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Recovery of cold-water immersion as a reduction of lactic acid levels in Persebaya under-19 football athlete's context review

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ABSTRACT

The application of sports science is currently continuing to develop, the results of research in the field of sports produce theories or ideas that can be applied directly in the world of sports, especially sports that focus on athlete performance, namely team sports. Recovery is an important factor in a sports team, to maintain the physical condition of athletes in their best performance. The aim of this research is to discuss the effect of using cold water immersion on lactic acid levels in the blood in soccer athletes and how to use it based on temperature, duration and depth of immersion. The research method used was context review, to determine the effect of CWI on reducing lactic acid levels in the blood in more depth. Inspired by previous research conducted on 22 Persebaya U-19 football athletes, by carrying out a simple CWI method using a barrel and using water temperature maintained at 10°C - 15°C with a duration of 2.40 minutes of soaking and 1.15 minutes of rest for 5 sets. To find out more about the effects of CWI, there are several research results and CWI methods that have been used to restore reduced levels of lactic acid in the blood, quoted from several articles and research results from national and international e-journals to discuss the physiological effects of using CWI on athletes after intensity training. tall. The result is that CWI can help speed up neuromuscular recovery, reduce pain in muscles. There are several other sports such as running, tennis, cycling, which use the CWI method for recovery, especially reducing lactic acid levels in the blood. As a recommendation, it is hoped that future research can use this tool. which is easier to measure the temperature of the soaking water so that the temperature remains constant as expected.
***Keywords**: Recovery, Cold Water Soaking, Lactic Acid*

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INTRODUCTION

Sports Science is a science that studies how physical activity and function can influence sports performance and vice versa. The application of sports science is currently continuing to develop, the results of research in the field of sports produce theories or ideas that can be applied directly in the world of sports, especially sports that focus on athlete performance, namely team sports. If sports science is explained, it will form 5 scientific branches within it, namely physiology, biomechanics, psychology, nutrition, sports medicine (Abidini, Zainal, & Sudarwati, 2012.). Sports Physiology then applies the concept of Exercise Physiology to improve sports performance and train athletes to the maximum. Thus, exercise physiology derives its principles from exercise physiology.

Football is a sport that requires a fitness component. Research conducted by (Sham,

2020) shows that the physical fitness components of body composition, flexibility, power, speed and agility, aerobic capacity, acceleration, and speed are important predictors of the ability to play soccer. The trend of physical components that are widely used are general physical components such as strength, flexibility, speed, endurance, and anthropometric conditions, especially arm length and leg length (Awang, 2021).

The sport of soccer in this modern era requires soccer athletes to be able to attack and defend, it could be said to be a sport that uses high intensity. Current football, especially the Premier League, such as the Manchester City team coached by Pep Guardiola, requires its athletes to have good physical condition. Remembering that the way of playing Premier League football is characterized by high intensity and good physical condition. Football today is played quickly and at a very high tempo. Throughout the match there will always be a shift in moments from attack to defence or from defence to attack. This is called a transition, the transition from defence to attack and from attack to defence takes place quickly (Bhtra, 2022), and this can make football player exhausted.

There are several sports recoveries that are commonly carried out, including passive recovery, active recovery such as walking after doing high intensity exercise, sports massage, and what is often used by football teams is Cold Water Immersion (CWI), which uses low temperature water immersion. Where one of the factors of fatigue is the buildup of lactic acid levels, from the several recoveries described previously, the CWI, which is most often used by football teams, especially football teams in Indonesia, has also used this method, but it is still not known with certainty the operational standards for using this method so that provide optimal effects on athletes, while competition must continue. If the effects of fatigue are not treated immediately, it is feared that it will cause more serious injuries.

By making fast transitions in the game, the Athlete's body will activate an energy system called ATP-PC. It is a ready-to-use energy system that is stored in the muscles and does not require oxygen to produce this energy. Football athletes will activate the ATP-PC system when sprinting or when making transitions that change from attack to defence or which are done very quickly, therefore the ATP-PC energy system will be used when we make fast movements such as reactions. If the ATP-PC energy in the muscles is used continuously, muscle fatigue will occur which in the end will result in the body producing a chemical compound in the blood called lactic acid (Junaidi, 2020).

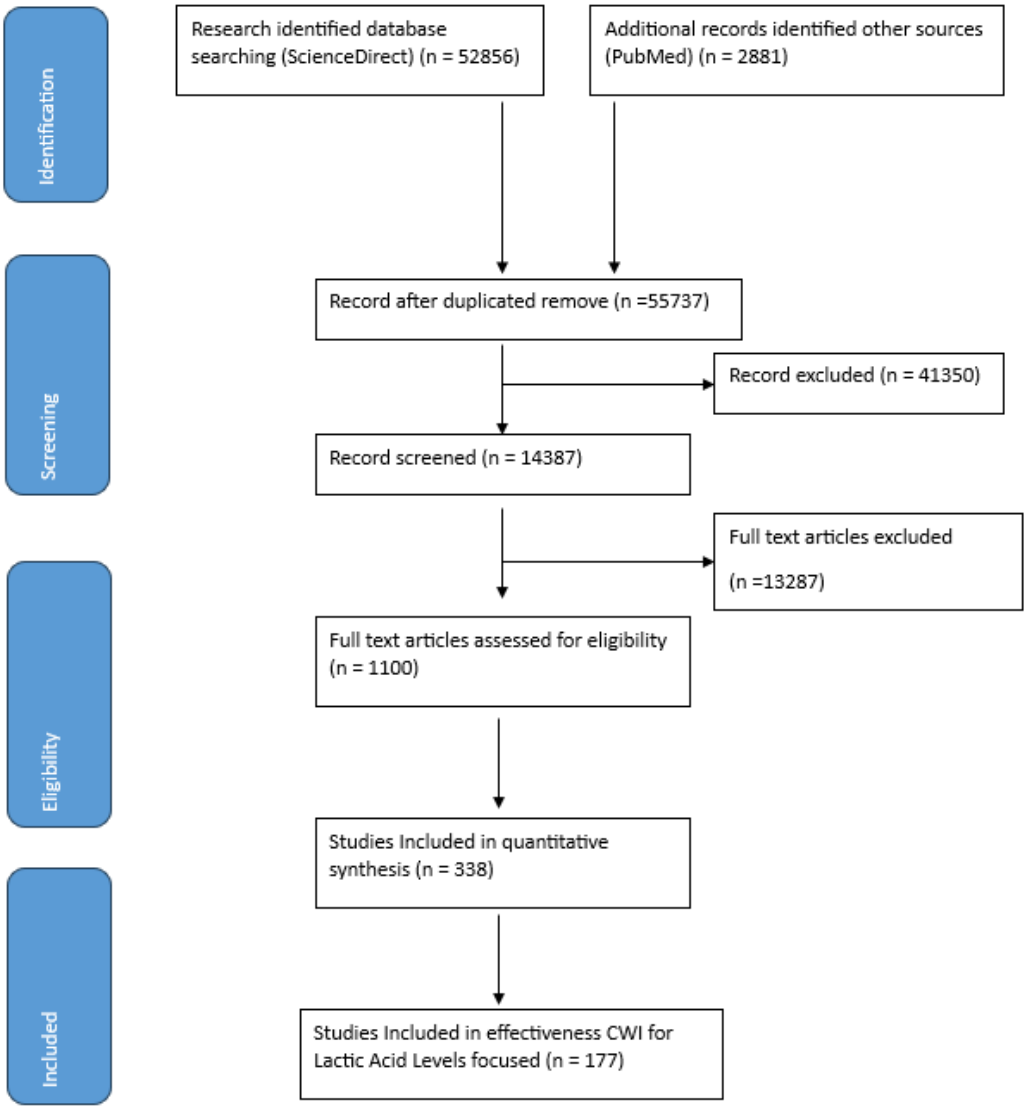
In football, the most popular recovery used is an ice bath, where you soak in ice water.

Cold Water Immersion is basically a hydrotherapy method used as recovery after exercise. The health effects of hydrotherapy generally appear as thermal, mechanical, and chemical effects, either alone or as a mixed effect An Jiyeon, Lee Insook, Y. Y. (2019). Many studies show that soaking in ice water can reduce lactic acid levels in the blood, cold water immersion. Water has been used in various forms of therapy and one of them is post-exercise ice water immersion therapy. After completing training, an ice bath at 12°C - 15°C appears to be common practice among many elite athletes. This exercise is believed to reduce muscle aches and pains after training sessions and competitions (Lateef Fatimah, 2010), the same thing was also stated by (Flauzino, 2015) that soaking in water temperature between 11°C - 15°C, and the best duration for soaking, which is between 10-15 minutes, shows that the recovery results are better than passive recovery.

METHODS

In this review, the context review method is used, which is a form of general review in literature study, where the author connects a particular study topic with a wider body of knowledge (Marzali, 2017). This research review examines the results of relevant research regarding the recovery of cold water immersion in reducing lactic acid levels and the effects on the body after carrying out sports activities, collected from various previous sports, quoted from several international journal websites by using PRISMA flow diagram for filters such as PubMed, ScienceDirect and several National Journal, by using the PRISMA flow diagram application a filter has been carried out to find research results that are relevant to research on the use of CWI to reduce lactic acid levels in the blood after exercise with similar research

found as many as n = 177.



Figur 1. PRISMA Flow Diagram filter relevant studies effect CWI for lactic acid levels after sport activity

In table 2 the researchers only took a few research results as a writing reference. articles, and You can see various results of previous research that analysed the use of cold-water immersion as recovery after football matches or other sports that use CWI as recovery after training or matches. The limitation of this research is that it only collects the results Previous relevant research used cold water immersion as a method of restoring reduced lactic acid levels and its effects on the body after carrying out sports activities, in athletes of various ages and different genders and operational standards that may vary.

RESULTS AND DISCUSSION

Results

Recovery is important in sports, especially in sports such as football where the risk of sports injury is very high, due to the high intensity of physical collisions between athletes. The relationship between recovery and fatigue and its impact on performance has interested sports science for many years. An adequate balance between stress (training and competition load, other life demands) and recovery is essential for athletes to achieve sustained high levels of performance (Kellmann Michael, 2018).

From previous research related to cold water immersion, active recovery, passive recovery, massage, we will compare these four remedies which are more effective in breaking down lactic acid levels. Decision making and action are systematic thoughts carried out by humans. In football competitions, a team can play twice a week, such as League 1 in Indonesia, not to mention the distance covered in away matches which can cause fatigue experienced by athletes, athletes are required to recover quickly in order to remain at their best performance during the competition. walk. Unfortunately, this is rarely considered and discussed within sports teams in Indonesia.

In research that has been done by (Utama, 2018) to Persebaya Surabaya U-19 youth football athletes, by providing rope jump training, after 2 recoveries will be given as a comparison of which recovery is more effective in reducing lactic acid, namely (CWI) cold water immersion recovery or (SM) sports massage, As a result, these two recovery methods can be used to reduce lactic acid levels in the blood after Rope Jump Exercise. In this article we will review several relevant studies regarding cold water immersion.

Table 1. Relevant Research Results

Reference	***Sample***	***Method***	***Analysis Result from Relevant Research***
(Bouchiba, 2022)	Football Player from Third Level Tunisian Football League n = 12 (age 22)	Twelve soccer players completed a 90-minute simulated soccer match followed by CWI or immersion in TWI thermoneutral water, each 10 min on 2°C temperature	This study suggests that CWI reduces both central and peripheral components of fatigue, which may ultimately lead to more rapid recovery of neuromuscular function and

Reference	*Sample*	*Method*	*Analysis Result from Relevant Research*
			performance indices. Therefore, CWI may be an attractive recovery strategy for soccer players
(Romadhona NF, 2019)	Table Tennis Athlete n = 30 (age 20-23)	The sample was divided into 3 groups of 8 people each, where group 1 was given sports massage as a recovery method, while group 2 was given a combination of cold water immersion with sports massage as a recovery method, and group 3 was given as a control group. CWI duration 15 min on temperature 15°C	Based on the research results, the reduction in blood lactic acid levels in the combination of CWI and the sports massage group was more significant than in the sports massage group.
(Miad Mokayef, 2014)	Table Tennis Athlete n = 30 (age 20-23)	Divided into three groups consisting of 10 people. All participants took the Bruce test as a training manipulation. Each group begins its own recovery for 15 minutes. In this study, we chose 12°C for cold water immersion recovery.	The CWI recovery method has a significant effect on reducing blood lactate compared to active and passive recovery and is a more effective method for reducing blood lactate levels after exercise.
(Kusuma, 2020)		Samples were categorized into experimental and control groups. Both	Cold water immersion using a water temperature of 5 degrees

Reference	***Sample***	***Method***	***Analysis Result from Relevant Research***
	Male Ahtlete PPLP n = 30, age unknown	groups performed weight training in the sub-maximal intensity training zone (3sets x 6reps x 85%-95% RM) with a rest period between sets of three minutes and rest sets of eight minutes. Samples perform half-squat, bench-press, power clean, leg press, leg curl, leg extension, pullover and lunges drills. 15-minute CWI 5°C in the experimental group, while the control group used the static stretching method for 15-minutes	(CWI5°C) for 15 minutes has a significant effect on reducing lactate levels, muscle pain and stress levels, while Static Stretching (SS) has a significant effect on increasing the flexibility of the lower back and hamstring muscles.
(Jj. Peiffer, 2010)	Male Cyclist n = 10 (Age 37)	10 male cyclists did two cycling training sessions at a constant speed of 254/22 Watt for 25 minutes, the cycling session was followed by a 4 Km time trial in weather conditions of 35°C with 40% humidity. Then both of them were divided into two recoveries, namely 15 minutes of sitting and the other group did cold water immersion for 5 minutes 14°C on 2 sessions.	Cold water immersion recovery can significantly reduce rectal temperature and maintain endurance performance during subsequent high-intensity exercise. These data indicate that repeated exercise performance in hot conditions can be improved when provided with short recovery cold water immersion during the recovery period. 5-min cold-water immersion recovery significantly

Reference	*Sample*	*Method*	*Analysis Result from Relevant Research*
			lowered rectal temperature and maintained endurance performance during subsequent high-intensity exercise. These data indicate that repeated exercise performance in heat may be improved when a short period of cold-water immersion is applied during the recovery period.

From the findings of previous relevant research results, there are several physiological effects that are obtained when using cold water immersion as a recovery method after exercise. In the table of findings, it can be concluded that the use of CWI can have several effects on the body, including reducing central and peripheral fatigue, reducing lactic acid levels in the body after training, reducing muscle pain and muscle stress, can reduce body temperature to prevent hyperthermia.

Discussion

In the results of research conducted by previous researchers, there were several CWI methods that were carried out as recovery after carrying out sports activities on several athlete subjects in different sports. On average, using the Cold-Water Immersion method with a time pattern ranging from 5 -15 minutes with air temperatures ranging from 10 - 15°C, with athletes in different sports as subjects, the use of CWI is said to help reduce lactic acid levels in the blood which can helps reduce fatigue after sports activities. It was also found that giving CWI combined with Sport Massage provided a significant reduction compared to active and passive recovery. In the discussion below we will explain the factors that influence why CWI can accelerate the reduction in lactic acid levels which are influenced by air hydrostatic pressure and icy air temperature.

In simple terms, the CWI method uses hydrostatic pressure from water, where this

pressure can help put pressure on the body in the hope that it can help speed up the flow process in the blood vessels, so that it can help improve blood flow, so that it can return to normal. The use of ice cubes has been widely explained in previous research, the use of ice cubes according to (Wang, Zhi Ru, 2021) explains that in general ice is used to reduce inflammatory reactions to trauma, reduce edema, reduce hematoma, and pain, reduces muscle spasms, reduces tissue metabolism, and reduces enzyme activity. Minor injuries that are often experienced by soccer athletes are swelling in the foot that is affected by the impact, for example the ankle and knee which causes limited movement due to swelling in the injured area of the foot. CWI can reduce edema, pain, and metabolite accumulation by lowering body temperature and regulating central nervous system mechanisms (Feiyan, 2023).

The Cold-Water Immersion method simply uses the physical properties of air in the form of buoyancy, viscosity, and hydrostatic pressure. Buoyancy will have the effect of becoming lighter body weight when entering the water. Viscosity is the property of air viscosity. Hydrostatic pressure is the effect of pressure on the body, the deeper the body is submerged, the greatest pressure occurs on the lower extremities, and the higher it rises, the lower the pressure, the higher the pressure on the lower extremities, with the hope that it can help speed up the flow process in the blood vessels, the goal is so that lactic acid levels in the lower extremities will be helped to rise to the liver to be reprocessed as energy to reduce lactic acid levels (Al, 2006).

Lactic acid is a compound that is produced in the body when the body is no longer able to supply oxygen to the blood, therefore the body uses the next energy system, namely the ATP-PCR energy system which is the final energy, as a result of using this system the body will automatically produce lactic acid (Junaidi, 2020). Lactic acid forms and accumulates in muscles under conditions of high energy requirements, rapid fluctuations in energy requirements, and insufficient O2 supply. During prolonged intense exercise to the point of exhaustion, muscle pH decreases to around 6.4-6.6. The accumulation of increased levels of lactic acid can cause central and peripheral fatigue. Central fatigue is defined as a lack of motor cortical output drive that weakens performance or can even stop exercise activities, thereby affecting inhibitory and excitatory processes recent research shows that central fatigue comes from the brain (Adam, 2015), which signals to the body that performance is decreasing when exercising due to muscle fatigue.

Delayed onset muscle soreness (DOMS) is pain or discomfort that usually occurs 1-2 days after eccentric loading of skeletal muscles and other unusual movements In research

conducted (Feiyan, 2023), it showed that the results of giving CWI after exercise had the effect of drastically reducing DOMS in the first 0 hours and returned to normal in the following 24 hours and 48 hours.

In fact, lactic acid is a waste/product of the anaerobic energy system, if the oxygen supply needed by the body is insufficient, while the body is forced to continue doing activities/exercising and in the end lactic acid is formed, this accumulation of lactic acid in the muscles will have a tired effect on the muscles. So that the muscles cannot contract or be used optimally. Basically, the body can reprocess the buildup of lactic acid levels in the muscles to be used again as energy. During aerobic exercise, lactic acid that accumulates in the muscles will be taken to the liver to be converted into glucose and reused as energy, this cycle is called the Cori cycle (Junaidi, 2020).

So basically, using the ice water method (Cold Water Immersion) as a very good recovery method to help biochemical processes in the body to speed up recovery due to the buildup of lactic acid in the muscles, adding cold water temperature can help reduce the process of edema, pain and DOMS. In practice in the field, appropriate operational standards are needed so that recovery using the CWI method can produce results, such as using the CWI recovery method with a time of between 5-15 minutes with a water temperature of between 10-15°C.

CONCLUSION

Analysis of several relevant studies and theories obtained from online article publications or e-books, indeed shows that there is an acceleration of recovery if using ice water immersion or other modalities such as massage and warm water immersion which can speed up recovery or maintain recovery. endurance performance during exercise. with high intensity, even with hot weather. It is hoped that the recovery method by immersion, especially using ice water or cold-water immersion, can be applied to football athletes in Indonesia, especially Surabaya, which has quite hot weather or temperatures. The recommendation for teams or athletes who want to do this method is to use the appropriate temperature by measuring their body temperature, so that recovery can be maximized, and pay attention to the soaking time, because this method is said to be very easy to do. performed by the football team or performed independently by the athlete to support recovery. during soccer practice or matches.

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