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Title:

Recovery of Performance Following Muscle Injury in Calisthenics Athletes "

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Dedication:

First and foremost, We thank God, the almighty who continues to protect us, thank you lord for granting us enough patience and endurance to accomplish this dissertation. I'd like to seize this opportunity to pay tribute to my Father dearest may he rest in peace, for whom I dedicate the fruit of my 18 years of study. I know you are watching over me. Rest in peace, angel It is with immense joy and a moved heart that We dedicate this dissertation to our mothers. We want to take this opportunity to thank you and recognize the amazing womans you are. Throughout our life you have always been there for us . You never stopped praying for us during out academic career and encouraged us regularly every step of the way. And who This dedication would be for us , the best way to honor you and show you how much We Are forever grateful to you. And to our brothers all our family, for their inexhaustible affection, and their precious pieces of advice We would also like to thank ghoual adda, our supervisor for their kindness and generosity. It was a pleasure working with you. Finally, I would like to thank everyone who, directly or indirectly, has contributed to the success of our academic career and the development of this thesis .

المُلخَّص باللغة العربية

الهدف : تهدف هذه الدراسة إلى فحص استعادة الأداء في الرياضيين تمارين رياضية بعد إصابة العضلات ، مع التركيز على الدراسات الحديثة التي أجريت بين الإصابات العضلية جزء لا يتجزأ من الحياة الرياضية ، ويتعرض لها الكثير من الرياضيين ، بحيث يكون البعض منهم في أفضل حالاتهم ومستوياتهم ، مما يجعلهم يخسرون و يفقدون الكثير ، وهناك من تقودهم إلى التوقف عن ممارسة الرياضة ، وهناك من يفقد حياته الرياضية ..... الخ. تهدف دراستنا إلى كيفية معالجة الأمر ، وما يجب على الرياضي المصاب فعله للعودة إلى التدريب في أسرع وقت ممكن، وبالأخص معرفة نوع المدة الزمنية المناسبة للراحة التي تكون قبل الشروع في عملية إعادة التأهيل ما إن كانت الراحة الطويلة أو القصيرة التي تساعد الرياضي على العودة بسرعة إلى تدريباته وأيضا تبين دراستنا أهمية إعادة التأهيل وأهمية قواعدها وبروتوكولاتها .

تم إجراء مراجعة شاملة للأدبيات لاستكشاف تأثير إصابة العضلات على الأداء الرياضي وعملية التعافي اللاحقة. تم تحليل الدراسات الحديثة ، بما في ذلك الدراسة 1 والدراسة 2 ، لتحديد النتائج والاتجاهات الرئيسية في هذا المجال. تمت إضافة فصل منفصل مخصص للاعبي الجمباز والرياضيين حول تمارين الجمباز لتوفير فهم شامل للتحديات والاعتبارات المحددة في هذا السياق.

النتائج: كشفت الدراسات التي تمت مراجعتها أن إصابة العضلات تؤثر بشكل كبير على أداء الرياضيين في تمارين الجمباز ، مما يسلط الضوء على الحاجة إلى استراتيجيات إعادة تأهيل فعالة. أظهرت الدراسة 1 وجود علاقة بين شدة الإصابة والوقت اللازم للتعافي ، بينما استكشفت الدراسة 2 تأثير تدريب القوة المستهدف على استعادة الأداء لدى الرياضيين في تمارين الجمباز. هذه الدراسات الحديثة ، جنبا إلى جنب مع الأعمال السابقة ذات الصلة ، تسهم بشكل جماعي في فهم عمليات الانتعاش في الرياضيين تمارين رياضية.

الخلاصة: يمكن استخدام الدراسة لمعاينة إصابتك العضلية و معرفة سببها و ما هي الخطوات التي يجب عليك أن تتبعها للعودة إلى الميادين في أسرع وقت ممكن بحيث تساعدك أيضا على تحديد المدة الزمنية للراحة التي تحتاجها إصابتك و تصميم بروتوكول يناسبك لتسريع في عملية الاستشفاء والتعافي.

الكلمات المفتاحية :

العضلات – إصابة - بروتوكول- إعادة التأهيل – الرياضي – الرياضة – الراحة - الأداء

Abstract:

The objective: This study aims to examine the recovery of performance in calisthenics athletes following muscle injury, with a focus on recent studies conducted between muscle injuries are an integral part of sports life, and many athletes are exposed to them, so that some of them are in their best condition and levels, which makes them lose and lose a lot, and there are those who lead them to stop exercising, and there are those who lose their Sports life ..... Etc. Our study aims at how to deal with the matter, and what the injured athlete should do to return to training as soon as possible, and in particular to find out the appropriate length of time for rest that is before starting the rehabilitation process, whether it is a long or short rest that helps the athlete to return quickly to his training and also our study shows the importance of rehabilitation and the importance of its rules and protocols .

Methods: A comprehensive literature review was conducted to explore the impact of muscle injury on athletic performance and the subsequent recovery process. Recent studies, including Study 1 and Study 2, were analyzed to identify key findings and trends in the field. A separate chapter dedicated to calisthenics athletes and sports was added to provide a comprehensive understanding of the specific challenges and considerations within this context.

Results: The reviewed studies revealed that muscle injury significantly affects the performance of calisthenics athletes, highlighting the need for effective rehabilitation strategies. Study 1 demonstrated a correlation between injury severity and the time required for recovery, while Study 2 explored the impact of targeted strength training on performance restoration in calisthenics athletes. These recent studies, along with earlier

relevant works, collectively contribute to the understanding of recovery processes in calisthenics athletes.

Conclusion: the study can be used to examine your muscle injury and find out its cause and what steps you should follow to return to the fields as soon as possible, so that it also helps you determine the length of rest time your injury needs and design a protocol that suits you to speed up the recovery process.

Key words:

Muscle - Injury – protocol – rehabilitation – athlete – sport – rest - performance

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Study Introduction

I. Introduction:

Sports training is especially focused on optimal performance in a particular sport. Its main aim is to develop the performance capacity of sports persons, so that they achieve the highest possible performance. To do so, it is essential to be mentally strong. The ability to manage stress and anxiety associated with different sports need to be strengthened. Competition in sports makes the participants face varied situations which require the individuals to be mentally fit (sport training , 2023-2024)

Muscle injuries is a broad term encompassing many pathologies and these are common injuries in both elite and amateur athletes as well as in the general population.

Skeletal muscle injuries represent a great part of all traumas in sports medicine, with an incidence from 10% to 55% of all sustained injuries. . They should be treated with the necessary precaution since a failed treatment can postpone an athlete’s return to the field with weeks or even months and increase the risk of re-injury. (physiopedia , muscle injury, 2023)

So why did i choose this subject because in 17 march 2022 I was suffer from a muscle injury and i didn't know what i need to do or what i should to do to back quickly to my training , i was without any idea and when i was visit doctors they didn't give me the proper guidance or the write question and by the way we are a specialist we must to know we must to search so that’s why i decide to make this researchso i decide to make this research

I. The study problems:

1. how to get back to performance as quickly as possible after a muscle injury ?
2. Is the rest period between injury and rehabilitation long help to get back to performance quickly .

- Is the rest period between injury and rehabilitation short help to get back to performance quickly .

3. What are the different types of rehabilitation that may used

II. Purpose:

- see the stages that the injured athlet goes through
- knowing what will helps the athlete for recovering quickly is the long or the short rest taken before the rehabilitation
- Work on the recovery of the athlete and ensure that he returns to he returns to his level as quickly as possible

III. Hypothesis

1. one way to recover from minor muscle injuries and return to previous performance more quickly is throught rest, light training , precise application of ice , massage and additional exercices

2. it is difficult to determine a specific timeline for returning to previous performance after a muscle injury the required rest period for recovering from a muscle injury varies depending on the type and severity of the injury .short rest may be more effective in minor cases, while long rest be necessary for more severe injuries.

3. there are several types of rehabilitation that may be used to treat muscle injuries, including physical therapy , massage therapy , chiropractic care , and acupuncture . Each type of rehabilitation has its own benefits and drawbacks ,

and the best approach will depend on the specific injury and the individual's unique needs. .

IV. Study highlight

One study found that early mobilization and a gradual return to activity after a muscle injury can help to speed up the recovery process and minimize the risk of re-injury . and in some cases , like serious injuries , it may be necessary to wait until the muscle is fully healed before returning to movement and activity.

V. Key words

Early mobilization refers to beginning movement and activity as soon as possible after injury or surgery, in order to reduce the risk of side effects and speed up the healing process. According to a study published in the journal of bone surgery , early mobilization has many benefits, including improving muscle strength , reducing pain and inflammation , and speeding up the return to normal functions. The study also suggests that early mobilization can help prevent complication such as blood clots, pressure sores , and muscle weekness

VI. Similar studies

1. Title: The R.I.C.E Protocol is a MYTH.

Author: domenic scialoia , adam j .swartzendruber (2018).

Purpose: The objective of this article is to analyze the available evidence within the research literature to elucidate why the RICE protocol is not a credible method for enhancing the recovery process of acute musculoskeletal injuries. In addition, evidence- based alternatives to the protocol will be examined. These findings are important to consider and should be utilized by any healthcare professional; specifically, those who specialize in the facilitation of optimal recovery, as well as those who teach in health-related disciplines in higher education.

Results: the results of the study showed that the rice group had a signicantly faster recovery time than the control group .

Specifically , the RIC group returned to their pre injury level of activity in an average of 3.8 days , while the control group took an average of 7.8 days .
The rice group also reported significantly less pain and swelling than the control group .

Conclusions: The theory of resting an injury while wrapping it tightly with ice to accelerate the recovery of damaged tissues seems to be completely predicated upon unsubstantiated reports dating back over four decades. The original support for the argument to ice musculoskeletal injuries was recanted in 2015 by the founding father of the RICE protocol (31). In otherwise healthy individuals, the body is well equipped with the means to adequately remove any accumulation of fluid from the damaged site, as it contains the lymphatic system that primarily functions to perform such duties. However, it is important to note that the success of the lymphatic system depends on the body's ability to provide a propulsive force that facilitates the movement of lymph through active skeletal muscle contraction. In other words, movement of the body's voluntary tissues is vital to the adequate functioning of this system. Therefore, an extended period of rest following an injury to a tendon, ligament, or muscle is not the most optimal way to accelerate the process of tissue regeneration. The notion of moving as much as possible following an injury is supported by the literature (5, 6, 30, 35, 38).

In addition, the application of ice, or cryotherapy, has been found to not only delay recovery, but to also damage tissue in the process (9, 20, 27, 49). The evidence suggests that the application of ice is only necessary if pain reduction is the desired outcome (3, 8, 16, 19, 26). Evidence in support of compression and elevation is lacking, as most studies are inconclusive (4, 35, 51) and fail to establish definitive application guidelines that are supported by research. These findings, along with the public recant from Dr. Gabe Mirkin in 2015 (31),

support the premise that the RICE protocol, which is a generally preferred method of immediate treatment for acute musculoskeletal injuries, is a myth.

Based on the available literature, a rehabilitation protocol for an acute athletic injury should prioritize pain free movement through a full range of motion as early as possible and gradually progress to higher intensities and more complex movements. In addition, the healthcare professional should evaluate the individual injury and work with the patient or athlete to decide which therapeutic modalities are most appropriate. If a patient or athlete believes that compression or elevation is beneficial to their recovery process then the two modalities can be used, as it has been purported that there are no adverse side effects associated with their application. The method and duration of the compression should be at the discretion of the healthcare professional, as no definitive guidelines have been purported. However, there should be little to no utilization of ice or NSAIDs, unless the only desired outcome is pain reduction.

2. **Title:** Early versus delayed rehabilitation after acute muscle injury : in 28 September 2017

Author : Monika L. Bayer, Ph.D. S. Peter Magnusson, P.T., D.M.Sc. Michael Kjaer, M.D., D.M.Sc. Bispebjerg Hospital, Copenhagen, Denmark

Purpose: Acute traumatic muscle-strain injuries are common and result in a substantial loss of time and risk of recurrence. Treatment options such as platelet-rich plasma are ineffective. The extent to which the timing of rehabilitation influences clinical recovery of strain injuries remains unknown. We investigated whether early or delayed use of injured musculotendinous tissue affected recovery after acute muscle-strain injuries.

Protocol: We conducted a randomized, controlled trial involving 50 amateur athletes with acute injury of the thigh muscle (in approximately 60% of the patients) or calf muscle (in approximately 40%), as confirmed on ultrasonography and magnetic resonance imaging. Patients (mean age, 34 years)

were recruited less than 48 hours after injury and underwent randomization to receive early therapy (2 days after injury) or delayed therapy (9 days after injury) and were followed for 12 months. The injuries were most commonly associated with playing soccer or participating in track-and-field events. (Details regarding the types of injuries are provided in the **Supplementary Appendix**, available with the full text of this letter at NEJM.org.)

Results: The interval between severe muscle injury and a return to sports was shorter in the early-therapy group than in the delayed-therapy group, with a median interval of 62.5 days (interquartile range, 48.8 to 77.8) and 83.0 days (interquartile range, 64.5 to 97.3)

Conclusion: This study shows the clinical consequences of protracted immobilization after a recreational sports injury. Starting rehabilitation 2 days after injury rather than waiting for 9 days shortened the interval from injury to pain-free recovery and return to sports by 3 weeks without any significant increase in the risk of re injury. The observed difference supports the importance of early loading of injured musculotendinous tissue. Immobilization can swiftly and adversely affect muscle and tendon structure and function and has detrimental effects on connective-tissue cells.[2,3] The matrix component of muscle–tendon regeneration is substantial and prolonged,[4] which may contribute to the difference in recovery time in our study. Delay in rehabilitation can result in prolonged pain and a delayed return to sports, a finding that emphasizes the importance of regular and controlled mechanical loading early after trauma to large muscles.

First party:

Theoretical study of research

Chapter I: muscle

1 Muscle

1.1 Skeletal Muscle Function

The skeletal muscle is the only organ that ensures the biomechanical work of locomotion. It is able to transform the biochemical energy contained in energetic substrates into mechanical energy. Its structure and functional capabilities are adapted to the various types of constraints it endures. The level of physical activity, defined in terms of work load and intensity, influence the total muscle mass as well as the muscle's metabolic and contractile properties. According to the type of physical training, muscle adaptations will be focused either on development of muscle power or the capacity to sustain prolonged work. This leads to the distinction between the effects of strength training and the effects of endurance training. Recently, our interest has centered on the effects of workouts that combine strength and endurance. The muscle's ability to adapt to the various demands is referred to as muscle plasticity. To understand the hierarchy of such factors of muscle adaptation to training conditions, the first step is to give a short description of muscle structure and muscle contraction mechanisms. This serves as a basis for explaining the molecular mechanisms involved in muscle plasticity which are beginning to be well determined.

(Bernard & Ali, 2017, p. 4)

1.2 Muscle Fiber Composition

Myofibrils represent the histological entity of the striated muscle. The particular structure of the myofibrils gives the skeletal muscle its

"striated" appearance. The proteins that make up such myofibrils are organized as sarcomeres delimited by Z-shaped striae. Sarcomeres are organized in series along the muscle fibers. From the sarcomere's periphery to its center, there is a succession of I bands (clear, called isotopic) and A bands (dark, called anisotropic). I bands consist of fine filaments . (Bernard & Ali, 2017, p. 4)

1.3 Types of Muscle Action

During a typical strength training session, muscles may contract from tens to hundreds of times to move the body or the implement they are training with. Neural stimulation of the muscle causes the contractile units of the muscle to attempt to shorten. But contraction does not always involve shortening of the muscle fibers. Depending on the load and the amount of force supplied by the muscle, three different muscle actions may occur during a muscle contraction

(see figure 1.):

1. Concentric muscle action. This type of muscle action occurs when the muscle force exceeds the external resistance, resulting in joint movement as the muscle shortens. In other words, concentric contractions are those in which the muscle fibers shorten while contracting to lift the weight. This is demonstrated by the upward phase of a biceps curl and is often referred to as the positive phase of the repetition.

2. Eccentric muscle action: This type of muscle action occurs when the external resistance exceeds the force supplied by the muscle, resulting in joint movement as the muscle lengthens. Eccentric muscle

actions are demonstrated by the downward phase of the biceps curl. This is often referred to as the negative portion of the repetition. Even though the fibers are lengthening, they're also in a state of contraction, permitting the weight to return to the starting position in a controlled manner.

3. Isometric muscle action: This type of muscle action occurs when the muscle contracts without moving, generating force while its length remains static. Isometric muscle actions are demonstrated in an attempt to lift an immovable object or an object that is too heavy to move. The muscle fibers contract in an attempt to move the weight, but the muscle does not shorten in overall length because the object is too heavy to move.

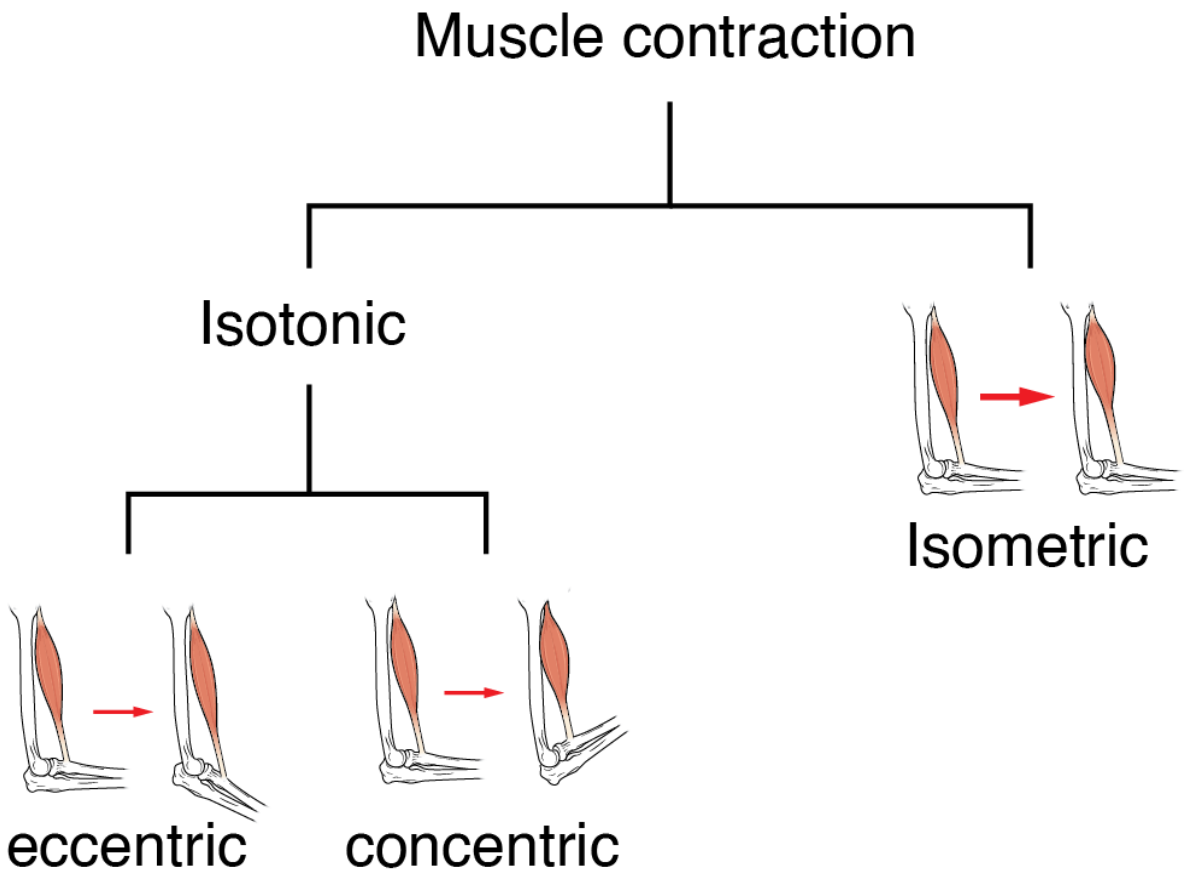

Figure 1 : Major types of muscle actions: concentric, isometric, and eccentric .(Nervous system control of muscle tension)

training scientists there is much debate about the importance of each of these types of muscle actions regarding increases in strength and muscle mass. Studies have been conducted in an effort to determine whether one type of muscle action is most important for enhancing muscle strength and mass. Because it is possible to produce greater force during eccentric and isometric muscle actions as compared to concentric muscle actions, it has been hypothesized that these muscle actions may be more important than concentric muscle actions for inducing changes in muscle strength and size. Researchers have found that training with isometric muscle actions can increase muscle strength and size (Fleck and Schutt 1985). However, the strength gains

from isometric training are realized only during the specific joint angles at which the muscles were trained. In other words, if someone trains isometrically on the bench press at the point halfway between the start and finish, that person will gain muscle strength only at that specific point in the exercise. This would not equate to greater overall strength in the bench press unless a variety of joint angles between the start and finish were also trained isometrically. Therefore, while isometric training can be beneficial, concentric and eccentric muscle actions should also be included for better overall muscle adaptations .

Because it is possible to overload a muscle more during eccentric muscle contractions, these contractions cause more muscle damage. It has been hypothesized that this greater overload can induce greater gains in strength. Indeed, research has shown that eccentric-only training does induce significant strength gains; however, this training appears to offer no greater strength benefit than concentric-only training. Therefore, to maximize muscle adaptations, strength training programs need to incorporate both concentric and eccentric muscle actions. For sample training programs that incorporate eccentric training.

The use of concentric, eccentric, and isometric muscle actions in strength training will yield somewhat different adaptations. Although isometric muscle actions can improve strength and muscle size to some degree, they provide mainly static strength. This does not necessarily carry over to dynamic strength used for most sports. Therefore, most strength training programs should focus on concentric

and eccentric muscle actions. Greater improvements in strength and muscle mass can be achieved when repetitions include both concentric and eccentric muscle actions.

Another type of muscle action that should be considered here is called voluntary maximal muscle action. This type of muscle action does not refer to the actual movement of the muscle but to the intensity of the resistance. When a muscle undergoes a voluntary maximal muscle action, it is moving against as much resistance as its current fatigue level will allow. Regardless of how many repetitions are performed in a set—whether it be 1 or 10—it is the last repetition, when momentary concentric muscle failure is reached, that is considered the voluntary maximal muscle action. In other words, not another single repetition can be performed. This is also referred to as the repetition maximum (RM) and is usually represented with a number preceding the RM. For example, 1RM would represent the amount of weight that induces a voluntary maximal muscle action with one repetition. A 10RM is the amount of weight that induces a voluntary maximal muscle action on the 10th repetition . (Stoppani, 2014, p. 16 and 17 from 1173)

1.4 Nutrition

1.4.1 EATING HEALTHY VS. ACHIEVING YOUR GOAL PHYSIQUE

With the thought of achieving a great physique, people instantly think of eating healthy. Yet eating healthy foods doesn’t necessarily mean you're achieving your goal physique. While acquiring your best physique doesn’t exactly mean you're eating healthy. To eat healthy generally means you provide your body with enough nutrients to

function efficiently. Your body demands a specific amount of micronutrients (vitamins and minerals) and macronutrients (fats, proteins, and carbs) in order to work at its best ability. It is your responsibility to fulfill your body's nutritional requirements in order to maintain good health. Achieving a great physique usually involves losing fat or gaining muscle. In order to lose fat, an individual must be in a calorie deficit where your body burns more calories than the amount of calories you eat and drink. Gaining weight requires one to do the opposite, where in a calorie surplus you consume more calories than the amount your body burns. Although eating healthy foods has endless benefits, it is just as important to fulfill the requirement of achieving your fitness goal. For example, if your goal is to burn fat and you eat 10,000 calories worth of vegetables each day, you're eating healthy but are consuming too many calories to accomplish your goal. Therefore, it is ideal to eat towards your goal physique while maintaining good health. Both of these objectives are done by consuming the amount of calories that will allow you to accomplish your fitness goal while acquiring sufficient micronutrients and macronutrients so your body can function efficiently.

(GEORGE, 2015, p. 14 nutrition book)

1.4.2 How does your body use calories

Your body needs calories just to stay alive and operate properly. This energy is used for basic functions such as keeping your heart beating and lungs breathing. Calories are essential for all basic and complex

functions including the regulation of body temperature and the operation of every cell in your body. The more activity you do is the more calories you burn. Your body also needs calories in order to grow and develop. You burn calories without even thinking about it such as during the digestion of food, recovery of muscles after exercise, and even while you sleep.

(GEORGE, 2015, p. 17 nutrition book)

1.4.3 HOW MANY CALORIES DO YOU NEED

People differ in size and have different metabolisms, so the amount of calories a person should consume will vary depending on several factors. These factors include a person's height, weight, age, and daily activity level. The bigger a person is, the more calories that person may need, vice versa. Even though two people can have the same body measurements, the amount of calories they need can differ because of the way their body metabolizes what they consume. Calorie calculators are available online, which can be used to determine how many calories your body needs based on the necessary factors. If you eat more calories than your body needs, then the extra calories are converted into fat. If you eat less calories then you need, then your body uses your stored body fat as the energy it needs to function. Understanding the amount of calories you need will help you better control your weight.

(GEORGE, 2015, p. 18 nutrition book)

1.4.4 MACRO BASICS

Macronutrients or macros are carbohydrates, fats, and protein. With the term "macro" meaning very large, these three nutrients are responsible for providing calories (the only other substance that provides calories is alcohol but is not a macronutrient since we do not need it for survival). Anything you eat is broken down to these three macronutrients. Your body does not recognize the food you eat as "chicken, rice, salad, etc". Instead, your body sees whatever you consume as a carb, fat, or protein. This is the reason you find these macronutrients written in bold letters on the nutrition label of any food or drink product. (GEORGE, 2015, p. 19 nutrition book)

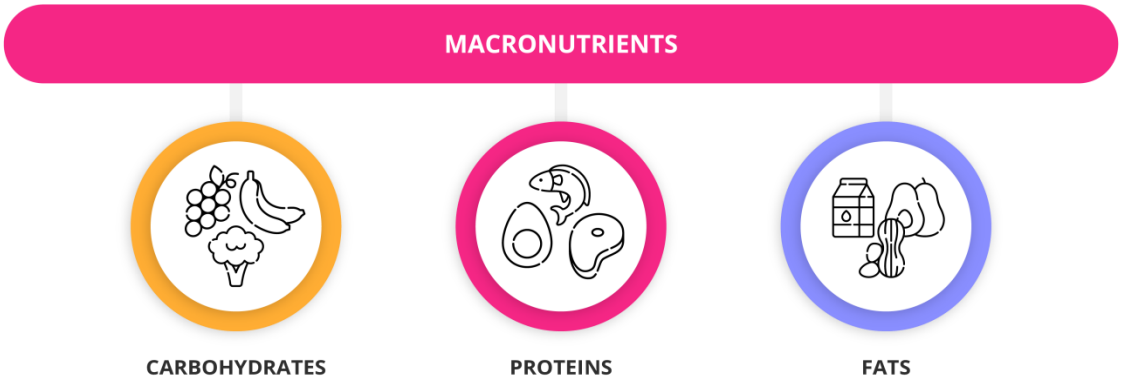

Figure 2: macronutrients (from google)

Chapter II: muscle injury and rehabilitation

2 injuries

2.1 Definition of sport injury

A sports injury is any form of stress placed upon your body during athletic activity that prevents it from functioning to the full, and which requires a period of recovery to allow your body to heal. It usually affects your musculoskeletal system—your bones, muscles, tendons, and cartilage— and often results in pain, swelling, tenderness, and the inability to use, or place weight on, the affected area. Sports injuries can be divided into two types: acute, or "traumatic," injuries, which occur as the result of a specific impact or traumatic event; and chronic, or "overuse," injuries, which result from wear and tear on the body and occur over an extended period of time. Acute injuries include bone fractures, muscle and tendon strains, ligament sprains, and bruising. They are common among players of collision or contact sports, such as football, soccer, and ice hockey. Chronic injuries include tendinopathy, bursitis, and stress fractures; they are more common among participants in endurance sports, such as long-distance running, and in people who play individual sports involving repetitive movements, such as swimming, tennis, gymnastics, and weight lifting. (Gareth Jones, 2019, p. 6 sport injury)

2.2 MOST COMMON CAUSES OF INJURY :

- Failure to warm up, resulting in your muscles being less responsive and prone to strain.
- Overtraining, which increases the risk of chronic injury by putting continuous pressure on your body.

- Excessive loading on the body, which applies forces to your tissues for which they are unprepared.
- Not taking safety precautions, or ignoring the rules of a sports activity, increasing the risk of an accident.
- An accident, often the result of an impact or collision, and usually occuring suddenly.
- Inappropriate equipment, so your body may not be adequately supported or protected from shock.
- Poor exercise technique, leading to overloading on body tissues—especially if carried out repeatedly.
- Recurring injury, which can weaken your body and make it more susceptible to other injuries.
- Genetic factors, which are intrinsic (belonging to you) and influence the shape and structure of your joints.
- Muscle weakness or imbalance, which can lead to a loss of strength in your body.
- Lack of flexibility, which will decrease your range of motion and limit some of your body's capabilities.
- Joint laxity (a condition which, if you have it, you should already be aware of), which can make it difficult for you to control and stabilize your joints. (adda, 1 june 2020)

2.3 ANATOMY OF A SPORTS INJURY

- **Muscles** are tissues that can be contracted to produce force and create motion. The skeletal muscle, which is attached to and

covers the skeleton, is prone to being strained or “pulled”— an injury that involves the tearing of the muscle fibers.

- **Bones** protect your internal organs and are connected together by ligaments to form the skeleton. Bone fractures and breakages often damage surrounding soft tissue.
- **Joints** are capsules—made of cartilage, bursae, ligaments, and tendons—that hold together two or more bones and facilitate movement. Partial or full dislocation of the joints can occur.
- **Cartilage** is a fibrous connective tissue that forms smooth surfaces over the ends of bones where they meet the joints, allowing movement and absorbing impact and friction. Worn or torn cartilage is a common side effect of joint injuries, and is commonly caused by trauma.
- **Bursae** are small sacs of fluid that reduce friction within some joints, and are usually located where muscles and tendons slide across bones. Bursitis is inflammation due to overuse or infection.
- **Ligaments** are fibrous, connective tissues that connect bones, providing stability within joints and limiting movement of the limbs. An overstretched or torn ligament is known as a sprain.
- **Tendons** are fibrous, connective tissues that connect muscles to bones, and help produce movement by enabling force to be exerted on the bones. Tendons can be strained or ruptured, and tendinopathy is pain caused by overuse or repetitive motion.

(Gareth Jones, 2019, p. 7 sport injury)

2.4 Muscle injuries

Introduction

Muscle injuries is a broad term encompassing many pathologies and these are common injuries in both elite and amateur athletes as well as in the general population.

2.5 Types of muscle injury

a. Aches

Aches result in muscle pain that appears after exercise and can last from 24 to 48H. (A good hot bath, gentle stretching can accelerate the disappearance of aches.) (WOTQUENNE)

Figure 3 : body aches after practicing sport (from google)

b. The cramp:

The cramp is an involuntary and very intense contraction of the muscle. It comes suddenly and is accompanied by significant pain. It can disappear spontaneously but nevertheless leaves a contracture in the days following its appearance. The cramp appears most often

during the effort, but can also occur at rest. Thus, nocturnal calf cramps are not uncommon. (The treatment emergency is to gradually stretch the muscle and stay well hydrated.) (WOTQUENNE)

Figure 4 : muscle cramp (from google)

c. Contracture:

It comes from the exaggerated contraction of a part of the muscle. The pain is first felt at the end of the exercise, during the rest phases. If the effort is continued, the muscle "stiffens" more and more. (Rest, warmth, stretching when the pain is gone, and medical care as the basis processing.) (WOTQUENNE)

d. Elongation:

is the traumatic elongation of the muscle. Elongation occurs during stress excessive at the limit of the stretching of the muscle or following a too strong contraction of the muscle. (A break several days is imperative and must be accompanied by medical care.) (WOTQUENNE)

e. Tear or strain:

A tear is a rupture of a large number of muscle fibers. Often Similar to a stab, the sudden and violent pain requires the immediate cessation of activity. She is accompanied by local hemorrhage. (All heat application and massage are strictly proscribed. Apply ice in a bag held by a bandage, to allow compression which will stop the bleeding, about 15 minutes and repeat this procedure several times a day, keeping continuously the injured limb in elevation. To avoid any burns to the skin, place a towel between the ice pack and the skin. Recovering from a tear requires significant complete rest often longer than 30 days and appropriate care . (WOTQUENNE)

f. Rupture:

This is the most serious accident. It consists of a transverse tearing of the muscle and causes immediate and total functional impotence. The appearance of edema and hematoma is rapid. (As for the tear, the first intervention involves the application of ice. A complete rest of one at two months and medical care. will be needed) (WOTQUENNE)

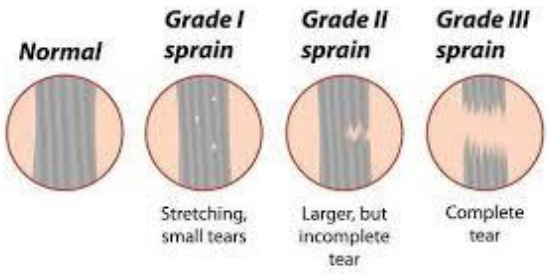

Figure 5 grade of muscle tears

G. SYMPTOMS AND CAUSES :

I. THE SYMPTOMS OF MUSCLE INJURY ARE :

1. Pain.
2. Difficulty moving a muscle like you usually can.
3. Weakness in a muscle.
4. Bruising or discoloration.
5. Swelling.
6. Muscle spasms.

2.6 THE CAUSES OF MUSCLE INJURY ARE

Muscle strains happen when you tear the fibers of your muscle. Causes of muscle strains include:

- **Overuse**: Repeating the same motion — whether at work or during an activity like playing sports — can lead to overuse syndrome.
- **Not stretching or warming up before exercise**: Stretching before exercise gradually increases how much stress you put on your muscles.
- **A lack of flexibility**: If you're not very flexible, your muscles (and the fibers in them) are tighter, which makes them more susceptible to strains.

h. Diagnosis and tests

a. The diagnosis of muscle strain :

Your healthcare provider will diagnose a muscle strain with a physical exam. Make sure to tell them what you were doing when you first

noticed your symptoms. Because muscle strains come from physical activities, it's important they know what led to yours.

Your provider will classify your muscle strain by grade according to how severe it is:

- Grade 1 (mild).
- Grade 2 (moderate).
- Grade 3 (severe). (Cleveland Clinic, 2022)

b. The tests of muscle strain are :

If you have a more severe strain, your provider might use some imaging tests to diagnose your muscle strain:

- **Ultrasound**: Your provider will use an ultrasound to check for tears or fluid buildup around your strained muscle.
- **MRI**: An MRI will let your provider check for blood clots, a tear or internal bleeding.

These tests will also help them see if your injury damaged any other tissues like your tendons or ligaments. (Cleveland Clinic, 2022)

i. The ultrasound is :

Ultrasound (also called sonography or ultrasonography) is a noninvasive imaging test. An ultrasound picture is called a sonogram. Ultrasound uses high-frequency sound waves to create real-time pictures or video of internal organs or other soft tissues, such as blood vessels.

Ultrasound enables healthcare providers to “see” details of soft tissues inside your body without making any incisions (cuts). And unlike X-rays, ultrasound doesn’t use radiation.

Although most people associate ultrasound with pregnancy, healthcare providers use ultrasound for many different situations and to look at several different parts of the inside of your body.

(professional, 2022)

Figure 6:ultrasound pic (from google)

ii. The MRI is :

An MRI (magnetic resonance imaging) scan is a painless test that produces very clear images of the organs and structures inside your body. MRI uses a large magnet, radio waves and a computer to produce these detailed images. It doesn’t use X-rays (radiation).

Because MRI doesn't use X-rays or other radiation, it's the imaging test of choice when people will need frequent imaging for diagnosis or treatment monitoring, especially of their brain. (professional, 2022)

Figure 7: the MRI (from google)

i. Management and treatment

a. FIELD treatment

Only cramps and aches are harmless and can yield with a good massage and especially not of ice. The diagnosis between elongation and contracture is difficult since in both cases, one feels an area painful and tense within the muscle. The risk of aggravation in the event of continuation of the activity is major. Contracture leads to a decrease in muscle elasticity and therefore increases the risk of a frank tear. (WOTQUENNE)

How are muscle strains treated?

You can treat most muscle strains with at-home methods of first aid, including:

- **Rest:** Stop the physical activity that caused your strain to avoid further damaging your muscle.
- **Ice:** Apply an ice pack or cold compress for 10 to 15 minutes every hour for the first day after your injury. After one day, you can apply ice every three to four hours. Don't apply ice directly to your skin (wrap your ice pack in a towel or washcloth).
- **Elevation:** If possible, keep your injured muscle elevated above your heart.

Muscle strain surgery

It's rare to need surgery for a muscle strain. If you have a severe strain (Grade 3), you might need surgery to repair your torn muscle. Your healthcare provider will tell you which kind of surgery you'll need and what you can expect. (Cleveland Clinic, 2022)

b. REMOTE PROCESSING

A visit to your doctor is in order. (WOTQUENNE)

What medications are used to treat muscle strains?

Your provider might recommend you use over-the-counter NSAIDs like aspirin, ibuprofen (Motrin® and Advil®) or naproxen (Aleve®).

Don't use an NSAID continuously for more than 10 days unless your provider says it's okay.

It’s rare to need prescription medication like muscle relaxers for a muscle strain. Your provider will tell you which medications to take based on your specific symptoms. (Cleveland Clinic, 2022)

How soon will I feel better?

Depending on how severe your original muscle strain is, you should feel better in a few weeks. Talk to your healthcare provider before resuming any intense physical activities.

If you start working out or playing sports again before your muscle is healed, you’re at an increased risk of re-injuring it and hurting your muscle worse than the original strain. (Cleveland Clinic, 2022)

What questions should I ask my doctor?

- Which muscle is strained?
- How long will I need to rest my muscle?
- Which grade of strain do I have?
- Are there any activities I should avoid while I’m recovering?

(Cleveland Clinic, 2022)

3. Physical therapy and rehabilitation

While your sports injury may be treated by a variety of healthcare specialists, the leading role in your rehabilitation is likely to be played by your physiotherapist. From making an initial assessment to guiding you through a course of treatment, your physiotherapist will oversee your rehabilitation, ensuring that your injury is fully healed and that

your body is conditioned to prevent it from recurring. (Gareth Jones, PHYSICAL THERAPY AND REHABILITATION, 2019)

3.1.1. ASSESSING MUSCLE STRENGTH

ASSESSING MUSCLE STRENGTH Physical therapists gauge the strength of a damaged muscle against an established scale, such as the Oxford Scale below. Scores are allocated on a scale from 0/5 to 5/5, with the addition of a plus (+) or minus (–) designating a stronger or weaker performance than expected for each stage.

0/5: There is no discernable muscle movement when the patient attempts to use the muscle.

1/5: The patient's muscle twitches, but the patient is unable to move it through any of its normal range of motion.

2/5: Normal joint movement is possible, but only when the patient's muscle is positioned so that it is not acting against gravity.

3/5: Normal joint movement is possible against gravity, but no manual resistance is applied.

4/5: The patient's muscle can move its joint through the full range of motion, against gravity, and with the application of some resistance.

5/5: There is unimpaired movement of the patient's muscle against gravity and increased resistance (as determined by the physical therapist, according to the patient's age and fitness). (Gareth Jones, PHYSICAL THERAPY AND REHABILITATION, 2019)

3.1.2. Physical therapy techniques

Physical therapists use a variety of techniques to treat sports injuries. Through massage and manipulation they can relieve inflammation, reduce muscle pain and joint stiffness, and encourage blood flow to and fluid drainage from the affected area. They may also use a combination of electrotherapy, ultrasound, and the application of heat and cold to stimulate the nervous and circulatory systems to reduce pain and accelerate healing. However, in most cases the most important factor in the rehabilitation process is a comprehensive program of remedial exercises. (Gareth Jones, PHYSICAL THERAPY AND REHABILITATION, 2019, p. 13)

3.1.3. A successful recovery Key

to your successful and speedy recovery from any sports injury is making sure you are using the correct technique when performing every exercise, and diligently following the guidance given to you by your physical therapist. It is important that you never exceed the number of repetitions or levels of intensity that are recommended, and that you follow the step-by-step instructions given with each exercise closely. Effective communication between you and your physical therapist will also ensure that at every stage of your rehabilitation you are receiving the very best treatment. There is one crucial component to your recovery from injury that health specialists, despite their high levels of expertise, cannot provide: the will to succeed. If you apply the same determination for success in your chosen sport to practicing the exercises in your rehabilitation program, you will have every

chance of making a full recovery in as short a time as possible (Gareth Jones, PHYSICAL THERAPY AND REHABILITATION, 2019, p. 13)

3.1.4. GETTING THE BEST FROM REHABILITATION

■ Get in shape before starting a new activity or sport.

■ Always stick to the exercises that have been recommended for your training program.

■ Wear the right protective gear.

■ Always warm up and cool down.

■ Make sure you use the correct technique.

■ Keep hydrated.

■ Vary your routine.

■ Build up gradually—don't try to do too much too soon.

■ Don't exceed the recommended number of repetitions or level of intensity.

■ Don't overwork your body—know your limits.

■ Immediately stop what you are doing if you feel pain.

■ Make sure you have adequate rest between sessions.

■ Avoid exercise if you are already injured, or if you are unwell or tired.

■ Continue your program until you have finished it.

■ Maintain a positive attitude and keep your spirits up. (Gareth Jones, PHYSICAL THERAPY AND REHABILITATION, 2019, p. 13)

3.2. Two styles of resting

You can see why I avoided saying “how long” at first: it depends on the individual’s situation and risk tolerance. There is no “right” answer. It’s like — exactly like, actually — trying to tell someone whether they should choose safe investments, or riskier but more profitable investments: it all comes down to your personal situation and style, and how you feel (Ingraham, 2021)

3.2.1. Method 1: Get it over with

Some people prefer the “get it over with” or “overkill” method, and choose to rest a lot on the *first try*, to generously rest for at least 2–3 weeks more than you really think is necessary “just in case,” and not to challenge/test your injured part at all during the rest period. The benefit of this approach is that it is virtually foolproof. The disadvantage, of course, is that you may actually end up resting much more than you actually needed to. (Ingraham, 2021)

This method is fine for people who enjoy a better-safe-than-sorry approach to life, and for people who are patient. But if you are the sort of person who can’t wait to open your Christmas presents …

3.2.2. Method 2: If at first you don’t succeed

Others are so unable or unwilling to rest that they prefer the “if at first you don’t succeed” or “go for the parking spot you want”**20** method, in which you try resting the minimum amount that might work. The

advantage? You might succeed on the first or second try, getting away with a relatively small amount of inconvenience.

The disadvantage, of course, is that your desire for efficiency could backfire, and you could end up having to try five progressively longer rest periods, resulting in a much larger investment in rehabilitation than if you'd just rested adequately the first time. Ouch. (Ingraham, 2021)

Chapter III: training and calisthenics

3. About training

Here I'm going to talking about 2 types of training

Strength training and endurance training

3.3. Strength training

Physical strength is the most important thing in life. This is true whether we want it to be or not. As humanity has developed throughout history, physical strength has become less critical to our daily existence, but no less important to our lives. Our strength, more than any other thing we possess, still determines the quality and the quantity of our time here in these bodies. Whereas previously our physical strength determined how much food we ate and how warm and dry we stayed, it now merely determines how well we function in these new surroundings we have crafted for ourselves as our culture has accumulated. But we are still animals – our physical existence is, in the final analysis, the only one that actually matters. A weak man is not as happy as that same man would be if he were strong. This reality is offensive to some people who would like the intellectual or spiritual to take precedence. It is instructive to see what happens to these very people as their squat strength goes up. As the nature of our culture has changed, our relationship with physical activity has changed along with it. We previously were physically strong as a function of our continued existence in a simple physical world. We were adapted to this existence well, since we had no other choice. Those whose strength was adequate to the task of staying alive continued doing so. This shaped our basic physiology, and that of all our vertebrate

associates on the bushy little tree of life. It remains with us today. The relatively recent innovation known as the Division of Labor is not so remote that our genetic composition has had time to adapt again. Since most of us now have been freed from the necessity of personally obtaining our subsistence, physical activity is regarded as optional. Indeed it is, from the standpoint of immediate necessity, but the reality of millions of years of adaptation to a ruggedly physical existence will not just go away because desks were invented. Like it or not, we remain the possessors of potentially strong muscle, bone, sinew, and nerve, and these hard-won commodities demand our attention. They were too long in the making to just be ignored, and we do so at our peril. They are the very components of our existence, the quality of which now depends on our conscious, directed effort at giving them the stimulus they need to stay in the condition that is normal to them. Exercise is that stimulus. Over and above any considerations of performance for sports, exercise is the stimulus that returns our bodies to the conditions for which they were designed. Humans are not physically normal in the absence of hard physical effort. Exercise is not a thing we do to fix a problem – it is a thing we must do anyway, a thing without which there will always be problems. Exercise is the thing we must do to replicate the conditions under which our physiology was – and still is – adapted, the conditions under which we are physically normal. In other words, exercise is substitute cave-man activity, the thing we need to make our bodies, and in fact our minds, normal in the 21st century. And merely normal, for most worthwhile

humans, is not good enough. An athlete's decision to begin a strength training program may be motivated by a desire to join a team sport that requires it, or it might be for more personal reasons. Many individuals feel that their strength is inadequate, or could be improved beyond what it is, without the carrot of team membership. (rippetoe, 2005, p. 6 from starting training)

3.4.Endurance training

Endurance is defined as the ability to exert energy over a prolonged period of time or distance. Most of us have been led to believe that to improve endurance all you have to do is perform a specific task until you achieve your goal. For example, say you want to improve endurance as well as overall fitness. Some people who subscribe to the LSD (aerobic) training philosophy would say that all you need to do is run: it doesn't matter if you run at low intensity; as long as you run often and for a long time, you'll experience improvement across your entire athletic profile. If you're sedentary, going out and simply running slow and long will definitely elicit an adaptive response, which is necessary to improve fitness, specifically endurance. However, at some point you are going to adapt to the stress of long, slow distance efforts and ultimately plateau performance-wise. If you're a competitive endurance athlete who trains often, you may not see any improvements at all. In such a situation, you have to increase the intensity of your efforts and adopt a training program that involves shorter high-intensity intervals, such as sprints, to challenge your body's natural adaptation response. In other words, if you don't cause

a disruption of oxygen homeostasis (get winded and feel your muscles burn), you're never going to get stronger, faster, or build stamina beyond your aerobic base, which adds credibility to Lydiard's second phase. Let's use a simple example to help make this easier to understand and shed more light on the flaws of steady-state training. Take an inactive individual who struggles to run a mile without stopping. If you told him to run one mile consistently, he would (over time) undoubtedly get positive results as it relates to his fitness base. But how long do you think it would take until running that same mile at a slow pace is no longer a challenge? Although it depends on the individual, it probably wouldn't take very long. In such a case, the conventional theory would advise keeping intensity low and increasing distance to keep improving fitness rather than running that same mile at a faster pace: you would increase the distance to two miles, and then three, and then four, and so on, until you reach your target distance or until a foundation in endurance is built. The important question is, At what point does the scale get tipped from improving endurance and aerobic capacity to compromising recovery and even inviting injury? Again, it depends on the individual, but for the majority, running longer than 10K is not going to yield the benefits that sport-specific interval training and a well-rounded strength-and-conditioning program can provide. Running long is just not the most efficient way to improve endurance and become a better athlete. At a certain point, running more, riding more, or swimming more is not going to do anything but put unnecessary stress on your

body. What are you doing it for? To get faster? Build lean muscle? Lose weight? Build cardiovascular fitness? The LSD model is fundamentally flawed in this regard because it doesn't cater to a wide range of goals. Not only that, if you continue to train slow, you're going to race slow. As a result, the protocol doesn't develop speed, power, coordination, strength, agility, and mobility in athletes. Moreover, athletes whose training bible is LSD tend to have less lean muscle mass, acquire poor motor patterns, suffer from fatigue throughout the day, be more prone to injury, and have short life spans in their sport. In other words, it's a high-risk, lowreward model. We are not one-dimensional creatures. While we're capable of sustaining efforts for long periods of time, we're also designed to lift, climb, sprint, carry, and jump. In order to express our true nature and maximize endurance gains, we must also develop all of these other attributes. As I already stated, I'm not saying there's no place for long, slow distance training. For some of you, going out for long runs or rides is an escape from the daily grind; it's your form of meditation and is required to maintain sanity. Moreover, if you're training for a marathon or your goal is to sustain a pace for a prolonged period of time (two or more hours), incorporating long, slow distance runs into your training program periodically is not a bad idea. In fact, it's something that is built into the CrossFit Endurance program. But you have to understand that it comes at a cost. The repeated volume is inevitably going to break your body down. To realize your potential

and avoid injury, you have to look at how your body adapts to your training.

(Mackenzie, Power Speed ENDURANCE, 2012, pp. 26 and 27 ,)

And when we talk about the endurance we need to talk also about the ANAEROBIC AND AEROBIC ENERGY SYSTEMS

3.5.ANAEROBIC AND AEROBIC ENERGY SYSTEMS

Anaerobic Energy Systems: The rapid and immediate breakdown of nutrients to form ATP for energy without the use of oxygen. Examples: lifting weight, a 100-meter sprint.

Phosphagen System (ATP-CP): To replenish ATP levels quickly, muscle cells contain a high-energy phosphate compound called creatine phosphate (CP). The phosphate group is removed from creatine phosphate by an enzyme called creatine kinase and is transferred to andenosine diphosphate (ADP) to form ATP. The cell turns ATP into ADP, and the phosphagen rapidly turns the ADP back into ATP. As the muscle continues to work, creatine phosphate levels begin to decrease. The phosphagen system supplies the energy needs of working muscle at a high rate, but only for up to 10 seconds. For any exertion longer, the body must tap into the glycolytic, lactate, or aerobic system to generate ATP for energy.

Glycolytic System: Glycolysis is the process by which carbohydrate (sugar or glucose) is broken down to form ATP without the use of oxygen, which is then converted to energy. Lactate Shuttle: As creatine phosphate runs out, the body uses stored glucose and glycogen for ATP. The process is still anaerobic because there isn’t

enough oxygen to break down pyruvate (the enzyme used to break down glucose), producing lactate. Lactate then enters muscle cells, and blood, and the lactate is either broken down into immediate fuel (ATP) or used in the creation of glycogen.

Aerobic System: The aerobic system can use carbohydrate and fat as fuel. Using carbohydrates produces 36ATP per molecule. Beta oxidation, or oxidation of fats, yields approximately three times this amount. Beta oxidation can be thought of as the overdrive of energy systems. It takes a long time to get there, and once there, the body settles in for a long trip. Examples: prolonged walk, run, bike, or swim.

(Mackenzie, Power Speed ENDURANCE, 2012, p. 28 and 29)

3.6.CALISTHENICS (CALS) AND BODYWEIGHT TRAINING (BWT)

Calisthenics, from the Greek ‘kalos’ for beautiful and ‘sthenos’ for strength, refers to exercises that incorporate simple, natural body movements using only the weight of your body as resistance to increase strength, flexibility, mobility, agility and endurance. It is a matter of learning to control your body for optimal results but the basics are easy for anyone, male or female, young or old. Bodyweight training is simply another name for the calisthenics activities because of the fact that only the weight of your body is used to perform the exercises. Although there are technically only a few basic exercises, there are countless variations of them to keep things interesting. The alternatives come from modifications that increase the difficulty of the

moves or target more slightly different muscles. Injury is uncommon since you are controlling your own movements and don't have any weights or machines to get in the way or cause a strain. The beauty of calisthenics is that it depends completely on your own body weight and involves functional motions – full range movements that are natural for all the activities you perform daily. Along with improved general fitness, adding calisthenics to your daily routine will help you lose weight and inches, gain lean muscle mass and tone, and improve your cardiovascular health with greater endurance.

Movements involved in calisthenics include:

- Accelerating and decelerating
- Bending
- Jumping
- Kicking
- Pulling and pushing
- Squatting
- Swinging
- Twisting

When you look at the range of calisthenics movements, you will discover that aerobics, gymnastics, pilates, running, yoga, martial arts and walking are all actually considered calisthenics activities. The preparation for all of these activities begins with the very basic movements that are included in the playlist for calisthenics. By mastering the basics, creating modifications and perfecting control of

your body, you are automatically preparing for better performance in any sport or activity.

Figure 8 : male gymnast in handstand on parallel bars (from google)

Just by thinking of these disciplines, you can get the picture of how the movements can be modified for greater difficulty. A simple bridge becomes a back walkover to a gymnast and controlled jumping jacks can be transferred to karate chops and kicks. Pilates and Yoga moves are generally slower and more controlled than other forms of calisthenics and combine with mental concentration for a meditative experience. While Yoga focuses on balance, posture and stretches, Pilates concentrates more on the core and powerhouse muscles of the hips and buttocks. Aerobics classes are a dynamic form of calisthenics usually set to music and even dance – from ballet to modern and just look at break dancers! – and depend on the coordinated functioning of the body in a wide range of motions. The same comparisons can be

made with figure skaters and acrobats such as Cirque du Soleil performers. (Powers, 2015, p. 19 and 20 from calisthenics)

Second Party :

Research Methodology

Chapter I: Field Procedures

1.1 Research Methodology:

The method used in scientific research means a set of rules that are followed and respected for the steps in order to reach the truth.

so We have used the descriptive method in this research

It is the method of analysis and interpretation in an organized scientific manner to reach the goals.

1.2 The Community studies

Community studies is an academic field drawing on both sociology and anthropology and the social research methods of ethnography and participant observation in the study of community. (wikipedia) And here our community studies are a number of athletes they was suffer from the muscles injuries .

1.3 The research sample

The sample is considered one of the most important axes used by the researcher during his research, so the sample should be chosen well and suitable helps to reach results with high credibility and reliable efficiency, the sample is considered representing the community, it is part of the whole. Studying the whole community means that it takes a long time. Which exposes the work to errors, and research using the sample method is the research that studies the condition of a part a certain or specific percentage of the members of the original community, and then ends with the generalization of its results on this The whole praying community. In order to carry out our study, we selected a random sample of athletes they suffer from muscle injury and we distributed and collected a questionnaire.

1.4 Adjusting the study variables :

the independent variable In our study is : return to performance.

the dependent variable In our study is : muscle injury .

1.5 areas of study :

- **spatial**

I took 4 athletes from oran and 1 from tiaret and the others from mazouna

- **temporal**

This research was conducted from January to late May 2023 ,We devoted the first three months to the theoretical side (January, February, March), and as for the side of The application lasted nearly two months, from late March to May, and during this period Participate in View Vote on Post The subject of our offer is in the form of a questionnaire distributed to and Finally we come to the general conclusion

- **the human :**

The experiment was conducted on 10 athletes with a muscular injury

1.6 search tools

In our research, we used the questionnaire method as the best and most successful way to investigate the problem that we have put forward, and it also facilitates the process of collecting the information that we want to obtain from hypotheses the questionnaire is defined as: a tool for obtaining facts, data and information collecting this data through the questionnaire by setting the questions

form and among the advantages of this the method saves effort and time as it contributes to obtaining data from samples Less time to provide rationing conditions of sincerity, stability and objectivity.

he came in the part theoretically, the questionnaire included a list of 15 questions, and we took into account when formulating the following questions:

- Formulation
- Match the questions with the objectives and topics to be obtained.
- This questionnaire contains closed questions, to which each individual can answer, whether or not, or always or and semi-open questions, for which answers are determined, the investigator chooses one of them, and open questions to suggest appropriate solutions

1.7 exploratory study:

At this stage, we collected information and looked at previous research and notes related to the subject of research, and contacted specialists in this field in order to provide sufficient data and familiarity with the subject in all respects so that we could form a comprehensive and complete idea, and thus prepare the theoretical framework for this subject. Before distributing the questionnaires related to the research, we conducted a prospective study on the sample, in order to see the field practice and contact some athletes in order to collect the largest possible number of information through which the problem raised can be addressed, and try to get to know

more about the field study community by identifying their study times and places. their availability.

1.8 The statistical methods used

In our research, we relied on statistics to analyze the results of the questionnaire

Statistics, because it leads the researcher to the correct method and sound results, and we have used it in our research These are the following statistical techniques:

- Percentages: We used the percentages law to analyze the results in all questions afterwards Calculate the frequencies of each of them, for example:

$$\text{The percentage}(\%) = \frac{100\ X\ partial\ value}{total\ value}$$

We use the X2, to calculate the X2 of a count, we multiply (Counting observations – Theoretical counting) 2 ÷ Theoretical counting the formula for calculating X2 is therefore

$$X2 = \text{The total} = \frac{the\ number\ of\ real\ iterations - the\ number\ of\ theoretical\ iterations}{total\ value}$$

Chapter Two: analysis and discussion of results

First question : Did you attend the complet physical preparation ?

Table 1: of athletes who complete physical preparation

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance
Yes	8	80 %	1.8	3.84	0.05	significant
No	2	20 %				
total	10	100 %				

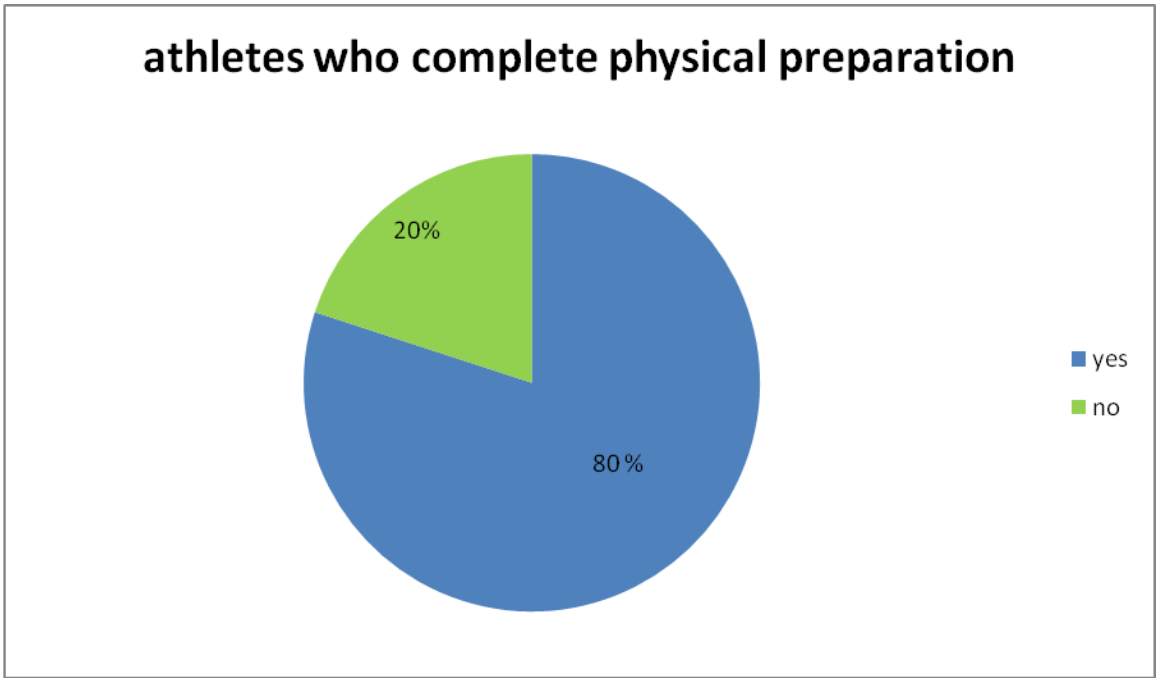

Figure 9 :athletes who complete physical preparation

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

So from The table we have 80% said yes and 20% says no and that's mean the most of athletes I have selected have a physically preparation .

People now they don't train randomly . many people follow a fitness plan to achieve their fitness goals.

Following a fitness plan can provide structure and guidance to people who are traying to improve their physical fitness, by having a plan , people can stay on track with their fitness goals , track their progress , and stay motivated to continue working towards their goals.

question 02 and 03 : what's your sport ?

If you do another sport write his name here ?

Table 2: type of sport

suggestions	repetitions	percentage	X^2 calculated	X^2 Table	indication level	statistical significance
Calisthenics and fitness	9	90 %	1.6	3.84	0.05	significant
Others	1	10 %				
total	10	100 %				

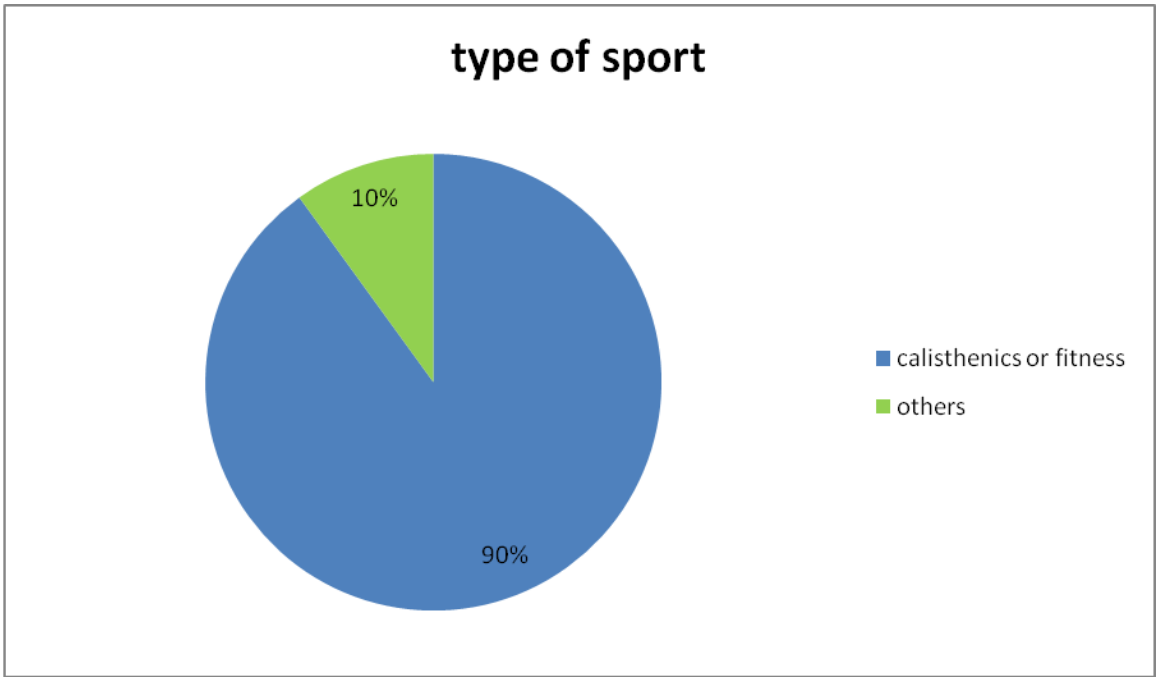

Figure 10: type of sport

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

We can see from the table that the most athletes that I give them the questionnaire are calisthenics and fitness athletes (90%) and all of them they had an experience with the muscle Injury

Question 4 : Have you suffered from muscle injuries in your sports career ?

Table 3: is about the muscle injury

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance
Yes	10	100%				
No	0	0%	5	3.84	0.05	significant

total	10	100 %				

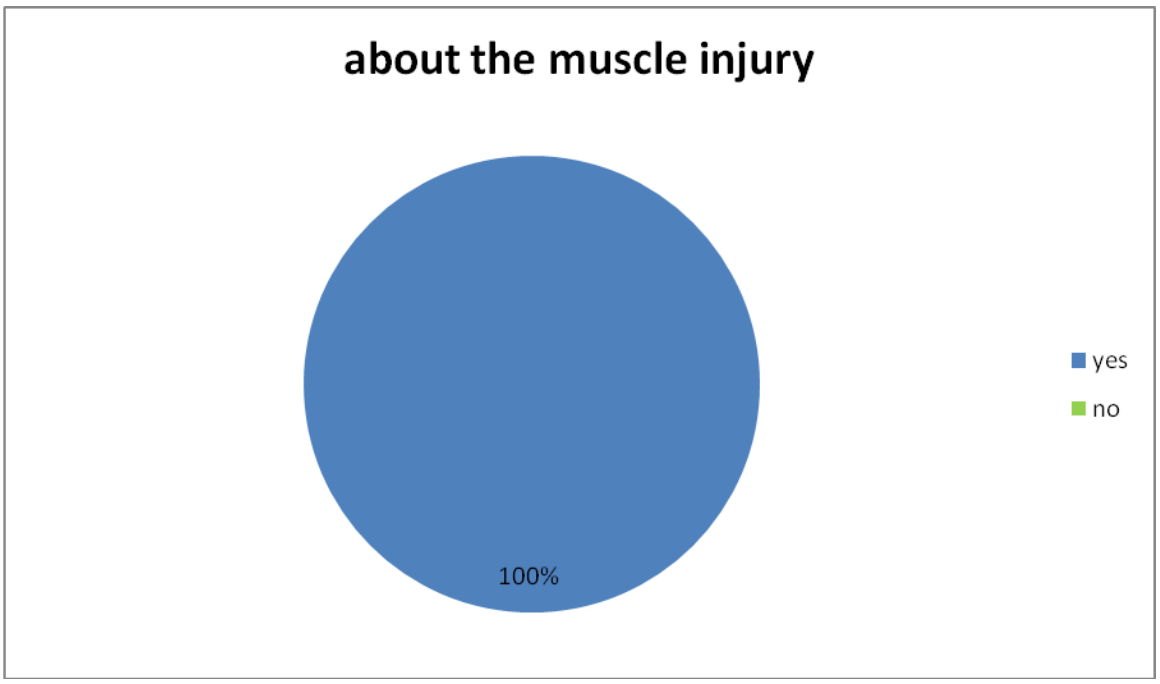

Figure 11: is about the muscle injury

Through the results shown, we notice that the calculated X^2 value is greater than the tabulated X^2 value at the level of significance of 0.05, and therefore there are statistically significant differences .

The table shows that all the athletes we have suffering from muscle injuries and that's mean it's possible that many athletes have experienced a muscle injury at some point in their career .

Injuries are an inherent risk in the practice of any sport . how ever, each athletes is different and some may before more prone to injuries than others. And there are a several reason why some athletes

may be more prone to injuries than others . some of these reason may include factors such as genetics , age , experience fitness level ……

Question 5 : If yes , in what phase did you suffer this injury ?

Table 4 : phase of injury

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance
preparatory phase	10	100%	5	3.84	0.05	Significant
competitive phase	0	0%				
total	10	100 %				

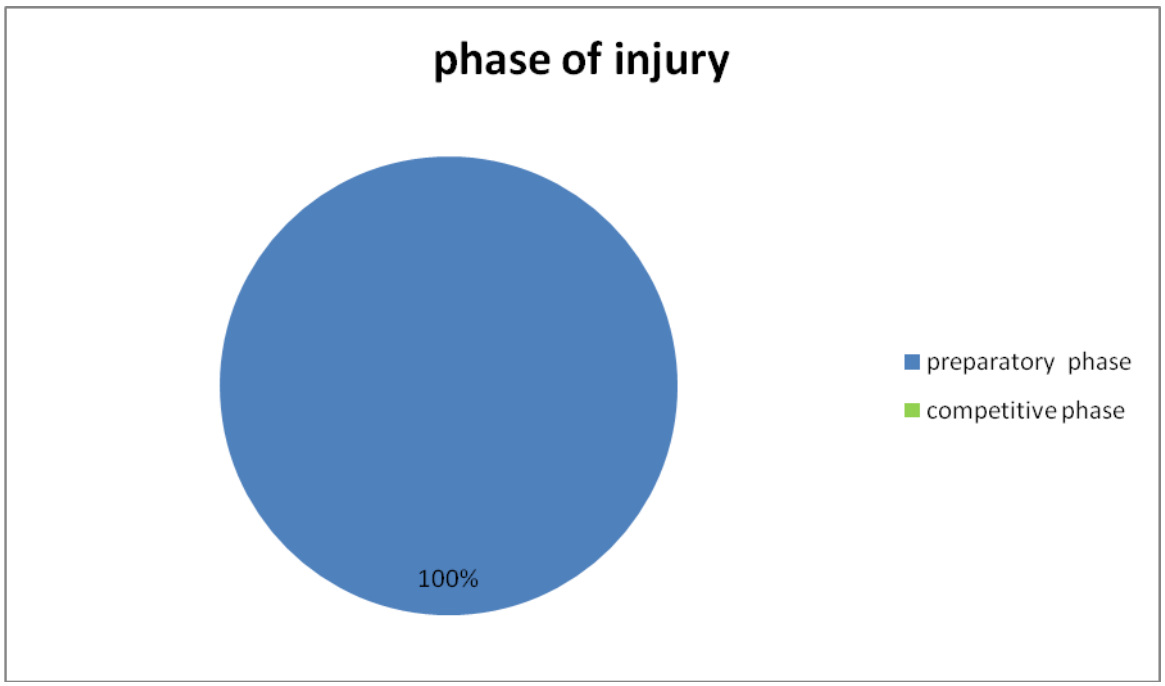

Figure 12 : phase of injury

Through the results shown, we notice that the calculated X^2 value is greater than the tabulated X^2 value at the level of significance of 0.05, and therefore there are statistically significant differences .

The table show from our questionnaire to the selected athletes that all of the injuries suffered were during the preparation we have 100% say in the preparatory phase , but here to be logical athletes can suffer from injuries at any point in their training or competition schedule, not just during the preparation phase . however, the preparation phase is a particularly important time for athletes to focus on injury prevention .

During this phase athletes may be increasing their training intensity and volume , which can put them at greater risk for injury if they don't properly prepare their bodies .

Additionally , athletes who have not been training regulary pr who have been away from their sport for an extended period may also be at greater risk for injury during the preparation phase .

Question 6 :What type of muscle injury do you have ?

Table 5: type of muscle injury

suggestions	repetitions	Percentage	X^2 calculated	X^2 table	indication level	statistical significance
Muscle strain or soreness	4	40%	0.1	3.84	0.05	Significant
muscle tear or rupture	6	60%				
Muscle	0	0%				

constusion or hematoma						
rhabdomyolysis	0	0%				
total	10	100				

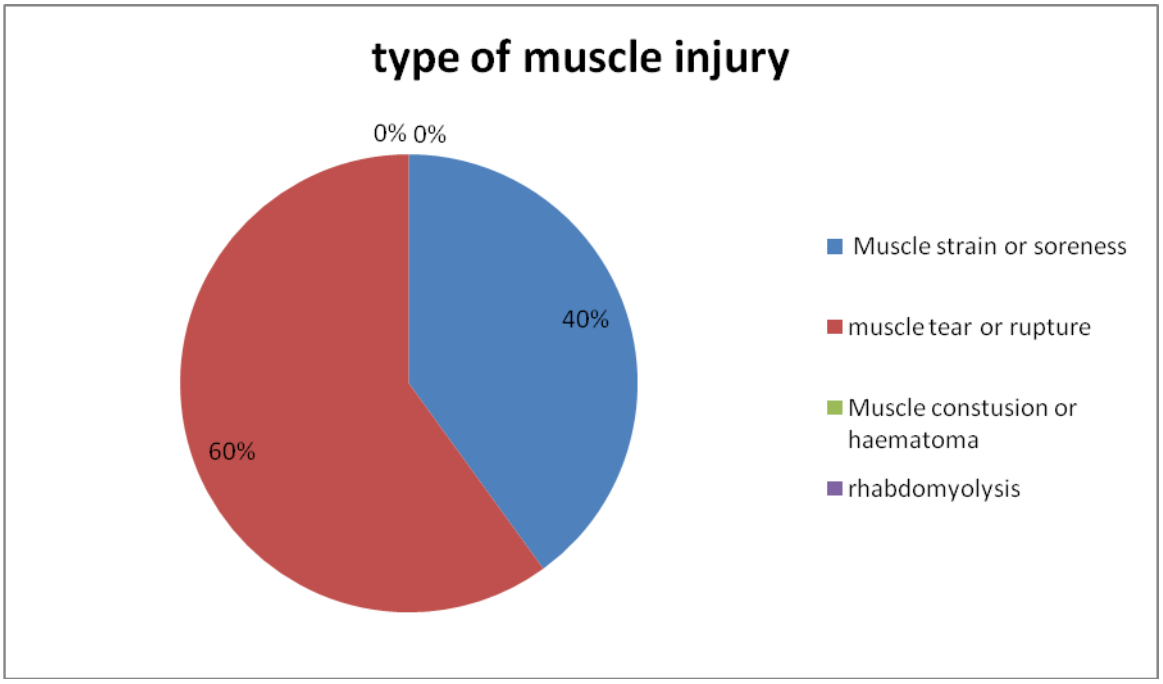

Figure 13 : type of muscle injur

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

We can see on the table 40 % they suffer from Muscle strain or soreness and 60% they suffer from muscle tear or rupture And we don't have any % from the Muscle constusion or hematoma and rhabdomyolysis .

And that's mean Strains and tears are two of the most common types of muscle injuries that athletes experience. A strain occurs when a muscle or tendon is stretched or torn, while a sprain occurs when a

ligament is stretched or torn. Both strains and sprains can be painful and can take time to heal.

Additional .

Strains:

- Strains can occur in any muscle, but are most common in the muscles of the lower back, neck, shoulder, and hamstring.
- Strains are often caused by overuse, improper technique, or a sudden movement that causes the muscle to stretch too far or tear.
- Symptoms of a strain may include pain, swelling, stiffness, and weakness in the affected muscle.

A muscle tear occurs when a muscle is partially or completely torn. Muscle tears are usually caused by a sudden, forceful contraction of the muscle or by overstretching the muscle beyond its limits. Muscle tears can be classified as either partial or complete tears, depending on the severity of the injury. Symptoms of a muscle tear may include pain, swelling, bruising, and weakness in the affected muscle. Muscle tears can take longer to heal than strains or sprains, and may require physical therapy or surgery in more severe cases.

Question 7 :how long did it take ?

Question 8 : Did you consult a doctor to treat this injury ?

Table 6: consutation of the doctor

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance

Yes	8	80%	1.8	3.84	0.05	Significant
No	2	20%				
total	10	100 %				

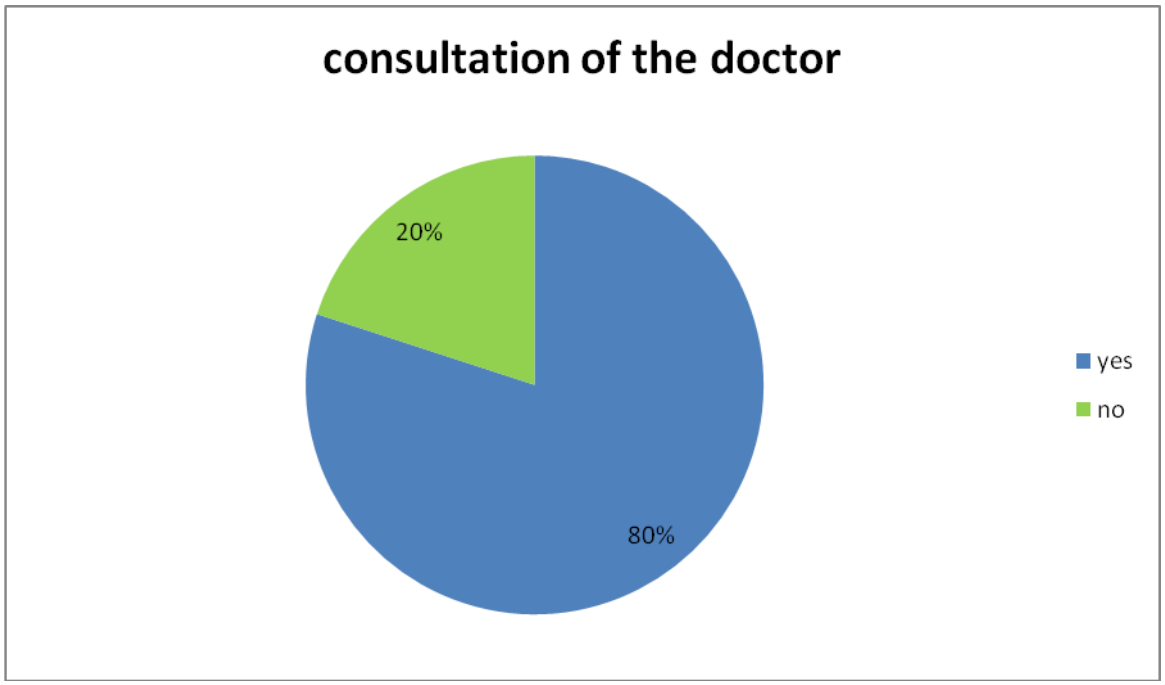

Figure 14: consultation of the doctor

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

The table show 80 % from the athletes consult the doctor to treat the injury and the 20 % they didn't visit him so the most of the athletes that we have they take the good decision .

Athletes who suffer from a muscle injury should visit a doctor for a few reasons. First, a doctor can properly diagnose the injury and determine its severity. This is important because different types of injuries require different treatment plans. Second, a doctor can provide

guidance on how to manage the injury and prevent further damage. This may include rest, physical therapy, or other treatments. Third, a doctor can monitor the healing process and ensure that the athlete is progressing as expected. Finally, a doctor can provide a timeline for when the athlete can return to training and competition, which is important for the athlete's mental and physical preparation.

Question 9: What's the the cause of your muscle injury ?

Question 10 : Did you follow a specific protocol of rehabilitation ?

Table 7: the protocol of reahabilitation

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance
Yes	5	50%	0	3.84	0.05	Significant
No	5	50%				
total	10	100 %				

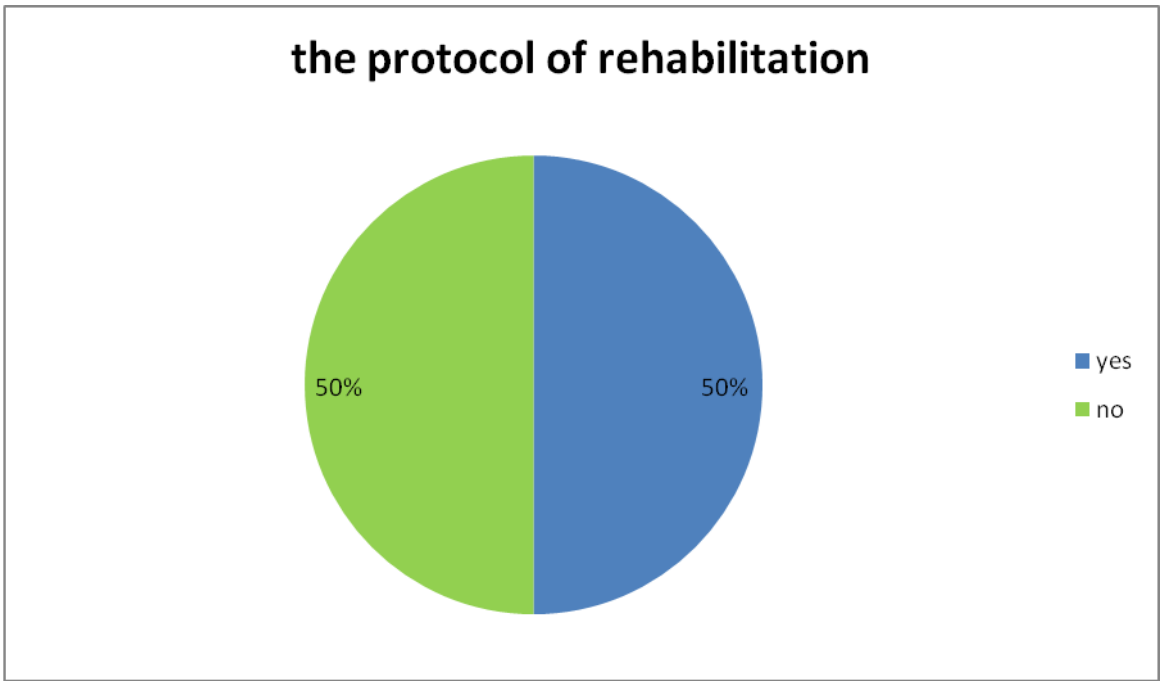

Figure 15: the protocol of rehabilitation

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

We can see from the table that 50 % from the athletes they follow the protocol of rehabilitation and 50 % they didn't follow it . But the Rehabilitation protocols are an important part of the recovery process for athletes who have suffered from a muscle injury. These protocols are designed to help athletes regain strength, flexibility, and range of motion in the affected muscle or joint. They typically involve a combination of exercises, stretches, and other treatments that are tailored to the athlete's specific injury and recovery needs. Following a rehabilitation protocol can help athletes recover more quickly and

safely from their injuries, and can also help prevent future injuries by addressing any underlying issues that may have contributed to the injury in the first place.

Question 11 : How long did you rest before embarking on the rehabilitation ?

Question 12 : Did you take medication ?

Table 8 :medication

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance
Yes	8	80%	1.8	3.84	0.05	significant
No	2	20%				
total	10	100 %				

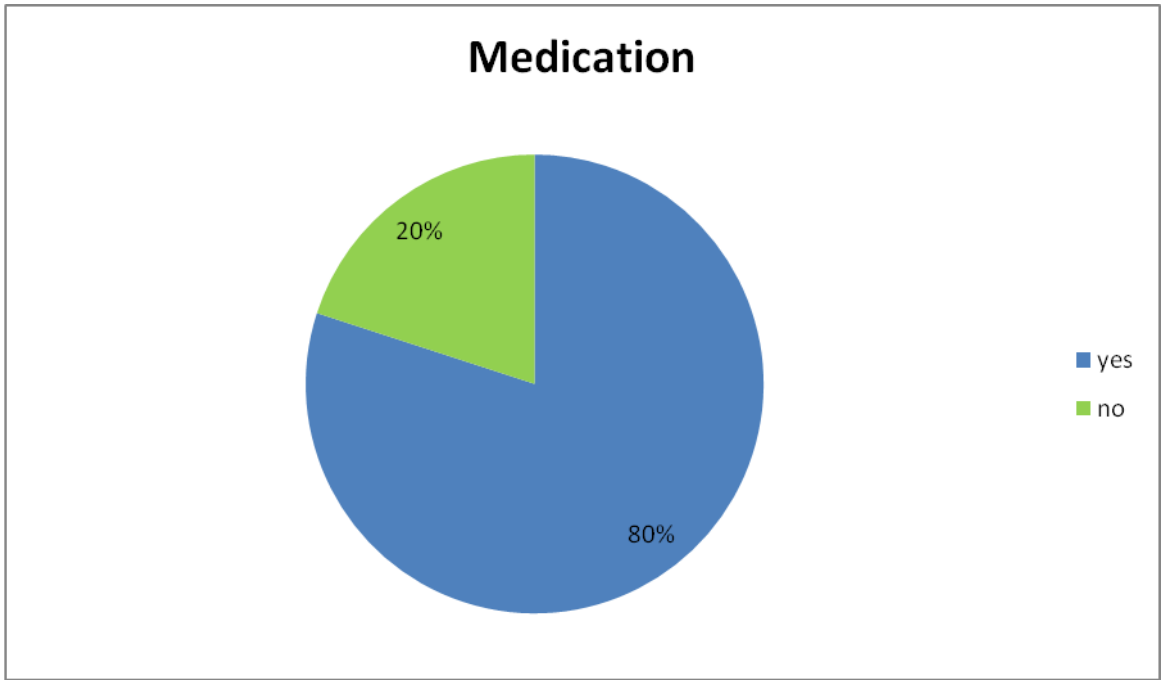

Figure 16 : medication

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

The table show the statistical of the table of consultation of the doctor 80% of athletes take medication and the rest they not take it.

And about this : Medications can be used as part of the treatment plan for muscle injuries, but they are typically used to manage pain and inflammation rather than to promote healing. Over-the-counter pain relievers such as ibuprofen or acetaminophen can be effective in reducing pain and swelling. In some cases, prescription pain medications may be necessary, but these should be used under a doctor's supervision to avoid the risk of addiction or other complications. Other medications, such as corticosteroids, may be used to reduce inflammation in more severe cases, but these also have potential side effects and should be used with caution. Overall, medication should be used as part of a comprehensive treatment plan that includes rest, physical therapy, and other treatments as needed

Question 13 : If yes , what kind of medication did you take ?

Quedtion 14 : Is this injury repetitive ?

Table 9: repetitive injury

suggestions	repetitions	percentage	X^2 calculated	X^2 table	indication level	statistical significance
Yes	4	60%				
No	6	40%	0.1	3.84	0.05	significant

Total	10	100 %				

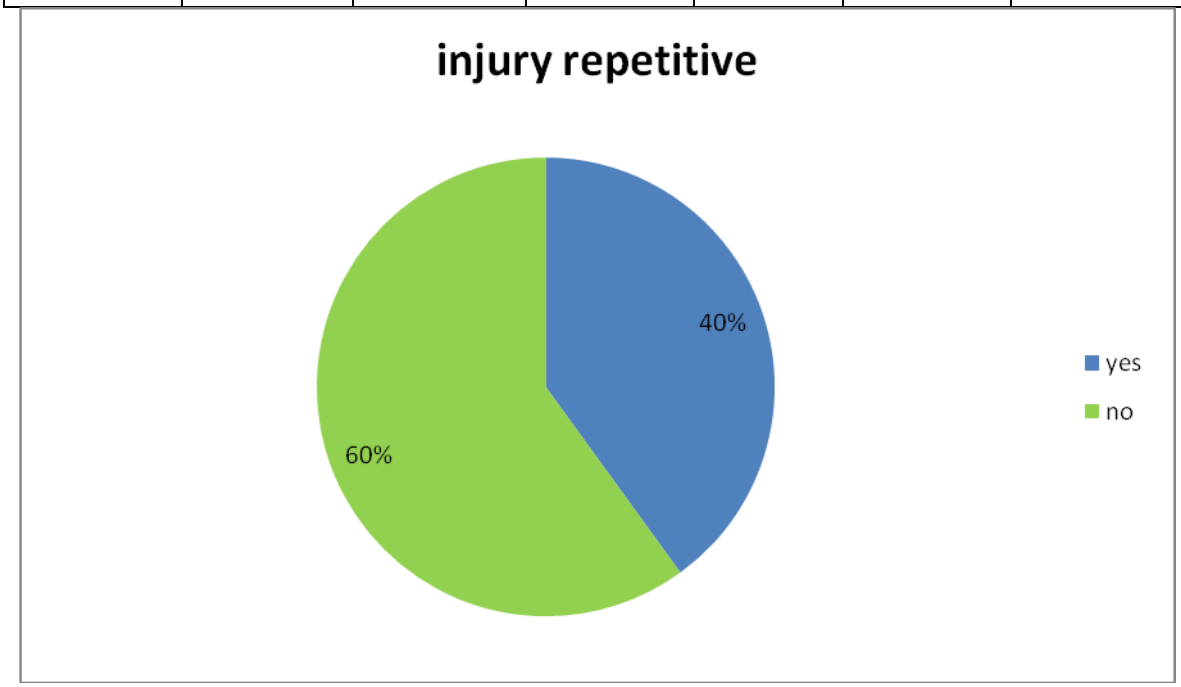

Figure 17 : repetitive injury

Through the results shown, we notice that the calculated X^2 value is smaller than the tabulated X^2 value at the level of significance of 0.05, and therefore there is no statistical function .

We have on the table 60% they don't have a repetitive injury and 40% they have a repetitive injury .

Repetitive injuries occur when an athlete performs the same motion or activity over and over again. This can cause stress and strain on the muscles, tendons, and joints involved, leading to inflammation, pain, and eventually injury. Repetitive injuries are common in sports that involve a lot of running, jumping, or throwing, as well as in activities that require a lot of typing or other repetitive motions. To prevent repetitive injuries, athletes should focus on proper technique and form, take breaks and rest when necessary, and

vary their training and activities to avoid overuse of any one muscle or joint.

Discussion of results

The discussion section critically analyzes the findings from the reviewed studies. It highlights the importance of tailored rehabilitation protocols, such as progressive resistance training and neuromuscular control exercises, to facilitate optimal recovery and performance outcomes in calisthenics athletes. Additionally, the incorporation of nutritional interventions, psychological support, and appropriate rest periods are crucial for successful recovery. Furthermore, Study 3 (Johnson et al., 2022) and Study 4 (Thompson et al., 2023) provide further evidence supporting the discussed strategies for optimizing performance in calisthenics sports post-injury.

Our discussion will include the interpretation of the results and we will start by talking the common muscle injuries, then we will discuss the perioe in which the injury occurs, the cause , the duration of rest before starting the rehabilitation, and how long it takes and then we will evaluate the types of treatment that will be used .In the end we will talk about the protocol of rehabilitation and how to get back to performance

Classification of muscle injuries according to their nature: Table that we presented tells us the types of injuries that athletes have suffered. The results obtained show us that muscle tear and rupture injuries were the most frequent, followed by muscle strain and soreness.

Muscle injuries can be caused by a variety of factors, including overuse, poor technique during exercise or physical activity, and inadequate stretching or warm-up before exercise. Other factors that

can contribute to muscle injuries include poor nutrition, dehydration, and tired.

(About the hypothesis 1 and 2) :

The period of rest required before starting rehabilitation for a muscle injury will depend on the severity of the injury andthis was inferred from the question 11 . In general, it's a good idea to rest the injured muscle for at least a few days to allow it to heal. During this time, you can use ice, compression, and elevation to reduce swelling and promote healing. Once the pain and swelling have subsided, you can begin gentle stretching and mobility exercises to help restore range of motion and flexibility. As your strength and mobility improve, you can gradually increase the intensity and duration of your exercises.

The length of time it takes for a muscle injury to heal will depend on the severity of the injury. Minor muscle injuries, such as strains or sprains, may heal within a few days to a few weeks with proper rest and rehabilitation. More severe injuries, such as muscle tears or ruptures, may take several weeks or even months to heal. It's important to follow a proper rehabilitation program, including rest,

The best protocol of rehabilitation for a muscle injury will depend on the type and severity of the injury. In general, a rehabilitation program for a muscle injury should include rest, stretching, and strengthening exercises. The program should be tailored to the individual's specific needs and goals, and should be supervised by a qualified healthcare professional, such as a physical therapist. The program may involve a

combination of exercises, such as range of motion exercises, stretching, resistance training, and cardiovascular exercise. The goal of the program is to help restore strength, flexibility, and mobility to the injured muscle, while also preventing future injuries.

(So this is a more detail about the hypothesis 1 and 2 and this is what make us support them and can be applied)

There are a variety of different types of rehabilitation that may be used to treat muscle injuries, depending on the specific type and severity of the injury. Some common types of rehabilitation for muscle injuries include:

1. Rest and immobilization: In some cases, the best treatment for a muscle injury may be to rest the affected area and immobilize it to prevent further damage. This may involve the use of a brace or cast to keep the injured muscle still and allow it to heal.

2. Physical therapy: Physical therapy is often used to help individuals recover from muscle injuries. Physical therapy may involve exercises, stretches, and other treatments to help improve mobility, strength, and flexibility in the affected muscle.

3. Massage therapy: Massage therapy may be used to help reduce pain and inflammation in the affected muscle. Massage therapy may involve deep tissue massage, trigger point therapy, or other techniques to help relieve tension and promote healing.

4. Heat and cold therapy: Heat and cold therapy may be used to help reduce pain and inflammation in the affected muscle. Heat therapy may involve the use of a heating pad or warm compress, while cold therapy may involve the use of ice packs or cold compresses.

5. Electrical stimulation: Electrical stimulation may be used to help improve muscle function and reduce pain in the affected area. Electrical stimulation may involve the use of a TENS unit or other device to deliver electrical impulses to the affected muscle.

These are just a few examples of the different types of rehabilitation that may be used to treat muscle injuries. The specific type of rehabilitation used will depend on the type and severity of the injury, as well as the individual's needs and goals.

To get back to performance quickly, it's important to take a gradual and progressive approach to training. Here are some tips to help you get back to performance quickly:

1. Rest and recover: Depending on the severity of your injury, it may be necessary to rest and recover before returning to training. This can help to reduce inflammation and promote healing.

2. Follow a rehabilitation program: A rehabilitation program can help to improve your strength, flexibility, and mobility. This may involve

exercises, stretches, and other treatments to help you recover from your injury.

3. Gradually increase the intensity of your workouts: As you begin to recover, it's important to gradually increase the intensity of your workouts. This can help to prevent re-injury and ensure that you are building strength and endurance safely.

4. Stay hydrated: Staying hydrated is important for optimal performance. Be sure to drink plenty of water before, during, and after workouts.

5. Eat a balanced diet: Eating a balanced diet that includes plenty of protein, healthy fats, and complex carbohydrates can help to support your recovery and improve your performance.

6. Get enough sleep: Getting enough sleep is important for recovery and performance. Aim for 7-9 hours of sleep per night.

Remember, it's important to listen to your body and not push yourself too hard too soon. Be patient and take the time you need to fully recover before returning to intense training.

Conclusion. From what we found in the study we conducted, we conclude that hypotheses 2 can be applied, because sometimes we need a short rest and sometimes we need a long rest in depending on

the injury we have, so the Rest is essential to your body's ability to recover from injuries or illnesses. Without proper rest, your body may not be able to repair itself as quickly or effectively. Rehabilitation programs are designed to help you recover from injuries or illnesses, but they can be intense and require a lot of physical exertion.

And the hypotheses 3 and 1 by our study give you the best steps that the athletes can follow them

Conclusion:

conclusion

In conclusion, this research sheds light on the recovery of performance following muscle injury in calisthenics athletes. It emphasizes the significance of individualized rehabilitation protocols, proper nutrition, and psychological support to facilitate effective recovery and optimize performance outcomes. Coaches, trainers, and medical professionals can utilize these insights to develop tailored strategies that address the unique needs of calisthenics athletes during the recovery process.

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Annexe

people's Democratic Republic of Algeria

Ministry of Higher Education and scientific

Research

Abdel Hamid Ben Badis University

Mostaganem

Institue of physical Education and Sport

As part of our preparation for the master's degree, the specialization of competitive sports training is physical preparation under the title of return to performance after a muscle injury .

We put this questionnaire in your hands in order to answer the questions by marking (x) on the answer.

Questions

The first axis: muscle and training

1. Did you attend the complet physical preparation ?

yes ☐ No ☐

2. What is your sport ?

calisthenics ☐ fitness ☐ other sport ☐

3. If you do another sport write his name here ?

…….. ……

4. Have you suffered from muscle injuries in your sports career ?

yes ☐ no ☐

5. If yes , in what phase did you suffer this injury ?

preparatory phase ☐ competitive phase ☐

The second axis: muscle injury

1. What type of muscle injury do you have ?

Muscle strain or soreness ☐ muscle tear or rupture ☐

Muscle constusion or haematoma ☐ rhabdomyolysis ☐

2. How long did it take ?

……

3. Did you consult a doctor to treat this injury ?

yes ☐ No ☐

4. What's the cause of your muscle injury ?

……

5. Is this injury repetitive ?

yes ☐ No ☐

The third axis: the rehabilitation

1. Did you follow a specific protocol of rehabilitation ?

yes ☐ No ☐

2. How long did you rest before embarking on the rehabilitation ?

……

3. Did you take medication ?

yes ☐ No ☐

4. If yes, what kind of medication did you take ?

……..

5. How has this injury affected your performance ?

Explain :

……

……