

Abstrakt

Metabolisme beskriver summen af biokemiske reaktioner, der finder sted i en levende organisme, som giver energi til vitale processer; dette kan studeres på hel krops-, organspecifikt- eller cellulært niveau. Energitilgængelighed, som bestemmes af forskellen mellem energiindtag og energiforbrug under fysisk aktivitet, påvirkes af forskellige eksterne faktorer som f.eks. ophold i højden, fysisk aktivitet og kost. Systemiske energiunderskud har konsekvenser for reguleringen af organspecifik substratudnyttelse og funktion. **Formålet med denne afhandling var at integrere hjerne-, skeletmuskulatur- og systemisk substratoxidation og relativ substratudnyttelse i sammenhæng med udvalgte miljømæssige og energi stressorer (ophold i højde, motion, kalorieunderskud).** *Studie 1* behandlede et grundlæggende spørgsmål for integrativ cerebrovaskulær fysiologi: Hvordan påvirkes de cerebrale metaboliske hastigheder for ilt- og glukoseudnyttelse (henholdsvis $CMRO_2$ og CMR_{Glu}) af ændringer i arteriel PCO_2 ($PaCO_2$)? Resultaterne af denne undersøgelse viste, at cerebral oxidativ metabolisme ($CMRO_2$) ændres med ca. 1 % pr. mmHg ændring i $PaCO_2$. Disse ændringer kan tildels forklares af et øget kompenserende bidrag fra anaerobe metaboliske veje. *Studie 2* undersøgte forskningsspørgsmålet: Hvordan påvirker systemisk brændstofudnyttelse ved ophold i højden, hjernens inflammatoriske reaktion på fysisk aktivitet? Resultaterne af denne undersøgelse giver nye beviser for, at 6-8 dages akklimatisering ved 3.800 m ikke fremkalder immunundertrykkelse eller forværrer systemiske proinflammatoriske reaktioner i hvile eller med maksimal fysisk aktivitet. Endvidere påvirkede højdeinducerede ændringer i systemiske inflammatoriske reaktioner ikke direkte frigivelsen af proinflammatoriske cytokiner i hjernen efter maksimal fysisk aktivitet. *Studie 3A* viste, at 14-dages lav energitilgængelighed (LEA) - der effektivt involverer 50% daglig kaloriebegrænsning - hos udholdenhedstrænede kvinder, fremkalder immunologisk stress, systemisk inflammation og forringer træningspræstationen. *Studie 3B* afslørede endvidere, at 14-dages LEA hos de samme kvinder fremkalder en øget afhængighed af fedtoxidation til det samlede energiforbrug under submaksimal fysisk aktivitet, der var uafhængig af ændringer i hvilestofskifte, insulinfølsomhed og mitokondriel respirationskapacitet i skeletmuskulaturen. Denne afhandling fremmer vores forståelse af integrativ hjerne, skeletmuskulatur og systemisk substratoxidation og relativ substratudnyttelse i forbindelse med miljømæssig og energi stressorer.

Lay Summary

Metabolism describes the sum of biochemical reactions that take place within a living organism which provide energy for vital processes; this can be studied at the whole-body, organ specific, or cellular level. Energy availability, which is determined by the difference between energy intake and exercise energy expenditure, is affected by selected environmental and energetic stresses (e.g., high-altitude, exercise, diet/nutrition). Systemic energy deficits have implications for the regulation of organ-specific metabolism. ***This thesis provides novel insights for integrative brain, skeletal muscle, and systemic substrate oxidation and relative fuel utilization in the context of environmental and energetic stress (e.g., high-altitude, exercise, nutritional caloric deficits).*** Experiments included: metabolism in the brain in response to CO₂; the brain's inflammatory response to maximal exercise following 6-8 days of acclimatization at 3,800 m; and a diet intervention in females involving 14-days of effectively 50% caloric restriction while maintaining 8 hours of endurance training per week.

Preface

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Chapter 1.

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Chapter 7.

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