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SECTION: ORIGINAL ARTICLE

The effectiveness of a theory-based educational intervention on promoting physical activity-related behavior in patients with chronic low back pain: a randomized controlled trial based on health center (TRA -BAC)

A eficácia de uma intervenção educacional baseada em teoria na promoção do comportamento relacionado à atividade física em pacientes com dor lombar crônica: um estudo controlado randomizado baseado em centro de saúde (TRA -BAC)

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Abstract

Aims: this study aimed to evaluate the effectiveness of a Theory of Reasoned Action (TRA) – based educational program in promoting physical activity (PA) behavior in Chronic low back pain (cLBP) patients.

Methods: the Reasoned Action Theory-based Back Care program was a randomized controlled trial conducted at a Health Service Center. It compared the TRA construct's effectiveness against a control group. Eighty patients referred to Shahid Beheshti University of Medical Sciences in Tehran were randomly assigned to either the TRA-based intervention group (n=40) or the control group (n=40). Both groups completed self-reported questionnaires at baseline, 3-month, and 6-month follow-ups. Additionally, a checklist was used to assess lumbar spine range of motion test skills using the modified Schober test.

Results: a significant interaction effect was observed between "group" and "test time" factors (p<0.001). A total of 77 cLBP patients were evaluated, with a mean age of 41.0±4.2 years in the intervention group and 39.0±3.5 years in the control group. While both groups initially aligned with TRA constructs (p>0.05), the intervention group demonstrated significant improvements in PA-related behavior at both 3-month (p<0.001) and 6-month (p<0.001) follow-ups. The mean score for PA behavior in the intervention group (8.4 ± 1.1) was significantly higher compared to the control group (3.2±1.0) (p<0.001). Similarly, pain intensity was significantly lower in the intervention group (3.8±2.2) compared to the control group (4.3±3.0) (p<0.001). Furthermore, the intervention group showed a significant improvement in lumbar spine range of motion test skills (p<0.05). The lumbar spine range of motion test skills of the intervention group significantly decreased (p<0.05).

Conclusions: the TRA-BAC program demonstrates promise in improving PA-related behavior and reducing pain in cLBP patients through targeted educational strategies based on the TRA framework.

Keywords: theory of reasoned action, health behavior, low back pain, educational intervention, theory of reasoned action.

Resumo

Objetivo: este estudo teve como objetivo avaliar a eficácia de um programa educacional baseado na Teoria da Ação Racionalizada (TRA) na promoção do comportamento de atividade física (AF) em pacientes com dor lombar crônica (cLBP).

Métodos: o programa *Reasoned Action Theory-based Back Care* foi um ensaio clínico randomizado realizado em um Centro de Serviços de Saúde. Comparou a eficácia do método TRA com um grupo de controle. Oitenta pacientes encaminhados para a Universidade de Ciências Médicas Shahid Beheshti, em Teerã,

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foram aleatoriamente designados para o grupo de intervenção baseado em TRA (n=40) ou para o grupo de controle (n=40). Ambos os grupos preencheram questionários autorrelatados no início do estudo, com acompanhamentos aos três e seis meses. Além disso, uma lista de verificação avaliou as habilidades de teste de amplitude de movimento da coluna lombar usando o teste de Schober modificado.

Resultados: foi observado um efeito de interação significativo entre os fatores "grupo" e "tempo de teste" (p<0,001). Foram avaliados 77 pacientes com cLBP, com idade média de 41,0±4,2 anos no grupo intervenção e 39,0±3,5 anos no grupo controle. Embora ambos os grupos inicialmente estivessem alinhados com os construtos TRA (p>0,05), o grupo de intervenção demonstrou melhorias significativas no comportamento relacionado à AF nos acompanhamentos de três (p<0,001) e seis meses (p<0,001). A pontuação média do comportamento de AF no grupo intervenção (8,4±1,1) foi significativamente maior em comparação ao grupo controle (3,2±1,0) (p<0,001). Da mesma forma, a intensidade da dor foi significativamente menor no grupo intervenção (3,8±2,2) em comparação ao grupo controle (4,3±3,0) (p<0,001). Além disso, o grupo de intervenção mostrou uma melhora significativa nas habilidades de teste de amplitude de movimento da coluna lombar (p <0,05), enquanto as habilidades de teste de amplitude de movimento da coluna lombar do grupo de intervenção diminuíram significativamente (p<0,05).

Conclusões: o programa TRA-BAC demonstra ser promissor na melhora do comportamento relacionado à AF e na redução da dor em pacientes com cLBP por meio de estratégias educacionais direcionadas baseadas na estrutura TRA.

Palavras-chave: teoria da ação racional, comportamento de saúde, dor lombar, intervenção educativa, teoria da ação racionalizada.

Introduction

Pain, a major global health concern, significantly impacts disability and productivity, particularly in individuals with chronic low back pain (cLBP) (1). According to the World Health Organization, cLBP is one of the seven most prevalent musculoskeletal disorders, impacting millions worldwide (2).

The cLBP is a complex interplay of pain, behavior, and bio-psychosocial factors (3). Chronic non-specific lumbar pain, the most common musculoskeletal disorder, disproportionately affects all populations (4). Defined as pain, muscle tension, or stiffness localized below the ribs and above the gluteal folds, with or without sciatica, lasting for 12 weeks or more, cLBP can be debilitating (5). Global cLBP prevalence is estimated at 19.6% among individuals aged 20 to 59 years (6).

Understanding the distribution and determinants of cLBP pain is crucial for effective intervention at both individual and population levels (7). Focused and tailored educational prevention strategies must consider the complex interplay of biological, psychological, socio-demographic, and lifestyle factors that influence pain and its outcomes (7). Current cLBP management programs require effective behavioral support interventions, with physical activity playing a key role (8). physical activities are encouraged as the principal part of treatment for cLBP pain (4). Educational interventions can significantly reduce musculoskeletal disorder costs through effective knowledge dissemination (9).

The Theory of Reasoned Action (TRA) provides a valuable framework for understanding health behavior determinants (3). It posits that individuals weigh the consequences of their actions before engaging in or avoiding specific behaviors (10). This theory posits that subjective norms significantly influence healthy behavior choices (10). Research has consistently demonstrated TRA's effectiveness as an attitude model for understanding and predicting health behaviors (11).

This study aimed to investigate the impact of a TRA-based intervention program on promoting physical activity (PA) behavior in cLBP patients referred to comprehensive health care centers. We hypothesized that this program, by targeting TRA-based predictors, could effectively increase stretching exercises and reduce musculoskeletal disorder burden among cLBP patients.

Materials and method

This was a parallel randomized controlled trial that was finished in Tehran, Iran. This randomized controlled trial (RCT) enrolled 80 patients diagnosed with chronic low back pain (cLBP) in comprehensive health service centers located within the Shargh and Shemiranat districts of Tehran, Iran. These centers, affiliated with Shahid Beheshti University of Medical Sciences, serve a geographically diverse population with varied socio-demographic characteristics. Patients were voluntarily recruited from August 2019 to February

2020 and attended eduational sessions.

The inclusion criteria were minimum ability to read and write in Persian, and diagnosed with clbp for at least 12 weeks, and mentally competent. The exclusion criteria were mental retardation, history of spinal surgery, acute low back pain, deep sensation/fracture, or spinal inflammation, congenital tumors or malformations, rheumatic diseases, history of spinal contraction, psychological problems, pregnancy, infection and depression.

The TRA-BAC intervention is a four-session educational program designed based on the principles of the TRA and informed by prior research (12, 13) (**Figure 1**).

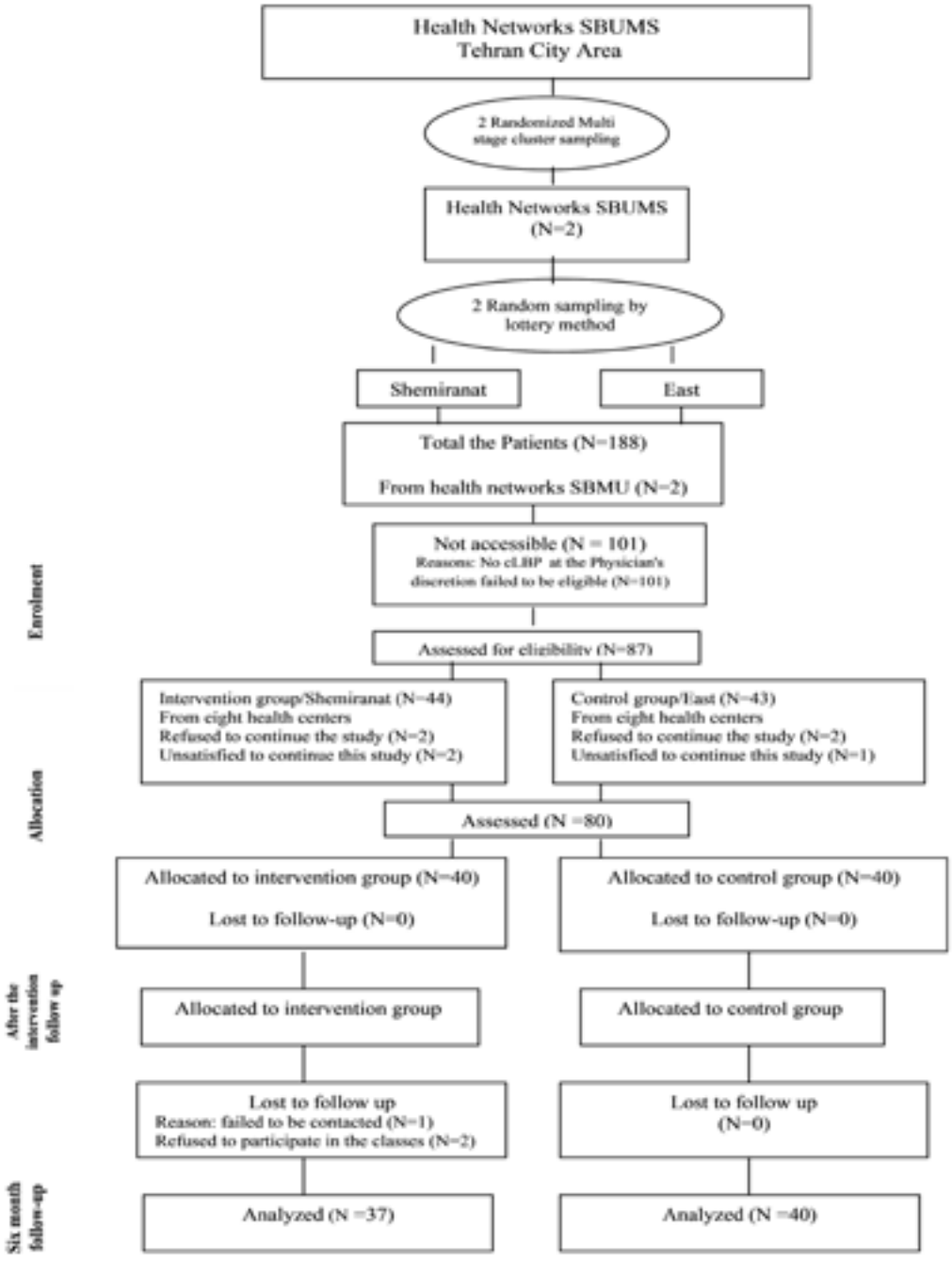

Figure 1. The TRA-BAC intervention the flow diagram of patients referring to comprehensive health service centers of Tehran in Iran.

Delivered at one-week intervals by two trained physical and health educators, each session lasts 40 minutes, with the first focusing on (14-16):

- *Knowledge and awareness*: Familiarizing participants with back exercises for managing musculoskeletal pain.
- *Educational methods*: Utilizing lectures, slide shows, and role-playing to enhance engagement.
- The second and third sessions, each with 20-minute segments, address:
- *Behavioral determinants*: Identifying factors influencing physical activity (PA) performance, including misconceptions, motivation, and normative beliefs.
- *Change strategies*: Discussing strategies to address these determinants, such as correcting misconceptions, building positive attitudes, and enhancing perceived social pressure to engage in PA.
- The final session focuses on:
- *Skill training*: Practicing specific low back pain exercises for targeted muscle groups.
- *Motivation and adherence*: Exploring techniques to maintain motivation and overcome potential barriers to PA adherence.
- Additional key elements of the intervention include:
- *Limited group size*: 6-8 participants per session to facilitate individual attention and interaction.
- *Comprehensive materials*: Providing a CD containing the complete training program for continued learning and reinforcement.
- *Dosage*: Instructing the intervention group to perform back, shoulder, leg, and knee exercises for 40 minutes daily, four times a week.
- *Control group*: Individuals in the control group received the TRA-BAC program six months after the study completion to ensure equal access to the intervention.

The primary outcome were improvement in physical activity PA-related behavior, measured by a validated PA questionnaire. The Secondary outcomes were enhancement in back care intention attitudes (e.g., attitude towards PA, perceived benefits, and costs), improvement in normative beliefs (perceived social pressure to engage in PA), increase in subjective norms (beliefs about others' expectations for PA engagement), reduction in pain intensity, assessed using the Visual Analog Scale (VAS) and improvement in lumbar spine range of motion test skills, assessed using a modified Schober test.

The measurements taken were:

- *Demographic questionnaire*: Collected baseline information on participants' age, gender, education, occupation, marital status, disease duration, treatment duration, and pain intensity at rest.
- *TRA-based PA behavior questionnaire*: Assessed PA-related behavior, attitude towards PA, perceived benefits and costs of PA, normative beliefs, and subjective norms. This questionnaire was validated in previous studies (12).
- *Visual Analog Scale (VAS)*: Measured pain intensity on a 10-cm scale, with 0 representing no pain and 10 representing the worst imaginable pain. Patients were asked to mark their perceived pain level on the scale. The VAS has well-documented validity and reliability, and its translation and validation in Persian have been published (18,19, 20).
- *Modified Schober test*: Assessed lumbar spine range of motion, a marker of flexibility and potential for improved back function. This checklist was completed by trained personnel and has established validity and reliability (17).
- The following validity criteria were adopted:
- *Face validity*: Assessed through qualitative interviews with 15 cLBP patients. All their recommendations were incorporated into the questionnaires.
- *Content validity*: Assessed by a panel of 12 experts from various fields (health education, psychology, psychometrics, physical medicine, and pain). All items had a Content Validity Index (CVI) of ≥0.79, indicating acceptable content validity.

Reliability was assessed using Cronbach's

alpha coefficient. All subscales of the TRA-based questionnaire had alpha values between 0.80 and 0.95, indicating good internal consistency.

All questionnaires were completed by participants in both groups at baseline and 6-month follow-up. The modified Schober test was also administered at baseline and follow-up.

The primary result was to improve PA-related behavior. The secondary consequences were enhancement in back care intention attitudes, normative beliefs, subjective norms, and evaluation results are performed. The TRA-BAC questionnaire specifically assesses the constructs of the TRA relevant to physical activity behavior in cLBP patients (12). It is based on eight subscales derived from the TRA framework and utilized a 10-item, 4-point Likert-type scale (1=strongly disagree, 4=strongly agree) with higher scores indicating stronger agreement with the statements (**Figure 2**).

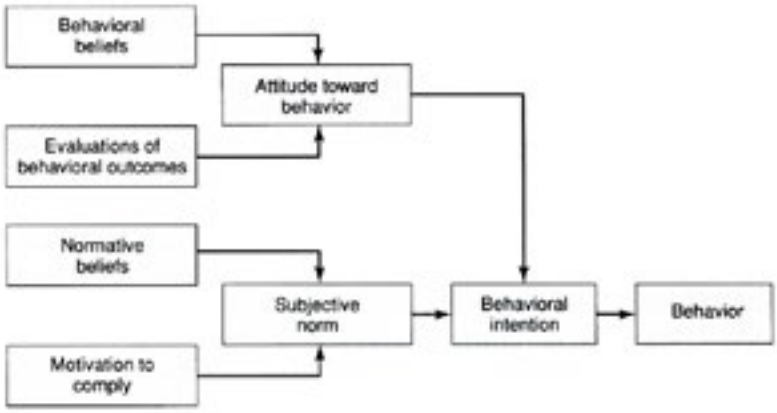

Figure 2. Schematic representation of Reasoned Action Theory (Ajzen, 2015). The TRA framework is based on the Theory of Reasoned Action (TRA) by which health behavior predicting factors have been shown (10).

Content validity was obteined by a panel of 15 experts in health education, health promotion, and pain medicine. They reviewed the questionnaire items against relevant literature and interview themes, ensuring comprehensive coverage of the TRA constructs. The Content Validity Index (CVI) for the TRA-BAC scale was 0.89, exceeding the acceptable threshold. Additionally, the Content Validity Ratio (CVR) was calculated as an additional measure of content relevance, further supporting the questionnaire's validity.

Internal consistency was assessed through a preliminary study on 30 cLBP patients using Cronbach's alpha coefficient. The TRA-BAC scale demonstrated good internal consistency, with an alpha of 0.87.

The sample size was determined based on a two-sample t-test for independent means with the following parameters: Effect size: Small effect size (Cohen's d = 0.60) based on a previous study (12, 21). Power: 0.80 to ensure adequate detection of the hypothesized effect size; significance level: alpha = 0.05; dropout rate: 10% to account for potential participant attrition. Using G*Power software version 3.1.9.6, the calculated minimum sample size per group was 39.6. To account for potential losses and refusals, the final sample size was set at 40 participants per group (intervention and control), resulting in a total of 80 participants for the study (22).

Participants were stratified by geographic district (East and Shemiranat) to ensure balanced representation across these diverse populations. Ten health networks were randomly selected within each district (multi-stage sampling). Two health networks were randomly assigned to either

the intervention group (Shemiranat Center) or the control group (East Center). This cluster method ensures participants within each health network share similar characteristics and minimizes contamination between groups. Within each health network, eligible cLBP patients were randomly assigned to either the intervention or control group by a blinded researcher. This ensures unbiased allocation and minimizes selection bias.

The physician confirming diagnosis and the researcher responsible for randomization were blinded to group assignment to minimize potential bias in participant selection and intervention delivery.

A total of 80 cLBP patients were recruited, with 40 assigned to the intervention group and 40 to the control group. Forty participants in the intervention group and 37 in the control group completed the study at the 6-month follow-up.

The study was conducted and reported following the Consolidated Standards of Reporting Trials (CONSORT) guidelines to ensure transparency and reproducibility.

Statistical methods

Quantitative data were analyzed using SPSS version 21. Baseline comparisons: Independent t-tests were conducted to compare baseline characteristics (demographic and TRA-based questionnaire scores) between the intervention and control groups. This comparison ensured that the groups were initially comparable on key variables. Repeated-measures multivariate analysis of variance (MANOVA) was used to assess the main effects of time (pre-test, 3-month follow-up, and 6-month follow-up) and group (intervention vs. control) on primary and secondary outcome measures (e.g., PA behavior, pain intensity, etc.). This allows for examining changes over time within and between groups and identifying potential interactions between time and group.

Informed consent was obtained from all participants. Confidentiality was maintained by not recording participant names on questionnaires. The study was approved by the ethics committee of Tarbiat Modares University (approval code: IR.MODARES.REC.1398.163). The study was registered with the Iranian Registry for Clinical Trials (TCTR20190728001) on 28 July 2019. The study was conducted in accordance with the Helsinki Declaration. The authors confirm that they will not share individual participant data without their consent.

Results

A total of 80 eligible cLBP patients completed the study, with 40 in the control group and 37 in the intervention group. Baseline demographic characteristics between the groups were comparable, as shown in **Table 1**. There were no statistically significant differences in age, gender, education level, or other relevant variables ($p = 0.65$).

Prediction constructs and physical activity behavior: **Table 2** presents the mean scores of TRA-based prediction constructs related to physical activity at baseline, 3-month, and 6-month follow-up. Initially, both groups had similar scores on these constructs ($p > 0.05$). This means their attitudes, beliefs, and intentions towards PA were similar. However, an independent t-test revealed a significant improvement in these scores in the intervention group after the educational program ($p<0.001$). This suggests the intervention positively influenced their thoughts and intentions regarding PA. Repeated-measures ANOVA confirmed a significant effect of time on prediction construct scores within both groups ($p<0.001$). In Time Effects, with the overall effect of time, both groups experienced changes in predictor construct score over time. However, the specific patterns of change differed between the groups. Additionally, a significant interaction between time and group was observed, indicating differential changes over time between the intervention and control groups ($p<0.001$). - Interaction Effect: The interaction between time and group was also significant, indicating that the intervention group's scores changed differently over time compared to the control group. This highlights the distinct impact of the intervention. Consistent with the improvements in prediction constructs,

the intervention group demonstrated significantly higher PA levels compared to the control group at the 3-month follow-up ($p<0.001$). This difference remained significant throughout the study. Consistent with the improvements in prediction constructs, the intervention group demonstrated significantly higher levels of PA compared to the control group at the 3-month follow-up. This difference remained significant throughout the study, suggesting that the intervention's effects on PA behavior were sustained over time.

TABLE 1 – Demographic characteristics of the studied cLBP patients of both groups at the initial of the study.

	Intervention (N=37)	**Control (N=40)**	P-value
Age (years), n (%)			0.65*
30-39	6(16.2)	7(17.5)	
40-49	10(27.1)	11(27.5)	
50-59	9(24.3)	9(22.5)	
60-69	6(16.2)	7(16.2)	
70-79	6(16.2)	6(16.2)	
Marriage status, n (%)			0.56ǂ
Single	2(5.4)	3(7.5)	
Married	33(89.2)	36(90)	
Widow	-	-	
Divorced	2(5.4)	1(2.5)	
Occupation Status, n (%)			0.22ǂ
Housewife`	16(43.2)	17(42.5)	
Employed	21(56.8)	23(57.5)	
Duration of the disease (in months)	12.3±8.6	12.3±7.2	0.63ǂ
Duration of treatment (in months)	14±11	17.9±11	0.22ǂ
Degree of back pain at rest	3.2±3.1	04.35±2	0.06ǂ
Degree of back pain, while moving	5.7±3.1	6.19±2.1	0.43ǂ

cLBP, chronic low back pain. *T- test, ǂChi-square test

TABLE 2 – The contrast of each group over time in terms of predictors of physical activity behavior at 3-time points (Baseline, 3- and 6-month follow-up) of the study.

Variables	**Time follow-up**	**Intervention (N=37)**	**Control (N=40)**	**Time difference**	**Group difference** P- value*	**Time & group interaction**
Intention	Baseline	3.4±1.2	3.5±1.2	<0.001	0.001	0.004
	3-month	9.3±1.3	4.3±2.0			
	6-month	5.0±0.6	4.0±1.0			
	P-valueǂ	<0.001	0.465			
Attitude	Baseline	44.0±323.0	25.3±10.0	<0.001	0.002	0.002
	3-month	62.0±31.1	48.6±12.1			
	6-month	68.1±18.7	46.1±12.2			
	P-valueǂ	< 0.001	0.218			
Behavior beliefs	Baseline	14.5±3.0	8.0±2.4	<0.001	0.003	0.003
	3-month	19.6±3.7	9.0±1.4			
	6-month	16.3±2.7	9.3±3.0			
	P-valueǂ	<0.001	0.323			

TABLE 2 – The contrast of each group over time in terms of predictors of physical activity behavior at 3-time points (Baseline, 3- and 6-month follow-up) of the study (cont.).

Variables	Time follow-up	Intervention (N=37)	Control (N=40)	Time difference	Group difference P- value*	Time & group interaction
Motivation to comply	Baseline	9.4±1.3	9.0±2.0	0.005	0.001	0.005
	3-month	11.3±1.0	9.0±2.0			
	6-month	12.0±1.2	10.0±1.0			
	P-value‡	<0.001	0.423			
Normative beliefs	Baseline	8.0±2.0	8.2±0.5	<0.001	0.002	0.002
	3-month	11.3±2.0	8.2±0.5			
	6-month	13.1±1.0	8.2±0.4			
	P-value‡	<0.001	0.425			
Evaluation outcome behavior	Baseline	8.1±3.1	8.1±1.4	<0.001	0.001	0.001
	3-month	12.2±1.0	9.1±1.7			
	6-month	11.3±1.0	9.1±2.4			
	P-value‡	<0.001	0.407			
Subjective norms	Baseline	40.6±18.8	40.0±06.4	<0.001	0.001	0.001
	3-month	68.1±15.8	53.0±10.3			
	6-month	72.3±13.0	48.0±10.2			
	P-value‡	<0.001	0.232			
PA behavior	Baseline	3.4±1.0	2.5±1.0	<0.001	0.001	0.001
	3-month	4.2±1.0	3.3±1.0			
	6-month	8.3±1.0	3.2±1.0			
	P-value‡	<0.001	0.232			

PA, Physical activity. Values are presented as Mean±SD. *Repeated measure analysis test, ‡independent t-test.

Pain intensity, measured by VAS, was initially similar between the groups (**Table 3**). However, after 6 months, the intervention group reported significantly lower pain severity compared to the control group (p<0.001). Lumbar spine range of motion, assessed using the modified Schober test, also improved significantly in the intervention group compared to the control group (p < 0.05) (**Table 4**).

TABLE 3 – Evaluation of cLBP severity among two at three-time points (Baseline, 3- and 6-month follow-up) of the study.

Variables	Time follow-up	Intervention (N=37)	Control (N=40)	Time difference	Group difference P-value*	Time & group Interaction
Degree of cLBP at rest	Baseline	3.2±3.1	4.3±2.0	0.058	0.008	0.069
	3-month	4.8±2.1	5.2±2.1			
	6-month	3.7±2.2	4.2±3.0			
	P-value‡	<0.001	0.387			
Degree of cLBP while moving	Baseline	5.7±3.1	6.1±2.1	0.053	0.001	0.025
	3-month	7.4±2.5	7.5±2.4			
	6-month	5.6±3.2	6.4±2.4			
	P-value‡	<0.001	0.294			

cLBP, chronic low back pain. Values are presented as Mean±SD. *Repeated measure analysis test, ‡independent t-test.

TABLE 4 – Comparison of the mean score of lumbar spine range of motion between two groups at three time points (Baseline, 3- and 6-month follow-up) of the study

Variables	Time follow-up	Intervention (N=37) Mean±SD	Control (N=40) Mean±SD	Time difference	Group difference P- value	Time & group Interaction
Range of motion of the lumbar spine	Baseline	8.6±11.3	8.9±11.2	<0.001	0.001	0.003
	3-month	16.3±11.8	11.8±11.7			
	6-month	13.5±17.0	10.2±18.4			
	P-value‡	<0.001	0.344			

Values are presented as Mean±SD. ˙Repeated measure analysis test, ‡independent t-test

Discussion

The present study showed that educational intervention based on TRA predictive constructs including intention, attitude, subjective norms, normative beliefs, and outcome behavior can significantly improve PA behavior in cLBP patients in 3 and 6 months after the intervention. The results of the present study showed that the intervention program can significantly increase the predictive structures in the intervention group. Therefore, it may be argued that the improvement in PA behavior in the intervention group was due to improvements in these predictive constructs.

The results of the present study confirmed that the educational program was able to strengthen and increase PA behavior in the intervention group. This was the strength of the present study comprehensive acquaintance with the importance of Subjective norms and normative beliefs for regular daily PA, which with this program, caused the patients in the intervention group to feel that their health is important for their family and friends (23).

According to the findings of the Carvalho study, misbeliefs can be due to disability for patients with cLBP (24).The present study determined standards for performing exercises, people accept or reject norm-based behavior. Thus, according to the Sonnet study, social support is a predictor of PA (25). Encouraging patients to engage in PA was considered in the educational program. The same thing happened in education to persuade patients because it increased PA in group discussions.

In study Chavo, like the present study, confronted patients with cLBP with misbeliefs (26). In this study, the intervention group received a motivational educational program based on one of the constructs of TRA, which showed that this motivation has increased compared to the control group and became statistically significant (27). The results of studies show that patients with cLBP are more motivated to engage in healthy behaviors when they visit health centers (28). Other studies have confirmed the conclusion that successive interventions have led to the correction of normative beliefs (28).

The results of research by Airaksinen et al. showed that people who attended more sports classes were more aerobically prepared. Levels of daily activities in this group were significantly improved after the intervention. Therefore, similar to the present study, in addition to the existence of various studies that indicate the predictability of health behavior (29). Findings of the present study, contrary to studies(29)., showed that behavioral intentions were predictors of PA behavior (30).

Akbari's study showed that regular yoga exercises reduce pain and disability and increase lumbar curvature in women with chronic lumbar disc herniation (31). This increase was also observed in the present study by evaluating the range of motion of lumbar spine curvature between the two groups the help of the modified Schubert test, but more studies are needed to test the effectiveness of different exercises, so that their comparative benefits in terms of Make the type of educational and non-educational interventions

clearer. Because in Akbari study, unlike the present study, there was no significant difference between the two methods in terms of reducing pain, reducing the intensity of ability, reducing anxiety, and changing the range of motion of lumbar flexion. Along with the results of other studies in this field and according to the available evidence, it is recommended to conduct a comprehensive study with advanced tools.

The present study significantly improved the performance of patients with this disease. The results of this study are consistent with the findings of Honesty et al., who examined the effect of strengthening the central stabilizing muscles the spine in water on the severity of lumbar pain and lordosis (32). It is also consistent with similar findings of the research of Rainville et al. (33) and Farhpour et al. (34,35) and is not consistent with the findings of Moon et al. (36).

Conclusions

This study suggests that a TRA-based intervention targeting intention, attitude, subjective norms, normative beliefs, and outcome evaluation can enhance PA behavior in cLBP patients. Patients with positive beliefs about PA consequences were more likely to hold favorable attitudes and perceive higher social pressure to engage in PA. Evaluation of PA behavior and normative beliefs appear to have a stronger influence on PA intentions compared to other constructs.

These findings highlight the importance of addressing cognitive, behavioral, and psychological factors in PA interventions for cLBP patients. The educational program effectively improved prediction constructs related to PA in the intervention group. These changes in beliefs and attitudes were associated with increased PA behavior in the intervention group. The intervention had a significant and lasting effect on both PA-related beliefs and actual PA behavior.

Future research should confirm these findings through larger-scale studies and explore the effectiveness of interventions specifically targeting evaluation and normative beliefs.Developing interventions based on these key predictors may provide a more targeted and effective approach to promoting PA in cLBP patients.

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Authors' contributions

MHD conducted whole study and had full access to all data for analysis. AH supervised this study and also she was involved in drafting the article

FP verified the data analysis. All authors confirmed the final version of the manuscript.

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