

ICT Supporting Daily Physical Activity - with Special Reference to Pedometers in the Step-Shape Project

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Abstract – Physical inactivity (PA) is one of the leading risks for mortality worldwide. One of future main drivers for physical activity could be information and communication technology gadgets and services that support active way of living. This study focuses on investigating and understanding how individuals use pedometers to support their physical activity and what their end-user experience is. In addition to individual scope, this is also important both for information society and healthcare organizations. They urgently require new approaches and tools to reshape their customers' inactive lifestyle. Data for this study was collected with semi-structured questionnaire from subjects who used pedometers for a three month period and reported the daily step. The participants increased their PA during the project and most of them also informed on their intention to continue the more active lifestyle. The pedometer and the developed step collection table were easy to use and useful in supporting PA. ICT will inevitably play a major role in promotion of physically active lifestyle.

Keywords – ICT supported physical activity, pedometer, end-user experience

I. INTRODUCTION

A sedentary and unfit lifestyle increases the risk of many chronic diseases and conditions and even decreases longevity [1]. In addition, physical inactivity is globally the fourth highest leading risk for mortality [2]. Physical inactivity and sedentary way of life are modern rising risk factors and they occur worldwide in high, as well as in low income countries.

Physical activity (PA) has many scientifically proven health enhancing effects and PA is also effective in preventing and treating specifically lifestyle connected diseases. Interestingly, studies also confirm that long term physical activity e.g. brisk walking is associated with significantly better cognitive function and reduced risk of dementia [3, 4].

In many countries PA has been promoted by recommendations. These recommendations vary from country to country. The recommendations for youth, adults and older adults in the USA are probably most well known [5]. The Finnish recommendations for PA are in line with these recommendations: For substantial health benefits, adults should accumulate weekly at least two hours and thirty minutes of moderate-intensity exercise, or one hour and fifteen minutes vigorous physical activity. Aerobic activity should be performed in episodes of at least 10-15 minutes. Activity should be spread throughout the week. Adults should also do muscle-strengthening activities (8 to 10 strength-training exercises, 8 to 12 repetitions of each exercise) twice a week.

Despite many benefits of the PA, initiation and maintenance rates of PA in the general population have been rather disappointing [6]. The sedentary lifestyle is a growing phenomenon of our modern society. The latest Finnish survey reveals that less than half of Finns fulfill physical activity recommendations [7]. Increasing of PA requires a change in people's everyday lifestyle and habits. Indeed, a newly published data in Finland indicate that physical fitness is an emerging factor of social divide in Finland [8]. The study shows that people who perform some kind of exercise at least three times a week are more satisfied with their well-being and social life than those who do physical exercise less than once a week.

To become physically more active is challenging as today there are several new attractive leisure time competitors like social media, computer and console games. As new gadgets and innovations are penetrating the society, the need for studying and understanding their usefulness in order to increase PA and wellness become vital.

PA is widely studied in medicine and sports. More than two hundred prominent studies report on new technology used to improve encouragement to achieve recommended PA levels [9]. To really increase PA in different population segments we have to understand how normal subjects use information and communication technology (ICT) to support their PA. In this study we focus on pedometers and on pedometer use to support daily PA.

In chapter two we discuss ICT devices that can be used to support PA. Chapter three has special focus on pedometer and the study design is described in the next chapter Results are presented in chapter five and the final conclusions in chapter six.

II. USE OF PEDOMETERS FOR PHYSICAL ACTIVITY IN INFORMATION SOCIETY

ICT has penetrated into our society to the extent it has started to show collective impact on the physical and mental state globally. This may require us to reshape our habits and lifestyle. This requires the society and its organizations also to reshape their behaviour.

Technology, particularly in combination with effective decision making, especially when combining motivational and environmental factors, can definitely improve health and well-being.

New challenging drivers for PA are ICT gadgets and services such as: pedometers, accelerometers, mobile in-built

accelerometers, heart rate monitors, social networking, sport gaming and devices, computer based counseling systems, global positioning technologies, and mobile entertainment electronics. We will shortly review the above mentioned supporting technologies, although this study focuses on the use and user experiences of pedometers.

A pedometer is a step counting device, usually portable and electronic or electromechanical. It counts each step made by movement detection. The advantage of pedometers is their low cost and easy use. More advanced pedometers can even estimate walking distance and burned daily calories.

An accelerometer is an electromechanical device measuring acceleration forces. These forces may be static, as the constant force of gravity, or dynamic - caused by movement or vibration of the accelerometer. The accelerometers are more accurate devices for measurement of body movement than pedometers.

A heart rate monitor measures the heart beats on a real time basis or for later use by recording the readings. The heart rate monitors developed for sport and exercise purposes may include timing, heart rate target zones, and calorie burning estimations.

Social medium technology tools like microblogging (Twitter) and networking with friends and groups on Facebook and Google+ enable information sharing via technological means. Internet may provide a useful modern tool to keep subjects engaged in PA and encourage them to achieve their targets.

Today our schedules are busy both in personal and business life. Therefore many classic PA activities and sports have been replaced by computer gaming and gadgets. Modern technology even allows us to be physically active when playing games thereby avoiding sedentary behavior.

A computer based counseling system allows serving a great number of customers with individual tailoring and feedback despite minimal human resources very cost-effectively. Information may be delivered and presented in a user-friendly way e.g. in videos, figures and audios which are adapted to the user needs. This kind of system can be part of shared decision aids also enabling exchange of experience and motivating and possibly supporting self-management.

The global positioning system is a space-based global navigation satellite system. It provides real-time location and time information under all weather conditions at all times and anywhere on Earth. Global positioning system in PA applications can be used to e.g. route recordings, show the distance made, present altitude information and make speed calculation.

Mobile entertainment electronics include such devices as tablets, mobile phones, mp3-players and radio devices. These may be used during PA sessions to make them more enjoyable.

III. PEDOMETER USE FOR PHYSICAL ACTIVITY

Pedometers can have a motivation impact for subjects willing to increase PA. Even the target of daily 10 000 steps is universally known originating from Japan in the early 90s

[10]. This general goal has been used for target settings. Reference [11] recommended more detailed step data for PA estimation:

- Less than 5000 daily steps suggest physical inactivity.
- 5,000-7,499 daily steps are typical for normal daily activity excluding sports or exercise.
- 7,500-9,999 steps are likely to include some exercise or additional walking and/or a job that requires more walking and thereby classify individuals as somewhat active.
- 10,000-12,000 daily steps characterize a physically active way of living.
- Individuals who take more than 12,500 daily steps are physically highly active.

Later it was found that for older adults (50–94 years) the daily steps ranged from 2,000–9,000 [9]. Males generally took more steps than females. Based on the results they argued that there is a need for determining some kind of age-related recommendation for daily steps.

In Finland 30-45-year-old adults report the daily steps varying between 4,800-10,300. In contrast to USA in Finland females took more steps than males. However, it was reported that the Finns take fewer steps than other Europeans [12]. This may be due to seasonal variation of the data collection or other methodological reasons.

Most studies have focused on determining daily steps in relation to different risk factors of diseases or directly to diseases. Therefore more information is needed on how the end-users use ICT gadgets like pedometers to support PA.

The Step-Shape Project aims to study end-user experience of ICT gadgets and services that support active way of living. This is the first study of the Step-Shape Project where the focus is on the role of pedometers in increasing PA.

IV. RESEARCH DESIGN

During January - February 2010 subjects were recruited via K5 www-page. K5 is a special Fun Run event for females and it has also over twenty years' tradition of promoting local PA. K5 organizes various activities throughout the year, but it climaxes with a special physical activity and well-being day for females in May. Participants of the study may download a special Step-Shape Project developed sheet (see appendix) to report daily steps with instructions. The subjects were asked to report their daily steps and the table itself counted the daily mean, weekly mean, weekend mean, monthly mean, maximal daily steps and the cumulative step number. The table also calculated the change of direction in weekly total steps as well as the absolute weekly change in total steps.

The step data collection occurred during three months (89 days) from February to April. Simultaneously a semi structured self-reported questionnaire on pedometer use was used. The questionnaire was team designed together with experts in physical activity, sports and exercise medicine and information systems. The questionnaire was twice pilot-tested in a small group of physically active women. After these pilot

tests some questions were reshaped and few questions were added.

The questionnaire included 26 questions; seven were focused on the use of pedometer, twelve questions were related to motivational, environmental and actual PA change issues. The questionnaire contained also four open and feedback comments. The remaining questions focused on different kinds of step results achieved during the project. At the end of step collection period the participants could open the web-questionnaire from the same page where they had downloaded the step-table. The open comments were analyzed by the main author with special focus on the interrelations of ICT and PA. The numerical data was analyzed by the Webropol-program (<http://w3.webropol.com>). The program was also used when developing the web-survey questionnaire.

V.RESULTS

Altogether 66 persons opened the questionnaire. Finally ten persons participated in this study. Nine of them were women. Mean age was 42 years. The motives (mean) for taking part were as follows (1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree):

1. I wanted to know the number of my daily steps (1.7).
2. I wanted to become physically more fit for the summer (2.4).
3. I wanted to change my lifestyle (2.4), and I want to lose some body weight (2.4).

All the participants used their own Omron walking style II pedometer (Omron Healthcare Co., Ltd., Kyoto, Japan). On average they had 3.4 years pedometer use experience. The participants think that pedometer was user-friendly and easy to use. Instructions to use the pedometer had been clear. The pedometer was like a "part of the body". The biggest challenge was to remember to take it along in the morning. Nine participants fulfilled the step table with the help of computer; two of them did it on daily basis, seven at least once a week. The computers were either own computers or work computers.

Three subjects made their own voluntary standardized two kilometers walk (Table I) at the beginning of the study and repeated it later. All reported smaller figure for time used and steps taken during the latter test.

TABLE I
REPEATED 2 KM STANDARDIZED WALK

Date 1	Date 2	Time 1 used(min.)	Time 2 used(min.)	Steps 1 taken	Steps 2 taken
13 Feb.	6 May	40:00	36:00	4600	4200
14 Feb.	2 May	16:00	16:00	2235	2228
1 April	1 May	19:12	16:42	2438	2305

TABLE II
STEPS TAKEN DURING THE 12 WEEK STEP-SHAPE PROJECT

	Step count
Mon-Fri daily mean (12 wk)	8879
Sat-Sun daily mean (12 wk)	7964
Daily mean steps	8326
February daily median	8570
March daily median	7964
April daily median	8493
Positive change	0,35
Maximal individual daily steps	28.000
Median daily steps	7575

Five out of ten subjects reported that they fulfilled the PA recommendations before Step-Shape Projects while during the project nine out of ten fulfilled the recommendations. The mean step number showed a positive trend during the project (Table II).

The participants followed mainly the daily steps as well as the total weekly steps and the change. The participants reported that Step-Shape Project affected mostly the following issues (1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree):

1. I am physically more active (2.4).
2. I am physically more fit (2.4).
3. Other reasons (2.4) (e.g. I have made my family members more active. I am going to continue step collection, this is fun. I take stairs always when possible.)

We also asked participants how the weather conditions and local environment affected their PA. The participants reported the following factors (1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree):

1. I am engaged in PA in my neighborhoods at daylight (1.2).
2. I am engaged in PA in my neighborhoods in the evening (1.4).
3. I prefer PA in sunny weather (1.6).
4. Traffic in the neighborhood is safe (2.1).

The use of pedometer was classified as follows (1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree):

1. The pedometer was easy to use (1.1).
2. The use of pedometer did not require any special consideration (1.3).
3. The pedometer was useful (1.4).
4. The use of pedometer motivated me walking more often (1.6).
5. The use of pedometer helped to go for a walk (2.1).

The use of the step-table was classified as follows (1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree):

1. The step-table was easy to use (1.2).
2. The use of the step-table did not require any special consideration (1.3).
3. The step-table was useful (1.8).
4. The use of the step-table motivated me to walk more often (2.2).
5. The use of the step-table helped to go for a walk (2.6).

The whole Step-Shape Project was classified as follows (1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree):

1. The Step-Shape Project was interesting (1.6).
2. The Step-Shape Project motivated and was inspiring (1.8).
3. The Step-Shape Project was innovative (2.3).
4. The Step-Shape Project was unfair because some activities do not provide steps (3.6).
5. The Step-Shape Project was boring (4.4).

The following issues were mentioned in the open comments: Step-Shape Project really supported and motivated my PA. I wished to lose some overweight, but I didn't. However, I feel more compact and my physical fitness is better than before the project. I feel myself younger. Step-Shape Project really motivated me for walking. Step-Shape Project motivated me to compete with myself. I recognized how inactive I really am. And it is very little. I was glad to notice that my daily steps easily amount to 5,000, I am normally physical very active person. Already my normal day includes pretty many steps. Without pedometer this positive activity would be a little bit unclear. Only using a pedometer makes me more physically active.

Eight persons promised to continue monitoring their daily steps with pedometer after the Step-Shape Project.

VI. CONCLUSIONS

Physical inactivity is one of the leading global risks for mortality. One of the major future contributors for PA may be ICT tools and services.

This study focuses on the end-user experience in using ICT, especially pedometer, to motivate and support PA. This is important both for the information society and the individual. We urgently need new approaches and tools to support the needed change towards more active lifestyle.

To study this, a pilot survey in the Step-Shape Project was conducted. The study included monitoring daily steps with a pedometer and self-reporting the steps in a step-table, which was especially tailored for this study. The study objects were recruited via the physical activity promotion internet page of K5. The data was collected with semi-structured questionnaire. Ten persons returned the questionnaire whereas

sixty-six opened it. The majority (90 %) of respondents were females.

The data collection lasted three months and was intensive. Information needs, i.e. how many daily steps were made and on health and fitness related issues were the main reasons to participate. The participants increased their physical activity level during the project and most of them informed on their intention to continue a more active lifestyle also in the future. The participants felt that both the pedometer and also the step-table were easy to use and useful in supporting PA.

Inactivity is the 4th highest risk for mortality in the modern society. Also ICT may play a major role in promotion of physically active lifestyle.

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APPENDIX

Step-Shape table (in Finnish):

Nimi:	Email-osoite:				
Ryhmän nimi*:					
Viikko	1.2.-7.2.2010	8.2.-14.2.2010	15.2.-21.2.2010	22.2.-28.2.2010	1.3.-7.3.2010
Maanantai	5000	5100	5000	5300	5400
Tiistai	5000	5000	5000	5000	5000
Keskiviikko	5000	5000	5000	5000	5000
Torstai	5000	5000	5000	5000	5000
Perjantai	5000	5000	5000	5000	5000
Lauantai	9000	9000	9000	9000	9000
Sunnuntai	10000	10000	10000	10000	10000
Yhteensä	44000	44100	44000	44300	44400
Muutos	100	100	-100	300	100
Viikko	8.3.-14.3.2010	15.3.-21.3.2010	22.3.-28.3.2010	29.3.-4.4.2010	5.4.-11.4.2010
Maanantai	5500	5600	5700	5800	5900
Tiistai	5000	5000	5000	5000	5000
Keskiviikko	5000	5000	5000	5000	5000
Torstai	5000	5000	5000	5000	5000
Perjantai	5000	5000	5000	5000	5000
Lauantai	9000	9000	9000	9000	9000
Sunnuntai	10000	10000	10000	10000	10000
Yhteensä	44500	44600	44700	44800	44900
Muutos	100	100	100	100	100
Viikko	12.4.-18.4.2010	19.4.-25.4.2010	26.4.-2.5.2010		**
Maanantai	6000	6100	6200	Ma-Pe ka	5117
Tiistai	5000	5000	5000	La-Su ka	9590
Keskiviikko	5000	5000	5000	He keskiluku	5000
Torstai	5000	5000	5000	Ma keskiluku	5000
Perjantai	5000	5000	5000	Hu keskiluku	5000
Lauantai	9000	9000	9000	Muutos ka	100
Sunnuntai	10000	10000	10000	Max luku	10000
Yhteensä	45000	45100	45200	Ka askeleet	6360
Muutos	100	100	100	Kaikki askeleet	579600

*Kirjaa tähän ryhmäsi nimi, jos kuuluut johonkin ryhmään.

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