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# The effect of the hammam and sauna on accelerating the recovery process of young Algerian footballers

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**Abstract**

The Object of the study aims to identify the impact of the hammam and sauna on accelerating the recovery process in young Algerian footballers, for this purpose, we used an empirical method. On a sample composed of 47 U19 soccer players from RC Kouba, NA Hussein Day and ES Benaknoun Chosen non-randomly, and for data collection, we used a TQR questionnaire. After collecting the results and having treated them statistically, we conclude that there are significant differences. On this basis, the study recommended the use of the sauna as a means of recovery

## 1. Introduction

Muscle recovery is a key factor in performance. The world of sport has made considerable progress in the area of training load programming. However, recovery methods are often left to the athlete, and their regular absence in the training sequence gradually leads the athlete to overload, or even overtraining. (Hausswirth, Bieuzena, Barbiche, & Brisswalter, 2010) The training load is made up of exercice and recovery. The volume of exercise is determined by the intensity and duration of the effort. Recovery is defined by its duration and nature. It should be envisaged at two moments: between series of exercises, but also between blocks of training. In training elite athletes, the solicitations are daily or even several times a day, so it's important to optimize the time athletes have to recover, since the time between two training sessions or two competitions can be extremely short, it's easy to see why this recovery phase is an important factor in preserving physical capital and improving performance. Accelerated recovery increases the conditions for making the most of training, so it's possible to train harder and more often. What's more, in the context of training, the ability to recover is central to maintaining performance levels; neglecting or failing to carry out recovery actions correctly doubles the total recovery time, so any means of shortening the total recovery time is of paramount importance to a top-level athlete who works hard at his or her sport. (Kenta & Hassmen, 2003) All coaches want their players to recover quickly, because the sporting season is so long, so they use means to speed up recovery and allow the players to benefit from the overcompensation and adaptation process; to prevent overtraining and injuries; to erase the traumas and micro-traumas related to practice and obtain a competitive advantage. Coaches have a wide panel of recovery tools at their disposal, and the aim of these techniques is to improve athletes' recovery compared to so-called passive recovery, i.e. when the subject is left in a state of rest without the use of any techniques (Hausswirth C. , Recovery and performance in sport,

2014) There are several means of recovery, natural such as: sleep, nutrition, hydration, a healthy lifestyle ..., or physiological care: sauna, hammam, hydrotherapy, cryotherapy, massage ..., and psychological such as: relaxation, stretching ... Some of these means are expensive especially for lower levels and even for higher levels in finding Algerian clubs that experienced an economic crisis during this pandemic corona virus 2019. So in this study we are going to make a comparison between two means of recovery adapted for everyone with economic character, these means are: the hammam and the sauna. The hammam is probably one of the oldest relaxation methods in human history, the predecessors of many methods we know today. An example of this type of therapy is the sauna, which works in a similar way, using heat to achieve its goal of relaxing the person. (hydro massage web, 2024)The principal question is: what impact will these resources have on accelerating the recovery process for Algerian U19 footballers?

We suppose that the means of recovery we have used (sauna, hammam) have a positive impact on the recovery process in soccer.

We suppose that there is a differential effect between the means of recovery used to accelerate the recovery process.

## 2- objective of the study :

The objectives of this research are to identify existing recovery techniques and to demonstrate the benefits of recovery for performance. To provide useful scientific information on both theoretical and practical aspects of high-level modern sports practice. From a scientific point of view, we are trying to prove through our modest experimentation the impact of these means on recovery in soccer. However, from a practical point of view, we're going to try and implement a cost-effective method suitable for players, coaches and their medical staff.

About the studies we analyzed: The article published in 2014 by Dr. Douili Manssouria, without objective is to know the impact of sauna in the professional athlete. The researcher compiled and synthesized the results of several studies that h. (Mansouria, 2014) The article published in 2007 by Guy Scoon, William Hopkins, Simon Mayhew, James Cotter aimed to study the endurance performance of six long-distance runners after a period of adaptation to the sauna immediately after training sessions. They concluded that 3 weeks of post-exercise sauna improved endurance running performance, probably by increasing blood volume. (scoon, william, Simon, & James , 2007) The article published in 2019 by Sabrina Skorski, Jan Schimpchen, Mark Pfeiffer, Alexander Ferrauti, Michael Kellmann, and Tim Meyer. The aim of this article is to investigate the acute effects of sauna bathing after an intensive training session on the recovery of swimming performance, 20 competitive swimmers and triathletes (3 women and 17 men) participated in the study. The researchers found that the swimmers performed significantly worse after using the sauna. (Skorski, et al., 2020) The case study by Dylan Dahlquist, Brad Dieter, James Brotherhood and Michael Koehle that aimed to determine whether a post-exercise sauna bath could increase the performance of collegiate track and field athletes competing in temperate as well as hot and humid environments. Conclusions: Post-exercise sauna bathing could be a practical and rapid method of improving the performance of track and field athletes in 5 and 10 km events in temperate and hot conditions (Dahlquist, Brad , James, & Michael, 2023)

We have seen from these studies that many researchers have approached the study variables in particular the sauna with different samples but almost the same objective which is to find out whether these methods affect the recovery process and sports performance and with the exception of the third study (Skorski, et al., 2020), most studies have concluded that sauna improves athlete recovery and sports performance. Our study aims to determine whether the recovery methods we used (the hammam and sauna) have a positive effect on accelerating the recovery process in U19 soccer

players, and to differentiate between these two methods in order to provide coaches with an effective and economical means.

### 1.1. Literature Review

**The effort:** According to Jérémy Coquart (effort in the broadest sense of the term) is seen as a concept that includes a physiological dimension (physical effort) and a psychological dimension (mental effort). In other words, the practitioner (whether a child, a professional athlete or a patient) will make a mental effort by engaging in the task, and this engagement will lead to physiological adaptations (represented by physical effort). Effort therefore has a double dimension.

**the fatigue:** There are generally two theoretical approaches to the application of subjective fatigue mechanisms: peripheral fatigue and central fatigue. As we shall see, the distinction between these two types of fatigue is based on the origin of the loss of strength in relation to the neuromuscular junction (the region where a motor neuron makes contact with a muscle fibre). If the cause of the fatigue is considered to be downstream of the neuromuscular junction, the fatigue is said to be "peripheral" (also known as "muscle fatigue"). If, on the other hand, the cause of fatigue is considered to be upstream of the neuromuscular junction, we speak of "central fatigue" (or nervous). (Coquart, 2016)

Escurat Eymeric also mentions another type of fatigue, neuro-immun endocrine fatigue, and shows that a disturbance of the neuro-endocrine systems can be responsible for a disturbance of the central nervous system (CNS), and thus produce a state of fatigue, whether peripheral or central?

Indeed there is communication between the CNS and the neuroendocrine and immune systems, based on a neuroanatomical relationship (most lymphoid organs are innervated by the sympathetic nervous system), the presence of common receptors and mediators (hormones and cytokines and

their receptors), and the modulation of one system by the other", responsible for the decreased excitation of motor neurons, for example. (Escurat, 2016)

**Causes of reduced performance:**

As defined by Hausswirth, fatigue is "a state resulting from physiological and psychological constraints leading to a reduction in physical and/or mental performance". The fatigue experienced by athletes corresponds to an acute fatigue that appears relatively rapidly and disappears just as rapidly. This fatigue can be divided into the following three etiologies:

- Metabolic fatigue: At the metabolic level, three principal reactions play a role in diminished performance.
  - Acidosis: At physiological hydrogen potential (pH), lactic acid is transformed into lactate and hydrogen ions (H+). The accumulation of hydrogen ions leads to a drop in pH. This leads to inhibition of glycolysis.
  - Muscle micro-lesions: These are either of metabolic origin (activation of proteases and phospholipases and inadequate mitochondrial respiration) or of mechanical origin (eccentric exercise, microtraumatisms).
  - Inflammatory reaction: Inflammation increases temperature through the effect of interleukin-1 on the hypothalamus, and intramuscular pressure through the presence of edema.
- Muscle fatigue: Increased oxygen consumption during exercise leads to increased production of free radicals. These radical species are extremely reactive chemical elements. Their production leads to the oxidation of several cellular components, impairing normal cell function. At the mechanical level, the accumulation of eccentric exercise also causes disruption, leading to catabolism of certain myocellular elements. High-level sports activities therefore have the

consequence of damaging cellular structures through significant metabolic modification.

- Psychological fatigue: High-level competition puts pressure on the athlete, leading to stress. Stress is defined in sport psychology by MacGrath as: "a significant imbalance between a requirement and the ability to meet that requirement in situations where the doubt of being able to meet the existing requirement can lead to significant consequences". The different forms of stress are: psychic stress, social stress, physical stress, etc. (Jaili, 2014)

**Recovery techniques (thermotherapy):**

The use of heat for recovery purposes goes back a long way. The following are the most widespread of today's various modes of use:

**Sauna :** Performed in a cabin heated to between 80° and 90°C, with a humidity level of between 15 and 30%, the maximum exposure time is ten minutes, followed by a cold shower. This principle is repeated three times. Exposure to a hot thermal environment triggers cardiovascular, neuromuscular, hormonal, pulmonary and immune responses.

**Hammam :** Unlike a sauna, here the temperature does not exceed 45°C, with humidity saturation close to 100%. The session lasts between ten and twenty minutes and ends with a cold shower. This is said to have a positive effect on releasing muscular tension and overall body relaxation. Note the importance of staying hydrated when using the various techniques, in particular to compensate for water loss. (Oletchia, 2014)

## 2. Method and Materials :

### 2.1. Participants :

After presenting the project to the team managers of RC Kouba, NA Hussein Day and ES Ben Aknoun, 47 men's footballers in the U19 to take part in the study.

### 2.1. Materials, Design and Procedure :

After the most intense training session of the microcycle (the week's spike), we move directly to the use of recovery resources. We used Borg's scale of perceived exertion (RPE 6-20) to quantify the training load of the two training sessions preceding the use of recovery means, and the training load was ≥ 90% of maximum intensity in both sessions. To assess the state of recovery, a total quality of recovery (TQR) questionnaire was used and players were asked to answer 1h, 12h, 24h after the use of the recovery means. In the hammam, the temperature exceeds 50°C. The heat is saturated with 90% humidity, and in this atmosphere players must remain inside for 20 minutes. Unlike the hammam, the sauna provides very dry heat (between 3 and 20% humidity, depending on the upper or lower installation on the benches) and higher temperatures (between 80 and 100°C). Players must take a lukewarm to cold shower and dry off correctly, then enter in the cabin for 5 minutes, exit and take a second lukewarm to cold shower (activates blood circulation), commencing with the feet (never the head or neck). Wait 5 minutes, then re-enter the cabin. Repeat this operation (shower then sauna) 3 times.

### 2.2. Statistical Analysis

We used the T-Student Test to determine the nature of the differences between the results of the means used (hammam and sauna) as means of recovery to accelerate the recovery process as shown in Table N°1:

***Table 1: Results of the differences between recovery in the hammam and recovery in the sauna***

| | Hammam | sauna | T | Prob | Test S |
|---|---|---|---|---|---|

| | Arithmetic Mean | Standard Deviation | Arithmetic Mean | Standard Deviation | | | |
|---|---|---|---|---|---|---|---|
| **1h after** | 8,77 | 1,32 | 14,28 | 0,97 | 21,37 | 0.000 | significant |
| **12h after** | 11,51 | 0,88 | 15 | 1,02 | 14,13 | 0.000 | significant |
| **24h after** | 12,28 | 0,97 | 16,28 | 0,97 | 26,84 | 0.000 | significant |

To determine the nature of the differences in the hammam recovery method after 1h, 12h and 24h of use, a one-way ANOVA test was used, as shown in Table 2:

According to table n°2, the probability of the ANOVA test is 0.000 and is less than the error rate of 0.05, which indicates that there are statistically significant differences between the results of the hammam recovery method after 1h, 12h, 24h of use.

***Table 2: Results of differences in hammam recovery after 1h, 12h, 24h of use***

| | **Arithmetic Mean** | **Standard Deviation** | **value ANOVA** | **probability ANOVA (sig)** | **Statistical index** |
|---|---|---|---|---|---|
| **after 1h** | 8,77 | 1,32 | 138,5 | 0.000 | significant |
| **after 12h** | 11,51 | 0,88 | | | |
| **after 12h** | 12,28 | 0,97 | | | |

To determine the nature of these differences, the Tuckey test was used, as shown in Table 3:

***Table 3: Tukey test results after 1h, 12h, 24h of steam room use***

| | | **value test TUKEY** | **probability TYKEY (sig)** | **Statistical index** |
|---|---|---|---|---|
| **Hammam after 1h** | **Hammam after 12h** | -2,74 | 0,000 | significant |
| **Hammam after 1h** | **Hammam after 24h** | -3,51 | 0,000 | significant |
| **Hammam after 12h** | **Hammam after 24h** | -0,76 | 0,002 | significant |

According to Table 3, the Tukey probability of the recovery level of soccer players 1h and 12h after using the hammam is 0.000, indicating that there

are statistically significant differences in favor of the recovery level of 12 h after using the hammam. We also observed that the Tukey probability of the recovery level of soccer players 1 h and 24 h after using the hammam is 0.000, indicating that there are statistically significant differences in favor of the recovery level 24 h after using the hammam. The Tukey probability in the recovery level of soccer players 12 hours and 24 hours after using the hammam was estimated at 0.002, indicating that there are statistically significant differences in favor of the 24-hour recovery level after using the hammam. Comparing the arithmetic means of the recovery level 1h, 12h and 24h after using the hammam, we conclude that there are statistically significant differences in favor of the recovery level 24 h after using the hammam as its arithmetic mean value (12.28) is higher than the arithmetic mean value of 1h after use (8.77) and 12 hours after use (11.51). To determine the nature of the differences in the sauna recovery mean after 1h, 12h, 24h of use, a one-way ANOVA test was used as shown in the following table:

***Table 4: Results of differences in sauna recovery after 1h, 12h, 24h of use***

| | **Arithmetic Mean** | **Standard Deviation** | **value ANOVA** | **probability ANOVA (sig)** | **Statistical index** |
|---|---|---|---|---|---|
| **after 1h** | 14,28 | 0,97 | 49,34 | 0.000 | significant |
| **after12h** | 15 | 1,02 | | | |
| **after 24h** | 16,28 | 0,97 | | | |

According to Table 4, the probability of the ANOVA test is 0.000 and she is less than the error rate of 0.05, which indicates that there are statistically significant differences between the results of the hammam recovery method after 1h, 12h and 24h of use, and to determine the nature of these differences the Tuckey test was used as shown in Table 5.

According to table n°5, the Tukey probability of the soccer players' recovery level 1h and 12h after using the sauna is 0.002, indicating that there are statistically significant differences in favor of the recovery level 12 h after using the hammam.

***Table 5: Tukey test results after 1h, 12h, 24h of sauna use***

| | **value test TUKEY** | **probability TYKEY (sig)** | **Statistical index** |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **sauna after 1h** | **sauna after 12h** | -0,72 | 0,002 | significant |
| **sauna after 1h** | **sauna after 24h** | -2 | 0,000 | significant |
| **sauna after 12h** | **sauna after 24h** | -1,28 | 0,000 | significant |

We also observed that the Tukey probability of the level of recovery of soccer players from 1 h and 24 h after using the sauna is 0.000, indicating that there are statistically significant differences in favor of the level of recovery from 24 h after using the hammam. The Tukey probability of the recovery level of soccer players 12h and 24 hours after using the sauna was estimated at 0.000, indicating that there are statistically significant differences in favor of the 24h recovery level after using the sauna. By comparing the arithmetic means of the recovery level 1h, 12h and 24h after sauna use, we conclude that there are statistically significant differences in favor of the recovery level 24 h after sauna use, as its arithmetic mean value (16.28) is higher than the arithmetic mean value of 1h after use (14.28) and 12h after use (15). To determine the nature of the differences in sauna recovery means after 1h, 12h, 24h of use, a one-way ANOVA test was used as shown in the following table:

***Table 6: Results of differences between hammam and sauna recovery methods after 1h, 12h, 24h of use***

| | **Arithmetic Mean** | **Standard Deviation** | **value ANOVA** | **probability ANOVA (sig)** | **Statistical index** |
|---|---|---|---|---|---|
| **Hammam after 1h** | 8,77 | 1,32 | 326,37 | 0.000 | significant |
| **Hammam after 12h** | 11,51 | 0,88 | | | |
| **Hammam after 24h** | 12,28 | 0,97 | | | |
| **Sauna after 1h** | 14,28 | 0,97 | | | |
| **Sauna after 12h** | 15 | 1,02 | | | |
| **Sauna after 24h** | 16,28 | 0,97 | | | |

According to Table 6, the probability of the ANOVA test is 0.000 and is less than the error rate of 0.05, indicating that there are statistically

significant differences between the results of the hammam and sauna recovery methods after 1h, 12h and 24h of use. As seen above, the probability of the Tukey test of the level of recovery after 1h, 12h and 24h of use of the hammam and sauna recovery methods is less than the error rate of 0.05, which indicates that there are statistically significant differences in favor of the level of recovery 24 h after sauna use, because their arithmetic mean value is 16.28 is superior to the arithmetic mean values of the other samples.

## 3. Discussion and interpretation of results:

When it comes to the players' perception of their state of recovery, the sauna recovery method describes better sensations. The difference is marked in the three periods: after 1 hour in the hammam, the perceptions of the players were: "extremely poor recovery", "poor recovery", while in the sauna, the perceptions of the players were: "passable recovery", "good recovery". Perceptions of the hammam after 12 hours were: "poor recovery", "passable recovery", while on the sauna side: "passable recovery", "good recovery", even "very good recovery". The players' expressions after 24h of hammam use were: much more "passable recovery", but on the sauna side saw expressions of: "good recovery" and "very good recovery". The comparison between the two means tested in the three periods (1h, 12h, 24h) after use shows statistically significant differences as ($p<0.05$) in favor of the sauna.

The main results of this study indicate that using the sauna as a recovery tool to accelerate the recovery process and reduce fatigue levels after an intense training session exceeding 90% of maximum intensity is the most effective of the methods tested, while the hammam is slightly less effective. Exposing players to this type of training is necessary to improve their performance, but it can lead to almost complete exhaustion, and recovery may take several hours or days.

Sauna use is therefore widespread, and is said to help combat hypertension, anxiety and irritability, as well as reducing the incidence of colds, asthma

and other bronchoconstrictive diseases. Exposure to ambient temperatures higher than skin temperature stimulates all thermoregulatory pathways and mechanisms. This heat can be recovered by the body via radiation and convection. Changes in cardiovascular activity result, in particular, from peripheral vasodilation and the movement of blood towards the periphery, linked to the phenomenon of sweating. The physiological effects of sauna exposure may explain the sauna's effectiveness, as body temperature rises as a result of the increase in ambient temperature. This rise in body temperature induces physiological changes in the cardiovascular, pulmonary and neuromuscular systems, as well as in the inflammatory, hormonal and immune systems. It's also worth noting the benefits of the local warm/cold temperature contrast, which has been envisaged to enhance athletes' recovery through :

By stimulating blood flow to a specific territory, increasing blood lactate displacement, reducing inflammation and oedema, stimulating circulation, relieving muscle stiffness and pain, increasing range of motion, reducing muscle pain and delaying its onset. (Hausswirth, et al., 2013)

The superior effect of the sauna compared to the hammam can be explained in part by the nature of the two protocols: the heat of the hammam increases the temperature of superficial tissues, causing vasodilatation, an increase in cutaneous blood flow and a rise in heart rate. This increase in heart rate is thought to prolong the time required for full recovery. The sleep-inducing effect of the Hammam can be triggered by taking a hot bath after the Hammam training session. This bath offers a sensation of intense heat that plunges the body into a gentle, soothing lethargy. The sauna, on the other hand, reduces the permeability of vessels to immune cells via vasoconstriction, thus reducing oedema and the inflammation process, which in turn attenuates the perception of pain. In addition, a reduction in nerve activity would have a positive impact, significantly reducing the perception of fatigue after use.

## 4. Conclusion

Recovery is a key element in the performance of professional athletes. If recovery and regeneration are neglected in favour of a more concentrated training load, there is a risk of depleting energy reserves and rapidly diminishing performance capacity. (Weineck, 2005) if a athlete's recovery is effective, he will be able to devote more time and intensity to sport-specific training, and thus improve performance in competition. Nearly 60% of team sports athletes surveyed have already carried out a recovery session after competition and/or training sessions, whatever the level of competition. This indicates that most athletes recognize that recovery is an integral part of performance and training, and supports the hypothesis that most athletes carry out a recovery session. (Maiia, 2024)It is up to the coaches to put in place more successful means of recovery in order to guide this stage in the most professional and scientific way possible.

The use of the sauna as a means of recovery seems to be widely advocated after strength training or energy-intensive exercise, with the aim of improving recovery and sports performance. Several studies have concluded that sauna has a positive effect, but the study by (Skorski, et al., 2020) demonstrated that swimmers performed significantly worse after sauna use. We recall that the problem of this work was to find out which of the techniques between the hammam and the sauna is the most effective in accelerating the recovery process in U19 footballers from RC Kouba, NA Hussein Day and ES Ben Aknoun after an intense training session, and the results were in favor of the sauna. It would seem useful to carry out further studies with more clarity to clarify the effects of the sauna on recovery. Sauna use remains a useful practice that is more easily accessible to the greatest number of people.

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