Ambulatory mobility and physical activity monitoring of elderly; a pilot study


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INTRODUCTION
As we age, our ability to be mobile – the ability to move physically – deteriorates slowly. Slow physical and cognitive decline results in reduced mobility over time and an increasing need for assistive devices. Mobility is a good indicator of health status and independent living. Mobility improves endurance and muscle strength, and can improve psychological well-being and quality of life by increasing the person's ability to perform a greater range of activities of daily living (ADL). The extent to which mobility aids fulfil all mobility needs of independently, solitary living elderly is unclear. We investigated a method to objectively monitor mobility and physical activity of elderly using ambulatory wireless technology during daily living, and studied the monitored physical activity compared to a sedentary population of healthy office workers.

METHODS
Four elderly women (age 77 ± 10), living independently, solitary and in need of some assistance to perform their activities of daily living (e.g. doing groceries) were asked to wear a wireless activity sensor (3D accelerometer, Promove3D from Inertia Technology, Enschede) for three days, during waking hours. The activity sensor provides counts per minute, similar to Bouten et al. (1997) [1]. The sensor was wirelessly connected to a smartphone. For measuring outdoor mobility, location was tracked using the GPS sensor of the smartphone. All measurement data is forwarded to a secure online database for remote monitoring. Physical activity is reported in an average cumulative scores per day [2], and in terms of activity and inactivity periods, based on an activity intensity threshold (150 counts). Also, the participants were asked to fill in the SF-36 and a dairy was filled in on the PDA, reporting their transportation means. The physical activity dataset is compared with physical activity of a sedentary population of healthy office worker monitored with the same devices.

RESULTS
The participants scored low on the physical functioning SF-36 subscale, 34 ± 16 points, compared to a norm score of 61 ± 26 of a Dutch population of men and women age 65-85 [3]. The participants reported functional limitations like having difficulty to walk several hundreds of meters and when climbing more than one staircase. Due to bad weather the elderly stayed indoors, more than normal, and GPS was not included in the analysis. Participants wore the activity monitoring system for 1 – 3 days, resulting in a total of 9 monitoring days, with an average duration of 12:15h; start time 08:22h ± 1:52, and end time 20:37h ± 1:46h. The average accumulated physical activity of the elderly was 3470 counts per day, which is 79% of the average cumulative score of healthy office workers (n=20) during their waking hours. Most activity takes place during short periods of activity; elderly accumulate 48.7% of their activity in bouts up to 5 minutes, office workers 60.3%. The activity intensity per activity bout is lower (8.2 ± 13 minutes Elderly; 7.3 ± 13 minutes Office workers) and shorter (394 ± 228 average counts per activity period Elderly; 465 ± 303 average counts per activity period Office workers) in elderly and shows lower standard deviations than in office workers.
DISCUSSION AND CONCLUSION
The pilot study with four elderly showed that physical activity of elderly can be captured by a wearable activity sensor. Though, how the reported measures of physical activity, like a cumulative score, duration and intensity of activity periods relate to mobility is not fully clear. The elderly participants were limited in their mobility and physical activity, and although there are differences with the healthy office workers, it is not so easy to link specific features to mobility and mobility needs for performance of activities of daily living. Office workers are more active than the elderly, but achieve this level in more activity bouts of a very short duration. Possibly, interventions on performing short activity bouts can also help elderly to increase their physical activity and improve their mobility. Telemonitoring can be applied to assess the health status of elderly persons, though further investigation of ambulant monitoring of activity patterns of elderly with activity sensors, GPS and possibly other measures is needed. A next step will be towards monitoring gradual deterioration in the health status of elderly persons.

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REFERENCES
