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A self-liberation intervention using a pedometer to encourage physical activity among sedentary nursing staff: A randomized controlled trial

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Abstract

Objective: Nurses make up the majority of the workforce in any healthcare system. Physical inactivity due to heavy workloads has been widely reported among nurses. This study aimed to examine whether a self-liberation intervention could help nurses increase their physical activity levels that would result in other health benefits.

Methods: A two-armed randomized controlled trial was implemented among 40 nurses (20 per arm). The control arm received information about the benefits of physical activity, but with no intervention. The intervention arm received the same information and were given pedometers for 12 weeks to record their daily steps while also receiving weekly reminders. Measurements were taken for anthropometric data, self-reported physical activity, exercise stage-of-change, exercise self-efficacy, and pedometer steps (intervention arm only). All statistical analyses were two-sided, with $p \leqslant 0.05$.

Results: The respondents' mean age was 47.9 ± 7.02 years with 90% being female. After the intervention, the intervention arm achieved a higher self-efficacy score (4.60 ± 1.75 to 5.63 ± 2.48) while a decline was observed in the control arm (5.02 ± 2.08 to 4.50 ± 1.90). At baseline, 16.7% ($n=3$) of the control arm and 27.8% ($n=5$) of the intervention arm were classified as moderately physically active (McNemar's test = 1.20, $p=0.549$). After 12 weeks, this proportion increased to 27.7% ($n=5$) in the control arm and 50.0% ($n=9$) in the intervention arm (McNemar's test = 5.00, $p=0.172$). For the intervention arm, mean daily step counts rose from 8889 ± 579.84 at week 1 to 9930 ± 986.52 at week 12 and reached the level of statistical significance ($p<0.01$). Waist circumference of the intervention arm decreased significantly more than that of the control group ($p<0.01$).

Conclusion: The self-liberation intervention using a pedometer had positive effects on assisting sedentary nursing staff to progress through the stages of health behavior change and on their exercise self-efficacy, which could further help increase their exercise adherence and overall physical and mental wellbeing.

Keywords

Nurses, pedometer, physical activity, randomized controlled trial, transtheoretical model

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Introduction

Nurses not only deliver a range of healthcare services to their patients, but they often carry administrative and didactic responsibilities toward novice nurses and nursing students. Delivery and completion of these sedentary tasks limit opportunities for movement and physical activity during a workday. Absence of physical activity among nursing staff and concerns about their wellbeing are part of a global phenomenon, not limited to one specific country or culture per se.[1–3] A study of Thai nurses in a tertiary care hospital found that over 50.0% did not undertake any exercise (58.5%). One-third exercised less than three times a week and only 8.0% exercised more than three times a week. It was also

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found that non-exercise was significantly associated with the occurrence and severity of musculoskeletal disorders.[2] Similarly, a study among nursing staff in South Africa found that 80% of the nurses did not exercise at all, and overall, had poor health and fitness profiles including a high incidence of back pain. Furthermore, there was a correlation between the prevalence of back pain and being overweight or obese amongst these nurses.[1] Therefore, efforts have been underway to develop opportunities for physical activity and to support this activity among nursing staff.

According to the Transtheoretical Model (TTM) of health behavior change, behavior change is based on a five-stage cycle: pre-contemplation, contemplation, preparation, action, and maintenance. Identifying the stages at which nurses are may result in more effective interventions to help them become physically active.[4] While individuals are in the pre-contemplation stage, they may need education about the health risks of inactivity and the value of being physically active, as well as motivational interventions to encourage them to move into the contemplation stage. Individuals who are in the contemplation or preparation stage may need to build self-efficacy for adopting healthy lifestyle changes and overcoming challenges. Some who are in the action or maintenance stage will need support to stay motivated by increasing self-efficacy and self-regulation. They need to be provided with the tools necessary for maintaining positive behavior changes.[4]

Research suggests that TTM stage identification may be an effective approach for becoming physically active.[4] Self-liberation is a behavioral process of change, based on the TTM, that involves making a commitment to achieve a goal. To activate this self-liberation process, there is a need to set specific goals related to health behavior change.[5]

Electronic devices, such as Fitbit or pedometers, can be used for tracking a walk or providing feedback on physical activity, and they serve as a tool to remind users to exercise and achieve lifestyle goals, such as a steps-per-day goal.[6] Many studies show that pedometers have been widely used with certain groups of people to enhance physical activity behaviors[7,8] as well as to improve anthropometric measures.[8]

An intervention using a pedometer based on self-liberation, such as making a commitment to achieving a steps-per-day goal, may serve as an effective motivational strategy for physical activity among sedentary nurses. We implemented a two-armed randomized controlled trial (RCT) with the overarching objective of assessing whether the use of a pedometer could motivate nurses to increase their physical activity levels and result in changes in anthropometric measurements.

Method

Study design

A RCT using a two-group design was conducted at a tertiary university hospital in Thailand from July to September 2020. A CONSORT 2010 checklist of information to include when reporting a randomized trial has been provided in the Supplemental Materials (Appendix A).

Study participants

In-patient nursing professionals were eligible to participate in our study if they were 35 years of age or older; we set this eligiblity criterion to increase the likelihood of participation of nurses who might be more sedentary due to the requirements of work related to positions of seniority. Eligible and interested individuals were excluded if their time availability or health conditions (e.g., cardiovascular diseases, musculoskeletal conditions) represented a limitation on taking part in the study, or if they had any difficulties with wearing and recording data on a pedometer.

We applied a sample size calculation for two independent groups to estimate the minimum number of participants for each arm of the study by using G Power 3.1.[9] Since the effect size was not determined in this study, the effect size value (0.68) was based on the previous study among nursing professionals.[10] We assumed the statistical power (β) of 0.8, the probability of a Type I error(α) of 0.05, and the intervention effect of 0.68 between the two arms of the study. The sample size was calculated as 15 for each group and 30% was added for attrition, resulting in the selection of 20 participants for each group.

The hospital database was used to identify nursing professionals who were 35 years or older. The lead researcher then met with prospective study participants and explained the objectives of the study as well as the duration and the data collection process. Additionally, they were provided with an information pamphelet about the study. The lead researcher took time to answer the questions and concerns of prospective participants. A total of 40 nurses from 16 wards of in-patient surgical services consented to take part in our study. All participants provided written informed consent prior to participation.

The participants were randomly assigned to either the intervention (n=20) or the control arm (n=20) of the study. The researcher wrote their names on slips of paper, placed them in a container and drew the names out one at a time without replacement (Figure 1).

Intervention arm of the study. The lead researcher met with the study participants at baseline and then at the end of the 12-week study. At baseline, the lead researcher explained the health benefits of regular exercise and provided the study participants with written information about the health benefits of regular physical activity. Additionally, they were provided with wristband pedometers and 12-week calendars. The lead researcher gave a detailed demonstration of the pedometer and instructed the study participants to wear the pedometer every day, from the time they woke up in the morning until the time they went to bed. They were advised to take off the pedometer if they were going

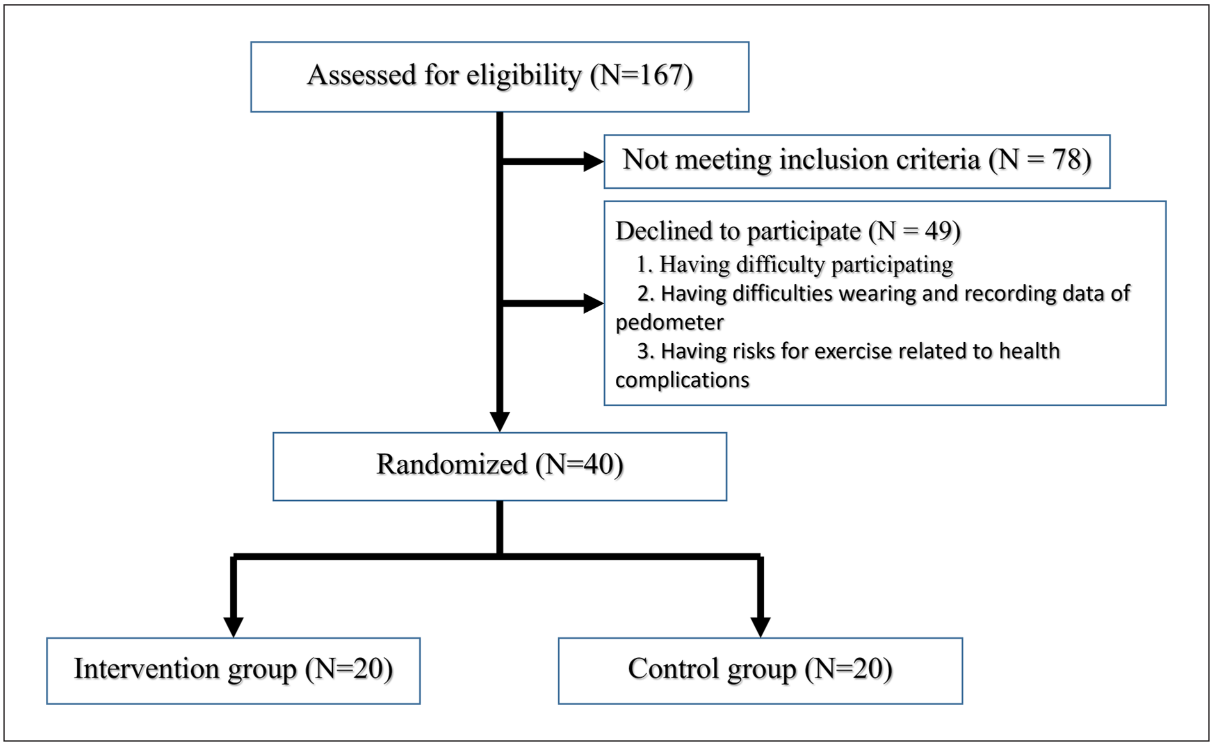

Figure 1. Flow diagram of recruitment and retention of participants in the study.

to be engaging in any water-based activities (e.g., bathing, hand washing) and were reassured that if they wished to take off the pedometer for any reason (e.g., discomfort), they were permitted to do so. However, a minimum wearing time of ⩾8 h was required to achieve reliable estimates of pedometer steps.[11]

The participants were advised to continue increasing their steps to reach at least 10,000 steps daily, the targeted number of steps recommended for healthy adults,[12] by the end of the study. They were also reminded of the importance of keeping records of their daily steps. Participants were then asked to complete the International Physical Activity Questionnaire (IPAQ), the Exercise Readiness-to-Change Questionnaire (ERCQ), and the Exercise Self-Efficacy Questionnaire (ESEQ) (descriptions of these questionnaires are under the subheading, Data Collection). Finally, their heights and body weights were measured at baseline.

At the end of the 12-week study, the lead researcher met with the study participants, measured their heights and weights, and asked the participants to complete the IPAQ, ERCQ, and ESEQ again.

Control arm of the study. At baseline, the lead researcher met with the control group, explained the health benefits of regular exercise, and provided them with the same written information about the health benefits of regular physical activity. They did not wear a pedometer or record their daily steps, but they were encouraged to increase their physical activity to meet the physical activity guidelines.[13] Meanwhile, similar to the intervention arm, these participants were asked to complete the IPAQ, the ERCQ, and the ESEQ. Finally, their heights and body weights were measured at baseline.

At the end of the 12-week study, the lead researcher met with the study participants, measured their heights and body weights, and asked the participants to complete the IPAQ, ERCQ, and ESEQ again.

Throughout the 12-week study period, the lead researcher sent messages via mobile messenger app (LINE application platform) to participants in either arm of the study to remind them of the 10,000-step goal and to encourage them in achieving their physical activity goals.

Data collection

Anthropometric data

Data on height and body weight were collected at baseline and at the end of the 12-week study period. Participants were barefoot and in light clothing; we used a stadiometer (TANITA® WB-3000, Tanita Corp., Itabashi-Ku, Japan) with a 0.01 cm level of accuracy to measure height and an electronic weighing scale (TANITA® BC-418, Tanita Corp.) with a 0.1 kg degree of accuracy to measure body weight. Body mass index (BMI) was calculated by dividing body weight (kg) by height in meters squared. BMI was classified into four categories: underweight ($<18.5\ kg/m^2$), normal

(18.50–24.99 kg/m^2), overweight (25–29.99 kg/m^2), and obese (⩾30 kg/m^2).[14] Waist circumference was measured at the level of minimal trunk girth using a flexible tape measure. The anthropometric measurements form which was used has been included in the Supplemental Materials (Appendix B).

Daily steps

Daily steps were recorded electronically using a wristband pedometer (Xiaomi Mi Band), which is considered one of the most reliable and valid pedometers.[6]

Assessment of physical activity

Individual physical activity levels were determined using the short version (seven questions) of the IPAQ, translated into Thai language. The IPAQ has been reported to have good reliability and validity among healthcare professionals[15,16] and has been designed to assess physical activities that individuals perform as part of their daily activities. Individuals are asked to report the level (vigorous or moderate) and duration (hours and minutes) of their physical activity, as well as time (hours/minutes) spent walking and sitting.[15]

The IPAQ that was utilized has been included in the Supplemental Materials (Appendix C). We used the guidelines for data processing and analysis of the IPAQ to calculate the average metabolic equivalent (MET) score for each study participant.[17]

Walking MET-minutes/week = 3.3 × walking minutes × walking days

Moderate MET-minutes/week = 4.0 × moderate-intensity activity minutes × moderate days

Vigorous MET-minutes/week = 8.0 × vigorous-intensity activity minutes × vigorous-intensity days

Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous

Study participants, based on their total physical activity MET-minutes per week, were then grouped into three categories. Levels of physical activity were classified into three categories: a total of less than 600 weekly MET minutes was considered light physical activity, a total of at least 600 MET minutes a week was classified as moderate, and a total MET minutes exceeding 3000 a week was classified as high.[17]

Assessment of readiness to change behavior

We developed and implemented the ERCQ to assess participants' motivation to change their physical activities toward achieving the goal of 10,000 steps/day. The content validity of the ERCQ was assessed by five experts from academic and clinical settings (S-CVI = 0.98).

After finalizing the content validity of our instrument, we proceeded with the test-retest reliability pilot study of the ERCQ. Five nursing professionals working at the in-patient units of the university hospital volunteered for this pilot study by completing the ERCQ twice, 7 days apart. Our analysis of the reported data yielded a high concordance ($K = 0.092$) between the two sets of responses.

The ERCQ has been included in the Supplemental Materials (Appendix D). It contains five items; responses to these items are scaled from 1 to 5, with a value of 1 indicating the pre-contemplation stage, defining individuals who do not have any plan to start exercising. A score of 2 defines individuals who have plans to initiate exercising sometime within the next 6 months, and the stage is referred to as the contemplation state. Stage 3, or the preparation stage, refers to individuals who plan to initiate an exercise regimen within the next 30 days. Stage 4 refers to individuals who have been exercising for <6 months; these individuals are classified into the action stage. Finally, stage 5 includes individuals who have been exercising 6 months or more, and these individuals are referred to as being at the maintenance stage.

Assessment of exercise self-efficacy

We designed and developed the ESEQ to evaluate participants' confidence levels in engaging in regular physical activity in different mental and/or physical circumstances (e.g., when you are feeling tired or stressed or depressed), or during periods of compromised temperament due to work (e.g., when you are feeling under pressure to get things done), family conditions (e.g., when your family or friends do not provide any kind of support), time limitations (e.g., when there are other more interesting things to do), vacation time (e.g., when you are traveling or on vacation), or inclement weather (e.g., when the weather is bothering you).[18]

ESEQ is based on an 11-point Likert scale ranging from "not confident" (0) to "very confident" (10). The scores are then summed to generate an exercise self-efficacy score. The higher the score, the better the perceived self-efficacy for exercise. The content validity of the ESEQ was assessed by five experts from academia and clinical practice (S-CVI = 0.96). Then, the reliability of the instrument was evaluated among five surgical nurses in a test-retest study over a 7-day period ($k = 0.86$). The ESEQ which was used has been included in the Supplemental Materials (Appendix E).

Statistical analysis. We used descriptive statistics to summarize the characteristics of the study participants. Data normal distributions were assessed using the Shapiro–Wilk test.[19] The differences between the two groups were tested using independent t-test for continuous variables and chi-square for categorical variables while paired t-tests and McNemar's test were used to compare changes within groups, respectively.[20] Relationships between two variables were tested using Spearman's Rho.[20] The repeated-measures analysis of variance

Table 1. Distribution of characteristics of intervention and control groups at the baseline.

Variable	Intervention group ($n=20$)	Control group ($n=20$)	p
Age (years)	46.55 ± 7.36	49.40 ± 6.54	0.204
BMI (kg/m^2)	23.73 ± 3.30	25.78 ± 4.00	0.416
Waist circumference (cm)	81.52 ± 9.70	88.10 ± 10.20	0.911
Sex			
Male	3 (15.0%)	1 (5.0%)	0.302
Female	17 (85.0%)	19 (95.0%)	
Marital status			
Single	9 (45.0%)	10 (50.0%)	0.946
Married	9 (45.0%)	8 (40.0%)	
Separate	2 (10.0%)	2 (10.0%)	
Years of nursing experience			
<10 years	2 (10.0%)	1 (5.0%)	0.220
>10 years	18 (90.0%)	19 (95.0%)	
Education			
Bachelor	14 (70.0%)	13 (65.0%)	0.500
Master	6 (30.0%)	7 (35.0%)	
Stage of exercise readiness			
Pre-contemplation	1 (5.0%)	0 (0%)	0.179
Contemplation	6 (30.0%)	14 (70.0%)	
Preparation	10 (50.0%)	4 (20.0%)	
Action	2 (10.0%)	2 (10.0%)	
Maintenance	1 (5.0%)	0 (0%)	
Exercise self-efficacy	4.60 ± 1.75	5.02 ± 2.08	0.487
Level of physical activity (n = 18 each arm)*			
Light	5 (27.8%)	10(55.6%)	0.284
Moderate	5 (27.8%)	3 (16.7%)	
Vigorous	8 (44.4%)	5 (27.8%)	

kg, kilograms; m, meter; cm, centimeter.
*Decreased participant number: in case of declared "don't know" or "refused" or data were missing for time/day of physical activity, then that case was removed from analysis of the physical activity level.

(rANOVA) was used to test differences in the number of steps for the intervention group.[20] All statistical analyses were two-sided, with $p \leqslant 0.05$. The data were analyzed using IBM SPSS Statistical Package for Windows (Version 13.0).

Results

A total of 40 in-patient unit nursing professionals, 20 in the intervention arm and 20 in the control arm, opted to take part in our 12-week exercise trial study. At baseline, the mean differences in age and anthropometric variables (BMI and waist) did not reach the level of statistical significance (Table 1). Additionally, distributions of the sociodemographic variables (sex, marital status, years of nursing experience) did not reach the level of statistical significance (Table 1). Finally, results from the assessment of state of exercise readiness, indicated that 70% ($n=14$) of the control arm were in the contemplation stage and 20% ($n=4$) were in the preparation stage. In contrast, 30% ($n=60$) of the intervention arm were classified in the contemplation stage and 50% ($n=10$) in the preparation stage. Meanwhile, the overall distributions of stages of exercise readiness between the two arms of the study did not reach the level of statistical significance ($p=0.179$) (Table 1). Similarly, neither the baseline distribution of level of physical activity nor the perception of exercise self-efficacy reached the level of statistical significance (Table 1).

After 12 weeks of the intervention, both groups had lower BMIs, compared with the baseline values although the intra-group changes did not reach the level of statistical significance; however, the difference in the mean value of BMI between the intervention group (23.50 ± 3.20) and the control group (25.68 ± 4.00) approached the level of statistical significance ($p=0.068$) (Table 2).

In addition, after 12 weeks, the mean value for waist circumference for both groups was lower than the baseline values. For the intervention arm, the mean waist circumference value dropped by 0.85 ± 0.85 cm (81.52 ± 9.70 versus 80.67 ± 9.30) ($t=4.42$, $p=0.001$). Similarly, the control arm of the study experienced a drop in its mean waist circumference value: 0.28 ± 0.41 cm (88.10 ± 10.20 versus 87.82 ± 10.10) ($t=2.98$, $p=0.008$). After 12 weeks, the difference in the waist circumference value between the

Table 2. Differences in anthropometric variables, physical activities, and perception of exercise self-efficacy between the intervention and the control group after 12 weeks of trial.

Variable	Intervention group (n = 20)	Control group (n = 20)	p
BMI (kg/m^2)	23.50 ± 3.20	25.68 ± 4.00	0.068
Waist circumference (cm)**	80.67 ± 9.30	87.82 ± 10.10	0.026
Exercise self-efficacy	5.63 ± 2.48	4.50 ± 1.90	0.264
Level of physical activity (n = 18 each arm)*			
Light	3 (16.7%)	8 (44.4%)	0.312
Moderate	9 (50.0%)	5 (27.7%)	
Vigorous	6 (33.3%)	5 (27.7%)	

*Decreased participant number: in case of declared "don't know" or "refused" or data were missing for time/day of physical activity, then that case was removed from analysis of the physical activity level.
**Significant difference was found ($p < 0.05$).

intervention arm (80.67 ± 9.30) and the control arm (87.82 ± 10.10) was statistically significant (F = 0.09, p = 0.026) (Table 2).

Analysis of the data showed an increase in the overall self-efficacy score after 12 weeks for the intervention arm (from 4.60 ± 1.75 to 5.63 ± 2.48) while overall self-efficacy declined for the control arm (from 5.02 ± 2.08 to 4.50 ± 1.90); however, the intra-group differences in self-efficacy values measured at baseline and after 12 weeks did not reach the level of statistical significance. Furthermore, the differences in self-efficacy scores after 12 weeks of intervention, between the two arms of the study did not reach the level of statistical significance (F = 1.283, p = 0.264).

At baseline, 16.7% (n = 3) of participants in the control group and 27.8% (n = 5) in the intervention group had reported their physical activity level as moderate, a difference which did not reach the level of statistical significance (McNemar's test = 1.20, p = 0.549). After 12 weeks, this proportion increased to 27.7% (n = 5) for the control group and 50.0% (n = 9) for the intervention group. Again, we did not detect a statistically significant difference between the two arms of the study (McNemar's test = 5.00, p = 0.172).

The overall trend in mean number of daily steps during the 12 weeks of observation for the intervention arm reached the level of statistical significance ($p < 0.01$). During the first week of the intervention, the documented mean number of daily steps was 8889 ± 579.84 (range = 8059–9837). This value remained relatively stable during the first 11 weeks of intervention. During the last week of the intervention, the mean number of daily steps was documented at 9930 ± 986.52 (range = 8810–11,947) (Table 3). We did not detect a statistically significant correlation between mean daily steps and changes in anthropometric measurements (r_s = −0.01, p = 0.945; r_s = 0.00, p = 0.995; and r_s = −0.09, p = 0.694 in BMI and waist circumference, respectively).

Table 3. Mean daily steps of the intervention arm of the study during the 12 weeks of trial (n = 20)***.

Week	Mean value	Range
Week 1	8889 ± 579.84	8059–9837
Week 2	8902 ± 514.86	8212–9648
Week 3	8658 ± 843.74	7726–9598
Week 4	8251 ± 726.75	7328–9052
Week 5	8465 ± 863.72	7260–9723
Week 6	8947 ± 541.08	7908–9555
Week 7	8173 ± 570.93	7138–8773
Week 8	8435 ± 690.42	7604–9433
Week 9	8207 ± 789.32	7128–9663
Week 10	8768 ± 524.18	7955–9311
Week 11	8973 ± 1369.08	7657–11,922
Week 12	9930 ± 986.52	8810–11,947

***Significant difference was found ($p < 0.01$).

Discussion

We implemented a two-armed, RCT with the overarching objective of motivating nursing professionals to increase their daily steps. The health benefits of physical activity are well accepted; in general, it is recommended for adults to assume 150 min of moderate or 75 min of vigorous physical activity per week which equals to about 10,000 steps/day.[13] Our intervention of empowering nursing professionals with personal pedometers suggested that increased awareness of one's daily steps can be a motivating factor for transitioning from one stage of TTM to the next in becoming more physically active. Our findings concur with previous reports suggesting devices such as pedometers can facilitate transition from one stage of TTM to the next.[8] However, a previous study in Poland found that using a pedometer alone was insufficient in facilitating nurses to meet the goal of 10,000 steps/day[21]; therefore, receiving motivational messages and reminders was most likely an important factor in our study. Findings from previously published work suggest sending motivational messages can have a positive effect in increasing steps taken per day; however, the positive impact of motivational messages seems to undergo attrition with time.[22] We also observed a decline in the positive effects of the reminders and motivational messages that were sent to nurses in the intervention group. Nurses

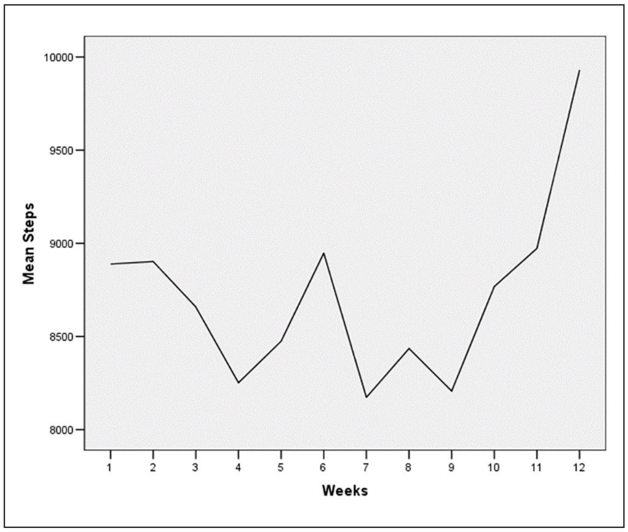

Figure 2. Change in intervention group's pedometer steps during the 12-week study period.

had the tendency to increase their daily steps shortly after receiving our text message reminders; then, the number of daily steps taken would gradually diminish. However, the continued increase of steps to approach 10,000 was observed by the last week of the intervention, suggesting the positive impact of the last message encouraging the 10,000-step goal (Figure 2).

In this study, participants in both groups had increased their physical activity level by the end of the study. With regards to the IPAQ, a small number of participants engaged in moderate physical activity at baseline while this number increased for both groups by week 12. There was also a decrease in the number of participants engaging in light physical activity in both groups by week 12. The control participants increased their physical activity level over the course of the study even without the use of pedometers. This may be the result of receiving education encouraging physical activity in the initial stage of the study and reinforcement over the 12-week study period. This finding is supported by research from Gemson et al.[23] which showed that education encouraging physical activity has had positive effects on physical activity. An additional concern for this result is that the intervention received by both groups may result in little differentiation, suggesting that provision of a pedometer and a diary for record keeping may not be enough to see a change in physical activity behaviors.

After the 12-week period, the nursing professionals in the intervention group reported increased levels of exercise self-efficacy, while decreased levels of exercise self-efficacy were reported in the nursing professionals in the control group. Even though the control participants were encouraged to increase their physical activity to achieve the goal regarding the physical activity guidelines, using a pedometer with the goal setting of at least 10,000 steps a day for the intervention group was shown to be more effective for exercise self-efficacy. This may be because these participants received the self-liberation intervention together with the pedometer, which increased their ability to objectively measure and record their daily steps, and this encouraged them to reach the goal (10,000 steps a day). Hence, they may need to build more exercise self-efficacy. This is linked to the model of changing health behavior (TTM).[4] However, the results did not achieve statistical significance despite trending in the desired direction.

Finally, we did not observe any correlation between step numbers and change in anthropometric measures after the 12-week intervention. A possible reason for this may be that changes in anthropometric measures may take longer than 12 weeks to become evident, and may be related to individual eating behaviors. Thompson and Eijsvogels[24] have acknowledged that weight loss is not just about physical activity. It is about the combination of physical activity and daily eating habits. Nonetheless, the 12-week weight loss and reduced waist circumference among both groups were demonstrated, suggesting that the intervention influenced their lives.

Strengths and Limitations

The main strength of our study is the uniformity of the study participants. The nursing professionals who were randomized to either arm of the study, were similar in their education and socioeconomic status and all worked in the same hospital. Therefore, the potential confounding effects of variables such as socioeconomic status, work environment, or education were reduced. Our study has two limitations. First of all, findings are based on a relatively small sample size of Thai nursing professionals practicing in an academic hospital which limits the generalizability of our findings. Second, we used a self-reporting approach to collect data; therefore, we cannot refute the influence of reporting and/or recall bias.

Conclusion

The use of a pedometer, which is a simple and practical tool for self-liberation, could be an effective strategy to facilitate nursing professionals to progress through the stages of change of the TTM and become more physically active. The use of pedometers can increase awareness about the number of daily steps required to maintain fitness, thereby motivating one to engage in physical activity. The elevated level of physical activity, in return, can increase the perception of exercise self-efficacy which can be a propelling factor for further physical activity, weight management, and overall physical and mental wellbeing.

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Author contributions

PC conceived the original idea. PC and NW carried out the experiment. PC analyzed the data with support from WL. PC wrote the manuscript with support from WL, KR, and WS. WU supervised the project. All authors have agreed on the final version and meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics statement

The research was approved by the Ethics and Human Subject Committee of the Faculty of Nursing, Chiang Mai University (No. 060/2020).

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Informed consent

All participants provided written informed consent prior to participation.

Trial registration

This randomized controlled trial was registered under Thai Clinical Trials Registry (TCTR20221030002).

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Supplemental material

Supplemental material for this article is available online.

References

1. Naidoo R and Coopoo Y. The health and fitness profiles of nurses in KwaZulu-Natal. *Curationis* 2007; 30(2): 66–73.
2. Chaisurin P, Moongtui W, Kaewthummanukul T, et al. Work-related musculoskeletal disorders and related factors among professional nurses in surgical division, tertiary care hospital. *Nurs J* 2012; 39(special): 46–61.
3. Chiou ST, Chiang JH, Huang N, et al. Health behaviors and participation in health promotion activities among hospital staff: which occupational group performs better? *BMC Health Serv Res* 2014; 14: 474.
4. Upton D and Thirlaway K. *Promoting healthy behaviour: a practical guide*. London: Routledge, 2014.
5. Karl T. The 5 stages of change & the Transtheoretical Model (TTM) - do you know the basics? [Internet]. R1 Team, https://r1learning.com/blog/2020/5-stages-of-change (2020, accessed 21 September 2021).
6. Luff CM. The 10 best pedometers of 2022, tested and reviewed. *Verywell Fit Commerce Team*, https://www.verywellfit.com/best-pedometers-4159148 (2022, accessed 18 October 2022).
7. Gany F, Gill P, Baser R, et al. Supporting South Asian Taxi Drivers to Exercise through Pedometers (SSTEP) to decrease cardiovascular disease risk. *J Urban Health* 2014; 91(3): 463–476.
8. Clarke KK, Freeland-Graves J, Klohe-Lehman DM, et al. Promotion of physical activity in low-income mothers using pedometers. *J Am Diet Assoc* 2007; 107(6): 962–967.
9. Faul F, Erdfelder E, Lang AG, et al. G* power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*, 2007; 39(2): 175–191.
10. Kang M, Marshall SJ, Barreira TV, et al. Effect of pedometer-based physical activity interventions: a meta-analysis. *Res Q Exerc Sport* 2009; 80(3): 648–655.
11. Airlie J, Forster A and Birch KM. An investigation into the optimal wear time criteria necessary to reliably estimate physical activity and sedentary behaviour from ActiGraph wGT3X+ accelerometer data in older care home residents. *BMC Geriatr* 2022; 22(1): 136.
12. Tudor-Locke C and Bassett DR Jr. How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Med* 2004; 34(1): 1–8.
13. World Health Organization. Global recommendations on physical activity for health, http://www.who.int/dietphysicalactivity/factsheet_recommendations/en/ (2010, accessed 20 November 2016).
14. World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation. *WHO Tech Rep Ser* 2000; 894(i–xii): 1–253.
15. Craig C, Marshall A, Sjostrom M, et al. International Physical Activity Questionnaire-Short Form. *J Am Coll Health* 2017; 65(7): 492–501.
16. Rattanawiwatpong P, Khunphasee A, Pongurgsorn C, et al. Validity and reliability of the Thai version of short format International Physical Activity Questionnaire (IPAQ). *J Thai Rehabil* 2006; 16(3): 147–160.
17. Sjöström M, Ainsworth B, Bauman A, et al. *Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)–short and long forms*. IPAQ core group (2005, accessed 20 February 2020); IPAQ Analysis (physio-pedia.com).
18. Resnick B and Jenkins LS. Testing the reliability and validity of the self-efficacy for exercise scale. *Nurs Res* 2000; 49(3): 154–159.
19. Mishra P, Pandey CM, Singh U, et al. Descriptive statistics and normality tests for statistical data. *Ann Card Anaesth* 2019; 22(1): 67–72.
20. Gray JR and Grove SK. *The practice of nursing research: appraisal, synthesis, and generation of evidence*. St. Louis, MO: Elsevier Health Sciences, 2020.
21. Kwiecień-Jaguś K, Mędrzycka-Dąbrowska W, Czyż-Szypenbeil K, et al. The use of a pedometer to measure

the physical activity during 12-hour shift of ICU and nurse anaesthetists in Poland. *Intensive Crit Care Nurs* 2019; 55: 102750.

22. Figueroa CA, Deliu N, Chakraborty B, et al. Daily motivational text messages to promote physical activity in university students: results from a microrandomized trial. *Ann Behav Med* 2022; 56(2): 212–218.
23. Gemson DH, Commisso R, Fuente J, et al. Promoting weight loss and blood pressure control at work: impact of an education and intervention program. *J Occup Environ Med* 2008; 50(3): 272–281.
24. Thompson PD and Eijsvogels TMH. New physical activity guidelines: a call to activity for clinicians and patients. *JAMA* 2018; 320(19): 1983–1984.