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Analysis of the Main Muscle Injuries Affecting Field Soccer and Futsal Players

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ABSTRACT

There are currently various forms of football. Notable examples include outdoor football (soccer), futsal, futebol society (small-sided turf football), and beach soccer. Although similar, each variation requires specific movements from the athlete, given the differences in playing surfaces and the dimensions of the court or field. Athletes are known to suffer muscle injuries during both training sessions and actual competitions. The primary objective of this study is to highlight the main types of muscle injuries—specifically first-, second-, and third-degree strains—and the muscle fiber types affected in outdoor football and futsal, while also comparing injury patterns across different player positions and identifying the most frequently injured muscles. The analysis revealed that contusions and muscle strains are the most common injuries and that the lower limbs are more affected than the upper limbs. Comparisons showed that, in outdoor football, midfielders and forwards suffer the most injuries, whereas in futsal, wingers record some of the highest injury rates. This study is justified by the need to determine how and where to implement preventive measures during the physical conditioning of football players—whether in the outdoor or indoor (futsal) game—to minimize the occurrence and consequences of sports injuries, given that such injuries are highly debilitating and impair athletic performance.

Keywords
Muscle injury, The soccer field, Indoor soccer.

Introduction

Foss and Keteyian [1] state, based on histological analyses using an electron microscope, that the connective tissues of skeletal muscle consist of the endomysium (surrounding muscle fibers), the perimysium (enveloping muscle bundles or fascicles), and the epimysium (enveloping the entire muscle). The primary components of skeletal muscle connective tissues are type I and II collagen fibers—which provide structural support and rigidity to the muscle—and elastic fibers, which impart a slight degree of elasticity to the muscle membranes. The muscle fiber's cell membrane, known as the sarcolemma (as previously mentioned), is encased in a connective tissue membrane that becomes continuous with the tendons connecting skeletal muscles to the bony skeleton.

According to Monteiro and Farinatti [2], skeletal muscle accounts for approximately 40% of total body mass, and muscle fibers are characterized as follows:
- cylindrical and elongated, potentially spanning the entire length of the muscle;
- multinucleated, due to their size and high rates of protein resynthesis;
- rich in mitochondria, indicating a high level of activity;
- incapable of regeneration.

Meanwhile, Rasch [3] notes that muscle mass can constitute up to 45% of an adult's body weight and that the voluntary muscular system comprises approximately 434 individual muscles, though only 75 pairs are directly involved in maintaining body posture. Skeletal muscle is composed of approximately 75% water and 20% protein; the remaining 5% consists of inorganic salts and other substances, including high-energy phosphates, urea, lactic acid, minerals (calcium, magnesium, and phosphorus), various enzymes, sodium, potassium, and chloride ions, amino acids, fats,

and carbohydrates. The most abundant muscle proteins are myosin (accounting for approximately 60% of muscle protein), actin, and tropomyosin. Additionally, about 700 mg of the conjugated protein myoglobin is found in every 100 g of muscle tissue [4].

Smith, Weiss, and Lehmkuhl [5] note that skeletal muscles are composed of fibers organized into bundles, with each bundle of muscle fibers referred to as a fascicle. Myofilaments make up myofibrils, which in turn are grouped together to form muscle fibers.

Each fiber possesses a covering or membrane—the sarcolemma—and contains a gelatin-like substance known as sarcoplasm; hundreds of contractile myofibrils, as well as other structures such as mitochondria and the sarcoplasmic reticulum, are located within the sarcoplasm.

Hamill and Knutzen [6] explain that the specific arrangement of muscles and muscle groups enables them to produce movement—whether small-scale or highly extensive and powerful—acting either collectively or individually.

According to Monteiro and Farinatti [2], several factors are required for muscle contraction to occur, including the sliding of actin filaments over myosin filaments; both pull on the Z-lines to shorten the sarcomere—in other words, muscle contraction results from the contraction of multiple sarcomeres.

Foss and Keteyian [1] emphasize that the primary function of skeletal muscle is contraction, which results in movement—where the quality of that movement is generally what matters most—and that it is therefore appropriate to discuss some basic muscle functions as they relate to movement.

A fiber is composed of thousands of myofibrils; the fluid surrounding them contains organelles common to all cells, notably the extensive sarcoplasmic reticulum, which is crucial to the contraction process. The plasma membrane is known as the sarcolemma and fuses at its ends with connective tissue fibers that give rise to tendons.

Myofibrils consist of protein molecules—actin and myosin—arranged in parallel. These filaments interdigitate, creating light and dark zones visible under a light microscope: light zones (I-bands, or isotropic) contain only actin filaments, while dark zones (A-bands, or anisotropic) occur where the filaments overlap. Within the A-band lies a slightly lighter area known as the H-zone, which contains only myosin filaments; a thickening in this area forms the M-line. The protein constituting this line provides structural support for the myosin filaments. Actin filaments are anchored to membranes or Z-lines, which extend from myofibril to myofibril, linking them across the entire thickness of the muscle. The space between two Z-lines is called a sarcomere [2].

According to Rasch [3], any tension within a muscle that does not result in visible muscle shortening is termed a contraction. These can be of three types:
- Static or isometric contraction: when the muscle develops tension insufficient to move a body part against a given resistance—that is, when the muscle length remains unchanged;
- Shortening or concentric contraction: when the muscle manages to overcome resistance through the generated tension—that is, the muscle visibly shortens and moves the resistance or body part;
- Lengthening or eccentric contraction: when a given resistance overcomes the muscle tension, causing the muscle to lengthen—for example, when a weight is slowly lowered onto a table.

For Hamill and Knutzen [6], however, muscle actions can be classified as follows:
- Isometric muscle action: muscle tension is generated against resistance to maintain a position—such as holding a segment or object, or lowering or controlling a segment;
- Concentric muscle action: if a muscle actively generates tension while visibly shortening, the action is termed concentric;
- Eccentric muscle action: when a muscle is subjected to an external torque greater than the internal torque generated within the muscle, lengthening occurs, and the action is termed eccentric.

As early as the 18th century, some anatomists observed differences among muscle fibers, noting that some exhibited a more intense coloration than others; over time, it was further established that there were distinct variations in the speed of response to external stimulation, such as electrical impulses [2]. According to Foss and Keteyian [1], McArdle, Katch, and Katch [4], Powers and Howley [7] and Wilmore and Costill [8], skeletal muscles are not merely a homogeneous group of fibers with similar metabolic and functional properties; rather, they exhibit distinct contractile and metabolic characteristics and are classified into two distinct types:
- Fast-twitch or Type II fibers: These possess a high capacity for the electrochemical transmission of action potentials, high myosin ATPase activity, and rapid rates of calcium release and uptake. They play a crucial role in sports involving stop-and-start movements and changes in pace—such as basketball, soccer, and field hockey—where rapid energy delivery is required for these activities.
- Slow-twitch or Type I fibers: These generate energy for ATP resynthesis predominantly through the aerobic energy transfer system. They are characterized by low myosin ATPase activity, a lower capacity for handling calcium, slower contraction speeds, and a glycolytic capacity that is less developed than that of their fast-twitch counterparts.

According to Tubino [9], Scandinavian physiologists made the most significant contributions to research on fiber types; it was only with the advent of histological studies using muscle biopsies in the 1970s that the two fiber types were identified: 1) fast-twitch fibers (FTF) and 2) slow-twitch fibers (STF).

Hamill and Knutzen [6] and Monteiro and Farinatti [2] further note that skeletal muscle cells also differ based on their innervation, leading to their subdivision into Type I fibers (slow, red, or ST) and Type II fibers (fast, white, or FT). Ultimately, due to their high myoglobin content, slow-twitch fibers are found in greater

quantities in the upper back muscles and the soleus. In contrast, type IIa fast-twitch fibers can sustain activity for prolonged periods, whereas type IIb fibers provide rapid force production but fatigue quickly.

Furthermore, type II fibers are further subdivided based on differing behaviors regarding glycolytic dominance—namely: Type I (aerobic); Type II (anaerobic, though capable of aerobic function); Type IIb (typically anaerobic); and Type IIC (undifferentiated, with characteristics intermediate between IIa and IIb), as cited by Monteiro and Farinatti [2].

According to Pochini, Runco, and Lasmar [10], muscle fiber type also influences the predisposition to strain injuries. Muscles dominated by type II fibers (fast-twitch, anaerobic fibers) generate greater force than type I fibers (slow-twitch, aerobic fibers) and are thus more frequently associated with injuries (Figure 1).

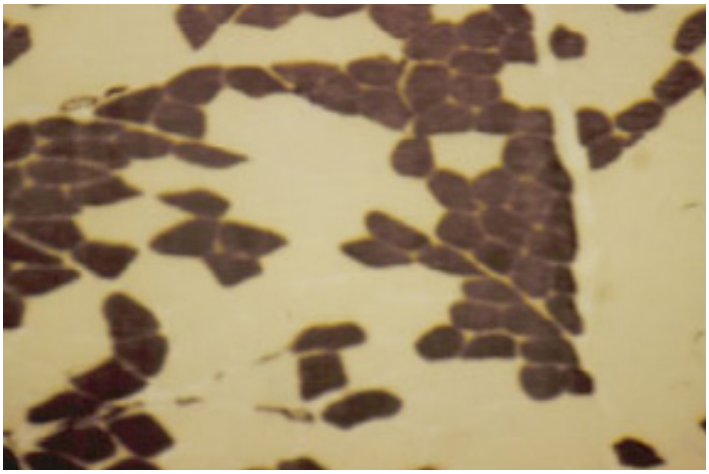

Figure 1: Microscopy following muscle biopsy, showing a predominance of type II fibers (lighter-colored cells). Source: Pochini, Runco, and Lasmar [10].

According to Clebis and Natali [11], morphological changes occur in muscle fibers following eccentric exercise; specifically, skeletal striated muscles contain different fiber types that adapt—both physically and biochemically—to meet the demands placed upon them. The authors further emphasize that the extent of muscle injury depends on the duration and intensity of the exercise; when performed to exhaustion, both factors cause cellular damage, with degeneration progressing in increasing stages: starting from the myofibrils (or myofibrils and sarcoplasm) and extending to the sarcolemma, eventually affecting myosatellite cells and reaching the endomysium and capillaries.

Soccer

According to some research, the earliest forms of soccer appeared in China around 2500 BC. According to this theory, soldiers amused themselves with the skulls of their beheaded enemies in a lively game. Conversely, other scholars attribute the invention of soccer to the Mayan civilization. Divided into two groups, the teams had to hit a fixed hoop. The contest was so intense that the leader of the losing team was punished with death.

According to França [12], there are many variations regarding the origin of soccer; some historians believe it emerged in 2500 BC, invented by the Chinese emperor Huang-ti. At the time, it was the only way to train his soldiers for battle, addressing both their physical and spiritual readiness.

Due to the great interest sparked by its engaging style of play, soccer is undoubtedly the most widely played sport in the world; historians note that traces of the sport date back to ancient cultures, indicating that this type of activity was already of great interest to people in those times [13].

In Brazil, soccer was introduced by Charles Miller, a native of the Brás neighborhood in São Paulo; he traveled to England to study at the age of nine, where he had his first contact with the sport. Upon returning to Brazil in 1894, he brought back the first soccer ball and a set of rules, thereby becoming the sport's pioneer in the country [14].

The first soccer match in Brazil—played between employees of the Gas Company and the São Paulo Railway Company—took place on April 15, 1895. Initially, Black players were excluded from the sport; it was only starting with the 1950 World Cup, held in Brazil, that Black players began to participate.

According to P.Q.D. [14], football has various origins and names; for instance, it originated in ancient China around 3000 BC, where the Chinese conditioned themselves for combat against their enemies as part of their military training. After battles, soldiers would gather to kick the heads of their enemies—heads that were later replaced by a leather ball wrapped in hair.

In Japan, there was a sport similar to modern soccer known as Kemari, played by members of the Japanese emperor's court. Kemari was played on a 200-square-meter field using a ball made of bamboo fiber, and the rules prohibited physical contact.

According to História [13], a game called Epyskiros was created in Greece during the 1st century BC; in it, soldiers were divided into two teams of nine players on a rectangular field. The ball was made from an ox bladder filled with soil or sand.

The same author also notes that in Italy, a sport known as gioco del calcio—featuring 27 players per team—was played in a public square. The objective was to get the ball to two posts located at the far ends of the square. Accounts suggest the game was extremely violent, as some players brought with them conflicts stemming largely from the social issues typical of the medieval era.

Futsal

According to the CBFS [15], there are two versions regarding the origins of futsal (indoor soccer/futsal), and, as with other sports, there are differing opinions concerning its invention. One version holds that the sport began to be played around 1940 by members of the YMCA in São Paulo; facing great difficulty in finding available

outdoor soccer fields, they began playing informal matches on basketball and hockey courts.

It is confirmed that, initially, teams consisted of five, six, or seven players, though the number was later standardized to five per side. The balls used were stuffed with sawdust, vegetable fiber, or granulated cork; however, they tended to bounce excessively and frequently left the playing area. Consequently, their size was reduced and their weight increased—a characteristic that led to the sport being nicknamed the "heavy-ball sport." There is also the version I consider most likely: that futsal was invented in 1934 at the YMCA in Montevideo, Uruguay, by instructor Juan Carlos Ceriani, who named the new sport "INDOOR-FOOT-BALL".

In São Paulo, the name Habib Maphuz stands out for his significant contributions during the early days of the sport in Brazil. In the early 1950s, Maphuz—an instructor at the São Paulo YMCA—helped draft the rules for various sports, including court-based soccer, within the organization. He went on to found the first futsal league (the YMCA Futsal League) and later served as the first president of the São Paulo Futsal Federation [15]. Despite differing opinions, the conclusion is that futsal (indoor soccer/futsal) originated at the YMCA—either in Montevideo in the 1930s or in São Paulo in the 1940s—with the first published rules issued in 1956 by Luiz Gonzaga de Oliveira Fernandes in São Paulo.

Fernandes [16] states that, after two decades of the sport being played, other countries—such as Italy and Japan—laid claim to its origins, asserting that they had practiced the discipline as early as 60 BC.
He also notes that there has been confusion regarding the sport's origin and authorship, as various physical education professors—such as Juan C. Ceriani, Asdrubal Monteiro, Romeu Pires Osório, and others based in either Montevideo or Brazil—hold conflicting views.

The CBFS [15] highlights that in 1980, under the presidency of Januário D'Alécio—who began his tenure by organizing the 1st Pan-American futsal Championship in Mexico—Brazil emerged victorious in a tournament that also included Mexico, Paraguay, Uruguay, Argentina, Bolivia, and the United States. In 1985, the 2nd World futsal Championship, sponsored by FIFUSA (International futsal Federation), was held in Spain, with Brazil winning again; subsequently, the 3rd World Championship took place in Australia in 1988, with Paraguay claiming the title.

The aforementioned author emphasizes that Juan Carlos Ceriani and Habib Maphuz, both YMCA professors, are the fathers of futsal. He further notes that, despite being a relatively new sport, it is indisputably the second most popular sport in Brazil—ranking only behind soccer—and is currently the fastest-growing sport worldwide, with the potential to become an Olympic sport in the near future. According to Ferreira, the practice of futsal (indoor soccer) emerged in the 1930s, evolving from informal matches played on open fields into a game adapted for basketball courts and small indoor halls.

In Brazil, the sport also took its first steps during the 1930s; the YMCA branches in Rio de Janeiro and São Paulo were the pioneers in promoting the activity, subsequently introducing it to recreational clubs and regular schools FERREIRA.

Meanwhile, Santana (n.d.) and Voser and Giusti [17,18] state that *futebol de salão* originated in the 1930s—created at the YMCA in Montevideo, Uruguay—and by around 1942, it had already won widespread popularity.

Furthermore, these same authors highlight that the first written account of the sport in Brazil was produced by Roger Grain in 1936 for a physical education magazine.

Muscle Injuries

According to Hamill and Knutzen [6], skeletal muscle injuries can occur during a bout of intense exercise or when a muscle is exercised over a prolonged period involving eccentric actions. Muscle injury is defined as a micro-injury involving small lesions within the muscle fiber; it may manifest as immediate pain or delayed-onset muscle soreness, edema, possible anatomical deformity, and athletic dysfunction.

According to Smith, Weiss, and Lehmkuhl [5], there are two types of muscle injuries induced by vigorous exercise involving eccentric contractions:
- Delayed-Onset Muscle Soreness (DOMS): occurs between 8 and 12 hours after the activity and is most intense 48 to 60 hours post-exercise. Functional signs may include a reduction in range of motion due to pain and a decrease in maximum concentric and eccentric strength—by more than 50%, depending on the exercise—as well as structural damage to the Z-line, resulting in a zigzag appearance (this alteration in the Z-line disrupts myofilament alignment, and in some cases, myosin filaments are absent).
- Strain (stretching injury): this second type of muscle injury affects the hamstrings (posterior thigh muscles) and occurs most frequently during running and jumping activities. This injury involves a macroscopic tear in a posterior thigh muscle, accompanied by intramuscular hemorrhage.

According to Clebis and Natali [11], muscle injuries can be defined as any alteration—whether morphological or histochemical—that impairs muscle function. The initial level of injury is termed microtrauma, a localized stress that does not manifest symptoms.

Foss and Keteyian [1] demonstrate that muscles composed of Type I fibers are more susceptible to exercise-induced injury than those formed by Type II fibers, a difference likely attributable to the selective recruitment process.

Pochini, Runco, and Lasmar [10] note that muscle injuries occur most frequently in athletes involved in speed-based disciplines, such as track and field and soccer.

Vijayan et al. found that red fibers sustained more damage in rats

running on a treadmill; they attribute this to selective recruitment, noting that these fibers have a low recruitment threshold. Conversely, Lieber and Fridén found that stretching under tetanic stimulation caused more damage to white fibers. Ultimately, it appears that Type I fibers are more prone to injury during low-intensity, long-duration exercise.

Injuries Muscle injuries can occur directly, such as through contusions during sports activities, or indirectly, often resulting from eccentric or concentric contractions. Injuries occurring during eccentric contraction are the most common indirect muscle injuries in sports, as this type of contraction is associated with the highest tension developed within the muscle-tendon unit. Muscles considered to be at risk include bi-articular muscles—such as the quadriceps, hamstrings, and triceps surae—where the tension generated during physical activity can be even greater because they span more than one joint [10].

Classification of muscle injuries

According to Pochini, Runco, and Lasmar [10], muscle injuries can be classified as traumatic or atraumatic. Traumatic injuries include strains, contusions, and lacerations (or ruptures, which may be partial or total). Atraumatic injuries include cramps and delayed-onset muscle soreness.

According to the aforementioned authors, traumatic injuries are:

- Muscle Strain: Classified as an indirect muscle injury, as the traumatic energy is not applied directly to the area of the muscle that undergoes anatomical alteration. It is caused by the stretching of muscle fibers beyond their physiological limits or may result from an eccentric muscle contraction during a specific sports movement—such as the hamstring contraction that modulates the concentric contraction of the quadriceps during a soccer kick. The most commonly affected sites are the myotendinous junction or the distal region of the muscle belly;
- Muscle Contusion: This injury is also very common in contact sports such as soccer, American football, rugby, basketball, handball, and combat sports. Unlike muscle strains, a contusion is caused by direct trauma to the musculature and most frequently affects the lower limbs. Depending on the energy generated by the sports movement that caused the trauma, muscle damage can be severe, triggering extensive bleeding both inside and outside the muscle compartment [10].

According to these same authors, atraumatic injuries are further divided into:

- Delayed-Onset Muscle Soreness (DOMS): This term refers to a type of generalized muscle soreness that typically occurs 36 to 72 hours after a sports event that is physically demanding for the athlete, whether professional or amateur. Typically, this pain is most common in recreational athletes who are physically unprepared for the sport; however, this condition can also occur in professional athletes involved in endurance sports (such as marathons) and long-duration sports that require speed and explosive movements.
- Cramp: This injury is frequently seen in regular sports activities, particularly among amateur athletes who lack adequate conditioning. Professional athletes can also be affected, especially when competing in high temperatures for prolonged periods (e.g., tennis players, marathon runners, and soccer players). The affected muscle may remain sore for several days, depending on the severity of the cramp. Cramps can be momentarily relieved by actively contracting the muscle antagonistic to the affected one or by forcibly stretching the affected muscle.

According to Clebis and Natali [11], based on the extent of muscle fiber damage, injuries can be classified as follows: Grade 1, involving minimal fiber rupture; Grade 2, involving muscle tearing with significant hemorrhage; and Grade 3, involving a complete loss of function and structural continuity of most or all of the muscle.

According to Villardi, as cited by Dantas and Silva [19], there are three grades of ligament injuries:

- Grade I: A mild injury characterized by the rupture of some fibers without functional loss, and an absence of localized swelling or tenderness;
- Grade II: A moderate injury where a large portion of the fibers are ruptured, though the ligament's overall integrity is not completely lost, resulting in joint instability.
- Grade III: This is severe, involving a complete rupture of the ligament. Treatment options for these injuries fall into two categories: conservative treatment and surgical treatment.

Muscle Injuries in Futsal

Kurata, Martins Junior, and Nowotny [20] note that muscle injuries have always been a concern for athletes; in high-level sports, the musculoskeletal system is subjected to significant strain during both training and actual competition.

According to Fernandes [16], there are three types of injuries to consider based on the affected tissue: muscle, tendon, and bone injuries. Within the category of muscle injuries, there are contusions, elongations, and strains:

- - Contusion: a simple blow to the muscle that sometimes goes unnoticed and requires no treatment;
- - Elongation: a pre-strain condition where muscle fibrils rupture, but not across the entire extent of the muscle; only a certain number of fibrils break, causing the muscle to stretch;
- - Muscle strain: an incomplete muscle rupture where more than 50% of the fibrils break, causing the muscle to stretch and lose its ability to contract.

Bone injuries—such as periostitis, the most common type in futsal—are generally just a temporary inflammation of the membrane surrounding the bone (the periosteum). Fractures also occur, though they are rarer [16].

According to Kurata, Martins Junior, and Nowotny [20], there is a high incidence of injuries among futsal athletes, predominantly

affecting the lower limbs (88.1%).

In a study involving soccer players, these same authors found a higher incidence of lower-limb injuries and non-contact trauma, with muscle injuries being the most frequent. In their study, Kurata, Martins Junior, and Nowotny [20] identified sprains and contusions as the most frequent types of injuries, each accounting for 26.47% of cases, followed by muscle injuries (17.64%), ligament injuries (14.71%), and others (14.71%).

According to Hoffman and Harris, excessive weight training, running, aerobic exercise, or repetitive movements can lead to stress fractures, muscle injuries, inflamed tendons, and emotional fatigue.

A study conducted by Siebert and Biazus [21] on the Unisul futsal team—involving 16 athletes across various positions—found that the highest frequency of injuries occurred among wingers; five out of the seven players in this position suffered injuries. This position involves the highest number of players and places the greatest demands on them during matches, as they must assist in defense when the team is under attack and contribute to counter-attacks.

It was also noted that there was only one instance of a recurring injury and that the dominant side plays a role in muscle strains, as that side remains under constant contraction due to the ease and dexterity with which players perform actions such as kicking, jumping, and pushing off. The sport's high physical intensity and agility requirements—along with the need for tight marking and rapid movement—contribute to the occurrence of muscle injuries [21]. In the same study, the aforementioned authors report that the highest number of injuries occurs during matches, with muscle strains being the most common type; they also observed that the peak frequency of injuries occurred between the 30th and 40th minutes of the game—that is, during the final ten minutes. This is a period of heightened physical fatigue, during which the athlete must maintain athletic performance despite compromised physical capacity; essentially, when a player is tired, performance may decline, thereby increasing the risk of injury.

In another study conducted by Dantas [19] involving 27 athletes from the Fundação Jorge Antunes and Famalicense Atlético Clube teams—aged between 20 and 37—it was found that 55.6% of the injuries were Grade II, followed by 37% Grade I and 7.4% Grade III. Regarding the specific muscles involved, the hamstrings were the most frequently injured (37%), followed by the quadriceps (29.6%), adductors (19.5%), and calf muscles (14.8%).

Muscle Injuries in Soccer

According to Silva et al. [22], soccer is characterized by significant physical contact and short, rapid, intermittent movements—such as acceleration, deceleration, changes of direction, jumping, and turning. For these reasons, the sport sees a high number of injuries. Research conducted by Lopes et al. [23] found that muscle injuries occur most frequently in the 18–28 age group, the active period for competitive athletes. Injuries are rarer in those under 18—due to the youthful nature of the muscle fibers—and in those over 28, when the intensity of competitive sports activity decreases; soccer players constituted the vast majority of the subjects in this study.

Today's soccer players generally possess superior physical attributes compared to athletes from the 1970s (with some exceptions), as they jump higher and have greater endurance. This likely increases the risk of injury. This assertion is supported by the data in this study regarding the types of injuries observed. The muscles most prone to injury are the flexors and extensors of the thigh and hip, which are primarily responsible for the movements typical of soccer. As players struggle to maintain the same level of stamina, they place greater demands on their muscles, thereby increasing the risk of injury—a situation exacerbated by concurrent competitions and rescheduled matches occurring in the final quarter of the year (Source: Center for Physical Activity and Sports Medicine).

Unpublished studies by the Santo André Futebol Clube medical department identified muscle injuries as the most common issue affecting players, accounting for 35% of all injuries in 2004. Of these, 43% involved the quadriceps, 29% the hamstrings, 14% the adductors, and 14% the abdominal muscles. Defenders were the players most prone to injury, followed by forwards.

Silva et al. [22] presents an analysis of injury rates by player position, demonstrating a lower incidence among goalkeepers, whereas midfield and forward positions suffered the most injuries—predominantly affecting the lower limbs. These findings reflect the changing style of modern football, in which attacking players face more intense and often violent marking.

The same author’s research also indicates that 75% of injuries occur in the lower limbs and 25% in the upper limbs, with lower-limb injuries being more common due to overload.

Final Considerations

Based on this analysis and the stated objectives, it is possible to conclude that muscle contusions and strains are the most common injuries affecting both field soccer and futsal players. Regarding fiber types, injuries occur most frequently in type II fibers (fast-twitch/anaerobic).

In terms of field position, midfielders and forwards suffer the highest number of injuries compared to players in other sectors. Lower-limb injuries occur more frequently than those affecting the trunk or upper limbs, with a high incidence of thigh injuries (specifically muscle strains) resulting primarily from indirect trauma. In futsal, however, wingers sustain the most injuries; they participate actively in both defense and counter-attacks—placing greater demands on their physical capabilities compared to other positions—and their injuries are typically caused by direct trauma. The vast majority of injuries are Grade II, followed by Grade I and, finally, Grade III; the most frequently injured muscles are the hamstrings, quadriceps, adductors, and gastrocnemius.

This study leads to the conclusion that the frequency of muscle injuries among professional futsal and field soccer players is extremely high, and that teams must take steps to prevent them in order to maintain or improve performance throughout the season. The role of the sports physical trainer is indispensable and critically important; they work directly with the team, monitoring technical, tactical, and physical training sessions to understand the athlete's biomechanics, exercise physiology, and injury mechanisms. Furthermore, athletes must maintain optimal physical conditioning to minimize the risk of direct or indirect trauma and to facilitate faster recovery should an injury occur.

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