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Health Wearables for Early Detection of Frailty Syndrome in Older Adults in Mexico: An Informed, Structured Process for the Selection of a Suitable Device

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Abstract

This paper presents an informed, structured process to the selection of health wearables in the context of mobile health projects, though it may be applied to other wearable devices in different contexts. In particular, this process was applied to the selection of a consumer heatlh wearable for physical activity tracking based on step count within the context of an actual mobile health project that aims to address the early detection of frailty syndrome in the geriatric population in Mexico. The process started with the identification of user needs, followed by their translation to technical specifications defined in terms of metrics (quantifiable features). These metrics were defined using ideal and marginally acceptable values based on national regulations and constraints imposed by the specific context. The devices available in the market were screened and rated against these technical specifications using weighted rating scales that recognise the relative importance of certain specifications. Finally, the selected device was submitted to a preliminary verification test for accuracy. Additional work is required to validate the device for its use under real-life conditions.

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1. Introduction

Population aging is an important demographic process that will shape societies of the 21st century[1]. Mexico is not exempt of this trend: with an increasing life expectancy at birth and a decreasing total fertility, the country will experience a significant change in its demographic composition in the years to come[2, 3]. This shift will imply new public health challenges for the country, which will require new healthcare models and services.

Among the health issues that derive from the process of ageing, human frailty is one the more pressing. Frailty syndrome is a condition characterized by a diminished homeostatic reserve and less tolerance of the subject to stress situations in old age (e.g. acute illness, surgery, falls and fractures)[4]. Frailty increases patient vulnerability, limited mobility and risk of fractures. Table 1 summarizes the criteria proposed in 4, 5 and 6 *vis-à-vis* the diagnosis of frailty syndrome; namely, weight loss, exhaustion, walking speed, physical activity level and falls occurrence. The early detection of the frail patient based on these criteria would allow to timely provide him/her with appropriate interventions in order to reverse this state[7].

Table 1. Frailty syndrome diagnosis

Criteria	Definition	Parameters
Weight loss	Unintentional weight loss [4]	Weight loss ≥ 3 kg in the last year
Exhaustion	Tiredness feeling [4]	"What I did required me a great effort"
Walking speed	Walking speed for 4 meters [4]	Female: < than 0.6 m/s Male: < than 0.8 m/s
Weakness	Grip strength [6]	Female: < 18 Kg Male: < 30 Kg
Physical activity level	Weekly physical activity [4], [5]	Female: < 270 kcal/week Male: < 383 kcal/week (excluding Basal Metabolic Rate in both cases)
Falls occurrence	Recurrent falls [4]	Falls > 1 per year

The use of wearable devices, in conjunction with other technologies and methods (e.g. mobile devices, big data, and machine learning) is a promising area of research and development towards the deployment of new healthcare models to tackle public health issues. However, there is concern about the variability of the measurements of wearable devices. Because devices are not considered to clinical use, the health sector regulation does not apply. Manufacturers shirk their responsibility by adding a label saying that their use does not have clinical or diagnostic purposes. Accordingly, the authors are working on a project to develop tools for the early detection of frailty among Mexican geriatric population. The project aims to define, measure, and assess frailty in order to trigger suitable interventions in a timely manner[8]. Another problem that has been identified in wearable devices is that the measurements that they provide are designed and calibrated for young and adult people with physical activity, but not for older people with mobility problems or limitations in their movements.

In a previous report[8], a working definition of frailty was presented (Table 1). In this paper, the application of an informed, structured decision-making process to the selection of a suitable device to quantify the level of physical activity (e.g. through the measurement of steps) within the specific context of the abovementioned project is presented. The focus was made on this criterion given that the other criteria can be determined in the doctor's office during follow-up consultations.

2. Methods

Fig 1 depicts the process followed in the selection of a suitable device to quantify the level of physical activity in Mexican elderly population. It was adapted from the process proposed in [9]. Originally, the process is meant to be used for product design and development. However, some of the activities and tools were deemed by the authors as useful and relevant for the selection of health wearables in the context of mobile health projects. In the following subsections, the stages of the process are briefly explained.

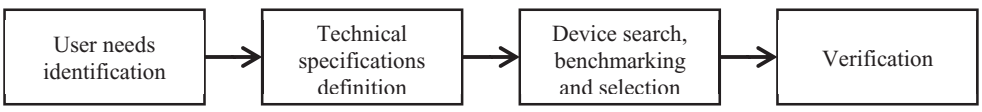

Fig. 1. An informed, structured process for health wearables selection in the context of mobile health