SOUTH AMERICAN JOURNAL
OF BASIC EDUCATION, TECHNICAL AND TECHNOLOGICAL
INSS: 2446-4821 (Online)
Artigo original

PREVALENCE OF OSTEOMUSCULAR INJURIES AND NUTRITIONAL STATUS OF PROFESSIONAL SOCCER PLAYERS FROM ACRE

PREVALÊNCIA DE LESÕES OSTEOMUSCULARES E ESTADO NUTRICIONAL DE JOGADORES DE FUTEBOL PROFISSIONAL DO ACRE

João José Albuquerque de Sousa Júnior[1*]; Jader Bezerra de Andrade[1]; Romeu Paulo Martins Silva[2]

[1]Universidade Federal do Acre – UFAC – Rio Branco, Acre, Brasil.
[2]Universidade Federal do Catalão – UFCAT – Catalão, Goiás, Brasil.

*Autor correspondente: e-mail: joaojrpersonal@hotmail.com

Abstract

Soccer is a sport with high physical, tactical, and technical demands, high rates of musculoskeletal injuries, and therefore the nutrition must be an important aspect. The objective was to verify the prevalence of musculoskeletal injuries and nutritional status of professional soccer players from Acre. Participated in the study thirty-nine football players, affected by musculoskeletal injuries in the 2019 and 2020 seasons. The athletes answered a questionnaire regarding the prevalence of injuries and a 24-hour food recall. As results, there was a prevalence of 19.37 injuries per 1000 hours of game, midfielders were the most affected (33.3%), stretching was the most common type of injury (46.2%), the anterior region of the thigh was the most affected (59%). It was verified the inadequate intake of nutrients by the athletes, carbohydrates (3.84 g/kg/day) and proteins (1.39 g/kg/day), as well as micronutrients, calcium, magnesium, copper, iodine and potassium, vitamins A, B5, C and B9. In conclusion, the prevalence of injuries in Acrean soccer is high and the low consumption of macro and micronutrients may be an indication of risk factors for the appearance of injuries.

Key words: Injury, Nutrients, Soccer.

Resumo

O futebol é um esporte com exigências físicas, táticas e técnicas elevadas, alto índice de lesões osteomusculares e por consequência a nutrição deve ser um aspecto importante. O objetivo foi verificar a Prevalência de Lesões Osteomusculares e Estado Nutricional de Jogadores de Futebol Profissional do Acre. Participaram do estudo 39 jogadores, acometidos por lesões osteomusculares nas temporadas de 2019 e 2020. Os atletas responderam um questionário referente a prevalência de lesões e um recordatório alimentar de 24 horas. Como resultados, houve uma prevalência de 19,37 lesões por 1000 horas de jogo, os meio campistas foram os mais afetados (33,3%), o estiramento foi o tipo de lesão mais acentuado (46,2%), a região anterior da coxa foi a mais acometida (59%). Verificou-se a inadequada ingestão de nutrientes por parte dos atletas, carboidratos (3,84 g/kg/dia) e proteínas (1,39 g/kg/dia), assim como, os micronutrientes, cálcio, magnésio, cobre, iodo e potássio, vitaminas A, B5, C e B9. Em conclusão a prevalência de lesões no futebol Acreano é alta e o baixo consumo de macro e micronutrientes, podem ser um indicativo de fator de risco para o surgimento de lesões.

Palavras-Chave: Lesão, Nutrientes, Futebol.

INTRODUCTION

Soccer is the most practiced and popular sport in the world, with approximately 400 million fans in various countries, with different social levels and age groups. The numbers of injuries are high, due to their characteristic of high intensity, physical contacts, short, fast and non-continuous movements, such as acceleration, deceleration and abrupt changes of direction [1].

According [2], soccer depends on an adequate control of tactical, technical, nutritional, psychological and physical factors, which the players cover different distances, intensities and movements, which tend to increase, considerably, injuries in the athletes.

According [3] soccer is the highest cause of injuries in athletes in the world and these are responsible for 50 to 60% of all sports injuries in Europe, and are associated with a significant economic, social, and sporting impact. At the professional level, epidemiological studies have shown an incidence rate of 16 to 28 injuries per 1,000 hours of exposure [4].

Food consumption is another important aspect, as soccer promotes high caloric expenditure in athletes, requiring an adequate food intake to provide muscle recovery that are essential for improving the performance [5]. Soccer players are athletes who train from moderate to high intensity, having daily energy needs of up to 4000 kcal according to their characteristics [6, 7].

Soccer is a sport in which the loss of nutrients is greater due to its long duration, requiring more energy compared to many other sports [8]. Adequate energy intake is essential for the athletic performance because of the demands, which include intense training, departures greater than or equal to 90 minutes, congested equipment and journey that lead to increased energy and nutrient needs [9].

Therefore, the objective of this study is to identify the prevalence of injuries and the diagnosis of nutritional status through food consumption in professional soccer players in the State of Acre.

METHODS

The present study is research with a descriptive model of longitudinal section. The study sample consisted of 39 athletes from 418 professional soccer players from the State of Acre - Brazil. The study included professional soccer athletes over 18 years old, hired by a club participating in the Acreano Championship in the 2019/2020 seasons and who suffered some type of musculoskeletal injury during training and matches. A questionnaire (anamnesis) was formulated with 7 (seven) questions, 3 (three) closed and 4 (four) open, to gather information about the athletes' profile, the injuries suffered and the 24-hour recall regarding the food consumption of the athletes validated in several studies [10, 11]. The variables of age, weight, height, BMI (Body Mass Index), player position, type of injury, injury site, time of injury, macronutrients (carbohydrates, lipids and proteins) and micronutrients (vitamins and minerals) were collected. The questionnaire related to injuries and a 24-

hour recall were applied in the clubs themselves in a private and air-conditioned room, individually, whenever possible the day after the injury occurred. The 24-hour recall was applied for three consecutive days to assess the player's average food consumption during that period. The data collection was performed by signing the Informed Consent Form. The research ethics committee of Centro Universitário Uninorte, under the protocol No. 3.966.502, have approved the project. The injury incidence, which is expressed by the number of injuries per 1,000 hours of exposure, was calculated. To assess the risk of injury, the following formula was used to calculate exposure in games: Exposure = number of games x number of players per match x duration of the match in hours. To calculate the incidence of injuries for every 1,000 hours of playing, the following formula was used: Incidence = total number of injuries × 1,000 hours divided by exposure [12]. The statistical procedures were treated with the SPSS 25 software. The variables were described by means with standard deviation, absolute (n) and relative (%) frequency. Pearson's chi square test with Bonferroni correction was used to assess the difference in the proportion of outcomes according to independent variables. The level of significance was $p \leq 0.05$.

RESULTS

An amount of 418 athletes has participated in the Acre Soccer Championship in the 2019 and 2020 seasons. The tournament took place with 20 rounds and 61 matches played among 10 soccer teams. During the championship, there was an average of 1.56 injuries per game and an incidence of 19.37 injuries per 1,000 hours of playing. The player data are described in table 01.

Table 01. Anthropometric Data.

Variable	A/D
Age	27,9 ± 5,03
Weight (kg)	78,4 ± 10,4
Height	1,79 ± 0,06
BMI (m/kg^2)	24,41 ± 2,95

BMI = body mass index

A/D = average and standard deviation

The Table 02 describes the characteristics of the players' injuries. There was a greater occurrence of injuries among midfield players with 33.3%; a higher frequency of stretching, 46.2%; occurring in the anterior thigh region, 59%. Most injuries were sustained during the game, 51.3%. Regarding the differences between seasons, the majority of injuries occurred regardless of the year. The exceptions were for the player's position (fullback), type of injury (contracture and sprain), and location of the injury (anterior thigh, posterior thigh and knee).

Table 02. Players' injuries characteristics during the 2019/2020 seasons.

VARIABLES	Groups		Total	*sig*
	Injuries 2019	Injuries 2020		
ATHLETE POSITION	**n=19 n(%)**	**n=20 n(%)**	**n(%)**	0,032
Goalkeeper	3 (15,0)	0 (0,0)	3 (7,7)	0,071
Center-back	2 (10,0)	3 (10,5)	4 (10,3)	0,920
Full-back	0 (0,0)	7 (36,8)*	7 (17,9)	0,002
Defensive midfielder	4 (20,0)	2 (15,8)	7 (17,9)	0,764
Attacking midfielder	9 (45,0)	5 (21,1)	13 (33,3)	0,109
Forward	2 (10,0)	3 (15,8)	5 (12,8)	0,617
INJURY TYPE	**n=19 n(%)**	**n=20 n(%)**	**n(%)**	0,020
Hamstring strain	10 (50,0)	2 (10,5)*	12 (30,8)	0,006
Muscle strain	9 (54,0)	9 (47,4)	18 (46,2)	0,920
Fracture	1 (5,0)	0 (0,0)	1 (2,6)	0,317
Luxation	0 (0,0)	1 (5,3)	1 (2,6)	0,317
Sprain	0 (0,0)	4 (21,1)*	4 (10,3)	0,027
Tendonitis	0 (0,0)	1 (5,3)	1 (2,6)	0,317
Others	0 (0,0)	2 (10,5)	2 (5,1)	0,133
INJURY LOCATION	**n=19 n(%)**	**n=20 n(%)**	**n(%)**	0,001
Anterior Thigh	18 (90,0)	5 (26,3)*	23 (59,0)	0,001
Ankle	2 (10,0)	2 (10,5)	4 (10,3)	0,920
Posterior Thigh	0 (0,0)	6 (31,6)*	6 (15,4)	0,006
Knee	0 (0,0)	4 (21,1)*	4 (10,3)	0,027
Others	0 (0,0)	2 (10,5)	2 (5,1)	0,133
TRAINING OR MATCH	**n=19 n(%)**	**n=20 n(%)**	**n(%)**	0,869
Training	10 (50,0)	9 (47,4)	19 (48,7)	0,841
Match	10 (50,0)	10 (52,6)	20 51,3)	0,841

* = p ≤ 0,05; n = absolute frequency; n (%) = relative frequency.

The Table 3 describes the values of macronutrients consumed by injured players. The average intake of macronutrients, carbohydrates and proteins are below the recommended values, which reflects, significantly, in the low levels of total energy value.

Table 03. Levels of total energy value and macronutrients consumed by players.

Variable	A/D	Reference amount
TEV (kcal)	2416,99 ± 682,90	4000kcal/day
Proteins (g/kg/day)	1,39 ± 0,44	1,4-1,7g/kg/day
Carbohydrates (g/kg/day)	3,84 ± 1,37	7-8g/kg/day
Lipids (g/kg/day)	1,14 ± 0,38	1g/kg/day

A/D = Average and Standard Deviation; TEV = Total Energy Value.

Table 04 describes the values of the micronutrients consumed by the players. It was observed that the micronutrients: Vitamin A, Vitamin B5, Vitamin C, folic acid, calcium, magnesium, copper, iodine and potassium were not present at adequate levels in the athletes' diet.

Table 04 – Values of micronutrients consumed by the athletes.

Variable	A/D	Reference values RDI
VITAMIN A (µg)	667,17 ± 994,11	900µg/day
VITAMIN D (µg)	3,31 ± 4,07	5µg/day
VITAMIN B1 (mg)	1,73 ± 1,12	1,2mg/day
VITAMIN B2 (mg)	1,55 ± 0,78	1,3mg/day
VITAMIN B5 (mg)	3,57 ± 1,85	5mg/day
VITAMIN B6 (mg)	1,67 ± 1,26	1,3mg/day
VITAMIN B12 (µg)	7,69 ± 12,70	2,4µg/day
VITAMIN C (mg)	56,26 ± 50,73	90mg/day
VITAMIN E (mg)	21,93 ± 9,96	15mg/day
FOLIC ACID (µg)	117,80 ± 83,96	400µg/day
CALCIUM (mg)	468,68 ± 196,86	1000mg/day
PHOSPHORUS (mg)	1042,99 ± 307,82	700mg/day
MAGNESIUM (mg)	202,64 ± 82,51	400mg/day
IRON (mg)	15,40 ± 6,44	8mg/day
ZINC (mg)	12,47 ± 4,81	11mg/day
COPPER (µg)	1,26 ± 0,79	900µg/day
IODINE (µg)	38,29 ± 28,39	150µg/day
SELENIUM (µg)	94,09 ± 49,16	55µg/day
MANGANESE (mg)	1,95 ± 2,03	2,3mg/day
POTASSIUM (mg)	1972,50 ± 940,02	4700mg/day
SODIUM (mg)	2413,89 ± 920,33	1500mg/day

M/D = Average and Standard Deviation; TEV = Total Energy Value; RDI = Reference Daily Intake

DISCUSSION

The high rate of injuries per match (1.56), as well as the prevalence per 1000 hours of game (19.37), are similar to the results of several other studies [4, 12, 13] in which they have rates ranging from 15 to 30 injuries per 1,000 hours of sports practice. These variations may be related to the various definitions of injury, the duration of the championship or season and the inclusion of injuries that occurred during training.

The position of the players on the field seems to influence the number of injuries, since most of the occurrences were in the athletes who act in the midfield and forward position. Some studies have already point to this tendency [14, 15] and according to the authors, these results may be related to the number of players working in this position. The greater distance ranged in high intensity, the biggest ball dispute both to attack and to defend it in this zone of game, and also, according to [4], a change of style in the soccer currently played, in which the attackers are marked in a more intense and violent way.

In the types of injuries, stretching and contracture are more prevalent. This type of injury is very common among soccer players [16]. The high rate of injuries in this musculature can be explained by the great request of the member during the game, in addition to the different situations to which the athlete is exposed [17]. The eccentric forces that stress the musculotendinous complex when kicking and changing direction [18], and the relative weakness of hip adduction, which is a risk factor for groin injury [19].

Regarding the injury site, the greatest involvement was the anterior thigh region. There are several factors that can justify the high injury rate in this musculature, inadequate muscular conditioning, repetitive explosive movements [20], excessive physical strengths, needed for kicking, accelerations, predominant use of pelvic muscles [21], high intensity, short sprints with sudden turns and speed increase or decrease [22].

The number of injuries was practically the same in training and matches, similar results to those found in the study [23] in Australian professional players. According to the author, it is suggested that the higher total training loads are related to the higher general incidence of injuries in training.

As for the total caloric value, the average daily caloric intake was below that recommended [7] who emphasizes, at least, 4000kcal to guarantee a good energy replenishment. According [24] the energy spent during a day of training for elite male soccer players is between 3442 kcal and 3824 kcal. Another study using double-labeled water, found that the average energy expenditure of elite soccer players is 3566 kcal over a 7-day period, including 5 days of training and two matches [25].

The average protein intake was 1.39 g/kg/day, being below the values suggested [26] 1.4-1.7g/kg/day and [6] that recommend values of up to 2g/kg/day. Therefore, this is a worrying fact, since amino acids have a fundamental role in the synthesis of proteins, a substrate for the production of energy and are still precursors of various hormones and enzymes. Thus, the deficit of this

macronutrient indicates the favoring of muscle injuries, mainly due to muscle losses due to protein degradation, promoted by training and games, which are not being adequately replenished [27].

The players' daily carbohydrate intake was 3.78 g/kg/day. According [28], it is below the recommended value for an athlete, since, to maintain muscle glycogen stores, the ideal value would be 7-8 g/kg/day. Some researchers, when observing energy deficits, have raised some concerns about low carbohydrate intake among young and adult soccer players, even with the protein requirements met [25, 29]. It is worth mentioning that together with the preservation of muscle mass, the glycogen reserve is an essential factor for a good performance of the athlete [30].

The micronutrients, vitamins A, D, B5 and C, folic acid, copper, calcium, magnesium, iodine and potassium did not present adequate levels in the diet of the athletes. These data are concerning, as, according [31] it is assumed that the micronutrient requirements for athletes are actually higher than the ones suggested for physically inactive people.

Among the micronutrients evaluated, vitamin D stands out, which in addition to regulating the absorption and metabolism of calcium and phosphorus, acts in mediating muscle metabolic function, preventing injuries, rehabilitation, reducing inflammation and reducing risk stress fracture [6]. However, vitamin D is also produced endogenously as a consequence of UVB radiation, considering that the group examined consisted of soccer players exposed to this radiation, and the concentration of vitamin D in the blood is expected to be at adequate levels.

Another prominent micronutrient is vitamin C, an antioxidant that can mitigate oxidative stress induced by exercise [32]. At adequate levels, protection of cell membranes is suggested, attenuating their degradation, and stimulating the activity of neutrophils, monocytes and lymphocytes. Thus, according to [33], the hypothesis of the implication of this vitamin in the stimulation of the immune system and in the protection of cell breakage induced by a soccer match is reinforced.

Regarding to vitamin B9 deficiency, folate, according [34], its deficiency reduces cell division, for example, red blood cells, producing anemia, and affects cells derived from bone marrow, leading to leukopenia and thrombocytopenia; and cells in the lining of the gastrointestinal tract, inducing malabsorption.

The micronutrient copper has important biological functions, including the modulation of the enzyme activity and also a role in the synthesis of hemoglobin, catecholamines and some peptide hormones [35], and can act as a cofactor for endogenous enzymes, thus, when there is deficiency of this nutrient, the activities of these enzymes can be compromised [33].

The inadequate intake of calcium by athletes is concerning, since this mineral is important for the growth, maintenance and repair of bone tissue, regulation of muscle contraction, nerve conduction and blood clotting. Thus, an inadequate consumption of this nutrient increases the risk of low bone mineral density and stress fractures [6].

The magnesium plays a number of vital roles in regulating energy metabolism, acting as a cofactor and activator of various enzymes, and is involved in calcium metabolism and in maintaining electrical gradients in the membranes of nerve and muscle cells [35]. There are evidences that

marginal magnesium deficiency impairs exercise performance and amplifies the negative consequences of strenuous exercise, for example, oxidative stress [34].

The physiological role of iodine in the human body is in the synthesis of thyroid hormones by the thyroid gland, where these hormones control various metabolic processes in the body such as metabolism of carbohydrates, fats, proteins, vitamins and minerals [34]. Thus, insufficient intake of energy, iodine, selenium, iron and vitamin D deficiency can be some of the factors of thyroid dysfunction [36].

Regarding to potassium, it is an important component of the diet, as it regulates the volume of intra and extracellular fluid and is involved in the conduction of nervous impulses and skeletal muscle contractions [37]. Also that the development of fatigue during intermittent high-intensity exercise can be caused by a complex interaction between intra and extracellular concentrations, as well as ion gradients, such as potassium [38].

CONCLUSION

In conclusion, we have found that there are several modifiable and non-modifiable factors that are associated with susceptibility to injuries [39, 40]. However, it was not found any study to demonstrate the nutritional status of the injured players and their relationship with the predisposition of injuries. Thus, the results found in the present study indicate that low consumption of macro and micronutrients by injured players can be an indicator of a risk factor for the appearance of injuries, given that these nutrients play an important role in metabolism. Therefore, more researches, including injured and uninjured groups must be carried out in order to establish better diagnoses.

DISCLOSURE STATEMENT

There is no potential conflict of interest.

REFERENCES

[1] STUBBE J. H.; BEIJSTERVELDT, A-M.M.C.V.; KNAAP S.V.D.; STEGE J.; VERHAGEN E.A.; MECHELEN, W.V. Injuries in Professional Male Soccer Players in the Netherlands: A Prospective Cohort Study. **Journal of Atlhetic Training**. 2015;50(2):211-6.

[2] MCCALL A.; CARLING, C.; NEDELEC, M.; DAVISON, M.; LE GALL, F.; BERTHOIN, S.; et al. Risk factors, testing and preventative strategies for non-contact injuries in professional football: current perceptions and practices of 44 teams from various premier leagues. **Br J Sports Med**. 2014;48(18):1352-7.

[3] PFIRRMANN, D.; HERBST, M.; INGELFINGER, P.; SIMON, P.; TUG, S. Analysis of Injury Incidences in Male Professional Adult and Elite Youth Soccer Players: A Systematic Review. **Journal of athletic training**. 2016;51(5):410-24.

[4] CRISTIANO NETTO, D.; ARLIANI, G.G.; THIELE, E.S.; CAT, M.N.L.; COHEN, M.; PAGURA, J.R. Prospective Evaluation of Injuries occurred during the Brazilian Soccer Championship in 2016 **Revista Brasileira de Ortopedia**. 2019;54:329-34.

[5] GONÇALVES, L.S.; DE SOUZA, E.B.; DE OLIVEIRA, E.P.; BURINI, R.C. Perfil antropométrico e consumo alimentar de jogadores de futebol profissional. RBNE - **Revista Brasileira de Nutrição Esportiva**. 2015;9(54):587-96.

[6] AMERICAN DIETETIC ASSOCIATION DIETISTAS DO CANADÁ, A.; AMERICAN COLLEGE OF SPORTS MEDICINE, A. Nutrition and Athletic Performance. **Med Sci Sports Exerc**. 2016;48(3):543-68.

[7] CLARK, K. Nutritional guidance to soccer players for training and competition. **J Sports Sci.** 1994;12 Spec No:S43-50.

[8] MANORE, M.; THOMPSON, **J. Sport nutrition for health and performance**. Kinetics H, editor. Human Kinetics 2000.

[9] KEEN, R. Nutrition-Related Considerations in Soccer: A Review. Am J Orthop (**Belle Mead NJ**). 2018;47(12).

[10] CARTER, R.L.; SHARBAUGH, C.O.; STAPELL, C.A. Reliability and validity of the 24-hour recall. **Journal of the American Dietetic Association**. 1981;79(5):542-7.

[11] LOPEZ-SEGOVIA, M.; VIVO FERNANDEZ, I.; HERRERO CARRASCO, R.; PAREJA BLANCO, F. Preseason Injury Characteristics in Spanish Professional Futsal Players: The LNFS Project. **J Strength Cond Res.** 2019.

[12] ARLIANI, G.G.; LARA, P.H.S.; ASTUR, D.C.; PEDRINELLI, A.; PAGURA, J.R.; COHEN, M. Prospective evaluation of injuries ocurred during a professional soccer championship in 2016 in são paulo, brazil. **Acta ortopedica brasileira**. 2017;25(5):212-5.

[13] SMPOKOS, E.; MOURIKIS, C.; THEOS, C.; LINARDAKIS, M. Injury prevalence and risk factors in a Greek team's professional football (soccer) players: a three consecutive seasons survey. **Res Sports Med**. 2019;27(4):439-51.

[14] BARBALHO, M.D.M.; DE NOVOA, H.J.D.; AMARAL, J.C. Prevalence of injuries in professional football players in the years 2013-2014. **Rev Bras Futsal Futeb**. 2017;9(33):144-50.

[15] HWANG-BO, K.; JOO, C-H. Analysis of injury incidences in the Korea national men's soccer teams. **Journal of exercise rehabilitation**. 2019;15(6):861-6.

[16] ALMEIDA, P.S.M.D.; SCOTTA, Â.P.; PIMENTEL, B.D.M.; BATISTA JÚNIOR, S.; SAMPAIO, Y.R. Incidência de lesão musculoesquelética em jogadores de futebol. **Revista Brasileira de Medicina do Esporte**. 2013;19(2):112-5.

[17] SILVA, D.A.S.; DEANSOUTO, M.; OLIVEIRA, A.C.C. Lesões em atletas profissionais de futebol e fatores associados. **Lecturas: Educación Física y Deportes** 2008;13(121):1-7.

[18] ESTEVE, E.; RATHLEFF, M.S.; BAGUR-CALAFAT, C.; URRUTIA, G.; THORBORG, K. Prevention of groin injuries in sports: a systematic review with meta-analysis of randomised controlled trials. Br **J Sports Med**. 2015;49(12):785-91.

[19] THORBORG, K.; BRANCI, S.; NIELSEN, M.P.; TANG, L.; NIELSEN, M.B.; HOLMICH, P. Eccentric and Isometric Hip Adduction Strength in Male Soccer Players With and Without Adductor-Related Groin Pain: An Assessor-Blinded Comparison. **Orthop J Sports Med**. 2014;2(2):2325967114521778.

[20] AGEL, J.; EVANS, T.A.; DICK, R.; PUTUKIAN, M.; MARSHALL, S.W. Descriptive epidemiology of collegiate men's soccer injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2002-2003. **Journal of athletic training**. 2007;42(2):270-7.

[21] ERGUN, M.; DENEREL, H.N.; BINNET, M.S.; ERTAT, K.A. Injuries in elite youth football players: a prospective three-year study. **Acta orthopaedica et traumatologica turcica**. 2013;47(5):339-46.

[22] ARNASON, A.; SIGURDSSON, S.B.; GUDMUNDSSON, A.; HOLME, I.; ENGEBRETSEN, L.; BAHR, R. Risk factors for injuries in football. **Am J Sports Med**. 2004;32(1 Suppl):5s-16s.

[23] HOWLE, K.; WATERSON, A.; DUFFIELD, R. Injury Incidence and Workloads during congested Schedules in Football. **Int J Sports Med**. 2020.

[24] OSGNACH, C.; POSER, S.; BERNARDINI, R.; INALDO, R.; DI PRAMPERO, P.E. Energy cost and metabolic power in elite soccer: a new match analysis approach. **Med Sci Sports Exerc**. 2010;42(1):170-8.

[25] ANDERSON, L.; ORME, P.; NAUGHTON, R.J.; CLOSE, G.L.; MILSOM, J.; RYDINGS, D. et al. Energy Intake and Expenditure of Professional Soccer Players of the English Premier League: Evidence of Carbohydrate Periodization. **Int J Sport Nutr Exerc Metab**. 2017;27(3):228-38.

[26] GUERRA, I.P.D.L.R.; NETO, T.B.; TIRAPEGUI, J. Dietary needs of soccer players: a review. **Sociedade Brasileira de Alimentação e Nutrição**. 2004;28:79-90.

[27] MAHAN, L.K.; ESCOTT-STUMP, S.; RAYMOND, J.L. Krause, **alimentos, nutrição & dietoterapia**: Editora Rocha; 2013.

[28] DUNFORD, M. A practice manual for professionals. American Dietetic Associati: **Health & Fitness**; 2006.

[29] DEVLIN, B.L.; LEVERITT, M.D.; KINGSLEY, M.; BELSKI, R. Dietary Intake, Body Composition, and Nutrition Knowledge of Australian Football and Soccer Players: Implications for Sports Nutrition Professionals in Practice. **Int J Sport Nutr Exerc Metab**. 2017;27(2):130-8.

[30] ARRUDA, M.D.; MARIA, T.S.; CAMPEIZ, J.M.; BOLAÑOS, M.A.C. **ciências aplicadas ao jogo e ao treinamento**. São Paulo. São Paulo: Phorte; 2013.

[31] DOBROWOLSKI, H.; KARCZEMNA, A.; WLODAREK, D. Nutrition for Female Soccer Players-Recommendations. **Medicina** (Kaunas). 2020;56(1).

[32] OLIVEIRA, D.C.X.; ROSA, F.T.; SIMOES-AMBROSIO, L.; JORDAO, A.A.; DEMINICE, R. Antioxidant vitamin supplementation prevents oxidative stress but does not enhance performance in young football athletes. **Nutrition (Burbank, Los Angeles County, Calif)**. 2019;63-64:29-35.

[33] GRAVINA, L.; RUIZ, F.; DIAZ, E.; LEKUE, J.A.; BADIOLA, A.; IRAZUSTA, J. et al. Influence of nutrient intake on antioxidant capacity, muscle damage and white blood cell count in female soccer players. **J Int Soc Sports Nutr.** 2012;9(1):32.

[34] MASCHERINI, G.; PETRI, C.; ERMINI, E.; PIZZI, A.; VENTURA, A.; GALANTI, G. Eating Habits and Body Composition of International Elite Soccer Referees. J Hum Kinet. 2020;71:145-53.

[35] MAUGHAN, R.J. Role of micronutrients in sport and physical activity. **Br Med Bull.** 1999;55(3):683-90.

[36] LARSON-MEYER, D.E.; GOSTAS, D.E. Thyroid Function and Nutrient Status in the **Athlete. Curr Sports Med Rep**. 2020;19(2):84-94.

[37] DOBROWOLSKI, H.; WLODAREK, D. Dietary Intake of Polish Female Soccer Players. **Int J Environ Res Public Health**. 2019;16(7).

[38] CHYCKI, J.; GOLAS, A.; HALZ, M.; MASZCZYK, A.; TOBOREK, M.; ZAJAC, A. Chronic Ingestion of Sodium and Potassium Bicarbonate, with Potassium, Magnesium and Calcium Citrate Improves Anaerobic Performance in Elite Soccer Players. **Nutrients.** 2018;10(11).

[39] GOES, R.A.; LOPES, L.R.; COSSICH, V.R.A.; DE MIRANDA, V.A.R.; COELHO, O.N.; DO CARMO BASTOS, R . et al. **Musculoskeletal injuries in athletes from five modalities: a cross-sectional study**. BMC Musculoskelet Disord. 2020;21(1):9.

[40] BIANCHI, F.P.; VENEZIANI, V.; CANTALICE, M.A.; NOTARNICOLA, A.; TAFURI, S. Epidemiology of injuries among Italian footballers: the role of the playing field. **Inj Prev**. 2019;25(6):501-6.