WELLNESS DIARY FOR MOBILE PHONES

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Abstract: The growing population of overweight and obese people calls for developing new methods and tools for independent weight management. Wellness Diary (WD), a cognitive behavioural treatment (CBT) based weight management application, was designed and implemented for Series 60 mobile phone platform. WD is a tool for recording CBT related self-observations and giving feedback on them. A three-month user study with 29 volunteer users was launched to study the acceptance and effect of the concept. The users recorded on average 5.6 (SD 0.59) self-observations to WD per day, and the recording activity was maintained at a high level throughout the study. The average weight change in the group was -1.4 kilograms (range: -12.0 - +1.5 kg, SD = 2.7 kg). The users found WD simple and easy-to-use, yet useful in weight management. The results indicate high level of acceptance for the approach and concept. The weight management results were encouraging and suggest that wellness diary concept supports success of CBT based weight management.

Introduction

Overweight is a growing problem in most modern societies. In Finland, 20% of working-age adults are obese (body mass index; BMI > 30kg/m^2), and an additional 50% of men and 33% of women are overweight (25 kg/m^2 < BMI < 30 kg/m^2) [1]. Similar trends are seen in other European countries [2], the United States of America [3], and also in Asian countries [4]. Obesity increases the risk of many health problems, including type 2 diabetes mellitus, cardiovascular disease, and certain types of cancers [5]. It is estimated that obesity accounts for 2-8% of healthcare costs in Europe [2].

Obesity is the result of an imbalance between energy intake and expenditure. Weight loss may be achieved through changes in diet and exercise, but maintaining these changes is difficult for most people [6, 7]. Long-term weight loss success rates in different studies range from two to twenty percent [8, 9, 10].

Cognitive behavioural therapy (CBT) is a psychological method for managing different kinds of behavioural problems. CBT is also a suitable approach for weight management, because the processes that maintain weight problems are behaviours, such as eating, being active, and exercising. The idea of CBT is to recognize the behaviours that maintain the problem (e.g., excess eating and too little physical activity) and through this recognition process change them. One of the key elements in CBT is self-monitoring, i.e., in CBT the subjects are taught to observe their behaviour, identify the variables affecting or maintaining problem behaviours, make changes in their daily habits, and monitor the effects of the changes [11]. Long-term recording of self-observations may delay weight regain [12], and promote weight management during holiday season when the risk of weight gain is high [13].

In CBT for weight management, the subjects record their food and fluid intake, and often summarize their data graphically. Ubiquitous computing technologies may be efficiently applied to support CBT based weight management [14]. Especially, mobile phone appears an optimal platform for this purpose because it can handle and process large amounts of data. The user interface of a mobile phone provides the means for input and visualization of data. Also the computing power and memory resources of a mobile phone are sufficient for most health and wellness applications. In addition, the mobile phone is often seen as a personal trusted device which is most of the time carried along and which may contain many kinds of personal and private information.

Wellness Diary (WD) for weight management was designed and implemented for Series 60 (S60) mobile phone platform. The application was integrated with S60 calendar, and it incorporated the central elements of CBT for weight management. The objective of the present study was to find out how users experience and accept a weight management application functioning in a mobile phone.

Materials and Methods

Wellness Diary: WD was integrated with S60 calendar. This approach offers users a familiar application extended with new features which are used in a similar way as the standard calendar. Inputting self-observations is done from the same menu as normal calendar entries, and health related observations are displayed on the calendar day view along with meetings and other calendar entries (Figure 1a). WD enables the user to record health and weight related self-observations, get graphical feedback, and send data via email or multimedia messages. The user may also personalize the application through configuration.

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Self-observations: The self-observation categories (inputs) include weight, steps, exercise, food and drinks, fat percentage, feelings, and health events. The inputs are made on specific forms (Figures 1b and 1c). All of the input forms have time and date fields for entering the time of the observation. In addition, the application enables downloading step counts directly from an infrared enabled pedometer.

Weight, fat percentage, and steps input forms are the simplest, having one numerical field for entering the measurement result. Weight is measured using personal scales. For fat percentage, there are several alternative measurement methods: skin fold callipers, personal fat percentage scales, and handheld body fat monitors. Step count represents the daily, mainly nonformal physical activity, and is measured with a pedometer. The measurement results are entered using numbers on mobile phone keypad.

Exercise form (for formal exercise) contains a field for entering the duration of exercise, a selection list of sports and another one for exercise intensity. There are also fields for entering distance and mean heart rate. The user can choose which fields are relevant for each exercise session and fill only those.

Food and drinks form consists of a selection list with a rough categorization of meals, and numerical fields for entering the number of drinks and the energy content of foods and drinks in kilocalories. There is also a possibility to write notes about foods and drinks in a free text field.

Feelings assessment is based on Visual Analogue Scale (VAS) [15] which is a widely used tool in measuring subjective experience. VAS was implemented as a slider (Figure 1c), i.e., a line on mobile phone screen on which a cursor is moved left and right using the navigation keys. The position of the cursor indicates the feelings or mood; the more on the right the cursor is, the better the mood, and vice versa.

Health events inputs are divided into three different forms: illnesses and symptoms, doctor visits, and treatments and medications. The forms contain free text fields for typing in health event information, e.g., the name of illness, doctor's name and clinic, and the name of the medication. Health event forms have also separate fields for entering the start date and time and the end date and time of the events.

Feedback: The application visualizes the entered data over time as line or bar graphs (Figure 1d). Feedback graphs are implemented as a tabbed view, where the user can browse different graphs by moving left and right in the tabs. If there is a user-defined goal associated with an observation, the goal is indicated in the graph by a green dash line. The possibility to change the time scale of the graphs is also provided, therefore enabling the user to examine either short-term or long-term changes in the observations.

Configuration: Configuration options of WD comprise of setting a daily steps goal and a weekly exercise duration goal. Weight target is automatically calculated based on the user's BMI and generally accepted BMI limits. If the user's BMI is over 25 kg/m^2, five percent's weight loss target is suggested.

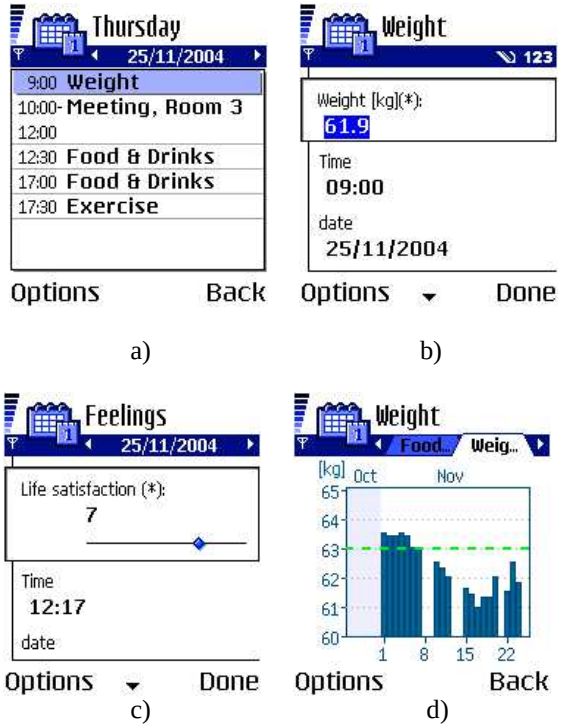

Figure 1: WD user interface: a) WD day view, b) Weight input form, c) Feelings input form, d) Weight feedback graph, green dash line represents weight goal.

Data transfer: WD supports data transfer via email and multimedia message. This feature enables sending data as a text file to other people, for example, weight management experts.

User study: Twenty-nine subjects (users), 20 males and 9 females (mean age 39.4 years, range 25-54 years, SD = 8.1 years), working in a Finnish technology company, volunteered in a three-month user study. The main inclusion criteria were overweight (BMI > 25 kg/m^2) and having an S60 phone. Exclusion criteria were attendance in other weight management programs simultaneously and pregnancy. It was emphasized to the users during recruitment that the study concerned first and foremost the use of the application, and that weight management was not the primary focus.

Study procedures: The study procedures consisted of a start-up session in groups of about ten users, individual usability interviews at start and at end, and a closing session. The start-up session consisted of a 1.5-hour lecture of CBT based weight management with written material given to the users (mini-intervention [16]), installation of WD applications into the users' mobile phones, and a short instructions lecture (~20-30 minutes) on use of the application. Infrared enabled pedometers (Fitness Monitor, Nokia, Helsinki, Finland) were given to all users, and personal scales to those who did not have one. WD enabled direct download of step counts from Fitness Monitor to WD via infrared connection. The users were instructed to record daily self-observations during the study. They were encouraged to make observations in as many categories as they felt feasible. For example, they were suggested to measure their weight and wear the pedometer daily, and make food and drinks entries after every meal. They were also asked to send their data to the researchers once a week.

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About a week after the end of the study, the users were invited to a closing session where the results of the study were summarized. The users had also a chance to get additional individual feedback on their results via email.

Usability interviews: The users were interviewed by usability experts after one week's use, and again after three months' use. The usability interviews consisted of a semi-structured interview and a feedback questionnaire about WD and Fitness Monitor. The feedback questionnaire contained statements, which the users rated using a Likert scale from 1-5 (strongly disagree – strongly agree). The first interview focused on early impressions and use routines of WD, and the second interview concentrated on long-term use experiences.

Results

Out of the 29 users, 27 users completed the study. There were two drop-outs, one male and one female.

Usage: During the study, each user entered on average 5.3 (SD 0.59) self-observations every day: weight 0.75 (0.27), steps 0.73 (0.20), exercise 0.26 (0.30), food and drinks 3.0 (1.1), fat percentage 0.03 (0.16), feelings 0.24 (0.35), and health events 0.08 (0.13) entries per day. Figure 2 shows the average number of daily inputs over the weeks of the study.

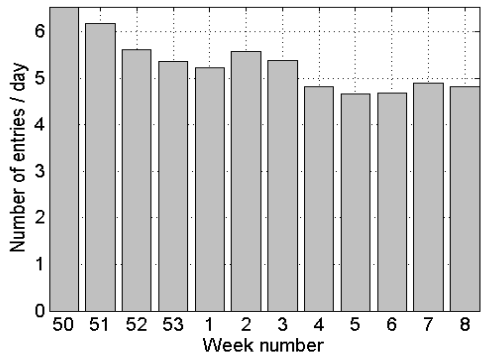

Figure 2: Average number of daily entries per user during the study.

Weight management: The average weight change in the group was -1.4 kg (range: -12.0 - +1.5 kg, SD = 2.7 kg). Thirteen users lost more than one percent of their initial weight (WL group; weight losers, N=13), and thirteen users maintained their initial weight or gained some weight (WM group; weight maintainers, N=13). One user had too few weight entries to determine weight change. Figure 3 presents the average normalized weight in the groups.

Both groups started losing weight in a similar way in the beginning of the study (beginning of December). During Christmas time and the end of the year, both groups gained some weight, and in the beginning of January, both groups lost some weight. But whereas WL group continued losing weight, the weight of WM group stabilized. Another simultaneous, although small, weight change occurred at the end of February, when both groups gained some weight. A probable explanation for this is that most of the users had a one-week winter holiday during that time.

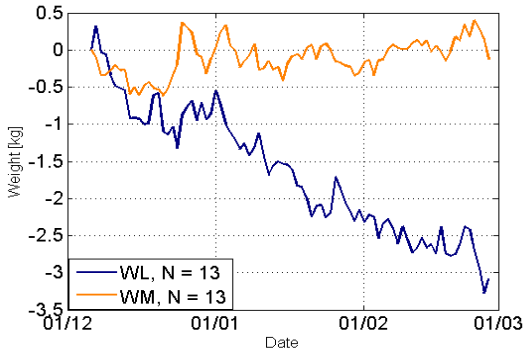

Figure 3: Average normalized weight in WL group (blue line) and WM group (orange line).

Physical activity: All users wore pedometers and made steps entries to WD. Twenty-two users (10 users in WL group and 12 users in WM group) made exercise entries. Figure 4 represents daily step counts averaged over study weeks in the two groups. Figure 5 represents average weekly exercise duration in the groups.

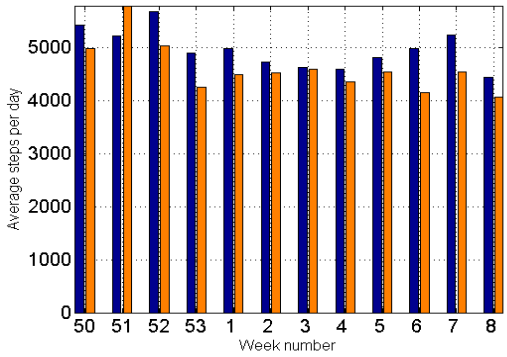

Figure 4: Average number of steps per day in WL (blue bars, N=13) and WM (orange bars, N=13) groups.

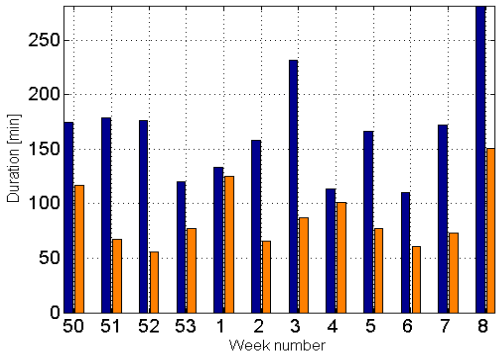

Figure 5: Average weekly exercise duration in WL (blue bars, N=10) and WM (orange bars, N=12) groups.

Usability: All 29 users were interviewed after one week of WD use. All remaining users as well as one drop-out participated in the second interview, and thus 28 users were interviewed after three months' use.

The users found WD simple and easy-to-use, yet a useful tool for weight management. They also saw calendar integration as a benefit. In the first interview, 27

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users disagreed (18 strongly) to a statement claiming that WD use required a lot of learning. Also in the first interview, 25 users disagreed (10 strongly) that WD was too complicated. By the second interview, this number had grown to 26 users, with one more user strongly disagreeing to the statement.

Users found WD useful as a weight management tool (Figure 6). Twenty users also agreed that WD motivated them to observe their weight related behaviour (eating and physical activity). Input of food and drinks was considered an effective diet intervention in itself. Weight, exercise, and steps were considered as the most important self-observations. The importance of weight and exercise observations increased during the study (Table 1).

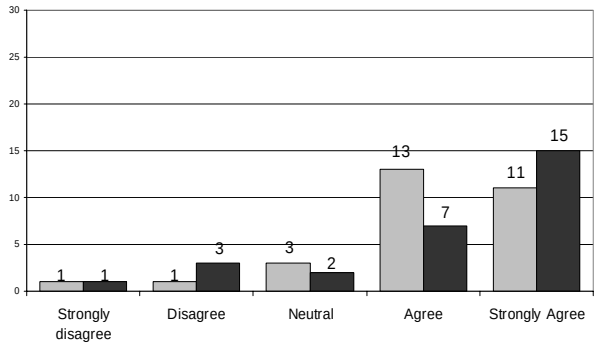

Figure 6: Light gray bars represent the answers in the first interview to statement: "I believe WD will help me in my weight management." Dark gray bars represent the answers in the second interview to statement: "WD helped me in my weight management. " "Strongly disagree" is on the left, "Strongly agree" on the right.

Table 1: Importance of weight, steps, and exercise observations on a scale 1-5 in the first and second interview.

Observation	1. interview	2. interview
Weight	4.69	4.85
Steps	4.31	4.11
Exercise	4.07	4.11

The users especially liked the CBT based weight management philosophy built in WD. They felt that the approach trusted the user as the decision-maker in weight management. The users commented that making self-observations felt natural and that WD was an ideal tool for recording them since it operates on a mobile phone, which is most of the time carried along. They also saw as a benefit the possibility to send data from WD to, e.g., a professional involved in weight management. At the end of the study, eighteen users (8 definitely, 10 likely) were willing to continue to use WD.

Discussion

The growing population of overweight and obese people calls for development of new methods and tools for independent weight management. These tools need to be easy-to-use, and provide motivating feedback to promote long-term use. The weight management tools should not burden the healthcare system, but on the other hand, the involvement of professionals should be made possible.

The first user study of WD yielded promising results. The users found the application easy-to-use and useful in weight management. The usage rate of the application, measured as the number of inputs per day, maintained at a high level throughout the three-month study (Figure 2). This implies that the application was perceived suitable for long-term use. Long-term use of WD did not decrease the high user-acceptance and perceived usefulness of the application. Furthermore, eighteen users were willing to continue to use WD after the study. Most of the users were already familiar with using S60 phones before starting the study, and therefore direct generalizations of these results to the general public should be made with caution.

Weight loss was not the primary focus of the user study. Nevertheless, 13 users managed to lose more than one percent of their initial weight, and the average weight change of the entire group was negative, -1.4 kilograms. This weight loss result is similar as observed in self-directed weight loss programs [17].

CBT based weight management philosophy was found well-suited to WD. The CBT approach emphasizes personal weight management as it is based on the cognitive processes of the individual. Self-monitoring and getting graphical feedback, which are central in CBT based weight management, are efficiently supported by WD.

Conclusions

The wellness diary concept based on CBT approach was implemented for S60 mobile phone platform. The acceptance and effect were studied in a three-month user study. The results suggest high level of acceptance for the approach and concept. The weight management results were encouraging and suggest that the wellness diary concept supports success of CBT based weight management.

The degree of contribution of the application on weight management success will be further studied in a controlled set-up. Also the effect of the application in long-term use will be studied.

Acknowledgement

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