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ORIGINAL ARTICLE

Incidence and Localization of Knee Pain and Injuries in Basketball Players

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ABSTRACT

Background. The primary aim of the study was to determine the incidence and localization of knee pain and injuries in basketball players. **Objectives.** Through partial objectives, this study aimed to determine the differences between the participants based on their player position and chronological age and to determine the basic metric characteristics of the questionnaire. **Methods.** The sample of participants included 57 male basketball players in the senior age category. The mean chronological age of players was 21.6 years. A newly-constructed questionnaire was applied, which was filled out anonymously. The questionnaire was adapted for basketball and has very good metric characteristics, which allows quality measurement of the incidence of knee pain, and consequently of knee injuries in basketball players. **Results.** It was determined that 66.67% of basketball players feel pain on the front side of the knee, 12.28% on the side, and 21.05% do not feel pain in the knee. Players who play at the center position have never experienced a knee injury, whereas players at the power forward position reported the highest percentage of injury, i.e., 71.43%, shooting guards reported 33.33%, small forwards 14.29%, and point guards, 12.50%. There was no statistically significant difference between the participants according to chronological age. **Conclusion.** The applied questionnaire represents a good measuring instrument for assessing knee pain in basketball.

KEYWORDS: ***Basketball, Player Positions, Injuries, Incidence of Pain, Knee.***

INTRODUCTION

Basketball is a poly-structural acyclic Olympic team sport. The goal is to win more points than the opponent and the points are won by throwing the ball into the hoop. Basketball has two phases: offense and defense. In the offense, the players try to win a point as simply as possible by throwing the ball into the opponent'shoop while their defense is preventing them with their defensive tactics and skills (zone defense or man-to-man defense), trying to organize a counter-attack. There are five player positions in basketball (1-4). Each position requires players to execute individual or collective tasks during a match and take responsibility in defense or offense according to their position. The knee joint is responsible for transferring specific forces through sudden stops, jumps, running, and sudden changes of direction. These movement patterns, in addition, to contact with other players and improper landing on the surface, are precisely the high-risk moments and mechanisms that lead to knee injuries (1, 2). Brzić (3) states that 80% of sports injuries are a consequence of trauma.

Through structurally demanding movements, the active stabilizers of the knee are groups of muscles that have their start points and grips on the skeletal segments of the knee joint with the associated tendons. Furthermore, pathologies

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related to the patella tendon are very common. Consistent jumping movements, along with long-term training loads and inadequately developed and trained musculature, create a mechanical load on the tendon-bone connection site, which causes a pathology called jumper's knee (4, 5). The anterior and posterior cruciate ligament and collateral ligaments along the articular capsule and menisci inserted between bone structures are responsible for the passive stabilization of the knee, and the highest incidence of acute injuries has been recorded precisely in these segments (6). Numerous studies (7-9) point out that lower extremity injuries are the most common injuries in basketball. Furthermore, 58% to 66% of all injuries affect specific anatomical regions – ankle and knee joints. McKay et al., (10) state that the lower extremities are exposed to a much greater risk of injury than the upper extremities.

Cumps, Verhagen, and Meeusen (11) state that wing players report the fewest chronic knee injuries related to the overexertion syndrome, significantly less than players in the center position, whereas pain symptoms most often occur in the anterior knee. Furthermore, Drakos et al. (9) mention patellar tendonitis as the most common reason for not playing matches. Moreover, the forces produced by the exchange of a large number of concentric-eccentric muscle contractions in the formation of jump and landing movements often exceed the strength of the muscle-tendon apparatus of the knee joint, which, along with frequent changes of movement direction during basketball play, favors the occurrence of acute injuries, overstrain syndrome, or pain in various locations of the knee joint.

The analysis of the literature reveals a trend of knee injuries in basketball. Moreover, the very structure of players' movements and the extent and intensity of training and matches increase the possibility of knee joint injuries. However, such studies, done on a sample of Croatian professional basketball players are lacking. Thus, the study aimed to determine the incidence and localization of knee pain and injuries in basketball players. Furthermore, partial objectives were to determine the differences between the participants according to their player position and to determine the basic metric characteristics of the questionnaire.

MATERIALS AND METHODS

Sample of participants. The sample of participants included 57 senior basketball players who compete at the highest level of the basketball league in Croatia, the Premier League. All players were of full age, from 18 to 28 years old. The players' mean chronological age was 21.6 years. Their mean body height was 191.63 cm and their mean body mass was 85.38 kg.

Variable sample and procedure. The variable sample was collected by an online Questionnaire on the incidence of knee pain and injuries (12) adapted for basketball. Before the data collection, verbal consent was obtained from the coaches and clubs, as well as personal consent from the players. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

The players were sent a link to a Google Docs survey, which they filled out on their own. Given that all respondents were of full age, consent from their legal guardians for participation in the research was not necessary. All participants had previously read the informed consent (available at the link), and after accepting it, they anonymously filled out the questionnaire on their own. After the measurement, the collected qualitative answers were coded and then entered into a single Microsoft Excel table.

Statistical analysis. Descriptive parameters for the collected data were determined, and frequencies and percentage values for the questionnaire variables were calculated. Furthermore, standard deviation, minimum and maximum results, and the difference between independent groups (ANOVA) were calculated. To determine the basic metric characteristics of the questionnaire, Cronbach's alpha coefficient and coefficients of SKEW and KURT of result distribution were calculated. Furthermore, a Fisher's test was calculated to obtain the differences between the groups of players. Also, the Kolmogorov-Smirnov test of normality was calculated, and no significant deviations in the results from the normal distribution were found.

All data were analyzed by the Statistica ver. 13.2 program package.

RESULTS

Descriptive parameters of the incidence of knee pain and injury in basketball players on the total sample of participants (N=57) are presented in Table 1.

The highest incidence of knee pain was reported by basketball players for the following

activities: after sports activity (1.35), during sports activity (1.21), at the beginning of sports activity (1.14), before the sports activity (0.95), and during landing (0.86). The lowest incidence of knee pain was reported during sliding (0.60) and during a change of direction (0.65), whereas the pain caused by exercise cessation had the lowest incidence (0.56). The Cronbach's alpha coefficient shows good metric characteristics of the questionnaire (0.94).

The locations of knee pain among basketball players are presented as cumulative frequencies and relative values in Table 2, on the total sample of participants (N=57).

Table 1. Descriptive parameters of the *Incidence of knee pain and injury* in basketball players (N=57)

Variable	AM	SD	M	SKEW	KURT
Pain before sport activity	0.95	1.14	1.00	1.15	0.44
Pain during sport activity	1.21	1.15	1.00	0.75	-0.34
Pain when activity stops	0.74	1.09	0.00	1.65	1.96
Pain when the change in direction	0.65	0.94	0.00	1.86	4.06
Pain when landing	0.86	1.11	0.00	1.26	0.85
Pain when sliding	0.60	0.98	0.00	1.97	3.88
Pain at the beginning of the activity	1.14	1.23	1.00	0.85	-0.33
Pain after sport activity	1.35	1.33	1.00	0.55	-0.99
Pain because of exercise cessation	0.56	0.95	0.00	2.18	5.10
Pain during normal daily activity	0.74	0.90	1.00	1.48	2.56
				Cronbach's alpha coefficient:	
				0.94	

AM: arithmetic mean, SD: standard deviation, M: median, Min: minimum result, Max: maximum result, SKEW: coefficient of asymmetry of result distribution, KURT: coefficient of peakedness of result distribution.

Table 2. Cumulative frequencies and relative values of the *most frequently reported locations of knee pain*, on the total sample of participants (N=57)

Variables				
Location of knee pain	**f**	**CF**	**%**	**C %**
Inside/Medial side of the knee	2	2	3.51	3.51
Outside/Lateral side of the knee	4	6	7.02	10.53
Outside/Lateral side of the knee, Inside/Medial side of the knee	1	7	1.75	12.28
No pain	12	19	21.05	33.33
Front/Anterior - below the patella	15	34	26.32	59.65
Front/Anterior - below the patella, Outside/Lateral side of the knee	6	40	10.53	70.18
Front/Anterior - below the patella, Front/Anterior - on the patella	3	43	5.26	75.44
Front/Anterior - below the patella, Front/Anterior - on the patella, Inside/Medial side of the knee	2	45	3.51	78.95
Front/Anterior - below the patella, Front/Anterior - on the patella, Front/Anterior - above the patella	3	48	5.26	84.21
Front/Anterior - below the patella, Posterior (back of the knee)	1	49	1.75	85.96
Front/Anterior - above the patella	3	52	5.26	91.23
Front/Anterior - above the patella, Outside/Lateral side of the knee	1	53	1.75	92.98
Front/Anterior - on the patella	2	55	3.51	96.49
Front/Anterior - on the patella, Front/Anterior - above the patella	1	56	1.75	98.25
Front/Anterior - on the patella, Front/Anterior - above the patella, Outside/Lateral side of the knee, Inside/Medial side of the knee	1	57	1.75	100.00

F: frequency, CF: cumulative frequency, %: relative, percentage value, C%: cumulative relative, percentage value.

The analysis of Table 2 shows that of the total sample of participants (N=57), 12 players reported no pain in the knee joint. The smallest number of participants, i.e., 5 players, reported pain in a larger area of the knee: Outside/Lateral side of the knee, Inside/Medial side of the knee; Front/Anterior - below the patella, Posterior (back of the knee), Front/Anterior - above the patella; Outside/Lateral side of the knee; Front/Anterior - on the patella, Front/Anterior - above the patella; Front/Anterior -

on the patella, Front/Anterior - above the patella, Outside/Lateral side of the knee, Inside/Medial side of the knee. The highest number of participants reported pain in the anterior knee below the patella, i.e., 15 players (26.32%). The analysis of the variance of basketball players according to player position on the total sample of participants (N=57) is presented in Table 3.

Table 3. Analysis of variance of basketball players at different player positions (N=57)

Variable	F	P
Pain before sports activity	2.02	0.11
Pain during sports activity	3.36	0.02*
Pain during sudden stops	3.17	0.02*
Pain during a change of direction	2.19	0.08
Pain during landing	2.56	0.05*
Pain when sliding on the court	0.48	0.75
Pain at the beginning of sports activity	1.83	0.14
Pain after sports activity	1.91	0.12
Pain is caused by exercise cessation	1.56	0.20
Pain during normal daily activities	0.77	0.55

F: coefficient of analysis of variance, P: level of statistical significance, *: statistically significant difference at the level of p<0.05.

Univariate analysis of variance for five player positions yielded significant differences in three of the measured variables of incidence of knee pain: pain during sports activity (p=0.02), pain during sudden stops (p=0.02), and pain during landing (p=0.05). No significant differences were found between these groups of participants in the other variables that were measured. Since the differences were found, inter-positional differences were calculated using a post-hoc Honest Significant Difference test. The differences between groups of players at different player positions in variables Pain during sports activity and Pain during sudden stops are presented in Table 4.

Table 4. Differences between groups of players with different indexes of incidence of knee pain in the variable *pain during sports activity, pain during sudden stops*

	Groups*					
Pain during sports activity						
Groups	**AM**	**Shooting guard**	**Center**	**Small forward**	**Power forward**	**Point guard**
Shooting guard	1.41		0.10	0.99	0.84	1.00
Center	0.27	0.10		0.54	0.03*	0.36
Small forward	1.14	0.99	0.54		0.56	1.00
Power forward	2.00	0.84	0.03*	0.56		0.68
Point guard	1.25	1.00	0.36	1.00	0.68	
Pain during sudden stops						
	AM	**Shooting guard**	**Center**	**Small forward**	**Power forward**	**Point guard**
Shooting guard	0.58		0.79	0.99	0.25	0.82
Center	0.91	0.79		0.63	0.03*	0.27
Small forward	0.86	0.99	0.63		0.52	0.99
Power forward	1.71	0.25	0.03*	0.52		0.81
Point guard	1.13	0.82	0.27	0.99	0.81	

AM: arithmetic mean, SD: standard deviation, *: the levels of statistical significance of the coefficient of the Fisher's test of the smallest possible differences between two groups are presented, *: statistically significant difference at the level of p<0.05.

The levels of statistical significance of coefficients of the HSD test of differences between different player positions in the variable incidence of knee pain during sports activity are presented in Table 4. Players at the center position differed significantly from players at the power forward position, i.e., power forwards reported a significantly higher incidence of knee pain during sports activity in comparison to players at the center position.

The analysis of the variable incidence of knee pain during sudden stops showed that players at the center position differed significantly from players at the power forward position. Power

forwards reported a significantly higher incidence of knee pain during sudden stops in comparison to players at center positions.

Cumulative frequencies and relative values of knee injuries, according to five player positions on the total sample of participants (N=57) are presented in Table 5.

The analysis of Table 5 shows that 42 participants, i.e., 73.68%, have not experienced a knee injury in their career, whereas 26.32% of participants reported previous knee injuries.

The analysis of Table 5 shows that 100% of the players who play the position of center in the team reported no previous knee injury, whereas most knee injuries occur in the position of power forward, i.e., 71.43% of them reported a previous knee injury. Shooting guards are in second place, with a high incidence of knee injuries, i.e., 8 players of the total sample of shooting guards (N=24) reported previous injuries. Among small forwards, 14.29% of players reported previous injury, whereas, in point guards, the percentage was 12.50%.

Table 5. Cumulative frequencies and relative values of a *previous knee injury*, on the total sample of participants (N=57)

Variables	Knee injury	f	CF	%	C %
On the total sample					
	Yes	15	15	26.32	26.32
	No	42	57	73.68	100.00
According to the playing position					
Shooting guard	**Yes**	8	8	33.33	33.33
	No	16	24	66.67	100.00
Center	**Yes**	0	0	0.00	0.00
	No	11	11	100.00	100.00
Power forward	**Yes**	5	5	71.43	71.43
	No	2	7	28.57	100.00
Small forward	**Yes**	1	1	14.29	14.29
	No	6	7	85.71	100.00
Point guard	**Yes**	1	1	12.50	12.50
	No	7	8	87.50	100.00

f: frequency, CF: cumulative frequency, %: relative, percentage value, C%: cumulative relative, percentage value.

DISCUSSION

The applied Questionnaire on the incidence of knee pain and injuries (12), adapted for basketball players, has good metric characteristics. The reliability of the questionnaire is excellent (Cronbach's alpha coefficient = 0.94), and the coefficients of asymmetry and peakedness of result distribution indicate a good sensitivity of this measuring instrument. Such results have been confirmed in previous studies on the incidence of knee pain and injuries in female basketball players (13).

The results obtained for the total sample of participants (N=57) indicate a relatively small percentage value of knee injuries in basketball. The relative value of participants who reported previous knee injuries was 26.32%, whereas 73.68% of participants stated they had never experienced a knee injury in their careers.

A low percentage of knee injuries was also reported in previous studies, which recorded a higher number of ankle, foot, and hip injuries than knee injuries (7-9).

The analysis of previous knee injuries among basketball players revealed a difference in the frequency of injury according to player positions. The obtained results show that the power forwards reported the most injuries, i.e., 71.43% of 7 participants reported previous knee injury, followed by 33.33% of the shooting guards. Regarding players in other positions, small forwards and point guards had relatively low values of previous injury reports, i.e., 13.33% of them reported a knee injury, whereas players in the center position reported no previous knee injury. The results of previous studies showed a different distribution of injuries by player position (11, 14), whereas this study brings new results

with a newfound distribution of injuries according to player position.

A descriptive analysis of the incidence of knee pain and injuries was conducted through a series of variables which indicated that the highest incidence of knee pain occurs after sports activity (AM=1.35). In the total sample of participants (N=57), pain caused by exercise cessation had the lowest incidence (AM=0.56). Ikić et al. (13), who used the same questionnaire on a sample of female basketball players, partially confirmed these results. Female players reported a higher incidence of pain caused by exercise cessation and a lower incidence of pain during normal daily activities. Furthermore, regarding pain location, male players reported the anterior knee as the most common location of knee pain, i.e., 66.67% of the total sample of participants (N=57), which has been confirmed by numerous authors (9, 11, 14). The area below the patella is the most common location of pain in the anterior knee (26.32%), which is the location of pain that might be indicative of various chronic problems in the knee (4, 5). Other participants reported no knee pain (21.05%) or pain on the sides of the knee (12.28%).

The analysis of variance of the incidence of knee pain according to chronological age yielded no statistical significance, thus, this parameter was excluded from the results and discussion. However, the analysis of the incidence of pain, according to player position revealed statistical significance in knee pain during sports activity and sudden stops (p=0.02). After examining the differences between player positions by the HSD test, statistical significance was determined in both parameters between players at power forward and center positions.

CONCLUSION

The Questionnaire on the incidence of knee pain and injuries has satisfactory metric characteristics (reliability and sensitivity). With this questionnaire, it is possible to qualitatively measure the incidence and localization of knee pain and injuries in basketball players. There is a significant difference in the incidence of knee pain and injuries, according to the participants' chronological age and player position. The obtained results show that there was no early specialization of basketball players, considering the even distribution of injuries according to chronological age. Also, the relatively small percentage of knee injuries indicates that coaches did good work with the players.

The limitation of this study is the small sample of respondents. Also, future studies should include both genders and more variables. Furthermore, the study lacks more precise reasons for injuries together with prevention methods. However, it is one of the first studies that show the localization and incidence of knee pain and injuries in professional Croatian basketball players.

APPLICABLE REMARKS

- The Questionnaire on the incidence of knee pain and injuries has satisfactory metric characteristics (reliability and sensitivity).
- There is no early specialization of basketball players.
- A small percentage of knee injuries indicates that coaches did good work with the players.

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AUTHORS' CONTRIBUTIONS

All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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