HOW MANY STEPS - DO THEY COUNT?
Experiments on Pedometer Use

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Abstract: Physical inactivity is the fourth highest risk for mortality globally. One of the main drivers for physical activity (PA) in the future could be information and communication technology (ICT) gadgets and services that support active way of living. This paper focuses on how pedometer use supports PA and the end-user experience of the device. 26 subjects took part in a five-month study. Data was collected with a semi-structured questionnaire from individuals using pedometers and reporting their daily steps. The participants increased their PA during the project and most of them wanted to continue with the more active lifestyle.

1 INTRODUCTION

Technology, urbanization, increasingly sedentary work environments and automobile-focused community design have significantly reduced daily physical activity (PA). Obesity, type II diabetes, cardiovascular diseases and sedentary way of living are rapidly increasing epidemics in the western world. They challenge the health and well-being of modern society. Sedentary and unfit way of living increases numerous chronic diseases and decreases longevity (Blair and Haskell 2006). Physical inactivity is globally the fourth highest risk for mortality (WHO 2009). PA is known to improve health and is extremely effective in preventing and treating lifestyle related diseases at all ages (The Toronto Charter for Physical Activity 2010).

PA has been promoted by recommendations which vary from country to country. The recommendations for youth, adults and older adults in the USA are probably the best known (PA USA 2008). The Finnish recommendations for PA are in line with these. For substantial health benefits, adults should accumulate at least two and a half hours of moderate-intensity exercise, or one hour and fifteen minutes vigorous PA, weekly. One bout of aerobic PA should last at least 10-15 minutes, and the activity should be spread throughout the week. Adults should also do muscle-strengthening activities (8 to 10 exercises with 8 to 12 repetitions of each) twice a week.

The Toronto meeting for PA addressed technology as one of the reasons for sedentary behaviour. However, ICT applications have expanded from automating to accompanying, entertaining and fantasizing ones (Iivari 2007), activity monitors and sport games as examples. This paper focuses on how pedometer use supports PA, and what the end-user experience of the device is.

2 ICT ADAPTION AND PEDOMETER FOR PA

Technology acceptance and the intention to use information systems have been widely studied since the technology acceptance model (TAM) was published (Davis 1989). Usefulness and ease of use are key factors in technology acceptance. User acceptance of IT has been thoroughly studied in UTAUT-model (Unified Theory of Acceptance and Use of Technology) (Venkatesh et al. 2003). Performance expectancy, effort expectancy, social influence, and facilitating conditions are direct determinants of usage intention and behaviour. Gender, age, experience, and voluntariness of use

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moderate the impact of the four key constructs on usage intention and behaviour (Venkatesh et al. 2003). DeLone and McLean (1992) argue that an information system is not successful, if it is not used by its intended users. Indeed, there is a need for more parsimony in TAM models and meta-analysis (Burton-Jones and Straub 2007).

Traditional research of the individual use of IT applications has taken place at work (e.g. Davis 1989; DeLone and McLean 1992; Venkatesh et al. 2003; Burton-Jones and Straub 2006). However, IT applications are increasingly used outside of work. This is true especially with the ICT services and gadgets for PA. Their determinants of use may be different from those supporting work or business processes. If an application or service is not used to support business activity, measures such as perceived usefulness (Davis 1989) and performance expectancy (Venkatesh et al. 2003) may not be directly applicable. As knowing, identifying, contacting, sampling, involving and representing users is becoming more complicated, it is vital to understand them thoroughly when developing new IT applications and services (Iivari et al. 2010).

PA promoters and PA related ICT gadget and service developers face a challenge as end-users have become more heterogeneous, complex and diverse. The same service or gadgets may be used by an IT professional, an average middle-aged layperson, a teenager nerd, or a granny. How to make their adaption and use attractive in the PA domain?

A pedometer is a usually portable and electronic or electromechanical step counting device. It counts each step by movement detection. More advanced pedometers can also estimate e.g. walking distance and burned daily calories. Hatano (1993) was the first person to introduce technology into PA in the format of a portable motion sensor (pedometers). The device was commercialized in Japan in 1965 under the name of mampo-kei (ten-thousand-step meter). The target of 10,000 daily steps is today universally accepted, although more detailed daily steps activity levels have also been identified (e.g. Tudor-Locke and Bassett 2004). Pedometers have been used to evaluate the daily activity (e.g. Hirvensalo et al. 2010). The advantage of pedometer is their low cost and easy use. Pedometers can motivate subjects willing to increase PA. The general goal of 10,000 daily steps has often been used for target settings. Tudor-Locke and Bassett (2004) classified the number of daily steps for PA as follows:

- < 5,000: physical inactivity
- 5,000-7,499; normal daily activity
- 7,500-9,999; somewhat physically active
- 10,000-12,000: physically active way of living
- >12,500: physically highly active.

The daily steps for older adults (50–94 years) range from 2,000–9,000 (Tudor-Locke et al. 2009). Males generally take more steps than females. Based on these results a concept of age-related recommendation for daily steps has been proposed.

The daily steps taken by Finnish adults aged 30-45 years vary between 4,800-10,300. In contrast to the Americans, Finnish females took more steps than males. Finns reportedly take fewer steps daily than other Europeans (Hirvensalo et al. 2010). This may be due to seasonal variation of data collection or other methodological reasons.

Most studies have focused on determining daily steps in relation to different disease risk factors, or diseases. More experience is needed with ICT gadget use in working-aged population. This 5-month study seeks further evidence on the role of pedometers in increasing PA. It also collects user-experience for the device.

3 RESEARCH DESIGN

Subjects were recruited at two sports clubs with an open e-mail invitation in October 2010. The participation was offered to all club members. Altogether 36 persons registered for this study.

Initially, the subjects were trained to use the pedometer and the sheet used to report the daily steps. The subjects reported their daily mean, weekly mean, and weekend mean steps. In addition, change of weekly total steps as well as monthly mean, maximal daily steps and the cumulative number of steps were collected. High intensity sports and muscle-training were also reported. During the study, the subjects received three motivational e-mails to support their PA.

The data collection lasted 5 months (22 weeks) from November to April. Also a semi-structured, self-reporting questionnaire on pedometer use was used. The questionnaire was designed by a team of experts in PA, sports and exercise medicine, and information systems. At the end of the study subjects received a link to a web-based questionnaire by e-mail.

4 RESULTS

Twenty-six (26) subjects replied to the web-

questionnaire and 24 subjects returned the step sheet. Twenty (20) of the subjects were females and six (6) males. Five (5) were born in the late 40's or 50's (aged 59-72 years), 12 were born in the 60's (aged 40-50 years), four (4) in the 70's (aged 30-40 years) and four (4) in the 90's (10-20 years). On average the subjects reported their step data for a period of 21 weeks (median 19 weeks, range 6-22 weeks). The subjects were experienced pedometer users, the mean experience being 3.5 years (range 5 months to 10 years and 6 months). Eighteen (18) had their own pedometers and eight (8) had a borrowed one. All 26 subjects considered the use of pedometer easy.

Seventeen (17) used computers to fill in the step sheet, and 6 did it manually. Seven (7) filled the sheet daily, 12 did it once a week. Twelve (12) used their own computer and four used a work-site computer.

The motives (mean) for taking part in the study were as follows (scores: 1 = strongly agree, 2 = agree, 3 = not agree/not disagree, 4 = disagree, 5 = strongly disagree) *:

1. I wanted to know the number of my daily steps (2.1).
2. I wanted to become physically more fit for the summer (2.4).
3. I want to lose some body weight (2.6).

The project increased the subjects PA (Tables 1 and 2).

Table 1: Reported moderate-intensity PA before and during the study.

PA (30 min moderate-intensity)	before	during
PA < once a month	2	1
once a month <PA< once a week	5	3
1-2 times weekly	12	5
3-4 times weekly	6	11
5 or more times weekly	1	6

Table 2: Reported vigorous PA before and during the study.

PA (20 min vigorous)	before	during
PA < once a month	5	2
once a month <PA<once a week	5	3
1-2 times weekly	10	5
3-4 times weekly	4	11
5 or more times weekly	1	1

The participants followed mainly the daily steps as well as the total weekly steps and the change. The participants reported that the project affected the most the following*:

1. I am physically more active (2.1).
2. The study has activated me (2.5).
3. I am physically more fit (2.7).

The use of pedometer was classified as follows*:

1. The pedometer was easy to use (1.3).
2. The use of pedometer did not require any special effort (1.4).
3. The pedometer was useful (2.0).

The use of the step table was classified as follows*:

1. The use of the step-table did not require any special effort (1.6).
2. The step-table was easy to use (1.2).
3. The step-table was useful (2.4).

The reported step numbers are reported in Table 3.

Table 3: Steps taken during the 22-week project.

Step category	Mean	Median	Range
Mon-Fri	7929	7540	5248-17195
Sat-Sun	7887	7788	4624-17867
Nov	7217	7135	4480-18140
Dec	6712	6331	3966-14249
Jan	7957	7179	3425-19729
Feb	7427	6924	3245-15335
March	7617	7407	4136-18712
Daily mean	8030	7781	5424-17382
Daily median	7395	6958	4495-17046
Daily max	21227	19518	9888-58825

Table 4 illustrates the previous user experience for different ICT gadgets and services. Altogether 75 % of the subjects reported experience with more than one device or service. The majority were unsatisfied with ICT gadgets that had not worked well or were complicated to use. The gadgets that had been received as a gift were often not used.

Table 4: User experience of previous PA related ICT gadgets or services.

ICT gadget / service	# of subjects
pedometer	17
heart rate monitor	11
mp3 player / radio	8
PA websites	3
sport videos / TV	3
gaming consoles	2

Table 5 illustrates from where subjects would prefer to get feedback for their PA. Health care and sports/PA professionals, and family members and friends were preferred.

Table 5: Favourite feedback providers.

Feedback provider	# of subjects
• sports / PA instructors	11
• health care professionals	7
• family member	6
• friends	5
• sports clubs	4
• personal trainer	3
• employer	1

The majority wished for personal feedback (15 subjects). Nine (9) would like to receive feedback via e-mail and three (3) with a text-message.

5 CONCLUSIONS

Twenty-six individuals completed this 5-month pedometer study. The subjects reported an increase in their PA during the study (especially females). Most reported also an intention to continue with a more active lifestyle in the future.

The step trend during the study was pretty stable. Based on the median number of steps the subjects were normal physically active.

The participants felt that the pedometer was easy to use and useful in supporting PA. Most of the subjects had experience of more than one PA related ICT device or service, and they had been unsatisfied with ICT gadgets that had not worked well or had been complicated to use. The gadgets that had been received as a gift were not used.

Professionals, and friends and family were considered the most important sources of feedback and support.

Based on this study, ICT gadgets that are easy to use and that can be combined together with social and professional support, provide the best positive impact on PA performed by individuals. PA increase is important for an individual, but also for overall public health. New, innovative approaches and tools to reshape our inactive lifestyle are needed.

We propose development of individually tailored PA programs, and advising and monitoring according to mass-customisation models for public health and PA promoters. Studies of the importance of family and friends in ICT gadget and service adaption for PA should be considered. Use and development of social media to support positive attitude with reliable information to health and PA should also be evaluated.

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