Title

Improved interoceptive awareness in chronic low back pain: A comparison of Back School versus Feldenkrais method

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Abstract

PURPOSE: To determine the efficacy of the Feldenkrais method in relieving pain in patients with chronic low back pain (CLBP) and the improvement of interoceptive awareness.

METHOD: This study was designed as a single-blind randomized controlled trial. Fifty-three patients with a diagnosis of CLBP for at least 3 months were randomly allocated to the Feldenkrais (mean age 61.21±11.53 years) or Back School group (mean age 60.70±11.72 years). Pain was assessed using the visual analog scale (VAS) and McGill Pain Questionnaire (MPQ), disability was evaluated with the Waddel Disability Index, quality of life was measured with the Short Form-36 Health Survey (SF-36), and mind-body interactions were studied using the Multidimensional Assessment of Interoceptive Awareness Questionnaire (MAIA). Data were collected at baseline, at the end of treatment, and at the 3-month follow-up.

RESULTS: The two groups were matched at baseline for all the computed parameters. At the end of treatment, there were no significant differences between groups regarding chronic pain reduction ($p=0.290$); VAS and MAIA-N sub scores correlated at Tend ($R=0.296$, $p=0.037$). By Friedman analysis, both groups experienced significant changes in pain ($p<0.001$) and disability ($p<0.001$) along the investigated period.

CONCLUSIONS: The Feldenkrais method has comparable efficacy as Back School in CLBP.

Keywords: exercise, low back pain, Feldenkrais method, interoceptive awareness, quality of life, proprioception.

Introduction

Low back pain is a common and disabling disorder in Western society. It is managed using a range of intervention strategies, including pharmacological interventions, such as drug therapy, and nonpharmacological interventions, such as rehabilitation and surgery. Many studies attest to the high frequency of back pain in society: 70% to 85% of all persons suffer from pain at some point in their lives. The annual prevalence of back pain ranges from 15% to 45%, with the point prevalence averaging 30% [1][2] and only 5% to 10% of patients developing persistent back pain [3]. Further, as the population ages over the coming decades, the number of individuals with low back pain (LBP) and its duration and severity are likely to increase substantially.

An alternative rehabilitative intervention suggests that a behavioral or biopsychosocial approach lays the foundation for gaining insight into how pain becomes a persistent condition [4]. The chief assumption is that pain and pain disability are influenced by organic pathology, if found, and by biological, psychological, and social factors that act on the 3 response systems of pain: psychophysiological reactivity; overt pain behaviors; and attention, attributions, and expectations [5].

Interoceptive awareness, which is the sense of the physiological condition of the body, might have significant function in mediating self-rated health, particularly in the perception of pain and especially in the maintenance of chronic pain [6][7]. Of the many rehabilitation approaches to chronic low back pain (CLBP), the Back School (BS) has been reported to be effective [8]. BS, due to the validity of its educational exercises, enhances quality of life and reduces disability in LBP [9][10] and improves mental well-being.

One alternative and innovative rehabilitative approach in the treatment of CLBP is mind-body therapy, such as the Feldenkrais method, which modifies interoceptive attentional styles regarding pain [11][12][13][14]. The Feldenkrais method is taught in 2 parallel forms: awareness through movement (conducted as a group exercise) and functional integration (one-on-one approach) [15]. Positive experiences from Feldenkrais treatment have been reported, especially concerning movement ability and body awareness [16] [17], but few studies have examined the value of interoceptive awareness and body awareness during rehabilitation for CLBP [9].

No randomized controlled trials have been conducted to determine the efficacy of the Feldenkrais method in patients with CLBP, in contrast to established traditional rehabilitation approaches, such as the Back School (BS). Thus, we aimed to measure the efficacy of the Feldenkrais method in relieving pain in patients with CLBP compared with a standardized rehabilitative method BS as the primary outcome. As a secondary measure, we determined the significance of interoceptive awareness during rehabilitation treatment with regard to the perception and improvement of chronic pain.

Material and Methods

The study was designed as a single-blind randomized controlled trial with a 3-month follow-up. An independent examiner (a physiatrist) performed a standardized, blinded assessment at baseline and at the follow-up to minimize his potential bias when performing the clinical examination and recording data. To maintain the state of masking and limit the risk of biased observations, the examiner did not have access to the clinical or radiological examination results.

This study was approved by the University Sapienza of Rome ethical committee (registration number 3297, protocol number 845/14, ClinicalTrials.gov identifier NCT02231554). All participants signed informed consent forms after receiving detailed information about the study's aims and procedures per the Declaration of Helsinki. The study was performed in the outpatient rehabilitation center of Policlinico Umberto I Hospital, Rome, Italy. Subjects aged between 30 and 75 years with a diagnosis of chronic nonspecific LBP for at least 3 months were eligible for inclusion. The exclusion criteria were: acute LBP; LBP due to specific causes; concomitant rheumatological, neurological, or oncological disease; previous back surgery; severe cognitive impairments; and pregnancy.

Seventy-two patients were screened in the study from September 2014 to March 2015, 53 of whom were enrolled and then randomized to the Feldenkrais group (FG, N=26, 83% females, mean age 61.21±11.53 years, BMI 25.55±2.62, VAS 5.3 ±2.7) or Back School group (BG, N=27, 81% females, mean age 60.70±11.72 years, BMI 26.18±2.62, VAS 5.4±4.1) at a 1:1 ratio according to a computer-generated randomization list (flowchart, Figure 1). Allocation was concealed for patients and examiner: each patient's allocation was on a computer generated

list in which the allocation was covered by a path that was removed after patient's inclusion in the study. Examiner was unaware of group allocation".

[Insert Figure 1 about here]

We proposed for 10 intervention sessions both rehabilitation groups. Each session lasted 1 hour and was performed twice per week for 5 weeks to ensure better compliance and participation of working patients. Each group comprised 4 or 5 participants.

All patients were instructed not to take any new medication of NSAIDs during the study protocol and not to undergo other rehabilitation approaches (those who did so dropped out of the study). During the rehabilitation sessions, no patients reported any increase in pain that led to treatment discontinuation or an increase in current drug therapy. We excluded patients who attended fewer than 9 lessons.

The Feldenkrais method is based on awareness through movement lessons, which are verbally guided explorations of movement, conducted by a physiotherapist who is experienced and trained in this method. Each lesson encouraged the exploration of movements that were related to a specific function (eg, tying one's shoes) to enhance one's awareness of how movements are performed and to invite the participant to investigate how he can expand his actions and functional abilities. The lessons addressed habitual patterns of movement and sought to expand a person's self-image. By exploring new movement sequences, attention is directed to the body parts that the subject might not be aware of or might have excluded from his functioning (Figure 2). The method aimed to increase self-awareness, broaden one's repertoire of movements, and improve function in a context in which the entire body cooperates in executing movements and in which maximum efficiency is achieved with minimal effort.

The 10 lessons were structured to enhance trunk mobility in improving overall function without pain.

Segment 1 focused on helping participants learn how to pay attention to and develop awareness of their "breathing" while lying on a mat in a supine position. Segment 2 focused on the perception of the trunk while the subject was lying on a mat in a supine position with regard to gaining control of the pelvis; freeing the hip joints; and improving ankle, knee, and hip function. Segment 3 focused on improving flexion-extension and learning

self-care while the subject switched from a supine to prone position. Segment 4 focused on improving flexion-extension and rotation of the trunk, learning self-care, and acquiring control of the shoulders. Segment 5 was directed toward improving balance and walking. The lessons were sequential, and each lesson dealt with themes from the previous session. Lessons returned to earlier functional themes, building on them as the program progressed. Patients could take a break when they wished. The exercises were always described verbally and were never demonstrated by the physical therapist, typically for this rehabilitative approach.

[Insert Figure 2 about here]

The Back School program was a mild 5-week intervention that was administered by a multidimensional professional team. Considering previous efficacy trials on BS for LBP [9][10], we developed a rehabilitative program as follows. In the first session, participants were provided with general anatomical information on the spine and its function and ergonomic positions in daily living. Teachers (physicians) also gave information on chronic pain and LBP, the related psychological aspects, and stress management.

Physiotherapists conducted another 9 sessions that included exercises that were based on diaphragmatic breathing (10 minutes), self-stretching the trunk muscles (10 muscles), erector spine reinforcement, abdominal reinforcement, and postural exercises (3 series of 10 repetitions for each exercise, with 3 minutes of rest) (Figure 3). Explanations were provided regarding the ergonomic use of the spine in daily life and its related self-correction. Further, techniques on how to cope with spine-stressing positions during work were also illustrated. The trainer was instructed to emphasize simulations in daily living environments and actively involve patients during the lessons. Pamphlets were given to participants with further explanations on theoretical aspects; exercise protocols that were proposed during the rehabilitation sessions; and information with images of the ergonomic use of the spine in daily life and recreation, such as the recommended posture at work, the correct way to carry weights, and the proper manner which certain daily activities should be engaged, such as dressing, eating, and bathing.

[Insert Figure 3 about here]

Sociodemographic and clinical data were collected at baseline. The following outcome measures were assessed at baseline (T0), at the end of the treatment program (Tend), and at the 3-month (T3m) follow-up.

The primary outcome measure was the reduction in pain per the visual analog scale **(VAS**), a simple, robust, sensitive, and reproducible instrument that enables patients to express their pain intensity as a numerical value. Patients were asked to mark the point that corresponded to their perceived pain intensity on a 10-cm line, with 0 indicating the absence of pain and 10 reflecting the most severe pain [18].

Specifically, CLBP was evaluated using the **McGill Pain Questionnaire (MPQ)** and **Waddel Disability Index (WI)**. The MPQ is the most common tool for assessing clinical and experimental pain [19] and comprises 3 classes (sensory, affective, and evaluative) of word descriptions (total of 78), grouped into 20 subclasses each containing 2 to 6 words that are used by patients to articulate their subjective pain experiences. Patients have to choose 1 word from each subclass if a word in that class properly reflects their current pain. From the analysis of the questions is achieved the pain rating index (PRI) and 4 subscales sensory (PRIS), affective (PRIA), evaluative (PRIE), and a miscellaneous category (PRIM) (PRIS scores range from 0 to 35,50 points; PRIA scores range from 0 to 21,30 points; PRIE scores range from 0 to 4,60 points; and PRIM scores range from 0 to 16,10 points) the number of words that are chosen (NWC scores range from 0 to 80,50 points); the present pain intensity (PPI), based on a 5-point intensity scale (PPI scores ranges from 0 to 5 points); and the relationship between sensory and affective scores (S/A). Each word in the PRI has an assigned value, based on its placement in the subclass. The total score ranges from 0 (minimum pain) to 78 (maximum pain).

The MPQ has been translated into many languages, including Italian [20]. The Waddel Disability Index (WDI) is a 9-item scale for assessing disability that evaluates daily living activities, such as sitting, traveling, standing, walking, lifting weights, sleeping, social life, sex, and putting on or removing footwear. Patients answer questions with only positive or negative statements (yes/no). The final score is calculated by adding up the positive items and ranges from 0 to 9 (maximum score). A score > 5 indicates significant disability [21].

The **Multidimensional Assessment of Interoceptive Awareness Questionnaire (MAIA)** is a new 32-item multidimensional self-reporting survey that evaluates key aspects of mind-body interactions [22]. It comprises 8 scales that measure various modes of attention toward bodily sensations. These scales, each containing 3 to 7

items, were defined as Noticing (N), Not Distracting (ND), Not Worrying (NW), Attention Regulation (AR), Emotional Awareness (EA), Self-Regulation (SR), Body Listening (BL), and Trusting (T). Each item is rated from 0 (never) to 5 (always); for all scales (including "Not Distracting" and "Not Worrying"), the highest score (= 5) indicates the highest level of awareness, and each scale is scored separately. The MAIA has been validated in English, Spanish, and German and has been translated into many languages, including Italian [23]. We have used the translated version made up by the Prof. PhD Giorgia Committeri. [24].

As a secondary outcome, the **Short Form (SF)-36 Health Survey** was administered to evaluate quality of life. The SF-36 is a generic health scale that collects practical, reliable, and valid information about patients' functional health and well-being [25][26] and comprises 36 items, subdivided into physical and mental health. The physical health is represented by 4 domains: physical function (PF), physical role (PR), bodily pain (BP), and general health (GH). Emotional health includes mental health (MH), social function (SF), emotional role (RE), and vitality (VT). Each scale ranges from 0 to 100 (worst and best health state, respectively). The validity and reliability of the Italian version of SF-36 have been well documented [27].

The mean and standard deviation were calculated for continuous data, whereas the median and interquartile range (third quartile value - first quartile value) were calculated for clinical ordinal data. Student's t-test was used to compare continuous data between groups, Mann-Whitney U-test was performed to compare data between groups, and Friedman's analysis was used to compare data along the 3 assessment times in each group. Chi-squared test was used to compare the number of cases between groups. Spearman's coefficient R was computed to assess correlations. The critical alpha level was set to 0.05 for all analyses. The sample size was calculated, based on the preliminary data: the visual analog scale (VAS) was used to rate pain, because it was the chief reference scale for the primary outcome. To have a power of analysis of 90% and $\alpha = 0.05$, we determined that each group needed at least 16 patients. Considering a possible dropout rate of 20%, we aimed to enroll 20 patients in each group. Our approach also considered the minimal clinically important difference for the VAS [28]. An intention to treat approach has been followed in terms of including into the analysis also patients who performed less sessions than those planned but that were retested at the end of treatment (indipendently if completed or not). Conversely, patients who abandoned the protocol and also refused to be retested at T1 or T2 were considered dropped out.

Results

Fifty-three patients were enrolled and randomly assigned to 2 groups (N=26 for the Feldenkrais group, FG; N=27 for the Back School group, BG). Two FG subjects dropped out during the training and were not considered in the study. One subject was not assessed at T2; thus, we used the last observation carried forward method.

Table 1 reports the demographic and clinical data at baseline for the 2 groups. The 2 groups were perfectly matched with regard to demographics and clinical characteristics at baseline. At the end of treatment, there were no significant differences between groups respect chronic pain reduction (P>0,05).

[Insert Table 1 about here]

Conversely, at the follow-up, VAS score (p=0.005), McGill PPI (p=0.017), SF-36 Vitality score (p=0.033), and SF-36 Social Functioning (p=0.022) differed significantly. FG subjects had better VAS and McGill PPI scores, whereas SF-36 scores were higher in the BG, as shown in Figure 4. MAIA scores did not differ between groups, although at the follow-up, the disparity in MAIA EA scores approached significance (p=0.056), with greater improvements seen in the FG versus BG subjects.

[Insert Figure 4 about here]

By Friedman analysis, we noted significant changes in VAS (p<0.001 for both), McGill PRIS (p=0.014 for FG, p=0.001 for BG), PRIA (p=0.002 for FG, p=0.013 for BG), PPI (p<0.001 for both), Total (p<0.001 for both), SF-36 Physical Role (p=0.002 for FG, p=0.028 for BG), SF-36 General Health (p=0.003 for FG, p=0.001 for BG), SF-36 Mental Health (p<0.001 for FG, p=0.009 for BG), all MAIA (p<0.001 for both groups), and Waddel (p<0.001 for both groups) scores in both groups.

Mc Gill PRIE and PRIM scores changed only in BG subjects (p=0.018, p<0.001), as did SF-36 Physical Functioning (p<0.001), Bodily Pain (p=0.001 for BG), Vitality (p<0.001), Social Functioning (p=0.001), and Emotional Role (p=0.002 for BG). SF-36 Bodily Pain and Emotional Role scores were only significant for FG patients (p=0.069 and p=0.066, respectively).

Table 2 shows the MAIA subscores. A significant correlation between the change in VAS scores between Tend and Tf-up and the MAIA-N subscore at Tend was found (R=0.296, p=0.037).

[Insert Table 2 about here]

Discussion

Our goal was to determine the efficacy of the Feldenkrais method in alleviating pain in patients with chronic nonspecific LBP, thereby highlighting the value of interoceptive awareness in mitigating pain. Then, wanted to determine whether good interoceptive awareness could effect better results for patients during rehabilitation. Based on the work of Craig and Melzack on chronic pain and the neuromatrix [29][30], we hypothesized that existed a correlation between interoceptive awareness and chronic pain. We assumed that the pain that we examined was related to alterations in the CNS, corresponding to changes in perception or the loss of the ability to integrate sensory information. Thus, pain can be considered to be the product of the output of a widely distributed neural network in the brain, rather than the direct consequent of sensory input that is evoked by an injury.

Our results demonstrate good efficacy of FG and BG treatment for nonspecific CLBP. Specifically, the Feldenkrais method was more effective in terms of VAS and MPQ PPI scores, whereas the Back School method was better with regard to SF-36 Vitality and Social Functioning and certain MPQ subscores. These differences are consistent with the purpose of these rehabilitation programs: the Feldenkrais method involves a mind-body approach to pain perception, and the BS method uses a more educational-ergonomic-reducing method and aims to prevent pain [10][11][15]. There was some ambivalence about the Feldenkrais method in another study, especially regarding the difficulty in continuing the exercises at home; nevertheless, the participants' feelings of improved body awareness remained after 4-6 months by the end of the treatment [16]. The Feldenkrais method reduced pain intensity more quickly, and it altered the perception of pain faster. These results indicate that Feldenkrais exercises are an alternative method that can help offset age-related declines in mobility. Further, these exercises help reduce the risk of falling in community-dwelling older adults [17].

The frequency of the sessions was decreased from 3 to 2 times per week compared with previous studies [9][10] to ensure better compliance for patients who were working and to increase the observation time in terms of quality of life and interoceptive awareness. Also, this choice was validated, because we maintained a dropout rate of under 10% for the FG. Moreover, no BG subject experienced any difficulty in following the course, and we did record any dropouts. The patient's involvement in his therapy and his self-management of psychosocial and work-related conditions are critical in obtaining positive results in chronic nonspecific LBP [31]. Changing movement habits and improving posture take time and practice [32]. Current evidence suggests that individuals with LBP have a poorer quality of life than those without LBP, with a worse impact on their future physical quality of life. Thus, strategies that reduce the effects of LBP, such as the BS method, should be the focus of rehabilitation [33] [34].

The good efficacy of the Feldenkrais and BS methods for nonspecific CLBP strengthen the increasingly accepted biopsychosocial model the idea that CLBP is a condition that is best understood with regard to the interaction of physical, psychological, and social influences [35] [36].

Yet, alternative rehabilitation methods that are based on a body-mind approach have demonstrated efficacy in improving CLBP. For example, tai chi is a gentle form of low-intensity exercise that uses controlled movements in combination with relaxation techniques and is used as a safe form of exercise for people who suffer from other chronic pain conditions, such as arthritis [37][38]. There is strong and moderate evidence for the short-term and long-term effectiveness of yoga, respectively, for CLBP on the most important patient-centered outcomes. Yoga can be recommended as an ancillary therapy for patients with CLBP [39].

There are no randomized controlled trial (RTC) studies that have examined the efficacy of the Feldenkrais method in CLBP. Our study is the first attempt in what remains a highly debated field.

We also asked what rehabilitation treatment could improve interoceptive awareness in patients with CLBP. Astin JA stated that "*multi-component mind-body approaches that include some combination of stress management, coping skills training, cognitive restructuring and relaxation therapy may be an appropriate adjunctive treatment for chronic low back pain*" and offered directions for future research in these areas [40], because CLBP alters interoceptive attentional styles in terms of pain.

Our results showed a significant improvement in MAIA subscores, which did not differ between groups. In the analysis of both groups, the change in VAS scores correlated with the MAIA-N subscores at Tend (R=0.296, p=0.037). The rehabilitation treatment, regardless of approach, improved the ability to notice what happens in one's body, accompanied by a reduction in pain intensity. Better perception of one's body necessarily heightens one's awareness of pain, which can be difficult. These results support those of Mehling WE et al. [9]: mind-body interactions shape the prognosis of chronic pain, and self-reported aspects of interoceptive awareness differ between primary care patients with past or current LBP and mind-body–trained individuals. Scores on the MAIA scale did not differ between groups, although at the follow-up, the MAIA EA score approached significance (p=0.056), with greater improvements in FG versus BG patients. This result is also consistent with the improvement in the "emotional" subscale of SF36: bodily pain and emotional role scores were nearly significant for FG subjects. The positive outcomes in pain and other wellness measures following Feldenkrais interventions have been ascribed to self-regulation [41]. Clark D. et al. followed Feldenkrais's suggestion that mindful learning of skills for organizing the body in movement would transfer to other forms of mental activity [42]. In particular, a short, nonintrusive sensorimotor intervention can have short-term effects on spontaneous cortical activity in functionally related brain regions [43].

Emotional awareness is stressed in all segments of the Feldenkrais treatment, encouraging the exploration of movements that are related to a particular function. Feldenkrais described his method, depicting an example of "*increased consciousness of how a movement works*," not through muscular effort but through minimal effort and maximum efficiency. At the beginning of rehabilitative session, to improve individual conscientisation of the movement, the practitioner does not show the movement that requires to the patient, as a routine practice of this approach. The practitioner then intervenes only if the patient needs to improve the movement itself through touch or short demonstrations. The physical therapist lends the feeling of his/her own hands and his/her own motor awareness to help the patient to expand and reorganize those movements and postures usual nonfunctional. This is not to be considered as a correction but rather as suggesting an option, showing an alternative choice in the search for a safer and more effective action. Hands guiding a non-verbal dialogue. Accordingly, how each person organizes his movements during an action to modify interoceptive attentional styles regarding chronic pain is critical [14].

Also, Craig identified 2 components of chronic pain: perceptual and emotional. The perceptual component is the perception of the physiological condition of the body, whereas the emotional component generates behavioral responses by virtue of the unpleasantness of the painful experience [7]. Consequently, the sensation of pain activates behavioral responses that are not aimed at restoring homeostasis, the purpose is to maintain the integrity of the body-self. The inability to effect homeostasis of the body, for alteration of perceptual channels and the threshold of pain, would slowly abandon the body segment sore, with implications for interoceptive awareness [44].

The two rehabilitative approaches are equally as effective in improving interoceptive awareness. However, this study has several limitations. The patients had mild to moderate pain on participation. Thus, we do not know whether our data are valid for patients with more intensive chronic pain. Also, a short-term follow-up does not allow us to determine whether the overlap between the efficacy of the Feldenkrais or BS method can be maintained for longer periods. A bias could have arisen, because we adopted a translated version of the MAIA scale by G. Committeri, which is recognized and approved by the official organization of the MAIA scale, the Osher Center for Integrative Medicine, University of California, (http://www.osher.ucsf.edu/maia/), but has not been validated in Italian language.

The efficacy of the Feldenkrais method was comparable with that of the BS for nonspecific CLBP. Thus, the physician can recommend a body-mind rehabilitation approach, such as the Feldenkrais method, or an educational and rehabilitation program, such as the BS, to the patient, based on his individual needs. Interoceptive awareness, which improves with rehabilitation, has a complex function in the perception of chronic pain and should be examined in greater detail in future research. Other areas in this field that should be studies are the function of body awareness, attentional focus, and kinesthesia in motor learning in a traditional rehabilitative approach or mind-body therapy rehabilitation in the treatment of chronic pain regarding brain activity and plasticity.

Declaration of Interest Statement

The authors report no declarations of interest, and they declare that there is no involvement of funding sources.

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