Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
June 2024 5(6), 2688–2696

EFFECTS OF FOAM ROLLING AND COLD-WATER IMMERSION ON SELECTED PHYSIOLOGICAL COMPONENTS

Riya [1], Dinanath Nawathe [2]

[1] Research Scholars, Degree College of Physical Education, Amravati, Maharashtra, India
[2] Degree College of Physical Education, Amravati, Maharashtra, India

ABSTRACT

The purpose of the study was to find out the effects of foam rolling and cold-water immersion (CWI) recovery method on selected physiological condition after matches among badminton players. A total 30 subjects were purposely selected from the Degree College of Physical Education Amravati and were divided into 3 groups of 10 subjects each. The study was delimited to male players only age ranged 18 to 25 years. The selected dependent variables for the study were Lactic Acid, Heart rate and Breathing rate. Foam roller and CWI were taken as independent variables. The reading of Lactic acid, Heart rate and Breathing rate were measured and recorded accordingly after match and after Recovery method. The subjects performed different recovery method on different days. The data for selected physiological variables were collected pre and post recovery methods. Capillary blood samples were taken for lactic acid, breathing rate and heart rate were measured manually. The data was analyzed through two-way mixed ANOVA at 0.05 level of significance. The study overall concludes that foam rolling recovery modality can be preferred in place of cold-water therapy for recovery process. The major physiological change i.e. lower lactic acid allows a shuttler to recover faster and get ready for another match in the same day. As the rough surface of the roller apply specific pressure at specific muscle which allows the proper blood flow at that particular area further it removes all the edema which occur at the time of playing, it increases inflammatory responses. By observing the result of the study one can say that the shuttlers can prefer to do foam rolling at the time of recovery.

Keywords: Foam Rolling, Cold Water Immersion, Recovery Method, Lactic Acid

Corresponding Author

Riya, singhriya1309@gmail.com

DOI
10.29121/shodhkosh.v5.i6.2024.3304

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

1. INTRODUCTION

Excessive loads during training and competition can cause acute physiological fatigue, from which recovery is necessary to maximize athletic performance. Because of this, a variety of techniques are frequently used to quicken the healing process after training or exercise in an effort to maximize the benefits of recovery for future performance (Mujika, 2018).

The desire to provide peak physical and physiological performance during competition necessitates preparation involving intense and stressful training. Adaptations to heavy workloads are dependent upon the athlete's physical and

emotional ability to cope up with increase work volume and intensities. Successful completion of long and intensive athletic training for achieving top performance depends largely on the extent to which the athlete can regenerate his/her physical and mental strength after training. Regeneration is a bio chemical process, fostered by athlete for regaining strength and preventing injury. Poor regeneration for athlete leads to overtraining.

The aim of recovery is to improve the general, physical, psychological condition of the athlete and providing regular and intermediate relief from fatigue. The most important goal is recovery of the entire organism, especially the nervous system (Kautedakis and Sharp, 1999. Biochemically athletes who are relaxed have more control on their movement thus they are able to maintain optimal performance (Knox et a1. 1986). Recovery is a proactive self-initiated process to re-establish psychological and physiological resources. Active recovery such as muscle relaxation and stretching are known as cool-down activities after practice and competition. The purpose of those exercises is to eliminate the results of fatigue through aimed physical activity. During cool-down, an increased blood circulations in the muscles results in a high state of metabolism; lactic acid does not have a chance to build up in the muscles, and the blood gases can more quickly sink to a normal level. Light exercise is superior to rest during recovery period because a faster rate of blood flow is maintained. Thus, more lactic acid can be removed from muscle in less time. At lower levels of effort, including complete rest, the rate of removal is slower. If the effort is too high, however, additional lactic acid will be produced (Maglischo, 1993). There has been an increase in the use of modalities such as massage, floatation, hyperbaric oxygenation therapy and acupuncture with little scientific evaluation of its use and effectiveness for exercise recovery. Alternating hot-cold water immersion is one technique that is very popular and is practiced with increased frequency in aiding recovery after physical training and competition (Calder, 2001). Anecdotal reports from coaches, medical personnel and athletes suggest that this method of water immersion has positive effects on subsequent performance. Foam rolling can help with separating these muscle hitches, continuing ordinary blood stream and work. Rollers are the most prominent system for self-myofascial discharge, or SMR, and are picking up fame among first class competitors of all strolls on account of the intense and normally quick effect it has on their execution and general wellbeing. The Foam roller, as conventional extending, is an extraordinary device for stretching and lengthening muscles, yet its advantages are particularly useful for runners, who frequently experience the ill effects of tight and exhausted muscles.

Therefore, the objective of the study is to find out the recovery of badminton players after Foam Roller and Cold-Water Immersion recovery method by assessing the selected physiological changes (Lactic acid, Heartrate, Breathing rate).

2. METHODOLOGY

Subjects

For this study 30 male badminton players were purposely selected as subjects from Degree College of Physical Education, Amravati who have representing Inter Collegiate Level. The selected players were divided into 3 groups of 10 subjects each.

Group-A: Foam Roller Recovery Method

Group- B: Cold-Water Immersion Recovery Method

Group- C: Control Group

Test Administration

1) Blood lactic acid test

Subjects were told to sit on deck of the pool immediately after the schedule; a fresh new strip was placed in the lactic acid analyzer. A small capillary blood sample was taken from either 3rd or 4th finger of the non-dominant hand. The finger was wiped clean with an alcohol (Dettol) followed by wipe dry with cotton and then a needle was ingested in the finger and the first drop of the blood drawn was wiped clean with cotton. As the blood again came out, the tester placed the lactic acid analyzer with the lactate strip over the blood and measured the blood lactate. The measurement displayed over the analyzer were recorded.

2) Heart rate

The researcher had taken the heart rate from carotid artery of the subjects. By placing three fingers over the carotid artery the heart rate of 6 second counted and then it is multiplied with 10 and final reading had been recorded.

3) Breathing rate

The breathing rate had been taken by allowing to subject to lie on the deck of the pool and through up and down movement of stomach allows the researcher to count the breath done by subject in one minute.

4) Treatment Procedure

The age of the subjects was ranged from 18 to 25 years. First of all, the subjects get introduced about the whole study and the procedure which we were supposed to follow. On day 1 subjects were allowed to play singles match and it was ensured that match must be played between two equivalent players. The intensity of match was moderate to high. Pre and post-match data of lactic acid, heart rate and breathing rate was collected. Just after the match BR and HR were collected by the researcher and after an interval of 2 min the lactic acid data collection was done. Then Foam Rolling Recovery method were implemented on shuttlers Group A. The Bumpy foam rollers were used by the shuttlers and implemented specially in lower body muscles. After a 20 min foam rolling recovery the data of same physiological variables were collected implementing the same schedule which was followed after the match.

On day 2 the second shift data collection process was followed on group B. This time the shuttlers were given Cold Water Immersion method taking all the environmental condition same as day 1 the pre and post-match data of lactic acid, heart rate and breathing rate were collected. The water temperature was maintained between 14-15o C. the subjects were allowed to submerge in water at least minimum of 10 min and max 20 min after this duration their 3 readings were taken. Group C followed the same process till the match but at time of giving recovery they were supposed to sit at a place without doing any type of stretch and all. Rest all the condition applied over the group C were same as group A and B.

5) Statistical Analysis

The descriptive statistics was applied to know about the nature of the data and for further analysis of group variation 2-way mixed ANOVA was applied.

3. RESULTS AND DISCUSSION

TEMPERATURE

Table 1 Descriptive Statistics of Temperature

Recovery modality	N	Mean temp 1	Std. Dev	Mean Temp 2	Std. Dev	Mean temp 3	Std. Dev
foam rolling	10	97.36	.89094	99.29	1.14450	96.59	1.41849
cold water immersion	10	97.34	.70742	99.74	1.04690	94.63	.71344
control group	10	97.36	.89094	98.13	.90437	95.79	1.48881

Table 2 Tests of Between-Subjects Effects

Measure: TEMPERATURE					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	853087.792	1	853087.792	461686.195	.000
Recovery modality	7.075*	2	3.537	1.914	.167
Error	49.890	27	1.848		

* The mean difference is seen at 0.05 level of significance

Graph 1: Mean plot graph of temperature

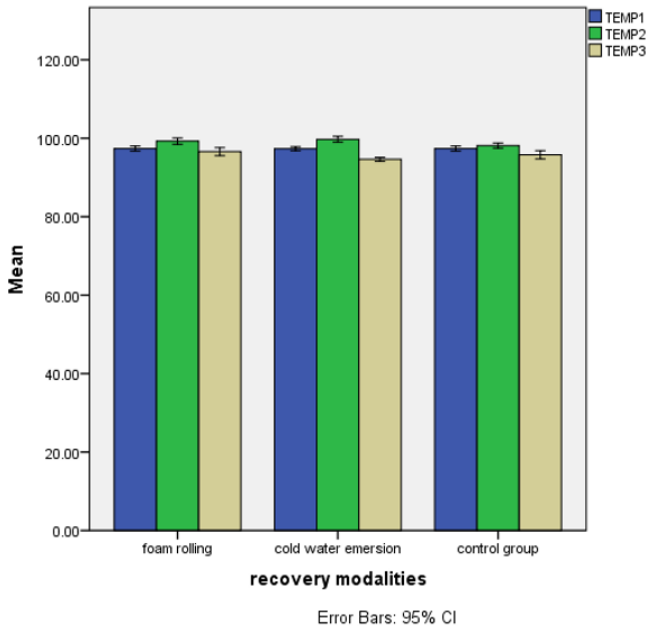

Table 3 Tests of Within-Subjects Effects

Measure: TEMPERATURE						
Source		**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Time	**Sphericity Assumed**	171.706*	2	85.853	114.314	.000
Time * Recovery modality	**Sphericity Assumed**	26.152*	4	6.538	8.706	.000

* The mean difference is seen at 0.05 level of significance

It is clear from the statistics of within subject effect (Table 3) that mean differences are significant at 0.05 level of significance it refers to that there is significant difference between temp2 and temp 3 of all the three groups. If comparing the difference between 3 group means (between subject effect (>0.05) Table 2), then the results are not significant at this level which means no specific recovery modality plays an important role in cooling down body temperature. As the mean difference is not significant at between subject effect hence no further pair wise comparison will be done

4. HEART RATE

Table 4: Descriptive Statistics of Heart Rate

Recovery modality	N	Mean temp 1	Std. Dev	Mean Temp 2	Std. Dev	Mean temp 3	Std. Dev
Foam rolling	10	70.50	11.6547	141.00	27.3658	95.80	7.5836
Cold water immersion	10	67.00	11.5950	144.60	25.5046	132.60	16.5274
Control group	10	73.00	15.6702	147.50	23.9083	78.40	3.9214

Graph 2: Mean plot graph of heart rate

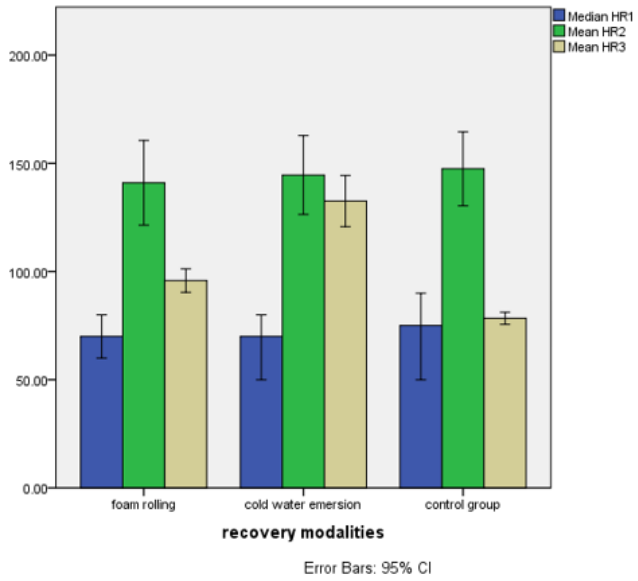

Table 5: Tests of Within-Subjects Effects

Measure: HEART RATE						
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Time	**Sphericity Assumed**	83084.600	2	41542.300	162.687	.000
Time * recovery modality	**Sphericity Assumed**	11837.800	4	2959.450	11.590	.000
Error (Time)	**Sphericity Assumed**	13788.933	54	255.351		

The mean difference is significant at the .05 level

Table 6 Tests of Between-Subjects Effects

Measure: HEART RATE					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	1003622.400	1	1003622.400	2314.693	.000
Recovery modality	3871.400	2	1935.700	4.464	.021
Error	11706.867	27	433.588		

The mean difference is significant at the .05 level

Table 6 Pairwise Comparisons

Measure: HEART RATE						
(I) recovery modality	**(J) recovery modality**	**Mean Difference (I-J)**	**Std. Error**	**Sig.[b]**	**95% Confidence Interval for Difference[b]**	
					Lower Bound	**Upper Bound**
foam rolling	**cold water immersion**	-12.300	5.376	.091	-26.023	1.423
	control group	2.800	5.376	1.000	-10.923	16.523
cold water immersion	**foam rolling**	12.300	5.376	.091	-1.423	26.023
	control group	15.100*	5.376	.027	1.377	28.823
control group	**foam rolling**	-2.800	5.376	1.000	-16.523	10.923
	cold water immersion	-15.100*	5.376	.027	-28.823	-1.377
Based on estimated marginal means						
***. The mean difference is significant at the .05 level.**						

b. Adjustment for multiple comparisons: Bonferroni.

It is evident from the above-mentioned table that results are significant at 0.05 level of significance when compared between the three recovery modalities then cold-water immersion groups shows significant difference with the control group.

5. LACTIC ACID

Table 7 Descriptive Statistics of Lactic Acid

Recovery modality		N	Mean LAC 1	Std. Dev	Mean LAC 2	Std. Dev	Mean LAC 3	Std. Dev
Foam rolling		10	3.9700	1.04780	12.6400	2.27704	3.4800	1.60955
Cold water immersion		10	4.2400	1.13940	12.9100	1.33787	6.0500	.69162
Control group		10	3.5000	.89194	12.0640	1.39079	7.6300	1.28932

Graph 2D Mean plot graph of lactic acid

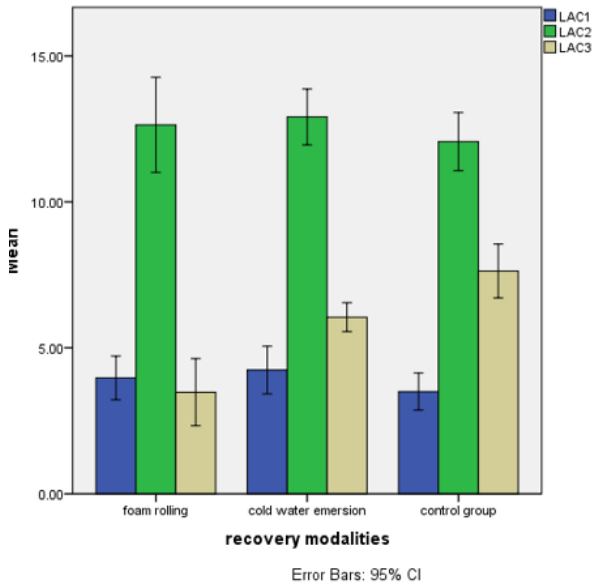

Table 8 Tests of Within-Subjects Effects

Measure: LACTIC ACID						
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Time	**Sphericity Assumed**	1243.429	2	621.714	316.033	.000
Time * recovery modality	**Sphericity Assumed**	72.833	4	18.208	9.256	.000
Error(Time)	**Sphericity Assumed**	106.231	54	1.967		

Table 9 Tests of Between-Subjects Effects

Measure: LACTIC ACID					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	4911.247	1	4911.247	2929.988	.000
Recovery modality	21.452	2	10.726	6.399	.005
Error	45.257	27	1.676		

Table 10 Pairwise Comparisons

Measure: LACTIC ACID						
(I) recovery modality	(J) recovery modality	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
foam rolling	cold water immersion	-1.037*	.334	.013	-1.890	-.183
	control group	-1.035*	.334	.014	-1.888	-.181
cold water immersion	foam rolling	1.037*	.334	.013	.183	1.890
	control group	.002	.334	1.000	-.851	.855
control group	foam rolling	1.035*	.334	.014	.181	1.888
	cold water immersion	-.002	.334	1.000	-.855	.851
Based on estimated marginal means						
*. The mean difference is significant at the .05 level.						
b. Adjustment for multiple comparisons: Bonferroni.						

It is evident from the above-mentioned table of pair wise comparison that foam rolling showed significant difference (<0.05) with cold water immersion and control group (Table 10) but when we compared the cold water immersion lactic acid value and control group lactate value then insignificant difference (>0.05) in found (table 10) in between both the groups.

6. DISCUSSION

6.1. TEMPERATURE

It is seen that mean temperature difference between groups is insignificant, but if we consider the mean values of the temperature then the difference can be observed. The insignificant difference may be seen because of minor fluctuation in the values of the temperature but it is not desirable to show significant difference. But by just observing the mean values it can be said that cold water immersion decreases the body temperature followed by control group and foam rolling group as foam rolling required some muscular work to perform the rolling efficiently which may create heat in muscles and less cool down of body temperature. Water immersion methods cause's athletes to feel more relaxed and this issue can happen due to the floating force that is oppose of gravity and supports the part of body weight that is floating in water. Exposure to a cold-water immersion intervention can rapidly decrease muscle temperature and muscular force output (Bergh, 1979) The shuttlers have lower fat mass in lower body i.e. lower will be the adipose tissue which will act as an insulator, the legs' reduced subcutaneous body fat would have permitted more connective heat escape from these muscles which lowers the (Peiffer, 2009). Also periffer's studies result support the concept of Coldwater immersion significantly lowered temperature after the recovery phase (Periffer, 2011).

6.2. HEART RATE

The descriptive statistics of the heart rate in table 4 shows that heart rate of cold-water immersion recovery modality shows highest heart rate post recovery method followed by foam rolling and then control group. Talking about the Bonferroni post hoc test then it is seen that cold water immersion modality group shows significant difference in mean with the control group, but no difference is seen in between foam rolling and control group. CWI was associated with an increase in heart rate (Bleakley, 2009) as submerging in cold water (approx. 140c) allows the body to shunt the blood away from the peripheral portion of the body which prevents the heat transfer from the body directly into the water. It creates an increase in heart rate in the CWI group. Further while performing the foam rolling the body shifts from one posture to another which needs some physical activity, but as it does not needs a sound effort and it supports the body in proper colling down which is very similar to the passive recovery (control group) hence we have seen that there is no any significant difference between the foam rolling group and control group. Moreover, Cold water immersion leads to the reduction of heart rate compare to the warm water immersion. This force causes lightness and weightlessness feeling. Also, during water immersion neuromuscular responses reduce. As a result, general comfort and a reduction in fatigue would be felt after exercise. Various methods of water immersion cause the complete comfort in muscles and a reduction in tension and anxiety.

6.3. LACTIC ACID

Lactic acid is one of the major physiological components which shows the recovery progress of the body. The result of the current study shows that the foam rolling recovery modality significantly removes lactic acid followed by cold water immersion. The Primary concept behind the cold-water immersion is in reducing the painful feeling that depends on Delayed onset muscle soreness (DOMS) that occurs with damage of muscle fibers and causes to decrease of muscle pain and increases the speed of recovery time (Bleakley, 2012). Cold water immersion may cause a reduction in pain through several possible mechanisms, namely the inhibition of nociceptors, reduction in metabolic enzyme activity, reduction in muscle spasms or an altered nerve conduction velocity (A Airaksinen, 2003). The physiology of foam rolling is that it is a self induced massage therapy in this the players uses his own body weight and rough surface of the roller to apply specific pressure at specific muscle which allows the proper blood flow at that particular area further it removes all the edema which occur at the time of playing, it increases inflammatory responses. All these factors play positive role during recovery process and allows the lactic acid to recover quickly from the blood and allow the downfall of lactic acid. This kind of recovery causes the contraction of blood vessels, depletion of waste product such as lactate acid to the tissues that are not involved in pain.

7. CONCLUSION

Overall results of the study concluded that that cold water immersion decreases the body temperature followed by control group and foam rolling group as foam rolling required some muscular work to perform the rolling efficiently which may create heat in muscles and less cool down of body temperature. The sensitivity of muscle temperature to immersion in cold water is higher (Peiffer, 2009). Hence the result of our study concludes that cold water immersion group showed the lowest body temperature as compared between all the recovery modalities group. Talking about the HR then CWI group shows highest HR post recovery than foam rolling and control group. Also when compared the lactic acid then foam rolling group showed lowest value of lactic acid in blood samples.

The study overall concludes that foam rolling recovery modality can be preferred in place of cold-water therapy for recovery process. The two major physiological changes, i.e. lower heart rate and lower lactic acid allows a shuttler to recover faster and get ready for another match in the same day. By observing the result of the study one can say that the shuttlers can prefer to do foam rolling at the time of recovery.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Airaksinen, Susana., Jokilehto, Terhi., Christina, M.I. Rabeegh,. And Nikinmaa, Mikko. 2003. Heat- and coldinducible regulation of HSP70 expression in zebrafish ZF4cells. Comparative Biochemistry and Physiology, Part B,136:275-282.

Bergh U, Ekblom B. 1979. Influence of muscle temperature on maximal muscle strength and power output in human skeletal muscles. Acta Physiol Scand, 107:33 37.

Bleakley, C., McDonough, S., Gardner, E., Baxter, GD., Hopkins, JT. And Davison, GW. 2012. Cold-water immersion (cryotherapy) for preventing and treating muscle soreness after exercise. Cochrane Database of Systematic Reviews 2012:2.

Calder, A. (200 I). The science behind recovery: strategies for athletes. SportsMed News. August 2-3

Calder, A. (200 I). The science behind recovery: strategies for athletes. SportsMed News. August 2-3

Crowe, MJ., O'Connor, D., and Rudd, D. 2007. Cold water recovery reduces anaerobic performance. Int J Sports Med, 28(12):994-998.

Das R, Jhajharia B. Fascia and Myofascial Pain Syndrome - An Overview. Asian Pac. J. Health Sci., 2022;9(4S):228-232.

Das, R., Jhajharia, B., Ciocan, V. C., Majumdar, I., & Sharma, A. (2023). The Relationship Between Latent Myofascial Trigger Point and Range of Motion of Knee Flexor and Extensor Muscles. Physical Education Theory and Methodology, 23(2), 192–198. https://doi.org/10.17309/tmfv.2023.2.06

Das, R., Jhajharia, B., Shukla, D., Boto-Montillano, V., & Kumar, D. (2023). Determine the Occurrence of Latent Myofascial Trigger Points Through Binary Logistic Regression Model in Sportsmen. Sport Mont, 21(3), 93-100.

Das, R., Jhajharia, B., Shukla, D., Boto-Montillano, V., & Kumar, D. (2023). Determine the Occurrence of Latent Myofascial Trigger Points Through Binary Logistic Regression Model in Sportsmen. Sport Mont, 21(3), 93-100.

Knox, B.E., Devreotes, r.N., Goldbeter, A., & Segel, L.A. (1986). A molecular mechanism for sensory adaptation based on ligand-induced receptor modification. Proc Natl Aead Sci, USA 83, 2345-2349.

Koutedakis, Yiannis., & Sharp, N. C. Craig. (1999). The Fit and Healthy Dancer, 1st edition, Wiley.

Kumar, D., & Das, R. Effect of positional role on isokinetic muscles torque production of selected movements of basketball players.

Maglischo, Ernest W. (1993). Swimming Even Faster, Mayfield Pub. Co. (Mountain View, Calif.

Mujika I, Halson S, Burke LM, Balagué G, Farrow D. An integrated, multifactorial approach to periodization for optimal performance in individual and team sports. Int J Sports Physiol Perform. 2018;13(5):538–61.

Peiffer, J. J., Abbiss C. R., Watson, G., Nosaka, K., and Laursen P. B. 2011. Effect of a 5-min cold-water immersion recovery on exercise performance in the heat. Br J Sports Med, 44:461-465.

Peiffer, J. J., Abbiss, C. R., Watson, G., Nosaka, K., & Laursen, P. B. (2009). Effect of cold-water immersion duration on body temperature and muscle function. Journal of Sports Sciences, 27(10), 987–993. doi:10.1080/02640410903207424.