

**PERBEDAAN PENGARUH *COLD WATER IMMERSION* DAN *ACTIVE RECOVERY* TERHADAP *CREATINE KINASE* DAN RASA NYERI ATLET**

**TESIS**

Diajukan untuk memenuhi sebagian dari syarat memperoleh gelar Magister  
Pendidikan Program studi Pendidikan Olahraga



Disusun oleh:

Muhamad Iqbal Nugraha

2105581

**PROGRAM STUDI PENDIDIKAN OLAHRAGA**

**SEKOLAH PASCASARJANA**

**UNIVERSITAS PENDIDIKAN INDONESIA**

**2024**

**PERBEDAAN PENGARUH *COLD WATER IMMERSION* DAN *ACTIVE RECOVERY* TERHADAP *CREATINE KINASE* DAN RASA NYERI ATLET**

**Oleh:**

**Muhamad Iqbal Nugraha**

Diajukan untuk memenuhi salah satu syarat memperoleh gelar Magister Pendidikan (M.Pd) Sekolah Pascasarjana Program Studi Pendidikan Olahraga

©Muhamad Iqbal Nugraha

Universitas Pendidikan Indonesia

2024

Hak cipta dilindungi undang-undang

Tesis ini tidak boleh diperbanyak seluruhnya atau sebagian, dengan dicetak ulang, difotocopy, atau cara lainnya tanpa ijin dari penulis

Muhamad Iqbal Nugraha, 2024

**PERBEDAAN PENGARUH *COLD WATER IMMERSION* DAN *ACTIVE RECOVERY* TERHADAP *CREATINE KINASE* DAN RASA NYERI ATLET**

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

**LEMBAR PENGESAHAN**  
**MUHAMAD IQBAL NUGRAHA**  
**PERBEDAAN PENGARUH *COLD WATER IMMERSION* DAN *ACTIVE RECOVERY* TERHADAP *CREATINE KINASE* DAN RASA NYERI ATLET**

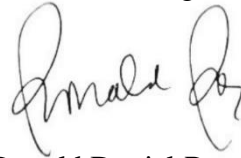
Disetujui dan disahkan oleh pembimbing

Pembimbing I



dr. Pipit Pitriani, M.Kes., Ph.D  
NIP. 197908262010122003

Pembimbing II



Prof. dr. Hamidie Ronald Daniel Ray, M.Pd., Ph.D., AIFO  
NIP. 197011022000121001

Mengetahui,

Ketua Program Studi Pendidikan Olahraga

Sekolah Pascasarjana



Prof. Dr. Amung Ma'mun, M.Pd  
NIP. 196001191986031002

## ABSTRAK

### **PERBEDAAN PENGARUH *COLD WATER IMMERSION* DAN *ACTIVE RECOVERY* TERHADAP *CREATINE KINASE* DAN RASA NYERI ATLET**

**Pembimbing 1 : dr. Pipit Pitriani, M.Kes., Ph.D**

**Pembimbing 2 : Prof. dr. Hamidie Ronald Daniel Ray, M.Pd., Ph.D., AIFO**

**Muhamad Iqbal Nugraha  
2105581**

Tujuan dari penelitian ini adalah untuk mengetahui perbedaan pengaruh *cold water immersion* dan *active recovery* terhadap *creatine kinase* dan rasa nyeri atlet. Penelitian ini menggunakan metode kuantitatif dengan studi quasi eksperimen. Sampel penelitian ini adalah atlet bola tangan pelatda Jawa Barat sebanyak 15 orang yang diambil dengan menggunakan teknik total sampling. Instrumen dalam penelitian ini adalah alat *UV NAC Activated* untuk *creatine kinase*, dan *visual analog scale* (VAS) untuk rasa nyeri. Dari total 15 sampel dibagi menjadi tiga kelompok, yaitu kelompok *cold water immersion*, kelompok *active recovery* dan kelompok *active recovery* dan *cold water immersion* dengan jumlah sampel tiap kelompok 5 orang. Hasil dari penelitian ini menunjukkan kelompok *cold water immersion*, kelompok *active recovery* dan kelompok *active recovery* dan *cold water immersion* memberikan pengaruh yang signifikan terhadap *creatine kinase* dan rasa nyeri. Namun hasil penelitian perbedaan pengaruh antara ketiga kelompok tersebut tidak ada perbedaan sehingga dapat disimpulkan bahwa ketiga kelompok memberikan pengaruh yang sama terhadap *creatine kinase* dan rasa nyeri.

***Kata kunci*** : *active recovery*, *cold water immersion*, *creatine kinase*, *rasa nyeri*

## ABSTRACT

### DIFFERENCES IN THE EFFECTS OF COLD WATER IMMERSION AND ACTIVE RECOVERY ON CREATINE KINASE AND PAIN ATHLETE

Pembimbing 1 : dr. Pipit Pitriani, M.Kes., Ph.D

Pembimbing 2 : Prof. dr. Hamidie Ronald Daniel Ray, M.Pd., Ph.D., AIFO

Muhamad Iqbal Nugraha  
2105581

The purpose of this study was to determine differences in the effects of cold water immersion and active recovery on creatine kinase and athlete's pain. This study uses a quantitative method with a quasi-experimental study. The sample of this study were 15 West Java regional handball athletes who were taken using the total sampling technique. The instruments in this study were the UV NAC Activated device for creatine kinase, and the visual analog scale (VAS) for pain. A total of 15 samples were divided into three groups, namely the cold water immersion group, the active recovery group and the active recovery and cold water immersion group with a total sample of 5 people in each group. The results of this study showed that the cold water immersion, active recovery and active recovery and cold water immersion groups effect significant changes in creatine kinase and pain. However the results of the study, there was no difference in the effect between the three groups, so it could be interpreted that the third group the same effect on creatine kinase and pain.

*Keywords: active recovery, cold water immersion, creatine kinase, pain*

## KATA PENGANTAR

Puji syukur kehadiran Illahi Rabbi atas segala rahmat dan Karunia-Nya, shalawat serta salam selalu tercurah kepada junjungan Nabi Muhammad SAW, sehingga penulis dapat menyelesaikan tesis ini.

Tesis ini berjudul: “Perbedaan Pengaruh *Cold Water Immersion* dan *Active Recovery* terhadap *Creatine Kinase* dan Rasa Nyeri Atlet”.

Tesis ini merupakan syarat untuk memperoleh gelar magister pendidikan selama mengikuti studi pada Prodi Pendidikan Olahraga, Universitas Pendidikan Indonesia.

Penulis menyadari bahwa tesis ini masih ada kekurangan. Oleh karena itu masukan dan saran yang membangun sangat penulis harapkan. Akhir kata semoga tesis ini dapat bermanfaat bagi penulis khususnya, dan bagi para pembaca pada umumnya.

Bandung, Januari 2024

Penulis,

Muhamad Iqbal Nugraha  
NIM. 2105581

## UCAPAN TERIMAKASIH

Penulis dalam menyelesaikan tesis ini melibatkan bantuan dan dorongan berupa masukan, saran, bimbingan dari berbagai pihak. Dalam kesempatan ini dengan segala kerendahan hati penulis mengucapkan terima kasih kepada:

1. Kedua orang tua tercinta, bapak Dudung Supriadi dan ibu Ir. Evi Junaedi selalu mensupport dalam segala hal berupa do'a, motivasi, dan memberikan kasih sayang tak terhingga kepada penulis dalam menyelesaikan tesis.
2. Bapak Prof. Dr. Amung Ma'mun, M.Pd. selaku ketua Prodi Pendidikan Olahraga Sekolah Pasca Sarjana Univeristas pendidikan Indonesia.
3. Ibu dr. Pipit Pitriani, M.Kes, Ph.D., dan Bapak Prof. dr. Hamidie Ronald Daniel Ray, M.Pd., Ph.D., AIFO., selaku Pembimbing I dan Pembimbing II yang memberikan masukan, saran serta motivasi kepada penulis sehingga terselesaikannya tesis ini.
4. Ibu dr. Kurnia Eka Wijayanti, M.K.M., Ph.D. dan ibu Dr. Syifa F. Syihab, S.Tp., M.Si, selaku penguji yang telah memberikan masukan dan saran.
5. Saudara kandung saya Aldy Abdul Kodir, S.Pd. dan Arya Naufal Wiguna yang selalu memberikan do'a tulus serta motivasi dalam menyelesaikan tesis.
6. Andini Nurul Ajmi, S.Pd. yang selalu menemani dalam proses perkuliahan sampai tesis, selalu memberikan motivasi dan semangat.
7. Sahabat-sahabat saya Agil Gusti Zaidan, S.Pd., Rizki Ramadhan, S.Pd., Peri Budiawan, S.Pd., Faisal Helmi, S.Pd., Moch. Alfian, S.Pd. yang selalu memberikan motivasi dan semangat.
8. Tim Pelatda Bola Tangan Jawa Barat yang telah membantu serta memberikan izin dalam penelitian tesis ini.
9. Seluruh pihak yang tidak dapat disebutkan satu persatu pada ruang terbatas ini, atas partisipasi dan kontribusi yang diberikan sehingga tesis ini dapat terselesaikan dengan tepat waktu.

Serta kepada semua pihak yang telah membantu penulis dalam segala hal, Semoga Allah SWT. Senantiasa membalas atas segala kebaikannya dan melimpahkan rahmat-Nya kepada kita semua. *Āmīn.*

## DAFTAR ISI

LEMBAR PENGESAHAN.....	i
LEMBAR PERNYATAAN .....	ii
ABSTRAK.....	ii
ABSTRACT .....	iii
KATA PENGANTAR.....	iv
UCAPAN TERIMA KASIH.....	v
DAFTAR ISI.....	vii
<b>BAB I PENDAHULUAN.....</b>	<b>1</b>
<b>1.1 Latar Belakang .....</b>	<b>1</b>
<b>1.2 Rumusan Masalah .....</b>	<b>4</b>
<b>1.3 Tujuan Penelitian .....</b>	<b>5</b>
<b>1.4 Manfaat Penelitian .....</b>	<b>5</b>
<b>1.5 Struktur Organisasi Tesis .....</b>	<b>6</b>
<b>BAB II KAJIAN PUSTAKA .....</b>	<b>7</b>
<b>2.1 Recovery .....</b>	<b>7</b>
<b>2.2 Cold Water Immersion .....</b>	<b>10</b>
<b>2.3 Active Recovery .....</b>	<b>11</b>
<b>2.4 Creatine Kinase .....</b>	<b>13</b>
<b>2.5 Rasa Nyeri .....</b>	<b>15</b>
<b>2.6 Penelitian yang relevan .....</b>	<b>18</b>
<b>2.7 Kerangka Pemikiran .....</b>	<b>19</b>
<b>2.8 Hipotesis .....</b>	<b>21</b>
<b>BAB III METODE PENELITIAN .....</b>	<b>22</b>
<b>3.1 Metode .....</b>	<b>22</b>
<b>3.2 Desain.....</b>	<b>22</b>
<b>3.3 Sampel .....</b>	<b>23</b>
<b>3.4 Langkah-Langkah Penelitian .....</b>	<b>23</b>
<b>3.5 Prosedur Penelitian .....</b>	<b>24</b>
<b>3.6 Instrumen .....</b>	<b>26</b>
<b>3.7 Analisis data .....</b>	<b>27</b>
<b>BAB IV TEMUAN DAN PEMBAHASAN .....</b>	<b>30</b>
<b>4.1 Temuan Penelitian .....</b>	<b>30</b>
<b>4.2 Pembahasan .....</b>	<b>39</b>



<b>BAB V KESIMPULAN, IMPLIKASI DAN REKOMENDASI .....</b>	<b>48</b>
<b>5.1 Kesimpulan .....</b>	<b>48</b>
<b>5.2 Implikasi.....</b>	<b>49</b>
<b>5.3 Rekomendasi.....</b>	<b>49</b>
<b>DAFTAR PUSTAKA .....</b>	<b>50</b>

## DAFTAR PUSTAKA

- Abaidi, A. E., Lamblin, J., Delecroix, B., Leduc, C., McCall, A., Nédélec, M., Dawson, B., Baquet, G., & Dupont, G. (2017). Recovery from exercise-induced muscle damage: Cold-water immersion versus whole-body cryotherapy. *International Journal of Sports Physiology and Performance*, 12(3), 402–409. <https://doi.org/10.1123/ijsp.2016-0186>
- Adamczyk, J. G., Krasowska, I., Boguszewski, D., & Reaburn, P. (2016). The use of thermal imaging to assess the effectiveness of ice massage and cold-water immersion as methods for supporting post-exercise recovery. *Journal of Thermal Biology*, 60, 20–25. <https://doi.org/10.1016/j.jtherbio.2016.05.006>
- Ahokas, E. K., Ihalainen, J. K., Kyröläinen, H., & Mero, A. A. (2019). Effects of water immersion methods on postexercise recovery of physical and mental performance. *Journal of Strength and Conditioning Research*, 33(6), 1488–1495. <https://doi.org/10.1519/JSC.0000000000003134>
- Al-Ani, B., Mark, G., & Semaan, B. (2010). Blogging in a region of conflict. 1069–1078. <https://doi.org/10.1145/1753326.1753485>
- Allen, D. G., & Westerblad, H. (2001). Role of phosphate and calcium stores in muscle fatigue. *Journal of Physiology*, 536(3), 657–665. <https://doi.org/10.1111/j.1469-7793.2001.t01-1-00657.x>
- Andersson, H., Raastad, T., Nilsson, J., Paulsen, G., Garthe, I., & Kadi, F. (2008). Neuromuscular fatigue and recovery in elite female soccer: Effects of active recovery. *Medicine and Science in Sports and Exercise*, 40(2), 372–380. <https://doi.org/10.1249/mss.0b013e31815b8497>
- Arren, C. O. D. W., Rown, L. E. E. B., & Anders, M. E. R. L. (2011). *E t d b - i r m b p p*. 25(3), 683–688.
- Ascensão, A., Leite, M., Rebelo, A. N., Magalhães, S., & Magalhães, J. (2011). Effects of cold water immersion on the recovery of physical performance and muscle damage following a one-off soccer match. *Journal of Sports Sciences*, 29(3), 217–225. <https://doi.org/10.1080/02640414.2010.526132>
- Ascensão, A., Rebelo, A., Oliveira, E., & Marques, F. (2008). Biochemical impact of a soccer match — analysis of oxidative stress and muscle damage markers throughout recovery. 41, 841–851. <https://doi.org/10.1016/j.clinbiochem.2008.04.008>
- Barber, S., Pattison, J., Brown, F., & Hill, J. (2020). Efficacy of Repeated Cold Water Immersion on Recovery After a Simulated Rugby Union Protocol. *Journal of Strength and Conditioning Research*, 34(12), 3523–3529. <https://doi.org/10.1519/JSC.0000000000002239>

- Barnett Anthony. (2006). Using recovery modalities between training sessions in elite athletes. Does it help? *Sports Medicine*, 36(9), 781–796. <https://link.springer.com/content/pdf/10.2165/00007256-200636090-00005.pdf>
- Bieuzen, F., Borne, R., Toussaint, J. F., & Hausswirth, C. (2014). Positive effect of specific low-frequency electrical stimulation during short-term recovery on subsequent high-intensity exercise. *Applied Physiology, Nutrition and Metabolism*, 39(2), 202–210. <https://doi.org/10.1139/apnm-2013-0185>
- Brancaccio, P., Limongelli, F. M., & Maffulli, N. (2006). Monitoring of serum enzymes in sport. *British Journal of Sports Medicine*, 40(2), 96–97. <https://doi.org/10.1136/bjism.2005.020719>
- Brancaccio, Paola, Maffulli, N., & Limongelli, F. M. (2007). Creatine kinase monitoring in sport medicine. 209–230. <https://doi.org/10.1093/bmb/ldm014>
- Bulqini, A., Hartono, S., & Wahyuni, E. S. (2022). Nutrisi untuk Peak Performance bagi Atlet Profesional Sebelum, Selama dan Setelah Kompetisi. *Jurnal Pendidikan Kesehatan Rekreasi*, 8(2), 376–385. <https://ojs.mahadewa.ac.id/index.php/jpkkr/article/view/1914>
- Darani, M. M., Abedi, B., & Fatolahi, H. (2018). The effect of active and passive recovery on creatine kinase and C-reactive protein after an exercise session in football players. *International Archives of Health Sciences*, 5(1), 1. [https://doi.org/10.4103/iahs.iahs\\_31\\_17](https://doi.org/10.4103/iahs.iahs_31_17)
- Dawson, B., Gow, S., Modra, S., Bishop, D., & Stewart, C. (2005). Effects of immediate post-game recovery procedures on muscle soreness, power and flexibility levels over the next 48 hours. *Journal of Science and Medicine in Sport*, 8(2), 210–221. [https://doi.org/10.1016/S1440-2440\(05\)80012-X](https://doi.org/10.1016/S1440-2440(05)80012-X)
- Gagliano, M., Corona, D., Giuffrida, G., Giaquinta, A., Tallarita, T., Zerbo, D., Sorbello, M., Paratore, A., Virgilio, C., Cappellani, A., Veroux, P., & Veroux, M. (2009). Low-intensity body building exercise induced rhabdomyolysis: A case report. *Cases Journal*, 2(1), 3–4. <https://doi.org/10.1186/1757-1626-2-7>
- Ganda, E. K., Bisinotto, R. S., Vasquez, A. K., Teixeira, A. G. V., Machado, V. S., Foditsch, C., Bicalho, M., Lima, F. S., Stephens, L., Gomes, M. S., Dias, J. M., & Bicalho, R. C. (2016). Effects of injectable trace mineral supplementation in lactating dairy cows with elevated somatic cell counts. *Journal of Dairy Science*, 99(9), 7319–7329. <https://doi.org/10.3168/jds.2016-10989>
- Greco, C. C., Barbosa, L. F., Caritá, R. A. C., & Denadai, B. S. (2012). Is maximal lactate steady state during intermittent cycling different for active compared with passive recovery? *Applied Physiology, Nutrition and Metabolism*, 37(6), 1147–1152. <https://doi.org/10.1139/h2012-105>

- Gregson, W., Black, M. A., Jones, H., Milson, J., Morton, J., Dawson, B., Atkinson, G., & Green, D. J. (2011). Influence of cold water immersion on limb and cutaneous blood flow at rest. *American Journal of Sports Medicine*, 39(6), 1316–1323. <https://doi.org/10.1177/0363546510395497>
- Hammami, M., Gaamouri, N., Ramirez-Campillo, R., Shephard, R. J., Bragazzi, N. L., Chelly, M. S., Knechtle, B., & Gaied, S. (2021). Effects of high-intensity interval training and plyometric exercise on the physical fitness of junior male handball players. *European Review for Medical and Pharmacological Sciences*, 25(23), 7380–7389. [https://doi.org/10.26355/eurrev\\_202112\\_27434](https://doi.org/10.26355/eurrev_202112_27434)
- Hojati, S. S., Reza, S., Hosseini, A., Soltani, H., Hojati, Z., Hojati, S. S., Reza, S., Hosseini, A., Soltani, H., Hojati, Z., & Effect, T. (2013). The Effect of RAST Anaerobic Test on Creatine Phosphokinase and Lactate. 7(7), 1271–1274.
- Jemni, M., Sands, W. A., Friemel, F., & Delamarche, P. (2003). Effect of active and passive recovery on blood lactate and performance during simulated competition in high level gymnasts. *Canadian Journal of Applied Physiology*, 28(2), 240–256. <https://doi.org/10.1139/h03-019>
- Junaidi, J., Sobarna, A. S., Apriyanto, T. A., Apriantono, T. A., Winata, B. W., Fahmi, M. F., & Inarota, L. I. (2021). Effects of cold-water immersion to aid futsal athlete's recovery after exercise induced muscle damage. *Gazzetta Medica Italiana Archivio per Le Scienze Mediche*, 180(9), 441–447. <https://doi.org/10.23736/S0393-3660.20.04431-9>
- Liu, Shuang, Kelliher, Leigh. (2022). Physiology of pain—a narrative review on the pain pathway and its application in the pain management, *Digestive Medicine Research*, 5, 56-56
- McGorm, Hamish; Roberts, Llion A.; Coombes, Jeff S.; Peake, J. M. (2015). Cold water immersion: practices, trends and avenues of effect. *Aspetar Sports Medicine Journal*, 4(1), 106–111.
- McLellan, C.P., & Caldwell, J. (2012). The effects of active recovery on muscle soreness and creatine kinase levels following exercise. *Journal of Strength and Conditioning Research*, 26(2), 1-8.
- Meeusen, R., Duclos, M., Foster, C., Fry, A., Gleeson, M., Nieman, D., Raglin, J., Rietjens, G., Steinacker, J., & Urhausen, A. (2013). Prevention, diagnosis, and treatment of the overtraining syndrome: Joint consensus statement of the european college of sport science and the American College of Sports Medicine. *Medicine and Science in Sports and Exercise*, 45(1), 186–205. <https://doi.org/10.1249/MSS.0b013e318279a10a>

- Monedero, J., & Donne, B. (2000). Effect of recovery interventions on lactate removal and subsequent performance. *International Journal of Sports Medicine*, 21(8), 593–597. <https://doi.org/10.1055/s-2000-8488>
- Mota, M. R., Dantas, R. A. E., Oliveira-Silva, I., Sales, M. M., da Costa Sotero, R., Espíndola Mota Venâncio, P., Teixeira Júnior, J., Chaves, S. N., & de Lima, F. D. (2017). Effect of self-paced active recovery and passive recovery on blood lactate removal following a 200 m freestyle swimming trial. *Open Access Journal of Sports Medicine*, Volume 8, 155–160. <https://doi.org/10.2147/oajsm.s127948>
- Mujika, I., Halson, S., Burke, L. M., Balagué, G., & Farrow, D. (2018). An integrated, multifactorial approach to periodization for optimal performance in individual and team sports. *International Journal of Sports Physiology and Performance*, 13(5), 538–561. <https://doi.org/10.1123/ijsp.2018-0093>
- Musthofa, H., & Kafrawi, F. R. (2019). Analisis Pengetahuan Pelatih Klub Handball Bumi Wali Tuban Terhadap Recovery. *Jurnal Kesehatan Olahraga*, 7(2).
- Parouty, J., Al Haddad, H., Quod, M., Leprêtre, P. M., Ahmaidi, S., & Buchheit, M. (2010). Effect of cold water immersion on 100-m sprint performance in well-trained swimmers. *European Journal of Applied Physiology*, 109(3), 483–490. <https://doi.org/10.1007/s00421-010-1381-2>
- Peake, J. M., Neubauer, O., Gatta, P. A. D., & Nosaka, K. (2017). Muscle damage and inflammation during recovery from exercise. *Journal of Applied Physiology*, 122(3), 559–570. <https://doi.org/10.1152/jappphysiol.00971.2016>
- Physiology, E., Jules, P., & Cedex, A. (2011). *E r m e t e , c r , b l a p , i s e*. 25(1), 205–210.
- Pooley, S., Spendiff, O., Allen, M., & Moir, H. J. (2020). Comparative efficacy of active recovery and cold water immersion as post-match recovery interventions in elite youth soccer. *Journal of Sports Sciences*, 38(11–12), 1423–1431. <https://doi.org/10.1080/02640414.2019.1660448>
- Reilly, T., & Ekblom, B. (2005). The use of recovery methods post-exercise. *Journal of Sports Sciences*, 23(6), 619–627. <https://doi.org/10.1080/02640410400021302>
- Rowlands, D. S., & Aboud, E. P. A. (2012). Oxidative stress , inflammation , and muscle soreness in an 894-km relay trail run. 1839–1848. <https://doi.org/10.1007/s00421-011-2163-1>
- Sands, W. A., McNeal, J. R., Murray, S. R., Ramsey, M. W., Sato, K., Mizuguchi, S., & Stone, M. H. (2013). Stretching and its effects on recovery: A review.

Strength and Conditioning Journal, 35(5), 30–36.  
<https://doi.org/10.1519/SSC.0000000000000004>

- Sciences, R. B. (2014). Role of the phosphocreatine system on energetic homeostasis in skeletal and cardiac muscles musculaturas esquelética e cardíaca. 12(55 27), 126–132. <https://doi.org/10.1590/S1679-45082014RB2741>
- Sellwood, K. L., Brukner, P., Williams, D., Nicol, A., & Hinman, R. (2007). Ice-water immersion and delayed-onset muscle soreness: A randomised controlled trial. *British Journal of Sports Medicine*, 41(6), 392–397. <https://doi.org/10.1136/bjism.2006.033985>
- Tessitore, A., Meeusen, R., Cortis, C., & Capranica, L. (2007). Effects of different recovery interventions on anaerobic performances following preseason soccer training. *Journal of Strength and Conditioning Research*, 21(3), 745–750. <https://doi.org/10.1519/R-20386.1>
- Toubekis, A. G., Tsolaki, A., Smillos, I., Douda, H. T., Kourtesis, T., & Tokmakidis, S. P. (2008). Swimming performance after passive and active recovery of various durations. *International Journal of Sports Physiology and Performance*, 3(3), 375–386. <https://doi.org/10.1123/ijsp.3.3.375>
- Vaile, J., O'Hagan, C., Stefanovic, B., Walker, M., Gill, N., & Askew, C. D. (2011). Effect of cold water immersion on repeated cycling performance and limb blood flow. *British Journal of Sports Medicine*, 45(10), 825–829. <https://doi.org/10.1136/bjism.2009.067272>
- Versey, N. G., Halson, S. L., & Dawson, B. T. (2013). Water immersion recovery for athletes: Effect on exercise performance and practical recommendations. *Sports Medicine*, 43(11), 1101–1130. <https://doi.org/10.1007/s40279-013-0063-8>
- Vygotsky, L. S. (2020). Exercise and Fatigue. *Educational Psychology*, 39(5), 273–282. <https://doi.org/10.4324/9780429273070-14>