Chapter LII
Accelerometer-Based Actimetry as Technology Applied to Healthcare

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ABSTRACT

This chapter reviews new quantification possibilities for the assessment of physical activity, a variable intimately related to good health. First, a variety of existing instruments are described with regard to their validity and functionality. Then, their applications are analyzed and categorized into two broad branches: sedentary lifestyle prevention and applications in special population segments. The authors' intention is to make existing possibilities for assessment of physical activity known to researchers and public health professionals, as it is important for the achievement and promotion of active and healthy lifestyles in the population.

INTRODUCTION

The use of technology applied to Health Care has led to the involvement of a quantitative and qualitative step in the progress of physical activity assessment and control. The health benefits concerning physical activity are well documented (Blair et al., 1995; Lee, Hsieh, & Paffenbarger, 1995; Paffenbarger et al., 1993; Paffenbarger et al., 1994). Overweight and sedentary lifestyles are both characteristic of most developed societies, as a consequence, interest in the promotion of physical activity has become a major constituent of overall health promotion strategies (Centers for Disease Control and Prevention [CDCP], 2001). Many studies have already researched multiple applications of activity monitors, as a means to bringing about the prevention of diseases as well as to monitor and control healthy habits in specific population segments.

ACCELEROMETER-BASED ACTIVITY MONITORS: DESCRIPTION AND VALIDATION AS OBJECTIVE INSTRUMENTS IN PHYSICAL ACTIVITY ASSESSMENT RELATED TO HEALTH CARE

Technological investigation has been innovating and implementing new physical activity registration systems for many years. The pulsometer and portable metabolic units have, without a doubt, revolutionized the ability to study physiological parameters, sport, and physical training. However, these instruments, in spite of their objectivity, are difficult to apply and manage in large samples. Moreover, it turns out to be very difficult to document physical activity without interruption over a multiple-day period, which is what really interests us when attempting to quantify lifestyles. For this reason accelerometers came onto the market in the early 1980's and continue to be innovated to better achieve this outcome. As Puyau et al. indicate (2002), activity monitors were developed in response to the lack of reliability of self-report measures, the intrusiveness of direct observation, and the complexity of heart rate monitoring. With the advent of small accelerometer-based activity monitors, the ability to monitor personal activity has improved greatly, both quantitatively and qualitatively.

Description and Main Features

Technically, an accelerometer consists of a device with a piezoelectric sensor that registers physical activity via body movement (acceleration) produced during a limited period of time. The Caltrac Personal Activity Monitor (Muscle Dynamics, Torrence, CA) was the first accelerometer to be widely used in research. Now, a broad range of models are offered on the market. Table 1 shows technical specifications of some of them.

First of all, it should be stated that the term acceleration is defined as a change in velocity with respect to time, often expressed in gravitational units (1 G = 9.8 m/s^{-2}).

Depending on the model, these accelerations may be detected in one, two or three movement planes (vertical, anteroposterior, and mediolateral). Built-in software is used to execute basic calculations related to physical activity parameters with the option of exporting, in major cases, complete data from the instrument to a spreadsheet. Physical activity information is saved in the form of "counts." The accelerometer mechanism converts voltage signals into a digital series of numbers (raw counts). Basically, counts are the summation of the measured accelerations during a certain epoch, an epoch being the time period over which accelerometer counts are averaged. For instance, in the ActiGraph GT1M model, a count is equivalent to 0.1664 Gs and it is possible to program recording periods from 33.3 milliseconds to 300 seconds. This model measures changes in acceleration 30 times per second. When one minute cycles are used, as in most studies, 1,800 measurements are summed and the value is written to memory at the end of the epoch period (ActiGraph LLC, 2007). The capacity to record data depends on accelerometer memory and battery life.

The time interval selected for a research study greatly affects its results. Usually, the majority of studies that use accelerometers to measure energy expenditure or levels of physical activity, program

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