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original article

Nosographic profile of soccer injuries according to the age group

Perfil nosográfico de lesões desportivas no futebol segundo faixa etária

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Abstract – Soccer is one of the world's most popular team sports and corresponds to one of the leading causes of sports injuries (SI). This study aimed to analyze the nosographic profile of the sports injuries common to soccer, according to the age group: childhood, youth and adulthood. We selected 209 soccer players, from amateurs to professional players of a sports club from Campo Grande/MS. Participants were divided into four age groups: G1 (childhood), G2 (juvenile), G3 (teenagers) and G4 (adults). To obtain information about the injuries, we used a morbidity survey. Generally, 74 athletes reported sports injuries, with register of 92 SI. Concerning injury types, muscle injuries totalized 43.47%, followed by joint damage (34.78%) and tendon injury (14.13%), respectively ($p<0.05$). The affected anatomical sites were predominantly lower limbs (91.3%). Contact was the main etiologic mechanism of injuries, integrating almost half of the cases (47.82%), followed by technique (20.65%) and running (19.56%). Training consisted in the main situation of occurrence of SI (74.3%) in G2 and G4; in other groups, occurrence of SI was similar between training and competition situations ($p> 0.05$). A higher proportion of registers involved medical-therapeutic approach and asymptomatic return. The evidence shows a higher rate of muscle and joint injuries by contact in the lower limbs in soccer practitioners, regardless of age group. The practice of training seems to be the main cause of injuries in adolescents and adults.

Key words: Age; Athlete; Soccer; Sports injury.

Resumo – *O futebol é a modalidade desportiva mais popular no mundo e responde pelos principais índices de lesões desportivas (ld). O objetivo deste trabalho foi traçar o perfil nosográfico de lesões músculo-esqueléticas típicas do futebol, relacionando-as com a faixa etária de desenvolvimento: infância, adolescência e adultez. A casuística contemplou 209 praticantes de futebol, procedentes das equipes de base profissionalizante e profissional de um clube desportivo da cidade de campo grande/ms. os participantes foram distribuídos em quatro grupos etários: g1 (infância), g2 (infanto-juvenil), g3 (adolescentes) e g4 (adultos). Para a tomada de informações sobre lesões, utilizou-se de um inquérito de morbidade referida. No geral, 74 atletas relataram lesões, com registro de 92 ld. Quanto à natureza, 43,47% configuraram agravos musculares, seguidos por lesões articulares (34,78%) e tendíneas (14,13%), respectivamente ($p<0,05$). Os locais anatômicos predominantemente acometidos foram membros inferiores (91,3%). Como mecanismo de ld, o contato desportivo integrou quase metade dos casos (47,82%), seguidos pela técnica (20,65%) e corrida (19,56%). As situações de treino consistiram na principal forma de ocorrência (74,3%) nos grupos g2 e g4; nos demais grupos, denotou-se um equilíbrio entre situações de treino e competição ($p>0,05$). A maior proporção de registros envolveu abordagem médico-terapêutica e retorno assintomático. As evidências comprovam um maior índice de lesões musculares e articulares por contato em membros inferiores, em praticantes de futebol, independente de faixa etária. quanto à situação de ocorrência, a prática de treino é a principal circunstância de origem de lesões em jovens e adultos.*

Palavras-chave: *Atleta; Futebol; Idade; Lesão desportiva.*

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INTRODUCTION

Soccer is the world's most popular sport, with approximately 400 million fans of various nationalities, classes and age groups[1,2]. Considering the important contingent of players, soccer accounts for the highest indices of sports-related musculoskeletal disorders (MSDs)[3]. Because it is a competitive sport, the high risk of injuries worries coaches, trainers and players in all categories as it disrupts the evolutionary processes and systematic adjustments imposed by training[4,5].

From a socioeconomic standpoint, the high indices of sports injuries (SI) results in financial losses to teams and sponsors, including additional health costs and temporary inaction that may result in permanent functional deficits[3]. Hence it is important to highlight that soccer is marked by physical contact and performance of specific sports actions such as running, jumping, landings, acceleration, slowdown, abrupt changes of direction, kicks and tramping[1,5]. Features such as resistance, velocity, agility, flexibility and strength are essential requirements to the full exercise of soccer[1]. These physical demands, specific to soccer, are consensus in the literature[1-3] and, whether associated or not, may represent extrinsic causative factors related to the occurrence of SI. Along with such features, the continuous requirement for physical, technical and tactical improvement, common in modern sports training, also relates to the occurrence of MSDs[6].

Along with extrinsic causes, other etiologic components of SI also include inherent features of the athlete (intrinsic factors)[7]. Among other features, height, body weight[8] and flexibility[9] are postulated as potential risk factors to the occurrence of SI. Recent studies have been showing that the exposure to causal factors derived from age have been increasing the propensity to MSDs[10-12]. Indeed, the incidence of injuries tends to increase with age, and 16-18 y. o. athletes are proving to be as vulnerable to SI as adult players[12,13].

In view of these considerations, several studies have been showing the occurrence of injuries in various age groups, in the following intervals; 4-17 y. o.[12] 18-35 y. o.[12], 6-16 y. o.[14], and 16-20 y. o.[15]. However, we did not find studies evaluating the nosography of SI in relation to the various age development cycles: childhood (up to 10 y. o.), adolescence (11-18 y. o.) and adulthood (over 18 y. o.)[16]. Therefore, this study is aimed at outlining the profile of typical SI according to age group. Another objective was to find out which age group is more susceptible to injuries. Considering that SI propensity is proportional to the level of competitiveness demanded in soccer[11,12], our initial hypothesis was that adult players would show a higher prevalence of sports injuries compared to other categories.

METHODOLOGY

Study participants

Descriptive and cross-sectional, observational study comprising soccer players in professionalizing and professional teams of CENE (Clube Es-

portivo Nova Esperança) in Campo Grande/MS. The study had the participation of 209 male individuals, which had been intentionally selected.

Participants were informed of the objectives of the study, as well as of the voluntary participation. All participants or their guardians signed the consent form. This study was approved by the Research Ethics Committee of UFMS, in accordance with Resolution 196/96.

Population and design of study groups

Participants were divided into four groups, according to age cycle of human development[16]. Group 1 (G1) - childhood – was comprised of 6-10 y. o. players. As for the Teenagers group, in order to distinguish athletes with different histories of regular soccer practice, there were two age groups: Group 2 (G2), comprised of 11-14 y. o. athletes and Group 3 (G3), comprised of 15-18 y. o. athletes. Group 4 (G4) comprised athletes over 18 y. o., i.e. adults.

Registration methods and nosographic MSD characterization

Information on injuries was recorded using a Morbidity Survey (IMR). Frequently, the IMR has been used to collect health-related information in specific population groups[17,18]. This queue method is based on the application of closed format questionnaires, through interrogation directed to the target audience of the study[18]. Using the IRM provided nosographic information related to the nature, frequency, anatomical parts and condition causing injuries.

Data acquisition occurred by requesting specific information. The whole process was initiated by approaching the participant and/or their guardians, passing through various stages until the notes on the investigation itself. For study purposes, we considered SI as any manifestation of symptoms of pain or MSDs due to sports training and competition and resulting from changes in training practices, i.e. length, intensity or frequency[17-19].

Morbidity Survey

In order to characterize injuries, participants reported the onset date (month/ year), its nature, anatomical segment involved, etiologic mechanism and circumstance of occurrence of injury or manifestation of symptoms, requisition of professional therapeutic treatment and symptomatology of return to sports[17].

It is important highlighting that changes on IRM suitability to the actual conditions essentially involved the specific sports gestures of Soccer, especially regarding the etiologic aspects of the injury[1-3]. Thus, they have been classified as follows: running, jumping, technique (specific soccer gestures), contact, and others (e.g., gym workout and situations not included in preceding categories).

The anatomical segment affected by aggravations has been classified into four great segmental parts: head and neck, upper limbs, body and lower

limbs, in compliance with related records[18,20]. The training period in which the injury occurred has been divided into two classes: Training (comprising training circumstances and physical, technical or tactical improvement) or match (official competition or training matches).

The requisition for medical therapeutic treatment was considered if a lesion was diagnosed and/or treated by any of the following professionals: Physiotherapist, General Practitioner, Physician specialized in Sports Medicine or Orthopedics[12]. In turn, the symptoms of the athlete's return to sport activities (asymptomatic or symptomatic) have been recorded after addressing each injury reported[17].

Statistical analysis procedures

For data analysis, we used the Goodman test between and within multinomial populations[21]. Thus, in order to represent the significance of findings we used the followed letters in tables: lowercase indicates the comparison of groups with fixed response category; uppercase indicates the comparison of response categories within the group. All findings have been discussed for 5% statistical significance.

RESULTS

Table 1 shows demographic measures along with information on the training history and incidence of lesions according to the age cycle. Regarding age, groups were different in the anthropometric aspect in relation to the training history, considering the practice time and the weekly exposure period. Among the 209 athletes evaluated, 74 (35.4%) reported one or more sports injuries, totaling 0.44 SI per participant. Although Group 2 has reported the higher prevalence of injuries (43.5%), Groups G3 (1.4 SI/athlete injured) and G4 (1.2 SI/athlete) revealed the highest incidence rates of MSDs (Table 1).

Table 1. Demographic profile, training history and incidence of sports injuries according to age group

Variables	Groups			
	G1	G2	G3	G4
Age (years)	8.9 ± 1	12.5 ± 1.2 *	15.6 ± 0.8 *#	24.4 ± 4.7 *#†
Height (cm)	133 ± 9	152 ± 20 *	171 ± 8 *#	177 ± 8 *#
MC (kg)	30 ± 9	45 ± 11 *	64 ± 9 *#	74 ± 6 *#†
HT (years)	1.7 ± 1.4	3.7 ± 2.3 *	5.3 ± 2.9 *	13.0 ± 4.8 *#†
TS (hours)	4h - 6h	6h - 10h	6h - 10h	>10h
Injuries	8 (8.7%)	40 (43.5%)	9 (9.8%)	35 (38%)
TAL	1.14	1.00	1.40	1.30
TLA	0.20	0.41	0.20	1.20
Subjects (Total)	39	97	44	29

Demographics and training history (HF) expressed as mean ± standard deviation; TS: weekly exposure to training; Injuries: total number of lesions per category; TAL: Rate of injury per injured athlete; TLA: Rate of injury per athlete; *p<0.05 versus G1; #p<0.05 versus G2; †p<0.05 versus G3; ANOVA and Student-Newman-Keuls test (p<0.05).

The proportion of athletes affected was greater in the adult group (G4), with 72.4% of participants (n=21) reporting injuries. In Group G2, 40 athletes reported MSDs, totaling 41.2% of the group; Groups G1 and G3 were similar in the proportion of athletes affected, with a record of 8 (20.5%) and 9 (20.5%) cases, respectively. Among injuries reported, 18 cases of recurrence of injury were reported and distributed in groups G1 (1 case: 12.5%), G2 (1 case: 2.5%), G3 (2 cases: 22.2%) and G4 (14 cases: 40.0%).

Considering the nature of injuries, muscle and joint injuries proved to be the most frequent in all categories, followed by bone and tendon injuries, in that order. Muscle injuries were the most prevalent in teenagers, as observed in groups 2 and 3, while in groups G1 and G4 had similar occurrences for muscle and joint injuries (Table 2).

Table 2. Absolute and relative distribution of sports injuries according to nature and age development cycle

Groups	Nature				Total
	Muscles	Joints	Bones	Tendons	
G1	3 (37.5%) ^{Aa}	3 (37.5%) ^{Aa}	1 (12.5%) ^{Aa}	1 (12.5%) ^{Aa}	8 (100%)
G2	20 (50.0%) ^{Ac}	13 (32.5%) ^{Abc}	3 (7.5%) ^{Aa}	4 (10.0%) ^{Aab}	40 (100%)
G3	4 (44.4%) ^{Ab}	3 (33.3%) ^{Aab}	0 (0.0%) ^{Aa}	2 (22.2%) ^{Aab}	9 (100%)
G4	13 (37.1%) ^{Ab}	13 (37.1%) ^{Ab}	3 (8.6%) ^{Aa}	6 (17.1%) ^{Aab}	35 (100%)
Total	40 (43.5%) ^{b}	32 (34.8%) ^{b}	7 (7.6%) ^{a}	13 (14.1%) ^{a}	92

A, B: Vs. age group; a, b: Vs. nature, different characters indicate significant difference, where A < B and < b. Goodman test for contrast between and among multinomial populations; $p<0.05$.

In turn, we have found no significant difference between age categories, when analyzing the distribution of injuries according to the anatomical part. Indeed, there was the predominance of SI in lower limbs for all groups. No affections in body segments for any group analyzed (Table 3) have been found.

Table 3. Absolute and relative distribution of sports injuries according to nature and age development cycle

Groups	Anatomical Part			
	Head	UL	LL	Total
G1	0 (0.0%) ^{Aa}	0 (0.0%) ^{Aa}	8 (100.0%) ^{Ab}	8 (100%)
G2	2 (5.0%) ^{Aa}	4 (10.0%) ^{Aa}	34 (85.0%) ^{Ab}	40 (100%)
G3	0 (0.0%) ^{Aa}	0 (0.0%) ^{Aa}	9 (100.0%) ^{Ab}	9 (100%)
G4	0 (0.0%) ^{Aa}	2 (5.7%) ^{Aa}	33 (94.2%) ^{Ab}	35 (100%)
Total	2 (2.2%) ^{a}	6 (6.5%) ^{a}	84 (91.3%) ^{b}	92

UL: Upper Limbs; LL: Lower limbs. A, B: versus age group; a, b: versus anatomical segment, different characters indicate a significant difference, where A < B and a < b. Goodman test for contrast between and within multinomial populations, $p<0.05$.

As for the etiologic mechanism causing injuries, the main event of origin of SI was contact traumas, totaling 47.8% of occurrences. Nevertheless, Group G3 comprised of 15-18 y. o. teenagers had running as the main cause of injuries (Table 4).

Table 4. Absolute and relative distribution (%) of sports injuries according to the mechanism of manifestation and age development cycle

Groups	Mechanism of injury					
	Running	Jumping	Technique	Contact	Others	Total
G1	0 (0.0) ^{Aa}	0(0.0) ^{Aa}	3(37.5) ^{Aab}	5 (62.5) ^{Ab}	0 (0.0) ^{Aa}	8 (100%)
G2	10 (25.0) ^{Bbc}	0(0.0) ^{Aa}	5(12.5) ^{Aab}	23 (57.5) ^{Ac}	2 (5.0) ^{Aab}	40(100%)
G3	4 (44.4) ^{ABa}	0(0.0) ^{Aa}	3(33.3) ^{Aa}	2 (22.2) ^{Aa}	0 (0.0) ^{Aa}	9 (100%)
G4	4 (11.4) ^{Aba}	5(14.2) ^{Aa}	8(22.8) ^{Aa}	14(40.0) ^{Aa}	4 (11.4) ^{Aa}	35(100%)
Total	18 (19.6) ^{a}	5 (5.4)^{a}	19(20.7) ^{a}	44 (47.8) ^{b}	6 (6.5)^{a}	92

A, B: Vs. age group; a, b: vs. mechanism, different characters indicate significant difference, where A < B and < b. Goodman test for contrast between and among multinomial populations; p<0.05.

The circumstance of manifestation of sports injuries integrated primarily training events, although in Groups G1 and G3 we have observed the balance between training and competition events (Table 5). In the clinical context, the majority of cases of injuries resulted in pursuit of medical therapeutic support: 76 SI (82.6%); this profile of responses was observed in all age groups. Along with therapeutic support, the majority of sports injuries (67%) resulted in asymptomatic return, in contrast to the 30 records (33%) with symptomatic manifestation in the returning to sports (p<0.05) (Table 5).

In turn, the time of withdrawal was increasingly different between groups (p<0.004). Group G4 had longer withdrawal time due to MSDs (60±14 days) followed by groups G3 (57±39 days; p>0.05), G2 (36±8 days; p<0.05) and G1 (14±8 days; p<0.05). We did not find significant differences between groups G1, G2 and G3.

Table 5. Absolute and relative distribution of sports injuries according to circumstance of origin, treatment, symptomatology and age development cycle

Variables		Groups				Total
		G1	G2	G3	G4	
Competition	No	4 (50.0%) ^{Aa}	23 (57.5%) ^{Ab}	5(55.6%) ^{Aa}	26(74.3%) ^{Ab}	62 ^{b}
	Yes	4 (50.0%) ^{Aa}	17 (42.5%) ^{Aa}	4(44.4%) ^{Aa}	09 (25.7%) ^{Aa}	30 ^{a}
Treatment	No	0 (0.0%) ^{Aa}	13 (82.3%) ^{Ba}	1 (6.3%) ^{Aa}	02 (12.5%) ^{Aa}	16 ^{a}
	Yes	8 (10.5%) ^{Ab}	27 (35.5%) ^{Bb}	8(10.5%) ^{Aa}	33 (43.4%) ^{Bb}	76 ^{b}
Symptomatic R.	No	4 (6.5%) ^{Aa}	27 (43.5%) ^{Ab}	5 (8.1%) ^{Aa}	26 (41.9%) ^{Ab}	62 ^{b}
	Yes	4 (13.3%) ^{Aa}	13 (43.3%) ^{Aa}	4(13.3%) ^{Aa}	09 (30.0%) ^{Aa}	30 ^{a}

Symptomatic R.: symptomatic return, A, B: comparisons between age groups; a, b: comparisons between categories (No Vs. Yes), distinct characters reveal a significant difference, where A < B < b. Goodman test for contract between and within multinomial populations; p<0.05.

DISCUSSION

This study analyzed the incidence of SI and nosography in soccer, characterizing them according to age development cycles[16]. The study design is justified by the possibility of providing subsidies to professional prophylaxis and treatment of specific injuries according to age group, thus contributing

to the evolution of physical, tactical and technical performance of soccer players in the main age groups[18].

Among the main findings, the prevalence of SI was higher in G4, but the absolute distribution of injuries was higher in group G2. In soccer, the manifestation of risk factors related to the occurrence of SI, especially exposure to training, are very common to increase with age[12,22]. The adult group is particularly comprised of high performance athletes, who take part of various regional and national soccer championships. Thus, they integrate a select group to which a possible lesion is especially remarkable, as it prevents athletes from practicing sports due to ergonomic withdrawal, causing important socioeconomic impacts[3,20,23]. Indeed, group G4 had the higher withdrawal time after the occurrence of injuries compared to the other age groups.

In addition to the greater sports exposure, anthropometric features were progressively increased with age, thus evidencing that possible interactions between extrinsic and intrinsic factors may have caused higher incidence of injuries during biological maturation. This assumption is also supported by the proportion of athletes affected by SI with age progression, which is 72.4% of the adult group. Further evidence concerns the severity of SI in G4; 22 injuries (63%) comprise serious injuries[24], with more than 21 days of withdrawal. Among other factors predisposing to SI that are increased by age, there are biomechanical gait alterations[25], segmental deficits of flexibility[16] and postural changes[26], which have not been approached in this study. Therefore, the etiologic understanding of sports injuries should be conceived from a multifactorial perspective, by defining the main causal agents[27], characterizing them according to age group. Although characterizing a painful and impracticable task[18], this approach proves to be essential in developing prophylactic strategies by professionals focused on the care soccer players' health.

In turn, the prevalence and severity of sports injuries among children was particularly low, thus confirming the findings of prior studies[4,14]. Generally, child soccer is considered as a playful activity, with no potential risks to the players' physical integrity, mainly due to the lower competitive demand[14]. On the other hand, the values of SI incidence were particularly high in teenagers (G2 and G3), even being lower than the indices of adult players. As for nosography, this study confirms the findings of other authors[3,10-12,20]. Almost 20% of the records involved relapses and the prevalence of muscle injuries was higher for all groups. Likewise, injuries in lower limbs were more frequent, while contact was the main injury mechanism. However, curiously, group G3 reported running as the event causing most injuries. As in the adult category, adolescent players are frequently exposed to collective matches. Such condition finds support in triggering mechanisms and circumstances of occurrence of injuries (Tables 4 and 5). In G3, running and game technique comprised the mechanisms responsible for 77.7% of SI, which were distributed equitably among training and competitions. Therefore, frequent requests at matches in the official Sub-16

and Sub-18 categories[28], or even in training, added to the lack of fitness resulting from the nonsystematic training, could result in increased rates of injury in this age group. Nevertheless, other disorders, such as postural changes[26,29] and muscle imbalances[25] could also contribute to the occurrence of SI in teenagers.

For the other groups, specific training requests may be related when considering the circumstances of manifestation of injury (Table 5). In groups G2 and G4, most injuries were caused by training events. These findings reinforce that the repeating requirement of game, integrating specific gestures aligned with the competitive nature of the game[3,7,27], could be better listed as causes of SI reported in these categories.

Finally, the highest proportion of SI culminated in medical therapeutic approach. As for the socioeconomic aspect, in addition to volume of injuries, costs related to injuries depend on the search for medical help and the length of the withdrawal[12]. Nevertheless, it is important emphasizing that the greater adherence to treatment was associated to lower indices of symptomatic manifestations in the return (Table 5). Indeed, the inadequate recovery sets an important indication to relapses[12]. It should be noted that most SI cases reported were regularly assisted by a sports physiotherapist. According to Silva et al.[30], the main chief task of sports physiotherapy in soccer has been related to the return of athletes after the occurrence musculoskeletal injuries. Therefore, the design of nosography of the main injuries according to category may set up an important foundation for the establishment of prophylactic propositions to be performed in different age groups.

CONCLUSIONS

Based on the results were reported, our initial hypothesis that adult athletes would have a higher SI prevalence was confirmed and proved to be associated with several intrinsic risk factors, including anthropometric attributes, training history and relapses. As for the intrinsic aspect, weekly exposure to matches and training turns out to be an etiologic factor in all categories. Conversely, this study did not allow to identify which etiologic factors were the strongest determinants of the occurrence of injuries in specific age groups of players (childhood, adolescence and adulthood). Therefore, future studies focusing on each specific age group are warranted to better reveal the causes of injuries.

In sum, the nosographic profile of injuries was similar between categories, with a high prevalence of musculoskeletal and joint injuries in lower limbs, especially as a result of contact events. Most SI involved a physiotherapeutic approach, providing significant indices of asymptomatic return. The role played by preventive measures and analysis of the efficiency of different modalities and interventional procedures to these injuries still need further research.

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