

## BAB 7

### KESIMPULAN DAN SARAN

#### 7.1 Kesimpulan

Berdasarkan hasil penelitian yang telah dilakukan dapat disimpulkan:

1. Diet ketogenik tidak jenuh dengan olahraga merupakan diet yang paling disarankan dari penelitian ini karena bisa meningkatkan diameter *quadriceps* dan massa m.*quadriceps* pada akhir penelitian.
2. Diet ketogenik jenuh dengan olahraga dapat menjadi alternatif dikarenakan bisa meningkatkan diameter *quadriceps* walaupun tidak signifikan dan bisa meningkatkan massa m. *quadriceps* pada akhir penelitian
3. Diet ketogenik jenuh dan tidak jenuh tanpa olahraga tidak disarankan dikarenakan ketogenik jenuh tanpa olahraga bisa menyebabkan inflamasi pada otot dan ketogenik tidak jenuh tanpa olahraga tidak bisa meningkatkan diameter *quadriceps* dan massa m. *quadriceps*.

#### 7.2 Saran

1. Melakukan penelitian jangka panjang terhadap efek diet ketogenik terhadap diameter dan massa otot.
2. Memisahkan antara m. *quadriceps* dengan tulang femur agar bisa mengetahui massa asli dari m. *quadriceps*.
3. Menyesuaikan metode olahraga dengan keperluan penelitian, mungkin bisa menggunakan treadmill jika dana cukup.
4. Menambah durasi olahraga untuk melihat perubahan diameter *quadriceps* dan massa m. *quadriceps*.

5. Melakukan pelatihan memegang tikus dan memasukkan sonde ke tikus agar rasa sakit pada tikus berkurang.

## DAFTAR PUSTAKA

1. World Health Organization. Obesity and overweight [Internet]. 16 February 2018. 2018 [cited 2019 Apr 5]. Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
2. Chan T. Diet review: ketogenic diet for weight loss. HsphHarvardEdu [Internet]. 2018;1–8. Available from: <https://www.hsph.harvard.edu/nutritionsource/healthy-weight/diet-reviews/ketogenic-diet/>
3. Masood W, Uppaluri KR. Ketogenic diet [Internet]. StatPearls. StatPearls Publishing; 2019 [cited 2019 Apr 6]. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/29763005>
4. Saito H, Shimizu K, Iida K, Tachi Y, Sakamoto Y, Sumi K. Short-term and long-term ketogenic diet therapy and the addition of exercise have differential impacts on metabolic gene expression in the mouse energy-consuming organs heart and skeletal muscle. Nutr Res [Internet]. 2018;60:77–86. Available from: <https://doi.org/10.1016/j.nutres.2018.09.004>
5. McCleary SA, Lowery RP, Sharp MH, D’agostino DP, Weiner SI, Shields KA, et al. The effects of ketogenic dieting on skeletal muscle and fat mass. J Int Soc Sports Nutr [Internet]. 2014;11(Suppl 1):P40. Available from: <http://www.jissn.com/content/11/S1/P40>
6. Dashti HM, Mathew TC, Hussein T, Asfar SK, Behbahani A, Khoursheed MA, et al. Long-term effects of a ketogenic diet in obese patients. Exp Clin Cardiol [Internet]. 2004;9(3):200–5. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/19641727>
7. Holland AM, Kephart WC, Mumford PW, Mobley CB, Lowery RP, Shake JJ, et al. Effects of a ketogenic diet on adipose tissue, liver, and serum biomarkers in sedentary rats and rats that exercised via resisted voluntary wheel running. Am J Physiol Integr Comp Physiol [Internet]. 2016;311(2):R337–51. Available from: <https://www.physiology.org/doi/pdf/10.1152/ajpregu.00156.2016>
8. Gregory RM. A low-carbohydrate ketogenic diet combined with 6-weeks of crossfit training improves body composition and performance. Int J Sport Exerc Med [Internet]. 2017;3(2). Available from: [https://www.researchgate.net/publication/320201244\\_A\\_Low-Carbohydrate\\_Ketogenic\\_Diet\\_Combined\\_with\\_6-Weeks\\_of\\_Crossfit\\_Training\\_Improves\\_Body\\_Composition\\_and\\_Performance](https://www.researchgate.net/publication/320201244_A_Low-Carbohydrate_Ketogenic_Diet_Combined_with_6-Weeks_of_Crossfit_Training_Improves_Body_Composition_and_Performance)
9. Zajac A, Poprzecki S, Maszczyk A, Czuba M, Michalczyk M, Zydek G. The effects of a ketogenic diet on exercise metabolism and physical performance in off-road cyclists. Nutrients [Internet]. 2014 Jun 27;6(7):2493–508. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/24979615>

10. Parry HA, Kephart WC, Mumford PW, Romero MA, Mobley CB, Zhang Y, et al. Ketogenic diet increases mitochondria volume in the liver and skeletal muscle without altering oxidative stress markers in rats. *Heliyon* [Internet]. 2018 Nov 24;4(11):e00975–e00975. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/30533548>
11. Bielohuby M, Sisley S, Sandoval D, Herbach N, Zengin A, Fischereder M, et al. Impaired glucose tolerance in rats fed low-carbohydrate, high-fat diets. *Am J Physiol Metab* [Internet]. 2013;305(9):E1059–70. Available from: <https://www.physiology.org/doi/pdf/10.1152/ajpendo.00208.2013>
12. Rogovik AL, Goldman RD. Ketogenic diet for treatment of epilepsy. *Can Fam Physician* [Internet]. 2010 Jun;56(6):540–2. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/20547519>
13. Shilpa J, Mohan V. Ketogenic diets: Boon or bane? *Indian J Med Res* [Internet]. 2018 Sep;148(3):251–3. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/30425213>
14. Paoli A, Rubini A, Volek JS, Grimaldi KA. Beyond weight loss: A review of the therapeutic uses of very-low-carbohydrate (ketogenic) diets. *Eur J Clin Nutr* [Internet]. 2013;67(8):789–96. Available from: <http://dx.doi.org/10.1038/ejcn.2013.116>
15. Puchalska P, Crawford PA. Multi-dimensional roles of ketone bodies in fuel metabolism, signaling, and therapeutics. *Cell Metab* [Internet]. 2017 Feb 7;25(2):262–84. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/28178565>
16. World of Sports Science. Muscle mass and strength [Internet]. [cited 2019 Apr 9]. Available from: <https://www.encyclopedia.com/sports/sports-fitness-recreation-and-leisure-magazines/muscle-mass-and-strength>
17. Kary JM. Diagnosis and management of quadriceps strains and contusions. *Curr Rev Musculoskelet Med*. 2010;3(1–4):26–31.
18. Guyton AC, Hall E J. Guyton and hall textbook of medical physiology, thirteenth edition. Elseiver. 2016.
19. SKELETON | meaning in the Cambridge English Dictionary [Internet]. [cited 2019 Nov 1]. Available from: <https://dictionary.cambridge.org/dictionary/english/skeleton>
20. Skeleton | Definition of Skeleton by Merriam-Webster [Internet]. [cited 2019 Nov 1]. Available from: <https://www.merriam-webster.com/dictionary/skeleton>
21. Miles L. Physical activity and health. 2007;314–63. Available from: [https://www.nutrition.org.uk/attachments/101\\_Physical\\_activity\\_and\\_health.pdf](https://www.nutrition.org.uk/attachments/101_Physical_activity_and_health.pdf)
22. Campbell N, De Jesus S, Prapavessis H. Physical fitness. In: Gellman MD, Turner JR, editors. *Encyclopedia of behavioral medicine* [Internet]. New

- York, NY: Springer New York; 2013. p. 1486–9. Available from: [https://doi.org/10.1007/978-1-4419-1005-9\\_1167](https://doi.org/10.1007/978-1-4419-1005-9_1167)
23. Carlson J. Exercise. In: Gellman MD, Turner JR, editors. Encyclopedia of behavioral medicine [Internet]. New York, NY: Springer New York; 2013. p. 727–9. Available from: [https://doi.org/10.1007/978-1-4419-1005-9\\_1127](https://doi.org/10.1007/978-1-4419-1005-9_1127)
  24. Abou Elmagd M. Benefits, need and importance of daily exercise. *Int J Phys Educ Sport Heal* [Internet]. 2016;22(August):22–7. Available from: [https://www.researchgate.net/publication/306118434\\_Benefits\\_need\\_and\\_importance\\_of\\_daily\\_exercise](https://www.researchgate.net/publication/306118434_Benefits_need_and_importance_of_daily_exercise)
  25. Manzanares G, Brito-Da-Silva G, Gandra PG. Voluntary wheel running: Patterns and physiological effects in mice. *Brazilian J Med Biol Res*. 2019;52(1):1–9.
  26. Sharp P, Villano J. The laboratory rat, second edition. *The Laboratory Rat, Second Edition*. 2012.
  27. Fauziah KR. Profil tekanan darah normal tikus putih ( *Rattus norvegicus* ) galur wistar dan sprague-dawley. *Skripsi* [Internet]. 2016;1–27. Available from: <https://repository.ipb.ac.id/jspui/bitstream/123456789/84620/1/B16krf.pdf>
  28. Wistar Institute. Our history philadelphia: the wistar institute [Internet]. 2016 [cited 2019 Apr 2]. Available from: <https://wistar.org/our-history>
  29. Olsson AS, Robinson P, Sandoe P. Handbook of laboratory animal science. In: *Ethics of animal research*. 2011.
  30. Pratt SJP, Lovering RM. A stepwise procedure to test contractility and susceptibility to injury for the rodent quadriceps muscle. *J Biol Methods* [Internet]. 2014;1(2):8. Available from: [https://www.researchgate.net/publication/269400018\\_A\\_stepwise\\_procedure\\_to\\_test\\_contractility\\_and\\_susceptibility\\_to\\_injury\\_for\\_the\\_rodent\\_quadriciceps\\_muscle](https://www.researchgate.net/publication/269400018_A_stepwise_procedure_to_test_contractility_and_susceptibility_to_injury_for_the_rodent_quadriciceps_muscle)
  31. Ding J, Xu X, Wu X, Huang Z, Kong G, Liu J, et al. Bone loss and biomechanical reduction of appendicular and axial bones under ketogenic diet in rats. *Exp Ther Med*. 2019;2503–10.
  32. Goutianos G, Tzioura A, Kyparos A, Paschalis V, Margaritelis N V., Veskoukis AS, et al. The rat adequately reflects human responses to exercise in blood biochemical profile: A comparative study. *Physiol Rep*. 2015;3(2).
  33. Gonzalez NC, Kuwahira I. Systemic Oxygen Transport with Rest, Exercise, and Hypoxia: A Comparison of Humans, Rats, and Mice. *Compr Physiol*. 2018;8(4):1537–73.
  34. Vargas S, Romance R, Petro JL, Bonilla DA, Galancho I, Espinar S, et al. Efficacy of ketogenic diet on body composition during resistance training in trained men: a randomized controlled trial. *J Int Soc Sports Nutr* [Internet]. 2018 Jul 9;15(1):31. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/29986720>

35. Okamura T, Hashimoto Y, Hamaguchi M, Obora A, Kojima T, Fukui M. Ectopic fat obesity presents the greatest risk for incident type 2 diabetes: a population-based longitudinal study. *Int J Obes* [Internet]. 2019;43(1):139–48. Available from: <https://doi.org/10.1038/s41366-018-0076-3>
36. Sitnick M, Bodine SC, Rutledge JC. Chronic high fat feeding attenuates load-induced hypertrophy in mice. *J Physiol*. 2009;587(23):5753–65.
37. Kennedy A, Martinez K, Chuang C-C, LaPoint K, McIntosh M. Saturated Fatty Acid-Mediated Inflammation and Insulin Resistance in Adipose Tissue: Mechanisms of Action and Implications. *J Nutr*. 2009;139(1):1–4.
38. Zabala L, Saldanha C, Martins E Silva J, Souza-Ramalho P. Red blood cell membrane integrity in primary open angle glaucoma: Ex vivo and in vitro studies. *Eye*. 1999;13(1):101–3.
39. Çinar Y, Şenyol AM, Duman K. Blood viscosity and blood pressure: Role of temperature and hyperglycemia. *Am J Hypertens*. 2001;14(5 I):433–8.
40. Guo X, Li H, Xu H, Halim V, Zhang W, Wang H, et al. Palmitoleate induces hepatic steatosis but suppresses liver inflammatory response in mice. *PLoS One*. 2012;7(6):1–9.
41. Starkie R, Ostrowski SR, Jauffred S, Febbraio M, Pedersen BK. Exercise and IL-6 infusion inhibit endotoxin-induced TNF- $\alpha$  production in humans. *FASEB J*. 2003;17(8):884–6.
42. Kohut ML, McCann DA, Russell DW, Konopka DN, Cunnick JE, Franke WD, et al. Aerobic exercise, but not flexibility/resistance exercise, reduces serum IL-18, CRP, and IL-6 independent of  $\beta$ -blockers, BMI, and psychosocial factors in older adults. *Brain Behav Immun*. 2006;20(3):201–9.
43. Flynn MG, McFarlin BK, Markofski MM. The Anti-Inflammatory Actions of Exercise Training. *Am J Lifestyle Med* [Internet]. 2007 May;1(3):220–35. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/25431545>
44. Chung HY, Cesari M, Anton S, Marzetti E, Giovannini S, Seo AY, et al. Molecular inflammation: underpinnings of aging and age-related diseases.1. Chung HY, Cesari M, Anton S, et al. Molecular inflammation: underpinnings of aging and age-related diseases. *Ageing Res Rev*. 2009;8(1):18-30. doi:10.1016/j.arr.2008.07.002. *Ageing Res Rev* [Internet]. 2009;8(1):18–30. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18692159> <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC3782993>