

# In-situ Monitoring of Energy Expenditure by the Application of Wireless Patch Type Sensor Module

Li Meina, Dinh Luan, Ji Hwan Lee, and Youn Tae Kim

## INTRODUCTION

FOR ubiquitous healthcare systems, in-situ monitoring of energy expenditure is one of essential requirement. In this study, accurate quantification of physical activity energy expenditure has been evaluated by the wireless patch type sensor module. The combined heart rate and movement sensors method used for measuring energy expenditure against indirect calorimetry. The sensing module for the heart rate (HR), movement (Agility Index) detection, is proposed to assess physical activity in populations. For the desired correlation equations between physical activity and energy expenditure; heart rate, movement data measured from Bruce protocol test on the treadmill (0~15Km/h).

## MATERIALS AND METHODS

Thirty participants walked and run on a treadmill (NEW

### SUBJECT DESCRIPTION

	Total (n=30)	SD
Age, yr	26	0.82
Weight, kg	65.25	4.57
Height, m	1.69	0.04
BMI, kg/m <sup>2</sup>	22.6	0.69

Values are means; SD, standard deviation; BMI, body mass index.

ROAD 21S AE 25 TAKEI Scientific Instruments co. Led., Japan) following a Bruce protocol for 12 minutes.

During the test, the participants were patched AirBeat sensor for measuring HR, MI, temperature and humidity in real time. HR and MI were used to estimate EE from the graded exercise test regression equation. Heart rate was used to convert the amount of O<sub>2</sub> consumed into heat equivalents. MI was use to concern about the activity intensity. Although it is not exact, the caloric expenditure of exercise is open estimated to be approximately 5 kcal (or 21 kJ) per liter of O<sub>2</sub> consumed. Predicted values were compared to measured values, obtained from portable indirect calorimeter Cosmed K4b<sup>2</sup> (Cosmed, Srl, Italy).

Manuscript Manuscript received Feb. 29, 2010. This study was supported by research funds from Chosun University.

Li Meina, Dinh Luan, Ji Hwan Lee, and Youn Tae Kim\*

Dept. of IT Fusion Technology, Graduate School, Chosun University, Gwangju, Korea. Tel.: +82-62-230-6269, Fax: +82-62-230-6469, E-mail: [petruskim@chosun.ac.kr](mailto:petruskim@chosun.ac.kr)

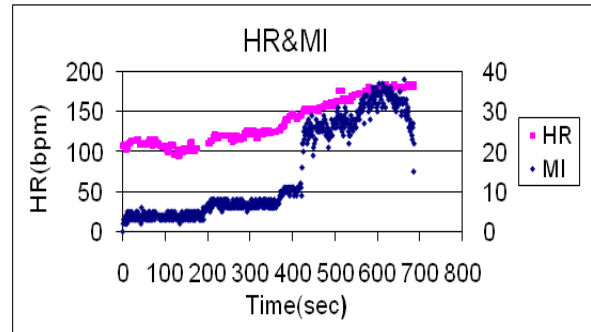


Fig. 1. Heart rate and Movement Index are recorded in real-time.

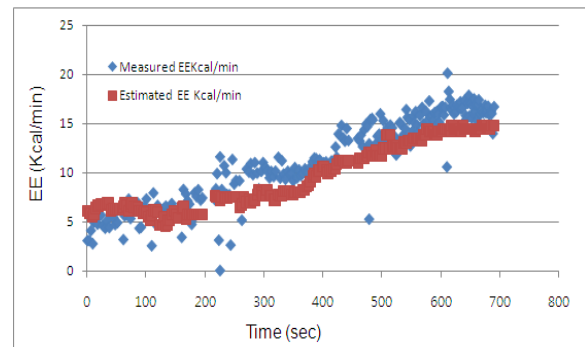


Fig. 2. Measured and estimated energy expenditure (EE) during 12 minutes Bruce protocol.

## RESULTS

The chest patched type wireless sensor module AirBeat system has strong relationship with VO<sub>2</sub> ( $R^2 = 0.78$ ). However, the wireless HR-MI sensor overestimated energy expenditure during low activities and underestimated the energy cost of intensity activities ( $p < 0.001$ ).

## REFERENCES

- [1] S. Brage, N. Brage, PW Franks, U Ekelund, NJ Wareham, "Reliability and validity of the combined heart rate and movement sensor Actiheart," *European Journal of Clinical Nutrition*, 59: pp. 561-570, 2005.
- [2] I. Zakeri, A. L. Adolph, M. R. Puyau, F. A. Vohra, N. F. Butte, "Application of cross-sectional time series modeling for the prediction of energy expenditure from heart rate and accelerometer," *J Appl Physiol*, 104: pp. 1665-1673, 2007.
- [3] S. J. Strath D. R. Bassett, JR., A. M. Swartz, D. L. Thompson, "Simultaneous heart rate-motion sensor technique to estimate energy expenditure," *Med. Sci. Sports Exerc*, 33(12): pp.2118-2123, 2001.
- [4] SE Crouter, JR Churilla DR Bassett Jr, "Accuracy of the Actiheart for the assessment of energy expenditure in adults," *European Journal of Clinical Nutrition*. 62; pp. 704-711, 2008.