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Research Article

Contribution of Mindfulness to Functional Restoration Program for Treatment of Chronic Iow Back Pain

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Abstract

Chronic low back pain (CLBP) is a global public health problem. It is also a major issue for the Armed Forces and functional restoration programs (FRP) are currently the main treatment indicated for disabling CLBP. Research has shown mindfulness to be effective in managing chronic pain but, to date, no report exists on the use of mindfulness as part of an FRP. The aim of this study was to assess the effect of combining mindfulness with FRP on functional improvement in CLBP. A retrospective study was conducted over 13 months in three groups: FRP C (standard rehabilitation treatment), FRP RM (standard rehabilitation that incorporated mindfulness during individual's therapy sessions) and FRR MM (the standard rehabilitation treatment with a concurrent group mindfulness meditation course). Data outcomes measuring pain, function and key psychosocial factors were gathered at days 0, 21 and 90 for each subject. 26 patients were included. The addition of mindfulness to FRP reduced the functional impact of CLBP by decreasing the impact of pain and the disability. Mindfulness based training is effective, added to FRP and physiotherapists trained to mindfulness improve the interest of FRP without changing the format of the program. These techniques could also be applied to other chronic pathologies that are treated with physical and functional rehabilitation therapy where development of mental resilience would be valuable. Furthermore, mindful rehabilitation could help improving well-being of caregivers.

Keywords: Chronic Iow Back Pain (CLBP); Mindfulness; Mindfulness-Based Stress Reduction (MBSR); Functional Restoration Program (FRP).

Keymessages: Interest of mindfulness associated to a multi biopsychosocial rehabilitation for the treatment of chronic low back pain appears essentially on the impact of pain and disability.

By reducing the burden of negative emotions related to chronic pain, mindfulness seems able to change the significance of pain for individuals, and thus reduce its impact on their quality of life. Physiotherapy rehabilitation based on mindfulness could be applicable to other chronic pathologies that are treated by physical and functional rehabilitation where development of mental resilience is also valuable and useful.

Introduction

The term chronic low back pain (CLBP) refers to pain located between the thoraco-lumbar hinge and the lower gluteal fold, without prejudging the causes of this symptom. The duration of the pain determines the degree of chronicity. According to the French High Health Authority, CLBP is acute if it lasts less than six weeks, sub-acute if it lasts between six weeks and three months, and chronic if it lasts longer than three months. As highlighted by Maher et al. [1] in a review in the Lancet, CLBP is "a symptom rather than a disease". Indeed, CLBP can have several causes, identified or not. When the cause can be identified, an etiologic treatment can be delivered (i.e. tumoral cause, traumatic cause etc.). Otherwise, treatment remains symptomatic, aimed primarily at relieving pain and reducing disability. Several non-pharmacological approaches have been proposed with greater or lesser success. These include exercise, psychological therapies, multidisciplinary rehabilitation, spinal manipulation, massage, acupuncture [2].

In French Army, CLBP was defined as a priority objective, due to its significant human, economic and operational impact [3].

Studies have reported high prevalence of CLBP in French military (for example, between 19 and 20% among firefighters [4], about 53% among helicopter pilots [5]. To meet that need, the Physical and Rehabilitation therapy department at Percy Military Hospital offers a multidisciplinary program to treat CLBP. Functional Restoration Program (FRP) is currently a main type of treatment for the management of disabling, CLBP. The underlying idea is based on a biopsychosocial approach that considers three health determinants (biological, psychological, and social factors) to participate equally and simultaneously in the maintenance of health, or development of disease, in an individual. The goal is to provide a multi-disciplinary treatment that aims to improve the quality of life for patients with CLBP by treating the whole person; an FRP helps people to manage their day-to-day activities both at work and home and supports them in overcoming any worries or beliefs that are barriers to their recovery. Key concepts are based on an active patient participation and pain acceptance [6].

During rehabilitation sessions of FRP, physiotherapists often divert patients' attention from their pain by talking about something else or playing music, for example. Diverting attention can be an effective strategy for coping with pain. Indeed, a recent study [7] showed that people who are more preoccupied with their pain and those who are less likely to reappraise their pain have more pain interference with daily activities. Diverting attention from the pain during physiotherapy sessions seems a logical way to encourage movement and mobilization of the painful body part. Nevertheless, studies have shown improvements in pain management and functioning in people with CLBP following participation in a mindfulness-based stress reduction (MBSR) program [8] that was offered, along with specific CLBP management protocols. Furthermore, mindfulness meditation has been studied for its benefits in the management of CLBP [9,10]. Benefits of mindfulness may seem counter-intuitive since mindfulness is defined as a state of consciousness that results from intentionally paying attention to the present moment without judging the experience that unfolds moment by moment [11]. In fact, it was recently pointed out that "mindfulness-based interventions likely have a role in pain management but should not be considered a panacea" [12]. Nonetheless, mindfulness based interventions (MBI) appear to be useful therapeutic approach for body distress in adults, reducing the severity of somatic symptoms, comorbid psychopathology and perceived health status [13].

We then decided to combine MBI to FRP, not to decrease pain but to promote the acceptance of pain. Mindfulness was added to the routine management of patients with CLBP in the Physical and Rehabilitation therapy department at Percy Military Hospital. Based on the notion of acceptance of pain, the aim of the mindfulness approach was more to learn how to better feel one's body in order to better understand its limitations than to reduce pain *per se*. Mindfulness was delivered in two separate ways : a top-down approach with a classically-delivered program derived from MBSR, mixing formal meditation exercises with discussions on the workings of emotions, acceptance of emotions and pain, and the ability to express oneself and a *bottom-up* approach where mindfulness was delivered by physiotherapists and aimed to focus attention to the movement and "consciously feel the body" without top-down approaches. Indeed, MBSR instructor trained a physical therapist and an occupational therapist on the ward to enable them to offer mindfulness guidance to patients as part of their rehabilitation therapy sessions. Schematically, one could say that when mindfulness was delivered by the instructor it was delivered "via the brain" and when mindfulness was delivered by the physiotherapist, it was delivered "via the body".

The aim of this study was to evaluate the use of mindfulness as an addition to an existing FRP for CLBP treatment and to compare the impact of mindfulness deliver to the patient (top-down and bottom-up). Objective impact of programs was evaluated by the measure of the flexibility on flexion (distance between fingers and floor) and data on functional improvement were obtained from questionnaires routinely completed by patients, as well scores from as the Dallas Pain Scale, evaluating the impact of the pain [14] and the Oswestry Disability Index, evaluating the disability [15].

Material and Methods

Ethics

The research protocol was approved by the ethical committee of Percy Hospital (n° 18-2018 HIA-CS). A request for SSA (French Army Medical Services) promotion was granted. Patients were provided with information about the study and each signed an informed consent form before their data were used. The data recorded during this research are subject to computerized processing in compliance with the law n° 78-17 of January 6, 1978, relating to data processing, files, and freedoms (modified by the law 2004-801 of August 6, 2004).

Patients

Subjects were recruited from people with chronic low back pain hospitalized for an FRP in the Physical and Rehabilitation therapy department of Percy Military Hospital (Paris, France) between February 2019 and March 2020. Inclusion criteria were: aged between 18 and 65 years, admitted for an FRP that required a 3-week hospitalization, and not having opposed the collection and usage of their health data.

Data collected

Self-reported questionnaires were systematically completed for each patient at three points: D0 (day 0 was the start of the FRP), D21 (day 21 was the end of the FRP) and D90 (at the 3-month follow-up outpatient appointment). Questionnaire data allowed evaluation of the functional impact of the different FRP

interventions on CLBP and psychosocial factors that impacted on the pain. More details of the questionnaire outcome measures are presented in Table 1. We also measured each patient's level of dispositional mindfulness using the Freiburg Mindfulness Inventory-short form (FMI). At D90, patients were asked if they had continued to practice mindfulness meditation and, if so, specifically how many times per week.

Outcome Measures / Scales Used

Flexibility in flexion measured with the distance between fingers and floor:

The flexibility in flexion was measured with a tape measure, in centimetres. It was measured on D0 and D21, not on D90.

Pain was self-assessed using a numerical scale ranging from zero (no pain) to 10 (worst pain imaginable). Minimal and maximal pain levels were recorded.

The Freiburg Mindfulness Inventory Short form (FMI) Walach et al. [16] is a self-reporting questionnaire measuring the level of mindfulness with 14 items. Patients scoring high were higher on mindfulness.

The Dallas Pain questionnaire (Lawlis, et al. [14]) is composed of sixteen questions divided into four sections that correspond to the impact on i) daily activities. ii) professional and leisure activities. iii) sociability and iv) anxiety/depression. In their answers, patients are asked to rate their pain using a score between 0 and 100%, where the higher the score, the greater the impact of pain.

The Oswestry Disability Index questionnaire: Fairbank & Pynsent [15] also known as the Oswestry Low Back Pain Disability Questionnaire, is composed of 10 sections, each containing a list of six statements which are ranked from 0 (no pain) to 5 (extreme pain). Patients are asked to choose one statement from each section and their scores are combined, enabling a percentage to be calculated where the higher the score, the greater the disability. The score is between 0 and 100%. A reduction of 10% on the scale is recognized as clinically significant.

Three different types of FRP

Some patients received the standard FRP which did not include any aspect of mindfulness, since neither an MSBR instructor, nor a therapist trained in mindfulness was involved. In this **FRP C group** (where 'C' is 'control'), patients received the standard three-week FRP that involved a multidisciplinary staff to restore the physical, psychological, and social situations of patients through their active participation in treatment. The FRP was an intensive program that included psychological and social assessment as well as stretching, strengthening and aerobic exercises and sessions with an occupational therapist to explain the importance of maintaining spinal mobility.

A second group of participants attended a separate course in mindfulness meditation (MM) in addition to the standard FRP, as described above. To integrate the two courses, the MM course was not done in the 'full, classic' form (i.e., once a week for eight weeks) but instead the eight sessions were evenly divided over the three weeks without modifying the course program: the program format was different but the content was the same. The MM course was led by a mindfulness-based stress reduction (MBSR) instructor. These groups are referred to as FRP MM. The MM course was added to the patients' timetables at end of the day, after the activities planned for their FRP had finished and it was a group activity. It was in three-week workshop with eight sessions based on three formal techniques: mindfulness meditation, body scanning and simple yoga postures. Group discussions and exploration of experience of the meditation practice and its application to life was a central part of the program. At the end of each session, the MBSR instructor led a debriefing.

The third group of participants received the same standard FRP course but with mindfulness-based rehabilitation exercises integrated into their individual programs which were led by therapists who had been trained in mindfulness. These modified rehabilitation + mindfulness (RM) sessions had been validated by the MBSR instructor before their use; this group is referred to as the **FRP RM**. These sessions took place in a calm environment, to facilitate the focusing of attention on the 'here and now'. The therapist's role was to guide the patient to become aware of, and to heighten their perception of, not only bodily sensations, but also emotions and thoughts that were generated by the exercises. When pain appeared, patients were asked to make a conscious decision about how to behave, adjust his or her posture, change or stop the exercise. The MK then asked how the pain had evolved in this situation (worsening, calming, no change). In this way, the MK helped the patient to accept pain for what it was: sensory information produced by the body. Patients were invited to focus their full attention on each movement, on their breathing and their sensations without judgment. At the end of each session, the therapist led a debriefing.

Statistical analysis

The data were analysed using non-parametric tests with Statistica (TIBCO Software Inc., United States of America). A non-parametric Kruskal-Wallis test was used for comparison between three FRP groups (C, MM and RM) and Friedman-type non-parametric tests were used with time of collection (days 0, 21 and 90) as a within-subjects factor. On ly D0 and D21 was used in the statistical analysis of flexion flexibility. When the results indicated a statistically reliable effect of the time, the effects at that time were studied for each of the three groups. A value of $p<0.05$ was considered to be statistically significant.

Results

During the period of data collection, data from n=26 patients were available. Because of the COVID-19 pandemic, n=15 patients could not be reviewed at the D90 outpatient appointment. Complete FRP data were available from twenty-nine patients, but a further n=3 patients were excluded: one subject developed flu-like symptoms, another, a stress-fracture of their foot during the FRP, and the third subject opposed data collection. Therefore, a total of n=26 patients were included in the study.

The characteristics of these 26 subjects included are detailed in Table 1. The majority were men (81%) and military personnel (84.6%). CLBP was attached to a work-related accident in 30.8% of cases. There were n=7 patients in the FRP C group, n=9 patients in the FRP RM group and n=10 patients in the FRP MM group. For the n=10 people in the MM group, there were two mindfulness group sessions, each containing n=5 participants. Each MM group had 8 MBSR sessions, making a total of 16 MBSR sessions.

	FRP C n=7	**FRP RM n=9**	**FRP MM n=10**
	Mean ± StDev [min-max]	Mean ± StDev [min-max]	Mean ± StDev [min-max]
Sex (male / female)	5/2	7/2	9/1
Age (years)	35.9±6 [25-44]	31.8±10 [20-50]	38.5 ± 7.3 [28-46]
BMI (kg/m^2)	24.6±1 [23.5-26]	26.3±5.6 [18.8-36.1]	27± 2.9 [23.2-31.6]
Profession: (civilian/ military)	3/4	0/9	1/9
Performing a regular sporting activity (%)	71.4	55.5	60
Percentage of back pain caused by an accident at work (%)	28.6	33.3	30
Duration of chronic low back pain(CLBP; months)	30.3±30.7 [4-96]	36.4±30.5 [12-108]	28.8±10.9 [12-48]
Duration of time off work with CBLP (months)	4.9±4.1 [0-12]	5.6±11.1 [0-28]	5.2±10 [0-24]
Percentage of people off work at FRPstart (%)	42.8	22.2	30

Table 1: Characteristics of the study population of twenty-six patients with chronic low back pain (CLBP) who participated in one of three, 21-day functional restoration programs (FRP) that either (i) included mindfulness within the rehabilitation sessions (FRP RM), or (ii) had a course in mindfulness meditation (MM) that ran in parallel with the FRP or (iii) were control programs that did not have any mindfulness input FRP (C); Abbreviations: Min = minimum; max = maximum; StDev = standard deviation.

The flexibility in flexion measured with the distance between fingers and floor: was sensitive to the moment of the measure with a decrease of the distance finger-floor on D21 (6.13 cm) compared to D0 (15.40 cm) (Wilcoxon matched pairs test : $Z=3.48$, $p<0.001$). Analysis by group (Table 2) revealed that only on groups with mindfulness, the difference stayed significant between D0 and D21 (**FRP MM**, $Z=2.38$, $p< 0.05$; FRM **RM**, $Z=2.10$, $p< 0.05$; **FRP C** $Z=1.06$, $p=0.29$).

	Flexion		
	J0*(mean)*	J21*(mean)*	*p*
FRP C	12.25	7.17	0.28
FRP RM	23.17	18.6	0,036
FRP MM	12.36	-2	0,018

Table 2: Mean and p-value of flexibility in cm in flexion at D0 and D21, for the 3 groups.

Pain level evaluated with numerical scale revealed a global decreased of minimal pain level ($p<0.001$) and of maximal pain ($p<0.001$) for all groups. Minimal pain level and maximal pain level was reduced in all groups. No group effect was found at any time both for minimal pain and maximal pain. The decrease was global and could not been explained by a group (Figure 1) (Minimal pain level; D0: p=0.95**;** D21: p=0.61; D90: p=0.44; Maximal pain level; D0: p=0.24**;** D21: p=0.09; D90: p=0.84).

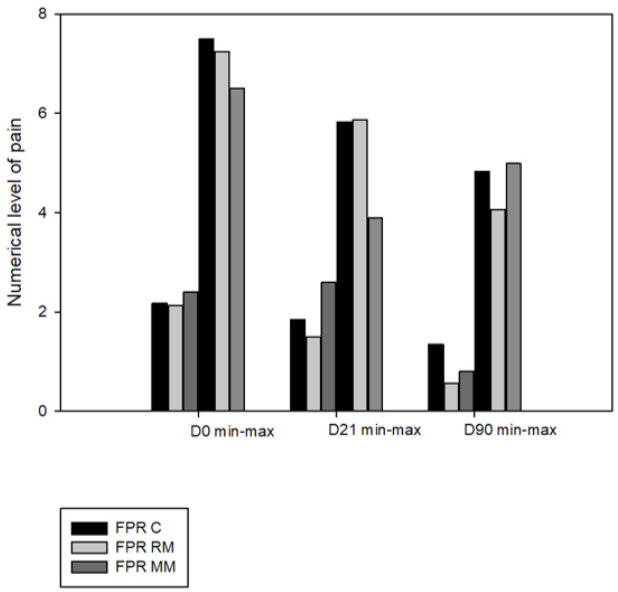

Figure 1: Bar charts showing numerical levels of pain recorded with numerical scales from 0 (no pain) to 10 (worst pain) of twenty-six patients with chronic low back pain (CLBP). On the left: D0, in the middle: D21 and on the right: D90. For each block, the first three bars are the minimal pain reported and the last three bars, the maximal pain reported. In black, scores for FRP C group, in grey: scores for FPR RM group and in dark grey, scores for FPR MM group.

The Freiburg Mindfulness Inventory Short form (FMI) score increased only on the FRP MM group (**FRP MM** D0: 36.4, D90 : 43.8, p< 0.01 ; **FRM RM** D0 : 40.37, D90 : 39.67, p=0.22 ; **FRP C** D0 : 40.1, D90 : 41.8, p=0.84).

At D90, n=6/9 (**FRP RM**) and n=9/10 **FRP MM** patients reported that they had continued to practice mindfulness meditation regularly (defined as more than once a week) since leaving hospital. No patient had started mindfulness meditation practice in the **FRP C** group.

The Dallas Pain Questionnaire results significantly decreased in all sections between D0 and D90, only in the **FRP MM** group, (Figure 2): for daily activity: F(10.2)=9.21; p=0.01, for professional activity: F(10.2)=14; p<0.001, for anxiety-depression: F(10.2)=14.75; p<0.001 and for sociability F(10.2)=10.56; p<0.01. In the **FRP RM** groups, results only significantly decreased in professional activity and anxiety /depression but not in other sections. No changes were observed in scores from the **FRP C**.

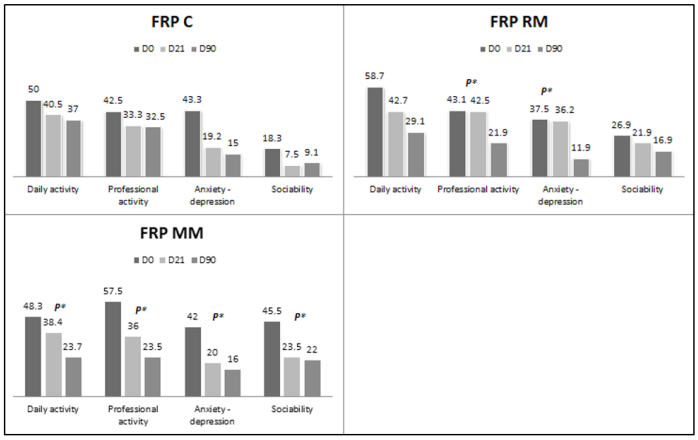

Figure 2: Bar charts showing the mean **Dallas Pain scale scores** of twenty-six patients with chronic low back pain (CLBP) who participated in one of three, 21-day functional restoration programs (FRP) that either (i) included mindfulness within the rehabilitation sessions (FRP RM; n=9), or (ii) had a course in mindfulness meditation (MM; n=10) that ran in parallel with the FRP or (iii) were control programs that did not have any mindfulness input FRP (C; n=7). Scores were recorded at the start of FRP (D0), D21 and at an outpatient follow up at 3 months (D90). p* indicates that the difference between the values shown was significant.

The results of the Oswestry Disability Index are shown in (Figure 3). In **FRP C** group, the mean score decreased between D0 and D21, but not between D21 and D90 and only groups whose treatment included mindfulness (**FRP RM** and **FRP MM**) showed significantly decreased scores between D0 and D90. The mean score of the **FRP RM** group decreased from 20.2% ±10 at D0 to 8% ±8 at D90 (p<0.03); over the same period the mean score of the **FRP MM** group decreased from 24.2% ±11 to 14.2% ±8.6 (p<0.02).

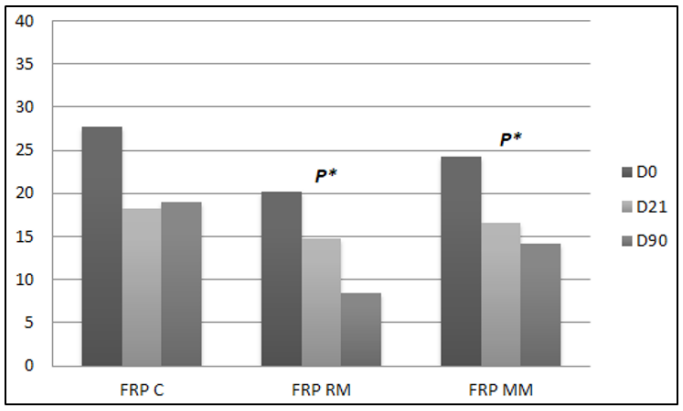

Figure 3 : Bar charts showing the mean **Oswestry Disability Index scores** of twenty-six patients with chronic low back pain (CLBP) who participated in one of three, 21-day functional restoration programs (FRP) that either (i) included mindfulness within the rehabilitation sessions (FRP RM; n=9), or (ii) had a course in mindfulness meditation (MM; n=10) that ran in parallel with the FRP or (iii) were control programs that did not have any mindfulness input FRP (C; n=7). Scores were recorded at the start of FRP (D0), D21 and at an outpatient follow up at 3 months (D90). p* indicates that the difference between the values shown was significant.

Discussion

The aim of this study was to evaluate the contribution of mindfulness to FRP in terms of functional impact in patients with CLBP. Mindfulness was delivered either as a program in addition to the FPR by an instructor or indirectly by physiotherapists in the way they practiced rehabilitation. These two approaches of mindfulness could be seen as two ways to deliver mindfulness, top-down approach when delivered by instructor through a MBI and *bottom-up* approach when delivered by physiotherapist.

FRP decreased minimal and maximal pain perceived buy patients. Mindfulness didn't improved FRP on pain levels. This result echoes Sharpe et al. [12] comment that mindfulness is not "a panacea for pain management". Nonetheless, the addition of mindfulness to FRP improved flexion flexibility, whatever the way to deliver mindfulness (with a physiotherapist or an instructor). Furthermore, as expected regarding previous studies [17], MBI improved functional impact measured by Dallas Pain Scale scores, suggesting that these skills allowed subjects to put negative emotions at a distance, and be less affected by pain in different fields of activity. The impact of pain was decreased in all aspects explored by the Dallas questionnaire (daily activities, professional and leisure activities, sociability and anxiety/depression) but only on top-down approach of mindfulness. The bottom-up approach improved professional activity and anxiety depression scores whereas no score were improved on FPR control group. The disability score was improved on all groups just after the end of the FPR and persisted three months later only on groups with mindfulness approaches.

We also replicated Braden et al. [18] results on Oswestry Disability Index (ODI) (these authors showed a significant decrease in ODI scores after four weeks of an MSBR program in a population of patients with CLBP, compared to a control group without any other management). In our study, ODI scores decreased by 12% in the FRP RM group, and by 10% in the FRP MM group. These reductions corresponded to clinically significant decreases (since they were ≥10%) and importantly, according to Copay et al. [19], moved the patients from a 'moderate' to a 'minimal' disability category. Mindfulness approaches improved objective (flexion flexibility) and subjective scores usually used to evaluate the impact of back pain.

Our results showed several limitations

The number of subjects (n=26) was low. This was a retrospective study with fewer subjects included than expected (n=26 participants instead of n= 44), in part due to the COVID-19 pandemic and in part due to the natural availability of patients admitted for FRP. This was a preliminary study; a planned, prospective study with more subjects randomly allocated to the FRP treatment groups is clearly necessary to confirm these findings and provide a better understanding of the mechanisms of how mindfulness in FRP can improve patient outcomes.

The difficulty of extrapolating data from this study to a wider population with CLBP : In our study, nearly 85% of the participants were military personnel, with an average age of 35.5 years and 81% were male. The causes of their back pain were often specific to their profession (such as carrying heavy military webbing or parachute jumping) and studies have also highlighted the fact that chronic low back pain is less disabling in military personnel than in the civilian population; this seems likely to be because a certain level of physical activity is expected, regardless of any low back pain, from military personnel so that they maintain their required level of operational fitness [20].

Physical activity remains the primary treatment for chronic low back pain according to the French National Authority for Health recommendations [21]. Furthermore, we'd like to open the discussion to the possible relation between to chronic pain and post-traumatic stress disorders (PTSD). Indeed, our population is highly exposed to PTSD [22] and mindfulness seems effective on PTSD symptoms [23-30]. May be, the effectiveness of mindfulness associated to FRP could be a side effect of effectiveness of mindfulness on PTSD symptom. More studies are required to determine the ratio of PTSD on military population which consult for chronic pain.

To integrate the MBI program, based on MBSR program, into the existing FRP, the course was shortened to fit the same number of sessions into three, instead of eight, weeks. However, the change in format of the MBI program has not called into question its effectiveness. In the literature, several studies have looked at similarly shortened MBSR programs. They have shown that they still improved symptoms of depression, anxiety, and quality of life in people with cancer [24]. Moreover, a meta-analysis in 2009 [25] which looked at the link between MBSR and psychological suffering did not show any relationship between the extent of symptom improvement and the number of hours of mindfulness meditation instruction (between 6 and 28 hours of classes). They did, however, underline the link between the effectiveness of mindfulness and the duration of self-practice time declared by the subjects. Our patients trained to mindfulness with an instructor still practiced three months after the end of the program.

Nevertheless, the principal strength of this work is that, to our knowledge, it is the first study is to assess the addition of mindfulness meditation to an FRP on patient outcomes. The literature already contains descriptions of the effectiveness of FRP for CLBP, and it is also known that some patients with CLBP generate negative cognitive strategies that lead to a vicious circle of pain restricting movement/ kinesiophobia augmenting pain. Despite the small number of participants, the data showed that mindfulness led to significant improvements in primary endpoints measuring pain and function (the Dallas Pain and Oswestry Disability Index scales). Our study also provides guidance on how mindfulness meditation can be delivered in clinical practice: either through the 'mind' top-down approach where it is offered as a parallel meditation course (FRP MM) or via a 'body' bottom-up approach, where mindfulness principles are applied to physical rehabilitation sessions (FRP RM). In our study, the FRP RM group showed improvements, without changing the format of the FRP while training hours were being added in the FRP MM group. No supplementary intervener was required. In addition, the subjective feelings of physiotherapists trained in mindfulness and applying mindfulness-based rehabilitation reported less stress-related fatigue at the end of the three weeks of FRP. Indeed, for caregivers, three weeks of FRP are very demanding. Small differences reported between FRP MM and FRP RM could be explained by the fact that the FRP MM participants showed a significant increase in their mindfulness score (FMI). They could integrate mindfulness in their individual functioning.

Finally, it is important to remember that LBP is a global public health problem. Mindfulness meditation is an inexpensive tool with few side-effects. Such rare effects as have been found seem to occur in individuals with unstable psychiatric conditions. Van Dam et al. [27-40] for example, reported how for these people, introspection may have aggravated their condition.

Conclusion

FRP is an efficient multi biopsychosocial rehabilitation which could be improved by mindfulness intervention. Interest of mindfulness appears essentially on the impact of pain and disability. By reducing the burden of negative emotions related to chronic pain, mindfulness seems able to change the significance of pain for individuals, and thus reduce its impact on their quality of life. Even if our results suggested that mindfulness meditation was most effective when delivered in a 'classic' group format and provided as a supplement to the FRP, physiotherapists trained in the practice of mindfulness improve the impact of FRP without changing the program format. This could lead to a new approach of physiotherapy rehabilitation based on mindfulness and applicable to other chronic pathologies that are treated by physical and functional rehabilitation where development of mental resilience is also valuable and useful.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, [author initials], upon reasonable request.

Author Contributions statement

The authors confirm contribution to the paper as follows: study conception and design: Ramdani C, Facione J; data collection: Freyssinges P, N'guyen van thanh J, Ramdani C; analysis and interpretation of results: Ramdani C, N'guyen van thanh J, Freyssinges P, Facione J; draft manuscript preparation: Ramdani C, N'guyen van thanh J. All authors reviewed the results and approved the final version of the manuscript.

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