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Unilateral and bilateral jumping performance in female basketball players with and without a history of lower limb injuries

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Abstract

Introduction: Lower limb injuries are major problems in team sports, especially among female players. The study aimed to investigate how lower limb injury history compared to no history of injuries affects unilateral and bilateral jumping performance in female basketball players. Additionally, knee and ankle mobility were investigated.

Material and methods: Twenty-one female basketball players participated in this study: 12 players from the elite level and 9 from the university team. There were 21 limbs with an injury history of knee or ankle sprain. Two jumping tests were conducted: a two-leg countermovement jump (CMJ) without arm swing, and a series of single-leg jumps within 15 seconds. Parameters of jumps were detected and measured using the optical measuring system. Injury history was investigated using a survey.

Results: Elite players had a greater CMJ height, specific and total energy, active knee extension and smaller ankle dorsiflexion than university players. No significant differences were found between knee and ankle injuries in terms of the parameters of CMJ and single-leg jumps or range of motion. There were significant correlations between the frequency of jumps ($r = -0.66$, $p = 0.001$), total energy ($r = 0.55$, $p = 0.009$), contact time ($r = 0.49$, $p = 0.02$), height ($r = 0.46$, $p = 0.03$) and the time elapsed since the injury.

Conclusions: Coaches and physiotherapists should consider the connection between time elapsed since the injury and jumping performance when evaluating female basketball players' abilities and risk factors for re-injury.

Keywords: ankle, knee, plyometric exercise, rehabilitation, sports

Introduction

Lower limb injuries are significant problems in team sports, especially among female players. Previous research has shown that females had a 25% greater risk of sustaining an ankle sprain compared with their male counterparts [1]. About 65% of all sports injuries were localized in the lower extremities and lateral ankle sprain (13.7%) was the most common injury among female basketball players [2]. However, knee injuries had the greatest long-term impact on games missed due to injury [3].

Various factors contribute to differences in neuromuscular performance. These factors include anatomical asymmetries in the lower limb, neural development with side dominance, incomplete recovery from previous injuries, repetitive asymmetrical sport-specific demands, professional training, and age [4]. To determine limb symmetry, one can compare the scores of an injured limb to an uninjured one and express the ratio as a percentage. The asymmetry index is another important screening tool for athletes who have not been injured yet [5]. To determine this, the ratio between the scores of the dominant and non-dominant limbs is calculated. Many athletes, whether professional or amateur, tend to favour one leg during training or competition, which can lead to a noticeable difference in muscular strength between their dominant and non-dominant legs over time [6]. However, the role of asymmetries as risk factors for future injuries still needs to be established, as previous studies have provided limited evidence [5,7]. It is common for sports players to have differences in strength or flexibility on either side of their body, which are known as bilateral asymmetries. However, there is no indication that this negatively affects their performance or increases their risk of injury [8]. On the other hand, it is widely recognized that basketball players and other athletes may experience asymmetries in strength and jumping abilities following an injury [9–11]. It is suggested that female athletes who have experienced knee injuries and returned to sports may continue to exhibit biomechanical limb asymmetries even after 2 years [12].

Recent research suggests that the height asymmetry in running single-leg jumps among collegiate basketball players may be due to ankle joint kinematics during take-off. This could impact their ability to transmit run-up velocity effectively and achieve the optimal jump height [13]. Many studies have already investigated asymmetry between the limbs in performance during different types of vertical jumps [14,15]. Vertical jumps are frequently used as a test for monitoring neuromuscular status in many sports [16,17]. The connection between inter-limb asymmetries and physical performance measurements has been researched previously [18,19]. Performing unilateral (one-leg) and bilateral (two-leg) jumps involves a dynamic muscle action called the stretch-shortening cycle, which includes concentric and eccentric muscle contraction [20]. Although there is speculation that arm swing could potentially counteract lower extremity actions and mask lower limb force asymmetries, both countermovement jump (CMJ) variations (with and without arm swing) offer reliable insights into inter-limb asymmetries [21]. The single-leg countermovement jump may be the most accurate indicator of injury risk, as compensatory mechanisms are restricted when compared to jumping with both legs [4]. However, one task may not be enough to identify asymmetrical movement patterns [7,22].

A plyometric exercise, in which a person falls from a certain height and immediately after landing performs a vertical jump with maximum effort, is an important element of preparation and testing in basketball, especially when single-leg exercises are performed [13,16]. Previous injuries may significantly affect the performance of single-leg landings and trigger several compensatory mechanisms [9]. It can lead to an increased risk of re-injury and limit the development of players' sports careers. Despite many scientific papers demonstrating how lower limb injuries negatively affect sports performance due to recognized asymmetries and abnormal biomechanics, only a few studies have investigated these aspects in female basketball players. Moreover, although CMJ is widely used in players' assessments, little is known about the influence of injuries on serial one-leg jumps.

Bearing in mind the relevance of the previous investigations, the study aimed to investigate how a history of lower limb injury in the knee and ankle compared to no history of injuries affects unilateral and bilateral jumping performance in female basketball players. Additionally, knee and ankle mobility were investigated to compare injured and uninjured limbs further. We hypothesized that there would be a decrease in jumping ability and limitation in range of motion as a result of lower limb injuries.

Materials and methods

Participants

A convenience sample of 21 female basketball players participated in this study: 12 players from the elite lever (I Ligue) and 9 from the university team (lower level of competition). The study was approved by the Bioethics Committee of the local university (KE-0254 /93/2020) and was carried out by the ethical principles of the Declaration of Helsinki. All participants signed informed consent to participate in the study. Participants were excluded if they had limited participation in training due to a recent injury.

Basketball players were asked whether they had ever suffered knee and ankle injuries that excluded them from training or matches for at least 2 weeks. Next, the players were asked what the injury was, which limb it affected, and how long ago it occurred. Based on the survey and interview, 12 out of 21 players were diagnosed with an ankle sprain, which had excluded them from games and/or training for a minimum of 2 weeks but had returned fully to training. The injuries affected 17 limbs – five players experienced bilateral injuries (elite: 58.33%, number of players = 7; university:

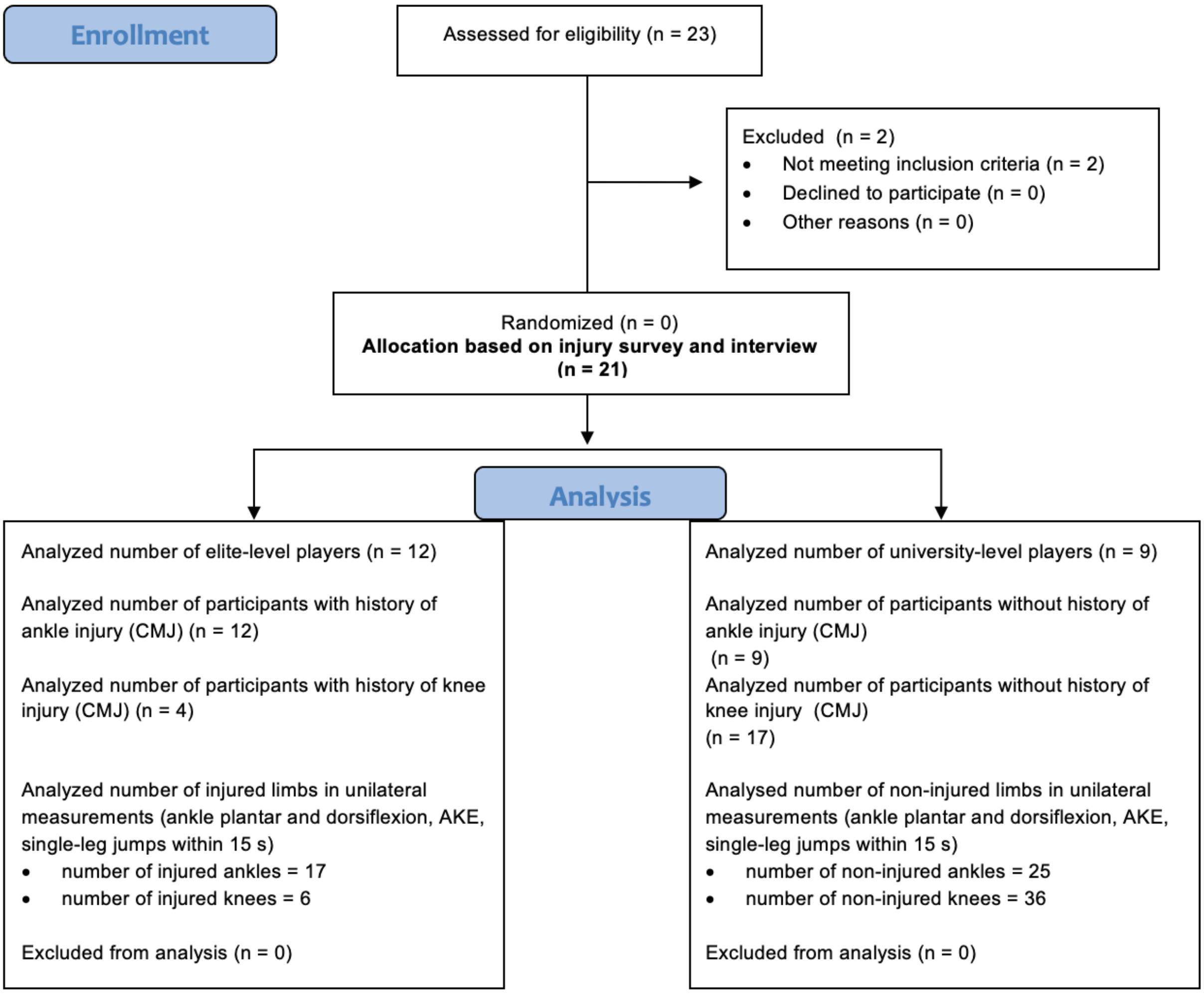

Fig. 1. Modified CONSORT flow diagram of the cross-sectional study

CMJ – counter movement jumps; AKE – active knee extension.

55.56%, number of players = 5; Pearson's Chi^2 = 0.16, p = 0.89).

Four players (two from the "elite group" and two from the "university group") had anterior cruciate ligament (ACL) injuries (number of injured legs = 4) or jumper's knee (number of legs = 2) which had excluded them from games and/or training for a minimum of 2 weeks but the players made a return to full training. In total, there were 21 limbs with an injury history.

A flowchart illustrating the study participation process is presented in Figure 1.

Procedure

The testing procedure was conducted in one session as follows:

1. Warm-up.
2. Range of motion (ROM) measurements:
   • ankle plantarflexion and dorsiflexion
   • active knee extension test (AKE)
3. Jumping tests (random order):
   • two-leg countermovement jump (CMJ) without arm swing
   • series of single-leg jumps within 15 seconds.

The athletes did a 30-minute warm-up that included jogging, free-running, and exercises in various positions (standing, sitting, and lying down). Following that, they did three tests: ankle plantar and dorsiflexion, weight-bearing ankle dorsiflexion, and AKE. The positions for the measurements are illustrated in Figure 2.

A standard plastic goniometer was used to measure ankle plantarflexion and dorsiflexion ROM [23]. Two measurements of both movements were taken in positions against gravity using standard procedure [24]. In the standing position, the knee-to-wall test was performed twice to measure ankle dorsiflexion under weight-bearing. Maximal dorsiflexion ROM was defined as the maximum distance of the toe from the wall without lifting the heel and maintaining contact between the wall and the knee [25]. Ankle dorsiflexion ROM was measured using a tape measure according to

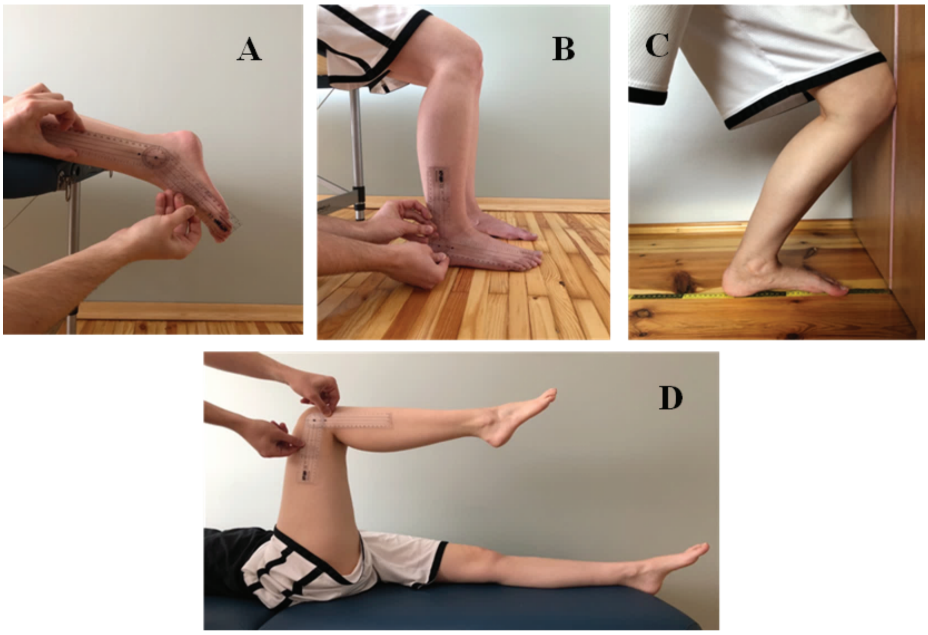

Fig. 2. Positions of mobility measurements: ankle plantarflexion (A); ankle dorsiflexion (B); ankle dorsiflexion under weight-bearing (C); active knee extension (D)

the procedure suggested by Konor et al. [25]. AKE was performed in the supine position by active extension of the knee while maintaining 90 degrees of hip flexion [26]. Each parameter was measured twice, and the mean angle was used for analysis.

Outcome measures

Two jumping tests were conducted in a random order to evaluate jumping performance. The first was the two-leg CMJ without arm swing, and the second was a series of single-leg jumps within 15 seconds. Each subject performed the countermovement jump twice, with a 10-second break between repetitions. The average value of these two measurements was used for statistical analysis. Participants began in their habitual standing position, with feet shoulder-width apart and hands on their waist. They then dropped into a squat position to a self-selected depth, followed by a maximal effort vertical jump. Participants wore the standard practice shoes of their choosing. The instruction given was to “jump as high as you can”.

Participants were instructed to perform a series of vertical single-leg jumps in place for 15 seconds. Starting from standing on one leg with hands on hips, there were no breaks between jumps. The participants were asked to jump with maximal effort, following the instruction to “jump as high and as fast as possible.” This procedure was repeated on both the left and right legs.

Previous research has suggested that most jump parameters during unilateral and bilateral CMJ testing have demonstrated acceptable reliability, and the measurement tool offers practitioners a reliable method for assessing CMJ performance [27,28].

Data collection and analysis

The parameters of the jumps were detected and measured using the optical system OptoJump (Microgate, Bolzano, Italy) device consisting of a transmitting and receiving bar [29–31].

- Height – the distance from the ground to the highest point during the flight, expressed in (cm),
- Number of jumps in 15 seconds – number of jumps on one leg (right or left) during a series of jumps on one leg for 15 seconds, with no break between the jumps,
- Contact time – time from the moment of contact of the foot/feet to detaching them from the ground, expressed in (s),
- Frequency – the quotient of the number of jumps (of a full cycle of one jump) to the duration of the test, i.e. 15 s, expressed in (jumps/s),
- Total energy – includes the total energy that is generated by the competitor during the test; it is the product of the specific energy and the weight of the person being tested, expressed in (J),
- Specific energy – generated during the test, is expressed in (J/kg) and calculated according to the formula: $\sum h_{jumps} \cdot g$.
- Max-min difference – determines the difference between the largest and smallest measurement during a series of jumps within 15s about the largest value,

expressed in (%). This parameter can be used as a measure of the dispersion (variability) of measurement results under the influence of fatigue and is calculated according to the formula:

$$R_{max-min} = \frac{\max \mathit{height} - \min \mathit{height}}{\max \mathit{height}}.$$

Statistical analysis

Statistical analysis was performed using Statistica™ (Tibco, version 13.3). The normality of the distribution was verified using the Shapiro-Wilk test. If the assumption of normal distribution was met, a two-way factorial analysis of variance (ANOVA) was used to examine the relationship between the sports level of the players and the occurrence of injuries and jumping performance. Levene's test was used to check the homogeneity of variances. Due to the small number of participants with knee injuries, the U-Mann-Whitney test was performed instead of ANOVA.

Pearson's chi-square test of independence was used for categorical variables. To analyze the relationship of quantitative variables, Spearman's rank correlation was used. It was assumed that a value of the correlation coefficient (r) in the range of 0–0.3 means weak correlation; 0.3–0.5 – moderate correlation; 0.5–0.7 strong correlation; 0.7–1 – very strong correlation. A statistical significance level of p = 0.05 was assumed for all tests. The results are presented as means and standard deviations.

Results

Detailed characteristic of participants is presented in Table 1. Elite players were slightly higher than University players. The years of regular training were 13.17 in elite players and 7.11 in University players. The comparison showed that players who had knee injuries were older and had greater experience in training than players without knee injuries.

Statistical analysis revealed that Elite and University players significantly differ regarding AKE and ankle dorsiflexion. Elite players had greater AKE and smaller ankle dorsiflexion than University players. There were no significant differences between groups regarding ankle and knee injuries. Detailed results are shown in Table 2.

Regarding CMJ, Elite players had a greater jump height and specific and total energy than University players. No significant differences were found between the groups of knee and ankle injuries. Table 3 presents detailed results.

There was also a statistically significant difference between Elite and University players in total energy during the 15s single-leg jumps. There were no other significant differences in terms of the parameters of single-leg jumps. Detailed results are presented in Table 4.

We have observed a noteworthy correlation between the time since the last injury and the parameters of single-leg jumps within a 15-second timeframe (Fig. 3). There was a strong and moderate correlation between

Tab. 1. Descriptive statistics and comparison of groups

Variable	Level of advancement	M	SD	Stat.	Ankle injury	M	SD	Stat.	Knee injury	M	SD	Stat.
Age (year)	Elite	22.67	4.31	F = 0.32 p = 0.58	Injured	21.83	3.27	F = 0.56 p = 0.46	Injured	23.75	1.71	Z = –2.39 **p = 0.02**
	University	22.00	1.00		Control	23.11	3.33		Control	22.06	3.51	
Height (cm)	Elite	179.33	9.58	F = 6.03 **p = 0.03**	Injured	177.42	7.94	F = 1.53 p = 0.23	Injured	173.75	11.93	Z = 0.41 p = 0.68
	University	169.78	6.53		Control	172.33	11.15		Control	175.59	9.29	
Weight (kg)	Elite	72.25	11.86	F = 3.62 p = 0.07	Injured	69.00	10.92	F = 0.20 p = 0.66	Injured	67.50	12.37	Z = 0.05 p = 0.96
	University	61.89	10.84		Control	66.22	14.53		Control	67.88	12.70	
BMI (kg/m2)	Elite	22.35	2.21	F = 1.31 p = 0.25	Injured	21.94	1.73	F = 0.001 p = 0.97	Injured	21.85	1.80	Z = 0.01 p = 0.99
	University	21.34	2.48		Control	21.90	2.73		Control	21.93	2.46	
Years of training	Elite	13.17	4.02	F = 9.43 p = 0.01	Injured	10.92	5.38	F = 0.12 p = 0.73	Injured	13.50	2.52	Z = –1.99 **p = 0.045**
	University	7.11	4.51		Control	10.11	5.09		Control	9.88	5.41	

BMI – Body Mass Index, F – results of ANOVA, M – mean, SD – standard deviation, Stat. – statistics, Z – results of the U-Mann-Whitney test. Bold values denote statistical significance at the p < 0.05 level.

Tab. 2. Summary statistics for ROM in groups

Variable ROM	Level of advancement	M	SD	Stat.	Ankle injury	M	SD	Stat.	Knee injury	M	SD	Stati.
AKE (°)	Elite	177.21	5.73	Z = 2.16	Injured	176.35	4.70	Z = 0.46	Injured	173.50	6.25	Z = 1.46
	University	174.22	5.36	**p = 0.03**	Control	175.64	6.38	p = 0.64	Control	176.33	5.61	p = 0.15
Ankle dorsiflexion (°)	Elite	19.63	2.83	F = 29.79	Injured	21.29	3.18	F = 0.60	Injured	21.00	3.22	Z = 0.63
	University	25.17	3.09	**p < 0.001**	Control	22.48	4.50	p = 0.44	Control	22.17	4.15	p = 0.53
Ankle plantarflexion (°)	Elite	40.17	3.20	F = 3.04	Injured	38.82	2.65	F = 1.11	Injured	38.67	2.07	Z = 0.72
	University	38.39	2.85	p = 0.09	Control	39.80	3.44	p = 0.30	Control	39.53	3.30	p = 0.47
Knee-to-wall (mm)	Elite	92.17	16.69	F = 2.15	Injured	90.77	16.84	F = 0.01	Injured	81.83	16.56	Z = 1.42
	University	86.50	13.66	p = 0.15	Control	89.04	14.92	p = 0.93	Control	91.06	15.21	p = 0.16

AKE – active knee extension, F – results of ANOVA, M – mean, ROM – range of motion, SD – standard deviation, Stat. – statistics, Z – results of U-Mann-Whitney test. Bold values denote statistical significance at the p < 0.05 level.

Tab. 3. Summary statistics for CMJ parameters in groups

Variable CMJ	Level of advancement	M	SD	Stat.	Ankle injury	M	SD	Stat.	Knee injury	M	SD	Stat.
Height (cm)	Elite	30.90	3.90	F = 7.94	Injured	29.15	4.67	F = 0.34	Injured	28.00	6.01	Z = 0.31
	University	25.73	4.24	**p = 0.01**	Control	28.06	5.03	p = 0.57	Control	28.84	4.59	p = 0.75
Specific energy (J/kg)	Elite	3.03	0.38	F = 7.90	Injured	2.86	0.46	F = 0.34	Injured	2.75	0.59	Z = 0.40
	University	2.52	0.42	**p = 0.01**	Control	2.75	0.49	p = 0.57	Control	2.83	0.45	p = 0.68
Total energy (J)	Elite	217.45	35.14	F = 11.59	Injured	197.13	42.85	F = 0.44	Injured	183.28	42.95	Z = 0.40
	University	156.80	42.09	**p = 0.003**	Control	183.88	56.53	p = 0.52	Control	193.38	50.5	p = 0.68

CMJ – countermovement jump, F – results of ANOVA, M – mean, SD – standard deviation, Stat. – statistics, Z – results of U-Mann-Whitney test. Bold values denote statistical significance at the p < 0.05 level.

the frequency of jumps ($r = -0.66$, $p = 0.001$), total energy ($r = 0.55$, $p = 0.009$), contact time ($r = 0.49$, $p = 0.02$), height ($r = 0.46$, $p = 0.03$) and the time elapsed since the injury.

Discussion

In this study, we investigated the relationship between lower limb injuries (specifically, those affecting the ankle and knee) and both bilateral and unilateral jumping performance in female basketball players at the elite and university levels. We have noted four main results from our study. Firstly, participants with a history of knee injury were found to be older and more experienced players than females without knee injuries. Secondly, there were no significant differences in the jumping abilities of injured and non-injured players, regardless of whether they were using one or two legs. Thirdly, there were significant differences in jumping performance between elite-level players and university-level players. Lastly, we discovered that jumping performance is related to the length of time since the injury occurred.

It was expected that there would be a correlation between age, years of training, and injuries. This conclusion was also reached in a previous study conducted by Schiltz et al [11]. It was revealed that male basketball players who had a history of knee injuries were typically older than those who had not been injured [11]. Lewis's research demonstrated that increased experience in basketball at the highest level of competition is linked to a higher risk of injury [32].

The lack of differences between groups in terms of jump parameters was confusing. Research has shown that basketball players and other athletes may develop imbalances in strength and jumping abilities after sustaining an injury [9–11]. However, the asymmetry needs

Tab. 4. Summary statistics for single-leg jump parameters in groups

Variable single-leg jumps	Level of advancement	M	SD	Stat.	Ankle injury	M	SD	Stat.	Knee injury	M	SD	Stat.
Number of jumps/15 s	Elite	24.83	3.37	F = 1.41 p = 0.24	Injured	25.47	2.81	F = 0.13 p = 0.72	Injured	23.83	2.86	Z = – 0.49 p = 0.63
	University	26.00	2.50		Control	25.24	3.26		Control	25.58	3.05	
Specific energy (J/kg)	Elite	27.05	6.89	F = 0.61 p = 0.44	Injured	26.68	5.29	F = 0.01 p = 0.91	Injured	28.90	9.69	Z = 1.47 p = 0.14
	University	25.81	5.74		Control	26.41	7.12		Control	26.12	5.75	
Total energy (J)	Elite	1910.87	365.25	F = 11.78 **p = 0.001**	Injured	1849.58	349.75	F = 0.52 p = 0.48	Injured	1871.17	423.27	Z = – 0.84 p = 0.40
	University	1562.51	289.40		Control	1701.73	385.25		Control	1743.31	368.80	
Specific strength(W/Kg)	Elite	14.40	3.70	F = 0.50 p = 0.48	Injured	14.25	2.98	F = 0.02 p = 0.89	Injured	15.32	5.11	Z = – 0.34 p = 0.73
	University	13.87	2.98		Control	14.12	3.69		Control	13.98	3.07	
Contact time (s)	Elite	0.31	0.05	F = 0.81 p = 0.37	Injured	0.30	0.04	F = 0.67 p = 0.42	Injured	0.31	0.04	Z = – 0.23 p = 0.82
	University	0.30	0.06		Control	0.31	0.06		Control	0.30	0.05	
Height (cm)	Elite	11.45	3.87	F = 1.51 p = 0.23	Injured	10.89	2.99	F = 0.07 p = 0.79	Injured	12.73	5.25	Z = – 0.93 p = 0.35
	University	10.21	2.68		Control	10.93	3.75		Control	10.61	3.03	
Frequency (jumps/s)	Elite	1.67	0.24	F = 1.12 p = 0.30	Injured	1.72	0.22	F = 0.19 p = 0.67	Injured	1.61	0.22	Z = 1.47 p = 0.14
	University	1.75	0.17		Control	1.69	0.22		Control	1.72	0.21	
Difference max-min (%)	Elite	0.43	0.13	F = 0.25 p = 0.62	Injured	0.43	0.13	F = 0.34 p = 0.56	Injured	0.43	0.12	Z = – 0.49 p = 0.63
	University	0.43	0.13		Control	0.43	0.12		Control	0.43	0.13	

F – results of ANOVA, M – mean, SD – standard deviation, Stat. – statistics, Z – results of U-Mann-Whitney test. Bold values denote statistical significance at the $p < 0.05$ level.

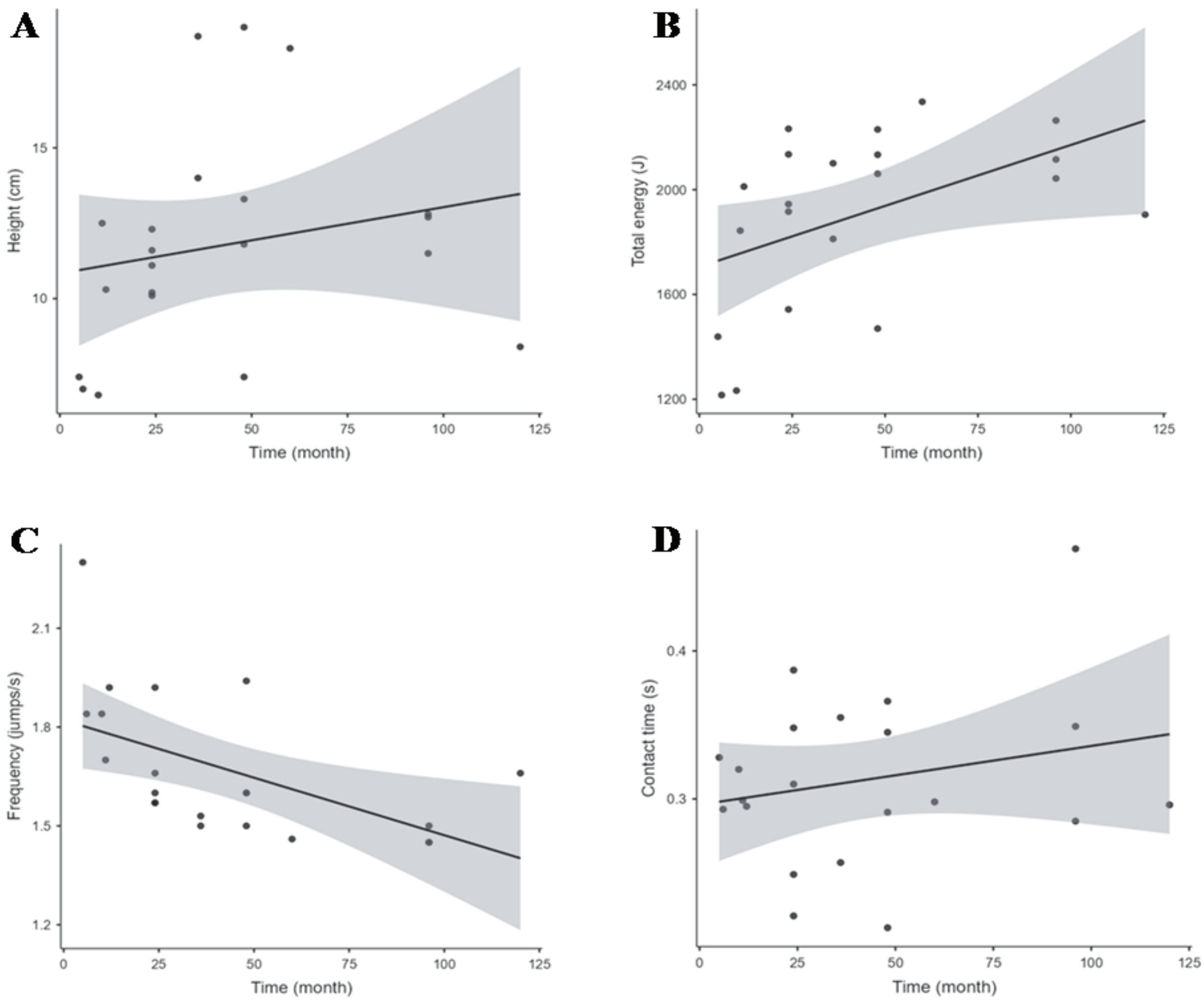

Fig. 3. Scatterplots for the relationship between single-leg jumps parameters and time since the injury occurred: Height (A); Total energy (B); Frequency (C); Contact time (D)

to reach a certain threshold to be considered significant [21]. Further analysis of the relationship between time since injury and performance results can explain our findings. Moreover, previous studies demonstrated that kinematic and kinetic differences between limbs are evident during agility tests 9 months after a knee injury, despite no statistical differences in performance time [33]. There may be neuromuscular differences between injured and uninjured limbs, but they may not necessarily impact athletic performance [34]. However, no statistically significant differences in ankle mobility and AKE between injured and uninjured limbs were discovered. A lack of significant differences in two-leg CMJ was previously observed in soccer players and suggests that in multi-joint activities, any deficiencies may be compensated for, which could potentially hide any abnormalities [35].

Our results indicate that there are significant differences in jumping performance between elite-level players and university-level players. Statistical analysis revealed that players differ significantly about AKE and ankle dorsiflexion. These results are quite understandable in that more advanced players obtain better results in jumping tests. Better mobility in AKE and significantly smaller mobility of ankle dorsiflexion in elite players can be a result of greater experience and adaptation to more demanding competition.

Despite the lack of significant differences between the groups in terms of jumping performance on one leg, there was a correlation between the parameters of jumps and the time elapsed since the injury. These results indicate that the movement pattern chosen by female basketball players was affected by the time elapsed since injury. Those participants who had experienced their injury recently had a greater frequency of jumps but a smaller jump height. The longer the time since the injury occurred, the greater the jump height, the lower the frequency, and the greater the total energy and contact time. It was previously suggested that female athletes who have experienced knee injuries and returned to sports may continue to exhibit biomechanical limb asymmetries even after 2 years [12]. Sharafoddin-Shirazi et al. [36] conducted a longitudinal observational study and concluded that patients who had undergone ACL injury suffer from limb asymmetries during landing tasks, which appear to normalize by 24 months post-surgery. In our study, time since injury ranged from 5 months to 120 months (10 years). Further research is needed to establish a cut-off point beyond which comparing injured and uninjured limbs is no longer meaningful. A history of previous injury is a significant risk factor for new injuries to the same region [37]. This also requires examining how the time elapsed since an injury affects the risk of another injury.

Limitations

Our study has a few limitations worth mentioning. First, the sample size is rather small. Second, the group of females is heterogeneous in terms of injury type and time since a trauma occurred. In the population of highly competitive team sports, it is difficult to put together a very homogenous group due to the wide range of injuries and their frequencies. There are also difficulties in finding a control group without a history of injuries. Except for major injuries, there are some minor injuries (ones that exclude athletes from training for a few days) whose additional effect on sports performance and biomechanics is not known.

Clinical implications

Female basketball players are at greater risk of lower limb injuries (especially knee injuries) than male athletes [38]. The ankle is the most common site of injury and ACL reconstruction is the most common surgery in elite female basketball players [39]. According to the literature, single-leg vertical jump testing is recommended to detect differences between injured and healthy young athletes [40]. However, in our study, we failed to confirm this thesis, although we did notice a significant relationship between time elapsed since injury and motor strategy during a series of single-leg vertical jumps within a 15-second timeframe. Thus, coaches and physiotherapists should consider this aspect when testing and evaluating female basketball players' abilities and risk factors for re-injury. Moreover, it might also be recommended to investigate the history of limb injury more carefully about specific types of injury in a more homogeneous group.

The most relevant finding in our study is the connection between time elapsed since an injury and a series of single jumps in female basketball players. However, we failed to demonstrate the impact of traumatic injuries on the performance of uni – and bilateral jumping tests. Our research may explain previous disagreements among researchers regarding the impact of past sports performance [41]. The factor explaining these discrepancies may be the time since the injury. The results may also suggest that a series of single-leg jumps may provide new information about post-injury compensation, which is due to the unilateral character and fatigue during the test.

Conclusions

In conclusion, previous knee and ankle injuries do not have an impact on both unilateral and bilateral jumping abilities. However, time from injury occurrence can influence this relationship. When assessing basketball players' skills and risk factors for re-injury, coaches, and physiotherapists should take into account the relationship between jumping performance and the time that has passed since the injury. For evaluating jumping performance after limb injury, a series of 15-second jumps may be more appropriate than a two-leg CMJ, due to the test's unilateral character and endurance, which can cause fatigue.

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Conflicts of interest

The authors declare no conflict of interest.

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