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Prevalence and characteristics of overuse injuries in female college soccer and volleyball players: a pilot study

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Abstract

Introduction. Insufficient understanding of overuse injuries in female collegiate soccer and volleyball players hampers prevention programs in women's sports. Aim of Study. This pilot study aims to investigate prevalence and severity of overuse injuries, and to examine an impact of age, playing position, training duration, and weekly training time on the prevalence and severity of overuse injuries among female collegiate athletes from volleyball and soccer teams. The study has potential to identify at-risk players and lay a foundation for future injury prevention programs in women's soccer and volleyball. Material and Methods. Data on overuse injuries in a knee, lower back, shoulder, and anterior thigh of 45 participating highly trained/national level female university athletes, including 19 soccer (mean age 20.98 ± 1.35 years) and 26 volleyball players (mean age 20.89 ± 1.66 years) were collected weekly for four weeks, using a questionnaire from the Oslo Sports Trauma Research Center. Results. A total of 80% (95% CI, 68.9 to 91.1) of female athletes had overuse injuries, with significant problems in 31.1% (95% CI, 17.8 to 44.4) of cases. Knee injuries were most prevalent (55.6%), followed by lower back (42.2%), shoulder (35.6%), and anterior thigh injuries (22.2%). In soccer, players under the age of 20 training over 10 hours/week had more injuries, with defenders experiencing more lower back pain and forwards having more lower extremity issues. Experienced volleyball players (over 10 years of playing) with over 18 hours/week of training had a higher incidence of injuries. Weekly training hours significantly influenced injury frequency in female volleyball players ($\chi^2(3) = 7.97$, $p = 0.047$). Conclusions. Sport-specific factors like age, experience, and training volume were identified as risk factors for knee and hip injuries in the female soccer players, as well as knee, lower back, and shoulder injuries in the female volleyball players. These findings emphasize importance of considering these factors in designing injury prevention programs for female soccer and volleyball players.

KEYWORDS: risk factors, cumulative trauma disorders, team sports, female athletes, surveys and questionnaires.

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Introduction

In recent years, ball sports have experienced a surge in popularity worldwide, attracting diverse demographics, including female college athletes. In Taiwan, college and university players play a vital role within the sports system, serving as reserves for elite sports and forming a cornerstone of national teams. Among these sports, volleyball and soccer have emerged as the most popular. During a 2021-2022 season, a volleyball league for higher educational institutions consisted of 225 teams with 4,768 participants, including 107 women's teams. Similarly, a soccer league featured 63 women's teams and 1,861 participants, marking the highest number since leagues' inception [5]. Both soccer and volleyball put a significant physical strain on athletes due to intense emotional tension, unpredictable game situations, and high skill demands [28]. Extensive research has highlighted prevalence and impact of injuries in these sports, hindering athletes' training progress, competitive performance, and psychological

well-being. Soccer, being a contact sport that demands physical prowess and high-intensity play, carries a significant risk of musculoskeletal and osteoarticular injuries for players. On the other hand, although volleyball is not traditionally categorized as a contact sport like soccer, physical demands of a game, such as jumping and diving, contribute to a considerable number of injuries similar to contact sports. Intense competition, escalating dynamics of a game in recent years, and strains resulting from overtraining and overexertion during intense muscular activity are just a few reasons contributing to an increase in injury rates among athletes. Researchers emphasize importance of monitoring injury rates among female soccer and volleyball athletes to develop effective prevention strategies [3, 4, 20].

Research has shown that collegiate female volleyball players commonly experience injuries in areas of shoulders, lower back, knees, and ankles, with no significant difference in injury rates across different skill levels [4]. Playing position also influences injury prevalence, with hitters and blockers reporting higher injury rates [19, 25, 30]. Overuse injuries pose a unique challenge as they develop gradually and may not lead to significant time off, but still cause pain and functional limitations [9, 21, 30]. Factors such as training load, fatigue, overexertion, physical and mental maturity, and an influence of female hormones contribute to a risk of overuse injuries [9, 21, 30]. The Oslo Sports Injury Research Center Overuse Injury Questionnaire (OSTRC-O) is a widely used tool to monitor overuse injuries, assessing pain, restricted participation, training volume reduction, and decreased performance [6, 10]. It has been employed to investigate prevalence and burden of knee, lower back, and shoulder issues among high-level male volleyball players [25]. Additionally, it has been used to examine prevalence and burden of overuse injuries in youth soccer players [16]. However, there is a research gap in understanding prevalence and characteristics of overuse injuries in women's collegiate soccer and volleyball players.

This pilot study aims to investigate the prevalence and severity of overuse injuries, and to examine an impact of age, playing position, training duration, and weekly training time on the prevalence and severity of overuse injuries among female collegiate athletes from volleyball and soccer teams. The study has potential to identify at-risk players and lay a foundation for future injury prevention programs in women's soccer and volleyball.

Material and Methods

This pilot study, a part of a larger investigation into injuries among female ball sports participants (focusing on lower limb asymmetry and injury risks), examined women's varsity volleyball and soccer teams from a single university. The pilot's nature and a limited sample size (two teams) restricted an ability to recruit a wider range of athletes. According to results of an a priori power analysis (G*Power; v. 3.1.9.2), it was determined that a total of 44 athletes would be required in each group to detect a significant effect size of 0.3 between groups, using $\alpha = 0.05$ and $1 - \beta = 0.80$ [11]. While the authors acknowledge a necessity for caution in interpreting the results due to exclusive nature of the sample, it has been decided to proceed with the study despite these limitations. Inclusion criteria for participants were as follows: being over 18 years old, competing at a sub-elite or elite level, engaging in a training program at least three days a week, and having a means of communication (e.g., email) for questionnaire-related correspondence. Presence of current or previous injuries did not exclude female athletes from participating. Certain exclusion criteria were applied, including athletes who lost contact with the investigators for more than two weeks, and those with severe injuries preventing them from training or competing for more than two weeks.

The study adhered to the ethical principles of human medical research and received approval from the Research Ethics Committee of the University (REC Number: 202112HM045).

Data collection procedure

The participants in this study, comprising varsity soccer and volleyball teams, were prospectively followed for four weeks. Every Saturday during the main competition season, the participants received an email containing a link to an online overuse injury questionnaire created using Google Forms. To ensure participation, the participants were required to answer all questions before submitting the questionnaire. In case of a non-response, a reminder email was sent two days later.

Questionnaire

In this study, the OSTRC-O was employed to detect overuse injuries in different body regions. The questionnaire was developed and validated by Clarsen et al. [6] in 2013. To accommodate Chinese-speaking players, the questionnaire was translated following guidelines for cross-cultural adaptation of self-report scores by Beaton et al. [1].

The OSTRC-O questionnaire consists of 16 questions that address pain, training and competition restrictions, reduced training volume, and sports performance. It assesses prevalence and severity of overuse injuries in specific body regions. This study focused on a knee, lower back, shoulder, and anterior thigh because these areas are commonly affected in sports like volleyball and soccer, as supported by existing literature [3, 4].

For each body region, four questions evaluated symptoms and their impact on training volume, performance, and pain during play. Each question was assigned a score ranging from 0 to 25. The scores were summed to calculate a severity score ranging from 0 to 100 for each overuse problem, and the four questions were summed to obtain a score from 0 to 100 for each body region. A severity score of 0 indicated no problem, while a score of 25 represented the highest severity level. Response values were selected to maintain an even distribution, using whole numbers. Questions 1 and 4 were scored on a scale of 0-8-17-25, while questions 2 and 3 were scored on a scale of 0-6-13-19-25 [6]. An average severity score was calculated for each body region. On a weekly basis, the average severity score for each body region was computed by calculating a mean of scores reported by all athletes experiencing issues. At the end of the study, average weekly measurements for each body region were summarized. These measurements included average prevalence of all reported issues, average prevalence of significant issues, and the average severity score. A 95% confidence interval was calculated to determine precision of these measurements.

In addition to injury-related questions, the participants provided information on their total years of playing volleyball and soccer (categorized as 3-6 years, 7-10 years, and 10+ years) and a number of hours they trained per week (categorized as less than 10 hours, 10-14 hours, 14-18 hours, and 18+ hours) during each week of the study. They also indicated their playing roles, such as hitters, setters, blockers, and defensive specialists for volleyball players, and forwards, defenders, midfielders, and goalkeepers for soccer players. Age data was grouped into three categories: 18-19.99 years, 20-21.99 years, and 22+ years.

To determine the prevalence of overuse-related problems, the number of athletes reporting any type of problem was divided by the total number of survey respondents. The prevalence was calculated for the entire study period (summing all weeks for each body region) and on a weekly basis (for each week in each body region). Overuse injuries that resulted in reduced participation or inability to participate were considered "substantial problems" based on a classification by Clarsen et al. [6].

Statistical analysis

The data was analyzed using SPSS version 22.00 software (IBM SPSS, Armonk, NY, USA). Confidence intervals of 95% were calculated for parameter estimates, and a two-tailed alpha level was set at 0.05 for all statistical tests. Descriptive statistics, such as means and standard deviations (SD) or numbers and percentages (%), were used to describe baseline characteristics of all participants. Pearson correlation coefficients were calculated to examine variations in the prevalence of overuse injuries over time. Chi-squared tests were performed to assess relationships between overuse injuries and players' age, experience, training volume, or role, with a significance level of $p < 0.05$. An effect size, i.e., the strength of association among the features, was estimated using a φ (phi) criterion for four-field tables or a Cramér's V criterion for multi-field tables for nominal data. The φ and Cramér's V criteria values were interpreted according to recommendations of Rea and Parker [23], namely 0.00 and under 0.10 – negligible association; 0.10 and under 0.20 – weak association; 0.20 and under 0.40 – moderate association; 0.40 and under 0.60 – relatively strong association; 0.60 and under 0.80 – strong association; 0.80 and under 1.00 – very strong association.

Results

A total of 45 highly trained/national level female university athletes, consisting of 19 soccer players and 26 volleyball players, provided written informed consent and were included in the study. The average age of the female soccer players was 20.98 ± 1.35 years, while the average age of the volleyball players was 20.89 ± 1.66 years. Basic characteristics of the participants are presented in Table 1.

The female athletes experienced high prevalence of overuse injuries (OI) across various anatomical regions, with mean prevalence of 80% (95% CI, 68.9 to 91.1). Significant overuse injury problems were reported in 31.1% of cases (95% CI, 17.8 to 44.4). Specifically, the knee region had average prevalence of 55.6% (95% CI, 42.2 to 68.9) throughout the study, while lower back injuries were reported in 42.2% of cases (95% CI, 28.9 to 55.6). Shoulder pain and injuries were observed in 35.6% of cases (95% CI, 22.2 to 48.9), and anterior thigh problems were reported in 22.2% of cases (95% CI, 11.1 to 35.6). The prevalence of overuse injuries by anatomical region is presented in Table 2.

Table 1. Basic characteristics of participants

Participants	Volleyball (n = 26)		Participants	Soccer (n = 19)	
	Number	Percentage		Number	Percentage
Age (years)					
18-19.99	8	30.8	18-19.99	5	26.3
20-21.99	10	38.5	20-21.99	9	47.4
22+	8	30.8	22+	5	26.3
Playing position					
Hitter	13	50.0	Forward	6	31.6
Setter	6	23.1	Defender	7	36.8
Blocker	3	11.5	Midfielder	4	21.1
Defensive specialists (including libero)	4	15.4	Goalkeeper	2	10.5
Athletic career (years)					
3-6	2	7.7	3-6	2	10.5
7-10	8	30.8	7-10	7	36.8
10+	16	61.5	10+	10	52.6
Training volume (hours/week)					
<10	3	11.5	<10	3	15.8
10-14	3	11.5	10-14	4	21.1
14-18	1	3.8	14-18	8	42.1
>18	19	73.1	>18	4	21.1

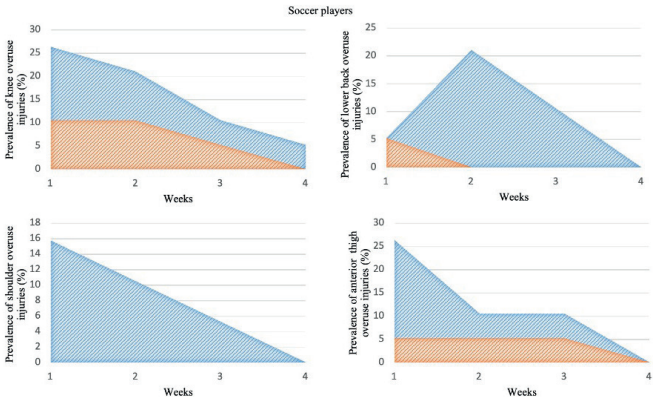
Table 2. The overall prevalence and mean severity of injuries from overload by anatomical region (4 weeks, in percent) for volleyball players (n = 26) and soccer players (n = 19)*

Anatomical region	Knee		Lower back		Shoulder		Anterior thigh	
Kind of sport	Volleyball	Soccer	Volleyball	Soccer	Volleyball	Soccer	Volleyball	Soccer
Average weekly prevalence, % (all problems)*	49.04 (39.27, 58.81)	15.79 (7.4, 24.18)	30.77 (21.75, 39.79)	9.21 (2.56, 15.86)	25.0 (16.54, 33.46)	7.89 (1.69, 14.1)	9.62 (3.85, 15.38)	11.84 (4.41, 19.27)
Average weekly (%) (significant problems) prevalence*	13.46 (6.76, 20.13)	6.58 (0.88, 12.28)	4.81 (0.63, 8.99)	1.32 (0.03, 7.11)	1.92 (0.24, 7.04)	0[a]	1.00 (0.02, 5.45)	3.95 (0.82, 11.11)
Average weekly severity score	25.69 (20.73, 30.64)	35.0 (5.17, 64.83)	27.6 (15.76, 39.44)	26.33 (15.33, 37.33)	23.19 (18.42, 27.96)	22.83 (13.77, 31.9)	21.1 (14.88, 27.32)	20.5 (10.07, 30,93)

* The percentages are displayed with 95% CI (confidence interval) indicated in parentheses.
[a] Due to lack of data, 95% CI could not be determined.

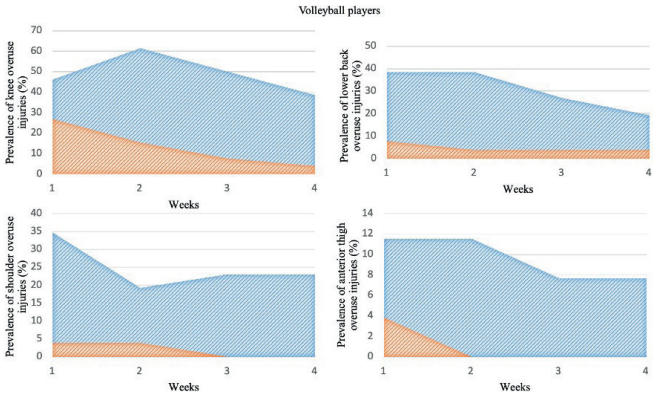
The analysis of the overuse injury prevalence revealed variations in injury occurrence between both groups of female athletes over the course of the four weeks. Figure 1 shows fluctuating prevalence of injuries in the female soccer players, while Figure 2 displays fluctuating prevalence of injuries in the female volleyball players. It is noteworthy that the female volleyball players exhibited the highest frequency of injuries across all

anatomical regions. Overall, the prevalence of injuries during the month showed instability for all injury outcomes in both groups of athletes.



Light blue area: all complaints, red area: significant problems

Figure 1. Prevalence of overuse injuries in female soccer players (n = 19) during a four-week period



Light blue area: all complaints, red area: significant problems

Figure 2. Prevalence of overuse injuries in female volleyball players (n = 26) during a four-week period

Overuse knee injuries: Among the female soccer players, six athletes reported nine cases of overuse knee injuries, with three players experiencing moderate or severe symptoms. In comparison, the female volleyball players reported 51 cases of overuse knee injuries, involving 19 athletes, with seven players having moderate or severe symptoms (Figure 1). There was a significant difference in the prevalence of knee injuries between the volleyball and soccer players ($\chi^2_{(1)} = 7.66$, $p = 0.006$). The obtained value of the Cramér's phi coefficient ($\varphi = 0.412$, $p = 0.006$) suggests that the variables are relatively strongly related. The sport itself was identified as a risk factor for injury likelihood (RR = 2.31, 95% CI, 1.15-4.67). Both groups of athletes showed a decreasing trend in the prevalence of knee injuries over the course of the month, and this correlation was statistically significant ($rp = 0.47$, $p = 0.001$).

Lower back overuse injuries: Among the soccer players, four athletes reported seven cases of overuse back injuries, with one case being severe. In the volleyball players, 15 athletes reported 32 cases of overuse back injuries, with three players experiencing a decrease or inability to participate in training and competition (Figure 1). A significant difference was found in the prevalence of back injuries between the volleyball and soccer players ($\chi^2_{(1)} = 6.041$, $p = 0.014$). The obtained value of the Cramér's phi coefficient ($\varphi = 0.365$, $p = 0.014$) indicates a moderate strength of the relationship between the variables. Similarly to the knee injuries, the sport itself was identified as a risk factor for injury likelihood (RR = 2.74, 95% CI, 1.08-6.95). Both groups of athletes demonstrated a noticeable decrease in the prevalence of lower back injuries over the course of the month, and this correlation was statistically significant ($rp = –0.82$, $p = 0.0001$).

Shoulder overuse injuries: In the initial two weeks of the study, three female soccer players reported a total of six cases of overuse shoulder injuries, none of which had moderate or severe symptoms (Figure 2). Among the volleyball players, 13 athletes reported 26 cases of overuse shoulder injuries, with two cases (involving two players) showing mild symptoms. There was a significant difference in the prevalence of shoulder injuries between the volleyball and soccer players ($\chi^2_{(1)} = 5.607$, $p = 0.018$). The obtained value of the Cramér's phi coefficient ($\varphi = 0.353$, $p = 0.018$) indicates a moderate strength of the relationship between the variables. The sport itself was identified as a risk factor for injury likelihood (RR = 3.17, 95% CI, 1.05-9.58). Although there was a tendency towards a decrease in the shoulder joint injuries in both groups over the month, the correlation was not statistically significant ($rp = –0.48$, $p = 0.753$).

Anterior thigh overuse injuries: Over the four weeks, six soccer players reported nine cases of overuse anterior thigh injuries, with two players experiencing moderate to severe symptoms, resulting in three cases. In contrast, only four volleyball players reported 10 cases of overuse anterior thigh injuries during the same period, with one case exhibiting moderate symptoms (Figure 2). There was no significant difference in the prevalence of anterior thigh injuries between the volleyball and soccer players ($\chi^2_{(1)} = 1.666$, $p = 0.197$). The obtained value of the Cramér's coefficient ($\varphi = –0.192$, $p = 0.197$) indicates that the relationship between the variables is insignificant. There was no association between the

type of sport and the presence of injury due to excessive load (RR = 0.49, 95% CI, 0.16-1.49). A trend towards a decrease in thigh injuries was observed in both groups of athletes throughout the month, and this trend was statistically significant (rp = 0.371, p = 0.012).

Effect of age, playing position, years of sport participation, and weekly training time on overuse injuries: In the analysis of injuries among the volleyball players, it was observed that the female players aged 20-22 years, with more than 10 years of playing experience, and training more than 18 hours per week, were particularly prone to injuries. Figure 3 depicts prevalence rates of overuse injuries in different anatomical regions for each age group. Knee problems were the most common in the 18-22 age groups, while lower back problems were prevalent in the female volleyball players aged 21-22. Shoulder problems were more common in the female athletes over the age of 22 ($\chi^2_{(2)}$ = 7.12, p = 0.028), and the Cramér's V test showed a correlation with magnitude of 0.398 (p = 0.028). The highest number of anterior thigh problems was found in the 18-19.99 age group, but no statistically significant differences were observed (p = 0.987). Among the female volleyball players, those with more than 10 years of playing experience and a training load of over 18 hours per week reported the highest number of issues in all anatomical areas. A frequency of all overuse injury problems in the female volleyball players was significantly influenced by the number of training hours per week ($\chi^2_{(3)}$ = 7.97, p = 0.047), and the Cramér's V test showed a moderate association, with a value of 0.276 (p = 0.047). Furthermore, the forwards were identified as the most susceptible to injuries based on their specific game role (Table 3).

Regarding the relationship between the injuries and the specific game roles, it was established that the forwards were the most susceptible to injuries (Table 3). The analysis of injuries among the female soccer players revealed that those aged 18-19.99, who train for more than 10 hours per week, are the most susceptible to

Table 3. The prevalence of all problems and significant problems depending on age, playing position, length of athletic career, and weekly training time for volleyball (n = 26) and soccer (n = 19) players

Volleyball players	Average of all problems (%)	Average prevalence of significant problems (%)	Soccer players	Average of all problems (%)	Average prevalence of significant problems (%)
Age (years)					
18-19,99	32.0	55.6	18-19,99	45.5	40.0
20-21,99	36.0	11.1	20-21,99	27.3	20.0
22+	32.0	33.3	22+	27.3	40.0
Playing position					
Hitter	48.0	33.3	Forward	27.3	40.0
Setter	24.0	44.4	Defender	54.5	40.0
Blocker	12.0	0.0	Midfielder	18.2	20.0
Defensive specialists (including libero)	16.0	22.2	Goalkeeper	0.0	0.0
Athletic career (years)					
3-6	8.0	0	3-6	9.1	0.0
7-10	32.0	22.2	7-10	45.5	40.0
10+	60.0	77.8	10+	45.5	60.0
Training volume (hours/week)					
<10	12.0	22.2	<10	18.2	20.0
10-14	8.0	0	10-14	27.3	20.0
14-18	4.0	0	14-18	27.3	20.0
>18	76.0	77.8	>18	27.3	40.0

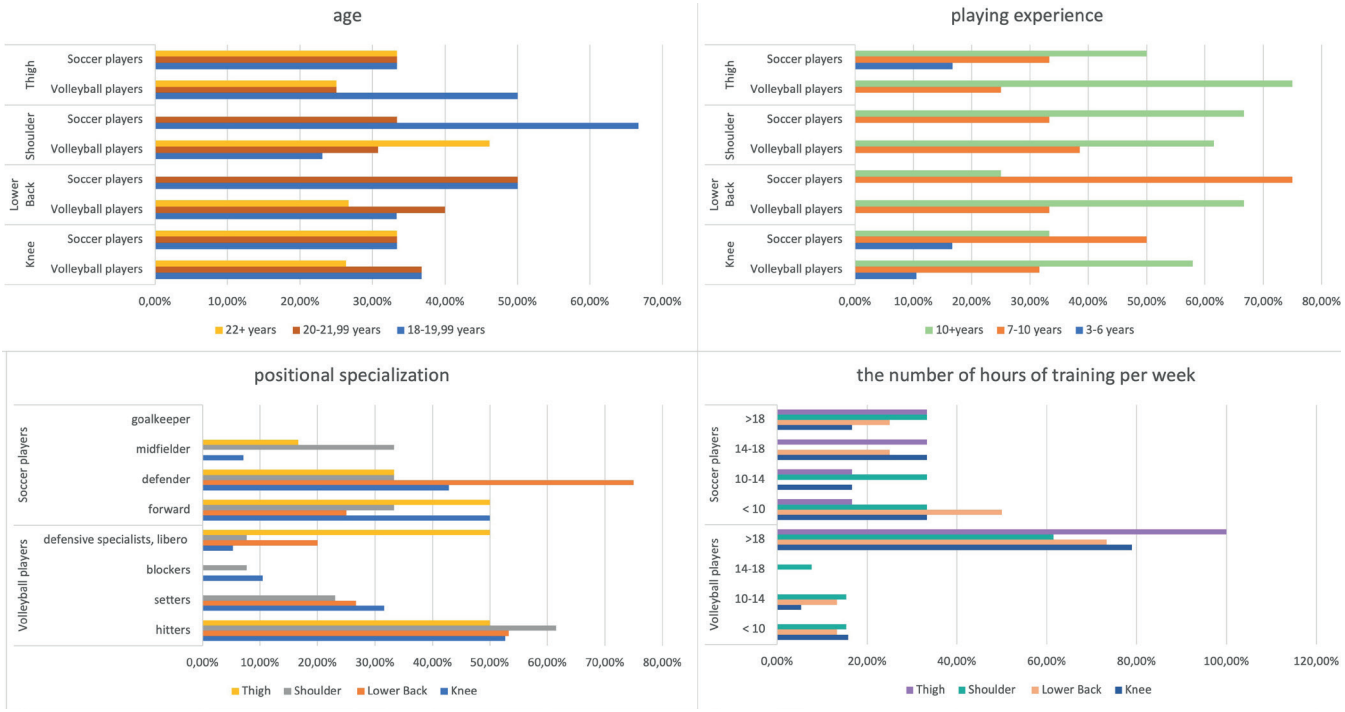


Figure 3. The prevalence of overuse injuries varies by age, playing experience, positional specialization, and number of training hours per week among groups of female volleyball players (n = 26) and soccer players (n = 19)

injuries. Shoulder problems were the most common, with a particular emphasis on the 18 to 19.99 age group (Figure 3). Lower back and knee problems were the most prevalent among the female soccer players with 7-10 years of playing experience, while shoulder and anterior thigh problems were more common among those with more than 10 years of playing experience. Regarding the relationship between the injuries and the specific playing roles, it was established that the defenders were the most susceptible to back injuries, while the forwards were more prone to knee and thigh injuries (Table 3).

Discussion

This study examined the relationship between the overuse injuries, age, training experience, weekly training load, and playing position in the college volleyball and soccer players. The female soccer and volleyball players in university teams were found to have the high prevalence of overuse injuries in various anatomical areas. The female volleyball players had higher rates of knee, back, and shoulder problems compared to the female soccer players, while hip injury rates were similar. The overuse injuries decreased within a month in both groups.

The female soccer players training more than 10 hours per week had the highest prevalence of overuse injuries. The defenders in soccer reported more lower back pain, while the forwards experienced more lower extremity pain. In volleyball, the attackers with over 10 years of experience and high training loads were more susceptible to injuries. Non-contact injuries and gradual onset injuries are frequently observed in elite female football players, despite variations in data collection methods across previous studies [7, 26]. A two-year prospective study conducted in Norway and Ireland, involving elite female athletes aged 22 ± 4 years, revealed that nearly one in four athletes experienced overuse injuries [13, 27]. While studies on male cohorts may not be directly applicable to females, Mashimo et al. [18] found average prevalence of 4.5% for all overuse injuries and 2.3% for significant overuse problems in male college football players during a competitive season. Bere et al. [2] identified prevalence of 20.7% for overuse injuries among world-class volleyball players (junior and senior, male and female) and expressed concerns that true magnitude of overuse injuries could be even higher, as players often continue competing despite chronic overuse injuries. Skazalski et al. [25] reported knee, back, and shoulder overuse injuries at rates of 31%, 21%, and 19%, respectively, in male volleyball players, using the same methodology as the present study, which aligns with its findings.

Overuse knee injuries: The current study's findings regarding the high prevalence of knee injuries in the soccer and volleyball players are consistent with previous studies [2, 5, 8, 25]. The specific activities involved in these sports, such as rapid turns while running, and rotational movements during landings after jumps, can disrupt knee joint coordination and increase an injury risk. Risk factors like knee hyperextension, imbalanced hamstring-to-quadriceps strength ratio, and longer duration of athletic practice contribute to knee injuries in both soccer and volleyball players [22]. In volleyball, repetitive high-intensity jumps and unstable landings during training may lead to abnormal biomechanics and subsequent knee injuries [8].

Lower back overuse injuries: The current study found that the mean weekly prevalence of back injuries was three times higher in the female volleyball players compared to the female soccer players, while the mean weekly severity score was similar. The prevalence of back injuries in the female soccer players in this study (9.21% [95% CI, 2.56-15.86]) aligns with findings from other studies on adult elite soccer players. Horan et al. [13] reported 7.5% torso/spine injuries in women, Östenberg and Roos [22] found 11% back injuries in female athletes. Several factors contribute to back pain and injuries in female soccer players, including physical collisions with opponents, "idle" hits on a ball, playing surface characteristics, and inadequate trunk muscle strength. Hormonal fluctuations during a menstrual cycle may also influence back pain in conjunction with these factors [13, 14, 22]. Volleyball players are at increased risk of lower back injuries and pain, particularly during movements involving extensor and rotational loads on a spine and repetitive asymmetric movements. Even young volleyball players can experience lower back pain [2, 20, 24, 25]. Microtrauma resulting from acute and chronic overstrain to osseous-ligamentous and muscular structures is considered a likely cause of lower back injuries [24].

Shoulder overuse injuries: The higher incidence of overuse shoulder injuries in the volleyball players compared to the soccer players is consistent with previous studies [19, 24]. The specific shoulder movements performed in volleyball, with a maximum range of motion and high angular velocity, put the joint at risk of injury. One study reported that shoulder overuse injuries accounted for approximately 19.0 ± 11.2% of total shoulder injuries in volleyball players [24]. The high incidence of such injuries in volleyball is attributed to intensity and frequency of ball strikes, serves, blocking, and other movements involving the shoulder joint, which impose excessive loads and lead to tissue overloading, disruption of nutrition, and subsequent microtrauma [19, 24, 25].

While there is limited literature on shoulder overuse injuries in female soccer players, the present study's findings on overuse injuries in this area are comparable to some earlier studies, although those studies did not differentiate between acute injuries and overuse injuries [7]. It is worth noting that the authors did not record any complaints of overuse injuries in female soccer goalkeepers, which could be due to the short duration of the study and a small number of goalkeeper participants. However, previous research has shown that female goalkeepers experience overuse injuries 7.7 times more frequently than female field players and 1.9 times more frequently than male goalkeepers [12].

Anterior thigh overuse injuries: The higher average weekly prevalence of anterior thigh injuries in the female soccer players compared to the female volleyball players was expected. While the authors did not find similar studies specifically on this topic, the current study's findings indirectly align with previous research on prevalence of hip injuries in female soccer players [13, 15, 17]. These injuries in female soccer players are often associated with non-contact mechanisms, which can be attributed to dynamic movements performed during a game, specific characteristics of ball interactions, and increasing fatigue experienced by players, especially towards an end of matches or training sessions [7, 22]. Conversely, the authors observed low prevalence of hip overuse injuries in the female volleyball players, which is consistent with previous findings [20].

In the present study, the authors observed a peak of problems in the second week in the volleyball players, primarily affecting the knees and back, while the soccer athletes experienced the increase in back injuries. This pattern is consistent with a multi-sport study by Ekman et al. [10], which can be explained by nature of overuse injuries. Initial microtrauma and mild pain may be ignored by athletes, leading to a progression of pain and impaired function, especially when time for recovery is insufficient. The authors cautiously conclude that the findings align with general trends and are broadly consistent with other investigations indicating that overuse injuries are the most prevalent among female athletes during a competition season [3, 4, 14].

Effect of playing position on overuse injuries: Even within a group of athletes specializing in the same sport, differences exist regarding an influence of playing positions on injury characteristics [3, 4, 15, 25]. The

present study partially aligns with Chandran et al. [3] who reported higher injury rates in midfielders (30.65%) and defenders (27.87%) regardless of cause, although the current study's authors found the defenders and forwards to be the most susceptible to injuries. While this study did not identify overuse issues among goalkeepers, possibly due to the limited number of goalkeepers included, Joo's [15] investigation into epidemiology of soccer injuries within a Korean women's team over a 5-year period revealed a heightened occurrence of upper limb injuries in goalkeepers compared to other positions, attributed to their unique playing characteristics.

In the volleyball players, the majority of complaints of pain and injuries came from the hitters and setters, which is in line with a study where outside hitters and central blockers were reported to have high injury rates [4]. These positions involve more frequent jumping and landing with a deeper crouch, which may contribute to an increased risk of injuries.

Effect of age on overuse injuries: Lower back and shoulder pain and injuries were more common among the female soccer players aged 18 to 22 and the female volleyball players aged 20 and older. Knee and hip injuries were evenly distributed across all age groups of the female soccer players. The current study's findings are consistent with longitudinal epidemiological studies of injuries and diseases in women's international soccer teams, which found no difference in localization and severity of injuries based on age [7, 26].

In the female volleyball players, knee problems were predominant in the under-20 age group, while hip injuries were more common among the youngest (18-19.99 years) athletes. This aligns with prior research indicating that younger elite players tend to face a higher risk of injury compared to their older counterparts [29]. There is also evidence that an incidence of overuse injuries increases significantly as gifted young athletes progress to a professional level [16].

Effect of weekly training time on overuse injuries: Interestingly, the present study found that the female soccer players who trained less than 10 hours per week had the highest incidence of knee and lower back injuries, contradicting the findings of previous research. On the other hand, the soccer players who trained 10-14 hours per week had the fewest injuries. In the volleyball players, the highest number of injuries was observed in the athletes with more than a decade of experience and who practiced more than 18 hours per week. These findings are consistent with previous research, which also reported increased likelihood of serious injuries with increasing years of experience.

Effect of years of sport participation on overuse injuries: The results of the current study showed that the female soccer participants with 3-6 years of playing experience had the lowest prevalence of overuse injuries in all studied anatomical areas. This may be attributed to their shorter participation time in training and matches compared to the adult female athletes [7]. On the other hand, the female soccer participants with more than seven years of experience had higher likelihood of serious overstrain-related knee and lower back injuries, and those with more than 10 years of experience had greater likelihood of serious shoulder and hip injuries. A similar trend was observed among the volleyball players, with a twofold increase in the odds of overuse injuries in the knee, back, and shoulder areas, and a threefold increase in the odds of hip injuries among those with more than 10 years of experience. These findings align with previous studies in the literature, which also reported increased likelihood of serious injuries with increasing years of experience [19, 25].

However, it is important to consider certain limitations when interpreting the results of the present study. Firstly, the study involved only two Taiwanese university teams, which may limit generalizability of the findings to other populations. It should also be noted that this study did not collect objective data on training load parameters, which limits an ability to analyze effects of training volume, intensity, recovery time, density, specificity, and frequency on the prevalence and characteristics of overuse injuries. In addition, although the OSTRC-O questionnaire used to collect injury data has been validated for tracking and monitoring injuries over time, the subjective nature of the data collected directly from the players over the four-week period may introduce some limitations in terms of accuracy and completeness. Specifically, due to a broad definition of recordable injuries, it is likely that some of the recorded complaints may have been caused by factors such as delayed onset muscle soreness rather than an overuse injury.

Conclusions

This study has yielded several important conclusions that can be instrumental in developing injury prevention programs for women in soccer and volleyball. The authors observed notable differences in the prevalence of overexertion injuries between the female soccer players and female volleyball players from the university teams. Various factors such as sport-specific aspects, playing activities and movements, age, playing experience, and weekly training volume were identified as risk factors for knee and hip injuries in the female soccer athletes,

and knee, lower back, and shoulder injuries in the female volleyball athletes. While minor overexertion injuries may have a relatively smaller impact on player participation and performance, the prevalence of problems and pain associated with overuse was significant in both female soccer players and volleyball players. The continuous and intense physical activity involved in these sports can exacerbate symptoms and increase the likelihood of more severe overuse injuries.

Coaches, physical therapists, and clinicians should take into account the substantial prevalence of these injuries and implement evidence-based prevention strategies tailored to specific sports, teams, and groups of female athletes. The findings of this study can offer valuable guidance to coaches and medical staff in terms of prescribing and adjusting training loads, optimizing recovery and performance of female athletes, and minimizing the risk of overtraining and injury. By considering the frequency and prevalence of sport-specific injuries, appropriate measures can be taken to enhance well-being and longevity of female athletes in soccer and volleyball.

Conflict of Interest

The authors declare no conflict of interest.

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