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Predictors of injuries among young players team games

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Abstract:

Introduction: The aim of the study was to determine the relationship between the basic somatic traits and the metric age and training experience of players and the injuries suffered.

Material and methods: 125 male athletes aged between 14 and 19 years old were examined. They represented 4 sports disciplines. Respondents practicing American football (22 players), respondents playing football (30 players), respondents practicing handball (49 players), respondents practicing volleyball (24 players). All players belonged to the category of juniors.

The research tool was a short questionnaire, in which the surveyed person gave their name and date of birth. The next part of the questionnaire contained questions about the sport practiced. The next stage of the study was the measurement of body height, which was performed with a Swiss anthropometer, and body weight was measured on electronic weight. The Body Mass Index (BMI) was calculated from the formula: body weight [kg]/height [m]^2.

Results: In all analysed sports, body weight is the most important for the number of injuries. BMI is important in all team sports. Slim body reduces the number of injuries by about 2-8 injuries. From among the analysed variables the body structure features have an influence on the number of injuries. There were no correlations between the age of competitors and their training experience. The number of injuries depends mainly on the body weight of the player.

Conclusion: Football players suffered the most injuries during their career, followed by handball players. Average injuries of American football players and volleyball players were much lower and similar to each other. While analysing the whole group of the respondents, it was observed that among the variables discussed above, the weight of competitors has the strongest influence on the number of injuries suffered. The body weight has the strongest statistically significant effect on injuries in American football, and secondly in volleyball. The weakest, statistically insignificant, body weight affects injuries in footballers.

Keywords: team games, injuries, predictors

Introduction

Injuries are indelibly inscribed in both amateur and professional sports. Their aetiology and pathomechanism are usually defined by the specificity of the discipline practiced (Dziak 2001). Sports injuries can be divided into typical and accidental injuries. The typical ones are characteristic for a particular sport discipline. The accidental ones are characterized by randomness (Kochański 2015). The causes of injuries may be technical or man-made. Nowadays, there are sports disciplines with the so-called high level of risk associated with practicing them. This group includes, among others, combat sports, cycling and team sports games (Kochański 2015). American football, football, handball and volleyball belong to the last group. They are very different in terms of rules, type of training and competition (Jacobson 2013). The champions in each of these sports are individuals appropriately

selected, properly trained and lucky (Bujak 2008). Morphological conditions are one of the key factors influencing sports success (Klimczyk 2012). In individual sports, the champion model is attributed to the characteristics of the players with the highest scores in the world: age, anthropomotorics, fitness and performance indicators (Eider 1984, 1990, 2000). Similarly to team sports, the model of a football champion includes, among other things, features such as age, height and weight, as well as training experience (Eider 2004). Football is the most popular and most widespread team sport in the world (Żołnowski 2013). Football players are characterized by quite a diverse body structure (Burdukiewicz 2013, Gil 2007). This is due to the diversity of positions on the football pitch and the tasks to be fulfilled during the game, as well as the importance of technical skills (Kalapotharakos 2006). A characteristic feature that distinguishes volleyball from other sports and team games is that players compete without the right of physical contact. Despite this, volleyball belongs to team sports, in which injuries occur very often and are characteristic for this sport. Volleyball players are most often exposed to sharp twists in the ankle and knee (Truszczyńska and Skubała 2015). The specificity of handball promotes high and massive players, but there are differences between players playing on particular positions (Hadała et al. 2006). Particularly exploited during the game is the shoulder joint (Kużdżał 2010). American football is considered to be one of the most brutal team games. The specificity of the discipline requires from players to wear helmets and protectors. Particularly desirable are people with high body weight and a high level of physical fitness (Jacobson 2013). Ligaments, meniscus and joint capsules are at risk of damage (Walczak 2012). Many studies try to identify the factors and individual parameters that are most strongly associated with injuries.

Aim of the study

The aim of the study was to determine the relationship between the basic somatic traits and the metric age and training experience of players and the injuries suffered. The aim was defined by the following research questions: 1) What is the frequency of injuries to players in given team sports?, 2) Which of the analysed variables are most strongly related to the number of injuries to players of team sports?, 3) What do these relationships looks like in each discipline separately?

Material and methods

Study material

125 male athletes aged between 14 and 19 years old were examined. They represented 4 sports disciplines. Respondents practicing American football (22 players) were characterized by an average age of 16.80 years. Their training experience was 1.5 years. They trained on average 4 times a week and played a match once a week. Respondents playing football (30 players) were 15.98 years old. Their average training experience was 8.5 years. They trained on average 6 times a week, and played a match once a week. Respondents practicing handball (49 players) were on average 16.06 years old. Their average training experience was 4.5 years. They trained 4 times a week and played a match once a week. Respondents practicing volleyball (24 players) were characterized by an average age of 16.20 years. Their average player experience was 2.5 years. They trained about 3 times a week, and played a match once a week. All players belonged to the category of juniors.

Methods of collecting material

The research tool was a short questionnaire, in which the surveyed person gave their name and date of birth. The next part of the questionnaire contained questions about the sport practiced: type, training experience and frequency of training during one week. In the last part, the participant answered questions about the number of injuries he suffered in his career, in which body area and what kind of injuries they were. Respondents also provided information on how many times they were injured in competitions, and how many times during training.

The next stage of the study was the measurement of body height, which was performed with a Swiss anthropometer, and body weight was measured on electronic weight. The Body Mass Index (BMI) was calculated from the formula: body weight [kg]/height [m]^2.

Methods of statistical analysis of the material

The obtained results were characterized by basic descriptive statistics. The Shapiro-Wilk test did not give grounds to reject the hypothesis of the assumption of normal distribution of all analysed variables.

Average and standard deviations were calculated. The percentages of injuries among the subjects were presented. For a multidimensional assessment of the diversity of all variables as a factor in *sports discipline*, the statistics of partial square eta (^{2}) were used. On the basis of mean square differences (MS - *mean square effect*), which can be considered as a measure of differentiation between categories of a given factor (the higher the value, the greater the differences), the relative strength of factors (age, training experience, morphological parameters) on the number of injuries was evaluated. One-way ANOVA was used to compare mean values. Tuckey's test (for different N) was used for detailed comparisons.

The relationship between the frequency of injuries and the sport was assessed with the $\chi 2$ independence test (Stanisz 2007). The strength of the calculated effect (dependence) was determined on the basis of the quota coefficient for multi-division tables - Cramer's V(φc) and Spearman's χ (Acock, Stavig 1979).

Multiple regression was used to assess the relationship between the number of injuries suffered (during the three years preceding the study) and the set of explanatory variables (somatic traits, metric age and number of training years). The analysis was performed in two versions:

a) **first one** – in the whole examined group of players (without division into sports disciplines); its task was to estimate the relative strength of relations between the number of injuries and somatic traits, metric age and the length of training experience among players practicing team games,

b) **second one** – in given sports disciplines; its task was to assess the relative strength of the links between the disciplines in question.

The hierarchy of strength of compounds of individual explanatory variables with the number of sports injuries was based on the evaluation of standardized β coefficients.

In all analyses the level of statistical significance was assumed to be $\chi=0.05$.

Result of surveys

The somatic characteristics of the respondents (in total and in particular team games) are presented in Table 1.

Table 1. Statistical characteristics of injuries in general and in particular disciplines.

	total		american football		soccer		handball		voleyball	
	mean	s	mean	s	mean	s	mean	s	mean	S
age [years]	16,21	0,85	16,81	1,04	15,97	0,53	16,07	0,69	16,24	1,05
training experience [years]	4,73	3,01	1,59	1,10	8,70	1,64	4,78	1,82	2,54	1,53
body height [cm]	179,91	7,46	177,32	6,33	177,90	7,12	180,65	7,24	183,29	8,12
body weight [cm]	71,06	11,03	75,14	12,01	65,30	9,48	72,65	11,07	71,25	9,53
BMI [kg/m^2]	21,92	2,99	23,94	3,98	20,54	1,87	22,21	2,75	21,19	2,54

Multidimensional variance analysis showed that the sport practiced strongly differentiates the respondents in terms of the analysed variables. The total variability of all parameters is explained by this factor at the level of about 44% (^{2}=0,438) (Table 2).

Table 2. Main effects of ANOVA and multidimensional ^{2}

	^{2} part icle	age		training experience		body height		body weight		BMI	
		MS	p	MS	P	MS	p	MS	p	MS	p
free term	0,99	30070,20	**0,000**	2201,04	**0,000**	671627,00	**0,000**	573955,40	**0,000**	54823,19	**0,000**
sports discipline	0,44	3,52	**0,002**	268,22	**0,000**	190,00	**0,015**	495,40	**0,006**	54,54	**0,000**

The type of the sport practiced strongly influences the somatic features of the respondents, especially the height of the body. This is the effect of selection for sport. The influence of the sport on body weight and weight/growth ratio may also be the effect of training. The differences between disciplines are confirmed by the calculated mean square differences (MS) (Table 2).

The studied groups differ in terms of somatic, morphological age and training experience (Table 3). Volleyball players and handball players show a slightly greater morphological similarity.

Table 3. Detailed comparisons of age, training experience and somatic features – Tuckey test.

comparison variable	V-S	V-HB	V-AF	S-HB	S-AF	HB-AF
age	0,657	0,879	0,095	0,969	**0,004**	**0,013**
sport experience	**0,000**	**0,000**	0,207	**0,000**	**0,000**	**0,000**
body height	**0,049**	0,587	0,032	0,454	0,993	0,421
body weight	0,210	0,968	0,617	**0,036**	**0,011**	0,865
BMI	0,848	0,592	**0,006**	0,095	**0,000**	0,167

V - voleyball HB - handball

S - soccer AF - american football

Football players suffered the most injuries during their career, followed by handball players. Average injuries of American football players and volleyball players were much lower and similar to each other (Table 4). The diversity of these averages between sports disciplines was statistically significant (Table 5). Similarities and differences in terms of trauma of the analysed sports disciplines were discussed in a separate article (paper in print). We analysed in detail the diversity of team games in terms of the total number of injuries as well as similarity and differences in terms of types of injuries and places of their occurrence.

Table 4. Statistical characteristics of the number of injuries in total and in particular sports disciplines.

	average	s
total	3,32	2,91
voleyball	1,88	1,51
soccer	5,23	3,06
handball	3,82	2,97
american football	1,18	0,87

Table 5. Detailed comparisons of injuries – Tuckey test.

comparison variable	V-S	V-HB	V-AF	S-HB	S-AF	HB-AF
injuries	**0,000**	**0,040**	0,802	0,134	**0,000**	**0,003**

V - voleyball HB - handball

S - soccer AF - american football

Strong, statistically significant relations were observed between the sports discipline practiced and the frequency of players who were and were not injured (Table 6). Football is the most traumatic sport. Then go handball and volleyball. The least injuries were observed in American football.

Table 6. Relationship between the sport practised and the incidence of injuries to players.

sports discipline	injuries – Y	injuries – N
voleyball	75,00%	25,00%
soccer	96,67%	3,33%
handball	87,76%	12,24%
american football	54,55%	45,45%
Total	81,60%	18,40%
χ^2=17,193 p=**0,000** φ_c =0,371 χ Spearmana=0,198 p=**0,047**		

In order to establish the hierarchy and directions of influence of the analysed factors, the analysis was limited to the comparison of the size of coefficients and the direction of their influence, abandoning the wider analysis of partial or semi-molecular correlations or the forecasting model.

In order to obtain an answer to the second research question, the relationship between the variables in question and injuries among all the examined athletes (regardless of sports discipline) was analysed.

The model of variables selected for analysis explains the obtained dependencies to a medium degree. The calculated determination coefficient indicates 33% of model fitting appropriateness (Table 7). Measurements of model fitting in particular sports disciplines are similarly shaped. The highest value was obtained for American football (the model explains about 38% of the observed variability), and the lowest for football - 29% of the explained variability (Table 7).

Table 7. Determination coefficients of models built for all competitors and in particular disciplines.

statistics	total	voleyball	soccer	handball	american football
adjusted R^2	0,338	0,294	0,262	0,316	0,376
F	3,955	2,108	2,191	2,853	4,931
P	**0,000**	0,111	0,163	**0,020**	**0,000**

While analysing the whole group of the respondents, it was observed that among the variables discussed above, the weight of competitors has the strongest influence on the number of injuries suffered. The relationship is statistically significant (Table 8). A positive value indicates that the higher the body weight, the more injuries. Increasing the body weight by 2kg results in increasing the number of injuries by 3. The relationship between the height of the body and, as a consequence, the weight/growth ratio (BMI) is formed conversely. With the increase in body height and relative sliming the number of injuries decreases. BMI is particularly important. A change by one unit reduces the number of injuries by 4. Slightly smaller, but statistically significant, training experience is important for injuries, while the least impact on the number of injuries is the metric age.

In all analysed sports, body weight is the most important for the number of injuries (Table 8). However, the strength of its impact on the injury varies from one team game to another. At the same time, it has the strongest statistically significant effect on injuries in American football, and secondly in volleyball. The weakest, statistically insignificant, body weight affects injuries in footballers.

BMI is important in all team sports. Slim body reduces the number of injuries by about 2-8 injuries. However, it is statistically significant only in American football players.

Table 8. Values of standardized β coefficients and their significance levels

group	parameter	variable				
		age	sport experience	body height	body weight	BMI
total	β	0,060	**0,305**	**-1,290**	**2,622**	**-1,974**
	b^0	0,464	**0,673**	**-1,147**	**1,577**	**-4,382**
	p	0,500	**0,001**	**0,036**	**0,020**	**0,039**
volleyball	β	0,355	**0,595**	-3,466	5,257	-4,251
	b^0	0,800	**0,922**	-1,013	1,308	-3,968
	P	0,100	**0,011**	0,201	0,195	0,206
soccer	β	0,104	0,028	-0,392	1,058	-0,784
	b^0	0,869	0,076	-0,243	0,492	-1,847
	P	0,638	0,891	0,833	0,758	0,723
handball	β	0,095	0,147	-0,934	1,905	-1,339
	b^0	1,215	0,718	-1,142	1,524	-4,311
	P	0,562	0,347	0,544	0,508	0,561
american football	β	-0,133	**0,389**	**-2,545**	**6,268**	**-5,731**
	b^0	-0,741	**2,052**	**-2,331**	**3,025**	**-8,353**
	P	0,255	**0,004**	**0,001**	**0,000**	**0,000**

To sum up, the team games selected for comparison differ in the number of trauma. From among the analysed variables the body structure features have an influence on the number of injuries. There were no correlations between the age of competitors and their training experience. The number of injuries depends mainly on the body weight of the player.

Discussion

The aim of this study was to determine the relationship between the basic somatic traits and the metric age and training experience of players and the injuries suffered. Many studies show that the basic criterion for the selection of athletes in team games is body height (Duncan et al. 2006, Bozo et al. 2012). This confirms the authors' conclusion that the type of sport practiced differentiates in terms of the analysed variables and influences the somatic features of the examined athletes. The highest ones are basketball players and volleyball players (Sheppard et al. 2013, Gaurav et al. 2010). In the own research volleyball players also turned out to be the highest group of players. The group of the lowest players included American football players, they had the highest body weight and the highest BMI. Football

players were characterized by the lowest body weight and the highest number of injuries. Żołnowski et al. (2013) examined injuries in football of youth aged 15-19 years. The conducted research shows that 95.7% of the surveyed players suffered a sports injury, which is confirmed by the results of the own research. In a study by Walentukiewicz (2002), who analysed the epidemiology of sports injuries among 157 players in 6 disciplines: football, handball, volleyball, basketball, athletics and judo, handball was the most traumatic. Volleyball belonged to one of the less traumatic sports. In its own research, volleyball also belonged to the less injury causing sport, right after American football. A large number of studies, especially in Europe, on football trauma is mainly due to its popularity. Also in our own research, football was the most traumatic in terms of injury. The situation is different in other regions of the world. For example, in Nigeria, West Africa, football is only sixth in terms of injury frequency. The first place is occupied by athletics, whose injuries are considered less serious on our continent (Owoeye et al. 2009).

In a study conducted by Wójcik et al. (2016), the results of the study showed that 96.7% of the examined female volleyball players had been injured. Only one of the surveyed athletes was had not been injured in her career (3.3%). Probably no acute injury occurred in this athlete, but micro-damages appeared, which did not give visible symptoms, or were neglected by her. In the paper of Walczak et al.(2012) on injuries among American football players, researchers proved that competitors playing on the offensive line positions suffered ACL injuries, 3 (42%) of them additionally suffered damage to the medial meniscus and 1 - lateral. One offensive line competitor additionally damaged PCL. This may be due to the fact that players playing on these positions are characterized by high body weight, which can cause additional strain on the joints, which is also confirmed by the results of their own research.

In studies on the occurrence of injuries requiring medical assistance in junior high school students depending on body weight and physical activity (Mazur et al. 2011), a relationship was also found between excess body weight and the occurrence of injuries requiring medical assistance. Wagner et al. (2011) indicate obesity as a factor increasing the risk of disorders of coordination and balance, which is directly related to dealing with physical activity and the likelihood of experiencing bodily injury. Similarly, Masłoń et al. (2013) claim that too much body weight undoubtedly has an impact on the increase in loads that have a negative impact on the skeletal system. Nowak and Supiński (2014), contrary to the results of their own research, in which the training experience was not so important, proved that in the group of

beginner runners slightly more than half of the respondents had never suffered any trauma associated with running. The situation was the opposite in the group of those training for a longer time (over 3 years), where most of the respondents suffered at least one injury. The study by Mleczkowska et al. (2016) did not show any correlation between the increase in the BMI coefficient and the incidence of injuries, which puts these results in opposition to the results of the own study, in which it was proved that BMI is of great importance in each of the sports disciplines studied.

Boguszewski's study (2011) on bodily injury of young cross-country skiers did not show any correlation between the epidemiology of injuries and therapeutic management, gender, age, sports level and the number of starts in a season, which is a confirmation of the results of the own study.

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