【Review Article】

Measurements of Physical Activity and Sedentary Behavior by Tri-axial Accelerometers and their Application to Epidemiological Studies

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Abstract

At present, an accelerometer is the most accurate method for measuring minute-by-minute physical activity intensity under free-living conditions. Activity monitors with acceleration sensors can predict activity intensity due to the relatively strong relationship between acceleration and physical activity intensity. Uni-axial accelerometers were widely used previously, however, recently multi-axial accelerometers have become popular. Most activities in daily life including walking, are within ±2 G (1 G = 9.8 m/s^2), and most non-locomotive activities are < tens of mG, while sedentary behavior is < about 20 mG. Therefore, high resolution is necessary for evaluation of lower intensity activities including sedentary behavior. Different relationships between acceleration and physical activity intensity were observed for locomotive and non-locomotive activities. In order to classify locomotive and non-locomotive activities, several types of indices, such as the coefficient of variation of acceleration count, the ratio of vertical to horizontal acceleration, and the ratio of unfiltered to filtered synthetic acceleration, have been proposed. Prediction errors by the Active style Pro (Omron Healthcare) are relatively minor, particularly in lower intensity activities. Because waist-worn accelerometers are unable to detect the additional energy expenditure resulting from some activities such as cycling, uphill/downhill walking, and holding standing posture with extra weight, the characteristics of the device and algorithm must be considered when determining the type of accelerometers to use. We investigated physical activity levels in a Hisayama population by a tri-axial accelerometer (Active style Pro). Physical activity of 3 METs or more gradually decreased according to age, and a significant sex difference was observed in 2 physical activity patterns. Specifically, locomotive activity and sedentary time were significantly higher in males, and non-locomotive activity was higher in females. We have summarized the significance and feasibility of using tri-axial accelerometer in epidemiological studies, and have introduced several ongoing longitudinal studies, including prospective studies. These ongoing epidemiological studies will provide useful information that can contribute to the development of guidelines related to light-, and middle to vigorous-intensity activities, and sedentary behavior based on objective measurement by a tri-axial accelerometer.

Key words: epidemiology, objective measurement, physical activity, sedentary behavior, tri-axial accelerometer

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