

# A NEW METHOD TO ASSESS PERCEIVED WELL-BEING AMONG ELDERLY PEOPLE – A FOLLOW-UP STUDY

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*Abstract - This is a follow-up study to a previous experiment that evaluated the feasibility of a simple monitoring device, Con-Dis, in assessing perceived well-being (PWB) among elderly people. Additionally, in the present study Con-Dis was used at the same time as blood pressure and heart rate monitors and pedometers to see the possible correlation between PWB, blood pressure, heart rate, and time spent on outdoor activity. The Con-Dis device proved technically functional, feasible, and informative throughout the four-week follow-up test period among elderly test subjects. In addition, PWB (measured by Con-Dis) appeared to correlate with mood, QoL, and time spent on outdoor activity.*

**Index terms:** Monitoring system, perceived well-being, electronic device, care home for the elderly, Con-Dis

## I. INTRODUCTION

Because of several factors, including improvements in social healthcare systems, the population of the world is ageing [1,2]. Similarly, the incidence of cardiovascular diseases and type 2 diabetes mellitus has increased among them [3,4,5]. Chronic diseases such as heart failure cause a burden for the economy and are commonly suffered by elderly people [6]. Additionally, healthcare systems in developed countries are experiencing severe financial stress as a result of a larger percentage of older adults needing care [7]. This exerts pressure on healthcare professionals to take care of these patients more efficiently since many of them

have a higher risk of developing these diseases than younger patients do [8,9]. An important demographic observation is that the incidence of diabetes appears to be increasing most rapidly in the segment of people over 65 years of age [10]. It is important for healthcare professionals to foresee the risk of these patients developing a serious illness and provide them with preventive measures [11]. The psychological self-assessment of elderly patients has been found to be an effective indicator of their health status [12]. Thus the voluntary self-monitoring of perceived well-being should be emphasised in order to promote health among elderly people.

A simple self-monitoring device named Con-Dis was used earlier to gather perceived well-being information from a test group of ten elderly people [13]. The time period for the pilot study was two weeks.

In the present study Con-Dis was used for four weeks along with two multi-parameter questionnaires, a heart rate and blood pressure monitor, and a pedometer. These devices were used to evaluate how the physical condition of the elderly test subjects correlates with their perceived well-being – measured with Con-Dis. The four-week follow-up period was selected to confirm our previous pilot findings from a shorter experiment [13] and to gain more thorough information on Con-Dis and its feasibility in field studies.

More specifically, our aim was to find out if perceived well-being, measured with Con-Dis, had a statistically significant correlation with mood and quality of life but not pain, as we discovered in the previous pilot study [13]. Additionally, the study was designed to find out whether perceived well-being (measured with Con-Dis) had a correlation with systolic blood pressure, diastolic blood pressure, heart rate (measured with blood pressure monitoring devices), and outdoor exercise (measured with pedometers).

## II. METHODS

### STUDY POPULATION

The present study was performed in the Social and Health District of South Karelia, Lappeenranta, a city located 250 kilometres east of Helsinki, Finland. Ten elderly test subjects (six of them women) were selected for the study. The test subjects were aged between 69-89 years (mean 80.1). Five of the test subjects lived in a municipally owned care home for the

elderly (A). Four of the test subjects lived in a care home for the elderly that was owned by a private foundation (B). One test subject lived at home.

Care home A was staffed by day and night nurses, while B did not have nurse assistance. The test subject living at home had a medium-sized three-room apartment and had no nurse assistance, while all the test subjects living in care homes for the elderly had relatively small either single- or double-room apartments that had their own kitchen and bathroom. The general health condition of the test subjects is shown in Table 1. All the test subjects were fully able to walk and thus participate in normal outdoor activity for their age group.

Table 1: Subjects' medical status

1	B	Female	85	1.29	CV, MS
2	None	Female	75	1.29	None
3	B	Female	80	1.29	CV, DM
4	B	Female	84	1.68	CV, MS, R
5	A	Male	76	1.29	CV, MS
6	B	Female	89	1.58	A, CV, MS
7	A	Male	83	1.29	CV, MS
8	A	Male	82	1.34	CV, R
9	A	Female	69	1.34	CV, D, HT, MS
10	A	Male	78	2.69	CV, N

\*)

A: Asthma

CV: Cardiovascular disease

D: Depression

DM: Diabetes mellitus

HT: Hypothyreosis

MS: Muscular-skeletal disease

N: Neurological disease

R: Renal disease

Table 1 shows a chart of the test subjects' (n=10) medical status. Included are the test subject's care home, gender, age, RAVA index score and disease type.

#### CON-DIS DEVICE

Con-Dis is a monitoring system for recording and storing patients' perceived levels of well-being. This information can later be accessed with a PC. The Con-Dis device interface consists of three buttons illustrating the patient's perceived well-being – happy, neutral, and unhappy. More detailed information on Con-Dis is provided elsewhere [14].

In the study all the test subjects reported their perceived level of well-being by pressing one of the three Con-Dis buttons (happy, neutral, or unhappy) twice per day – every morning and evening. Each time they pressed one of the buttons they received audible feedback indicating that the button had been accessed. During the test period of four weeks, each test subject answered 57 times altogether.

#### RAI

A paper-based questionnaire, comprising three questions from the original RAI questionnaire (Resident Assessment Instrument – consists of 160 questions), was used in the study [15,16]. Mood, pain, and quality of life were the chosen parameters, broadly measuring the patients' daily routines. The test subjects reported on their perceived mood, pain, and quality of life twice per day. Each morning and evening they reported if they felt their perceived mood was good, normal, or depressed by putting a cross in a box corresponding to one of the three. The same applied to the pain they experienced (no pain, some pain, or constant, bothering pain) and quality of life (good, satisfactory, or unsatisfactory). During the four-week test period, each test subject answered the paper-based questionnaire 171 times altogether.

#### RAVA

Along with the RAI questionnaire, an older and simpler questionnaire comprising 12 questions about the test subjects' health – the RAVA index score (range 1.29-4.23 or grading 1-6) – was assessed [17]. The questions evaluated the test subjects' sight, hearing ability, mobility, urine, stools, eating, usage of medicine, ability to dress and wash, memory

functionality, and psyche. The test was used for comparison with RAI. A low RAVA index means good overall health and a high RAVA index means poor overall health.

### BLOOD PRESSURE AND HEART RATE MONITORING

Each test subject had a blood pressure and heart rate monitoring device, which they used twice a day, each morning and evening. The blood pressure and heart rate monitoring devices (M6 Comfort, Omron) were commercially available. The measurement was carried out after sitting for ten minutes at rest, with a cuff bound around the upper left arm. The patients measured their blood pressure and heart rate without the assistance of a nurse. After using the blood pressure and heart rate monitor, the patients recorded their results (systolic and diastolic blood pressure and heart rate) by writing them down twice a day on a paper-based questionnaire form (altogether 171 answers per test subject).

### PEDOMETERS

Along with the other monitoring devices, a pedometer (Actiped, FitLinxx) was used on the test subjects to monitor their activity outdoors. A monitoring device was attached to each test subject's left shoelace by a nurse at the beginning of the test period. The female test subjects used hard soled shoes while the male test subjects used soft soled shoes. The test subjects were told not to detach the monitoring device at any point of the test period and always wear the same shoes. The pedometer was only used while outside because while indoors the test subjects never wore shoes and it was not possible to attach the pedometer to the test subjects' socks. The data were collected on a daily basis. Each time the test subjects went outside the pedometer recorded the time and date of their steps in its internal memory.

### TEST PROTOCOL

Altogether, the nine test subjects from care homes (A and B) for the elderly and the one test subject living at home reported their perceived well-being twice per day (early morning and late evening) using the Con-Dis device. In addition, they answered the RAI questionnaire and reported their blood pressure and heart rate twice per day. This equals a total of 57 perceived well-being evaluations, 171 RAI evaluations, and altogether 171 blood pressure and heart rate values per test subject. Additionally, a RAVA index was calculated after the test period for each test subject. Simultaneously, the pedometer recorded the patients' outdoor activity by calculating their steps and the distance travelled in real time. The data were collected wirelessly by a laptop computer placed near each of the pedometers after the test period.

All the test subjects were trained by a nurse to use the Con-Dis device and answer the RAI questionnaire. The test subjects were told to push the buttons of Con-Dis as described below.

If the test subjects considered their perceived well-being to be better than their average, they were asked to press the “happy face” button. The “happy face” button depicts a situation in which the test subjects have no depression, feel no abnormal pain, and their physical condition is above average at the moment.

If the test subjects considered their perceived well-being to be average, they were asked to press the “neutral face” button. The “neutral face” button depicts a condition of stable well-being for the test subject. The test subjects may experience mild but not harmful pain and their mental situation and physical condition is seen as average.

If the test subjects assumed their perceived well-being was worse than average, they were asked to press the “unhappy face” button at the given time intervals. The “unhappy face” depicts a situation in which the test subject feels moderate or severe pain. The person may suffer from depression and their physical condition may be seen as notably below average.

The test subjects were told to contact a nurse if they needed further assistance in operating the Con-Dis device. The data were collected from the Con-Dis device by using a (SD) memory card, which included a simple utility program that displays the well-being and mood measurements when inserted into a PC.

The ethics committee of the Pirkanmaa Hospital District, Tampere, Finland has approved the present study.

### STATISTICAL METHODS

The probability errors in Figure 1 were measured using the Matlab (version 7.3.0 R2006b) “Anova” function. Statistical differences in the levels between the groups were tested using the SAS 9.1 program and Pearson Correlation Coefficients.

### III. RESULTS

## CON-DIS DEVICE, RAI, AND RAVA

All ten Con-Dis monitoring devices functioned well and no problems concerning their technical functionality were found during the test period. All of the test subjects reported practically all of the required information about mood, pain, quality of life, and perceived well-being (over 98% of the total number of questions being answered). There did not seem to be any misinterpretations concerning the Con-Dis device and each of the test subjects seemed to have understood the instructions correctly, since their answers were registered at the designated moments in time (early each morning and late each evening).

On the basis of the results collected from the ten test subjects and their total of 2280 mood, pain, quality of life, and perceived well-being assessments (measured with Con-Dis), the perceived well-being of a test subject had a statistically significant correlation with their mood ( $r=0.814$ , Pearson Correlation Coefficient) and quality of life ( $r=0.715$ ) (Table 2). However, perceived well-being did not have a statistically significant correlation with pain ( $r=0.161$ ). The associations between the mean values in all of the parameters were statistically very significant ( $p<0.05$ ). The RAVA index scores were also calculated for each of the test subjects, but they did not have a statistically significant correlation with mood, pain, quality of life, or perceived well-being (Figure 1).

Table 2. Subjects' r-values

Parameter	Mood	Pain	Quality of life	Perceived well-being
<b>Mood</b>		0.132	0.765	<b>0.814</b>
<b>Pain</b>	0.132		0.221	<b>0.161</b>
<b>Quality of Life</b>	0.765	0.221		<b>0.715</b>
<b>Perceived well-being</b>	0.814	0.161	0.715	

Table 2 shows a chart of the test subjects' ( $n=10$ ) Pearson Correlation Coefficients (r-values) between mood, pain, quality of life, and perceived well-being. For each of the cases, the association and difference between the mean values in all of the above-mentioned parameters were also measured and were statistically very significant ( $p<0,05$ ).

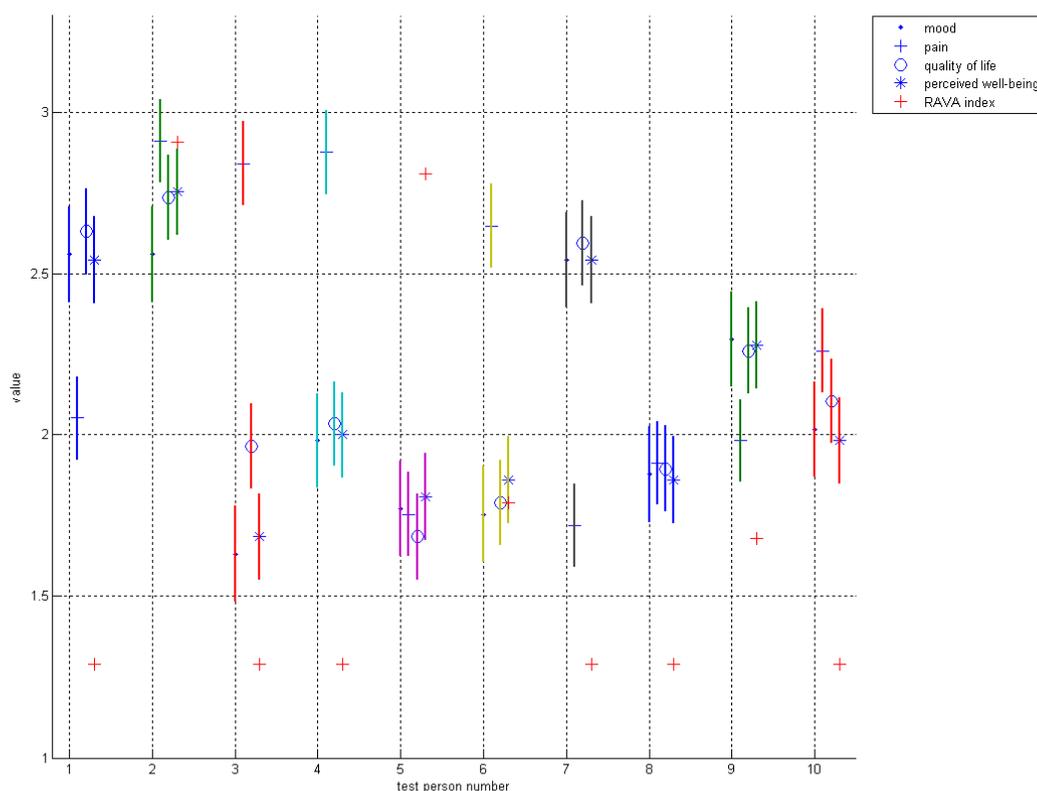


Figure 1. Data collected from 10 test subjects during a 4-week survey using the RAI questionnaire, Con-Dis device, and the RAVA index. The test subjects are shown on the x-axis (subjects numbered 1-10) and their reported well-being parameters, along with their probability errors, are shown on the y-axis.

In Figure 1 the individual results for each of the test subjects show the close correlation between perceived well-being, mood, and quality of life. Among all the test subjects the difference between perceived well-being, mood, and quality of life is minor, but pain can be seen as differing noticeably from the other parameters.

### BLOOD PRESSURE AND HEART RATE MONITORING

All the blood pressure and heart rate measuring devices functioned faultlessly throughout the four-week test period. However, two of the test subjects, numbers 4 and 10, were unable to monitor their own blood pressure and heart rate as a result of their poor medical condition; they had the two highest RAVA index scores, of 1.68 and 2.69 respectively (Table 1). Thus they were left out and this part of the test was carried out with eight test subjects. The remaining test subjects measured practically all (over 95%) of the required measurements.

The collected results are shown in Table 3. According to the results that were collected perceived well-being does not have a statistically significant correlation with systolic blood pressure ( $r=0.185$ ,  $p<0.05$ ), diastolic blood pressure ( $r=0.238$ ,  $p<0.05$ ), or heart rate ( $r=0.051$ ,  $p=0.444$ ).

Table 3. Subjects' r-values

Parameter	Systolic blood pressure	Diastolic blood pressure	Heart rate	Perceived well-being
Systolic blood pressure		0.453	0.281	<b>-0.185</b>
Diastolic blood pressure	0.453		-0.155	<b>-0.238</b>
Heart rate	0.281	-0.155		<b>-0.051</b>
Perceived well-being	<b>-0.185</b>	<b>-.238</b>	<b>-0.051</b>	

Table 3 shows a chart of the test subjects' ( $n=8$ ) Pearson Correlation Coefficients (r-values) between systolic blood pressure, diastolic blood pressure, heart rate, and perceived well-being. For each of the cases, except heart rate vs. perceived well-being ( $p=0.444$ ), the association and difference between the mean values in all of the above-mentioned parameters were also measured and were statistically very significant ( $p<0,05$ ).

## PEDOMETERS

Most of the pedometer devices were functional throughout the test period. Two pedometers became detached from the test subjects' (numbers 2 and 7) shoelaces during the test period and were eventually lost. Thus their data could not be read and their results were not available for this segment of the study. Test subject number 5 had a faulty pedometer device that had unreadable data and thus he was discarded from this segment of the study as well.

The results for seven test subjects were compiled. However, the device failed to successfully record all of the female test subjects' (test subjects 1, 3, 4, 6, and 9) steps outside. For example, according to this study test subject number 4 took only four steps altogether throughout the four-week test period. Therefore the steps calculated by the pedometer were left out of the analysis in this study. The pedometer successfully recorded the duration of time each of the test subjects had spent outside during the four-week time period. Therefore,

instead of steps taken outside, the time that each of the test subjects had spent outside was analysed in this segment of the study.

According to the data that were collected, perceived well-being has a statistically significant correlation with time spent outdoors ( $r=0.617$ ,  $p<0.05$ ). This can also be observed in Figure 2, which shows the perceived level of well-being and the time spent outside each day.

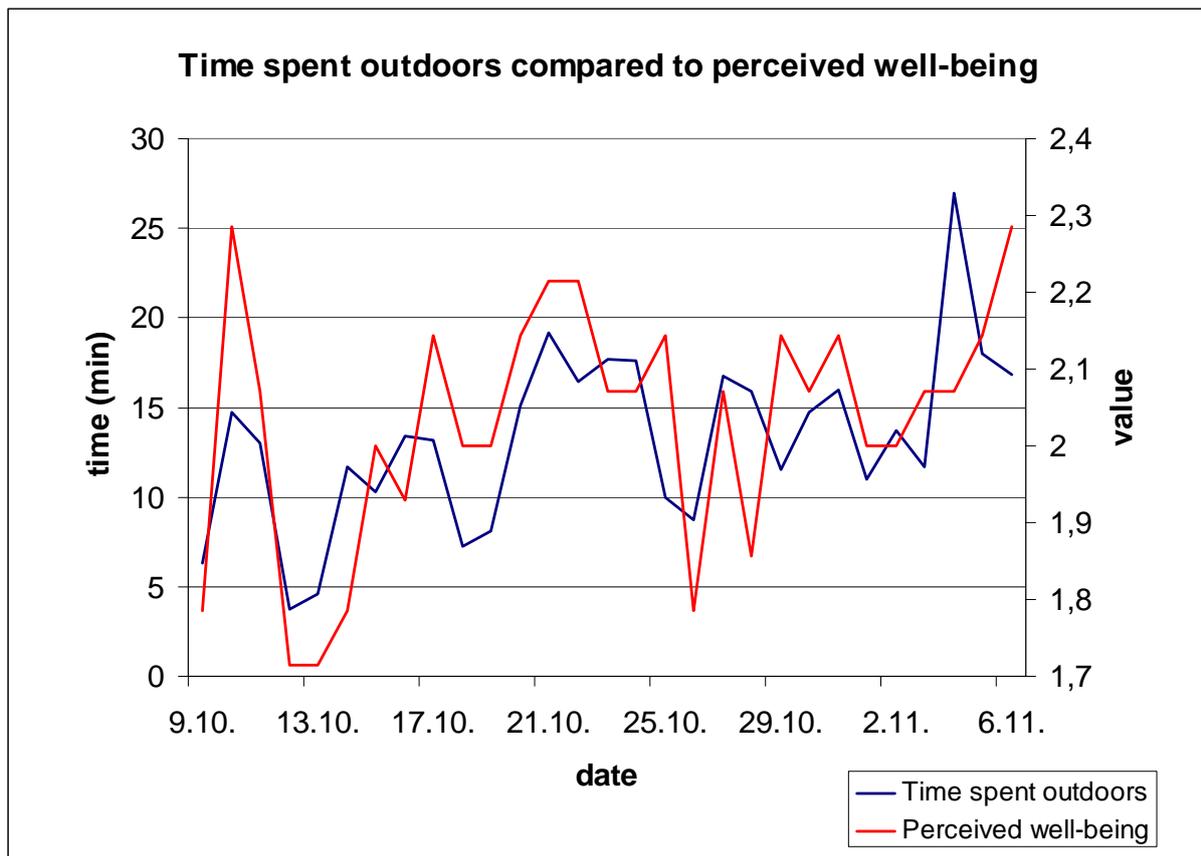


Figure 2. Data from 7 test subjects during a 4-week survey using the Con-Dis device and the pedometer. The dates are shown on the x-axis and the average perceived well-being index and the average time spent outdoors are shown on the y-axis.

#### IV. DISCUSSION

A previous study focusing on the feasibility of the Con-Dis device in assessing perceived well-being among elderly people had been performed earlier [13]. That two-week study indicated that Con-Dis can give adequate information on a test subject's perceived well-being. However, there was a demand for a more extensive follow-up study to verify these results.

CON-DIS DEVICE, RAI, AND RAVA

No problems occurred concerning the technical functionality or feasibility of Con-Dis during the study. Furthermore, no problems concerning the usage of Con-Dis occurred within the test period. An important factor concerning the usage of the device was the received audible feedback after one of the buttons had been pressed. The elderly test subjects reported that this information was essential in order for them to be aware that one of the buttons had actually been accessed. This was even further emphasised when, during the test period, test subject number 7 attempted to press one of the Con-Dis smiley faces (above the Con-Dis buttons) instead of the buttons. Not receiving any audible feedback, the test subject later figured out that it was necessary to press the device buttons instead.

All the test subjects seemed to have understood the instructions they were given on how to use the device correctly and answered a high percentage (over 98%) of the questions asked about perceived well-being, RAI, and RAVA. This is enough to validate the study. It also indicates that Con-Dis is a feasible monitoring device for people living in care homes for the elderly and can be used in the circumstances in question.

The analysis of the test results shows a strong correlation between perceived well-being and mood ( $r=0.814$ ) (Table 2). Additionally, there was a statistically significant correlation between perceived well-being and quality of life ( $r=0.715$ ), but not with pain ( $r=0.161$ ). In addition, RAVA did not seem to correlate with any of the above-mentioned parameters (Figure 1). This presents evidence supporting and strengthening the findings of the previous study [13].

#### BLOOD PRESSURE AND HEART RATE MONITORING

Some studies have suggested that psychological well-being does not have a correlation with blood pressure or heart rate [18,19], but more numerous studies have been carried out that suggest that positive psychological well-being does in fact have an association with reduced blood pressure [20,21,22]. Similar findings have been made that connect psychological well-being and heart rate [23].

During the present study, no problems occurred with the technical functionality of the blood pressure and heart rate monitoring devices. In consequence of their physical handicaps the measurement proved too laborious for two test subjects (numbers 4 and 10) to carry out by themselves. As a result of limited nursing staff resources it was impossible for the nurses to

perform the blood pressure and heart rate measurements for these test subjects, so they had to be left out of the study. However, most of the test subjects were able to measure their own blood pressures and heart rates. Eight test subjects reported these values with a high measurement percentage (over 95%).

Contrary to the authors' presumption, perceived well-being (measured with Con-Dis) did not have statistically significant correlations with systolic blood pressure ( $r=-0.185$ ,  $p<0.05$ ), diastolic blood pressure ( $r=-0.238$ ,  $p<0.05$ ), or heart rate ( $r=-0.051$ ,  $p=0.444$ ). This could be explained by the poor physical condition of the test subjects. Blood pressure and heart rate monitoring requires physical activity to first seek and access the monitoring device and then fasten the cuff and use the device. Even though the test subjects were advised to rest for ten minutes before using the device, it is likely that they did not always follow the advice. In addition, poor physical condition may elevate blood pressure and heart rate levels for a relatively long time after exercise, for example after a walk outside. Thus elderly test subjects measuring their blood pressures and heart rates are susceptible to heightened blood pressure and heart rate levels for these two reasons.

## PEDOMETERS

Several studies suggest that exercise and physical activity have a correlation with a perception of psychological well-being [24,25,26]. Various studies performed on elderly people suggest that exercise and physical activity also show a correlation with their quality of life [27].

In the present study, two pedometer devices became detached and were lost during the test period. This shows that the fastening mechanism used by the pedometer device was inadequate when used with elderly test subjects. In addition, one of the pedometer devices proved faulty and was thus left out of the study. Three out of a total of ten pedometer devices proving faulty (30% of the total number of devices) is too high a number for Actiped pedometers to be recommended for everyday use with elderly people. Additionally, the pedometers were unable to successfully record all the steps taken outside by the female test subjects. This may be due to the slow and light walking style of the elderly female test subjects. In addition, the snowy ground might have had a negative impact on the steps measured. Thus the time spent on outdoor exercise was measured instead. Further research on this subject is essential in order to draw further conclusions on the usage of pedometers with elderly people.

In the present study, the test results for the seven elderly test subjects emphasise that the time spent on outdoor exercise has a statistically significant correlation with the perceived well-being of the test subject ( $r=0.617$ ,  $p<0.05$ ).

## V. CONCLUSIONS

The study carried out was a follow-up study assessing the technical functionality and feasibility of the Con-Dis device. The main focus of the study was to evaluate whether Con-Dis could be used over a longer four-week time period instead of the two-week study carried out previously. According to the results that were collected, Con-Dis is seen as a technically functional and feasible device to assess elderly persons' levels of well-being.

In addition, a blood pressure monitoring device, a heart rate monitoring device, and a pedometer device were used during the test period to assess the correlation between perceived well-being, blood pressure, heart rate, and time spent on outdoor activity. The data collected from the test subjects using Con-Dis suggest that perceived well-being has a statistically significant correlation with mood and experienced quality of life, but not with pain. Perceived well-being also has a statistically significant correlation with time spent on outdoor activity, but not with systolic blood pressure, diastolic blood pressure, or heart rate.

## COMPETING INTERESTS

None of the writers have competing interests to declare.

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## AUTHORS' CONTRIBUTIONS

Jori Reijula, MSciTechn, was responsible for collecting the test information, processing the information, and writing the article. Toni Rosendahl, MSciTechn, was responsible for designing and building the Con-Dis device and providing help with the Con-Dis device. Paula Roilas, RN, was responsible for organising the test in Lappeenranta and collecting the data and test information. Heikki Roilas, MD, PhD, and Kari Reijula, MD, PhD, were responsible for providing help in planning the project and with medical questions. Raimo Sepponen, DTechn, was the director of the project and came up with the idea of Con-Dis.

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