A smartphone application to evaluate energy expenditure and duration of moderate-intensity activities

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Obesity and **sedentary lifestyles** are constantly increasing for many years. Most of the studies use expensive and / or complex methods in order to estimate energy expenditure in controlled conditions or in free-living conditions. The aim of the project is to recognize **low to moderate physical activities** and to estimate volunteers' **energy expenditure** in free-living conditions by using **smartphones**, equipped with tri-axial **accelerometers**.

The project consists of 2 main steps: 1) the creation of energy expenditure estimation functions; 2) their validation over 18 volunteers.

Twelve volunteers have first been equipped with an Android smartphone (a Samsung Galaxy Xcover) and with two sensors used in research to estimate energy expenditure (Armband and Actiheart) during several controlled activities such as sitting, standing, walking and transportation. The accelerometry data collected by the smartphone allowed creating functions of energy expenditure prediction. Then, 6 other participants had the smartphone and sensors during one day in free-living conditions. Their data allowed testing the functions.

Two functions have been created during the research study:

- f(AEDES), which recognizes physical activities in order to estimate energy expenditure.
- f(NRJSI), which uses accelerometry data for estimating energy expenditure directly.

The results of our study showed that the difference between the energy expenditure estimation provided by f(AEDES) and f(NRJSI) were 14.03% and 9.60% from Armband, respectively. Moreover, physical activity categorization was good for categories "immobile activities" (less than 2 METs) and "light and moderate activities" (from 2 to 6 METs). However, it was not possible to conclude over the "vigorous activities" category (6 METs or more), since there were not enough data.

The next step will consist in recruiting 24 new volunteers for validating this study's results. Indeed, the functions have been optimized over the data of all the 18 volunteers, so it is normal to obtain low error rates for this population. New volunteers will allow us to estimate performances of the functions with a population that has not been used to parameter them.

Keywords: obesity, sedentary lifestyles, low to moderate physical activities, energy expenditure, smartphones, accelerometers, free-living conditions