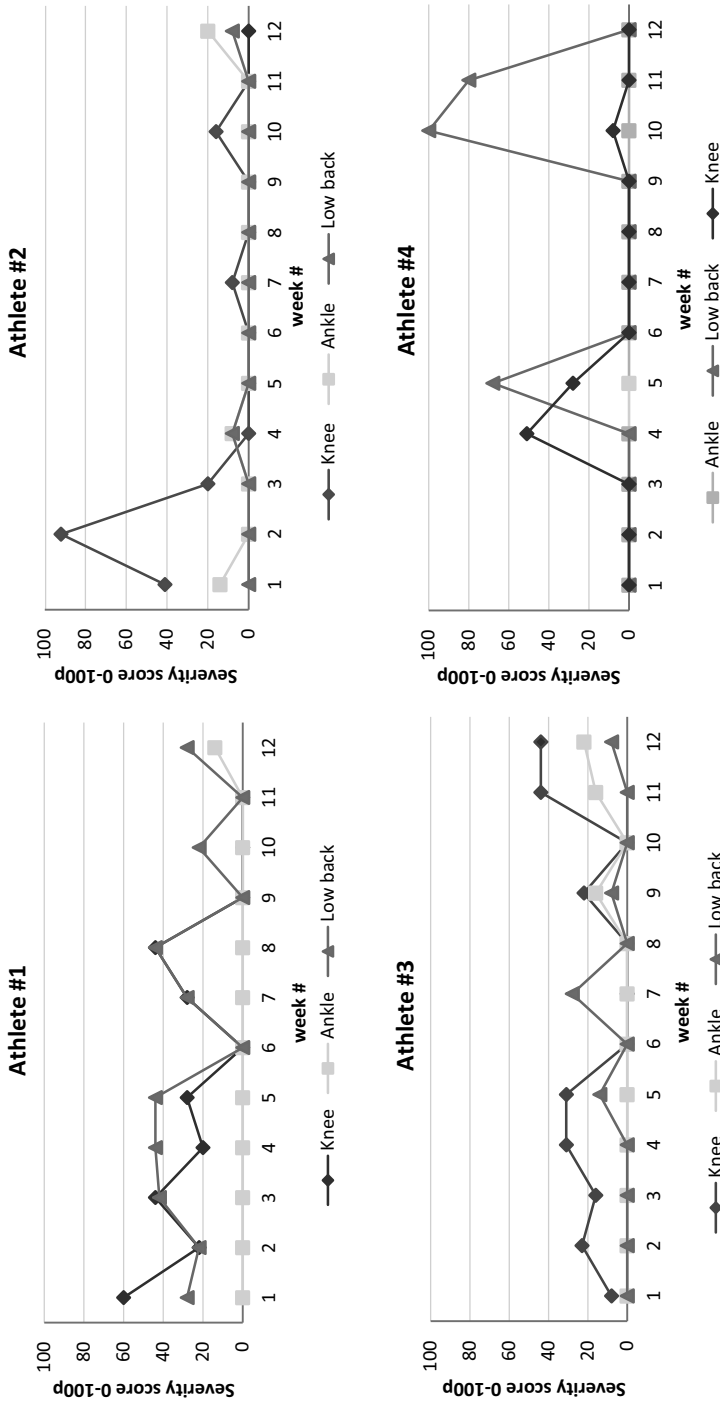
**Figure 2.** Prevalence of all overuse problems (dark grey) and substantial overuse problems (light grey) around the ankle area in basketball players (n = 16) during a 12-week period.

Figure 3 shows the prevalence of all and substantial problems in low back during the 12 weeks in 16 male adolescent basketball players. The highest average weekly severity score in low back problems was  $4.5 \pm 4.4$  points.



**Figure 3.** Prevalence of all overuse problems (dark grey) and substantial overuse problems (light grey) around the low back area in basketball players ( $n = 16$ ) during a 12-week period.

Figure 4 shows the example of responses to the OSTRC Overuse Injury Questionnaire and the severity scores in four random subjects in the areas of ankle, knee and low back during the study period of 12 weeks, where the score of “0” represented no problems and the score of “100” represented a problem in the case of which the athlete could not participate in his sport due to the problem. Athletes #1 and #2 showed a tendency similar to the whole group by reporting more problems at the start of the study. In athletes #2 and #4, it can be seen that knee and low back problems prevented them from participating in the basketball trainings for one or two weeks. In athlete #3, we can see that knee problems bothered him during the entire study period, yet he continued to train and play basketball without missing any training.



**Figure 4.** Example responses of four basketball players to the OSTRC questionnaire and the severity scores in ankle, knee and low back areas during the study period of 12 weeks. The responses to each of the four questions had a numerical value from 0 to 25 for each overuse problem in an anatomical area, were 0 represented no problem and 25 represented the maximum level for each question. These values were summed up to calculate a severity score from 0 to 100.

60

40

20

0



## DISCUSSION

The purpose of the study was to measure the prevalence of overuse-related problems in ankle, knee and low back areas in high-level adolescent basketball players ( $n = 16$ ) using the weekly OSTRC Overuse Injury Questionnaire [6]. The main findings of the study were that 15 out of 16 athletes (93.8%) in this group reported having knee problems, while low back problems were reported by 7 out of 16 athletes (43.8%). Ankle problems were reported by 5 out of 16 athletes (31.3%). Furthermore, self-reported lower extremity problems occurred with higher prevalence at the beginning of the study period.

Information about adolescents' basketball-related injuries in Europe are lacking today [7, 20], but previous studies have found the lower extremity, specifically the knee and ankle areas, to be the most commonly affected area in basketball players [1, 9, 19, 24]. Additionally, adolescent team sport athletes have shown a high prevalence of low back pain, which seems to be more common during the competitive season [22]. The results of our study also show that the knee area was the most affected, followed by low-back and ankle overuse problems in a group of highly training adolescent basketball players. This was registered at the start of their season and not in the middle or later stages of their competitive season where fatigue and overuse were thought to accumulate. These high overuse injury rates clearly show the direction of increased overuse injuries in young athletes, and this might be the reason why so many young athletes drop out from sport. Youth basketball academies and coaches should incorporate more injury prevention programs that have shown positive effects on youth players to reduce injuries and enhancing performance [11].

Overuse injuries may be caused by frequent fluctuations in competition to training ratio in team sports [18, 26]. It has been shown that team sport athletes who perform < 18 weeks of pre-season training and players whose off-season  $VO_{2max}$  values are lower may be at increased risk of overuse injuries [14]. Similarly, subjects in the present study reported more overuse problems at the beginning of the study and the prevalence decreased after the fourth week. This phenomenon appeared mainly with knee problems where the whole group reported problems during the first three weeks. Remarkable variations in training loads from summer to autumn and winter might explain the higher prevalence of knee and lower back problems at the beginning of the study period. Also, one possible explanation for increased knee problems at the start of the season may be the sharp increase in basketball-specific training volumes and intensity where jumping, landing and cutting movements are required, adding extra load to the tendons and therefore resulting in anterior knee pain. Therefore,

a progressive loading program should be established in adolescent basketball players' pre-seasonal trainings to better prepare their musculoskeletal system for high intensity running and jumping activities after the relative rest period during the summer [10].

As previous injury is probably one of the biggest risk factors for subsequent injury [13], the future focus should be on preventing, delaying or decreasing the impact of the first injury incident. In many cases, athletes train and compete despite their injuries. Therefore, the standard injury surveillance method [12] based on time-loss from training might not be best suited for registering overuse injuries. Clarsen et al. compared the standard injury surveillance method to the weekly OSTRC Overuse Injury Questionnaire and found that the standard method registered ten times fewer injuries than the weekly OSTRC Overuse Injury Questionnaire [6, 8]. In our study, (Table 1) only 10 cases of minimal to mild injuries to the lower limb and lower back areas were found using the traditional time-loss injury severity scores. However, by using the OSTRC Overuse Injury Questionnaire, 94 cases were registered in the same areas (Figures 1–3). Therefore, the traditional injury registration system might not be best suited for measuring the prevalence of overuse injuries, and adding OSTRC to the traditional injury surveillance system could give more accurate data on the prevalence of overuse injuries. The severity score of the OSTRC questionnaire could be used as an objective measure of overuse problems for each individual athlete to monitor the progress of overuse problems during training periods [6].

The main limiting factors in this study were the small sample size ( $n = 16$ ) and the fact that the OSTRC questionnaire concentrated only on three areas – ankle, knee and low back. To be more specific, further studies should add calf, anterior thigh, groin and hamstring areas to the questionnaire, and the study should include the whole season.

## **CONCLUSION**

Knee and low back problems are very common in adolescent basketball players especially at the start of the season and should be the focus of regular injury prevention programmes with progressive pre-season loading to prepare adolescent athletes' musculoskeletal system for the loads of everyday basketball trainings and competitions. Also, the weekly OSTRC questionnaire helps to measure the extent of overuse problems more precisely and, therefore, might be a good addition to the traditional injury surveillance system for coaches and medical personnel to develop prevention strategies for certain overuse problems.

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