Rehabilitation interventions incorporating self-management improve psychological factors: A non-randomized controlled trial of patients after total Knee arthroplasty

Yuki Hiraga¹,²*, Akira Babazono³, Ryusei Hara⁴, Katsuhiro Nomiyama⁵ and Yoshiyuki Hirakawa⁶

Abstract: Psychological factors affect chronic pain and may lead to inactivity after total knee arthroplasty (TKA). This study aimed to determine whether using an activity diary for early postoperative rehabilitation after TKA reduced pain and improved physical functioning and psychological factors. In this non-randomized controlled trial (intervention group: n = 140; control group: n = 150), postoperative rehabilitation with physical and occupational therapy was performed for both groups, and self-monitoring using an activity diary one week postoperatively was implemented for the intervention group. The outcome variables were the numerical rating scale of pain, Timed Up & Go Test score, timed 10 m walk test score, the Pain Catastrophizing Scale (PCS), and the Pain Self-Efficacy Questionnaire (PSEQ). The data were analyzed using ANOVA with post hoc tests. Time-by-group interactions were obtained for PCS and PSEQ (p < .05), which were both more favorable in the intervention group. The intervention group showed greater improvement in PCS and PSEQ four weeks postoperatively, compared with the control group (p < .05). However, no significant results were observed for neither physical performance.

ABOUT THE AUTHOR
The research activities of this group are focused on monitoring the physical activity, functional performance, and psychological factors in real-world settings during occupational therapy. This study of daily physical activity includes monitoring of steps collected using accelerometers for an activity diary. The target population includes patients with chronic pain, total knee arthroplasty, high tibial osteotomy, and distal radius fracture. This study investigated the impact of using an activity diary to assess the variation in physical activity during the early period following total knee arthroplasty. It was found that the rehabilitation led to an improvement in psychological factors. Therefore, after total knee arthroplasty patients should use the activity diary to record their daily activities and gain a sense of accomplishment. By doing so, negative psychological factors will improve, and the patients may become more energetic.

PUBLIC INTEREST STATEMENT
This study aimed to determine whether using an activity diary for rehabilitation after total knee arthroplasty (TKA) reduced pain and improved physical functioning and psychological factors. In this non-randomized controlled trial (intervention group: n = 140; control group: n = 150), postoperative rehabilitation with physical and occupational therapy was performed for both groups, and self-monitoring using an activity diary one week postoperatively was conducted for the intervention group. Outcomes were pain, Timed Up & Go Test score, timed 10 m walk test score, pain catastrophizing, and pain self-efficacy. The intervention group showed greater improvement in pain catastrophizing and pain self-efficacy four weeks postoperatively compared with the control group. Including an activity diary increased postoperative rehabilitation effectiveness: mobility improved as did self-reported pain behaviors. An activity diary is an effective and feasible addition to postoperative care for TKA patients.
measures assessed. These results indicated that including an activity diary increased postoperative rehabilitation effectiveness, improved pain catastrophizing and pain self-efficacy. An activity diary is an effective and feasible addition to postoperative care for TKA patients.

**Subjects: Health Psychology; Disability; Acute phase; Cognitive behavioral**

**Keywords: Behavioral Neuroscience; Health Psychology; Mental Health; Social Psychology**

1. **Introduction**

Knee osteoarthritis is a widespread condition and one of the most common causes of musculoskeletal disability (Rousseau & Garnero, 2012); it is associated with disrupted sleep, depression, increased sedentary behavior, less physical activity, obesity, and polypharmacy, all of which decrease patients’ quality of life (Felson et al., 2000). Although evidence-based medicine made a great improvement in the last few decades, where various treatments showed to be beneficial, there are still some patients experiencing chronic pain and reduced physical function for months following surgery. Thus, countermeasures, apart from the current one, are needed.

Surgical treatments such as total knee arthroplasty (TKA) are commonly performed in patients with severe knee osteoarthritis, with women being more likely to undergo this treatment (Bonnin et al., 2011). Women lose articular cartilage four times more than the annual rate of men in the proximal tibia and three times more in the patella (Hanna et al., 2009). Although more women than men undergo TKA in the United States, data suggest that TKA for severe knee osteoarthritis is underused by both men and women but the degree of underuse is three times greater in women (Hawker et al., 2000). In Japan, the level of patient satisfaction with their postoperative condition is 74% (Hosaka et al., 2011). TKA has been estimated to result in chronic pain in approximately 15% of cases (Ackerman et al., 2005). The complications caused by pain catastrophizing among patients who have undergone TKA are associated with a risk of developing chronic pain postoperatively (Lewis et al., 2015). In this vein, negative psychological factors including pain catastrophizing have been reported to affect chronic pain after TKA (M. Sullivan et al., 2011). Self-efficacy is a positive psychological factor that mitigates pain catastrophizing (Wylde et al., 2012). Additionally, a reduction in physical performance and psychological factors such as depression have been identified as factors that affect activities among patients with musculoskeletal pain (Kaleth et al., 2014). Further, walking balance and self-efficacy reduction in the first postoperative month affected physical activity of patients six months post-TKA (Taniguchi et al., 2016). Therefore, to prevent post-surgical pain among post TKA patients, we believe that it is necessary to develop intervention strategies focusing on improving psychological factors such as catastrophizing and self-efficacy, as well as physical functioning such as walking.

In recent years, mental simulation practice has been effective in improving physical function in patients who have undergone TKA (Paravlic et al., 2020). Furthermore, transcutaneous electrical nerve stimulation has been shown to be useful in managing pain in these patients (Vance et al., 2014). However, it is not clear how effective these methods are on pain catastrophizing and depression associated with pain. Therefore, based on previous studies (Hirase et al., 2018), we hypothesized that an activity diary may reduce the occurrence of persistent pain and improve physical performance after TKA. In a previous study, we found that using an activity diary along with occupational therapy promoted self-management, and improved pain, psychological factors, and physical activity levels for post-TKA patients in a non-randomized controlled trial (Hiraga et al., 2019). However, because this previous study had a low number of participants in the intervention and control groups, with 20 TKA patients in each group, a larger-scale study with more participants was needed. Therefore, in the present study, we investigated whether using an activity diary during post-surgical rehabilitation would reduce pain and improve physical performance and psychological factors among patients after TKA.
2. Method

2.1. Study design
This study comprised a non-randomized controlled trial. Although there are many limitations in non-randomized controlled trials, randomization of the subjects was not possible in this case, as the study was conducted within the participating hospital. This study is an extension of previous studies, with each study using data from different patients (Hiraga et al., 2019; Hirase et al., 2018). Patients were divided into two groups: an intervention group (post-surgical rehabilitation plus activity diary) and a control group (post-surgical rehabilitation only).

2.2. Ethical considerations
All study participants provided written informed consent. The study design was approved by the ethics review board of Fukuoka Rehabilitation Hospital (FRH 2014-R-011).

2.3. Participants

2.3.1. Power analysis
We used G*Power 3 (Faul et al., 2007) to perform a preliminary analysis and estimate the required sample size. The minimal clinically important difference (MCID) of walking pain is reportedly ≥ 2 points, when assessing pain using a numerical rating scale (NRS; Salaffi et al., 2004). The effect size was set at .25, as shown in a previous study (Hiraga et al., 2019). The power was set at .95 and the significance level (α) at .05 (Cohen, 1992). The power analysis indicated that 256 patients (128 per group) were required for rehabilitation evaluations pre-surgery and four weeks post-surgery.

2.3.2. Target participants
We performed this non-randomized controlled trial using data from two independent cohorts at Fukuoka Rehabilitation Hospital. The inclusion criterion was undergoing TKA from May 2014 to July 2018 at Fukuoka Rehabilitation Hospital (Fukuoka, Japan), and 295 patients were evaluated for enrollment in the study. The patients hospitalized from May 2014 to March 2016 were assigned to the control group, and those hospitalized from April 2016 to July 2018 were assigned to the intervention group. Exclusion criteria included a diagnosis of dementia or a mental illness (e.g., depression) that would interfere with the completion of the questionnaire, as well as refusal to participate in post-surgical rehabilitation. Additional exclusion criteria included postoperative complications (e.g., nerve injury or deep vein thrombosis), other significant medical diseases interfering with postoperative rehabilitation, previous TKA (TKA of the opposite limb or revision surgery), and TKA performed for causes other than degenerative diseases (e.g., rheumatoid arthritis or bone necrosis). These screenings were performed by an orthopedic surgeon before surgery. The TKA surgeries were performed by four surgeons. Target participants were hospitalized 1–2 days prior to surgery and postoperative rehabilitation began the day after surgery.

2.4. Surgery and postoperative rehabilitation
All patients (both intervention and control groups) received general anesthesia, which was required for 2–3 hours. Non-steroidal anti-inflammatory drugs were administered at a dose of 60 mg (three tablets per day) for two weeks, postoperatively. No opioids were used. All patients (both groups) followed the same physical therapy and occupational therapy protocols after their operations, and began physical therapy, including knee mobility exercises (flexion/extension) and stretching, on the first postoperative day. Subsequently, patients continued practicing mobility with a physical therapist, alongside topical icing treatment. Occupational therapy to improve patients’ everyday lives began at 1–2 weeks post-surgery. First, the therapy focused on self-care, such as bathing. Subsequently, patients were encouraged to practice skills tailored to their individual lifestyles. All post-TKA patients were discharged four weeks after surgery.
2.5. Combination of rehabilitation and self-management using an activity diary
We used an activity diary developed by Fukuoka Rehabilitation Hospital in the intervention group (Hiraga et al., 2019). The activity diary was configured to record the date, number of steps, and pain (11 items) each day; this was intended to facilitate the achievement of activity goals while encouraging active self-management. A pedometer (Pleasure Walker P2-150; Yamasa Co., Ltd., Tokyo, Japan) was used to record the number of steps per day; the pedometer was attached to the patient's foot on the non-operative side. The activity diary was delivered to patients in the rehabilitation room, by physical therapists or occupational therapists specialized in treating patients undergoing TKA. Individual therapists received at least one day of training specific to the trial from an experienced therapist. In addition, we focused on improving activity, rather than only evaluating pain. The activity diary involved manageable strategies such as reducing the speed of activities, taking breaks, and maintaining a consistent pace. Pain levels and comments were recorded in the activity diary, and we implemented feedback to enable patients to experience a sense of achievement. For example, if a patient commented, “I am in pain every day,” we asked, “Why do you have knee pain?” “How can this be done more easily?” This feedback was implemented to shift from negative to positive comments. This intervention explained that successful long-term self-management requires motivation. The intervention was incorporated into the rehabilitation program after surgery for 40 minutes per day, every day. In addition, the activity diary started seven days after surgery.

2.6. Assessment
Assessment was performed pre-surgery and post-intervention (four weeks post-surgery).

2.7. Primary outcomes

2.7.1. Pain
A numerical rating scale (Jensen et al., 1994) was used to evaluate pain on an 11-point scale (range: 0 = no pain to 10 = worst imaginable pain). Resting and walking pain were both assessed using the scale.

2.8. Secondary outcomes

2.8.1. Physical performance
2.8.1.1. Walking balance. The Timed Up & Go Test (TUG; Shumway-Cook et al., 2000) measures the time in seconds for an individual to stand up from a chair without using their arms, walk 3 m straight ahead, turn around, return to the chair, and sit down again. The objectives and protocol of the TUG were described to each participant with the following verbal commands: “When I say ‘Go’, stand up, walk to the marker, turn around, come back to the chair, and sit down again. You must do this as quickly as possible … Go.” The time was measured with a chronometer, starting at the “go” signal and ending the moment the participant was sitting again. The TUG was performed twice, and the average time was used for the analysis.

2.8.1.2. Walking time. A timed 10 m walk test was conducted to assess walking speed (Bohannon, 1997). The therapist provided the following oral instruction: “I will say ‘Ready, set, go.’ When I say ‘Go,’ walk as fast as you safely can until I say stop.” The time taken to walk 10 m was recorded using a stopwatch. This test was performed twice, and the average speed was used for the analysis.

2.8.2. Psychological factors
2.8.2.1. Pain catastrophizing. The Pain Catastrophizing Scale (PCS; M. J. L. Sullivan et al., 1995) was used to evaluate pain catastrophizing. This self-evaluation scale comprises 13 items on three subscales: rumination, helplessness, and magnification. The patient evaluates the time spent in a described condition on a five-point scale (range: 0 = not at all to 4 = all the time). Higher scores indicate stronger pain catastrophizing.
2.8.2.2. Self-efficacy. The Pain Self-Efficacy Questionnaire (PSEQ; Adachi et al., 2014) was used to evaluate self-efficacy for pain. This scale uses self-reported scores for 10 items measured on a seven-point scale (range: 0 = not at all confident to 6 = completely confident).

2.9. Statistical analysis
We used t-tests to identify differences in age and body mass index. Moreover, we used chi-squared tests for group comparisons of sex, employment, smoking, drinking, and long-term care insurance. We analyzed the effects of the intervention protocol on the outcome measures using a $2 \times 2$ (time [baseline/pre-surgery or four weeks post-intervention] $\times$ group [intervention or control group]) ANOVA. Post hoc analysis was performed, regardless of whether the interactions had been significant or not. Post hoc Tukey–Kramer tests were used for specific comparisons, and two-sided significance was determined. The Cohen’s $d$ effect size to describe the magnitude of the treatment effect was as follows: small, 0.20 to $<0.50$; medium, 0.50 to $<0.80$; and large, $\geq 0.80$ (Livingston et al., 2009). Statistical analyses were performed with the JMP statistical package, Version 14.0 (SAS Institute Co., Ltd).

3. Results
Figure 1 presents a flow chart outlining participation in this study. In total, 295 individuals were screened for enrollment, and five failed to meet the inclusion criteria. We enrolled the remaining 290 individuals in the study and non-randomly allocated each patient to either the intervention group ($n = 140$) or the control group ($n = 150$). Eight patients in the intervention group and 12 in the control group withdrew. A total of 132 patients in the intervention group and 138 in the control group completed the study. Two patients in the control group were excluded because of missing data.

3.1. Baseline characteristics
Table 1 summarizes the baseline characteristics of the patients. There were no significant differences between the two groups in age, sex, body mass index, employment, smoking, drinking, long-term care insurance, pain intensity, physical performance, or psychological status.

3.2. Intervention group and control group effects
Figure 2 presents the progress of activity diary use on daily step count mean. The data shown refers only to the intervention group, as the control group was not equipped with a pedometer. Table 2 presents the pre- and post-intervention outcomes by group and the time-by-group interaction (time [baseline/pre-surgery or post-surgery] $\times$ group [intervention or control group]). There were significant differences in group measurements between the intervention and control groups in PCS total, rumination, helplessness, magnification, and PSEQ total scores ($p < .05$). There were no group-time interactions for NRS pain and mobility.

The graph shows the trends of mean step count in the intervention group, between days 7 and 28 after surgery.

3.3. Intervention effects
Table 3 presents comparisons of the outcome measurements in the intervention and control groups. In addition, the intervention group and the control group are shown (figure 3). The mean PCS total score four weeks post-surgery was significantly better for the intervention group ($14.9 \pm 9.2$) than for the control group ($21.4 \pm 12.9$; $p < .01$, standardized mean difference [SMD]: $-0.58$, 95% confidence interval [CI]: $-0.82$ to $-0.33$). Likewise, the mean scores for rumination ($8.0 \pm 4.6$ for the intervention group vs. $10.6 \pm 6.0$ for the control group; $p < .01$, SMD: $-0.47$, 95% CI: $-0.72$ to $-0.23$), helplessness ($4.2 \pm 3.0$ for the intervention group vs. $6.8 \pm 5.0$ for the control group; $p < .01$, SMD: $-0.63$, 95% CI: $-0.87$ to $-0.38$), and magnification ($2.6 \pm 2.5$ for the intervention group vs. $4.0 \pm 3.0$ for the control group; $p < .01$, SMD: $-0.51$, 95% CI: $-0.75$ to $-0.26$) four weeks post-surgery were all significantly better for the intervention than for the control group. The mean PSEQ total score four weeks post-surgery was significantly better.
for the intervention group (45.3 ± 11.8) than for the control group (41.2 ± 13.2; p < .01, SMD: 0.33, 95% CI: 0.09 to 0.57).

4. Discussion
In this study, we examined the effects of using an activity diary during post-surgical rehabilitation on pain, physical performance, and psychological factors following TKA. Post hoc tests in the intervention and control groups revealed intragroup improvements (intervention group) and intergroup differences in PCS total, rumination, helplessness, magnification, and PSEQ total scores. However, no differences in the treatment effect on pain and mobility were observed between the intervention and control groups. Therefore, post-surgical rehabilitation that included an activity diary was found to be beneficial for psychological factors after TKA.

Harkin et al. (2016) reported on the use of an activity record table, finding that, when goals were set and progress was recorded, achievement increased, and additional goals were set. In the present study, using the activity diary together with normal post-surgical rehabilitation was found to provide a sense of accomplishment while exercising self-control over the amount of activity and pain, reducing catastrophizing, and improving pain self-efficacy. Previous studies have shown that pain catastrophizing and pain self-efficacy are associated with quality of life (Vogel et al., 2019; Yazdi-Ravandi et al., 2013). Therefore, improvement in these psychological factors may lead to improvement in quality of life. In the present study, however, we did not investigate this. Future research should focus on these factors.
| Variable                        | Intervention group (n = 132) | Control group (n = 136) | p-Value | mean difference (95% CI) |
|--------------------------------|-----------------------------|-------------------------|---------|--------------------------|
| Age (years)                    | 76.4 ± 6.4                  | 76.6 ± 7.0              | 0.598   | 0.20 (-1.40 to 1.80)     |
| Female, n (%)                  | 116 (87.8)                  | 116 (85.2)              | 0.776   |                          |
| Body Mass Index                | 25.3 ± 3.6                  | 26.2 ± 3.8              | 0.982   | 0.95 (0.06 to 1.85)      |
| Nonworker (%)                  | 113 (85.6)                  | 122 (89.7)              | 0.680   |                          |
| Nonsmoker (%)                  | 126 (95.4)                  | 127 (93.3)              | 0.847   |                          |
| Nondrinker (%)                 | 113 (85.6)                  | 113 (83.0)              | 0.793   |                          |
| Non-long-term care insurance (%)|                             |                         |         |                          |
| No care (%)                    | 130 (98.4)                  | 123 (90.4)              | 0.112   |                          |
| NRS rest pain (points)         | 1.7 ± 1.2                   | 1.5 ± 1.2               | 0.290   | 0.16 (-0.74 to 0.48)     |
| NRS Walk pain (points)         | 5.5 ± 2.2                   | 5.4 ± 2.3               | 0.356   | 0.10 (-0.44 to 0.44)     |
| TUG                            | 13.2 ± 6.0                  | 17.2 ± 12.5             | 0.052   | 4.01 (-0.07 to 7.95)     |
| 10-m (s)                       | 11.8 ± 5.1                  | 13.1 ± 6.0              | 0.065   | 1.25 (-0.08 to 2.58)     |
| PCS total score (points)       | 27.4 ± 11.6                 | 27.8 ± 12.3             | 0.807   | 0.3 (-2.50 to 3.21)      |
| Rumination score (points)      | 13.2 ± 4.7                  | 13.2 ± 5.2              | 0.487   | 0.01 (-1.20 to 1.16)     |
| Helplessness score (points)    | 8.9 ± 5.2                   | 9.2 ± 5.2               | 0.701   | 0.33 (-0.91 to 1.57)     |
| Magnification score (points)   | 5.2 ± 3.3                   | 5.3 ± 3.5               | 0.537   | 0.03 (-0.77 to 0.85)     |
| PSEQ total score (points)      | 37.8 ± 12.6                 | 36.2 ± 13.5             | 0.317   | 1.58 (-4.69 to 1.52)     |

Values are expressed as means ± standard deviations.
CI: confidence interval; NRS: numeric rating scale; TUG: Timed Up & Go Test; 10-m: timed 10-m walk test; PCS: Pain Catastrophizing Scale; PSEQ: Pain Self-Efficacy Questionnaire
Kristjánsdóttir et al. (2013) also reported that feedback on daily changes in self-management improved psychological factors through a sense of accomplishment. In addition, Seminowicz et al. (2013) demonstrated that feedback improved positive emotion, pain catastrophizing, and mental health. In the present study, we aimed to help patients increase their amount of physical activity rather than focusing on pain through the introduction of the activity diary; we found that feedback encouraging a sense of accomplishment also contributed to improving pain catastrophizing and pain self-efficacy. However, it is unclear whether these goals have been achieved, because physical activity was not measured for the control group. It will be necessary to verify these factors in future studies.

However, the post-surgical rehabilitation intervention using an activity diary did not improve pain or physical performance among patients after TKA. Bloxham et al. (2016) showed that introducing pain management, step management, and physical activity for patients with chronic low back pain improved the amount of activity and acceptance of pain but not the intensity of pain. In addition, Hirase et al. (2018) reported that a psychological intervention using a diary for patients with chronic pain did not affect their physical performance such as the TUG score. Likewise, our results suggest that, in the present study, patients’ pain and physical performance after TKA were not affected by the rehabilitation intervention using an activity diary. Thus, the rehabilitation intervention using an activity diary may be effective for TKA patients in terms of improving pain catastrophizing and pain self-efficacy.

Our study had several limitations. First, this was a longitudinal study with a non-randomized design. Therefore, it was difficult to control unknown confounding factors. Second, surgery was performed between the initial and final assessments and the study does not take into account the effects of surgery. Although the surgical procedures may have varied throughout the study period, we are unaware of evidence indicating that the differences found in this study were because of differences in surgical techniques over this relatively short time interval. Third, our study was limited to four weeks, as it was conducted within the participating hospital; evaluating long-term benefits will require a long-term follow up by future studies. Fourth, therapists were non-blinded so they may have affected patients’ behavior towards the intervention. Five, in this study, the difference in TUG at baseline was 4.01 sec, and in previous studies (Yuksel et al., 2017) the minimal detectable change was reported to be 2.27 sec; thus, it is possible that physical function at baseline affects the results. Finally, the influence of medication therapy (type and quantity) was not considered.
Table 2. Pre- and post-intervention (four weeks) outcomes, by group

| Variable                  | Intervention group (n = 132) | Control group (n = 136) | Time-by-Group interaction |
|---------------------------|-----------------------------|-------------------------|---------------------------|
|                           | Pre-                        | Post-intervention (4 weeks) | Pre-                     | Post-intervention (4 weeks) | F-value | p-value |
| NRS rest pain (points)    | 1.7 ± 1.2                   | 1.1 ± 0.4               | 1.5 ± 1.2                 | 1.3 ± 0.8                    | 0.711    | 0.399   |
| NRS walk pain (points)    | 5.5 ± 2.2                   | 1.7 ± 1.5               | 5.4 ± 2.3                 | 2.3 ± 1.0                    | 3.618    | 0.057   |
| TUG (s)                   | 13.2 ± 6.0                  | 130 ± 6.2               | 17.2 ± 12.5               | 16.0 ± 9.0                    | 0.169    | 0.680   |
| 10-m (s)                  | 11.8 ± 5.1                  | 124 ± 8.3               | 13.1 ± 6.0                | 13.7 ± 8.5                    | 0.001    | 0.968   |
| PCS total score (points)  | 27.4 ± 11.6                 | 149 ± 9.2               | 27.8 ± 12.3               | 21.4 ± 12.9                   | 9.288    | 0.002   |
| Ruminination score (points) | 13.2 ± 4.7                | 8.0 ± 4.9               | 13.2 ± 5.2                | 10.6 ± 6.0                    | 8.488    | 0.003   |
| Helplessness score (points) | 8.9 ± 5.2                 | 4.2 ± 3.0               | 9.2 ± 5.2                | 6.8 ± 5.0                     | 6.851    | 0.009   |
| Magnification score (points) | 5.2 ± 3.3                | 2.6 ± 2.5               | 5.3 ± 3.5                | 4.0 ± 3.0                     | 6.092    | 0.013   |
| PSEQ total score (points) | 37.8 ± 12.6                 | 45.3 ± 11.8             | 36.2 ± 13.5               | 41.2 ± 13.2                   | 1.378    | 0.024   |

Values are expressed as means ± standard deviations.

NRS: numeric rating scale; TUG: Timed Up & Go Test; 10-m: timed 10-m walk test; PCS: Pain Catastrophizing Scale; PSEQ: Pain Self-Efficacy Questionnaire
Table 3. Multiple comparisons of intervention and control groups

|                          | Pre- (4 weeks) | Post-intervention (4 weeks) | p-value | Standard mean difference (95% CI) |
|--------------------------|----------------|-----------------------------|---------|----------------------------------|
| PCS total score          |                |                             |         |                                  |
| Intervention group (n = 132) | 274 ± 11.6     | 14.9 ± 9.2                  | *       | ††                               | -0.58 (-0.82 to -0.33) |
| Control group (n = 136)  | 27.8 ± 12.3    | 21.4 ± 12.9                | ††      |                                  |
| Rumination score         |                |                             |         |                                  |
| Intervention group (n = 132) | 13.2 ± 4.7    | 8.0 ± 4.9                   | *       | ††                               | -0.47 (-0.72 to -0.23) |
| Control group (n = 136)  | 13.2 ± 5.2     | 10.6 ± 6.0                  | ††      |                                  |
| Helplessness score       |                |                             |         |                                  |
| Intervention group (n = 132) | 8.9 ± 5.2     | 4.2 ± 3.0                   | *       | ††                               | -0.63 (-0.87 to -0.38) |
| Control group (n = 136)  | 9.2 ± 5.2      | 6.8 ± 5.0                   | ††      |                                  |
| Magnification score      |                |                             |         |                                  |
| Intervention group (n = 132) | 5.2 ± 3.3     | 2.6 ± 2.5                   | *       | ††                               | -0.51 (-0.75 to -0.26) |
| Control group (n = 136)  | 5.3 ± 3.5      | 4.0 ± 3.0                   | ††      |                                  |
| PSEQ total score         |                |                             |         |                                  |
| Intervention group (n = 132) | 37.8 ± 12.6   | 45.3 ± 11.8                 | *       | ††                               | 0.33 (0.09 to 0.57)   |
| Control group (n = 136)  | 36.2 ± 13.5    | 41.2 ± 13.2                | ††      |                                  |

Values are expressed as means ± standard deviations.

PCS: Pain Catastrophizing Scale; PSEQ: Pain Self-Efficacy Questionnaire; CI: Confidence Interval

* Significant difference in 4-week post-intervention results between groups (p < 0.05)
** Significant difference in 4-week post-intervention results between groups (p < 0.01)
† Significant difference between pre- and 4-week post-intervention results within the group (p < 0.05)
†† Significant difference between pre- and 4-week post-intervention results within the group (p < 0.01)
This can be a huge methodological flaw, considering the focus of the current study on pain and physical performance. Future studies should investigate these factors.

In conclusion, a postoperative rehabilitation program including an activity diary appeared to improve psychological factors among TKA patients in Japan. Therefore, we believe that using an activity diary is an effective and feasible supplement to post-surgical interventions for TKA patients.
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Author details
Yuki Hiraga1,2
E-mail: nakopata_nakopata@yahoo.co.jp
ORCID iD: http://orcid.org/0000-0001-3118-5987

Akira Babazono3
E-mail: nakopata_nakopata@yahoo.co.jp

Ryusei Hara4
E-mail: babazono@hcam.med.kyushu-u.ac.jp

Katsuhro Nomiyama5
E-mail: ryusei132@gmail.com

Yoshiyuki Hirakawa6
E-mail: yutsuk0903@yaho.co.jp

1 Department of Occupational Therapy, Faculty of Health Science, International University of Health and Welfare, Okawa, Japan.
2 Department of Health Sciences, International University of Health and Welfare Graduate School, Okawa, Japan.
3 Department of Health Care Administration and Management, Graduate School of Kyushu University, Fukuoka, Japan.
4 Department of Rehabilitation, Fukuoka Rehabilitation Hospital, Fukuoka, Japan.

Disclosure statement
No potential conflict of interest was reported by the author(s).

Data availability
The clinical trial registration information for this research is available online. The documents can be viewed at UMIN (https://www.umin.ac.jp/ctr/; ID number UMIN0000034250).

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