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Effects of brief self-exercise education on the management of chronic low back pain: a community-based, randomized, parallel-group pragmatic trial

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ABSTRACT

Objective

This study aimed to develop and assess additional effects of brief self-exercise education (brief-See) for individuals with chronic low back pain (CLBP). The brief-See comprised 100-minute consultation, individualized self-exercise program, and direct short teaching.

Methods

We conducted a 6-month, community-based, randomized, parallel-group trial in a community setting, and allocated into a brief-See or material-based education alone. Pain intensity (NRS, numeric rating scale), functional limitation (RDQ, Roland-Morris disability questionnaire), self-efficacy (PSEQ, pain self-efficacy questionnaire), and quality of life (EQ-5D, European quality of life-5 dimensions) were evaluated at 4, 12, and 24 weeks after the initial consultation.

Results

The brief-See did not show additional improvement over material-based education on the NRS, but it did on the RDQ, PSEQ, and EQ-5D; the estimated mean group differences in changes from the baseline were -2.1 (-3.5 to -0.7, P=0.005) on the RDQ, 6.9 (1.7 to 12.1, P=0.010) on the PSEQ, and 0.07 (0.02 to 0.12, P=0.004) on the EQ-5D.

Conclusions

The 100 minutes' education program could be more acceptable, and restores functional limitation, self-efficacy, and quality of life in addition to the effects of material-based education. This has the potential to contribute to the management of CLBP in a community.

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MAIN BODY OF THE TEXT

1. Introduction

Chronic low back pain (CLBP) is defined as low back pain persisting for at least 3 months, leading to limitation in activities of daily living and decreased quality of life.[1,2] One community-based prevalence study has shown that 20.9% of middle-aged and elderly people have CLBP.[3] Previous studies have revealed that therapist-led (e.g., physical therapist) individualized exercise therapy with psychological support (e.g., cognitive behavioural therapy) improves pain intensity and functional loss among people with CLBP.[4-9]

However, several pragmatic challenges have remained for primary care in a community. Although effectiveness of exercise for individuals with CLBP have been reported by many previous studies, most of them primarily did not provide exercise as a way of self-management. Also, total education time on self-management supports, including exercise therapy modalities, was generally set to at least 720 minutes (e.g., 12 sessions at 60 minutes per session),[10, 11] and was ranged from 250 to 4320 minutes (e.g., 6 group sessions at 15-60 minutes[12] or 36 individual sessions at 120 minutes per session[13]). The adequate dosage has remained unclear, and abundant education time does not always lead to a superior effect.[12] This is probably because a brief education program could be preferable for individuals with CLBP (i.e. in whom the condition is not so severe as to require hospitalization) in a community, mainly from the perspective of compliance.[12] This potentially means a need to develop a more acceptable to individuals with CLBP consisting of few sessions (e.g., 2 to 4 times) and short consultations (e.g., less than 100 minutes).

Besides, previous studies have not revealed the additional effects of individualized self-exercise education and those of material-based education (e.g., booklet). This is due to the nature of the study design such as group-based education[14] and inconsistency in the materials used.[15, 16] It is practically important to identify additional effects of individualized education

compared to material-based education because of the differences in system, human resources, and cost. To solve this issue, a community-based pragmatic randomized controlled trial was needed.

The purpose of this randomized controlled trial is to develop brief self-exercise education (brief-See), and to investigate the additional effects compared to that of material-based education among community-dwelling people with CLBP.

2. Materials and Methods

2.1. Participants and Setting

This trial is an ancillary study of the Circulatory Risk in Communities Survey (CIRCS). The detailed trial protocol is described in a previous paper.[17] The trial design was a community-based, 6-month, parallel-group, randomized, superiority study. A flow diagram of the study is shown in Figure 1. We systematically recruited 252 eligible persons from a community (Ikawa, located in northeastern Japan) via an annual cardiovascular risk survey as part of the CIRCS, and identified 52 participants who applied voluntarily. Details of the CIRCS protocol have been described elsewhere.[18]

The inclusion criteria for participants were as follows: i) the presence of CLBP, defined as low back pain that had been recognized in the previous 4 weeks and had persisted beyond 3 months with/without buttock pain, ii) aged 40-74 years, and iii) provision of informed consent to participate in the study. We excluded people i) with suspected specific low back pain (e.g. intervertebral disc herniation, spinal compression fracture, and rheumatoid arthritis), ii) who could not accommodate the study schedule, iii) with a scheduled move or long-term trip within a year, iv) with difficulty comprehending the Japanese language, v) with obvious cognitive impairment which would impact their ability to respond to the questionnaires, vi) with any difficulty providing consent, or vii) who were deemed ineligible by a public health or orthopaedic doctor. This study protocol was approved by the Ethics Committees of the Osaka Centre for Cancer and Cardiovascular Disease Prevention and Osaka University. The trial registration number is UMIN000024537.

2.2. Baseline and Follow-up Variables

For eligible participants, we administered baseline assessments 4 months after the

survey. The baseline assessments included pain intensity (NRS, numeric rating scale), functional limitation (RDQ, Roland-Morris disability questionnaire)[19, 20], self-efficacy (PSEQ, pain self-efficacy questionnaire)[21, 22], Quality of life and economic evaluation (EQ-5D, European quality of life-5 dimensions)[23, 24], current pain consultation use, current pain medication use, and psychological factors assessment (STarT Back, subgroups for targeted treatment back screening tool).[25-27] The STarT Back stratifies people with low back pain into 3 subgroups: low risk, medium risk, and high risk.[25] We also referred to other basic information from the survey such as age, sex, height, weight, current job, depressive symptoms ("in the past 4 weeks, little interest or pleasure in doing things" and "feeling down, depressed, or hopeless"), pain duration, and pain frequency.

The NRS, RDQ, PSEQ, and EQ-5D were measured at 4, 12, and 24 weeks after the initial intervention. The primary major outcome was the NRS, followed by the RDQ, as both have been recommended for use as outcome measures according to the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT).[28] We also assessed frequency of self-exercise, global improvement, and satisfaction with the intervention.

2.3 Allocation

Eligible participants who provided informed consent and fulfilled the inclusion criteria were randomly assigned to 1 of 2 groups in a 1:1 ratio: an intervention group (brief-See) or control group (material-based education). We employed stratified randomization in terms of age (65 years old or older/younger), sex (female/male), pain intensity (NRS, 7 or higher/lower), and the STarT Back subgroup (low risk/medium to high risk). The allocation sequence was performed by randomization of staff who were not involved in the intervention and baseline assessment. The intervention therapists were informed of the results of patient

allocation before the initial intervention. Self-administered questionnaires were applied for all assessment measures, which were submitted by mail or were collected by visiting the participants. The staff responsible for collating data were different from the intervention therapists, and they ensured that there were no missing values.

2.4. Interventions

The aim of the brief-See we developed was to foster independent exercise skills thorough self-exercise education using the following materials based on the ACE concept.[29,30] The brief-See comprised of 100-minute consultation, tailor-made self-exercise program, and individualized direct short teaching.

We provided a ready-made textbook and DVD for all participants during the intervention period. These materials were composed of 13 therapeutic self-exercises: standing trunk extension, standing trunk lateral flexion, prone press up into lumbar extension, seated hamstring stretches, kneeling hip flexor stretches, a seated postural exercise (scapular retraction with external rotation), quadruped opposite arm and leg raises, a single-leg bridging exercise, an abdominal drawing-in exercise, walking with good posture, aquatic exercise, cycling, and bicycle ergometer (Figure 2). The “ACE concept”, proposed by Matsudaira, is a basic concept of exercise therapy for CLBP. The ACE concept consists of 3 types of exercise: type I (Alignment), optimizing postural alignment; type II (Core muscles), strengthening deep muscles; and type III (Endogenous activation), activating endogenous substances in the body[29,30]. All types of exercises can be combined. More detailed information on the types of exercise and recommended dosage are available in the protocol.[17]

In the brief-See, the initial consultation was performed 2 weeks after the baseline

measurements were taken. The following sessions were conducted at 2, 4, and 12 weeks after the initial consultation. The last two sessions were conducted at the participants' request. The initial and second sessions lasted up to 30 minutes, and the last two sessions lasted up to 20 minutes. The total amount of consultation time could range between 60 and 100 minutes. At the initial consultation, the intervention therapists used a pain-provocation test to confirm that the participants could identify subjective changes before and after self-exercise, provided information about individualized recommended self-exercises (which exercises should be selected), individually advised on how to correctly perform these self-exercises, and informed the participants of the relationships between their functional limitations and the recommended exercises (possible mechanisms).

At the following session or sessions, the participants shared their progress with one of the two intervention therapists (a physical therapist and a doctor), who in turn provided additional advice with regard to exercise form and modification of the exercise combination, as well as encouragement to continue the self-exercises. Participants met with the same intervention therapist for all of their sessions. Both therapists had experience in treating musculoskeletal disorders and specialized exercise therapy skills (more than 10 years of experience).

2.5. Statistical Methods

The required sample size was calculated in advance. We planned a 1:3 repeated-measures design, which led to a reduction in sample size.[31] Considering a dropout rate of 15%, we estimated 24 participants per group to achieve a power level of 0.80 and a significance level of 0.05. This sample size allowed detection of a true group difference of 1.5 points on the NRS and 2.0 points on the RDQ as a moderate effect for community-dwelling people.[5,9,32,33]

We used a generalized linear mixed-effects model to analyse changes in NRS, RDQ, PSEQ, and EQ-5D over time. A model was constructed on the basis of group (the brief-See and the material-based education), time (baseline, 4, 12, and 24 weeks after the initial consultation), and group-by-time interaction. This model estimated least square group mean changes at all measurement times from the baseline. Based on intention-to-treat principles, the main data analyst, one of the intervention staff, analysed all data according to the original allocation without any consideration of the level of attendance. The main interest of this analysis was a group-by-time interaction effect on the changes at 4, 12, and 24 weeks from the baseline on the NRS, RDQ, PSEQ, and EQ-5D. At each follow-up time, we also estimated the group differences in exercise frequency based on the proportion of participants performing 1 day or 4 days or more of self-exercise, global improvements in back pain, global satisfaction with the self-exercise education, and 30% improvement from the baseline, which is also an IMMPACT-recommended outcome measure for the NRS and RDQ. The statistical software used was SAS Version 9.4 (SAS Institute Inc., Cary, NC), and the level of significance was set at an alpha level of 0.05.

223 3. Results

224 **3.1 Basic Characteristics at Baseline**

225 As shown in Table 1, there were no significant group differences in characteristics at
226 baseline. The calculated overall standard deviations for the outcomes were 1.99 for the NRS,
227 4.05 for the RDQ, 10.87 for the PSEQ, and 0.132 for the EQ-5D score. Compared to non-
228 participants in the present study, participants were older, with reported shorter pain duration,
229 higher severe pain, and less frequently office workers than non-participants (see the
230 Supplemental Table 1).

231

232 At the follow-up sessions at 4, 12, and 24 weeks, 1 participant (4%) in the brief-See and 3 to
233 4 participants (12 to 15%) in the material-based education did not respond to the follow-up
234 questionnaire. In the brief-See, all participants completed the essential sessions including the
235 initial consultation and 2-week follow-up. Two to three participants (8 to 12%) did not attend
236 the optional sessions at 4 and 12 weeks.

237

238 **3.2. Within-Group Changes from the Baseline**

239 Changes from the baseline on the NRS, RDQ, PSEQ, and EQ-5D are shown in Figure
240 3 (see the Supplemental Table 2 for more details). For within-group differences, all pain
241 parameters showed significant improvement at 4, 12, and 24 weeks from the baseline in the
242 brief-See. The estimated mean changes from the baseline with 95% confidential intervals
243 were -1.9 (-2.5 to -1.2, P<0.001) on the NRS, -2.3 (-3.3 to -1.3, P<0.001) on the RDQ, 8.2
244 (4.6 to 11.8, P<0.001) on the PSEQ, and 0.08 (0.04 to 0.11, P<0.001) on the EQ-5D.
245 However, the NRS was the only pain parameter to show significant improvement in the
246 material-based education. The mean changes in the material-based education were -1.3 (-2.0
247 to -0.4, P<0.001) on the NRS, -0.3 (-1.3 to 0.8, P=0.61) on the RDQ, 1.3 (-2.4 to 5.0, P=0.48)

on the PSEQ, and 0.01 (-0.03 to 0.04, P=0.74) on the EQ-5D.

3.3. Additional Effects of the brief-See on the Material-Based Education

The brief-See did not show additional improvement on the NRS over the material-based education: the estimated mean group difference was -0.6 (-1.5 to 0.3, P=0.22). However, with regard to NRS changes at the 4-week follow-up, a 30% reduction was more frequent in the brief-See compared to the material-based education (39.1% versus 69.2%; P<0.05) (see the Supplemental Table 4). The brief-See, however, showed additional favourable changes on the RDQ, PSEQ, and EQ-5D over the material-based education. The estimated mean group differences were -2.1 (-3.5 to -0.7, P<0.05) on the RDQ, 6.9 (1.7 to 12.1, P<0.05) on the PSEQ, and 0.07 (0.02 to 0.12, P<0.05) on the EQ-5D. Standardized effect sizes (Cohen's d) for the point-estimated values were 0.519 on the RDQ, 0.635 on the PSEQ, and 0.530 on the EQ-5D. We analyzed the sub-samples of 41 participants, excluding non-exercisers (less than once a week in the first 4 weeks), i.e. 17 participants of the material-based education and 24 participants of the brief-See. The results did not vary materially. (see the Supplemental Table 3 for more detail).

3.4. Changes in Self-Exercise Frequency and Subjective Evaluations

As shown in Figure 4 (see the Supplemental Table 4 for more detail), the proportion of brief-See performing self-exercise at a frequency of 4 days or more per week was 42.9% (15.9 to 69.9, P<0.05) more than the material-based education at 4 weeks after the initial consultation. The group differences were no longer statistically significant thereafter. We also assessed the effects of exercise frequency, categorized into three levels (less than 1 per week, 1 to 4 times per week, and more than 4 times per week), and found significant improvements were observed only for 4 times or more per week within the group. Almost 80% of

273 participants in the brief-See reported moderate or greater subjective global improvement in
274 back pain, and more than 90% of that reported moderate or greater satisfaction with the self-
275 exercise education at all period. These proportions were significant greater in the brief-See
276 than in the material-based education. Additional analysis revealed that favourable changes in
277 the RDQ were greater in younger participants, and favourable changes for the PSEQ were
278 smaller in pain consultation users than non-users (see the Supplemental Tables 5 and 6).
279

4. Discussion

This community-based randomized controlled trial for the management of CLBP revealed that the brief-See, comprising of individualized self-exercise program and low frequency 100-minute direct teaching, did not show additional improvement in pain intensity (NRS) compared to material-based education, but did in functional limitation (RDQ), self-efficacy (PSEQ), and quality of life/economic evaluation (EQ-5D). The brief-See boosted self-exercise frequency during the initial 4 weeks, and participants reported greater subjective improvement and satisfaction with their education.

There are several previous trials of group or individualized exercise therapy using larger time to investigate the additional effects on other interventions.[14,16,34] In a previous study of individuals with CLBP (average age: 82 years, severity at baseline: RDQ, 12 points; NRS, 5 points), self-management program, a 630 minutes' group class including exercise therapy modalities (7 weekly sessions of 95 minutes per session), did not show any superiorities to self-care books at reducing functional limitation nor at reducing pain intensity and self-efficacy at 12, 24, and 48 weeks.[14] In another previous study of individuals with CLBP (age: 48 years, severity at baseline: RDQ, 9 points; NRS, 6 points) to investigate the effectiveness of general exercise compared to material-based education, an exercise class consisting of 900 minutes of systematic stretching (12 weekly group sessions of 75 minutes per session) was shown to be superior to self-care books at reducing functional limitation (RDQ: -1.5 points at 26 weeks), but not significantly better at reducing pain intensity (NRS: -0.4 points at 26 weeks; not assessed neither self-efficacy nor quality of life).[16] In another previous study of individuals with CLBP (age: 50 years, severity at baseline: RDQ, 12 points; NRS, 6

304 points), additional individualized education program, comprising 250 minutes' low
305 frequency sessions delivered by psychologist and physical therapist onto physicians'
306 primary care, showed moderate reduction in functional limitation (RDQ: -2.0 points at
307 24 weeks), small reduction in pain intensity (NRS: -0.5 points at 24 weeks) and no
308 improvement in quality of life (not assessed self-efficacy).[34] In the above trials, the pre-
309 post difference in the control group (booklet or primary care alone) showed a significant
310 improvement in pain intensity, but without additional effect. The latter two studies
311 observed an additional effect on functional limitation. Report on self-efficacy and
312 quality of life were incomplete. The present pragmatic trial of individuals with CLBP
313 (age: 65 years, severity at baseline: RDQ, 5 points; NRS, 5 points) showed significant
314 improvements with the latter trial, i.e., RDQ, -2.0 points at 24 weeks; and NRS, -0.2
315 points at 24 weeks; accompanied by significant improvements of self-efficacy and
316 quality of life. These results suggested that a total of 100-minute low-frequency
317 therapist-led self-exercise education might have additional favourable effects on
318 functional limitation, as well as on self-efficacy and quality of life, compared to
319 material-based education for individuals with CLBP. Pain reduction, functional
320 recovery, and self-efficacy enhancement are important to prevent disability.[28, 35, 36] The
321 brief-See did not show obvious additional improvement on pain intensity compared to
322 the material-based education as did the several previous studies.[14,16,34] The improvement
323 on pain intensity, however, could be due to not only pain reduction *per se* but also
324 restriction of activities to avoid pain exacerbation.[37] That situation made it difficult to
325 detect a difference in pain intensity between the two groups.
326 Although optimal education time and content for CLBP remain uncertain, a previous
327 study has shown that greater education time or abundant educational content are not

always superior at ameliorating outcomes.[12] A randomized controlled trial of 348 primary care patients with low back pain (age: 52 years, severity at baseline: RDQ, 8 points; NRS, 8 points) investigated the effects of active management education. In addition to primary care, additional education was divided into 3 strategies: 15 minutes of unrelated health education (control), 15 minutes of active management education, and 30 minutes of active management + a total of 240 minutes of physical therapy. As a result, patients receiving the latter two education strategies showed significant improvements in both pain intensity and functional limitation compared to the controls, although there was no significant difference between recipients of the latter two education strategies. They mentioned that a low-dose and/or low-compliance education strategy seems to be most appropriate in a primary care setting. Our sub-analyses about effects of exercise frequency suggested that exercise frequency of 4 times or more per week during the first 4 weeks suggested to have favorable outcomes. The present 100 minutes' education program could be a valuable option for community-dwelling individuals with CLBP.

The consensus meeting of pain has recommended to evaluate global improvement and satisfaction as core outcome.[28] The previous study reported that global improvement tended to be higher in primary care + education (67%) and primary care + education + physical therapy (81%) than in primary care + 15-minute unrelated education (14%) at 24 weeks, but little differences for satisfaction (42% v.s. 31% v.s. 35%).[12] Another study reported for global improvements that 51% in stretching classes, 51% in Yoga class, and 20% in self-care books at 26 weeks.[16] In the present study, we observed 80% or more global improvement and 90% or more global satisfaction in the brief-See at 4 to 24

weeks, and the both were 30 to 40% higher than the material-based education. This seems to be a preferable result, while global improvement and satisfaction may be pointed out as placebo effects caused by interaction with therapists.

The strengths of our study include several unique characteristics. First, our proposed self-exercise education was brief (low frequency and 100 minutes duration or less) compared to most previous studies, and was also a pragmatic and concrete education program for the general community. Second, this study systematically recruited the target population and provided a clear explanation of the base population used in our analysis, it helped to specify adequate target population to apply the present results. Third, the same textbooks and training DVDs were provided for the both groups, so that this study could detect the additional effect of the brief-See. Forth, this intervention consolidated of several types of exercise therapy and cognitive-behavioral therapy is not special technique, the generalizability of intervention, therefore, is high. For example, it can be performed by a general physical therapist who has experience in orthopedic rehabilitation. On the other hand, participants and therapists were not blinded, which could affect the patient's response. Diminishing the ability to generalize findings may be a limitation in the present study. Conversely, participants and therapists were not blinded and potentially influenced patient responses. It could be a limitation to diminish our ability to generalize our findings.

Among community-dwelling people with CLBP, this pragmatic randomized controlled trial found additional favourable effects of the brief-See for functional limitation, self-efficacy, and quality of life, without significant additional reduction in pain intensity

compared to material-based education. The brief-See could be a feasible self-management support option on disability prevention for individuals with CLBP in a community.

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411 **Conflict of Interest**

412 None.

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515 **TABLES**

516 Table 1. Characteristics of participants at baseline

	Material-based	brief-See	P-value
N	26	26	-
Age, years	66, 64-71	65, 62-70	0.613
Male, %	38.5	34.6	0.779
Height, m	157, 149-166	156, 149-162	0.803
Body mass index, kg/m^2	24.4, 21.0-24.4	23.9, 21.1-26.1	0.690
Depressive symptom, %	4.0	11.5	0.307
Job, %			
No job	27.0	34.6	0.570
Homemaker	23.1	23.1	1.000
Farmer	19.2	23.1	0.740
Other office worker	30.8	19.2	0.346
Pain duration, %			
3 months to 1 year	3.9	0.0	0.322
1 to 5 years	42.3	53.8	0.415
5 to 15 years	19.2	26.9	0.520
15 years or longer	34.6	19.2	0.219
Pain frequency, %			
1 day or less per week	11.5	11.5	1.000
1 to 3 days per week	19.2	38.5	0.131
4 days or more per week	69.2	50.0	0.164
Current pain consultation use, %	46.2	38.5	0.583
Current pain medication use, %	26.9	23.1	0.755
Psychometric factor (STarT Back)			
Total, points	2.5, 1-4	2.8, 2-4	0.553
Subtotal, points	1.0, 0-2	1.3, 0-2	0.280
Risk severity, %			
Low risk	65.4	65.4	1.000
Medium risk	34.6	30.8	0.773
High risk	0.0	3.8	0.322
Pain intensity (NRS)			
Rating, points	5.1, 4-6	5.4, 4-7	0.680
Severity, %			
Mild (0 to 3)	19.2	19.2	1.000
Medium (4 to 6)	57.7	46.2	0.415
Severe (7 to 10)	23.1	34.6	0.368
Functional limitation (RDQ)			
Total, points	5.1, 1-9	4.7, 1-7	0.736
Self-efficacy (PSEQ)			
Average, points	4.4, 3.7-5.2	4.0, 3.1-5.0	0.171
Quality of life (EQ-5D)			
Quality of life score, points	0.83, 0.71-0.90	0.79, 0.76-0.90	0.336

Proportions for category variables, and average, lower-upper quartiles for continuous variables; Statistical significance was set at P-value < 0.05.
STarT Back, subgroups for targeted treatment back screening tool; NRS, numeric rating scale; RDQ, Roland-Morris disability questionnaire; PSEQ, pain self-efficacy questionnaire; EQ-5D, Euro quality of life 5 dimensions; brief-See, brief self-exercise education.

517

518 **FIGURE LEGENDS**

519 Figure 1. Flow diagram of the present study

520 Flow chart illustrating recruitment, enrolment, allocation, and follow-up.

521

522 Figure 2. Basic concept and self-exercise variations for management of chronic low back
523 pain: the ACE concept

524 The ACE concept consists of three types of exercise: type I (Alignment), optimizing
525 postural alignment; type II (Core muscles), strengthening deep muscles; and type III
526 (Endogenous activation), activating endogenous substances.

527

528 Figure 3. Mixed-effect model of additional effects of brief self-exercise education (brief-See)
529 on pain-related outcomes changes at 4, 12, and 24 weeks from baseline compared to material-
530 based education

531 Asterisks (*) indicate statistical significant of group x time interaction effect at each
532 time point ($P<0.05$). Mean within-group changes and mean between-group differences are
533 shown as estimated average values and 95% confidential intervals of pain-related outcomes
534 in 4 to 24 weeks from baseline. Pain intensity, functional limitation, self-efficacy, and quality
535 of life were evaluated by using numeric rating scale (NRS), Roland-Morris disability
536 questionnaire (RDQ), pain self-efficacy questionnaire (PSES), and Euro quality of life 5
537 dimensions score (EQ-5D), respectively. Detailed information on which this table based is
538 shown in the Supplemental Table 2.

539

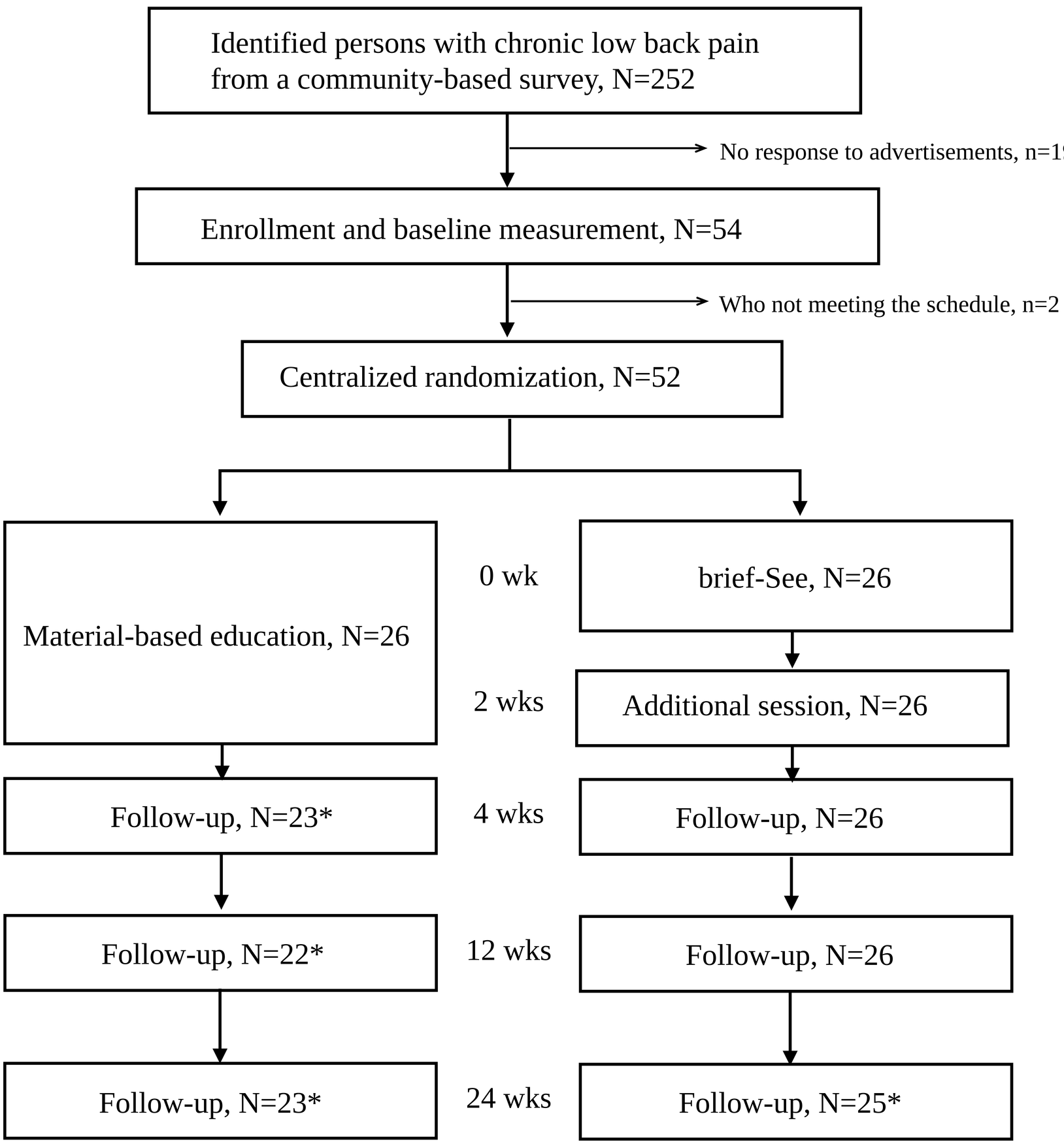
540 Figure 4. Group differences between brief self-exercise education (brief-See) and material-
541 based education in frequency of self-exercise, global improvement and satisfaction at 4-, 12-,
542 and 24-week after the initial consultation

543 Asterisk (*) indicates statistical significant of group x time interaction effect (P<0.05).

544 Detailed information on which this table based is shown in the Supplemental Table 3.

545

Figure 1



*Due to no answer to follow-up questionnaires

Figure 2

ACE Let's try "ACE"!!

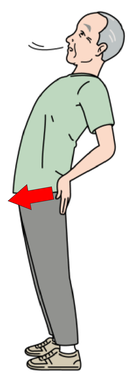
Type I

Alignment

Optimizing postural alignment

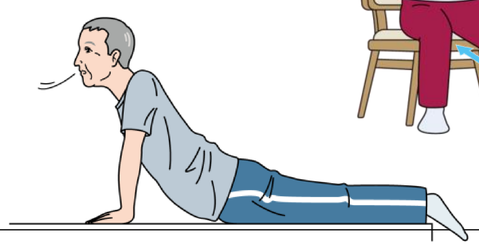
Stretching exercises help to improve defects of spinal discs or joint, and inadequate posture.

Standing trunk extension



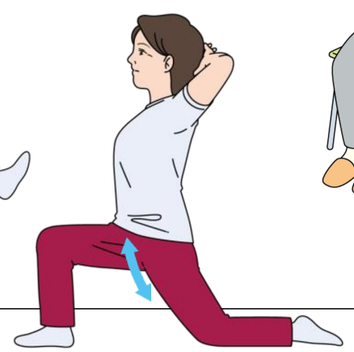
Standing trunk lateral flexion

Prone press up into lumbar extension

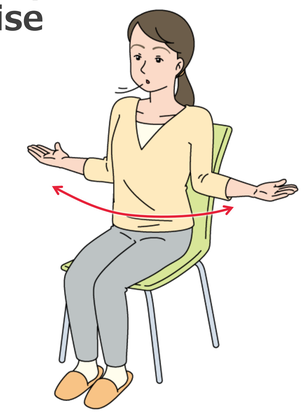


Seated hamstring stretches

Kneeling hip flexor stretches



Seated postural exercise



Type II

Core muscles

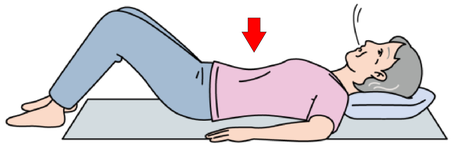
Strengthening core muscles

Trunk stabilizing exercises help to prevent recurrent back pain.

Quadruped opposite arm and leg raises

Single-leg bridging exercise

Abdominal drawing-in exercise



Type III

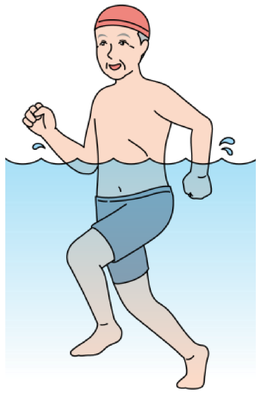
Endogenous activation

Aerobic exercises such as walking help to activate endogenous substances. This leads to positive effects on mind as well as body.

Walking

Keep your good posture, and walking faster!!

Aquatic exercise

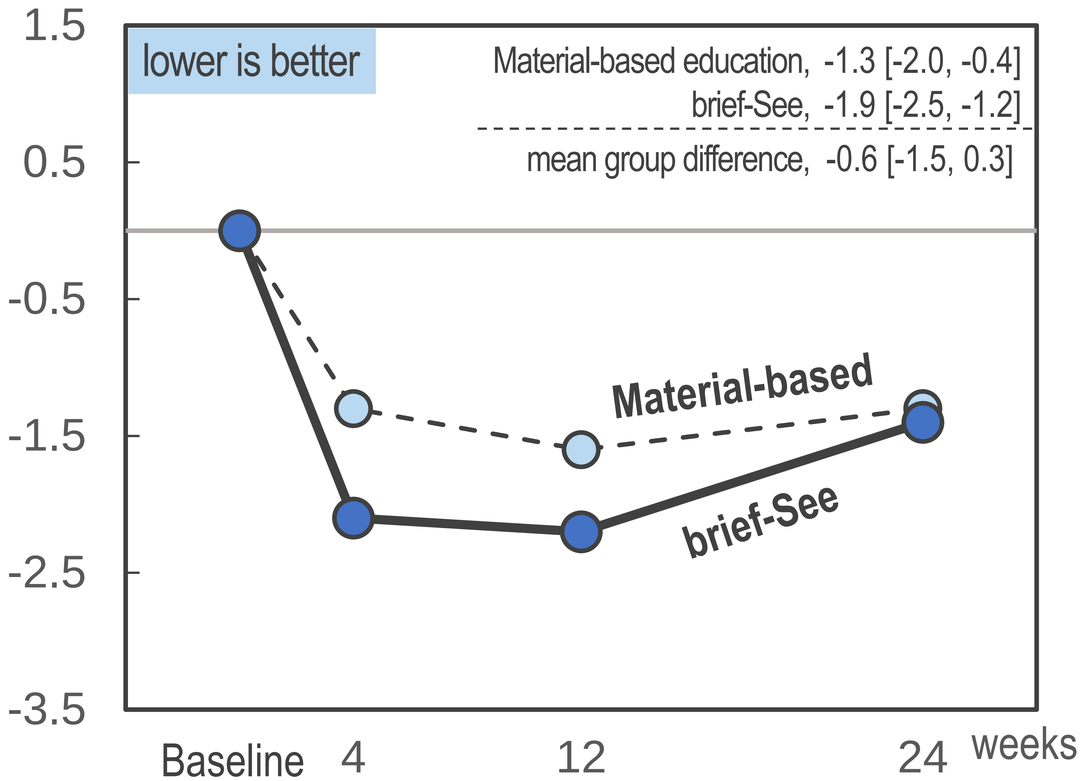


Cycling

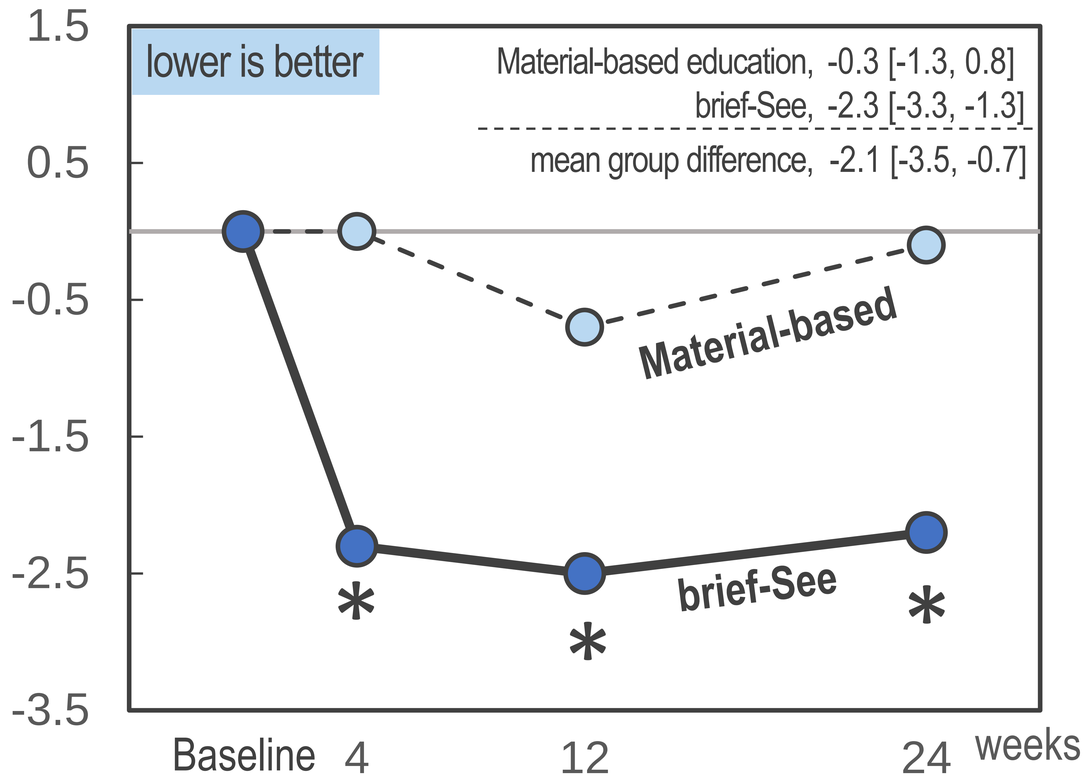
Bicycle ergometer

Figure 3

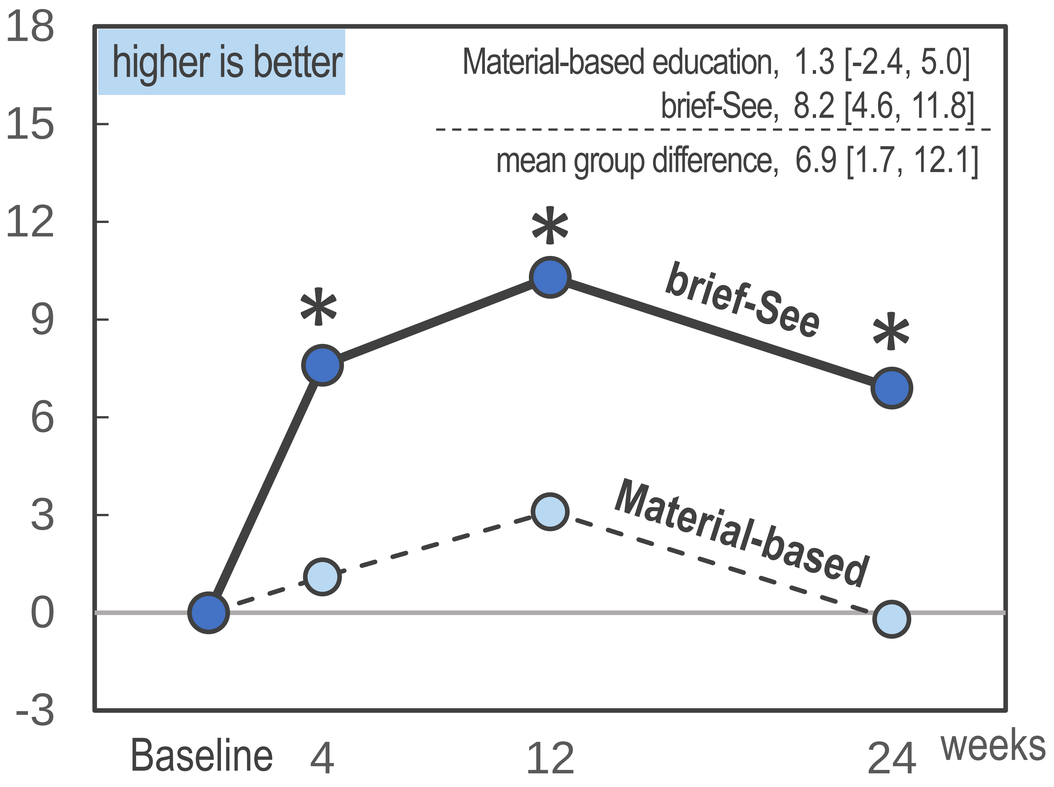
Pain intensity (NRS)



Functional limitation (RDQ)



Self-efficacy (PSEQ)



Quality of life (EQ-5D)

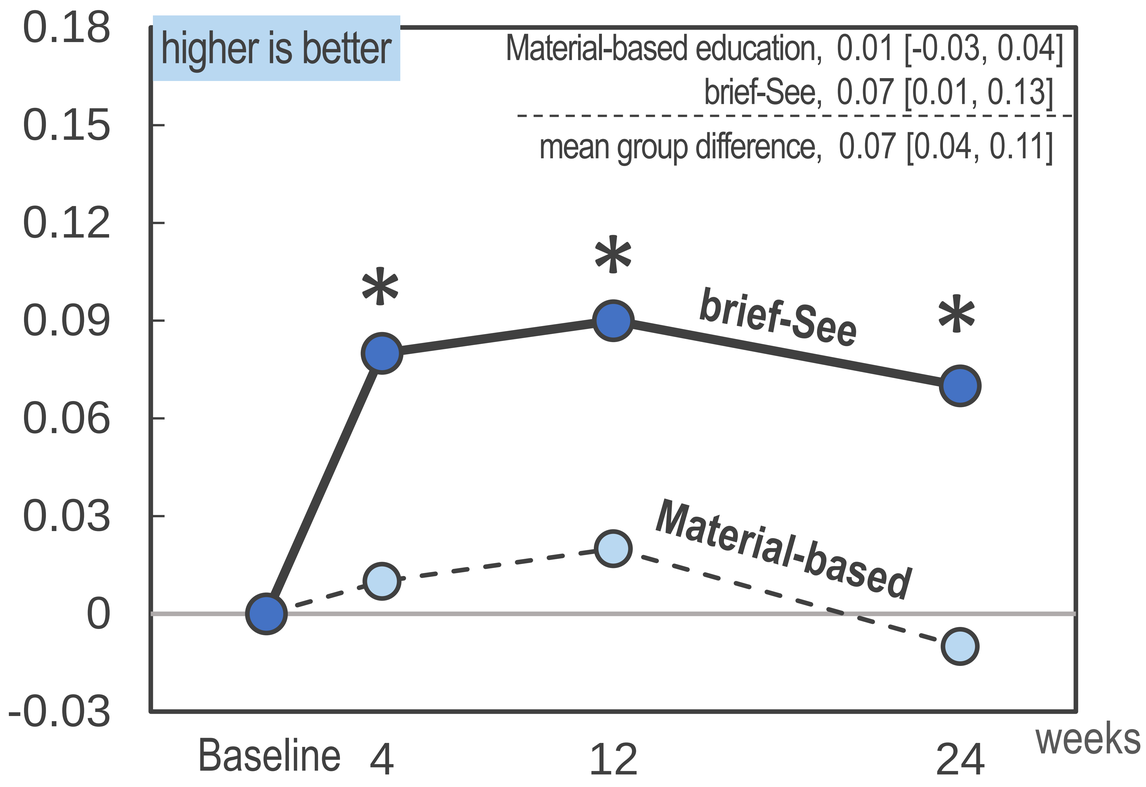


Figure 4

Evaluation item	Time	Group	Proportion
Frequency of self-exercise			
4 days or more per week	4-week	Material-based	30.4
		brief-See	73.1 *
	12-week	Material-based	36.4
		brief-See	42.3
	24-week	Material-based	34.8
		brief-See	32.0
1 day or more per week	4-week	Material-based	73.9
		brief-See	92.3
	12-week	Material-based	86.4
		brief-See	88.5
	24-week	Material-based	78.3
		brief-See	76.0
Global improvement for back pain			
Improved or more	4-week	Material-based	34.8
		brief-See	76.9 *
	12-week	Material-based	54.5
		brief-See	84.6 *
	24-week	Material-based	52.2
		brief-See	80.0 *
Global satisfaction for the education			
Satisfied or more	4-week	Material-based	56.5
		brief-See	96.2 *
	12-week	Material-based	68.2
		brief-See	96.2 *
	24-week	Material-based	47.8
		brief-See	92.0 *

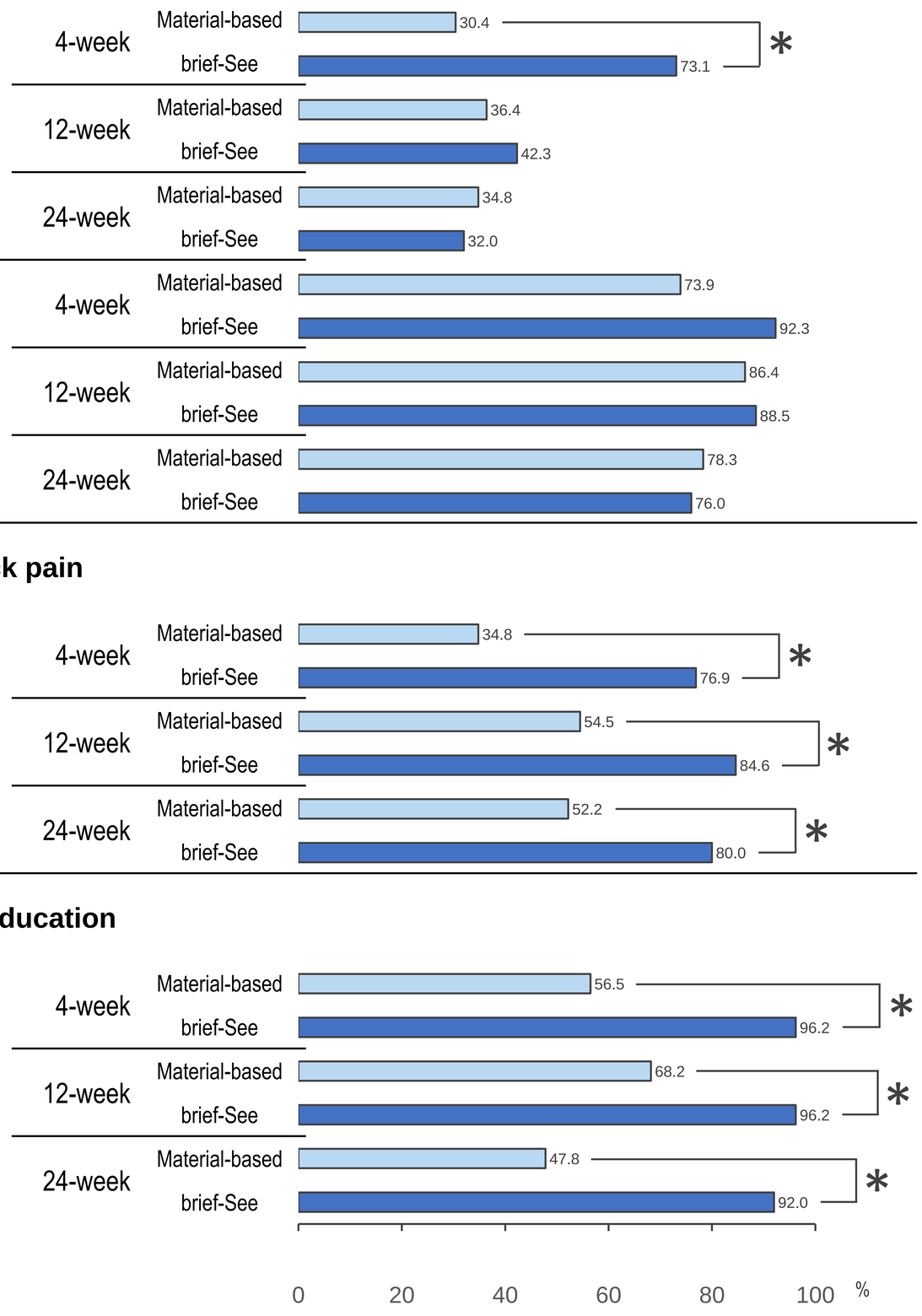


Figure X

Let’s track your exercise!!

Please record what types of exercise you actually have done. “ACE” is a treatment concept for low back pain, and classifying exercise into three types: optimizing postural alignment, strengthening core muscles, and endogenous activation.

ACE Let’s try “ACE”!!

[EXAMPLE]

	Day X
A	
C	
E	

Please mark 👍 if you have done relevant exercises more than 1 time per day. If not, please mark 🪙 .

Please mark 👍 if you have done walking in good posture, and reach a total of 5 minutes per day. If not, please mark 🪙 .

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
A	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙
C	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙
E	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙

	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
A	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙
C	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙
E	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙	👍 🪙

NOTE