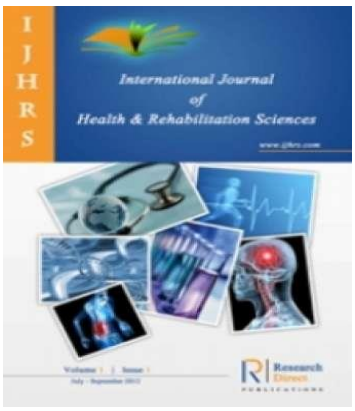

The Effects of Pedometer–Based Intervention on Patients After Total Knee Replacement Surgeries

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ABSTRACT

Background: Non-compliance is considered a major concern that challenges health care providers after total knee replacement (TKR). Noncompliance may lead to increase pain, loss of muscle strength, increase swelling, loss of normal movement and functional limitations. Pedometer was found to increase physical activity compliance in many populations. However, pedometers effect on rehabilitation outcomes in patients after TKR was not examined yet.

Objectives: The aim of this study was to examine the effects of pedometer based intervention on patients' rehabilitation outcomes following TKR surgeries.

Design: Randomized controlled trial

Materials and methods: 20 TKR patients were randomized into: pedometer group (n=10) and control group (n=10). Both groups received the same rehabilitation program. However, pedometers were given to the pedometer group patients in day 1 after surgery for seven consecutive days. Outcome measurements included: knee range of motion (ROM) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Results: After seven days, knee flexion ROM and physical function scores were significantly increased and pain score and stiffness was significantly decreased in pedometer group compared with the control group.

Conclusion: Pedometer is a wide spread, cheap, conservative and easily used device that could be used to increase compliance and improve knee outcomes in patients after TKR.

Keywords: Pedometer, total knee replacement, compliance, range of motion, adherence

Introduction

Noncompliance is considered as one of the most common determinants of successful of the rehabilitation programs following total knee replacement (TKR) surgeries [1]. It's a well-known fact that patient compliance and cooperation play a vital role in achieving rehabilitation goals and patient's satisfaction [1]. Non-compliance has been associated with increase morbidity, prolonged hospital stays and nursing home admissions [2,3]. Thus, non-compliance is considered as a major problem that challenge health care providers after knee surgeries[4,5].

Non-compliance after TKR surgeries may lead to increase pain level, increase muscle stiffness, loss of muscle strength, increase swelling, loss of normal movement and loss of daily functions [4]. Following knee surgeries, one study reported that 40 patients out of 59 discontinued rehabilitation before achieving the rehabilitation program goals [4]. Another study assessed the rehabilitation adherence and compliance and functional ability after knee surgeries showed that self-motivation was a predictor of home exercise completion and rehabilitation sessions' attendance were significant predictors of functional ability [5]. In line with this, it has been suggested that exercise programs in a monitored environment could improve the patient's compliance and adherence to the rehabilitation program after TKR [6]. However, examining a way to facilitate the monitored environment for TKR patients is not assessed yet.

One of the used methods to monitor and increase physical activity compliance in other populations is the pedometer. The pedometer is a portable electromechanical device, which counts each step a person takes by detecting the motion of the person's hands or hips [7]. A systematic review reported that the use of pedometer-based intervention was found to be associated with increase in physical activity level by an average of 26.9% over baseline values[8] Furthermore, pedometer-based intervention was used to increase physical activity levels in diabetes mellitus type two, chronic obstructive pulmonary disease patients and even in healthy people[9-11]. The feedback given by the pedometer was considered as an important factor to enhance physical activity in these populations [12]. However, pedometer-based intervention was not examined in TKR patients yet.

If found to be effective, pedometer will be cheap, feasible and easily used device to improve rehabilitation outcomes following TKR. Thus, this study aimed to assess the effects of using pedometer-based intervention on rehabilitation outcomes in patients after TKR surgeries.

Materials and Methods

Study design and subjects:

A longitudinal study was designed to examine the effects of pedometer-based intervention on patients after TKR surgeries. Twenty TKR participants were recruited from the orthopedic ward in King Abdullah University Hospital (KAUH). The participants were randomized into two groups; pedometer group (n=10) and control group (n=10). The inclusion criteria were: 1) TKR female patients, 2) osteoarthritis patients, 3) age group between 50-80 years old, 4) able to give informed consent and 5) able to return for follow-up. Exclusion criteria were: 1) bilateral TKR, 2) either hip or knee

replacement in the last 12 months, 3) severe locomotor limitation due to cardio-respiratory dysfunction, central or peripheral nervous system deficits, spinal conditions, and other musculoskeletal disabilities. Participants provided informed consent in accordance with the ethical approval obtained from the Institutional Research Board of King Abdulla University Hospital.

Participants in the pedometer group were given pedometers (Omron HJ-320; Omron Healthcare, Inc., Bannockburn, IL, USA) along with their usual physiotherapy program for the first seven days after the surgery. In the control group, participants received their usual physiotherapy program without pedometers.

Outcome Measures

In the first day after the surgery, knee range of motion (ROM) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for all participants were taken. The treatment effects were measured after seven days including ROM and WOMAC. The WOMAC is a questionnaire that contains three domains: pain intensity, stiffness and physical functions [13]. The WOMAC was found to be valid and reliable tool to be used in patients after TKR surgeries [14]

Statistical Analysis

Descriptive statistics were used to calculate the means and standard deviations of all variables. Data was assessed for normality using histograms and Q-Q plots; this was performed to confirm appropriate choice of statistical tests as well as to aid in the interpretation of data. Differences between the groups in the study variables were investigated using the independent-sample student t-test. SPSS (version 20). Significance level was set at $p<0.05$.

Results:

The means and standard deviations of age, number of TKR surgeries, flexion ROM scores in the first day after surgery of all participants (n=20) are presented in Table 1.

Table 1: Descriptive statistics of all participants at the first day post-surgery (n=20).

	Mean	SD*
Age	63.38	6.76
Number of previous TKR	1.29	0.46
First day flexion ROM	21.71	10.82

*SD: standard deviations; TKR: Total Knee Replacement; ROM: range of motion.

The mean age for the Pedometer group was 60.09years and for the Control group was 62.00 years. There were no significant differences between the two groups in age, number of TKR surgeries, as presented in Table 2. All participants were females. Baseline measurements of knee flexion ROM was not significantly difference between the pedometer and control groups as described in Table 3 below.

Table 2: Differences in descriptive statistics between the two group

	Mean ± SD (Pedometer group)	Mean ± SD (Control group)	Mean Difference ± Standard Error Difference	p-value
Age	60.09±5.13	62.00±6.66	2.90±2.58	0.70
Number of TKR	1.27±0.47	1.30±0.48	-.027±.207	0.897

*SD: standard deviations; TKR: total knee replacement.

Table 3: Differences in outcome measures between the two groups.

	Mean ± SD (Pedometer group)	Mean ± SD (Control group)	Mean Difference± Standard Error Difference	p-value
Flexion ROM First day	25.50±8.95	22.60±8.96	5.90±4.56	0.916
Flexion ROM last day	51.10±6.98	40.00±11.30	11.10±4.20	0.016*
Pain in WOMAC	7.80±4.29	16.50±2.32	3.10±1.56	0.042*
Stiffness in WOMAC	3.20±2.74	4.00±2.11	0.80±1.09	0.041*
Physical function in WOMAC	36.70±10.94	49.60±6.31	12.90±3.99	0.005*

SD: standard deviations; ROM: range of motion; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index

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Mean steps per day for the pedometer group were increased from (30.27±9.48) in the first day to (61.27±18.66) in the last day. After 7 days, significant differences appeared in flexion ROM, pain score, stiffness score and

physical function in WOMAC between the two groups.

Discussion:

To our knowledge, this is the first study to examine the effects of using pedometer-based interventions on patients' compliance following total knee replacement surgery during the first week post-surgery. Findings of this study showed no differences in the baseline measurements of Knee flexion ROM between the pedometer and control groups. Significant differences after 7 days between the pedometer group and the control group in knee flexion ROM. In addition, patients in the pedometer group were significantly having better physical function and pain scores, and less stiffness in the WOMAC domains, than the control group after 7 days.

As the results indicated, pedometer-based intervention for the first seven days after the TKR surgeries could help in improving ROM of the knee. In addition, the pedometer-based intervention showed improvement in the physical functions and decreased stiffness in TKR patients. These results could be explained by the psychological effects and enhancing the feeling of self-efficacy which in turn are associated with improved physical activity compliance [15] Previous researchers found that self-monitoring could help to increase exercise compliance and improve lifestyle in the general population[15].

Both knee ROM and WOMAC domains including stiffness, pain and physical function were considered to be the main outcome measures in assessing patients after TKR [16]. Improving ROM and stiffness could also help in returning back to usual functions earlier. Thus, this study suggests the use of pedometers after TKR in order to improve compliance for physical function. This is supported by findings of a study done to assess the effects of pedometer-based intervention on physical activity, in which pedometers found to have the monitoring effects on the patients and considered as a feedback to assess the motivation of the patients [17].

This interventional study showed that the use of pedometer, in conjunction with TKR rehabilitation is a feasible addition to improve some of the rehabilitation outcomes after TKR. Thus, this study recommends the use of pedometers in conjunction with TKR physiotherapy program. This study is not without limitations, for example the limitations of the current study include: small sample size (n=20), short follow-up period (seven days only) and absent of preoperative measurements. In addition, the sample included only females.

Future studies related to this work should assess the effects of pedometer-based intervention in a larger sample size with assessing short and long term effects in TKR patients. Also, Future studies should assess factors that may affect compliance after TKR such as psychological factors.

In summary, this study showed that the use of pedometer-based intervention increase, physical function and increase knee flexion after seven days of TKR. Thus, we expect that this method in particular of benefit in improving the results of rehabilitation as a short term after TKR. However, further studies with larger sample size and longer follow-up period should be done to confirm these preliminary results.

Conflict of interest: No conflict of interest

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