منابع

1 Mosso A (1915) Fatigue. London: Allen and Unwin Ltd.
2 Hill AV (1926) Muscular Activity. Baltimore, MD: Williams & Wilkins.
3 Bainbridge FA (1931) The Physiology of Muscular Exercise (3rd ed). New York: Longmans, Green and Co.
4 Merton PA, Pampiglione G (1950) Strength and fatigue. Nature: 166.
5 Marino FE, Gard M, Drinkwater EJ (2011) The limits to exercise performance and the future of fatigue research. Br J Sports Med 45: 65–7.
6 Ament W, Verkerke GJ (2009) Exercise and fatigue. Sports Med 39 (5): 389–422.
7 Moore B, ed. (2004) The Australian Concise Oxford Dictionary (4th edn). South Melbourne: Oxford University Press.
8 Hill AV, Lupton H (1923) Muscular exercise, lactic acid, and the supply and utilization of oxygen. QJ Med 16: 135–71.
9 Hill AV, Long CHN, Lupton H (1924) Muscular exercise, lactic acid and the supply and utilisation of oxygen: parts VII–VIII. Proc Royal Soc 97: 155–76.
10 Hill AV, Long CHN, Lupton H (1924) Muscular exercise, lactic acid, and the supply utilization of oxygen: parts I–III. Proc Royal Soc 96: 438–75.
11 Hill AV, Long CHN, Lupton H (1924) Muscular exercise, lactic acid, and the utilization of oxygen: parts IV–VI. Proc Royal Soc 97: 84–138.
12 Noakes TD (2012) Fatigue is a brain-derived emotion that regulates the exercise behaviour to ensure the protection of whole-body homeostasis. Front Physiol 3:
1–13.
13 Hill L, Flack M (1910) The influence of oxygen inhalations on muscular work. J Physiol 5.
14 Raskoff WJ, Goldman S, Cohn K (1976) The ‘athletic heart’: prevalence and physiological significance of left ventricular enlargement in distance runners. J Am Med Assoc 236: 158–62.
15 Bandschapp O, Soule CL, Iaizzo PA (2012) Lactic acid restores skeletal muscle force in an in vitro fatigue model: are voltage-gated chloride channels involved? Am J Physiol 302: C1019–25.
16 Kristensen M, Albertsen J, Rentsch M, et al. (2005) Lactate and force production in skeletal muscle. J Physiol 562: 521–6.
17 Nielsen OB, de Paoli F, Overgaard K (2001) Protective effects of lactic acid on force production in rat skeletal muscle. J Physiol 536: 161–6.
18 St Clair Gibson A, Noakes TD (2004) Evidence for complex systems integration and dynamic neural regulation of skeletal muscle recruitment during exercise in humans. Br J Sports Med 38: 797–806.
19 Amann, M, Eldridge MW, Lovering AT, et al. (2006) Arterial oxygenation influences central motor output and exercise performance via effects on peripheral locomotor muscle fatigue in humans. J Physiol 575 (3): 937–52.
20 Albertus Y (2008) Critical Analysis of Techniques for Normalising Electromyographic Data. PhD thesis, University of Cape Town, Cape Town: 1–219.
21 Noakes TD, St Clair Gibson A (2004) Logical limitations to the ‘catastrophe’ models of fatigue during exercise in humans. Br J Sports Med 38: 648–9.
22 Davis JM, Bailey SP (1997) Possible mechanisms of central nervous system fatigue during exercise. Med Sci Sports Exerc 29 (1): 45–57.
23 Graham TE, Rush JWE, MacLean DA (1995) Skeletal muscle amino acid metabolism and ammonia production during exercise. In: Hargreaves M (ed.) Exercise Metabolism. Champaign, IL: Human Kinetics: 131–75.
24 Gandevia SC, Allen GM, Butler JE, et al. (1996) Supra-spinal factors in human muscle fatigue: evidence for sub-optimal output from the motor cortex. J Physiol 490: 529–36.
25 Bigland-Ritchie B, Thomas CK, Rice CL, et al. (1992) Muscle temperature, contractile speed, and motor neuron firing rates during human voluntary contractions. J Appl Physiol 73: 2457–61.
26 Enoka RM, Stuart DG (1992) Neurobiology of muscle fatigue. J Appl Physiol 72: 1631–48.
27 Vøllestad NK (1997) Measurement of human muscle fatigue. J Neurosci Meth 74: 219–27.
28 Nybo L, Nielsen B (2001) Hyperthermia and central fatigue during prolonged exercise in humans. J Appl Physiol 91 (3): 1055–60.
29 Jones DA (1996) High- and low-frequency fatigue revisited. Acta Physiol Scand 156: 265–70.
30 Keeton RB, Binder-Macleod SA (2006) Low-frequency fatigue. Phys Ther 86: 1146–50.
31 Edwards RH, Hill DK, Jones DA, et al. (1977) Fatigue of long duration in human skeletal muscle after exercise. J Physiol 272: 769 –78.
32 Trimble MH, Enoka RM (1991) Mechanisms underlying the training effects associated with neuromuscular electrical stimulation. Phys Ther 71: 273–80.
33 Gandevia SC (2001) Spinal and supraspinal factors in human muscle fatigue. Physiol Rev 81 (4): 1725–89.
34 Warren GL, Lowe DA, Armstrong RB (1999) Measurement tools used in the study of eccentric contraction-induced injury. Sports Med 27: 43–59.
35 Martin V, Millet GY, Martin A, et al. (2004) Assessment of low-frequency fatigue with two methods of electrical stimulation. J Appl Physiol 97: 1923–9.
36 Vøllestad NK, Sejersted OM, Bahr R, et al. (1988) Motor drive and metabolic
responses during repeated submaximal contractions in man. J Appl Physiol 64 (4): 1421–7.
37 Schabort EJ, Hawley JA, Hopkins WG, et al. (1998) A new reliable laboratory test of endurance performance for road cyclists. Med Sci Sports Exerc 30 (12): 1744–50.
38 McLellan TM, Cheung SS, Jacobs I (1995) Variability of time to exhaustion during submaximal exercise. Can J Appl Physiol 20

(1): 39–51.
39 Hinckson EA, Hopkins WG (2005) Reliability of time to exhaustion analyzed with critical-power and log-log modelling. Med Sci Sports Exerc 37 (4): 696–701.
40 Bigland-Ritchie B, Jones DA, Woods JJ (1979) Excitation frequency and muscle fatigue: electrical responses during human voluntary and stimulated contractions. Exp Neurol 64: 414–27.
41 Mengshoel AM, Saugen E, Førre E, et al. (1995) Muscle fatigue in early fibromyalgia. J Rheumatol 22: 143–50.
42 Karelis AD, Smith JEW, Passe DH, et al. (2010) Carbohydrate administration and exercise performance: what are the potential mechanisms involved? Sports Med 40 (9): 747–63.
43 Bangsbo J, Nørregaard L, Thorsø F (1991) Activity profile of competition soccer. Can J Sport Sci 16 (2): 110–16.
44 Krustrup P, Mohr M, Steensberg A, et al. (2006) Muscle and blood metabolites during a soccer game: implications for sprint performance. Med Sci Sports Exerc 38: 1165–74.
45 Borg G (1970) Perceived exertion as an indicator of somatic stress. Scand J Rehab Med 2: 92–108.
46 Robertson RJ (2001) Development of the perceived exertion knowledge base: an interdisciplinary process. Int J Sport Psychol 32: 189–96.
47 Dunbar CC, Robertson RJ, Baun R, et al. (1992) The validity of regulating exercise intensity by rating of perceived exertion. Med Sci Sports Exerc 24: 94–9. Defining and measuring in sport and exercise 27
48 Eston RG, Williams JG (1988) Reliability of ratings of perceived effort regulation of exercise intensity. Br J Sports Med 22: 153–5.
49 Marriott HE, Lamb KL (1996) The use of ratings of perceived exertion for regulating exercise levels in rowing ergometry. Eur J Appl Physiol 72 (3): 267–71.
50 Groslambert A, Mahon AD (2006) Perceived exertion: influence of age and cognitive function. Sports Med 36 (11): 911–28.
51 Marcora S (2009) Perception of effort during exercise is independent of afferent feedback from skeletal muscles, heart and lungs. J Appl Physiol 106 (6): 2060–2.
52 Smirmaul BPC (2012) Sense of effort and other unpleasant sensations during exercise: clarifying concepts and mechanisms. Br J Sports Med 46: 308–11.
53 Potteiger JA, Schroeder JM, Goff KL (2000) Influence of music on ratings of perceived exertion during 20 minutes of moderate intensity exercise. Percept Mot Skills 91: 848–54.
54 White VB, Potteiger JA (1996) Comparison of passive sensory stimulations on RPE during moderate intensity exercise. Percept Mot Skills 82: 819–25.
55 Eston R, Stansfield R, Westoby P, et al. (2012) Effect of deception and expected exercise duration on psychological and physiological variables during treadmill running and cycling. Psychophysiol 49: 462–9.
56 Swart J, Lindsay TR, Lambert MI, et al. (2012) Perceptual cues in the regulation of exercise performance – physical sensations of exercise and awareness of effort interact as separate cues. Br J Sports Med 46: 42–8.
57 Eston R (2012) Use of ratings of perceived exertion in sports. Int J Sports Physiol Perf 7: 175–82.
58 Krssak M, Petersen KF, Bergeron R, et al. (2000) Intramuscular glycogen and intramyocellular lipid utilization during prolonged exercise and recovery in man:
A 13C and 1H nuclear magnetic resonance spectroscopy study. J Clin Endocrin Metab 85 (2): 748–54.
59 Larson-Meyer DE, Smith SR, Heilbronn LK, et al. (2006) Muscle-associated triglyceride measured by computed tomography and magnetic resonance spectroscopy. Obesity 14: 73–87.
60 Vanhatalo A, Fulford J, DiMenna FJ, et al. (2010) Influence of hyperoxia on muscle metabolic responses and the power–duration relationship during severeintensity
exercise in humans: a 31P magnetic resonance spectroscopy study. Exp Physiol 95: 528–40.
61 Sinha U, Sinha S, Hodgson JA, et al. (2011) Human soleus muscle architecture at different ankle joint angles from magnetic resonance diffusion tensor imaging. J Appl Physiol 110 (3): 807–19.
62 Wilson M, O'Hanlon R, Prasad S, et al. (2011) Biological markers of cardiac damage are not related to measures of cardiac systolic and diastolic function using cardiovascular magnetic resonance and echocardiography after an acute bout of prolonged endurance exercise. Br J Sports Med 45: 780–4.
63 Chambers ES, Bridge MW, Jones DA (2009) Carbohydrate sensing in the human mouth: effects on exercise performance and brain activity. J Physiol 587 (8): 1779–94.
64 Gant N, Stinear CM, Byblow WD (2010) Carbohydrate in the mouth immed - iately facilitates motor output. Brain Res 1350: 151–8.

منابع

1 Noakes TD, Gibson A (2004) Logical limitations to the 'catastrophe' models of fatigue during exercise in humans. Br J Sports Med 38: 648–9.
2 Gaitanos GC, Williams C, Boobis LH, et al. (1993) Human muscle metabolism during intermittent maximal exercise. J Appl Physiol 75 (2): 712–19.
3 Baldwin J, Snow RJ, Gibala MJ, et al. (2003) Glycogen availability does not affect the TCA cycle or TAN pools during prolonged, fatiguing exercise. J Appl Physiol 94: 2181–7.
4 Gibala MJ, Gonzalez-Alonson J, Saltin B (2002) Dissociation between muscle tricarboxylic acid cycle pool size and aerobic energy

provision during prolonged exercise in humans. J Physiol 545: 705–13.
5 Westerblad H, Bruton JD, Katz A (2010) Skeletal muscle: energy metabolism, fiber types, fatigue and adaptability. Exp Cell Res 316: 3093–9.
6 MacIntosh BR, Holash RJ, Renaud J (2012) Skeletal muscle fatigue – regulation of excitation-contraction coupling to avoid metabolic catastrophe. J Cell Sci 125: 2105–14.
7 Karatzaferi C, de Haan A, Ferguson RA, et al. (2001) Phosphocreatine and ATP content in human single muscle fibres before and after maximum dynamic exercise. Pflugers Arch 442: 627–41.
8 Jeneson JA, Schmitz JP, van Dijk JH, et al. (2010) Exercise ability is determined by muscle ATP buffer content, not Pi or pH. Proc Intl Soc Mag Reson Med 18: 864.
9 Bogdanis GC, Nevill ME, Lakomy HKA, et al. (1994) Muscle metabolism during repeated sprint exercise in man. J Physiol 475: 25–6.
10 Casey A, Constantin-Teodosiu D, Howell S, et al. (1996) Metabolic response of type I and II muscle fibres during repeated bouts of maximal exercise in humans. Am J Physiol 271 (1 Pt 1): E38–43.
11 Bogdanis GC, Nevill ME, Boobis LH, et al. (1995) Recovery of power output and muscle metabolites following 30 s of maximal sprint cycling in man. J Physiol 482 (Pt 2): 467–80.
12 Billaut F, Bishop D (2009) Muscle fatigue in males and females during multiplesprint exercise. Sports Med 39 (4): 257–78.
13 Bogdanis GC, Nevill ME, Boobis LH, et al. (1996) Contribution of phosphocreatine and aerobic metabolism to energy supply during repeated sprint exercise. J Appl Physiol 80 (3): 876–84.
14 Mendez-Villanueva A, Edge J, Suriano R, et al. (2013) The recovery of repeated sprint exercise is associated with PCr resynthesis, while muscle pH and EMG amplitude remain depressed. PLOS One 7 (12): 1–10.
15 Harris R, Hultman E, Kaijser L, et al. (1975) The effect of circulatory occlusion on isometric exercise capacity and energy metabolism of the quadriceps muscle in man. Scand J Clin Lab Invest 35: 87–95.
16 Trump ME, Heigenhauser GJ, Putman CT, et al. (1996) Importance of muscle phosphocreatine during intermittent maximal cycling. J Appl Physiol 80 (5): 1574–80.
17 Balsom PD, Ekblom B, Söerlund K, et al. (1993) Creatine supplementation and dynamic high-intensity intermittent exercise. Scand J Med Sci Sports 3 (3): 143–9.
18 Birch R, Noble D, Greenhaff PL (1994) The influence of dietary creatine supplementation on performance during repeated bouts of maximal isokinetic cycling in man. Eur J Appl Physiol 69 (3): 268–70.
19 Barnett C, Hinds M, Jenkins DG (1996) Effects of creatine supplementation on multiple sprint cycling performance. Aust J Sci Med Sport 28: 35–9. 54 What causes fatigue in sport and exercise?
20 Cox G, Mujika I, Tumilty D, et al. (2002) Acute creatine supplementation and performance during a field test simulating match play in elite female soccer players. Int J Sport Nutr Exerc Metab 12 (1): 33–46.
21 Dawson B, Cutler M, Moody A, et al. (1995) Effects of oral creatine loading on single and repeated maximal short sprints. Aust J Sci Med Sport 27: 56–61.
22 McKenna M, Morton J, Selig SE, et al. (1999) Creatine supplementation increases muscle total creatine but not maximal intermittent exercise performance. J Appl Physiol 87 (6): 2244–52.
23 Mohr M, Krustrup P, Bangsbo J (2003) Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci 21: 519–28.
24 Spencer M, Lawrence S, Rechichi C, et al. (2004) Time-motion analysis of elite field hockey, with special reference to repeated-sprint activity. J Sports Sci 22: 843–50.
25 Duthie G, Pyne D, Hooper S (2003) Applied physiology and game analysis of rugby union. Sports Med 33 (13): 973–91.
26 Sirotic AC, Coutts AJ, Knowles H, et al. (2009) A comparison of match demands between elite and semi-elite rugby league competition. J Sports Sci 27 (3): 203–11.
27 Krogh A, Lindhard J (2010) The relative value of fat and carbohydrate as sources of muscular energy. Biochem J 14: 290.
28 Levine S, Gordon B, Derick C (1924) Some changes in the chemical constituents of blood following a marathon race: with special reference to the development of hypoglycaemia. J Am Med Assoc 82: 1778–9.
29 Bergström J, Hultman E (1967) A study of the glycogen metabolism during exercise in man. Scand J Clin Lab Invest 19 (3): 218–28.
30 Bergström J, Hermansen L, Hultman E, et al. (1967) Diet, muscle glycogen and physical performance. Acta Physiol Scand 71 (2): 140–50.
31 Febbraio MA, Dancey J (1999) Skeletal muscle energy metabolism during prolonged, fatiguing exercise. J Appl Physiol 87: 2341–7.
32 Parkin JM, Carey MF, Zhao S, et al. (1999) Effect of ambient temperature on human skeletal muscle metabolism during fatiguing submaximal exercise. J Appl Physiol 86: 902–8.
33 Vissing J, Haller RG (2003) The effect of oral sucrose on exercise tolerance in patients with McArdle's Disease. New Eng J Med 349: 2503–9.
34 Williams JH, Batts TW, Lees S (2012) Reduced muscle glycogen differentially affects exercise performance and muscle fatigue. ISRN Physiol (2013): 1–9.
35 Ortenblad N, Nielsen J, Saltin B, et al. (2011) Role of glycogen availability in sarcoplasmic reticulum Ca2+ kinetics in human skeletal muscle. J Physiol 589 (3): 711–25.
36 Ortenblad N, Westerblad H, Nielsen J (2013) Muscle glycogen stores and fatigue. J Physiol 591: 4405–13.
37 Chin ER, Allen DG (1997) Effects of reduced muscle glycogen concentration on force, Ca2+ release and contractile protein func-

tion in intact mouse skeletal muscle. J Physiol 498: 17–29.
38 Duhamel TA, Green HJ, Perco JG, et al. (2006) Comparative effects of a lowcarbohydrate diet and exercise plus a lot-carbohydrate diet on muscle sarcoplasmic reticulum responses in males. Am J Physiol Cell Physiol 291: C607–17.
39 Nielsen J, Schrøder HD, Rix CG, et al. (2009) Distinct effects of subcellular glycogen localization on tetanic relaxation time and endurance in mechanically skinned rat skeletal muscle fibres. J Physiol 587: 3679–90.
40 Thibodeau GA, Patton KT (1999) Anatomy and Physiology. 4th ed. p. 317. Maryland Heights, MO: Mosby.
41 Nybo L, Møller K, Pedersen BK, et al. (2003) Association between fatigue and failure to preserve cerebral energy turnover during prolonged exercise. Acta Physiol Scand 179 (1): 67–74.
42 Matsui T, Soya H (2013) Brain glycogen decrease and supercompensation with prolonged exhaustive exercise. Social Neuroscience and Public Health: 253–64.
43 Nybo L (2003) CNS fatigue and prolonged exercise: effect of glucose supple - mentation. Med Sci Sports Exerc 35 (4): 589–94.
44 Coyle EF, Coggan AR, Hemmert MK, et al. (1986) Muscle glycogen utilization during prolonged strenuous exercise when fed carbohydrate. J Appl Physiol 61 (1):
165–72.
45 Coggan AR, Coyle EF (1987) Reversal of fatigue during prolonged exercise by carbohydrate infusion or ingestion. J Appl Physiol 63 (6): 2388–95.
46 Felig P, Cherif A, Minagawa A, et al. (1982) Hypoglycaemia during prolonged exercise in normal men. N Engl J Med 306 (15): 895–900.
47 Claassen A, Lambert EV, Bosch AN, et al. (2005) Variability in exercise capacity and metabolic response during endurance exercise after a low carbohydrate diet. Int J Sport Nutr Exerc Metab 15 (2): 97–116.
48 Karelis AD, Smith JW, Passe DH, et al. (2010) Carbohydrate administration and exercise performance: what are the mechanisms involved? Sports Med 40 (9): 747–63.
49 De Bock K, Derave W, Ramaekers M, et al. (2006) Fiber type-specific muscle glycogen sparing due to carbohydrate intake before and during exercise. J Appl Physiol 102: 183–8.
50 Hargreaves M, Costill DL, Coggan A, et al. (1984) Effect of carbohydrate feedings on muscle glycogen utilization and exercise performance. Med Sci Sports Exerc 16 (3): 219–22.
51 Tsintzas OK, Williams C, Boobis L, et al. (1995) Carbohydrate ingestion and glycogen utilization in different muscle fibre types in man. J Physiol 489 (1): 243–50.
52 Tsintzas K, Williams C, Constantin-Teodosiu D, et al. (2001) Phosphocreatine degradation in type I and type II muscle fibres during submaximal exercise in man: effect of carbohydrate ingestion. J Physiol 537 (1): 305–11.
53 Cohen D (2012) The truth about sports drinks. B Med J 345: 1–8.
54 Friedlander AL, Casazza GA, Horning MA, et al. (1999) Endurance training increases fatty acid turnover, but not fat oxidation, in young men. J Appl Physiol 86: 2097–105.
55 Friedlander AL, Casazza GA, Horning MA, et al. (1998) Effects of exercise intensity and training on lipid metabolism in young women. Am J Physiol 275: E853–63.
56 Martin WH, Dalsky GP, Hurley BF, et al. (1993) Effect of endurance training on plasma free fatty acid turnover and oxidation during exercise. Am J Physiol 265: E708–14.
57 Phillips SM, Green HJ, Tarnolpolsky MA, et al. (1996) Effects of training duration on substrate turnover and oxidation during exercise. J Appl Physiol 81: 2182–91.
58 Van Proeyen K, Szlufcik K, Nielens H, et al. (2011) Beneficial metabolic adaptations due to endurance exercise training in the fasted state. J Appl Physiol 110: 236–45.
59 De Bock K, Derave W, Eijnde BO, et al. (2008) Effect of training in the fasted state on metabolic responses during exercise with carbohydrate intake. J Appl Physiol 104: 1045–55.
60 Talanian JL, Holloway GP, Snook LA, et al. (2010) Exercise training increases sarcolemmal and mitochondrial fatty acid transport proteins in human skeletal muscle. Am J Physiol 299: E180–8.

منابع

1 Fletcher WM, Hopkins FG (1907) Lactic acid in amphibian muscle. J Physiol 35: 247–309.
2 Noakes TD, Gibson A (2004) Logical limitations to the ‘catastrophe’ models of fatigue during exercise in humans. Br J Sports Med 38: 648–9.
3 Hill AV, Lupton H (1923) Muscular exercise, lactic acid, and the supply and utilization of oxygen. Q J Med 16: 135–71.
4 Robergs RA, Ghiasvand F, Parker D (2004) Biochemistry of exercise-induced metabolic acidosis. Am J Physiol Regul Integr Comp Physiol 287: R502–16.
5 Fitts RH, Holloszy JO (1976) Lactate and contractile force in frog muscle during development of fatigue and recovery. Am J Physiol 231: 430–3.
6 Spriet LL, Sodeland K, Bergstrom M, et al. (1987) Skeletal muscle glycogenolysis, glycolysis, and pH during electrical stimulation in men. J Appl Physiol 62: 616–21.
7 Cairns SP (2006) Lactic acid and exercise performance: culprit or friend? Sports Med 36 (4): 279–91.
8 Lamb GD, Recupero E, Stephenson DG (1992) Effect of myoplasmic pH on excitation-contraction coupling in skeletal muscle fibres of the toad. J Physiol 448: 211–24.
9 Fitts RH (2008) The cross-bridge cycle and skeletal muscle fatigue. J Appl Physiol 104: 551–8.
10 Balsom PD, Seger JY, Sjödin B, et al. (1992) Physiological responses to maximal intensity intermittent exercise. Eur J Appl Physiol 65: 144–9.

11 Brooks S, Nevill ME, Meleagros L, et al. (1990) The hormonal responses to repetitive brief maximal exercise in humans. Eur J Appl Physiol 60: 144–8.
12 Christmass MA, Dawson B, Arthur PG (1999) Effect of work and recovery duration on skeletal muscle oxygenation and fuel use during sustained intermittent exercise. Eur J Appl Physiol 80: 436–47.
13 Gaitanos GC, Williams C, Boobis LH, et al. (1993) Human muscle metabolism during intermittent maximal exercise. J Appl Physiol 75: 712–9.
14 Bishop D, Edge J, Davis C, et al. (2004) Induced metabolic alkalosis affects muscle metabolism and repeated sprint ability. Med Sci Sports Exerc 36: 807–13.
15 Bishop D, Claudius B (2005) Effects of induced metabolic alkalosis on prolonged intermittent-sprint performance. Med Sci Sports Exerc 37: 759–67.
16 Lavender G, Bird SR (1989) Effect of sodium bicarbonate ingestion upon repeated sprints. Br J Sports Med 23: 41–5.
17 Lindinger MI, Kowalchuk JM, Heigenhauser GJF (2005) Applying physiochemical
principles to skeletal muscle acid-base status. Am J Physiol Regul Integr Comp Physiol 289: R891–4.
18 Brooks GA (2010) What does glycolysis make and why is it important? J Appl Physiol 108: 1450–1.
19 Robergs RA, Ghiasvand F, Parker D (2004) Biochemistry of exercise-induced metabolic acidosis. Am J Physiol Regul Integr Comp Physiol 287: R502–16.
20 Robergs RA, Ghiasvand F, Parker D (2005) Lingering construct of lactic acidosis. Am J Physiol Regul Integr Comp Physiol 289: R904–10.
21 Böning D, Strobel G, Beneke R, et al. (2005) Lactic acid still remains the real cause of exercise-induced metabolic acidosis. Am J Physiol Regul Integr Comp Physiol 289: R902–3.
22 Böning D, Maassen N (2008) Point: counterpoint: lactic acid is/is not the only physiochemical contributor to the acidosis of exercise. J Appl Physiol 105: 358–9.
23 Lindinger MI (2011) Lactate: metabolic fuel or poison? Exp Physiol 96: 1099 100.
24 Brooks GA (2007) Lactate: link between glycolytic and oxidative metabolism. Sports Med 37: 341–3.
25 Brooks GA (2009) Cell-cell and intracellular lactate shuttles. J Physiol 587: 5591–600.
26 Ide K, Schmalbruch IK, Quistorff B, Horn A, Secher NH (2000) Lactate, glucose and O2 uptake in human brain during recovery from maximal exercise. J Physiol 522: 159–64.
27 Quistorff B, Secher NH, Van Lieshout JJ (2008) Lactate fuels the human brain during exercise. Journal Fed Am Soc Exp Biol 22: 3443–9.
28 Morris DM, Schafer RS, Fairbrother KR, Woodall MW (2011) Effects of lactate consumption on blood bicarbonate levels and performance during high-intensity exercise. Int J Sport Nutr Exerc Metab 21: 311–7.
29 Monedero J, Donne B (2000) Effect of recovery interventions on lactate removal and subsequent performance. Int J Sports Med 21: 593–7.
30 Mense S (2009) Algesic agents exciting muscle nociceptors. Exp Brain Res 196: 89–100.
31 Aminian-Far A, Hadian M, Olyaei G, Talebian S, Bakhtiary A (2011) Wholebody vibration and the prevention and treatment of delayed-onset muscle soreness. J Athl Perf 46: 43–9.
32 Lewis PB, Ruby D, Bush-Joseph CA (2012) Muscle soreness and delayed onset muscle soreness. Clin Sports Med 31: 255–62.
33 Wada M, Kuratani M, Kanzaki K (2013) Calcium kinetics of sarcoplasmic reticulum and muscle fatigue. J Phys Fitness Sports Med 2: 169–78.
34 Nielsen OB, de Paoli F, Overgaard K (2001) Protective effects of lactic acid on force production in rat skeletal muscle. J Physiol 536: 161–6.
35 Kristensen, M, Albertsen, J, Rentsch, M, Juel, C (2005) Lactate and force production in skeletal muscle, J Physiol 562: 521–6.
36 Pedersen TH, de Paoli F, Nielsen OB (2005) Increased excitability of acidified skeletal muscle: role of chloride conductance. J Gen Physiol 125: 237–46.
37 Bishop D, Edge J, Goodman C (2004) Muscle buffer capacity and aerobic fitness are associated with repeated-sprint ability in women. Eur J Appl Physiol 92: 540–7.
38 Krustrup (2003) Muscle metabolites during a football match in relation to a decreased sprinting ability. Communication to the Fifth World Congress of Soccer and Science, Lisbon, Portugal.
39 Messonnier L, Denis C, Féasson L, et al. (2006) An elevated sarcolemmal lactate (and proton) transport capacity is an advantage during muscle activity in healthy humans. J Appl Physiol. DOI: 10.1152/japplphysiol.00807.2006.
40 Spriet LL, Lindinger MI, McKelvie RS, et al. (1989) Muscle glycogenolysis and H+ concentration during maximal intermittent cycling. J Appl Physiol 66: 8–13.
41 Gaitanos GC, Williams C, Boobis LH, Brooks S (1993) Human muscle metabolism during intermittent maximal exercise. J Appl Physiol 75: 712–9.
42 McCartney N, Spriet LL, Heigenhauser GJF, Kowalchuk JM, Sutton JR, Jones NL (1986) Muscle power and metabolism in maximal intermittent exercise. J Appl Physiol 60: 1164–9.
43 Katz, A, Costill, DL, King, DS, Hargreaves, M, Fink, WJ (1984) Maximal exercise tolerance after induced alkalosis. Int J Sports Med 5: 107–10.
44 Bangsbo, J, Madsen, K, Kiens, B, Richter, EA (1996) Effect of muscle acidity on muscle metabolism and fatigue during intense exercise in man. J Physiol 492: 587–96.
45 Lamb, GD, Stephenson, DG, Bangsbo, J, Juel, C (2006) Point: Counterpoint: Lactic acid accumulation is an advantage/disadvantage during muscle activity. J App Physiol 100: 1410–14.

46 Girard O, Mendez-Villanueva A, Bishop D (2011) Repeated-sprint ability. Part 1: factors contributing to fatigue. Sports Med 41: 673–94.
47 Cady EB, Jones DA, Moll A (1989) Changes in force and intracellular metabolites during fatigue of human skeletal muscle. J Physiol 418: 327–37.
48 Debold EP, Dave H, Fitts RH (2004) Fiber type and temperature dependence of inorganic phosphate: implications for fatigue. Am J Physiol 287: C673–81.
49 Metzger JM, Moss RL (1990) Calcium-sensitive cross-bridge transitions in mammalian fast and slow twitch skeletal muscle fibers. Science 247: 1088–90.
50 Fitts RH (1994) Cellular mechanisms of muscle fatigue. Physiol Rev 74: 49–94.
51 Knuth ST, Dave H, Peters JR, Fitts RH (2006) Low cell pH depresses peak power in rat skeletal muscle fibres at both 30°C and 15°C: implications for muscle fatigue. J Physiol 575: 887–99.
52 Nielsen HB, Bredmose PP, Stromstad M, Volianitis S, Quistorff B, Secher NH (2002) Bicarbonate attenuates arterial desaturation during maximal exercise in humans. J Appl Physiol 93: 724–31.
53 Knicker AJ, Renshaw I, Oldham ARH, Cairns SP (2011) Interactive processes link the multiple symptoms of fatigue in sport competition. Sports Med 41: 307–28.
54 Nybo L, Secher NH (2004) Cerebral perturbations provoked by prolonged exercise. Prog Neurobiol 72: 223–61.
55 Amann M, Calbert JAL (2008) Convective oxygen transport and fatigue. J Appl Physiol 104: 861–70.
56 Gandevia SC, Allen GM, Butler JE, Taylor JL (1996) Supraspinal factors in human muscle fatigue: evidence for suboptimal output from the motor cortex. J Physiol 490: 529–36.
57 Swank A, Robertson RJ (1989) Effect of induced alkalosis on perception of exertion during intermittent exercise. J Appl Physiol 67: 1862–7.
58 Tate P (2009) Seeley's Principles of Anatomy and Physiology. McGraw Hill, New York.

منابع

1 Casa DJ, Armstrong LE, Hillman SK, Montain SJ, Reiff RV, Rich BSE, Roberts WO, Stone JA (2000) National Athletic Trainers Association position statement: fluid replacement for athletes. J Athl Train 35: 212–24.
2 Sawka MN, Burke LM, Eichner ER, Maughan RJ, Montain SJ, Stachenfeld NS (2007) American College of Sports Medicine Position Stand: exercise and fluid replacement. Med Sci Sports Exerc 39: 377–90.
3 Logan-Sprenger HM, Heigenhauser GJ, Killian KJ, Spreit LL (2012) Effects of dehydration during cycling on skeletal muscle metabolism in females. Med Sci Sports Exerc 44: 1949–57.
4 Logan-Sprenger HM, Heigenhauser GJ, Jones GL, Spreit LL (2013) Increase in skeletal-muscle glycogenolysis and perceived exertion with progressive dehydra - tion during cycling in hydrated men. Int J Sport Nutr Exerc Metab 23: 220–9.
5 Ganio MS, Armstrong LE, Casa DJ, McDermott BP, Lee EC, Yamamoto LM, Marzano S, Lopez RM, Jimenez L, Bellego L, Chevillotte E, Lieberman HR (2011) Mild dehydration impairs cognitive performance and mood of men. Br J Nutr 106; 1535–43.
6 Casa DJ, Clarkson PM, Roberts WO (2005) American College of Sports Medicine roundtable on hydration and physical activity: consensus statements. Curr Sports Med Rep 4: 115–27.
7 Cheuvront SN, Carter III R, Sawka MN (2003) Fluid balance and endurance exercise performance. Curr Sports Med Rep 2: 202–8.
8 Sawka MN, Noakes TD (2007) Does dehydration impair exercise performance? Med Sci Sports Exerc 39: 1209–17.
9 Sawka MN (1992) Physiological consequences of hypohydration: exercise performance and thermoregulation. Med Sci Sports Exerc 24: 657–70.
10 Craig FN, Cummings EG (1966) Dehydration and muscular work. J Appl Physiol 21: 670–4.
11 Dougherty KA, Baker LB, Chow M, Kenney WL (2006) Two percent dehydration impairs and six percent carbohydrate drink improves boys basketball skills. Med Sci Sports Exerc 38: 1650–8.
12 Armstrong LE, Costill DL, Fink WJ (1985) Influence of diuretic-induced dehydration on competitive running performance. Med Sci Sports Exerc 17: 456–61.
13 Dugas JP, Oosthuizen V, Tucker R, Noakes TD (2006) Drinking 'ad libitum' optimises performance and physiological function during 80 km indoor cycling trials in hot and humid conditions with appropriate convective cooling. Med Sci Sports Exerc 38: S176.
14 Jeukendrup A, Saris WHM, Brouns F, Kester ADM (1996) A new validated endurance performance test. Med Sci Sports Exerc 28: 266–70.
15 Mündel T (2011) To drink or not to drink? Explaining 'contradictory findings' in fluid replacement and exercise performance: evidence from a more valid model for real-life competition. Br J Sports Med 45: 2.
16 Dion T, Savoie FA, Audrey A, Gariepy C, Goulet EDB (2013) Half-marathon running performance is not improved by a rate of fluid intake above that dictated by thirst sensation in trained distance runners. Eur J Appl Physiol 113: 3011–20.
17 Marino FE, Cannon J, Kay D (2011) Neuromuscular responses to hydration in moderate to warm ambient conditions during self-paced high-intensity exercise. Br J Sports Med 44: 961–7.
18 Nolte HW, Noakes TD, van Vuuren B (2011) Protection of total body water content and absence of hyperthermia despite 2% body mass loss ('voluntary dehydration') in soldiers drinking ad libitum during prolonged exercise in cool environmental conditions. Br J Sports Med 45: 1106–12.
19 Zouhal H, Groussard C, Minter G, Vincent S, Cretual A, Gratas-Delamarche A, Delamarche P, Noakes TD (2011) Inverse relationship between percentage body weight change and finishing time in 643 forty two-kilometre marathon runners. Br J Sports Med

45: 1101–5.
20 Aragón-Vargas LF, Wilk B, Timmons BW, Bar-Or O (2013) Body weight changes in child and adolescent athletes during a triathlon competition. Eur J Appl Physiol 113: 233–9.
21 Kao WF, Shy CL, Yang XW, Hsu TF, Chen JJ, Kao WC, Polun C, Huang YJ, Kuo FC, Huang CI, Lee CH (2008) Athletic performance and serial weight changes during 12-and 24-hour ultra-marathons. Clin J Sport Med 18: 155–8.
22 Rüst CA, Knechtle B, Knechtle P, Wirth A, Rosemann T (2012) Body mass change and ultraendurance performance: a decrease in body mass is associated with an increased running speed in male 100-km ultramarathoners. J Strength Cond Res 6: 1505–16.
23 Goulet ED (2013) Effect of exercise-induced dehydration on endurance performance: evaluating the impact of exercise protocols on outcomes using a meta-analytic procedure. Br J Sports Med 47: 679–86.
24 Maughan RJ, Shirreffs SM, Leiper JB (2007) Errors in the estimation of hydration status from changes in body mass. J Sports Sci 25: 797–804.
25 Zouhal H, Groussard C, Vincent S, Jacob C, Abderrahman AR, Delamarche P, Gratas-Delamarche A (2009) Athletic performance and weight changes during the 'Marathon of Sands' in athletes well-trained in endurance. Int J Sports Med 30: 516–21.
26 Dugas JP, Oosthuizen U, Tucker R, Noakes TD (2009) Rates of fluid ingestion alter pacing but not thermoregulatory responses during prolonged exercise in hot and humid conditions with appropriate convective cooling. Eur J Appl Physiol 105: 69–80.
27 Gigou PY, Dion T, Asselin A, Berrigan F, Goulet ED (2012) Pre-exercise hyperhydration-induced bodyweight gain does not alter prolonged treadmill running time-trial performance in warm ambient conditions. Nutrients 4: 949–66.
28 Goulet EDB (2011) Effect of exercise-induced dehydration on time-trial exercise performance: a meta-analysis. Br J Sports Med 45: 1149–56.
29 Convertino VA (1983) Heart rate and sweat rate responses associated with exercise-induced hypervolemia. Med Sci Sports Exerc 15: 77–82.
30 Mischler I, Boirie Y, Gachon P, Pialoux V, Mounier R, Rousset P, Coudert J, Fellmann, N (2003) Human albumin synthesis is increased by an ultra-endurance trial. Med Sci Sports Exerc 35: 75–81.
31 Leiper JB, McCormick K, Robertson JD, Whiting PH, Maughan RJ (1988) Fluid homeostasis during prolonged low-intensity walking on consecutive days. Clin Sci (London) 75: 63–70.
32 Fellmann N, Ritz P, Ribeyre J, Beaufrère B, Delaître M, Coudert J (1999) Intracellular hyperhydration induced by a 7-day endurance race. Eur J Appl Physiol 80: 353–9.
33 Fellmann N, Sagnol M, Bedu M, Falgairette G, Van Praagh E, Gaillard G, Jouanel P, Coudert J (1988) Enzymatic and hormonal responses following a 24 h endurance run and a 10 h triathlon race. Eur J Appl Physiol 57: 545–53.
34 Skenderi KP, Kavouras SA, Anastasiou CA, Yiannakouris N, Matalas AL (2006) Exertional rhabdomyolysis during a 246-km continuous running race. Med Sci Sports Exerc 38: 1054–7.
35 Knechtle B, Duff B, Schulze I, Kohler G (2008) A multi-stage ultra-endurance run over 1,200 km leads to a continuous accumulation of total body water. J Sports Sci Med 7: 357–64.
36 Knechtle B, Wirth A, Knechtle P, Rosemann T (2009) Increase of total body water with decrease of body mass while running 100 km nonstop – formation of edema? Res Quart Exerc Sport 80: 593–603.
37 Noakes TD, Sharwood K, Collins M, Perkins DR (2004) The dipsomania of great distance: water intoxication in an ironman triathlete. Br J Sports Med 38: e16.
38 Knechtle B, Senn O, Imoberdorf R (2011) No fluid overload in male ultra-runners during a 100 km ultra-run. Res Sports Med 19: 14–27.
39 Rosner MH, Kirven J (2007) Exercise-associated hyponatremia. Clin J Am Soc Nephrol 2: 151–61.
40 Almond CSD, Shin AY, Fortescue EB, Mannix RC, Wypij D, Binstadt BA, Duncan CN, Olson DP, Salerno AE, Newburger JW, Greenes DS (2005) Hyponatraemia among runners in the Boston Marathon. New Eng J Med 352: 1550–6.
41 Montain SJ, Cheuvront SN, Sawka MN (2005) Exercise associated hyponatraemia: quantitative analysis to understand the aetiology. Br J Sports Med 40: 98–106.
42 Sharwood KA, Collins M, Goedecke JH, Wilson G, Noakes TD (2004) Weight changes, medical complications, and performance during an Ironman triathlon. Br J Sports Med 38: 718–24.
43 Noakes TD, Speedy DB (2006) Case proven: exercise associated hyponatraemia is due to overdrinking. So why did it take 20 years before the original evidence was accepted? Br J Sports Med 40: 567–72.
44 Cheung SS, Sleivert GG (2004) Multiple triggers for hyperthermic fatigue and exhaustion. Exerc Sport Sci Rev 32: 100–6.
45 Maughan RJ (2012) Thermoregulatory aspects of performance. Exp Physiol 97: 325–6.
46 Nybo L (2008) Hyperthermia and fatigue. J Appl Physiol 104: 871–8.
47 Nybo L (2012) Brain temperature and exercise performance. Exp Physiol 97: 333–9.
48 Nybo L, Nielsen B (2001) Hyperthermia and central fatigue during prolonged exercise in humans. J Appl Physiol 91: 1055–60.
49 Sawka MN, Cheuvront SN, Kenefick RW (2012) High skin temperature and hypohydration impair aerobic performance. Exp Physiol 97: 327–32.
50 González-Alonso J, Calbet JAL, Nielsen B (1998) Muscle blood flow is reduced with dehydration during prolonged exercise in humans. J Physiol 513: 895–905.
51 González-Alonso J, Calbet JAL, Nielsen B (1999) Metabolic and thermodynamic responses to dehydration-induced reductions in muscle blood flow in exercising humans. J Physiol 520: 577–89.
52 Nybo L, Møller K, Volianitis S, Nielsen B, Secher NH (2002) Effects of hyperthermia on cerebral blood flow and metabolism during prolonged exercise in humans. J Appl Physiol 93: 58–64.
53 Tucker R, Marle T, Lambert EV, Noakes TD (2004) Impaired exercise performance in the heat is associated with an anticipatory

reduction in skeletal muscle recruitment. Pflug Arch 448: 422–30.
54 Rasmussen P, Nielsen J, Overgaard M, Krogh-Madsen R, Gjedde A, Secher NH, Petersen NC (2010) Reduced muscle activation during exercise related to brain oxygenation and metabolism in humans. J Physiol 588: 1985–95.
55 Caputa SS, McLellan TM (1986) Effect of brain and trunk temperatures on exercise performance in goats. Pflug Arch Physiol 406: 184–9.
56 White MD, Greiner JG, McDonald PLL (2011) Point: Humans do demonstrate selective brain cooling during hyperthermia. J Appl Physiol 110: 569–71.
57 Marino FE (2011) The critical limiting temperature and selective brain cooling: neuroprotection during exercise? Int J Hyperther 27: 582–90.
58 Nielsen B, Hales JRS, Strange NJ, Christensen NJ, Warberg J, Saltin B (1993) Human circulatory and thermoregulatory adaptations with heat acclimation and exercise in a hot, dry environment. J Physiol 460: 467–85.
59 Nielsen B, Savard G, Richter EA, Hargreaves M, Saltin B (1990) Muscle blood flow and muscle metabolism during exercise and heat stress. J Appl Physiol 69: 1040–6.
60 Ely BR, Ely MR, Cheuvront SN, Kenefick RW, DeGroot DW, Montain SJ (2009) Evidence against a 40°C core temperature threshold for fatigue in humans. J Appl Physiol 107: 1519–25.
61 Nybo L (2007) Exercise and heat stress: cerebral challenges and consequences. Progress Brain Res 162: 29–43.
62 Thomas MM, Cheung SS, Elder GC, Sleivert GG (2006) Voluntary muscle activation is impaired by core temperature rather than local muscle temperature. J Appl Physiol 100: 1361–9.
63 Hales JRS, Hubbard RW, Gaffin SL (1996) Limitation of heat tolerance. In: Handbook of Physiology, edited by Fregley MJ, Blatteis CM. New York: Oxford University Press.
64 Dubois M, Sato S, Lee DE, Bull JM, Smith R, White BG, Moore H, Macnamara TE (1980) Electroencephalographic changes during whole body hyperthermia in humans. Electroencephalogr Clin Neurophysiol 50: 486–95.
65 Montain SJ, Sawka MN, Cadarette BS, Quigley MD, McKay JM (1994) Physiological tolerance to uncompensable heat stress: effects of exercise intensity, protective clothing, and climate. J Appl Physiol 77: 216–22.
66 Latzka WA, Sawka MN, Montain SJ, Skrinar GS, Fielding RA, Matott RP, Pandolf KB (1998) Hyperhydration: tolerance and cardiovascular effects during uncompensable heat stress. J Appl Physiol 84: 1858–64.
67 Kenefick RW, Cheuvront SN, Palombo LJ, Ely BR, Sawka MN (2010) Skin temperature modifies the impact of hypohydration on aerobic performance. J Appl Physiol 109: 79–86.
68 Byrne C, Lee JK, Chew SA, Lim CL, Tan EY (2006) Continuous thermoregulatory response to mass-participation distance running in the heat. Med Sci Sports Exerc 38: 803–10.
69 Lee JK, Nio AQ, Lim CL, Teo EY, Byrne C (2010) Thermoregulation, pacing and fluid balance during mass participation distance running in a warm and humid environment. Eur J Appl Physiol 109: 887–98.

منابع

1 Allen DG, Lamb GD, Westerblad H (2008) Skeletal muscle fatigue: cellular mechanisms. Physiol Rev 88: 287–332.
2 Stephenson D (2006) Tubular system excitability: an essential component of excitation-contraction coupling in fast twitch fibres of vertebrate skeletal muscle. J Muscle Res Cell Motil 27: 259–74.
3 Clausen T, Nielsen OB, Harrison AP, Flatman JA, Overgaard K (1998) The Na+, K+ pump and muscle excitability. Acta Physiol Scand 162: 183–90.
4 Clausen T (2008) Role of Na+, K+ pumps and transmembrane Na+, K+ distribution in muscle function. Acta Physiol 192: 339–49.
5 McKenna MJ, Bangsbo J, Renaud JM (2008) Muscle K+, Na+, and Cl– disturbances and Na+, K+ pump inactivation: implications for fatigue. J Appl Physiol 104: 288–95.
6 Pedersen KK, Nielsen OB, Overgaard K (2013) Effects of high-frequency stimulation and doublets on dynamic contractions in rat soleus muscle exposed
to normal and high extracellular [K+]. Physiol Rep 1: 1–11.
7 Sejersted OM, Sjøgaard G (2000) Dynamics and consequences of K+ shifts in skeletal muscle and heart during exercise. Physiol Rev 80: 1411–81.
8 Clausen T (2011) In isolated skeletal muscle, excitation may increase extracellular K+ 10-fold; how can contractility be maintained? Exp Physiol 96: 356–68.
9 Davies NW (1990) Modulation of ATP-sensitive K+ channels in skeletal muscle by intracellular protons. Nature 343: 375.
10 Fitts RH, Balog EM (1996) Effect of intracellular and extracellular ion changes on E-C coupling and skeletal muscle fatigue. Acta Physiol Scand 156: 169–81.
11 Medbø JI, Sejersted OM (1990) Plasma potassium changes with high intensity exercise. J Physiol 421: 105–22.
12 Nordsborg N, Mohr M, Pedersen LD, Nielsen JJ, Langberg H, Bangsbo J (2003) Muscle interstitial K+ kinetics during intensity exhaustive exercise: effect of previous arm exercise. Am J Physiol Regul Integr Comp Physiol 285: R143–8.
13 Balog EM, Fitts RH (1996) Effects of fatiguing stimulation on intracellular Na+ and K+ in frog skeletal muscle. J Appl Physiol 81: 679–85.
14 Juel C (1986) K+ and sodium shifts during in vitro isometric muscle contraction, the time course of the ion-gradient recovery. Pflugers Arch 406: 458–63.
15 Jones DA, Bigland-Ritchie B, Edwards RHT (1979) Excitation frequency and muscle fatigue: mechanical responses during voluntary and stimulated contractions. Exp Neurol 64: 414–27.
16 Bigland-Ritchie B, Jones DA, Woods JJ (1979) Excitation frequency and muscle fatigue: electrical responses during human vol-

untary and stimulated contractions. Exp Neurol 64: 414–27.
17 Nielsen OB, de Paoli FV (2007) Regulation of Na+–K+ homeostasis and excitability in contracting muscles: implications for fatigue. Appl Physiol Nutr Metab 32: 974–84.
18 Clausen T (2003) Na+, K+ pump regulation and skeletal muscle contractility. Physiol Rev 83: 1269–324.
19 Cairns SP, Dulhunty AF (1995) High-frequency fatigue in rat skeletal muscle: role of extracellular ion concentrations. Muscle Nerve 18: 890–8.
20 Dutka TL, Lamb GD (2007) Transverse tubular system depolarisation reduces tetanic force in rat skeletal muscle fibres by impairing action potential repriming. Am J Physiol Cell Physiol 292: C2112–21.
21 Thompson LV, Balog EM, Riley DA, Fitts RH (1992) Muscle fatigue in frog semitendinosus: alterations in contractile function. Am J Physiol Cell Physiol 262: C1500–6.
22 Bangsbo J, Madsen K, Kiens B, Richter EA (1996) Effect of muscle acidity on muscle metabolism and fatigue during intensity exercise in man. J Physiol 495: 587–96.
23 Bangsbo J, Graham T, Johansen L, Strange S, Christensen C, Saltin B (1992) Elevated muscle acidity and energy production during exhaustive exercise in humans. Am J Physiol Regul Integr Comp Physiol 263: R891–9.
24 Nielsen JJ, Mohr M, Klarskov C, Kristensen M, Krustrup P, Juel C, Bangsbo J (2004) Effects of high-intensity intermittent training on potassium kinetics and performance in human skeletal muscle. J Physiol 554: 857–70.
25 Mohr M, Nordsborg N, Nielsen JJ, Pedersen LD, Fischer C, Krustrup P, Bangsbo J (2004) Potassium kinetics in human muscle interstitium during repeated intense exercise in relation to fatigue. Pflugers Arch 448: 452–6.
26 Bigland-Ritchie B, Cafarelli E, Vøllestad NK (1986) Fatigue of submaximal static contractions. Acta Physiol Scand Suppl 556: 137–48.
27 Bigland-Ritchie B, Furbush F, Woods JJ (1986) Fatigue of intermittent submaximal voluntary contractions: central and peripheral factors. J Appl Physiol 61: 421–9.
28 Bigland-Ritchie B, Johansson R, Lippold OC, Woods JJ (1983) Contractile speed and EMG changes during fatigue of sustained maximal voluntary contractions. J Neurophysiol 50: 313–24.
29 Sandiford SD, Green HJ, Duhamel TA, Schertzer JD, Perco JD, Ouyang J (2005) Muscle Na-K-pump and fatigue responses to progressive exercise in normoxia and hypoxia. Am J Physiol Regul Integr Comp Physiol 289: R441–9.
30 West W, Hicks A, Mckelvie R, O'Brien J (1996) The relationship between plasma K+, muscle membrane excitability and force following quadriceps fatigue. Pflugers Arch 432: 43–9.
31 Enoka RM, Stuart DG (1992) Neurobiology of muscle fatigue. J Appl Physiol 72: 1631–48.
32 Bigland-Ritchie B, Woods JJ (1984) Changes in muscle contractile properties and neural control during human muscular fatigue. Muscle Nerve 7: 691–9.
33 Balog EM, Thompson LV, Fitts RH (1994) Role of sarcolemma action potentials and excitability in muscle fatigue. J Appl Physiol 76: 2157–62.
34 Gandevia SC (2001) Spinal and supraspinal factors in human muscle fatigue. Physiol Rev 81: 1725–89.
35 Bigland-Ritchie B, Zijdewind I, Thomas CK (2000) Muscle fatigue induced by stimulation with and without doublets. Muscle Nerve 23: 1348–55.
36 Juel C (1988) Muscle action potential propagation velocity changes during activity. Muscle Nerve 11: 714–9.
37 Lännergren J, Westerblad H (1986) Force and membrane potential during and after fatiguing, continuous high-frequency stimulation of single Xenopus muscle fibres. Acta Physiol Scand 128: 359–68.
38 Clausen T, Nielsen OB, Harrison AP, Flatman JA, Overgaard K (1998) The Na+, K+ pump and muscle excitability. Acta Physiol Scand 162: 183–90.
39 Wallinga W, Meijer SL, Alberink MJ, Vliek M, Wienk ED, Ypey DL (1999) Modelling action potentials and membrane currents of mammalian skeletal muscle fibres in coherence with potassium concentration changes in the T-tubular system. Eur Biophys J 28: 317–29.
40 Van Beekvelt MC, Drost G, Rongen G, Stegeman DF, Van Engelen BG, Zwarts MJ (2006) Na+-K+-ATPase is not involved in the warming-up phenomenon in generalized myotonia. Muscle Nerve 33: 514–23.
41 Davies NW, Standen NB, Stanfield PR (1992) The effect of intracellular pH on ATP-dependent potassium channels of frog skeletal muscle. J Physiol 445: 549–68.
42 Davies NW, Standen NB, Stanfield PR (1991) ATP-dependent potassium channels of muscle cells: their properties, regulation and possible function. J Bioenerg Biomembr 23: 509–23.
43 Hansen AK, Clausen T, Nielsen OB (2005) Effects of lactic acid and catechol - amines on contractility in fast twitch muscles exposed to hyperkalemia. Am J Physiol Cell Physiol 289: C104–12.
44 Kristensen M, Albertsen J, Rentsch M, Juel C (2005) Lactate and force production in skeletal muscle. J Physiol 562: 521–6.
45 Overgaard K, Højfeldt G, Nielsen O (2010) Effects of acidification and increased extracellular potassium on dynamic muscle contractions in isolated rat muscles. J Physiol 588: 5065–76.
46 Pedersen TH, Nielsen OB, Lamb GD, Stephenson DG (2004) Intracellular acidosis enhances the excitability of working muscle. Science 305: 1144–7.
47 Pedersen TH, de Paoli F, Nielsen OB (2005) Increased excitability of acidified skeletal muscle: role of chloride conductance. J Gen Physiol 125: 237–46.
48 Place N (2008) Is interstitial K+ accumulation a key factor in the fatigue process under physiological conditions? J Physiol 586: 1207–8.
49 Dutka TL, Cole L, Lamb GD (2005) Ca2+ phosphate precipitation in the sarcoplasmic reticulum reduces action potential-mediated

Ca2+ release in mammalian skeletal muscle. Am J Physiol Cell Physiol 289: C1502–12.
50 Posterino GS, Lamb GD (2003) Effect of sarcoplasmic reticulum Ca2+ content on action potential-induced Ca2+ release in rat skeletal muscle fibres. J Physiol 551: 219–37.
51 Chin ER, Allen DG (1997) Effects of reduced muscle glycogen concentration on force, Ca2+ release and contractile protein function in intact mouse skeletal muscle. J Physiol 498: 17–29.
52 Duhamel TA, Perco JG, Green HJ (2006) Manipulation of dietary carbohydrates after prolonged effort modifies muscle sarcoplasmic reticulum responses in exercising males. Am J Physiol Regul Integr Comp Physiol 291: R1100–10.
53 Duhamel TA, Green HJ, Stewart RD, Foley KP, Smith IC, Ouyang J (2007) Muscle metabolic, SR Ca2+-cycling responses to prolonged cycling, with and without glucose supplementation. J Appl Physiol 103: 1986–98.
54 Helander I, Westerblad H, Katz A (2002) Effects of glucose on contractile function, [Ca2+]i and glycogen in isolated mouse skeletal muscle. Am J Physiol Cell Physiol 282: C1306–12.
55 Lees SJ, Franks PD, Spangenburg EE, Williams JH (2001) Glycogen and glycogen phosphorylase associated with sarcoplasmic reticulum: effects of fatiguing activity. J Appl Physiol 91: 1638–44.
56 Duhamel TA, Green HJ, Perco JD, Sandiford SD, Ouyang J (2004) Human muscle sarcoplasmic reticulum function during submaximal exercise in normoxia and hypoxia. J Appl Physiol 97: 180–7.
57 Duhamel TA, Green HJ, Sandiford SD, Perco JG, Ouyang J (2004) Effects of progressive exercise and hypoxia on human muscle sarcoplasmic reticulum function. J Appl Physiol 97: 188–96.
58 Favero TG (1999) Sarcoplasmic reticulum Ca2+ release and muscle fatigue. J Appl Physiol 87: 471–83.
59 Korge P (1998) Factors limiting ATPase activity in skeletal muscle. In: Biochemistry of Exercise X, edited by Hargreaves M and Thompson M. Champaign, IL: Human Kinetics: 125–34.
60 Ørtenblad N, Westerblad H, Nielsen J (2013) Muscle glycogen stores and fatigue. J Physiol 591: 4405–13.
61 Xu K, Zweier J, Becker L (1995) Functional coupling between glycolysis and sarcoplasmic reticulum Ca2+ transport. Circ Res 77: 88–97.
62 Coupland ME, Puchert E, Ranatunga KW (2001) Temperature dependence of active tension in mammalian (rabbit psoas) muscle fibres: effect of inorganic phosphate. J Physiol 36: 879–91.
63 Varian KD, Raman S, Janssen PML (2006) Measurement of myofilament calcium sensitivity at physiological temperature in intact cardiac trabeculae. Am J Physiol 290: H2092–7.
64 Martyn DA, Gordon AM (1992) Force and stiffness in glycerinated rabbit psoas fibers: Effects of calcium and elevated phosphate. J Gen Physiol 99: 795–816.
65 Millar NC, Homsher E (1990) The effect of phosphate and calcium on force generation in glycerinated rabbit skeletal muscle fibers: a steady-state and transient kinetic study. J Biol Chem 265: 20234–40.
66 Steele DS, Duke AM (2003) Metabolic factors contributing to altered Ca2+ regulation in skeletal muscle fatigue. Acta Physiol Scand 179: 39–48.
67 Jahnen-Dechent W, Ketteler M (2012) Magnesium basics. Clin Kidney J 5: 3–14.
68 Laver DR, Lenz GKE, Dulhunty AF (2001) Phosphate ion channels in the sarcoplasmic reticulum of rabbit skeletal muscle. J Physiol 537: 763–78.
69 Allen DG, Trajanovska S (2012) The multiple roles of phosphate in muscle fatigue. Front Physiol 3: 1–8.
70 Allen DG, Clugston E, Petersen Y, Röder V, Chapman B, Rudolf R (2011) Interactions between intracellular calcium and phosphate in intact mouse muscle during fatigue. J Appl Physiol 111: 358–66.
71 Westerblad H, Allen DG (1996) The effects of intracellular injections of phosphate on intracellular calcium and force in single fibres of mouse skeletal muscle. Pflügers Arch 431: 964–70.
72 Westerblad H, Allen DG (1991) Changes of myoplasmic calcium concentration during fatigue in single mouse muscle fibers. J Gen Physiol 98: 615–35.
73 Kabbara AA, Allen DG (2001) The use of fluo-5N to measure sarcoplasmic reticulum calcium in single muscle fibres of the cane toad. J Physiol 534: 87–97.
74 Dahlstedt AJ, Westerblad H (2001) Inhibition of creatine kinase reduces the fatigue-induced decrease of tetanic [Ca2+]i in mouse skeletal muscle. J Physiol 533: 639–49.
75 Westerblad H, Allen DG (1992) Myoplasmic free Mg2+ concentration during repetitive stimulation of single fibres from mouse skeletal muscle. J Physiol 453: 413–34.
76 Posterino GS, Fryer MW (1998) Mechanisms underlying phosphate induced
failure of Ca2+ release in single skinned skeletal muscle fibres of the rat. J Physiol 512: 97–108.
77 Blazev R, Lamb GD (1999) Low [ATP] and elevated [Mg2+] reduce depolarizationinduced Ca2+ release in mammalian skeletal muscle. J Physiol 520: 203–15.
78 MacDonald WA, Stephenson DG (2001) Effects of ADP on sarcoplasmic reticulum function in mechanically skinned skeletal muscle fibres of the rat. J Physiol 532: 499–508.
79 MacDonald WA, Stephenson DG (2006) Effect of ADP on slow-twitch muscle fibres of the rat: implications for muscle fatigue. J Physiol 573: 187–98.
80 Kabbara AA, Stephenson DG (1994) Effects of Mg2+ on Ca2+ handling by the sarcoplasmic reticulum in skinned skeletal and cardiac muscle fibres. Pflügers Arch 428: 331–9.
81 Laver DR, O'Neill ER, Lamb GD (2004) Luminal Ca2+-regulated Mg2+ inhibition of skeletal RyRs reconstituted as isolated channels or coupled clusters. J Gen Physiol 124: 741–58.
82 Dutka TL, Lamb GD (2004) Effect of low cytoplasmic [ATP] on excitationcontraction coupling in fast-twitch muscle fibres of the

rat. J Physiol 560: 451–68.
83 Dahlstedt AJ, Katz A, Wieringa B, Westerblad H (2000) Is creatine kinase responsible for fatigue? Studies of isolated skeletal muscle deficient in creatine kinase. FASEB J 14: 982–90.
84 Allen DG, Lamb GD, Westerblad H (2008) Impaired calcium release during fatigue. J Appl Physiol 104: 296–305.

منابع

Davis JM, Bailey SP (1997) Possible mechanisms of central nervous system fatigue during exercise. Med Sci Sports Exerc 29 (1): 45–57.
Amann M (2012) Significance of group III and IV muscle afferents for the endurance exercising human. Proc Austral Physiol Soc 43: 1–7
Amann M, Blain GM, Proctor LT, et al. (2011) Implications of group III and IV muscle afferents for high intensity endurance exercise performance in humans. J Physiol 589 (21): 5299–309.
Martin PG, Weerakkody N, Gandevia SC, et al. (2008) Group III and IV muscle afferents differentially affect the motor cortex and motor neurons in humans. J Physiol 586: 1277–89.
Enoka RM, Stuart DG (1992) Neurobiology of muscle fatigue. J Appl Physiol 72: 1631–48
Newsholme EA, Acworth I, Blomstrand E (1987) Amino acids, brain neurotransmitters and a function link between muscle and brain that is important in sustained exercise. In: Benzi G (ed.) Advances in Myochemistry. London: John Libbey Eurotext: 127–33.
Meeusen R, Watson P, Hasegawa H, et al. (2006) Central fatigue: the serotonin hypothesis and beyond. Sports Med 36 (10): 881–909.
Chaouloff F, Kennett GA, Serrurrier B, et al. (1986) Amino acid analysis demonstrates that increased plasma free tryptophan causes the increase of brain tryptophan during exercise in the rat. J Neurochem 46 (5): 1647–50.
MacLean DA, Graham TE, Saltin B (1994) Branched-chain amino acids augment ammonia metabolism while attenuating protein breakdown during exercise. Am J Physiol 267 (6 Pt 1): E1010–22
Blomstrand E, Hassmen P, Ekblom B, et al. (1991) Administration of branchedchain amino acids during sustained exercise-effects on performance and on plasma concentration of some amino acids. Eur J Appl Physiol 63 (2): 83–8.
Blomstrand E, Andersson S, Hassmen P, et al. (1995) Effect of branched-chain amino acid and carbohydrate supplementation on the exercise-induced change in plasma and muscle concentration of amino acids in human subjects. Acta Physiol Scand 153 (2): 87–96.
Blomstrand E, Hassmen P, Ek S, et al. (1997) Influence of ingesting a solution of branched-chain amino acids on perceived exertion during exercise. Acta Physiol Scand 159 (1): 41–9
Davis JM, Welsh RS, De Volve KL, et al. (1999) Effects of branched-chain amino acids and carbohydrate on fatigue during intermittent, high-intensity running. Int J Sports Med 20 (5): 309–14
Greer BK, White J, Arguello EM, et al. (2011) Branched-chain amino acid supplementation lowers perceived exertion but does not affect performance in untrained males. J Strength Cond Res 25 (2): 539–44.
Madsen K, MacLean DA, Kiens B, et al. (1996) Effects of glucose, glucose plus branched-chain amino acids, or placebo on bike performance over 100 km. J Appl Physiol 81 (6): 2644–50.
Struder HK, Hollmann W, Platen P, et al. (1998) Influence of paroxetine, branched-chain amino acids and tyrosine on neuroendocrine system responses and fatigue in humans. Horm Metab Res 30 (4): 188–94.
Wisnik P, Chmura J, Ziemba AW, et al. (2011) The effect of branched chain amino acids on psychomotor performance during treadmill exercise of changing intensity simulating a soccer game. Appl Physiol, Nutr Metab 36 (6): 856–62.
Heyes MP, Garnett ES, Coates G (1986) Central dopaminergic activity influences rats' ability to exercise. Life Sci 36 (7): 671–7.
Gerald MC (1978) Effects of (+)-amphetamine on the treadmill endurance performance of rats. Neuropharmacol 17 (9): 703–4.
Nestler EJ, Hyman SE, Malenka RC (2001) Molecular Neuro-pharmacology: A Foundation for Clinical Neuroscience. New York: McGraw-Hill.
Meeusen R, Roeykens J, Magnus L, et al. (1997) Endurance performance in humans: the effect of a dopamine precursor or a specific serotonin (5-HT2A/2C) antagonist. Int J Sports Med 18 (8): 571–7.
Piacentini MF, Meeusen R, Buyse L, et al. (2004) Hormonal responses during prolonged exercise are influenced by a selective DA/NA reuptake inhibitor. Br J Sports Med 38 (2): 129–33.
Watson P, Hasegawa H, Roelands B, et al. (2005) Acute dopamine/noradrenaline reuptake inhibition enhances human exercise performance in warm, but not temperate conditions. J Physiol 565 (Pt 3): 873–83.
Roelands B, Watson P, Cordery P, et al. (2012) A dopamine/noradrenaline reuptake inhibitor improves performance in the heat, but only at the maximum therapeutic dose. Scand J Med Sci Sports 22 (5): e93–8.
Piacentini MF, Meeusen R, Buyse L, et al. (2002) No effect of a noradrenergic reuptake inhibitor on performance in trained cyclists. Med Sci Sports Exerc 34 (7): 1189–93.
Roelands B, Meeusen R (2010) Alterations in central fatigue by pharmacological manipulations of neurotransmitters in normal and high ambient temperature. Sports Med 40 (3): 229–46.
Coimbra CC, Soares DD, Leite LHR (2012) The involvement of brain monoamines in the onset of hyperthermic central fatigue. In: Zaslav KR (ed.) An International Perspective on Topics in Sports Medicine and Sports Injury. ISBN: 978–953–51–0005–8. Available from: www.intechopen.com/books/ an-international-perspective-on-topics-in-sports-medicine-and-sports-injury/.

Romero-Gomez M, Jover M, Galan JJ, et al. (2009) Gut ammonia production and its modulation. Metabol Brain Dis 24: 147–57.
Buono MJ, Clancy TR, Cook JR (1984) Blood lactate and ammonium ion accumulation during graded exercise in humans. J Appl Physiol 57: 135–9.
Wagenmakers AJ, Coakley JH, Edwards RH (1990) Metabolism of branchedchain amino acids and ammonia during exercise: clues from McArdle's disease. Int J Sports Med 11 (Suppl. 2): S101–13.
Graham TE, Rush JWE, MacLean DA (1995) Skeletal muscle amino acid metabolism and ammonia production during exercise. In: Hargreaves M (ed.) Exercise Metabolism. Champaign, IL: Human Kinetics: 131–75.
Wilkinson DJ, Smeeton NJ, Watt PW (2010) Ammonia metabolism, the brain and fatigue; revisiting the link. Prog Neurobiol 91: 200–19.
Nybo L, Dalsgaard MK, Steensberg A, et al. (2005) Cerebral ammonia uptake and accumulation during prolonged exercise in humans. J Physiol 563: 285–90.
Shaney RA, Coast JR (2002) Effect of ammonia on in vitro diaphragmatic contractility, fatigue and recovery. Resp 69: 534–41.
Dalsgaard MK, Ott P, Dela F, et al. (2004) The CSF and arterial to jugular venous hormonal differences during exercise in humans. Exp Physiol 89: 271–7.
Monfort P, Cauli O, Montoliu C, et al. (2009) Mechanisms of cognitive alterations in hyperammonemia and hepatic encephalopathy: therapeutical implications. Neurochem Int 55: 106–12.
Shawcross DL, Balata S, Olde Damink SWM, et al. (2004) Low myoinositol and high glutamine levels in brain are associated with neuropsychological deterioration after induced hyperammonemia. Am J Physiol 287: 503–9
Pedersen BK, Hoffman-Goetz L (2000) Exercise and the immune system: regulation, integration and adaptation. Physiol Rev 80: 1055–81.
Gleeson M (2000) Interleukins and exercise. J Physiol 529: 1.
Clarkson PM, Hubal MJ (2002) Exercise-induced muscle damage in humans. Am J Phys Med Rehab 81 (Suppl. 11): S52–69.
Kapsimalis F, Richardson G, Opp MR, et al. (2005) Cytokines and normal sleep. Curr Opin Pulm Med 11: 481–4.
Robson-Ansley PJ, de Milander L, Collins M, et al. (2004) Acute interleukin-6 administration impairs athletic performance in healthy, trained male runners. Can J Appl Physiol 29: 411–8.
Dantzer R, Heijnen CJ, Kavelaars A, Laye S, Capuron L (2014) The neuroimmune basis of fatigue. Trends Neurosci 37: 39–46.
Finsterer J (2012) Biomarkers of peripheral muscle fatigue during exercise. BMC Musculoskelet Disord 13: 218–242.
Hill AV, Long CHN, Lupton H (1924) Muscular exercise, lactic acid and the supply and utilisation of oxygen: parts VII–VIII. Proc Royal Soc 97: 155–76.
Mosso A (1915) Fatigue. London: Allen and Unwin Ltd.
Noakes TD (2012) Fatigue is a brain-derived emotion that regulates the exercise behaviour to ensure the protection of whole-body homeostasis. Front Physiol 3: 1–13.
Ulmer HV (1996) Concept of an extracellular regulation of muscular metabolic rate during heavy exercise in humans by psychophysiological feedback. Experientia 15: 416–200
Lambert EV, St Clair Gibson A, Noakes TD (2005) Complex systems model of fatigue: integrative homeostatic control of peripheral physiological systems during exercise in humans. Br J Sports Med 39: 52–62.
Noakes TD (2000) Physiological models to understand exercise fatigue and the adaptations that predict or enhance athletic performance. Scand J Med Sci Sports 10: 123–45.
Noakes TD, Peltonen JE, Rusko HK (2001) Evidence that a central governor regulates exercise performance during acute hypoxia and hyperoxia. J Exp Biol 204: 3225–34.
Noakes TD, St Clair Gibson A, Lambert EV (2005) From catastrophe to complexity: a novel model of integrative central neural regulation of effort and fatigue during exercise in humans: summary and conclusions. Br J Sports Med 39: 120–4.
St Clair Gibson A, Noakes TD (2004) Evidence for complex system integration and dynamic neural regulation of skeletal muscle recruitment during exercise in humans. Br J Sports Med 38: 797–806.
Tucker R (2009) The anticipatory regulation of performance: the physiological basis for pacing strategies and the development of a perception-based model for exercise performance. Br J Sports Med 43: 392–400.
Crewe H, Tucker R, Noakes TD (2008) The rate of increase in rating of perceived exertion predicts the duration of exercise to fatigue at a fixed power output in different environmental conditions. Eur J Appl Physiol 103: 569–77.
Schabort EJ, Hawley JA, Hopkins WG, Mujika I, Noakes TD (1998) A new reliable laboratory test of endurance performance for road cyclists. Med Sci Sports Exerc 30: 1744–50.
Kay D, Marino FE, Cannon J, St Clair Gibson A, Lambert MI, Noakes TD (2001) Evidence for neuromuscular fatigue during high-intensity cycling in warm, humid conditions. Eur J Appl Physiol 84: 115–21.
St Clair Gibson A, Schabort EJ, Noakes TD (2001) Reduced neuromuscular activity and force generation during prolonged cycling. Am J Physiol 281: R187–96.
Marcora SM, Staiano W (2010) The limit to exercise tolerance in humans: mind over muscle? Eur J Appl Physiol 109: 763–70.
Wittekind AL, Micklewright D, Beneke R (2011) Teleoanticipation in all-out short duration cycling. Br J Sports Med 45: 114–9.
Edwards AM, Polman RCJ (2013) Pacing and awareness: brain regulation of physical activity. Sports Med 43(11): 1057–64.
Noakes TD (2011) Time to move beyond a brainless exercise physiology: the evidence for complex regulation of human exercise performance. Appl Physiol Nutr Metab 36: 23–35.
Paterson S, Marino FE (2004) Effect of deception of distance on prolonged cycling performance. Percept Mot Skill 98: 1017–26.
Dugas J, Oosthuizan U, Tucker R, Noakes TD (2009) Rates of fluid ingestion alter pacing but not thermoregulatory responses during prolonged exercise in hot and humid conditions with appropriate convective cooling. Eur J Appl Physiol 105: 69–80.

Marcora SM, Staiano W, Manning V (2009) Mental fatigue impairs physical performance in humans. J Appl Physiol 106: 857–64.
Rauch H, St Clair Gibson A, Lambert EV (2005) A signalling role for muscle glycogen in the regulation of pace during prolonged exercise. Br J Sports Med 39: 34–8.
Marino FE (2004) Anticipatory regulation and avoidance of catastrophe during exercise-induced hyperthermia. Comp Biochem Physiol B Biochem Mol Biol 139: 561–9.
Mauger AR, Jones AM, Williams CA (2009) Influence of feedback and prior experience on pacing during a 4-km cycle time trial. Med Sci Sports Exerc 41: 451–8.
Micklewright D, Papadopoulou E, Swart J, Noakes T (2010) Previous experience influences pacing during 20 km time trial cycling. Br J Sports Med 44: 952–60.
Saunders AG, Dugas JP, Tucker R, Lambert MI, Noakes TD (2005) The effects of different air velocities on heat storage and body temperature in humans cycling in a hot, humid environment. Acta Physiol Scand 183: 241–55.
Tucker R, Bester A, Lambert EV, Noakes TD, Vaughan CL, St Clair Gibson A (2006) Non-random fluctuations in power output during self-paced exercise. Br J Sports Med 40: 912–7.
Baden DA, McLean TL, Tucker R, Noakes TD, St Clair Gibson A (2005) Effect of anticipation during unknown or unexpected exercise duration on rating of perceived exertion, affect, and physiological function. Br J Sports Med 39: 742–6.
Eston R, Stansfield R, Westoby P, Parfitt G (2012) Effect of deception and expected exercise duration on psychological and physiological variables during treadmill running and cycling. Psychophysiol 49: 462–9.
Bolgar MA, Baker CE, Goss FL, Nagle E, Robertson RJ (2010) Effect of exercise intensity on differentiated and undifferentiated ratings of perceived exertion during cycling and treadmill exercise in recreationally active and trained women. J Sports Sci Med 9: 557–63.
Morton RH (2009) Deception by manipulating the clock calibration influences cycle ergometer endurance time in males. J Sci Med Sport 12: 332–7.
Faulkner J, Arnold T, Eston R (2011) Effect of accurate and inaccurate distance feedback on performance markers and pacing strategies during running. Scand J Med Sci Sports 21: e176–83.
Billaut F, Bishop DJ, Schaerz S, Noakes TD (2011) Influence of knowledge of sprint number on pacing during repeated-sprint exercise. Med Sci Sports Exerc 43: 665–72.
Swart J, Lindsay TR, Lambert MI, Brown JC, Noakes TD (2012) Perceptual cues in the regulation of exercise performance – physical sensations of exercise and awareness of effort interact as separate cues. Br J Sports Med 46: 42–8.
Presland JD, Dowson MN, Cairns SP (2005) Changes of motor drive, cortical arousal and perceived exertion following prolonged cycling to exhaustion. Eur J Appl Physiol 95: 42–51.
Tucker R, Marle T, Lambert EV, Noakes TD (2006) The rate of heat storage mediates an anticipatory reduction in exercise intensity during cycling at a fixed rating of perceived exertion. J Physiol 574: 905–15.
Noakes T (2008) Testing for maximum oxygen consumption has produced a brainless model of human exercise performance. Br J Sports Med 42: 551–5.
Noakes TD (2000) Physiological models to understand exercise fatigue and the adaptations that predict or enhance athletic performance. Scand J Med Sci Sports 10: 123–45.
Marcora SM (2008) Do we really need a central governor to explain brain regulation of exercise performance? Eur J Appl Physiol 104: 929–31.
Marcora S (2009) Perception of effort during exercise is independent of afferent feedback from skeletal muscles, heart, and lungs. J Appl Physiol 106: 2060–2.
Gallagher KM, Fadel PJ, Stromstad M, Ide K, Smith SA, Querry RG, Raven PB, Secher NH (2001) Effects of partial neuromuscular blockade on carotid baroreflex function during exercise in humans. J Physiol 533: 861–70.
Kjaer M, Hanel B, Worm L, Perko G, Lewis SF, Sahlin K, Galbo H, Secher NH (1999) Cardiovascular and neuroendocrine responses to exercise in hypoxia during impaired neural feedback from muscle. Am J Physiol 277: R76–85.
Smith SA, Querry RG, Fadel PJ, Gallagher KM, Stromstad M, Ide K, Raven PB, Secher NH (2003) Partial blockade of skeletal muscle somatosensory afferents attenuates baroreflex resetting during exercise in humans. J Physiol 551: 1013–21.
Myers J, Atwood JE, Sullivan M, Forbes S, Friis R, Pewen W, Froelicher V (1987) Perceived exertion and gas exchange after calcium and β-blockade in atrial fibrillation. J Appl Physiol 63: 97–104.
Braith RW, Wood CE, Limacher MC, Pollock ML, Lowenthal DT, Phillips MI, Staples ED (1992) Adnormal neuroendocrine responses during exercise in heart transplant recipients. Circulation 86: 1453–63.
Grazzini M, Stendardi L, Gigliotti F, Scano G (2005) Pathophysiology of exercise dyspnea in healthy subjects and in patients with chronic obstructive pulmonary disease (COPD). Respir Med 99: 1403–12.
Noakes TD, Tucker R (2008) Do we really need a central governor to explain brain regulation of exercise performance? A response to the letter of Dr Marcora. Eur J Appl Physiol 104: 933–5.
Smirmaul B (2012) Sense of effort and other unpleasant sensations during exercise: clarifying concepts and mechanisms. Br J Sports Med 46: 308–11.
Shephard RJ (2009) Is it time to retire the 'central governor'? Sports Med 39: 709–21.
Micklewright D, Parry D (2010) The central governor model cannot be adequately tested by observing its components in isolation. Sports Med 40: 91–4.
Davis J. M., Bailey S. P. (1997). "Possible mechanisms of central nervous system fatigue during exercise". Medicine & Science in Sports & Exercise. 29 (1): 45–57. doi:10.1097/00005768-199701000-00008. PMID 9000155.
Roelands B, de Koning J, Foster C, Hettinga F, Meeusen R (May 2013). "Neurophysiological determinants of theoret-

ical concepts and mechanisms involved in pacing". Sports Med. 43 (5): 301–311. doi:10.1007/s40279-013-0030-4. PMID 23456493. S2CID 30392999.

Jump up to:a b c d e Roelands B, De Pauw K, Meeusen R (June 2015). «Neurophysiological effects of exercise in the heat». Scand. J. Med. Sci. Sports. 25 Suppl 1: 65–78. doi:10.1111/sms.12350. PMID 25943657. S2CID 22782401. Physical fatigue has classically been attributed to peripheral factors within the Jump up to:a b Meeusen, Romain; Watson, Philip; Hasegawa, Hiroshi; Roelands, Bart; Piacentini, Maria F. (1 January 2006). «Central fatigue: the serotonin hypothesis and beyond». Sports Medicine. 36 (10): 881–909. doi:10.2165/00007256-200636100-00006. ISSN 0112-1642. PMID 17004850. S2CID 5178189.

Jump up to:a b Roelands, Bart; Meeusen, Romain (1 March 2010). "Alterations in Central Fatigue by Pharmacological Manipulations of Neurotransmitters in Normal and High Ambient Temperature". Sports Medicine. 40 (3):229–246. doi:10.2165/11533670-000000000 00000. ISSN 01121642. PMID 20199121. S2CID 25717280.

Jump up to:a b Young, S. N. The clinical psychopharmacology of tryptophan. In: Nutrition and the Brain. Vol. 7, R. J. Wurtman and J. J. Wurtman, (Eds.). New York: Raven, 1986, pp. 49–88

Newsholme, E. A., I. N. Acworth, and E. Bloomstrand. Amino acids, brain neurotransmitters and a functional link between muscle and brain that is important in sustained exercise. In: Advances in Myochemistry, G. Benzi (Ed.). London: John Libbey Eurotext Ltd., 1987

Choi, Sujean; Disilvio, Briana; Fernstrom, Madelyn H.; Fernstrom, John D. (November 2013). "Oral branched-chain amino acid supplements that reduce brain serotonin during exercise in rats also lower brain catecholamines". Amino Acids. 45 (5): 1133–42. doi:10.1007/s00726-013-1566-1. PMID 23904096. S2CID 1957988.

Chaouloff, F., D. Laude, and J. L. Elghozi. Physical exercise: evidence for differential consequences of tryptophan on 5-HT synthesis and metabolism in central serotonergic cell bodies and terminals.J. Neural Transm. 78:121–130, 1989.

Bailey, S. P., J. M. Davis and E. N. Ahlborn. Neuroendocrine and substrate responses to altered brain 5-HT activity during prolonged exercise to fatigue. J. Appl. Physiol. 74:3006–3012, 1993

Jump up to:a b Conlay, L. A., Sabournjian, L. A., and Wurtman, R. J. Exercise and neuromodulators: choline and acetylcholine in marathon runners.Int. J. Sports Med. 13(Suppl. 1):S141-142, 1992

Spector, S. A., M. R. Jackman, L. A. Sabounjian, C. Sakkas, D. M. Landers, and W. T. Willis. Effects of choline supplementation on fatigue in trained cyclists. Med. Sci. Sports Exerc. 27:668–673, 1995

Harrington, Mary E. (7 December 2016). "Neurobiological studies of fatigue". Progress in Neurobiology. 99 (2): 93–105. doi:10.1016/j.pneurobio.2012.07.004. ISSN 0301-0082. PMC 3479364. PMID 22841649.

Wilkinson, Daniel J.; Smeeton, Nicholas J.; Watt, Peter W. (1 July 2010). «Ammonia metabolism, the brain and fatigue; revisiting the link». Progress in Neurobiology. 91 (3): 200–219. doi:10.1016/j.pneurobio.2010.01.012. ISSN 1873-5118. PMID 20138956. S2CID 14495423.

Jump up to:a b Parr JW (July 2011). «Attention-deficit hyperactivity disorder and the athlete: new advances and understanding». Clin. Sports Med. 30 (3): 591–610. doi:10.1016/j.csm.2011.03.007. PMID 21658550

Jump up to:a b Liddle DG, Connor DJ (June 2013). «Nutritional supplements and ergogenic AIDS». Prim. Care. 40 (2): 487–505. doi:10.1016/j.pop.2013.02.009. PMID 23668655. Amphetamines

Bracken NM (January 2012). «National Study of Substance Use Trends Among NCAA College Student-Athletes». NCAA Publications. National Collegiate Athletic Association. Retrieved 8 October 2013.

Roelands, Bart; Meeusen, Romain (1 March 2010). "Alterations in Central Fatigue by Pharmacological Manipulations of Neurotransmitters in Normal and High Ambient Temperature". Sports Medicine. 40 (3): 229–246. doi:10.2165/11533670-000000000-00000. ISSN 0112-1642. PMID 20199121. S2CID 25717280.

Conger SA, Warren GL, Hardy MA, Millard-Stafford ML (February 2011). "Does caffeine added to carbohydrate provide additional ergogenic benefit for endurance?". Int J Sport Nutr Exerc Metab. 21 (1): 71–84. doi:10.1123/ijsnem.21.1.71. PMID 21411838.

Central nervous system effects of caffeine and adenosine on fatigue. J. Mark Davis, Zuowei Zhao, Howard S. Stock, Kristen A. Mehl, James Buggy, Gregory A. Hand. American Journal of Physiology. Regulatory, Integrative and Comparative Physiology Published 1 February 2003 Vol. 284 no. R399-R404DOI: 10.1152/ajpregu.00386.2002

Foskett A.; Williams C.; Boobis L.; Tsintzas K. (2008). "Carbohydrate availability and muscle energy metabolism during intermittent running". Med Sci Sports Exerc. 40 (1): 96–103. doi:10.1249/mss.0b013e3181586b2c. PMID 18091017.

DAVIS J. MARK; BAILEY STEPHEN P. (1997). «Possible mechanisms of central nervous system fatigue during exercise». Medicine & Science in Sports & Exercise. 29 (1): 45–57. doi:10.1097/00005768-199701000-00008. PMID 9000155.

Meeusen, R., & Watson, P. (2007). Amino acids and the brain: do they play a role in «central fatigue»? Int J Sport Nutr Exerc Metab, 17 Suppl, S37-46

Blomstrand, E., S. Andersson, P. Hassmen, B. Ekblom, and E. A. Newsholme. Effect of branched-chain amino acid and carbohydrate supplementation on the exercise-induced change in plasma and muscle concentration of amino acids in human subjects. Acta Phys. Scand. 153:87–96, 1995

Fatigue is a Brain-Derived Emotion that Regulates the Exercise Behavior to Ensure the Protection of Whole Body Homeostasis. Timothy David Noakes. Front Physiol. 2012; 3: 82. Prepublished online 2012 January 9. Published online 2012 April 11. doi: 10.3389/fphys.2012.00082.

Enoka, R. M. and D.G. Stuart. Neurobiology of muscle fatigue. J. Appl. Physiol. 72:1631–1648, 1992.

Murray R. Dehydration, hyperthermia, and athletes: science and practice. J Athl Train. 1996;31(3):248–252.

Evangard B; Schacterie R.S.; Komaroff A. L. (1999). "Chronic fatigue syndrome: new insights and old ignorance". Journal of Internal Medicine. 246 (5): 455–469. doi:10.1046/j.1365-2796.1999.00513.x. PMID 10583715.

Kent-Braun, J. A., K. R. Sharma, M. W. Weiner, B. Massie, and R. G. Miller. Central basis of muscle fatigue in chronic fatigue syn-

drome. Neurology 43:125–131, 1993
Riley, M. S., C. J. O›Brien, D. R. McCluskey, N. P. Bell, and D. P. Nicholls. Aerobic work capacity in patients with chronic fatigue syndrome. Br. Med. J. 301:953–956, 1990
Stokes, M. J., R. G. Cooper, and R. H. Edwards. Normal muscle strength and fatigability in patients with effort syndromes. Br. Med. J. 297:1014–1017, 1988.
“Data and statistics”. www.euro.who.int. 2011. Archived from the original on 23 October 2013. Retrieved 8 January 2022.
Frenzilli, Giada; Ryskalin, Larisa; Ferrucci, Michela; Cantafora, Emanuela; Chelazzi, Silvia; Giorgi, Filippo S.; Lenzi, Paola; Scarcelli, Vittoria; Frati, Alessandro; Biagioni, Francesca; Gambardella, Stefano (26 June 2017). “Loud Noise Exposure Produces DNA, Neurotransmitter and Morphological Damage within Specific Brain Areas”. Frontiers in Neuroanatomy. 11: 49. doi:10.3389/fnana.2017.00049. ISSN 1662-5129. PMC 5483448. PMID 28694773.

منابع

1 Coyle EF (2007) Physiological regulation of marathon performance. Sports Med 37: 306–11.
2 Casa DJ, Armstrong LE, Hillman SK, Montain SJ, Reiff RV, Rich BSE, Roberts WO, Stone JA (2000) National Athletic Trainers Association position statement: fluid replacement for athletes. J Athl Train 35: 212–24.
3 Pfeiffer B, Stellingwerff T, Hodgson AB, Randell R, Pottgen L, Res P, Jeukendrup AE (2012) Nutritional intake and gastrointestinal problems during competitive endurance events. Med Sci Sports Exerc 44: 344–51.
4 Lambert GP, Lang J, Bull A, Eckerson J, Lanspa S, O’Brien J (2008) Fluid tolerance while running: effect of repeated trials. Int J Sports Med 29: 878–82.
5 Millet GP, Vleck VE, Bentley DJ (2009) Physiological differences between cycling and running: lessons from triathletes. Sports Med 39: 179–206.
6 Leppik JA, Aughey RJ, Medved I, Fairweather I, Carey MF, McKenna MJ (2004) Prolonged exercise to fatigue in humans impairs skeletal muscle Na+-K+ ATPase activity, sarcoplasmic reticulum Ca2+ release, and Ca2+ uptake. J Appl Physiol 97: 1414–23.
7 Wada M, Kuratani M, Kanzaki K (2013) Calcium kinetics of sarcoplasmic reticulum and muscle fatigue. J Phys Fitness Sports Med 2: 169–78.
8 McKenna MJ, Medved I, Goodman CA, Brown MJ, Bjorksten AR, Murphy KT, Petersen AC, Sostaric S, Gong X (2006) N-acetylcysteine attenuates the decline in muscle Na+, K+-pump activity and delays fatigue during prolonged exercise in humans. J Physiol 576: 279–88.
9 Pires FO, Noakes TD, Lima-Silva AE, Bertuzzi R, Ugrinowitsch C, Lira FS, Kiss MAPDM (2011) Cardiopulmonary, blood metabolite and rating of perceived exertion responses to constant exercises performed at different intensities until exhaustion. Br J Sports Med 45: 1119–25.
10 Overgaard K, Lindstrøm T, Ingemann-Hansen T, Clausen T (2002) Membrane leakage and increased content of Na+-K+ pumps and Ca2+ in human muscle after a 100-km run. J Appl Physiol 92: 1891–8.
11 Noakes TD (2007) The central governor model of exercise regulation applied to the marathon. Sports Med 37: 374–7.
12 Duthie G, Pyne D, Hooper S (2003) Applied physiology and game analysis of rugby union. Sports Med 33: 973–91.
13 Gabbett T, King T, Jenkins D (2008) Applied physiology of rugby league. Sports Med 38: 119–38.
14 Bangsbo J, Mohr M, Krustrup P (2006) Physical and metabolic demands of training and match-play in the elite football player. J Sports Sci 24: 665–74.
15 Abt G, Zhou S, Weatherby R (1998) The effect of a high-carbohydrate diet on the skill performance of midfield soccer players after intermittent treadmill exercise. J Sci Med Sport 1: 203–12.
16 Mohr M, Krustrup P, Bangsbo J (2005) Fatigue in soccer: a brief review. J Sports Sci 23: 593–9.
17 Bangsbo J, Nørregaard L, Thorsø F (1991) Activity profile of competition soccer. Can J Sport Sci 16: 110–6.
18 Bangsbo J, Mohr M (2005) Variations in running speed and recovery time after a sprint during top-class soccer matches. Med Sci Sports Exerc 37: S87.
19 Mohr M, Krustrup P, Bangsbo J (2003) Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci 21: 519–28.
20 Krustrup P, Mohr M, Steensberg A, Bencke J, Kjaer M, Bangsbo J (2003) Muscle metabolites during a football match in relation to a decreased sprinting ability. Communication to the Fifth World Congress of Soccer and Science, Lisbon, Portugal.
21 Krustrup P, Mohr M, Steensberg A, Bencke J, Kjaer M, Bangsbo J (2006) Muscle and blood metabolites during a soccer game: implications for sprint performance. Med Sci Sports Exerc 38: 1165–74.
22 Krustrup P, Mohr M, Amstrup T, Rysgaard T, Johansen J, Steensberg A, Pedersen PK, Bangsbo J (2003) The Yo-Yo intermittent recovery test: physiological response, reliability and validity. Med Sci Sports Exerc 35: 695–705.
23 Bangsbo J, Iaia FM, Krustrup P (2007) Metabolic response and fatigue in soccer. Int J Sports Physiol Perf 2: 111–27.
24 Mohr M, Nielsen JJ, Bangsbo J (2011) Caffeine intake improves intense intermittent exercise performance and reduces muscle interstitial potassium accumulation. J Appl Physiol 111: 1372–9.
25 Balsom PD, Gaitanos GC, Söderlund K, Ekblom B (1999) High-intensity exercise and muscle glycogen availability in humans. Acta Physiol Scand 165: 337–45.
26 Maughan RJ, Shirreffs SM, Merson SJ, Horswill CA (2005) Fluid and electrolyte balance in elite male football (soccer) players

training in a cool environment. J Sports Sci 23: 73–9.
27 Reilly T (1997) Energetics of high-intensity exercise (soccer) with particular reference to fatigue. J Sports Sci 15: 257–63.
28 Shirreffs SM, Aragon-Vargas LF, Chamorro M, Maughan RJ, Serratosa L, Zachwieja JJ (2005) The sweating response of elite professional soccer players to training in the heat. Int J Sports Med 26: 90–5.
29 Edwards AM, Noakes TD (2009) Dehydration: cause of fatigue or sign of pacing in elite soccer? Sports Med 39: 1–13.
30 McGregor SJ, Nicholas CW, Lakomy HKA, Williams C (1999) The influence of intermittent high-intensity shuttle running and fluid ingestion on the performance of a soccer skill. J Sports Sci 17: 895–903.
31 Edwards AM, Mann ME, Marfell-Jones MJ, Rankin DM, Noakes TD, Shillington DP (2007) Influence of moderate dehydration on soccer performance: physiological responses to 45 min of outdoor match-play and the immediate subsequent performance of sport-specific and mental concentration tests. Br J Sports Med 41: 385–91.
32 Edwards AM, Clark NA (2006) Thermoregulatory observations in soccer match play: professional and recreational level applications using an intestinal pill system to measure core temperature. Br J Sports Med 40: 133–8.
33 Aughey RJ, Goodman CA, McKenna MJ (2014) Greater chance of high core temperatures with modified pacing strategy during team sport in the heat. J Sci Med Sport 17: 113–8.
34 Robinson TA, Hawley JA, Palmer GS, Wilson GR, Gray DA, Noakes TD, Dennis SC (1995) Water ingestion does not improve 1-h cycling performance in moderate ambient temperatures. Eur J Appl Physiol 71: 153–60.
35 Schlader ZJ, Simmons SE, Stannard SR, Mündel T (2011) Skin temperature as a thermal controller of exercise intensity. Eur J Appl Physol 111: 1631–9.
36 Temfemo A, Carling C, Said A (2011) Relationship between power output, lactate, skin temperature, and muscle activity during brief repeated exercises with increasing intensity. J Strength Cond Res 25: 915–21.
37 Rahnama N, Lees A, Reilly T (2006) Electromyography of selected lower-limb muscles fatigued by exercise at the intensity of soccer match-play. J Electromyogr Kinesiol 16: 257–63.
38 Rampinini E, Bosio A, Ferraresi I, Petruolo A, Morelli A, Sassi A (2011) Matchrelated fatigue in soccer players. Med Sci Sports Exerc 43: 2161–70.
39 Robineau J, Jouaux T, Lacroix M, Babault N (2012) Neuromuscular fatigue induced by a 90-min soccer game modelling. J Strength Cond Res 26: 555–62.
40 Gandevia SC (2001) Spinal and supraspinal factors in human muscle fatigue. Physiol Rev 81: 1726–89.
41 Duffield R, Dawson B, Goodman C (2005) Energy system contribution to 400- metre and 800-metre track running. J Sports Sci 23: 299–307.
42 Spencer MR, Gastin PB (2001) Energy system contribution during 200- to 1500-m running in highly trained athletes. Med Sci Sports Exerc 33: 157–62.
43 Dal Pupo J, Arins FB, Guglielmo LGA, Da Silva R, Moro ARP, Dos Santos SG (2013) Physiological and neuromuscular indices associated with sprint running performance. Res Sports Med 21: 124–35.
44 Ingham SA, Whyte GP, Pedlar C, Bailey DM, Dunman N, Nevill AM (2008) Determinants of 800-m and 1500-m running performance using allometric models. Med Sci Sports Exerc 40: 345–50.
45 Rabadán M, Díaz V, Calderón FJ, Benito PJ, Peinado AB, Maffulli N (2011) Physiological determinants of speciality of elite middle- and long-distance runners. J Sports Sci 29: 975–82.
46 Jung AP (2003) The impact of resistance training on distance running performance. Sports Med 33: 539–52.
47 Saunders PU, Telford RD, Pyne DB, Peltola EM, Cunningham RB, Gore CJ, Hawley JA (2006) Short-term plyometric training improves running economy in highly trained middle- and long-distance runners. J Strength Cond Res 20: 947–54.
48 Bird SR, Wiles J, Robbins J (1995) The effect of sodium bicarbonate ingestion on 1500-m racing time. J Sports Sci 13: 399–403.
49 Carr AJ, Gore CJ, Hopkins WG (2011) Effects of acute alkalosis and acidosis on performance: a meta-analysis. Sports Med 41: 801–14.
50 McNaughton LR, Siegler J, Midgley A (2008) Ergogenic effects of sodium bicarbonate. Curr Sports Med Rep 7: 230–6.
51 Wilkes D, Gledhill N, Smyth R (1983) Effect of acute induced metabolic alkalosis on 800-m racing time. Med Sci Sports Exerc 15: 277–80.
52 Bishop D, Edge J, Davis C, Goodman C (2004) Induced metabolic alkalosis affects muscle metabolism and repeated-sprint ability. Med Sci Sports Exerc 36: 807–13.
53 Cairns SP (2006) Lactic acid and exercise performance: culprit or friend? Sports Med 36: 279–91.
54 Knicker AJ, Renshaw I, Oldham ARH, Cairns SP (2011) Interactive processes link the multiple symptoms of fatigue in sport competition. Sports Med 41: 307–28.
55 Nybo L, Secher NH (2004) Cerebral perturbations provoked by prolonged exercise. Prog Neurobiol 72: 223–61.
56 Amann M, Calbert JAL (2008) Convective oxygen transport and fatigue. J Appl Physiol 104: 861–70.
57 Gandevia SC, Allen GM, Butler JE, Taylor JL (1996) Supraspinal factors in human muscle fatigue: evidence for suboptimal output from the motor cortex. J Physiol 490: 529–36.
58 Nielsen HB, Bredmose PR, Strømstad M, Volianitis S, Quistorff B, Secher NH (2002) Bicarbonate attenuates arterial desaturation during maximal exercise in humans. J Appl Physiol 93: 724–31.
59 Swank A, Robertson RJ (1989) Effect of induced alkalosis on perception of exertion during intermittent exercise. J Appl Physiol 67: 1862–7.
60 Medbø JI, Sejersted OM (1990) Plasma K^+ changes with high intensity exercise. J Physiol 421: 105–22.
61 Chapman R, Laymon AS, Wilhite DP, McKenzie JM, Tanner DA, Stager JM (2012) Ground contact time as an indicator of metabolic cost in elite distance runners. Med Sci Sports Exerc 44: 917–25.

62 Nummela AT, Paavolainen LM, Sharwood KA, Lambert MI, Noakes TD, Rusko HK (2006) Neuromuscular factors determining 5 km running performance and running economy in well-trained athletes. Eur J Appl Physiol 97: 1–8.
63 Tomazin K, Morin JB, Strojnik V, Podpecan A, Millet GY (2012) Fatigue after short (100-m), medium (200-m) and long (400-m) treadmill sprints. Eur J Appl Physiol 112(3): 1027–36.
64 Hirvonen J, Numella A, Rusko H, Rehunen M, Härkönen M (1992) Fatigue and changes of ATP, creatine phosphate and lactate during the 400 m sprint. Can J Sport Sci 17: 477–83.
65 Nummela A, Vuorima T, Rusko H (1992) Changes in force production, blood lactate and EMG activity in the 400m sprint. J Sports Sci 10: 217–28.
66 Hanon C, Gajer B (2009) Velocity and stride parameters of world-class 400-meter athletes compared with less experienced runners. J Strength Cond Res 23: 524–31.
67 Miguel PJ, Reis VM (2004) Speed strength endurance and 400m performance. New Stud Athlet 19: 39–45.
68 Lattier G, Millett GY, Martin A, Martin V (2004) Fatigue and recovery after high-intensity exercise part I: neuromuscular fatigue. Int J Sports Med 25: 450–6.
69 Allen DG, Lamb GD, Westerblad H (2008) Skeletal muscle fatigue: cellular mechanisms. Physiol Rev 88: 287–332.
70 Cheetham ME, Boobis LH, Brooks S, Williams C (1986) Human muscle metabolism during sprint running. J Appl Physiol 61: 54–60.
71 Gaitanos GC, Williams C, Boobis LH, Brooks S (1993) Human muscle metabolism during intermittent maximal exercise. J Appl Physiol 75: 712–9.
72 Maughan R, Gleeson M (2004) The Biochemical Basis of Sports Performance. Oxford: Oxford University Press.
73 Wittekind AL, Micklewright D, Beneke R (2011) Teleoanticipation in all-out short-duration cycling. Br J Sports Med 45: 114–9.
74 Mackala K (2007) Optimisation of performance through kinematic analysis of the different phases of the 100 metres. New Studies in Athletics 22: 7–16.
75 Mureika JR (2003) Modelling wind and altitude effects in the 200 m sprint. Can J Phys 81: 895–910.
76 Duffield R, Dawson B, Goodman C (2004) Energy system contribution to 100- m and 200-m track running events. J Sci Med Sport 7: 302–13.
77 Nevill AM, Ramsbottom R, Nevill ME, Newport S, Williams C (2008) The relative contributions of anaerobic and aerobic energy supply during track 100-, 400- and 800-m performance. J Sports Med Phys Fitness 48: 138–42.
78 Skare OC, Skadberg Ø, Wisnes AR (2001) Creatine supplementation improves sprint performance in male sprinters. Scand J Med Sci Spor 11: 96–102.
79 Spencer M, Bishop D, Dawson B, Goodman C (2005) Physiological and metabolic responses of repeated-sprint activities specific to field-based team sports. Sports Med 35: 1025–44.
80 Bogdanis GC, Nevill ME, Lakomy HKA, Boobis LH (1998) Power output and muscle metabolism during and following recovery from 10 and 20 s of maximal sprint exercise in humans. Acta Physiol Scand 163: 261–72.
81 Hirvonen J, Rehunen S, Rusko H, Härkönen M (1987) Breakdown of high-energy phosphate compounds and lactate accumulation during short supramaximal exercise. Eur J Appl Physiol 56: 253–9.
82 Fitts RH (2008) The cross-bridge cycle and skeletal muscle fatigue. J Appl Physiol 104: 551–8.
83 Metzger JM, Moss RL (1987) Greater hydrogen ion-induced depression of tension and velocity in skinned single fibres of rate fast than slow muscles. J Physiol 393: 727–42.
84 Mero A, Peltola E (1989) Neural activation fatigued and non-fatigued conditions of short and long sprint running. Biol Sport 6: 43–58.
85 Ross A, Leveritt M, Riek S (2001) Neural influences on sprint running: training adaptations and acute responses. Sports Med 31: 409–25.
86 Willardson JM (2006) A brief review: factors affecting the length of the rest interval between resistance exercise sets. J Strength Cond Res 20: 978–84.
87 Sahlin K, Ren JM (1989) Relationship of contraction capacity to metabolic changes during recovery from a fatiguing contraction. J Appl Physiol 67: 648–54.
88 Nordlund MM, Thorstensson A, Cresswell AG (2004) Central and peripheral contributions to fatigue in relation to level of activation during repeated maximal voluntary isometric plantar flexions. J Appl Physiol 96: 218–25.
89 van den Tillaar R, Saeterbakken A (2014) Effect of fatigue upon performance and electromyographic activity in 6-RM bench press. J Hum Kinet 40: 57–65.
90 Ahtiainen JP, Hakkinen K (2009) Strength athletes are capable to produce greater muscle activation and neural fatigue during high-intensity resistance exercise than nonathetes. J Strength Cond Res 23: 1129–34.
91 Westerblad H, Allen DG (2002) Recent advances in the understanding of skeletal muscle fatigue. Curr Opin Rheumatol 14: 648–52.
92 Taylor JL, Allen GM, Butler JE, Gandevia SC (2000) Supraspinal fatigue during intermittent maximal voluntary contractions of the human elbow flexors. J Appl Physiol 89: 305–13.
93 Gandevia SC, Allen GM, Butler JE, Taylor JL (1996) Supraspinal factors in human muscle fatigue: evidence for suboptimal output from the motor cortex. J Physiol 490: 529–36.
94 Taylor JL, Gandevia SC (2008) A comparison of central aspects of fatigue in submaximal and maximal voluntary contractions. J Appl Physiol 104: 542–50.
95 Rubinstein S, Kamen G (2005) Decreases in motor unit firing rate during sustained maximal-effort contractions in young and older adults. J Electromyogr Kinesiol 15: 536–43.
96 Andersen B, Westlund B, Krarup C (2003) Failure of activation of spinal motoneurons after muscle fatigue in healthy subjects

studied by transcranial magnetic stimulation. J Physiol 551: 345–56.
97 Butler JE, Taylor JL, Gandevia SC (2003) Responses of human motoneurons to corticospinal stimulation during maximal voluntary contractions and ischemia. J Neurosci 23: 10224–30.
98 Boerio D, Jubeau M, Zory R, Maffiuletti NA (2005) Central and peripheral fatigue after electrostimulation-induced resistance exercise. Med Sci Sports Exerc 37: 973–8.
99 Hunter SK (2009) Sex differences and mechanisms of task-specific muscle fatigue. Exerc Sport Sci Rev 37: 113–22.
100 Hunter SK (2014) Sex differences in human fatigability: mechanisms and insight into physiological responses. Acta Physiol 210: 768–89.
101 Guenette JA, Romer LM, Querido JS, Chua R, Eves ND, Road JD, McKenzie DC, Sheel AW (2010) Sex differences in exercise-induced diaphragmatic fatigue in endurance-trained athletes. J Appl Physiol 109: 35–46.
102 Fulco CS, Rock PB, Muza SR, Lammi E, Cymerman A, Butterfield G, Moore LG, Braun B, Lewis SF (1999) Slower fatigue and faster recovery of the adductort pollicis muscle in women matched for strength with men. Acta Physiol Scand 167: 233–9.
103 Hunter SK, Enoka RM (2001) Sex differences in the fatigability of arm muscles depends on absolute force during isometric contractions. J Appl Physiol 91: 2686–94.
104 Avin KG, Naughton MR, Ford BW, Moore HE, Monitto-Webber MN, Stark AM, Gentile AJ, Law LA (2010) Sex differences in fatigue resistance are muscle group dependent. Med Sci Sports Exerc 42: 1943–50.
105 Dearth DJ, Umbel J, Hoffman RL, Russ DW, Wilson TE, Clark BC (2010) Men and women exhibit a similar time to task failure for a sustained, submaximal elbow extensor contraction. Eur J Appl Physiol 108: 1089–98.
106 Yoon T, Schlinder Delap B, Griffith EE, Hunter SK (2007) Mechanisms of fatigue differ after low- and high-force fatiguing contractions in men and women. Muscle Nerve 36: 512–24.
107 Maughan RJ, Harmon M, Leiper JB, Sale D, Delman A (1986) Endurance capacity of untrained males and females in isometric and dynamic muscular contractions. Eur J Appl Physiol 55: 395–400.
108 Senefeld J, Yoon T, Bement MH, Hunter SK (2013) Fatigue and recovery from dynamic contractions in men and women differ for arm and leg muscles. Muscle Nerve 48: 436–9.
109 Power Ga, Dalton BH, Rice CL, Vandervoort AA (2010) Delayed recovery of velocity-dependent power loss following eccentric actions of the ankle dorsiflexors. J Appl Physiol 109: 669–76.
110 Sewright KA, Hubal MJ, Kearns A, Holbrook MT, Clarkson PM (2008) Sex differences in response to maximal eccentric exercise. Med Sci Sports Exerc 40: 242–51.
111 Billaut F, Bishop D (2012) Mechanical work accounts for sex differences in fatigue during repeated sprints. Eur J Appl Physiol 112: 1429–36.
112 Smith KJ, Billaut F (2012) Tissue oxygenation in men and women during repeated-sprint exercise. Int J Sports Physiol Perf 7: 59–67.
113 Laurent CM, Green JM, Bishop PA, Sjokvist J, Schumacker RE, Richardson MT, Curtner-Smith M (2012) Effect of gender on fatigue and recovery following maximal intensity repeated sprint performance. J Sports Med Phys Fitness 50: 243–53.
114 Hunter SK, Griffith EE, Schlachter KM, Kufahl TD (2009) Sex differences in time to task failure and blood flow for an intermittent isometric fatiguing contraction. Muscle Nerve 39: 42–53.
115 Parker BA, Smithmyer SL, Pelberg JA, Mishkin AD, Herr MD, Proctor DN (2007) Sex differences in leg vasodilation during graded knee extensor exercise in young adults. J Appl Physiol 103: 1583–91.
116 Roepstorff C, Thiele M, Hillih T, Pilegaard H, Richter EA, Wojtaszewski JF, Kiens B (2006) Higher skeletal muscle alpha2AMPK activation and lower energy charge and fat oxidation in men than in women during submaximal exercise. J Physiol 574: 125–38.
117 Li JL, Wang XN, Fraser SF, Carey MF, Wrigley TV, McKenna MJ (2002) Effects of fatigue and training on sarcoplasmic reticulum Ca2+ regulation in human skeletal muscle. J Appl Physiol 92: 912–22.
118 Harmer AR, Ruell PA, Hunter SK, McKenna MJ, Thom JM, Chisholm DJ, Flack JR (2014) Effects of type 1 diabetes, sprint training and sex on skeletal muscle sarcoplasmic reticulum Ca2+ uptake and Ca2+-ATPase activity. J Physiol 592: 523–35.
119 Wust RC, Morse CI, de Haan A, Jones DA, Degens H (2008) Sex differences in contractile properties and fatigue resistance of human skeletal muscle. Exp Physiol 93: 843–50.
120 Russ DW, Lanza IR, Rothman D, Kent-Braun JA (2005) Sex differences in glycolysis during brief, intense isometric contractions. Muscle Nerve 32: 647–55.
121 Esbjornsson M, Sylven C, Holm I, Jansson E (1993) Fast twitch fibres may predict anaerobic performance in both females and males. Int J Sports Med 14: 257–63.
122 Keller ML, Pruse J, Yoon T, Schlinder-Delap B, Harkins A, Hunter SK (2011) Supraspinal fatigue is similar in men and women for a low-force fatiguing contraction. Med Sci Sports Exerc 43: 1873–83.
123 Martin PG, Rattey J (2007) Central fatigue explains sex differences in muscle fatigue and contralateral cross-over effects of maximal contractions. Pflugers Arch
454: 957–69.
124 Janse de Jonge, XA (2003) Effects of the menstrual cycle on exercise performance. Sports Med 33: 833–51.
125 Janse DEJXA, Thompson MW, Chuter VH, Silk LN, Thom JM (2012) Exercise performance over the menstrual cycle in temperate and hot, humid conditions. Med Sci Sports Exerc 44: 2190–8.
126 Phillips SM, Green HJ, Tarnopolsky MA, Heigenhauser GJF, Hill RE, Grant SM (1996) Effects of training duration on substrate turnover and oxidation during exercise. J Appl Physiol 81: 2182–91.
127 Venables MC, Achten J, Jeukendrup AE (2005) Determinants of fat oxidation during exercise in healthy men and women: a cross-sectional study. J Appl Physiol 98: 160–7.

128 Nielsen J, Holmberg H, Schroder HD, Saltin B, Ortenblad N (2011) Human skeletal muscle glycogen utilization in exhaustive exercise: role of subcellular localization and fibre type. J Physiol 589: 2871–85.
129 Nielsen J, Ortenblad N (2013) Physiological aspects of the subcellular localization of glycogen in skeletal muscle. Appl Physiol Nutr Metab 38: 91–9.
130 Ortenblad N, Nielsen J, Saltin B, et al. (2011) Role of glycogen availability in sarcoplasmic reticulum Ca2+ kinetics in human skeletal muscle. J Physiol 589 (3): 711–25.
131 Yamashita K, Yoshioka T (1991) Profiles of creatine kinase isoenzyme compositions in single muscle fibres of different types. J Muscle Res Cell Motil 12: 37–44.
132 Takahashi H, Inaki M, Fujimoto K, Katsuta S, Izumi A, Nutsu M, Itai Y (1995) Control of the rate of phosphocreatine resynthesis after exercise in trained and untrained human quadriceps muscles. Eur J Appl Physiol 71: 396–404.
133 Bogdanis GC, Nevill ME, Boobis LH, Lakomy HK, Nevill AM (1995) Recovery of power output and muscle metabolites following 30 s of maximal sprint cycling in man. J Physiol 482: 467–80.
134 Yoshida T, Watari H (1993) Metabolic consequences of repeated exercise in long distance runners. Eur J Appl Physiol 67: 261–5.
135 Hamilton AL, Nevill ME, Brooks S, Williams C (1991) Physiological responses to maximal intermittent exercise: differences between endurance-trained runners and team games players. J Sports Sci 9: 371–82.
136 Helgerud J, Engen LC, Wisløff U, Hoff J (2001) Aerobic endurance training improves soccer performance. Med Sci Sports Exerc 33: 1925–31.
137 Glaister M (2005) Multiple sprint work: physiological responses, mechanisms of fatigue and the influence of aerobic fitness. Sports Med 35: 757–77.
138 Edge J, Bishop D, Hill-Haas S, Dawson B, Goodman C (2006) Comparison of muscle buffer capacity and repeated-sprint ability of untrained, endurancetrained and team-sport athletes. Eur J Appl Physiol 96: 225–34.
139 Juel C, Halestrap AP (1999) Lactate transport in skeletal muscle – role and regulation of the monocarboxylate transporter. J Physiol 517: 633–42.
140 Dubouchaud H, Butterfield GE, Wolfel EE, Bergman BC, Brooks GA (2000) Endurance training, expression, and physiology of LDH, MCT1 and MCT4 in human skeletal muscle. Am J Physiol 278: E571–9.
141 Berg K (2003) Endurance training and performance in runners. Sports Med 33: 59–73.
142 Holloszy JO, Coyle EF (1984) Adaptations of skeletal muscle to endurance exercise and their metabolic consequences. J Appl Physiol 56: 831–8.
143 Thomas C, Sirvent P, Perrey S, Raynaud E, Mercier J (2004) Relationships between maximal muscle oxidative capacity and blood lactate removal after supramaximal exercise and fatigue indexes in humans. J Appl Physiol 97: 2132–8.
144 Juel C (2006) Training-induced changes in membrane transport proteins of human skeletal muscle. Eur J Appl Physiol 96: 627–35.
145 Gladden LB (2004) Lactate metabolism: a new paradigm for the third millennium. J Physiol 558: 5–30.
146 Thomas C, Perrey S, Lambert K, Hugon G, Mornet D, Mercier J (2005) Monocarboxylate transporters, blood lactate removal after supramaximal exercise, and fatigue indexes in humans. J Appl Physiol 98: 804–9.
147 Cheung SS, McLellan TM (1998) Heat acclimation, aerobic fitness, and hydration effects on tolerance during uncompensable heat stress. J Appl Physiol 84: 1731–9.
148 Wright HE, Selkirk GA, Rhind SG, McLellan TM (2012) Peripheral markers of central fatigue in trained and untrained during uncompensable heat stress. Eur J Appl Physiol 112: 1047–57.
149 Hopper MK, Coggan AC, and Coyle EF (1988) Exercise stroke volume relative to plasma volume expansion. J Appl Physiol 64: 404–8.
150 Selkirk GA, McLellan TM (2001) Influence of aerobic fitness and body fatness on tolerance to uncompensable heat stress. J Appl Physiol 91: 2055–63.
151 Mora-Rodriguez R (2012) Influence of aerobic fitness on thermoregulation during exercise in the heat. Exerc Sport Sci Rev 40: 79–87.
152 Stephenson DG, Lamb GD, Stephenson GMM (1998) Events of the excitationcontraction- relaxation (E-C-R) cycle in fast- and slow-twitch mammalian muscle fibres relevant to muscle fatigue. Acta Physiol Scand 162: 229–45.
153 Sitsapesan R, Williams AJ (1995) The gating of the sheep skeletal sarcoplasmic reticulum Ca2+-release channel is regulated by luminal Ca2+. J Membr Biol 146: 133–44.
154 Fryer MW, Stephenson DG (1996) Total and sarcoplasmic reticulum calcium contents of skinned fibres from rat skeletal muscle. J Physiol (Lond) 493: 357–70.
155 Li JL, Wang XN, Fraser SF, Carey MF, Wrigley TV, McKenna MJ (2002) Effects of fatigue and training on sarcoplasmic reticulum Ca2+ regulation in human skeletal muscle. J Appl Physiol 92: 912–22.
156 Green H, Burnett M, Kollias H, Jing O, Smith I, Tupling S (2011) Malleability of human skeletal muscle sarcoplasmic reticulum to short-term training. Appl Physiol Nutr Metab 36: 904–13.
157 Ferreira JC, Bacurau AV, Bueno CR, Cunha TC, Tanaka LY, Jardim MA, Ramires PR, Brum PC (2010) Aerobic exercise training improves Ca2+ handling and redox status of skeletal muscle in mice. Exp Biol Med 235: 497–505.
158 Morissette MP, Susser SE, Stammers AN, O'Hara KA, Gardiner PF, Sheppard P, Moffatt TL, Duhamel TA (2014) Differential regulation of the fiber type specific gene expression of the sarcoplasmic reticulum Ca2+-ATPase (SERCA) isoforms induced by exercise training. J Appl Physiol 117(5): 544–55.
159 Nielsen JJ, Mohr M, Klarskov C, Kristensen M, Krustrup P, Juel C, Bangsbo J (2004) Effects of high-intensity intermittent training on potassium kinetics and performance in human skeletal muscle. J Physiol 554: 857–70.

160 Fraser SF, Li JL, Carey MF, Wang XN, Sangkabutra T, Sostaric S, Selig SE, Kjeldsen K, McKenna MJ (2002) Fatigue depresses maximal in vitro skeletal muscle Na(+)-K(+)-ATPase activity in untrained and trained individuals. J Appl Physiol 93: 1650–9.
161 McKenna MJ, Schmidt TA, Hargreaves M, Cameron L, Skinner SL, Kjeldsen K (1993) Sprint training increases human skeletal muscle Na+-K+-ATPase concentration and improves K+ regulation. J Appl Physiol 75: 173–80.
162 Green H, Dahly A, Shoemaker K, Goreham C, Bombardier E, Ball-Burnett M (1999) Serial effects of high-resistance and prolonged endurance training on Na+–K+ pump concentration and enzymatic activities in human vastus lateralis. Acta Physiol Scand 165: 177–84.
163 Travlos AK, Marisi DQ (1996) Perceived exertion during physical exercise among individuals high and low in fitness. Percept Motor Skill 82: 419–24.