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Pain anxiety and fear of (re)injury in patients with chronic back pain: Sex as a moderator

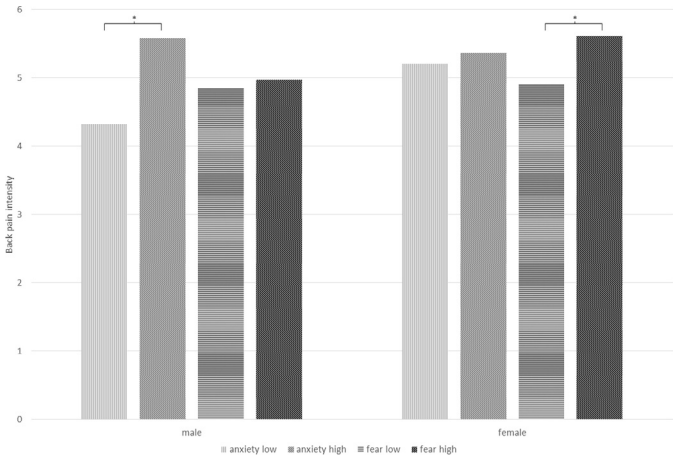
Nina Kreddig*, Monika I. Hasenbring

Department of Medical Psychology and Medical Sociology, Faculty of Medicine, Ruhr-University of Bochum, Universitätsstrasse, 44780 Bochum, Germany

HIGHLIGHTS

- Sex as a moderator in anxiety/fear and pain is suggested for the first time.
- Anxiety and fear are discussed as related, but distinct concepts.
- Pain anxiety is associated with pain intensity in men, but not in women.
- Fear of pain is associated with pain intensity in women, but not in men.

GRAPHICAL ABSTRACT



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ABSTRACT

Background and aims: Anxiety and fear are increasingly seen as related, but distinct concepts, with anxiety describing a reaction to unclear or future threats, and fear to immediate threats. Anxiety and fear both play influential roles in pain. Yet, the two concepts have not been clearly distinguished in pain research. Their reported intensity differs between the sexes, and sex differences in the way pain anxiety and fear of (re)injury relate to pain intensity have been found separately in previous studies. However, they seem to be of a curious nature: In one study, pain anxiety was associated with elevated pain intensity in men, while in another, fear of (re)injury was associated with elevated pain intensity in women. This indicates a moderator effect of sex. The present study is the first to unite previous findings, and to show a more integrative picture, by examining and discussing this moderator effect of sex in a joint study of both pain-related anxiety and fear in both sexes.
Methods: In 133 patients (mean age 43.6 years, 62% female) with chronic low back pain (mean duration 7.7 years), sex differences were examined with correlations and a multiple linear regression analysis with interaction terms. Differences between subgroups of low and high anxiety/fear were explored via *t*-tests, following previous studies.

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* Corresponding author at: Ruhr University Bochum, Department of Medical Psychology and Medical Sociology, Universitätsstrasse 150, 44780 Bochum, Germany.
E-mail addresses: kreddig@medpsych.rub.de (N. Kreddig), hasenbring@medpsych.rub.de (M.I. Hasenbring).

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Results: Sex was supported as a moderator in the association of pain intensity with pain anxiety (PASS-20), and fear of (re)injury (TSK). Higher pain intensity was linked to higher pain anxiety only in men, and to higher fear of (re)injury only in women. A basic regression model with fear, anxiety, sex and disability as predictors ($R^2 = .14$, $F(4,123) = 3.24$, $p = .042$) was significantly improved by the addition of the interaction terms Fear × Sex and Anxiety × Sex ($R^2 = .18$, $F(2,121) = 4.90$, $p = .001$), which were both shown as significant predictors for pain intensity. Further *t*-tests revealed a significant difference in pain intensity between high and low anxiety in men ($t(47) = -2.34$, $p = .023$, $d = -.43$), but not in women. Likewise, a significant difference in pain intensity between high and low fear showed in women ($t(80) = -2.28$, $p = .025$, $d = -.42$), but not in men.
Conclusions: The results support a moderator effect of sex and suggest differential mechanisms between the sexes in pain anxiety and fear in development and maintenance of back pain. The current study is the first to report and analyse this moderator effect. As potential underlying mechanisms, evolution and socialization are discussed, which may elucidate why fear might be more relevant for pain in women, and anxiety more relevant for pain in men.
Implications: The results indicate the need for a more cautious conceptual separation of fear and anxiety in research. Future studies on fear and anxiety in pain should be aware of the distinction, in order to avoid reporting only half of the picture. The next step would be to solidify the results in different samples, and to examine whether a distinction between anxiety and fear in the sexes could have any benefit in pain treatment.

1. Introduction

Chronic back pain, with a reported lifetime prevalence of about 20% [1], is considerably linked to disability, personal discomfort [2,3] and work absence [4]. Chronic pain interacts with cognition, behaviour and emotion, whereby especially emotional aspects like anxiety and fear are known to play an important role in its onset and maintenance [5].

Fear and anxiety are often considered as synonymous, an approach that is increasingly challenged by studies presenting evidence for anxiety and fear as distinct concepts [6–8]. Anxiety is described as a diffuse worry about a future threat, preparing the individual for its potential arrival, and is characterized by behavioural inhibition, risk assessment and a hypervigilant surveillance of the surroundings ("stop, look and listen"). Fear, by contrast, represents a concrete reaction to an already present threat, preparing the individual for "fight-flight-freeze" [6,7]. This distinction leads to different opportunities for action, which could benefit from being treated differently in pain treatment. Anxiety, being diffuse and future-oriented, concentrates on negative cognitive biases, worries and rumination, and it comprises a lot more possibilities, as the threat has not arrived yet. Fear, on the other hand, with a concrete, present threat, is limited to the three options of fight-flight-freeze. In treatment, the distinction between fear and anxiety could help improve the outcomes. If a patient is suffering from a concrete, present-oriented fear of pain, a treatment approach with confrontational techniques may be helpful. A patient suffering from pain-related anxiety, which revolves around uncertain, future-directed worries, may benefit more from techniques of cognitive restructuring and fighting rumination.

To measure specifically pain-related anxiety and fear, different concepts are employed. Among the most commonly used are "pain anxiety", "fear of pain", "kinesiophobia", or "fear of (re)injury". Pain-related anxiety and fear are linked with pain severity and pain-related disability in patients with pain [9–11]. The concepts represent anxiety and fear with an emphasis on one or the other, but are rarely constructed to sharply mirror the differences [6,12]. The lack of clear distinction could also be a potential reason for inconsistent results in research, which is the reason why looking deeper into these theoretical concepts is a worthwhile endeavour in untangling the issue.

In both sexes, pain-related anxiety and fear play a role in pain experience and pain behaviour, and sex differences are reported for both pain and anxiety/fear. In women, higher prevalences for most pain disorders, and higher pain intensity [13,14] as well as lower pain tolerance, and pain threshold [15,16] are reported frequently, but not consistently [17,18]. While sex differences were also shown in several concepts of anxiety and fear [19–21, for a review see 22], the exact interaction of fear and anxiety with pain in the sexes appears curious. Using the Pain Anxiety Symptoms Scale (PASS), Edwards et al. [14,23] found that men with high pain anxiety reported significantly stronger pain than men with low pain anxiety, while no such difference appeared in women. Bränström and Fahlström [24] studied fear of (re)injury with the Tampa Scale of Kinesiophobia (TSK) and found that women with high fear of (re)injury reported significantly stronger pain than women with low fear of (re)injury, while no such difference showed in men.

This discrepancy in how anxiety and fear relate differently to the sexes has not received a lot of attention yet, and none so far in pain research. It appeared as an incidental finding in the Bränström and Fahlström study, where it was subsequently not discussed, while Edwards et al., following their results, naturally assumed a unilateral influence. Each study may only paint half of the picture. To fill this gap, the present study is the first to examine the differential effect of anxiety and fear on pain intensity in the sexes. To this end, the relations of both pain-related anxiety and fear of (re)injury with pain intensity are examined in a single sample of chronic low back pain patients. The main question is: Is there a moderator effect for sex in the relationship of pain-related anxiety and fear with pain?

2. Methods

2.1. Participants

From 8 orthopaedic practitioners, 133 patients with chronic (>3 months) lower back pain and none or minor organic findings were consecutively recruited for this study. Inclusion criteria were pain without distal radiation, age above 18 years and ability to read German fluently. Exclusion criteria were severe injuries of the back (e.g., neoplasms, fractures and herniated discs that required immediate surgery) and major psychiatric illnesses, the latter were assessed via medical records. Prior to their participation, written informed consent was obtained from all individual participants included in the study. The study protocol was approved by the medical ethics committee of the Ruhr University of Bochum.

2.2. Measures

2.2.1. Demographic data, pain history variables and pain intensity rating

Sex, age, education and medical history were assessed using a general demographic and pain history checklist. Psychosocial gender was not assessed. Patients rated their average pain intensity during the past 3 months on a scale from 0 ('no pain') to 10 ('most intense pain imaginable').

2.2.2. Fear of movement or (re)injury

The Tampa Scale of Kinesiophobia (TSK-11) is an 11-item self-report questionnaire measuring kinesiophobia [25,26], defined as fear of movement and/or (re)injury. Patients rate each item on a 4-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The TSK-11 consists of two scales, Somatic Focus and Activity Avoidance. Example items are "My body is telling me I have something dangerously wrong" or "Pain lets me know when to stop exercising so that I don't injure myself", and reveal an emphasis on fear [27]. The TSK-11 is a short version of the original TSK, with improved, satisfactory internal consistency ($\alpha = .73$) and validity for the German version [28].

2.2.3. Pain anxiety

The Pain Anxiety Symptoms Scale (PASS-20) [29] is a self-report questionnaire assessing aspects of pain anxiety. It comprises 20 items which are rated on a 6-point Likert scale ranging from 0 ('never') to 5 ('always'). The PASS-20 measures four specific aspects of pain anxiety: cognitive anxiety, fear, physiological anxiety, and escape/avoidance. Typical items are "When I feel pain I am afraid that something terrible will happen" or "I try to avoid activities that cause pain", which reveal the focus of the PASS-20 on anxiety [27]. The PASS-20 is a short version of the original PASS [30], and retains the four-factor structure and the satisfactory reliability and validity of the original version [29]. Reliability ($\alpha = .90$) and validity of the German version are satisfactory to excellent [31].

2.2.4. Disability

The Oswestry Disability Index [32] is used to measure disability related to low back pain via self-report. It covers ten areas of disability, among them pain intensity, physical abilities, self-care abilities, and general participation in life. Each area is represented by 6 statements, which the patient scores on a scale of 0–5, with 5 indicating most severe disability. Reliability ($\alpha = .96$) and validity of the German version are excellent [33].

2.2.5. Distinction of fear of (re)injury and pain anxiety

The concepts of fear of (re)injury and pain anxiety are rarely sharply differentiated, neither in research nor in questionnaires [12]. The differentiation is out of the scope of this paper and interested readers can find validity analyses in our previous research [27,28,31] that are in line with the notion that the TSK measures aspects of fear rather than anxiety, while the PASS measures aspects of anxiety rather than fear.

2.3. Statistical analysis

The associations between pain, anxiety and fear were studied with Pearson product moment correlations, for the whole group and separately for each sex. Significant differences in the magnitude of the correlations were checked with a one-tailed Fischer's *Z*-test, as the directionality of the effect was already known. To examine the potential moderator role of sex in the association of pain anxiety and fear of (re)injury with pain intensity, a multiple linear regression was conducted [following 34] with pain intensity (3 months) as the dependent variable. The main variables Sex, TSK-11 and PASS-20 were entered in a first block, two interaction terms, TSK-11 × Sex and PASS-20 × Sex, were introduced in a second block, in order to check their additional contribution to the model. Disability (ODI) was also entered in the first block to control for its potential influence. All variables were centred in order to keep the interpretability of beta and to avoid multicollinearity (VIF range 1.06–1.86). The enter method was chosen in the regression analysis, in order to compare the beta weights. Advantages of one predictor over another were not of specific interest for the research question. Subsequently, subgroups of low and high anxiety (PASS-20) and low and high fear (TSK-11) were established by sex-specific median split [following 23]. To examine the exact nature of the moderator effect of sex, the differences in pain intensity between the subgroups (high and low anxiety/fear, male and female), each for pain anxiety and fear of (re)injury, were examined with separate *t*-tests [following 23,24], to enable a direct comparison of the present results with the previous studies. *T*-tests were also carried out for group differences regarding pain anxiety, fear of (re)injury, pain intensity and pain duration.

2.4. Procedure

All questionnaires were administered in their German versions. All measures were presented online in the research department.

3. Results

3.1. Sex differences in fear of (re)injury and pain anxiety

Regarding fear of (re)injury (TSK-11), *t*-tests revealed a significant difference in the mean score between the sexes, with men reporting significantly more fear of (re)injury. For pain anxiety (PASS-20), disability, age, pain intensity and pain duration, no significant general sex difference was found (see Table 1).

3.2. Correlation analyses of fear of (re)injury, pain anxiety, pain and sex

Fear of (re)injury showed a significant correlation with pain in women ($r = .249$, $p = .024$), and was almost entirely unrelated to pain in men ($r = -.009$, $p = .95$). The difference between the correlations in the sexes showed a trend ($z = 1.43$, $p = .076$). In pain anxiety, a trend correlation for men ($r = .254$, $p = .079$), and a non-significant correlation in women ($r = .180$, $p = .11$) was observed, there was no significant difference in the correlation between the sexes ($z = .42$, $p = .34$). The correlation between fear of (re)injury and pain anxiety was moderate-to-high ($r = .521$, $p < .001$) for the whole group, and significantly ($z = 1.67$, $p = .050$) higher in men ($r = .661$, $p < .001$) than in women ($r = .453$, $p < .001$).

3.3. Interaction between sex, pain anxiety/fear and pain intensity

The multiple linear regression analysis revealed a significant contribution to the model by the two interaction terms TSK-11 × Sex and PASS-20 × Sex. The model with the interaction variables significantly explained variance ($R^2 = .18$, $F(2,121) = 4.90$, $p = .001$) in pain intensity, and showed an improved prediction compared to the model without interaction terms ($R^2 = .14$, $F(4,123) = 3.24$, $p = .042$). Both interactions between sex and the TSK-11 ($\beta = .226$, $t(121) = 2.16$, $p = .033$) and sex and the PASS-20 ($\beta = -.250$, $t(121) = -2.34$, $p = .021$) were revealed as significant predictors (see Table 2) for pain intensity. They explained unique variance in addition to the predictors Sex, TSK-11, PASS-20 and ODI. The interpretation was restricted to the interaction effects, as it is advisable to tread with caution when interpreting main effects in a regression with interaction terms.

Table 1
Demographic and psychological data for male and female patients.

	All	Men	Women	Sig. m/w*	%
Sex		50	83		38/62
Age	43.6 ± 11.2	44.2 ± 10.6	43.2 ± 11.6	.62	
Pain duration (years)	7.7 ± 8.9	8.6 ± 8.4	7.1 ± 9.2	.37	
Anxiety (PASS-20)	33.5 ± 16.0	34.5 ± 14.6	32.9 ± 16.9	.59	
Fear (TSK-11)	21.6 ± 5.3	22.9 ± 5.0	20.8 ± 5.3	**.03**	
Disability (ODI)	8.7 ± 5.7	7.8 ± 5.7	9.2 ± 5.6	.17	
Pain intensity (3 months)	5.2 ± 1.7	4.9 ± 2.0	5.3 ± 1.4	.29	
Education					
- Lower					29.2
- Intermediate					22.5
- Higher					45.8
- Other					2.5

Data are presented as means ± standard deviations. *p-Values of the difference between men and women, significant differences are printed in bold.

Table 2
Blockwise linear regression analysis with interaction terms for PASS-20 × Sex and TSK-11 × Sex (N = 133), with pain intensity as the dependent variable.

Model	Predictor	B	SE B	β	t	p
1	(R^2 = .14, F(4,123) = 3.24, p = .042)					
	PASS-20	.006	.011	.057	.551	.583
	TSK-11	−.001	.032	−.002	−.023	.981
	Sex	.216	.298	.063	.725	.470
	ODI	.097	.028	.332	3.486	.001
2	(R^2 = .18, F(2,121) = 4.90, p = .001)					
	PASS-20	.019	.012	.178	1.584	.116
	TSK-11	−.031	.034	−.097	−.924	.357
	Sex	.172	.294	.050	.583	.561
	ODI	.092	.028	.314	3.342	.001
	PASS-20 × Sex	−.056	.024	−.250	−2.336	.021
	TSK-11 × Sex	.152	.070	.226	2.163	.033

B: un-standardised beta coefficient, SE B: standard error, β: standardized beta coefficient, t: t-test statistic, p = significance value.

The groups were split at the median, following [23], at 36 for the men and 30 for the women in the PASS-20, and 19.5 for the women and 23 for the men in the TSK-11. T-tests showed a significant difference between low-anxiety and high-anxiety men as classified by the PASS-20 (t(47) = −2.34, p = .023, d = −.43), in which high-anxiety men reported significantly more intense pain than low-anxiety men. No significant difference was observed between low-anxiety and high-anxiety women (see Fig. 1). T-tests also revealed significant differences in pain intensity between low-fear and high-fear women as classified by the TSK-11 (t(80) = −2.28, p = .025, d = −.42), in which high-fear women reported significantly more intense pain than low-fear women. No significant difference showed between low-fear and high-fear men (see Fig. 2).

4. Discussion

In a sample of patients with chronic pain, the sexes did not differ significantly in pain anxiety, which is supported by earlier studies [19,23], or pain intensity, which was also reported previously

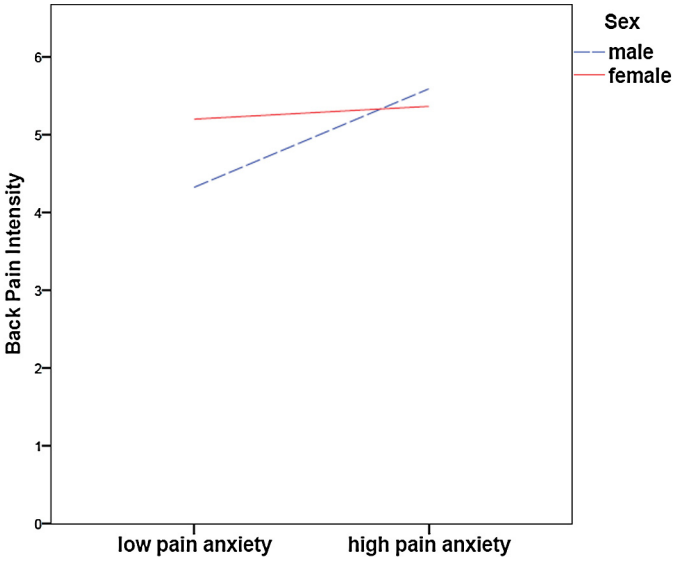

Fig. 1. Between low and high pain anxiety, only men show a significant difference in pain intensity.

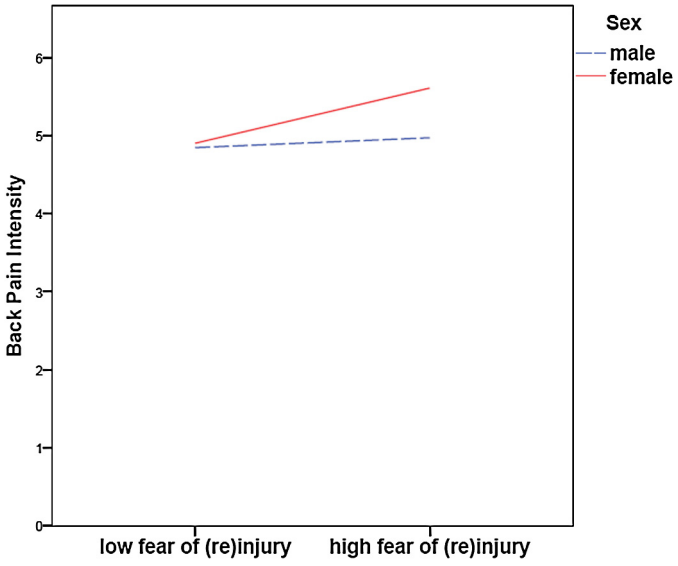

Fig. 2. Between low and high fear of (re)injury, only women show a significant difference in pain intensity.

[23,24,35,36]. In fear of (re)injury, men showed higher fear than women, which at first seems surprising, but is in line with the literature [24,37,38]. Explanations for the higher fear of (re)injury in men are currently scarce and largely undiscussed in previous studies. It may originate from easier fear conditioning in men [39] or the higher relevance of movement in "male" professions [40]. However, in the present study, this elevated fear of (re)injury in men was almost entirely unrelated to pain, and was only associated with pain in women. Pain anxiety, on the other hand, showed a trend association with pain in men, and no significant association with pain in women, but this sex difference did not reach significance. Overall, these results indicate a moderator effect of sex. The present study is the first to report and discuss differential effects of fear and anxiety on pain intensity in the sexes.

Further support for the moderator effect of sex on the relationship between anxiety/fear and pain was provided by the linear regression, which revealed sex as a moderator in the relationship of pain anxiety and fear of (re)injury with pain. Post hoc analyses showed that high pain anxiety was associated with high pain intensity in men and not in women, while high fear of (re)injury was associated with high pain intensity in women and not in men. These specific links of pain anxiety and fear of (re)injury with pain intensity in the sexes support the hypothesized moderator effect of sex that was indicated in previous studies [23,24], in which anxiety and fear were studied separately. Since this finding was previously undiscussed, the question remained open: Why would anxiety be more relevant for men, and fear more relevant for women? We attempted to explain the reported effects and found promising approaches in aspects of evolution and socialization.

The present results, pertaining specifically to pain-related fear and anxiety, are consistent with results from previous studies, which have showed differences in general fear and anxiety between the sexes [7,19,20,41]. Perkins and Corr [42] reported that women facing threat reacted preferentially with flight, which is associated with fear. In contrast, men rather reacted with risk assessment, which is associated with anxiety [7]. Pain can take the role of the threat eliciting the different behaviours that characterize fear and anxiety. From an evolutionary perspective, flight, which is associated with fear and a perceived closer proximity of threat [7], might have been a better choice for women than fight, as women typically show lower physical fighting abilities [43], but simultaneously bear a much higher relevance for the survival of their offspring than men [44,45]. Observational studies with primates accordingly showed that females tend to move away from danger [43]. Thus, it is plausible that women may have benefited more than men from an easily triggered very early warning system (fear) that prompts immediate escape. Their superior interoception [46] and their perception of bodily sensations as concrete and valuable information [46] may have prepared women for a perceived closer proximity of threat, prompting their fear. In contrast, men tend to ignore information from within, and perceive it as more diffuse [47], possibly prompting anxiety. Relatedly, symptom reporting was found associated with trait negative affect in women and health anxiety in men [20]. This way, evolution may have shaped humans for the facilitated fear reaction in women and anxiety reaction in men that is still observable today.

Yet, there are also mechanisms based in current socialization which may inspire the sex difference seen in the results. Adult men and women differ in terms of self-efficacy [48], and this difference has an early start. Typically, boys experience a greater degree of personal control, which lowers the anxiety risk [49], than girls [50,51]. As Barlow et al. [8] consequently comment, instead of fundamental biological differences, personal control may be distributed unequally between the sexes. Whether fear or anxiety is experienced in reaction to a threat, in this case a pain stimulus, may be dependent on these past control experiences. This may also explain why men, despite reporting higher fear than women, do not experience ramifications from that elevated fear, as they may know better how to handle it. If women, on the other hand, are generally affected by low(er) levels of perceived control over the course of their lifetime, they may have developed more, and more concrete, emotion regulation behaviour to help them cope with the pain than men, which was reported [52]. Men, by contrast, may for the first time experience a substantial lack of personal control when they have chronic pain. This may lead to feeling unequipped to cope with the situation and to worry and rumination, reflected in anxiety, which may be elicited in high-pain men as a reaction to chronic pain. Anxiety in men may also be particularly relevant in longer-lasting pain, as their initial behaviour in reaction to pain may not necessarily be fear/anxiety. The control experiences that enable men to feel a higher self-efficacy may prompt them to react with anger ("fight") as opposed to fear ("flight") [8,53,54] when they first experience pain. It was accordingly shown that men were more likely than women to react to threat with attack [42]. Additionally, men's body attitudes are instrumental. Men see their bodies as machines that have to function [55], and over 50% of them even see their body as an opponent [55], a sentiment which may prompt anger and fight when the body does not work properly. Consequently, it is possibly only when the men notice that anger and fight behaviours do not change the pain that a feeling of loss of control and uncertainty develops as a long-term consequence to lasting pain, resulting in anxiety.

The present study has several limitations that should be noted. It was part of a multicentre study about chronic back pain, limiting the results to chronic back pain. The results cannot be generalized to other pain diagnoses or healthy subjects. Overall, the effect is small. Yet, there is merit in presenting the idea (previously reported but undiscussed) that (a) women's pain is affected by fear and (b) the relationship of pain with fear/anxiety is moderated by sex. Therefore, we believe that the present study is a worthwhile addition to the existing literature on differences between the sexes and differences between fear/anxiety, as well as their intersection. This is especially important in pain, where differences in fear and anxiety are currently underreported, while the intersection has not been researched at all. In our sample, men showed a higher fear of (re)injury than women. This finding may at first seem surprising, but is supported by the literature [23,24,35,36]. Therefore, we have no reason to believe that our sample is unusual in this regard. A general concern is that the conceptual differences between the instruments used in the present study are not clear [12]. There may be some overlap in the measures, although validity examinations [27,28,31] support the TSK as a measure of fear of (re)injury and the PASS as a measure of pain anxiety. All measures of the present study were self-reported, and pain intensity was measured on a visual analogue scale from 0 to 10, which may limit the results accordingly.

5. Conclusions

The sex differences in the association of pain intensity with fear of (re)injury and pain anxiety, which were shown separately in previous studies, were now replicated together in one single sample of patients with chronic back pain, supporting sex as a moderator between pain intensity and fear/anxiety. The results unite two previously separate findings, and show a more integrated picture. They emphasize a likely difference between anxiety and fear that should be conceptually observed in research on the topic. Possible explanations for the present results include aspects of evolution as well as socialization.

6. Implications

The results have implications both for research and treatment. Studies about anxiety and fear in pain are numerous, yet often inconsistent. Sylvers et al. [6] suggest in their review that anxiety and fear are rarely conceptually separated in studies, and results are thus often confounded. The results from the present study are in line with this notion, and support a conceptual distinction of anxiety and fear that could help reconcile inconsistencies in this field of research. As research is ultimately used to improve treatment, it might be beneficial to differentiate important concepts like anxiety and fear, including their behavioural and cognitive aspects. Cognitive-behavioural therapy is a crucial component of psychological pain treatment, which is especially employed in chronic pain, targeting pain-related anxiety and fear issues. Anxiety and fear bear different opportunities for action: In anxiety, being future-oriented, there are many options to react, while fear, being present-oriented, is restricted to fight-flight-freeze. These differences could be considered in treatment, and approaches with different emphases could be employed to improve treatment outcomes. If pain is more closely linked with fear in women and anxiety in men, differential treatment approaches can be warranted to achieve better treatment outcomes. Female patients with pain may benefit from an emphasis on guided confrontational techniques and targeting flight behaviour, while male patients may improve with treatment emphasizing rumination or worries about pain. A sex difference in the influence pain anxiety has on treatment outcome was already shown by Edwards et al. [14], thus a worthwhile direction for further research would be to examine the suggested sex difference (in fear) regarding its influence on (treatment success).

Ethical issues

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the study.

Conflicts of interest

The authors declare that they have no conflict of interest. No funding sources were provided.

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