

Porównanie urazowości piłkarzy ręcznych wybranych drużyn z Superligi mężczyzn i I ligi mężczyzn w sezonie 2014/2015

Comparison of injury rate among members of selected handball teams (men's Super League and First Division), 2014/2015 season

Szymon Fugiel^{1(A,B,D,E,F)}, Marek Kiljański^{1,2,3(E,F,G)}

¹Instytut Fizjoterapii, Uniwersytet Jana Kochanowskiego w Kielcach, Polska/Department of Physiotherapy, Jan Kochanowski University, Kielce, Poland

²Pabianickie Centrum Rehabilitacji, PCM, Pabianice, Polska/Rehabilitation Center in Pabianice, PCM, Pabianice, Poland

³Wyższa Szkoła Informatyki i Umiejętności w Łodzi, Polska/University of Computer Science and Skills, Lodz, Poland

Streszczenie

Wstęp. Urazy sportowe to poważny problem zarówno w sporcie amatorskim, jak i w wyczynowym, gdyż często ograniczają lub całkowicie uniemożliwiają sportowcom wykonywanie czynności zawodowych. Niektóre polskie drużyny piłki ręcznej nie mają odpowiedniego zaplecza medycznego i odsuwają zdrowie zawodników na dalszy plan.

Cel pracy. Celem pracy była analiza urazowości piłkarzy ręcznych wybranych drużyn z Superligi i I ligi mężczyzn w sezonie 2014/2015.

Badaniom ankietowym poddani zostali piłkarze ręczni 4 drużyn: 2 z Superligi i 2 z I ligi. Informacje zbierane były od sierpnia do października 2015 roku, a pytania dotyczyły urazów sportowych doznanych w sezonie 2014/2015. Do oceny urazowości użyto wskaźnika urazowości, który obliczono za pomocą wzoru: Liczba urazów x 1000 godzin / Rzeczywisty czas ekspozycji na doznanie urazów.

Wyniki. Drużyna I miała najwyższy wskaźnik urazowości – 7,86, wyprzedzając kolejno drużynę III – 5,20, drużynę IV – 3,93 oraz drużynę II – 2,63. Wskaźnik urazowości zawodników, którzy mieli wykonane badania screeningowe oraz indywidualnie dostosowany program korekcji ich wyników wynosił: 2,71, a zawodników nie poddanych badaniu i terapii korekcyjnej – 7,02. Piłkarze ręczni najczęściej doznawali urazów w trakcie wykonywania rzutu (30,4% wszystkich urazów).

Wnioski. Obecność fizjoterapeuty oraz jego praca w drużynie piłki ręcznej wpływa na zmniejszenie ryzyka odniesienia urazów sportowych. Badania screeningowe narządu ruchu oraz indywidualnie dostosowany program korekcji ich wyników wpływają na zmniejszenie ryzyka odniesienia urazów sportowych. Należy tworzyć i wdrażać do treningów piłki ręcznej programy ćwiczeń doskonalących technikę wykonywania rzutu w sposób bezpieczny, nie niosący ze sobą ryzyka odniesienia urazu.

Słowa kluczowe:

urazy sportowe, wskaźnik urazowości, piłka ręczna, badania screeningowe

Abstract

Introduction. Sport injury needs to be considered a major issue, both in amateur and competitive circumstances; it often limits athletes' ability or totally prevents them from performing their professional activities. A number of handball teams in Poland fail to provide adequate medical facilities, which results in the situation where the players' health is not satisfactorily cared for.

Aim. The aim of this paper is to analyse the injury rate among members of selected handball teams from men's Super League and First Division, 2014/2015 season.

The respondents who participated in this study play in 4 different teams, 2 teams are currently in Super League and 2 in the First Division. The data was collected between August and October 2015 and the questions discussed only the sport injuries suffered in the 2014/2015 season. Injury rate coefficient was then calculated, based on the following formula: Number of injuries x 1000 hours / Actual time of injury risk exposure.

Results. The highest injury rate coefficient was calculated for Team 1, 7.86. This left the remaining teams behind with the coefficient value of 5.20 for Team 3, 3.93 for Team 4 and only 2.63 for Team 2. Injury rate coefficient calculated for these players who have been subject to screening examination and received a tailored result correction programme was recorded at the level of 2.71, as compared to 7.02 calculated for the players who have not been examined and received correction therapy. In general, handball players experienced injury primarily during the execution of a throw; these incidences amounted to 30.4% of all injuries.

Conclusions. Physiotherapist and his involvement in a handball team reduces the risk of sport injuries. Screening examination of musculoskeletal system, as well as tailored result correction programme, significantly reduce the risk of sport injuries. Therefore, technique improving exercise programmes should be created and incorporated into handball training, practising safe, injury risk-free way of executing a throw.

Key words:

sport injuries, injury rate, handball, screening examination

Introduction

Sport injury needs to be considered a major issue, both in amateur and competitive circumstances; it often limits athletes' ability or totally prevents them from performing their professional activities. A number of handball teams in Poland fail to provide adequate medical facilities, which results in the situation where the players' health is not satisfactorily cared for. Many players, from a range of Polish teams, shared that club medicine cabinets are empty and that they themselves cover the cost incurred by the purchase of necessary ointments, medicines or patches. Proper injury prevention is often not implemented and no comprehensive functional physiotherapeutic assessment of the players is performed. Any general wellness treatments are also rarely offered; in some teams players meet a physiotherapist only when they have already suffered an injury. It is not unheard of that the handball players, having experienced an injury, seek access to a specialist on their own, hoping to obtain a professional diagnosis and referral for further treatment this way. Lack of appropriate medical personnel, including a team physician and physiotherapists, results in greatly extended time needed for a player to return to full physical fitness after an injury.

Injury (Latin: trauma) is such an operation of external factors, including mechanical, physical or chemical, which causes anatomical and functional changes in the body, both local or local/general [6]. Sport injury is suffered during sport activities, mainly during training and competition and results in damage leading to temporary or permanent inability to perform sport activities [15]. A player is considered injured for as long as they need to recover and fully participate in team sport activities, including training or a match [12].

Due to their nature, injuries are divided into acute and these caused by excessive load. The acute injuries have a well-defined initial moment, which means it is possible to determine the traumatic incident that caused them. For the other type of injuries, associated with the exposure to excessive load, the symptoms grow gradually and no significant specific cause can be observed [11]. There are a number of different traumatic sport injuries, including bruises and local haematomas, ligament sprains and damage, other sprains, fractures and wounds. [16]

In order to determine the cause of injury, a thorough evaluation of a range of factors needs to be conducted. It is essential that a detailed description of the circumstances in which the injury took place is made, as well as assessment of internal and external risk factors which would support determining a player's individual susceptibility to injury. Internal factors include: age, sex, body structure and composition, health condition, physical fitness, body anatomy, skills level and psychological profile. External risk factors, on the other hand, include sport specific indicator (for example refereeing style, rules and regulations of the game), equipment and environment (including weather, surface on which the sport is performed and surface condition) [1]. Negative changes of any of the above-mentioned factors lead to increased risk of sport injury. Therefore, injury prevention programme should take into consideration all of these factors.

In order for a player to be ready to take part in a wide range of motor activities, necessary to be an athlete, prior to the season commencement, a preliminary examination should be organised in order to analyse their current performance of movement patterns. The aim of this examination, also referred to as screening test, is to identify and eliminate all weak points in the overall biomechanical chain of an athlete [5].

Injury treatment can be divided into two categories: non-surgical treatment (preservative) and surgical treatment. Preservative treatment is non-invasive, it does not require surgical intervention and is based on appropriate medication, diet and physical methods. Surgical treatment, on the other hand, requires a hospital stay and the performance of a surgery aimed at repairing damaged structures of the musculoskeletal system [7]. Initial treatment of all acute sport injuries should be conducted in compliance with P.R.I.C.E. protocol. P.R.I.C.E. is a specific set of actions which should be carried out during the first 48-72 hours after the injury, designed to prevent the spread of oedema, inhibit further tissues damage and reduce pain. The abbreviation can be deciphered as follows: P - Protection, R - Rest, I - Ice, C - Compression, E - Elevation [2].

Research aim

The aim of this paper is to analyse injury rates of members of selected handball teams from the men's Super League and First Division in Poland in the 2014/2015 season. The practical aim is to use the findings of this research to construct injury prevention programmes for handball players and raise awareness of club management on the subject of proper health care. It must be made clear that proper health care is not only the managers' duty, but also an investment in the sport success of the whole team.

Material and methods

The research was conducted using a diagnostic survey (questionnaire). The questionnaire consisted of 29 questions, both open and closed. The answers were given anonymously. The questionnaire was designed especially for handball players and focussed on the subject of sport injuries suffered by the athletes in the 2014/2015 season. The questionnaires were filled in by the players after the season has finished; the data was gathered between August and October 2015. A range of survey methods used in the research allowed to present the results (injuries volume and frequency), depending on the selected criteria. The variables such as age, number of matches and actual playing time were also presented (distribution parameters):

- Average: Arithmetic mean
- Stn. dev.: Standard deviation
- Me: Mean value
- Min - Lowest value
- Max - Highest value

Statistical analysis of the survey results was performed using Chi-Square test of Independence; the difference between quantitative variables in each selection category was evaluated with one-factor analysis of variance (ANOVA).

The research results were presented in tables and bar graphs. Test results for which the level of significance was less than or equal to 0.05 ($p \leq 0.05$) were considered statistically significant. When the results were found lacking statistical significance, the NS symbol (not statistically significant) was used.

Injury rate

In order to reliably compare the results obtained for specific teams, injury rate coefficient was used, calculated for each team member [13: 8]. The coefficient was based on the following formula: Number of injuries x 1000 hours / Actual time of injury risk exposure. This approach allowed to specify how many injuries would a specific player suffer, assuming that the actual time of exposure to risk of injury would equal 1000 hours. The higher the value of the coefficient, the higher the injury rate of a player. The actual time of exposure to risk of injury is total time spent training and taking part in matches during the season. Actual time of injury risk exposure = training time exposure + match time exposure. Time of risk exposure during training in a given season was calculated on the basis of the following manner: it was first established that the Super League season lasted 35 weeks and the First Division season lasted 32 weeks. The hours of player's absence following the injury (data gathered in the survey) was subtracted from the total length of the season; the result was then multiplied by the length of a weekly training exposure (1.5 hours x number of workouts per week, data gathered in the survey). Any additional absence of an athlete in training, not caused by suffered injury, was not taken into account. Match exposure in the season was calculated by multiplying the number of matches played by each player by 1 hour (duration of the handball match). It was assumed that the participation of a player in each match meant they lasted the full time, the 2-minute penalties and other exclusions were not taken into consideration. Injury rate coefficient is the result of the number of injuries suffered by a player, the total number of training sessions and the matches played by a player. This way all athletes have equal chances [4, 3]. It must be added that when determining the injury rate of Team 1, one player was not taken into account. At the beginning of a season he suffered a serious injury causing his temporary inability to take part in any sport activities. Moreover, a week after returning to sport activity, this player suffered from tearing front cruciate ligaments, which eliminated him from any training sessions or matches until the end of the season. Due to the very short time of injury risk exposure (15 hours), his injury rate equalled 133.33. It was therefore agreed that he should not be included in any calculations of injury rate, in order not to increase the mean coefficient value of Team 1. However, he was included in all the other calculations. Team injury rate coefficient was calculated as the average value of all coefficients calculated for individual players.

Research group characteristics

The respondents of the survey were members of 4 men's handball teams, two currently playing in the Super League and two in the First Division.

Table 1. Baseline clinical data of the studied patients

Team	Level	Number of players	The avg No. of matches played	Average age	Number of injuries	Physiotherapist	Sports circumstances
I	First Division	17	17	22.9	22.9	NO	1st Div., lower half of the table
II	Super League	17	17	25	25	YES	Super League, middle of the table
III	First Division	15	15	28.3	28.3	YES	1st Div., top of the table
IV	Super League	16	16	28	28	YES	Super League, top of the table

Team 1 participated in all division matches, finishing the season in the bottom part of the table. There were 17 players who trained five times a week for 1.5 hours. The average number of matches played by the members of this team totalled at 17.6. The average age was 22.9, the youngest player was 19 and the oldest - 39 years of age. The members of this team were not covered by a free health care of a team physiotherapist. There were 24 recorded injuries, causing sport absenteeism of the players. This number constituted 30.4% of the total number of injuries suffered by the members of all teams. 100% of members of this team declared having suffered from some type of a sport injury during their professional career; 82.35% of them declared suffering from a sport injury in the 2014/2015 season. The club did not provide the players with any form of screening tests: none of the players was subjected to such examination nor had individually tailored therapeutic programme aiming at dysfunction correction and compensation within the musculoskeletal system.

Team 2 participated in all Super League matches, completing the season in the middle of the table. There were 17 players who trained 7 times a week for 1.5 hours. The average number of matches played by the members of this team totalled at 28.1. The average age was 25, the youngest player was 21 and the oldest - 38 years of age. The members of this team were covered by a free health care of a club physiotherapist and could benefit from these services as required. There were 15 recorded injuries, causing sport absenteeism of the players. This number constituted 19% of the total number of injuries suffered by the members of all teams. 94.12% of members of this team declared having suffered from some type of a sport injury during their professional career; 64.71% of them declared suffering from a sport injury in the 2014/2015 season. The club did not provide the players with any form of screening tests; 47.06% of the players, however, decided to undergo such exami-

nation at their own expense. They then received individually tailored therapeutic programme aiming at dysfunction correction and compensation within the musculoskeletal system.

Team 3 participated in all First Division matches, completing the season in the top half of the table. There were 15 players who trained 5 times a week for 1.5 hours. The average number of matches played by the members of this team totalled at 23.5. The average age was 28.3, the youngest player was 23 and the oldest - 38 years of age. The members of this team were covered by a free health care of a club physiotherapist and could benefit from these services before, during and after each match. There were 17 recorded injuries, causing sport absenteeism of the players. This number constituted 21.5% of the total number of injuries suffered by the members of all teams. 100% of members of this team declared having suffered from some type of a sport injury during their professional career; 73.33% of them declared suffering from a sport injury in the 2014/2015 season. The club did not provide the players with any form of screening tests; 53.33% of the players, however, decided to undergo such examination at their own expense. They then received individually tailored therapeutic programme aiming at dysfunction correction and compensation within the musculoskeletal system.

Team 4 participated in all Super League matches, completing the season in the top of the highest league in Poland. There were 16 players who trained 7 times a week for 1.5 hours. The average number of matches played by the members of this team totalled at 37.4. The average age was 28, the youngest player was 24 and the oldest - 36 years of age. The members of this team were covered by a free health care of a club physiotherapist and were able to access these services whenever required. There were 23 recorded injuries, causing sport absenteeism of the players. This number constituted 29.1% of the total number of injuries suffered by the members of all teams. 100% of members of this team declared having suffered from some type of a sport injury during their professional career; 81.25% of them declared suffering from a sport injury in the 2014/2015 season. The club provided the players with screening tests. All players were subjected to such examination and received individually tailored therapeutic programme aiming at dysfunction correction and compensation within the musculoskeletal system.

Results

Injury rate coefficient varied significantly between the teams ($p = 0.008$) (Fig 1). The highest value of the coefficient was recorded in Team 1 (7.86); the lowest in Team 2 (2.63). In Team 3 and 4 the values of calculated coefficient were 5.20 and 3.93, respectively. Additionally, injury rate coefficient depended significantly ($p = 0.004$) on the current level the team played in. (Fig. 2). The mean value of injury rate coefficient of individual members of the First Division, calculated at 6.57, was actually the double of the injury rate coefficient of individual members of the Super League (3.26). In practice this meant that the members of the First Division suffered from sport related injury twice as often as the members of the Super League teams.

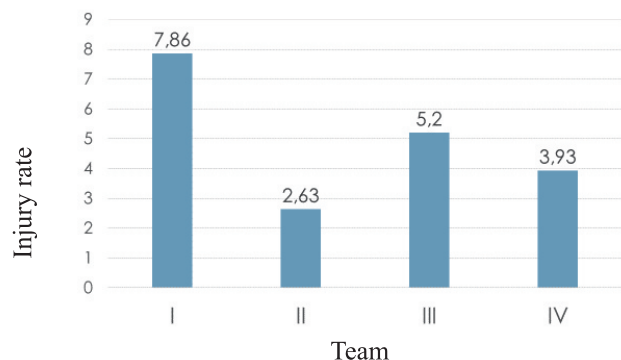


Fig. 1. Injury rate coefficient in specific teams

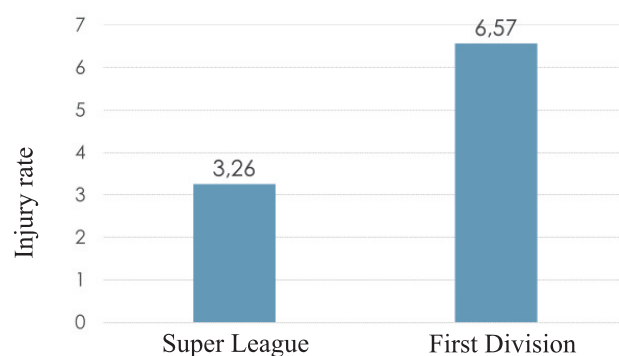


Fig. 2. Injury rate coefficient in each sport level

Injury rate coefficient depended significantly ($p = 0.002$) on the access to free health care provided by a club physiotherapist. The mean value of the injury rate coefficient was more than halved (3.86) for the athletes who benefited from free care of a physiotherapist, available at the club, as compared to the players who did not have such an opportunity (7.86). (Fig. 3). Injury rate coefficient depended significantly ($p = 0.024$) on the frequency the players used the services of a physiotherapist working with the club (Fig. 4). The team members who used these services more often recorded lower mean values of the coefficient. The lowest mean value of the injury rate coefficient was calculated for the players who used the services of a club physiotherapist daily (2.37), followed by those who used these services several times in a week (3.60), several times in a month (4.15), once a week (5.26) and not at all (7.86). The research showed that the injury rate coefficient depended statistically significantly ($p = 0.004$) on the time the team members had the opportunity to use the services of a team physiotherapist; for these who benefited from unlimited time (before, during and after each training session or a match as well as outside the training sessions/matches) the value was calculated at the level of 3.26; for the services available only before, during and after each training session or a match - 5.20; an lastly where there were no such services offered at all - 7.86 (Fig. 5).

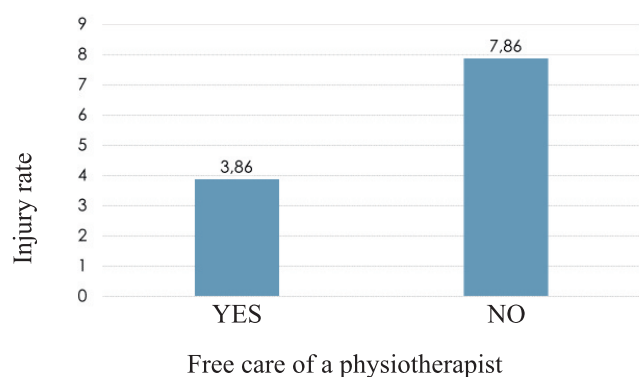


Fig. 3. Injury rate coefficient and the free care of a physiotherapist

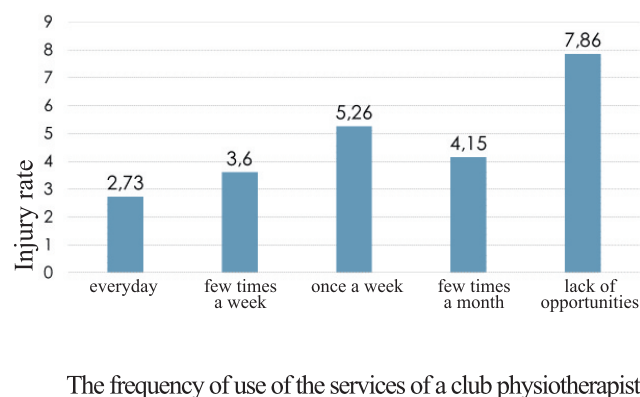


Fig. 4. Injury rate coefficient and the periods of opportunity to use the services of a club physiotherapist

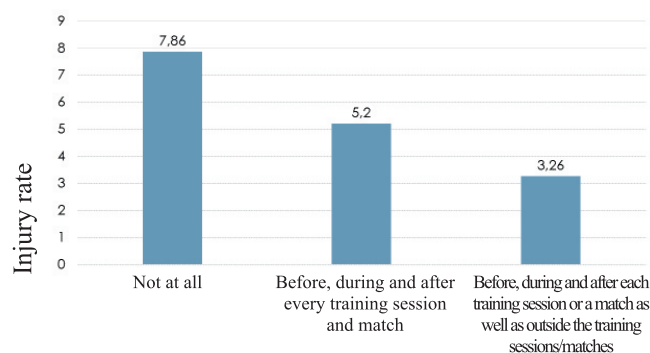
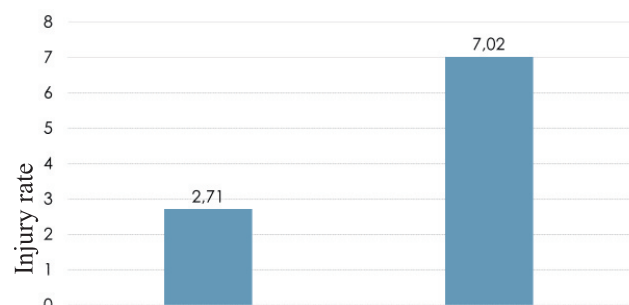


Fig. 5. Injury rate coefficient and calculated for individual players and the frequency of use of the services of a club physiotherapist



Screening test and individual corrective programme

Fig. 6. Injury rate coefficient and screening tests combined with individual corrective programme

Injury rate coefficient depended significantly ($p < 0.001$) on the conduction of a screening test and the receipt of individually tailored therapeutic programme aiming at dysfunction correction and compensation within the musculoskeletal system. (Fig. 6.) Injury rate coefficient calculated for the team members who have been examined to assess compensation and dysfunction of the musculoskeletal system and received individually tailored therapeutic programme was 2.5 - fold lower than the mean value (2.71) as compared to the players who were not subjected to a screening test and did not receive any indication towards corrective therapy (7.02).

The research also assessed the circumstances of injuries suffered by the respondents. The most common moment when injuries took place were the throws: 24 injuries (30.3% of all injuries), followed by sidestep and run: 15 injuries (19%), landing and throw blocking: 10 injuries each (12.7% each), goal-keeping: 5 injuries (6.3%).

The vast majority of all injuries were classified as acute ($n = 54$; 68.4% of all injuries); consequently, injuries caused by excessive load amounted to 25 (31.6%). Considering the nature of the injury, there were 39 non-contact injuries and 40 contact injuries, so it can be said the numbers were similar. Considering the circumstances of an injury, majority of the incidents took place during training (54.4%, 43 incidents), fewer during matches (45.6%, 36 incidents). Considering the total time of players participating in matches (17.346 hours) and training (1728 hours), it can be concluded that the athletes suffered from injuries during matches much more often than during training sessions; 20.83 injuries per 1000 hours of match time, as compared to 2.48 injuries per 1000 hours of training (Tab. 1, Fig. 7)

Considering the specific moment of in which injury takes place, the vast majority of injuries happened during attack (77.2%, 61), as compared with 22.8%, 18 during defence. The majority of injuries resulted in player absence in sport activities lasting between 1 and 7 days (32 injuries, 40.5%), followed by the length up to 1 month (30, 38%), and exceeding 1 month

(21.5% of all injuries). Most injuries were suffered to the hand, forearm and elbow. During the research 41 injuries of the lower limbs (52%) were recorded, as well as 31 injuries of the upper limb (39.2%) and 7 injuries of the torso and head (8.8%). The most common type of injury recorded during the survey was sprain and ligament damage (30, 38%), followed by 22 muscular and tendon damage (27.8%), 15 cases of bruising (19%), 9 fractures (11.4%) and 3 dislocations (3.8%). Most injuries were suffered by playmakers: 43 (54.4%), while wingmen suffered 18 injuries (22.8%), pivots suffered 10 injuries (12.7%) and goalkeepers - 6 (10.1%).

Tab. 1. Total number of injuries suffered by all players in 1000 hours of matches time and 1000 hours training

	Number of injuries	Time in hours	Total number of injuries suffered in 1000 hours of sport activities
Training	43	1728	2.48
Match	36	17346	20.83

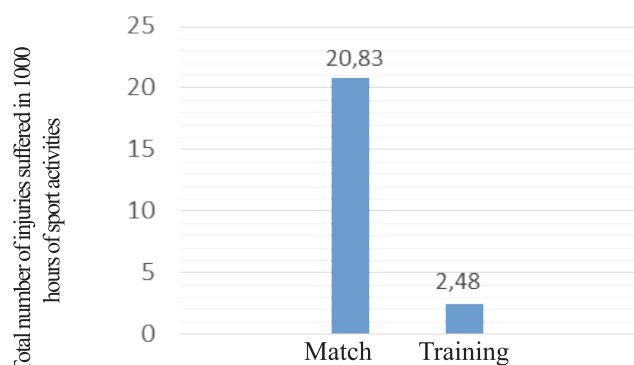


Fig. 7. Total number of injuries suffered by all players in 1000 hours of matches time and 1000 hours training

Discussion

The highest injury rate coefficient value was recorded in Team 1 (7.86), and the lowest in Team 2 (2.63). In Team 3 and 4 the values of calculated coefficients were 5.20 and 3.93, respectively. The coefficients calculated in this study were lower than these obtained in the research conducted by Tsigilis et al: 18.4 [14]; the coefficients calculated for Team 1 and 3 were higher than those that recorded in the survey conducted by Olsen and et al: 4.7 [11].

Further analysis of the obtained data led to conclusion that on average 2.48 of an injury incident is suffered per 1000 hours of sport activity, which is lower than the level determined in the research conducted by Olsen and et al, with 9 injuries per 1000 hours of sport activity [11], but, on the other hand, higher than the result obtained by Nielsen and et al, with 1.64 per 1000 hours of sport activities [10]. Injury rate during match time was recorded at the level of 20.83 injuries per 1000 hours of sport activity, which is similar to the value obtained by H. Pira et al, 20.7 injuries per 1000 hours of sport activity [13].

According to Myklebust [9] the injury rate increases with the level on which the team plays. Our research, on the other hand, showed that there were more incidents of injuries on the First Division level (6.57 per 1000 hours of sport activity) than in the Super League (3.26 per 1000 hours of sport activity).

The results also showed that there were more acute injuries ($n = 54$; 68.4%) than of the injuries caused by excessive load ($n = 25$; 31.6%). A similar trend was observed by Pira and et al in their research [13].

The numbers of contact and non-contact injuries were similar, while the results obtained by Bere and et al showed that contact injuries seemed to be slightly more common 61.4% [3], similarly in the case of the research conducted by Pira et al, 65% [13].

Olsen et al obtained similar results, far more injuries were suffered by players in attack (77.2%) than in defence [12]. 52% of all injuries were suffered to upper limbs, 39.2% to lower limbs, and 8.8% to head and torso. Bere et al observed a slightly different percentage distribution; the injuries to lower limbs constituted 58.3% of all incidents, head and torso 25% and upper limbs - 16.7% [3].

The most common type of injury was spraining and ligament damage (38% of all injuries); similar results were obtained by Olsen [31]. Bere et al in their research obtained different results. The most common type of injury, according to their data, was bruising [3].

Regarding the absence resulting from an injury, Moller et al obtained the same data, 1-7 days' absence was the most common period of absence (40.5%) [8].

Most commonly injuries were caused by throws, resulting in 24 incidents of injury, which accounted for 30.4% of all injuries, dissimilar to the research conducted by Olsen and Pira, where the main reason of injury was observed to be sidestepping [2, 14].

Most commonly injured players were playmakers. They suffered the total of 43 injuries, which represents 54.4% of all injuries. Similar results were obtained by Pira et al: 60% of all injuries [13]. However, Bere et al recorded the highest number of injuries among pivots [3].

The results clearly confirm that the club physiotherapist is crucial in the context of reducing the number of injury incidences among the players. Teams 1, 3 and 4, where the players benefited from free care of a physiotherapist, showed a significantly lower injury rate, compared with Team 1 which does not work with a physiotherapist. What's more, those players who used the services of a physiotherapist more often recorded a still lower rate of injuries.

It was also confirmed that the athletes who were subjected to an examination assessing their susceptibility to musculoskeletal injuries before or during the season and consequently received individually tailored corrective programme experienced 2.5 times fewer injuries (2.71) than the players who did not take part in such test and receive a treatment plan (7.02). This may suggest the effectiveness of this type of examination and therapy in the context of injury risk reduction.

Different sport clubs contributed to the financing of the treatment and physiotherapy after the injuries in varying degrees. The situation was the most difficult for the players of Team 1, where the cost of treatment and physiotherapy of over 70% of all injuries was covered privately by the players. On the other hand, the players of Team IV had most of the cost of treatment and physiotherapy covered by the club (35% of treated injuries, 95% of physiotherapy treated injuries). In all other teams in the vast majority of cases the players did not cover the costs incurred by medical treatment and physiotherapy of injuries.

Significant differences were also noticed in association of location in which rehabilitation physiotherapy is provided. In most cases, the

treatment was conducted by a club physiotherapist or in an institution partnering the club, especially for Team 4, then 3 and 2. However, all injuries suffered by the players of Team 1 were treated in institutions not cooperating with the club.

Conclusions

Analysis of the obtained data allowed the formation of the following conclusions:

1. Physiotherapist and their involvement in the handball team reduce the risk of sport injuries.
2. Screening tests of musculoskeletal system and individually tailored corrective programmes reduce the risk of sport injuries.
3. The success of a sports team is a result of appropriate approach of club managers to the team members.
4. In order to be able to assess the injury rates of handball players, it is necessary to create a short-term reporting system, to be used by trainers and club physiotherapists, taking into account as many factors which can affect injury rates as possible.
5. Technique improving exercise programmes should be created and incorporated into handball training, practising safe, injury risk-free way of executing a throw.

Adres do korespondencji / Corresponding author



Szymon Fugiel

ul. Robotnicza 15A
22-400 Zamość,
s.fugiel@wp.pl, 797-447-261

Piśmiennictwo/ References

1. Bahr R., Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med.* 2005.
2. Bahr R., Maehlum, S. *Clinical Guide to Sports Injuries.* Human Kinetics. 2003.
3. Bere T., Bhar R., Popovic N. Injury and illness surveillance during the 24th Men's Handball World Championship 2015 in Qatar. *Br J Sports Med.* 2015.
4. Brooks J.H., Fuller C.W. The influence of methodical issues on the results and conclusions from epidemiological studies of sports injuries. *Br J Sports Med* 36(6): 459-472.
5. Cook G., Burton L., Hoogenboom B., Pre – Participation Screening: The Use of Fundamental Movements as an Assessment of Function – Part 1, *North American Journal of Sports Physical Therapy* 1(2): 62-72, 2006.
6. Dziak A., Gusta A., Żuk, T. *Podstawy ortopedii i traumatologii.* Państwowy Zakład Wydawnictw Lekarskich. Warszawa 1980.
7. Gaździk T. *Ortopedia i traumatologia.* Tom 1-2. PZWL. Warszawa 2009.
8. Moller M., Attermann J., Myklebust G., Wedderkoop N. Injury risk in Danish youth and senior elite handball using a new SMS text messages approach. *Br J Sports Med.* 2012.
9. Myklebust G. Epidemiology of injury in olympic sports. Chapter 20. Team handball (handball). John Wiley and Sons. 2009.
10. Nielsen A.B., Yde J. An epidemiologic and traumatologic study of injuries in handball. *Int J Sports Med.* 1988; 9: 341-344.
11. Olsen O-E., Myklebust G., Engebretsen L., Bahr R.. Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial. *BMJ.* 2005.
12. Olsen O-E., Myklebust G., Engebretsen L., Bahr R.. Injury pattern in youth team handball: a comparison of two prospective registration methods. *Scand J Med Sci Sports.* 2006; 16: 426-432.
13. Piry H., Fallahi A. Handball injuries in elite asian players. *World Appl. Sci. J.*, 2011. 14 (10): 1559-1564.
14. Tsigilis N., Hatzimanouil D. Injuries in handball: Examination of the risk factors. *European Journal of Sport Science.* 2005; 3: 137-142.
15. Widuchowski J. *Kolano urazy i obrażenia sportowe.* Katowice 1997.
16. Widuchowski J., Widuchowski W. *Urazy i obrażenia narządu ruchu w sporcie.* Medicina Sportiva. Suplement. 2008.