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Research article

Biopsychosocial education improves workers' low back pain beliefs in a meat processing plant[GQ6]

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ABSTRACT

Background

[GQ2][GQ4][GQ5]Low Back Pain (LBP) is a major health problem at work. While prevention measures can focus on physical risk factors, negative beliefs about pain can also contribute to LBP chronicity.

Objective

This study evaluates the impact of educational training based on the biopsychosocial model of pain on meat processing workers' low back pain beliefs.

Methods

Workers of two sectors of a meat processing plant in France (n = 34) were assigned into a control group and an educational group. The latter participated in a training programme consisting of two 90-min sessions focused on the biopsychosocial model of pain. Low back pain beliefs were assessed with the Back Pain Attitudes Questionnaire (Back-PAQ, 34 items) in the two groups in pre- and post-intervention periods.

Results

In the pre-intervention period, the Back-PAQ score was not different between the control (118.5 ± 9.9) and the educational (122.5 ± 10.0) groups. In the post-intervention period, the Back-PAQ score was significantly reduced in the educational group (83 ± 16.5; −39.5

points; $p < 0.001$) while it did not significantly change in the control group (117.5 ± 10.3; −0.9 points, $p = 0.57$). The Back-PAQ score was significantly lower in the educational compared to the control group (−34.5 points, $p < 0.001$).

Conclusions

This study provides preliminary support that an educational training based on biopsychosocial model of pain can positively influence meat processing workers' low back pain beliefs. Therefore, such an educational programme may represent a course of action for limiting LBP and more globally improving musculoskeletal health management in an industrial environment.

KEYWORDS

- musculoskeletal pain
- occupational health
- health belief model
- health promotion
- health education
- food industry

Introduction

Low back pain (LBP), is a major public health problem worldwide affecting approximately 568 million people in 2019.[1] It particularly affects people of working age[2] and is one of the most common complaints in the workplace. It is the leading cause of absenteeism[3] and the most widespread health problem among workers in European countries.[4] In 85% to 90% of cases, LBP is categorised as non-specific, meaning that a single specific cause cannot be identified.[5] LBP is a common, complex, and multidimensional condition.[5,6] Occupational factors account for 37% of the risk.[7] Industrial workers, particularly in the food sector, are particularly exposed to numerous physical risk factors, such as repetitive movements, awkward postures, and excessive workload.[8–10] Studies lead In the meat processing industry demonstrated that the lumbar region seems to be the most affected and therefore prone to pain.[11,12]

To prevent LBP in the workplace, companies primarily adopt a biomedical approach focused on physical risk factors.[13,14] This biomedical model, which attributes LBP to biomechanical overload causing tissue damage,[15] appears insufficient to explain the chronicity of LBP and their associated disabilities.[13] This approach does not take sufficient account key organisational, psychosocial, and individual factors thereby limiting its effectiveness.[10,16] A more comprehensive approach that integrates biological, psychological, and social dimensions seems relevant to better understand and manage LBP.[17] Vlaeyen's fear-avoidance model[18] highlights that LBP chronicity is strongly linked to psychological traits and beliefs, which contribute to pain-related hyper-vigilance. According to this model, individuals who experience low back pain may develop unhelpful beliefs about their pain. These beliefs negatively influence how they manage their pain, its chronicity, its severity, and the disability it causes.[19,20] At work, those unhelpful beliefs lead to adopt avoidance strategies, exacerbating pain and hindering their return to work.[21–23]

Interventions based on the biopsychosocial model have been used to improve beliefs about LBP in different populations. The objective of the latter are to improve knowledge about pain so that populations perceive pain as a less threatening experience.[24,25] A randomised controlled trial conducted in a population of healthcare workers complaining of LBP[26] demonstrated that this type of intervention improved psychological state and quality of life. In another occupational context, among insurance professionals, Beales et al. demonstrated that a brief biopsychosocially informed education programme, consisting of two 1.5-h sessions, can positively influence workers' beliefs about their back pain.[27] However, such training programme are still rarely implemented among blue-collar populations, particularly in sectors unrelated to healthcare, despite their high exposure to LBP and associated risk factors. Although the biopsychosocial model includes a social dimension, this aspect is often neglected in interventions,[28] despite its crucial role in the workplace. Filling this gap reinforces the relevance of developing an educational programme among industrial workers. In this study, as regards to the occupational risk factors and prevalence of LBP in industrial context, we developed an education programme based on the biopsychosocial model. The objective of the present study was to assess the effect of this programme on the beliefs about LBP among workers in a meat processing plant.

Methods

This study was carried out between February and March 2024 as a part of an overall prevention project. The plant management is involved in implementing measures to improve working conditions and reduce the prevalence and incidence of musculoskeletal disorders (MSDs). The present programme was conducted in a legal framework with respect to the French labour law. Plant administrative council, management staff, and Health and Safety committee approved the prevention project. Furthermore, the study protocol was approved as non-interventional research by a local ethics committee of Université de Picardie Jules Verne ~~"Institution blinded for peer review"~~ (approval n° 2023-09-6 /2024-30)~~Blinded for peer review~~). The design and reporting of the educational intervention were conducted in accordance with the Template for intervention Description and Replication (TIDieR) checklist.[29] A comprehensive description of the intervention components, including trainer expertise and tailoring, is provided in Supplementary File 1.

Participants

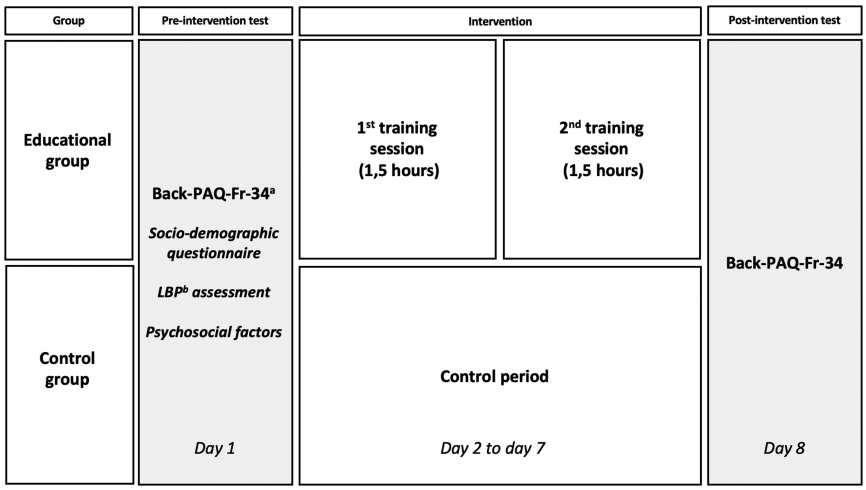
The participants of this study were recruited from a meat processing plant in France. The study involved all workers employed on permanent contracts within the packing and labelling sectors and was conducted at the workplace during paid working hours. These two sectors were selected due to their similar work demands and risk exposures. In both groups, workers performed manual handling tasks primarily involving the upper limbs for approximately 7 h per workday, and were exposed to cold environments (4–6 °C). Participants had completed secondary education (middle or high school). Participation in the study was directly proposed to all eligible workers from the packing and labelling sectors by the researcher during dedicated informational meetings. Workers were provided with comprehensive information regarding the study's objectives, the evaluation protocol, and the strict confidentiality of their data. It was explicitly stated that participation was entirely voluntary and that declining to participate would have no impact on their employment status. Consequently, all participants provided written informed consent prior to taking part in the study. Finally, workers who failed to attend any part of the study protocol were excluded from the final analysis.

Study design

Twenty workers from packing and twenty from labelling sectors were recruited. After the random draw, the "control" group was composed of the packing workers and the "educational" group of the labelling workers. The participants completed questionnaires to determine their socio-demographic characteristics, LBP level and psychosocial factors. Following which, the participants of the educational group attended two one-and-a-half-hour education sessions one week apart while the participants of the control group did not. To minimise potential contamination bias, the control group was not explicitly informed about the educational sessions provided to the other sector. Furthermore, to actively prevent cross-contamination, participants in the educational group formally committed via a written procedure to maintain strict confidentiality regarding the training content until the study protocol was completed. While sharing common break areas means that absolute information isolation cannot be guaranteed, these strict measures were implemented to severely restrict cross-sector communication about the intervention. The 2 groups were also asked to complete the French version of "Back Pain Attitudes Questionnaire" 34 items (Back-PAQ)[30] before and after the educational programme (pre and post intervention) (Figure 1).

Figure 1.

Study organisation. [a]Back-PAQ-Fr-34: Back Pain Attitudes Questionnaire (French version, 34 items); [b]LBP: Low Back Pain[AQ3].

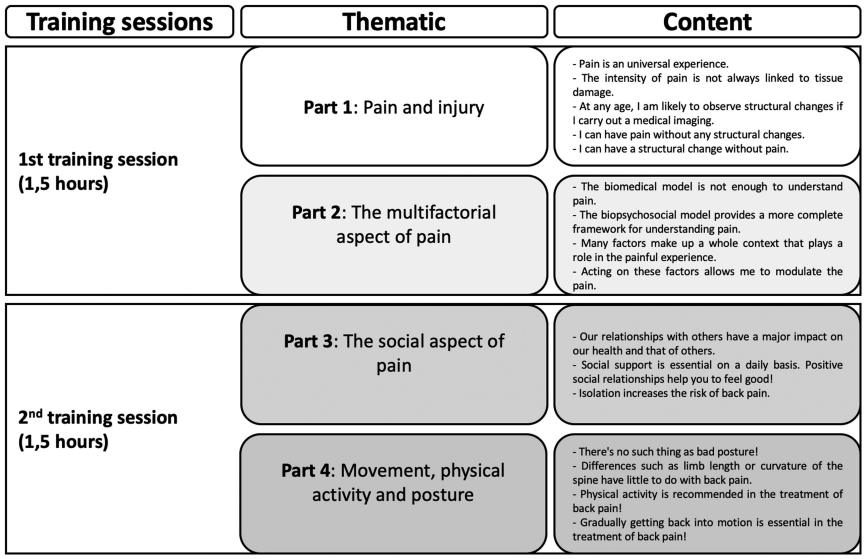


Intervention: Biopsychosocial education programme

The educational programme "*Biopsychosocial education of pain for workers*" was developed in collaboration with the principal investigators. The design team included a physiotherapist with 10 years of clinical experience specialising in the transposition of scientific musculoskeletal knowledge into practice, two senior researchers specialising in musculoskeletal disorders prevention, posture and movement with over 20 years of experience and an Adapted Physical Activity (APA) specialist. All educational sessions were consistently delivered by this same APA specialist, who is the internal Occupational Health Prevention Manager of the industrial plant. This trainer (the first author) is a PhD student holding a Master's degree in Rehabilitation Engineering, with more than 5 years of experience in physical health education and adapted exercise. In line with the aim of the study, the content of the education programme (Figure 2) was consistent with current knowledge about pain and was based on pedagogical and research work[20,31–34] (see Supplementary File 2 for exhaustive bibliography). Emphasis was placed on positive factors associated with a favourable course of pain such as resilience, compliance, motivation. The first training session was devoted to "Part 1: Pain and injury" and "Part 2: The multifactorial aspect of pain". The second training session was devoted to the "Part 3: The social aspect of pain" and "Part 4: Movement, physical activity and posture". Training sessions for the educational group were held in the morning 1.5 h before the participants started their work, and took place during working hours. Training sessions were conducted with groups of 10 workers, seated in front of a screen displaying the different training modules. An active teaching method was designed to promote active participation on learner engagement. Rather than passive teaching, the specialist engaged workers in dynamic question-and-answer processes, encouraging them to reflect on their experiences and knowledge in order to form new understandings.[35]

Figure 2.

Biopsychosocial education programme.



Primary outcome: Back Pain Attitudes Questionnaire (Back-PAQ)

The Back-PAQ questionnaire (34 items version)[36] is a self-report instrument designed to assess individuals' attitudes and beliefs about LBP. Each item is scored from 1 to 5 points on a Likert scale ranging from "False" to "True". Higher total score (range 34 to 170) indicates more unhelpful beliefs and attitudes about LBP. Items 1, 2, 3, 15, 16, 17, 27, 28, 29, 30 and 31 have an inverted score. The total score was calculated by adding up the scores for all the items, giving an overall score that reflects the participant's general orientation towards back pain. All items are written in the second person (e.g., "You believe…") to promote self-reflection and to ensure that responses reflect the participant's own beliefs rather than generalised opinions about other people with LBP. A higher score indicates a greater presence of unhelpful beliefs. Although the education was not specific to a body region, this measure related to unhelpful beliefs about back pain was chosen due to its established use in the literature and its specificity to back pain.[36] Unlike other questionnaires, the Back-PAQ 34 provides a comprehensive assessment of beliefs and attitudes specifically related to back pain. It explores various aspects, including the perception of fragility, the belief that any pain indicates structural damage, the impact of movement and physical activity, the belief in possible recovery or not and the psychological influence on pain and recovery. It is used both in patients with and without back pain, as well as among healthcare professionals, and helps measure the effectiveness of educational interventions aimed at changing these beliefs.

Characteristics of the participants

As pain, physical activity, social support and kinesiophobia levels could potentially interfere with perception and representation of pain, these factors were investigated before the intervention period by using following questionnaires: a self-developed Socio-demographic questionnaire, LBP assessment with an associated Numeric Rating Scale (NRS) and psychosocial factors. All these data were collected during a 20 min individual interview with a specifically designed mobile app.

Socio-demographic questionnaire

This self-administered questionnaire included a number of questions relating to the personal factors (age, gender, seniority at the workplace, seniority in the company) of the participants.

LBP assessment

Participants were asked to report their history of low back pain by answering two specific questions: “Have you experienced LBP during the past 7 days?” and “Have you experienced LBP during the past 3 months?”. For the 7-day period, participants were also asked to rate the intensity of their LBP using a NRS, ranging from 0 (“no pain”) to 10 (“worst imaginable pain”).

Psychosocial factors

Physical activity level

Participants’ physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ),[37] a validated instrument for measuring physical activity in population-based studies. Participants reported the frequency and duration of walking, moderate-intensity activity and vigorous-intensity activity over the previous seven days. Total physical activity was calculated in metabolic equivalent minutes per week (MET-min/week).

Social support at work

Social support at work was assessed using the social support subscale of the Job Content Questionnaire (JCQ) developed by Karasek.[38] This subscale comprises 8 items measuring perceived support from supervisors and colleagues. Each item is scored from 1 to 4 on a Likert scale, ranging from “strongly disagree” to 4 “strongly agree”. A score below 24 indicates a low level of social support, and above 24, social support is considered positive.

Fear of movement

Kinesiophobia was assessed using the 11-item version of the Tampa Scale of Kinesiophobia (TSK-11).[39] An instrument for measuring fear of movement or (re)injury in individuals with musculoskeletal pain. Each item is scored from 1 to 4 on a Likert scale ranging from “strongly disagree” to “strongly agree”. Total scores range from 11 to 44, with higher scores indicating greater fear of movement.

Statistical analysis

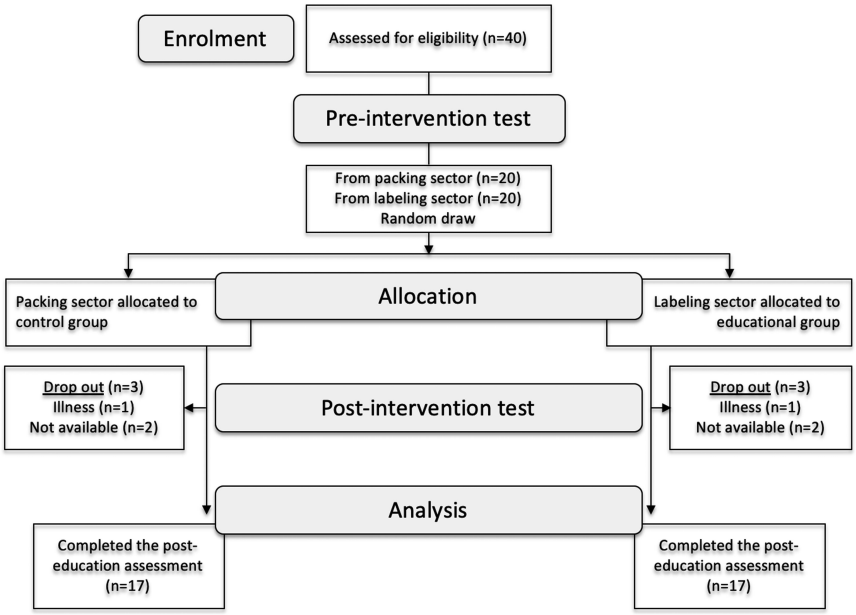
Statistical analyses were conducted using JASP (version 0.19.3; JASP team, Amsterdam, Netherlands) and RStudio Desktop (version 2025.05.1; Posit, PBC, Boston, MA, USA). A Shapiro-Wilk test was conducted on all parameters, confirming that they followed a normal distribution. Characteristics of the participants were compared between groups by using unpaired t-test for continuous variables or χ^2 for categorical variables. We used Ficher's exact test to test the differences in proportions for the 3 variables: ‘Male/Female’; ‘Have you experienced back pain in the last 7 days? Yes/No’; ‘Have you had back pain in the last 3 months? Yes/No’. Analyses of variance for repeated measures have been carried out to test the effects of group (Educational versus Control), time (pre- and post-intervention test) and their interaction for Back-PAQ scores. When ANOVA was significant, post-hoc t-tests were performed. The effect size between pre-intervention test and post-intervention test was calculated using Cohen's ds.[40] Interpretation of effect size was: small (ds = 0.2), medium (ds = 0.5), large (ds = 0.8), very large (ds = 1.2), and huge (ds = 2.0). A negative Cohen's ds indicate an improvement of the Back-PAQ score after the intervention. Finally, in order to be able to interpret changes in the Back-PAQ-34 total score, the Minimum Detectable Change (MDC) was also calculated using the following formulae: $MDC = SEM \times 1.96 \times \sqrt{2}$. The MDC was used to determine whether the observed statistical differences in scores could be interpreted in terms of clinical significance.[30] Each Back-PAQ item has also been tested to refine the analysis.

Results

At the end of the study, 34 participants (n = 17 per group) had completed the entire protocol, while 6 withdrew due to illness (n = 2) or were unavailable on the day of testing or training sessions (n = 4) (Figure 3).

Figure 3.

Flow diagram of the study.



Characteristics of the participants

Table 1 presents the sociodemographic data, the LBP assessment and the psychosocial factors of both groups. In the pre-intervention assessment, no significant differences were found between groups for company experience, LBP assessment, or psychosocial factors (Table 1). Only an indicative difference was observed for age and job experience: the educational group was younger but had greater seniority. Furthermore, 27 out of the 34 workers (79%) reported having suffered from an LBP episode in the past 3 months.

Table 1.

Characteristics of the participants.

	Control group (n = 17)	**Educational group (n = 17)**	**p**
Sociodemographic data			
Age	44.5(12.89)	37.5(7.57)	0.06
Males/Females	3/14	0/17	0.22
How many years of experience in your current job?	5.2(5.6)	8.9(6.8)	0.08
How many years of experience in your industry?	9.7(7.1)	12.7(6.5)	0.22
LBP assessment			
Have you experienced any LBP in the last 7 days?			
Yes/No	9/8	11/6	0.72
Intensity of LBP over the last 7 days	2.9(3.4)	3.6(3.1)	0.58
Have you experienced any lower back pain in the last 3 months?			
Yes/No	12/5	15/2	0.39
Psychosocial factors			
IPAQ (MET-minutes/semaine)	967(136.6)	724(529)	0.50

	Control group (n = 17)	Educational group (n = 17)	p
JCQ	24.7(3.0)	24.2(3.7)	0.68
TSK 11	25.9(3.3)	26.1(5.0)	0.93

Effect of the biopsychosocial education on LBP beliefs

A significant interaction between groups and time ($F_{1,32} = 62.3$; $p < 0.001$) was observed (Figure 4). Post-hoc tests showed that Back-PAQ-34 score did not differ ($p = 0.24$) in the pre-intervention test between the control group (118.5 ± 9.9) and the educational group (122.5 ± 10.0) (Figure 4). In post-intervention test, Back-PAQ-34 score was significantly reduced in the educational group (83.0 ± 16.5; −39.5 points, $p < 0.001$; Cohen's d = 2.08) and did not change significantly in the control group (117.5 ± 10.3; −0.9 points, $p = 0.57$; Cohen's d = 0.141) (Figure 4). This change in educational group exceeded the minimal detectable change (MDC = 12.6; Intra-class Correlation = 0.8; Standard Error of Measurement = 4.6; Limits of Agreement Lower = −12.1 /Upper = 14.0). Sixteen out of 17 participants of educational group presented a Back-PAQ-34 score change higher than the MDC. Finally, in post-intervention test, the Back-PAQ-34 score was significantly lower in the educational than in control group (−34.5 points; $p < 0.001$). Table 2 presents all 34 items with the mean differences. Ranked from the largest to the smallest change (Table 2), the five Back-PAQ items that demonstrated the most significant improvements were 8, 5, 3, 30 and 9 (all $p < 0.001$). Surprisingly the responses to item 4 did not shift significantly in the expected direction ($p = 0.022$).

Figure 4.

Back-PAQ-34 scores in the 2 groups (control and educational) in pre- and post-intervention tests (mean ± standard deviation). ***: significant difference ($p < 0.001$).

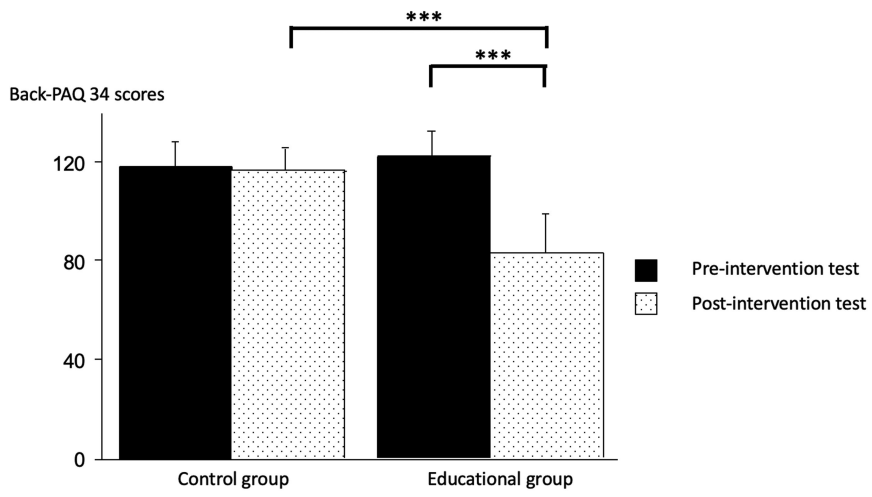


Table 2.

Back-PAQ items score before and after the biopsychosocial education.

Question	Educational group pre-intervention test		Educational group post-intervention test		Mean difference	p-value
	Mean	SD	Mean	SD		
8) Good posture is important to protect your back	4.94	0.24	2.29	1.61	2.65	<.001
5) Lifting without bending the knees is not safe for your back	4.82	0.53	2.24	1.48	2.59	<.001
[a]3) Bending your back is good for it	4.18	1.33	1.71	1.21	2.47	<.001

Question	Educational group pre-intervention test		Educational group post-intervention test		Mean difference	p-value
	Mean	SD	Mean	SD		
[a]30) Focusing on things other than your back helps you to recover from back pain	3.41	1.70	1.41	0.51	2.00	<.001
9) If you overuse your back. it will wear out	4.59	0.51	2.65	1.69	1.94	<.001
[a]16) Stress in your life (financial. work. relationship) can make back pain worse	3.06	1.60	1.24	0.44	1.82	<.001
10) If an activity or movement causes back pain. you should avoid it in the future	3.94	0.90	2.18	1.51	1.76	<.001
[a]1) Your back is one of the strongest parts of your body	3.00	1.27	1.35	0.61	1.65	<.001
23) It is important to see a health professional when you have back pain	4.53	0.72	2.88	1.58	1.65	<.001
[a]31) Expecting your back pain to get better helps you to recover from back pain 2	3.29	1.61	1.65	0.79	1.65	<.001
11) You could injure your back if you are not careful	5.00	0.00	3.41	1.50	1.59	<.001
[a]15) Thoughts and feelings can influence the intensity of back pain	3.00	1.54	1.47	1.01	1.53	<.001
6) It is easy to injure your back	4.82	0.39	3.35	1.73	1.47	0.002
22) If you ignore back pain. you may cause damage to your back	4.29	0.59	2.82	1.70	1.47	0.001
[a]17) When you have back pain. you can do things which increase your pain without harming the back	3.00	1.22	1.65	0.93	1.35	0.002
21) If your back hurts. you should take it easy until the pain goes away	3.47	1.42	2.18	1.70	1.29	0.002
13) Back pain means that you have injured your back	2.88	1.45	1.59	1.12	1.29	0.009
34) Once you have a back problem. there is not a lot you can do about it	2.88	1.50	1.59	1.12	1.29	0.002
32) Once you have had back pain there is always a weakness	3.53	1.37	2.24	1.44	1.29	<.001
[a]2) Your back is well designed for the way you use it in daily life	2.41	1.23	1.18	0.53	1.24	0.001
[a]29) Worrying about your back can delay recovery from back pain	2.71	1.26	1.71	1.21	1.00	0.030

Question	Educational group pre-intervention test		Educational group post-intervention test		Mean difference	p-value
	Mean	SD	Mean	SD		
14) A twinge in your back can be the first sign of a serious injury	2.88	1.22	2.12	1.45	0.76	0.011
25) If you have back pain you should avoid exercise	2.24	1.39	1.47	1.12	0.76	0.011
19) It is worse to have pain in your back than your arms or legs	3.59	1.62	2.88	1.54	0.71	0.055
18) Having back pain makes it difficult to enjoy life	4.53	1.01	3.82	1.33	0.71	0.055
26) When you have back pain the risks of vigorous exercise outweigh the benefits	3.65	1.00	3.00	1.66	0.65	0.180
12) You can injure your back and only become aware of the injury sometime later	4.88	0.33	4.29	1.05	0.59	0.056
33) There is a high chance that an episode of back pain will not resolve	3.12	1.17	2.59	1.54	0.53	0.177
24) To effectively treat back pain you need to know exactly what is wrong	4.41	1.00	4.00	1.54	0.41	0.3
[a]27) If you have back pain you should try to stay active	1.47	0.87	1.06	0.24	0.41	0.090
[a]28) Most back pain settles quickly. at least enough to get on with normal activities	2.18	0.64	1.76	1.15	0.41	0.186
20) It is hard to understand what back pain is like if you have never had it yourself	4.47	1.18	4.41	0.94	0.06	0.842
7) It is important to have strong muscles to support your back	4.59	0.51	4.82	0.53	−0.24	0.163
4) Sitting is bad for your back	2.76	1.48	4.00	1.27	−1.24	0.022

The items are ordered from the largest change to smallest change. Lowest scores are associated with more helpful beliefs (1 = false and 5 = true).

a scores are reversed for items worded in the reverse direction so that a lower score also indicates that the helpful belief is more strongly held.

Discussion

Previous studies have demonstrated a strong association between unhelpful beliefs and pain perception, disability, and the transition to chronic pain.[19] In this study, an educational programme based on the biopsychosocial model of pain positively impacted LBP beliefs in meat processing workers, a particularly exposed population, as 79% had experienced an episode of LBP in the preceding three months.

The training sessions presented the current evidence on the multifaceted nature of pain, emphasised the role of self-management, and directly challenged common misconceptions (e.g., "*the back is fragile and it needs to be protected*"). This intervention combined theory, discussion, active participation with a specialist, and concrete case studies. Consequently, this approach appeared effective for the study's

objective.

Physical activity levels in the control (967 MET-min/week) and educational, (724 MET-minute/week) groups indicated a moderate level of physical activity.[37] Social support scores in the control (JCQ = 24.7) and educational (JCQ = 24.2) groups suggested that social support at work was perceived as positive in both groups.[38] TSK-11 scores in the control (25.9) and educational (26.1) groups indicated a moderate level of fear of movement,[39] similar to that observed in patients with chronic LBP.[39]

In the pre-intervention test, the mean Back-PAQ score (120.5) was higher than that observed in people without specific physiotherapy training (113.2),[41] highlighting the prevalence of unhelpful beliefs about LBP in this population and supporting the value of setting up a training programme.

In the post-intervention test, the mean Back-PAQ score in the educational group (83.0) was similar to the average score of first-year physiotherapy students (87.7), reported by Christe et al. in their study on physiotherapy students,[42] suggesting substantial improvement in pain-related beliefs on the educational group. These results align with previous studies on the efficacy of educational programmes in modifying pain-related beliefs in healthcare professionals. For instance, Christe and colleagues observed a 26.9-point reduction in Back-PAQ scores among physiotherapy students following a spinal management module. The mean reduction of 39.5 points in Back-PAQ scores observed in the educational group highlights the positive impact of the intervention. In contrast, the score of the control group did not change, reinforcing the stability of scores in the absence of intervention.

The MDC calculated in our population (12.6) was similar to that reported by Demoulin et al. in their study (14.5).[30] The mean reduction in Back-PAQ scores (39.5 points) between pre- and post-intervention was approximately threefold greater than the MDC threshold (12.6), and 94% of participants in the educational group exhibited a change exceeding this threshold. These findings indicate that our intervention met its objective of improving LBP beliefs in this physically demanding work population.

This type of biopsychosocial intervention on back pain beliefs[27,42,43] or pain intensity[26] has previously been implemented only in healthcare and caregiving workers. In the present study, workers may hold different fundamental beliefs about back pain, partly due to lower health literacy and greater exposure to physical risk factors. Nevertheless, our results suggest that educational interventions are equally, if not more, effective in this population, supporting the idea that pain beliefs can be changed across occupational groups, particularly among industrial workers.

What's really changing about LBP beliefs?

An item-by-item analysis of Back-PAQ scores in the educational group was performed to understand changes in workers' beliefs. Twenty-five of the 34 items showed significant positive change, with higher scores in the post-intervention test. The most notable changes concern beliefs about the relationship between posture and back pain. The largest improvements were observed for items "*8) Good posture (…)"* and "*5) Lifting without (…)*". These changes were consistent with those previously described in a population of physiotherapy students.[42] Better responses to these items are particularly relevant, as they relate to the core tasks of the workers' daily activities, which involve handling and carrying loads.

In contrast, items "*4) Sitting is (…)*" and "7*) It is important (…)"* performed less well post-intervention test. This may indicate that the messages communicated during training need refinement to avoid misunderstanding. For the item relating to sitting posture, this finding is notable because participants worked exclusively in a standing position. It appears that they may have developed concerns about the dangers of sitting, despite not being exposed to this posture in their daily work.

Strengths and perspectives

The reduction in unhelpful beliefs about back pain, as measured by the Back-PAQ scores, demonstrates the effectiveness of the intervention. Based on existing literature, this suggests that the intervention could potentially help reduce the risk of LBP becoming chronic by targeting cognitive factors that contribute to pain persistence. These findings highlight the potential of targeted educational intervention to improve beliefs and influence the long-term trajectory of LBP.

A methodological strength of our study is the use of the Back-PAQ-34 questionnaire. While widely used in research, the Back Beliefs Questionnaire (BBQ) lacks specificity regarding movement-related fears, biomechanical misconceptions, and pain management beliefs – crucial aspects in workplace settings involving frequent physical tasks. Conversely, the Back-PAQ-34 offers a more comprehensive evaluation by assessing beliefs about the causes, consequences, and management of back pain. This broader scope enables a more nuanced understanding of how education influences various dimensions of pain perception. However, as the BBQ focuses more on chronicity and disability beliefs, it may underestimate shifts in movement-related fears or biomechanical misconceptions. Future research should examine whether these two tools show different sensitivities to change, particularly in occupational settings where the risk of

movement-avoidance behaviours is high.

One of the key strengths of this approach was the collaboration and involvement of the company's management as well the willingness of the workers. This is an essential factor in the success of the study. Additionally, conducting the research on the company's premises was a strength of the research protocol. The company's commitment to investigating health parameters and collaborating with research to develop training sessions and improve the health of its employees is also a very positive indicator.

Limitations

Several limitations of this study must be acknowledged. First, the allocation of participants was performed at the level of intact work sectors (packing versus labelling), reflecting real-world industrial constraints related to the organisation of training sessions. This approach, instead of randomising, may limit strict comparability between groups. Despite our initial assumptions, these two sectors may differ slightly in specific biomechanical demands, work pace, or micro-organisational culture. Furthermore, while we controlled for several sociodemographic and psychosocial variables at baseline, the two groups may still differ in terms of non-measurable characteristics (e.g., individual coping strategies or personal life stressors). Certain limitations need to be considered when interpreting these results, including potential confounding factors and the long-term durability of these changes. A cohort follow-up study would provide valuable insights into the long-term effects of the intervention on the evolution and possible chronicity of LBP, as well as its potential to influence pain-related outcomes over time. Such studies could help to refine our understanding of the relationship between beliefs, pain severity, and the course of LBP, ultimately informing more effective strategies for prevention and management, Beales et al. noted that improvements in back pain beliefs might diminish if not reinforced.[27] Therefore, future research should include follow-up assessments to evaluate the long-term sustainability of these effects. Second, while the Back-PAQ-34 provides a broader assessment, it remains self-reported. Future studies should consider combining it with behavioural measures (e.g., physical activity practice levels) to assess whether changes in beliefs translate into real-world behaviour. Finally, it may be difficult to involve workers from the meat processing industry, as it requires giving them time away from work for questioning and training.

Concluding remarks

In summary, our study supports the effectiveness of an educational intervention in modifying back pain beliefs among workers in a physically demanding industry. The inclusion of a control group strengthens the causal interpretation of our results. Moreover, the Back-PAQ-34 provided a comprehensive evaluation of belief changes, revealing a substantial reduction in misconceptions post-intervention test. Further research is still required to explore their long-term impact and the comparative sensitivity of different belief assessment tools. A word of caution: this type of approach must not absolve the company of its responsibility and role in a primary preventive approach aimed at reducing exposure to occupational risk factors for LBP in the workplace, which are physical workload (manual handling and carrying of heavy loads, awkward postures, whole-body vibrations and sedentary work) and psychosocial risk factors. This study was conducted to provide initial support for the relevance of training programme based on the biopsychosocial model of pain for limiting the process of LBP chronicity and more globally improving musculoskeletal health management in an industrial environment.

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Ethical approval

This study was performed in accordance with the ethical standards of the Helsinki declaration and its subsequent revisions. Ethical approval was provided by the local ethics committee of Université de Picardie Jules Verne, CERNI (n° 2023-09-6 /2024-30). All data were stored securely, in line with the European Union's General Data Protection Regulation and the guidelines issued by the French National Data Protection Commission (Commission Nationale de l'Informatique et des Libertés, Paris, France). All participants gave written informed consent.

Informed consent

All participants provided written informed consent prior to taking part in the study.

Author contributions

N.R., A.F., T.L. and F.T. conceived the ideas; N.R. collected the data; N.R., A.F., T.L. and F.T. analyzed the data; and F.T. led the writing.

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Declaration of conflicting interests

[GQ3]The first author is PhD student and an employee of the industrial company where the data collection took place. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

Supplemental material

Supplemental material for this article is available online.

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