

Physical activity and energy expenditure in clinical settings using multisensor activity monitors

Akademisk avhandling

som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien vid Göteborgs universitet offentligen kommer att försvaras i föreläsningssalen 1737, Läkemedels- och Nutritionscentrum, Medicinaregatan 13, Göteborg

Onsdagen den 10 juni 2009 kl. 13.00

av

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The thesis is based on the following papers:

- I. Arvidsson D, Slinde F, Nordenson A, Larsson S, Hulthén L. Validity of the ActiReg system in assessing energy requirement in chronic obstructive pulmonary disease patients. *Clin Nutr.* 2006; 25: 68-74.
- II. Arvidsson D, Slinde F, Larsson S, Hulthén L. Energy cost of physical activities in children: Validation of SenseWear Armband. *Med Sci Sports Exerc.* 2007; 39: 2076-2084.
- III. Arvidsson D, Slinde F, Larsson L, Hulthén L. Energy cost in children assessed by multisensor activity monitors. *Med Sci Sports Exerc.* 2009; 41: 603–611.
- IV. Arvidsson D, Slinde F, Larsson S, Hulthén L. Free-living energy expenditure in children using multi-sensor activity monitors. *Clin Nutr.* 2009 Apr 2. [Epub ahead of print]
- V. Arvidsson D, Slinde F, Hulthén L, Sunnegårdh J. Physical activity, sports participation and aerobic fitness in children who have undergone surgery for congenital heart defects. *Accepted for publication May 2009 in Acta Paediatrica.*



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Physical activity and energy expenditure in clinical settings using multisensor activity monitors

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Background: Objective methods need to replace subjective methods for accurate quantification of physical activity. For clinical settings objective methods have to show high reliability, validity and feasibility. The commonly used activity monitors are unable to detect the variety of physical activities. Multisensor activity monitors have large potential for accurate quantification of physical activity. Children who have undergone surgery for congenital heart defects have the possibility of a physical active lifestyle because of progress in cardiac surgery and cardiology.

Aims: I-IV) To evaluate the ability of the multisensor activity monitors ActiReg, SenseWear Armband and IDEEA to assess physical activity and energy expenditure, and **V)** to assess physical activity, sports participation and aerobic fitness in children who have undergone surgery for congenital heart defects.

Methods: I) Patients with chronic obstructive pulmonary disease (COPD) wore the ActiReg during 7 days with doubly labelled water as criterion for energy expenditure; **II-III)** 11-13 years old children performed different physical activities wearing the ActiReg, SenseWear Armband and IDEEA, with indirect calorimetry as criterion for energy expenditure; **IV)** a new ActiReg algorithm calibrated in 11-13 years old children was tested in 14-15 years old children wearing the ActiReg and the SenseWear Armband during 14 days with doubly labelled water as criterion for energy expenditure; **V)** children who have undergone surgery for congenital heart defects and healthy controls in the age-groups 9-11 and 14-16 years wore the ActiReg during 7 days, were interviewed about sports participation and performed a maximal exercise test with measured oxygen uptake.

Results: I) The ActiReg showed a mean (sd) accuracy of 99 (10) % in assessing energy expenditure in COPD patients; **II-III)** the accuracy of the SenseWear Armband and IDEEA in assessing energy expenditure varied between the different activities but showed an overall value of 81 (11) %/85 (8) % for the SenseWear Armband and 96 (10) % for the IDEEA; the SenseWear Armband showed increased underestimation with increasing intensity; the ActiReg algorithm overestimated moderate physical activity and the ActiReg had a limitation in registering vigorous physical activity; **IV)** the accuracy of the ActiReg with the new algorithm and the SenseWear Armband was 99 (11) % and 96 (10) %, both with increased underestimation with increasing intensity; **V)** children who have undergone surgery for congenital heart defects showed similar physical activity as healthy controls but a tendency to lower amount of sports participation; in older children, especially in boys, patients had lower aerobic fitness; still, their amount of sports participation was considered high and their aerobic fitness moderate.

Conclusions: The ActiReg, SenseWear Armband and IDEEA have to be improved to be accurate instruments in clinical settings. While children who have undergone surgery for congenital heart defects showed similar physical activity level as healthy children, some of them may require support for their engagement in exercise and vigorous physical activity.

Key words: Physical activity, energy expenditure, children, activity monitors, multisensor, validity, reliability, congenital heart defects, aerobic fitness.

ISBN: 978-91-628-7754-5

E-version: <http://hdl.handle.net/2077/19651>