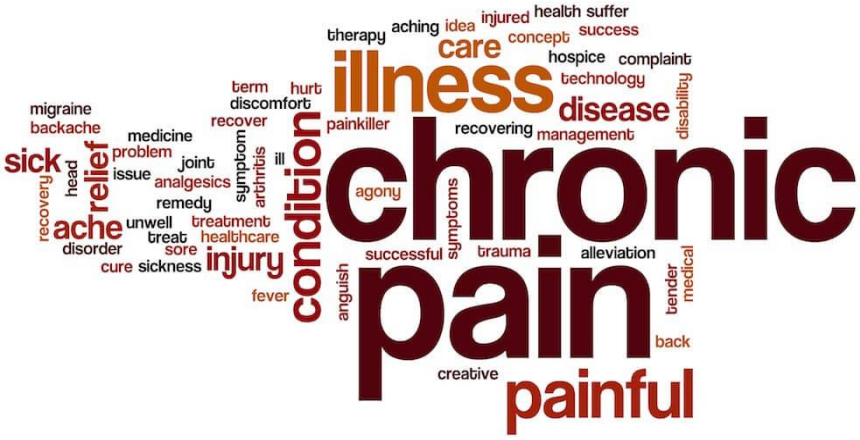

The Effect of Mental Health onto the Relationship of Pain Intensity and Pain Interference:

A Moderation Analysis.

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Abstract

The aim of this study was to determine the moderating effect of mental health on the relationship of pain intensity and pain interference in chronic pain sufferers. Therefore, a post-hoc moderation analysis of the randomized-control trial of Trompetter et al. (2014) was done with a convenience sample (N = 238) of individuals, suffering from chronic pain. The majority of the participants was age M = 57.72 (SD = 12.36), female (76.4%), had an intermediate level of education (68.8%), was married, lived together or in a registered partnership (74.3%), was not working (59.9%), had its complaints for more than five years (60.9%), suffered from daily complaints (92.8%), and had the diagnosis of fibromyalgia (20.3%). Data were collected using a demographic questionnaire, a Pain Numeric Rating Scale, the subscale Pain Interference of the Multidimensional Pain Inventory, and the Mental Health Continuum – Short Form. The results indicated that pain intensity positively correlates with pain interference, while mental health negatively correlates with pain interference. Furthermore, pain intensity and mental health accounted for a statistically significant amount of variance in pain interference. Finally, no significant interaction effect between pain intensity and mental health was found, but the results indicated that pain intensity and mental health do affect pain interference. These results implicated that mental health has no moderating effect on the relationship of pain intensity and pain interference. Despite, mental health could rather directly affect pain interference.

Samenvatting

Het doel van de huidige studie was het onderzoeken van het modererend effect van mentale gezondheid op de relatie tussen pijn intensiteit en pijn belemmering in chronische pijn patiënten. Om die reden werd een post-hoc moderatie analyse van het randomized control trial van Trompetter et al. (2014) met een convenience sample (*N* = 238) van chronische pijn patiënten uitgevoerd. Het merendeel van de participanten had een leeftijd van *M* = 57.72 (*SD* = 12.36), was vrouwelijk (76.4%), gemiddeld opgeleid (68.8%), was gehuwd, samenlevend of heeft in een geregistreerd partnerschap geleefd (74.3%), heeft niet gewerkt (59.9%), had de klachten al langer dan vijf jaren (60.9%), had dagelijks last van de pijn (92.8%), en had de diagnose fibromyalgie (20.3%). Data was verzameld met behulp van een demografisch enquête, een Pain Numeric Raing Scale, de subschaal pijn belemmering van de Multidimensional Pain Inventory, en de Mental Health Continuum – Short Form. De resultaten laten zien dat pijn intensiteit positief met pijn belemmering correleert en dat mentale gezondheid negatief met pijn belemmering correleert. Verder verklaren pijn intensiteit en mentale gezondheid een statistisch significant aandeel van de variantie in pijn belemmering. Ten slotte werd geen significant interactie effect tussen pijn intensiteit en mentale gezondheid gevonden, maar de resultaten laten zien dat pijn intensiteit en mentale gezondheid een invloed op pijn belemmering hebben. Deze resultaten impliceren dat mentale gezondheid geen modererend effect op de relatie tussen pijn intensiteit en pijn belemmering heeft. In plaats daarvan zou mentale gezondheid eerder een direct effect op pijn belemmering kunnen hebben.

Introduction

Chronic pain is a major health care problem, both in Europe and in the World in general (Breivik, Collett, Ventafridda, Cohen, & Gallacher, 2006; Turk, Wilson, & Cahana, 2011). From a survey of Breivik, Collett, Ventafridda, Cohen, & Gallacher (2006), it appeared that 19% of the European adults suffer from moderate to severe chronic pain. More general, the WHO estimates that 20% of the individuals worldwide suffer from some kind of chronic pain (Turk et al. 2011). Thereby, chronic pain, which is not derived by cancer, can be defined as "pain lasting longer than [three] months or beyond the expected period of healing of tissue pathology" (Turk & Okifuji as cited in Turk et al., 2011, p.2226). Unlike acute pain, which represents a symptom of an underlying acute disease or tissue damage, chronic pain constitutes a chronic disease of the nervous system (Cardosa et al., 2013). While acute pain arises suddenly and frequently due to an injury, chronic pain mostly arises gradually (Cardosa et al., 2013).

Chronic pain might come from an initially received injury or a continuing cause of pain like sensitive nerve endings (Cardosa et al., 2013). Additionally, chronic pain can occur although no injury is prevalent and no evidence regarding physical damage exists (Cardosa et al., 2013). This specific type of chronic pain, called "chronic benign pain", denominates chronic pain, in which a link between an organic damage and the perceived pain does not exist (Verhaak, Kerssens, Dekker, Sorbi, & Bensing, 1998, p.231). Whereas acute pain in general constitutes a sort of warning signal for physical damage, chronic pain has lost its warning function (Maxeiner & Leweke, 2016). Thereby, the course of chronic pain proceeds in waves and the pain level of chronic pain sufferers fluctuates over time (Cardosa et al., 2013). By that, it is common for chronic pain sufferers to have "bad days" as well as "good days", depending on the felt pain level. Furthermore, high levels of pain are frequently associated with re-injury and fear, which can result in fear avoiding behaviour (Cardosa et al., 2013). Considering the fact that chronic pain can lead to fear avoiding behaviour, chronic pain has not only lost its warning function, but it depicts false alarms (Cardosa et al., 2013). While acute pain is evaluated as positive due to its warning function, chronic pain is evaluated as negative, since it has no useful function (Gehling & Tryba, 2001). Regarding acute pain, the pain acceptance is stronger than in chronic pain. Acute pain sufferers want the pain to be bearable, while chronic pain sufferers preferably want to feel no pain at all (Gehling & Tryba, 2001). This decreases the pain acceptance of chronic pain sufferers. Finally, acute pain disappears if the tissue has healed or the acute disease has been cured, while chronic pain endures. Chronic pain does not disappear, although the healing process has been completed, quite apart from the specific case of chronic benign pain,

where no injury can be linked to the chronic pain at all (Cardosa et al., 2013; Verhaak et al., 1998). Frequently, chronic pain does even proceed in a progressive deterioration (Gehling & Tryba, 2001).

In general, chronic pain can be understood as a biopsychosocial disease (Kerssens, Verhaak, Bartelds, Sorbi, & Bensing, 2002; Niesert & Zenz, 2005). This means that chronic pain can evolve into an autonomous disease, which frequently goes along with a psychological change and which also affects the social surrounding of the chronic pain sufferer (Niesert & Zenz, 2005). Accordingly, the presence of chronic pain has many negative consequences. The individual itself experiences negative consequences in form of impairments in everyday and working life, emotional and social well-being and in the quality of life in general (Breivik et al., 2006). As the term “biopsychosocial disease” already implies, do chronic pain sufferers frequently and additionally suffer from mental diseases like depression, hypochondria or somatization (Gehling & Tryba, 2001; Niesert & Zenz, 2005, p. 1588). From their literature review, Bair, Robinson, Katon, and Kroenke (2003) concluded that, depending on the setting of the study, 5% to 85% of the patients with pain conditions additionally suffer from depression. In another study, Von Korff, Dworkin, Le Resche, and Kruger (1988) also found that different pain complaints were associated with an increase in depressive symptoms.

Suffering from chronic pain does not only affect the individual itself, but also the individual’s “significant others” (Turk, 2002, p. 356). By suffering from the chronic pain, also family members, spouses or partners become affected. Therefore, the absolute number of people, who is affected by chronic pain is expanding geometrically and more people than only the sufferers themselves are actually affected by chronic pain.

Next to those consequences, also society on a more general level gets affected. Thereby, society gets negatively affected by incurred costs, i.e. direct costs like health care costs and indirect costs like payments due to inability or a loss of productivity (Turk et al., 2011). In the UK, the estimation of annual costs for only lower back pain ranges from $26 billion to $49 billion (Maniadakis & Gray, 2000). In Germany, pain disorders in general are estimated to cost national economy €20.5 billion to €28.7 billion per year (Drießen, 2004).

Summarizing, a lot of negative consequences on different levels are evoked by chronic pain. The individual itself gets physically as well as mentally affected in different life domains.

Furthermore, the “significant others” of the pain sufferer as well as society become affected (Turk, 2002, p. 356). Therefore, the need to successfully alleviate chronic pain is essentially given.

Due to the frequent co-occurrence of chronic pain and mental diseases, the question arises, which role mental health does play in chronic pain sufferers (Bair, Robinson, Katon, & Kroenke, 2003; Gehling & Tryba, 2001; Von Korff, Dworkin, Le Resche and Kruger, 1988). As chronic pain sufferers frequently become mentally affected by their chronic pain, it might be interesting to analyze which influence mental health has onto the pain experience of a chronic pain sufferer. In the current study, the whole pain experience will be subdivided into pain intensity and pain interference, whereby pain intensity causes pain interference (Loeser & Melzack, 1999; Raspe & Kohlmann, 1994). In the following, the interrelationship between pain intensity, pain interference, and mental health will be explained in greater detail.

Loeser’s Chronic Pain Model

In order to be able to analyze, which influence mental health has onto chronic pain, it is necessary to firstly inspect different factors, which play an important role in chronic pain. One way to describe chronic pain is the model of Loeser (Loeser as cited in Raspe & Kohlmann, 1994; see Figure 1). Following Loeser & Melzack (1999), the components of pain are nociception, pain, suffering, and pain behaviour. At the centre of the model is the nociception allocated (Loeser & Melzack, 1999). Nociception can be described as the biochemical process of detecting tissue damage within the nervous system.

The following layer is called pain (Loeser & Melzack, 1999). It comprises the neurophysiological perception of the pain indicated by a noxious stimulus. In acute pain, the occurrence of the pain is linked to certain reflexes of the autonomic and somatic nervous system. However, in chronic pain these reflexes disappear, so that the perception of pain takes place despite no nociception has occurred. Additionally, the perceived intensity of the chronic pain is only sparsely associated with the tissue injury or quantifiable pathology. Frequently, the perceived intensity of the chronic pain is not in accordance with the severity of tissue damage, for example as it is the case in chronic benign pain (Verhaak et al., 1998). In general, the perception of pain takes place at a neurophysiological level.

The third layer is called suffering (Loeser & Melzack, 1999). Thereby, suffering can be understood as a negative response caused by the pain. Those responses can for example be stress, the loss of loved objects, anxiety, fear and other psychological states. Thus, suffering rather takes place on a psychological level in form of an interference, which the pain sufferer perceives within life.

The last layer of the model constitutes pain behaviour (Loeser & Melzack, 1999). Pain behaviour comprises the actions, which a pain sufferer does or does not do, in accordance to the perceived pain and the suffering. Thereby, the capability to undertake actions is ascribed to the present tissue damage, if a physical damage exists. Pain behaviour is observable and therefore, quantifiable by others. Despite the fact that this behaviour is "real", it might also be influenced by environmental consequences, which the pain sufferer expects to happen or which will actually happen (Loeser & Melzack, 1999). Loeser's model vividly depicts how the physiological, psychological, and behavioural components of pain are intertwined with each other.

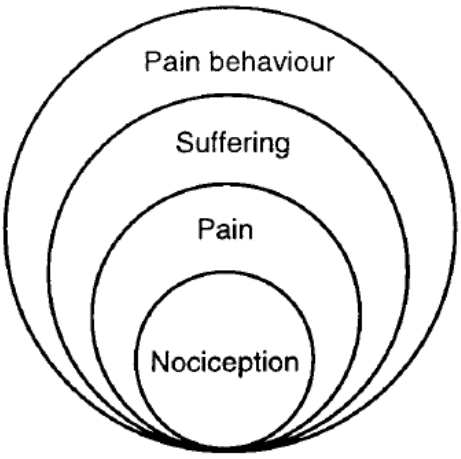

Figure 1. Loeser's multifaceted model of pain and its components. Adapted from "Concepts of Pain", by J. D. Loeser, 1982, In J. Stanton-Hicks and R. Boaz (Eds.), *Chronic low back pain* (pp. 109–142). New York: Raven Press.

Pain Intensity

One of the core components of chronic pain is pain intensity. Pain intensity describes the overall magnitude of the perceived pain (Dworkin et al., 2005). It can be understood as the severity of the pain at a present moment, which the individual perceives. Due to the fact that pain intensity refers to the perception of the pain itself, it does belong to the second layer of Loeser's model (Loeser & Melzack, 1999; Raspe & Kohlmann, 1994).

In the current study, pain intensity is operationalized as the severity of pain at different points in time. In order to do so, the pain intensity at the current moment, as well as the pain intensity of the best and worst moment of the last week are taken into account (Trompetter, Bohlmeijer, Veehof, & Schreurs, 2014). Additionally, the averaged pain intensity of the last week is considered (Trompetter et al., 2014).

Pain intensity, as part of the pain-layer in Loeser's model, causes suffering (Raspe & Kohlmann, 1994). In the process of suffering, the perceived pain intensity is correlated with the individual's abilities to deal with the pain. By that every individual might perceive different levels of impairments, which can be physical as well as mental (Breivik et al., 2006; Niesert & Zenz, 2005). Hence, the level of pain intensity determines in a way how much the individual feels interfered by the chronic pain. Therefore, it can be said that pain intensity causes pain interference.

Pain Interference

Another core component of chronic pain constitutes pain interference. Pain interference describes the impact, which the perceived pain has onto an individual's life and therefore, belongs to the third layer of Loeser's model (Kerns, Turk, & Rudy, 1985; Loeser & Melzack, 1999). Thereby, pain interference affects different domains of an individual's life, like work, family and social-recreational aspects. In general, an individual can be impaired within its abilities, actions, and in its satisfaction with life (Kerns et al., 1985). As mentioned above, pain intensity causes pain interference (Raspe & Kohlmann, 1994). As pain interference occurs in accordance to the perceived pain intensity, pain interference can also be understood as the psychological interpretation of the pain intensity.

In the current study, pain interference is operationalized with the aid of its two components, physical and mental functioning. The first construct measures the perceived pain interference regarding different activities and abilities of the individual (Kerns et al., 1985). In other words, the individual's physical functioning in the presence of the pain is operationalized. The second construct measures the perceived interference, which the pain has on the individual's satisfaction with life (Kerns et al., 1985). Thereby, the perceived interference of satisfaction with life constitutes rather a psychological than a physical impairment.

Mental Health

In the past, mental health was frequently measured as one continuum with mental illness (Keyes, 2007). Hence, an individual was seen as rather mentally healthy or mentally ill. Nowadays, mental health and mental illness are commonly measured as two continua (Keyes, 2002). Measuring both constructs as distinct but related continua means that being mentally healthy cannot be directly equalled with the absence of mental illness (Keyes, 2002). Mental health rather comprises the absence of mental illness as well as the presence of mental health symptoms.

Based on the two continua model the promotion hypothesis was formulated, which states that an increase in mental health should decrease the risk of becoming mentally ill over time (Keyes, 2010). Findings of the current literature are supporting the buffering function of mental health against mental illness. For example, Keyes, Dhigara, and Simoes (2010) studied the development of mental health and mental illness over time in the American population with the aid of two inquiries from 1995 and 2005. Within their article, they draw the conclusion that an increase in mental health decreases the chances of becoming mentally ill (Keyes, Dhigara, & Simoes, 2010). Further support for the buffering effect of mental health against psychopathology was found by Lamers, Westerhof, Glas, and Bohlmeijer (2015). In their longitudinal study, they found that 18% of the variance in psychopathology could be explained by changes in mental health as measured with the Mental Health Continuum – Short Form (MHC-SF) (Lamers, Westerhof, Glas, & Bohlmeijer, 2015).

In general, the concept of mental health denominates a certain condition of well-being, in which an individual is aware of its own abilities and is able to deal with an ordinary level of stress within its everyday life (Herrman, Saxena, & Moodie, 2004). Thereby, the individual can work productively and contribute meaningfully to society (Herrman et al., 2004). In other words, mental health denotes a balance between environmental and psychological resources.

Mental health comprises three components, i.e. emotional, psychological, and social well-being, which by themselves comprise different dimensions (Keyes, 2002). The first component is emotional well-being (EW). It comprises hedonic aspects of happiness, like the presence or absence of positive feelings (Keyes, 2002; Ryff, 2014). It encompasses two dimensions, which are the presence of positive affect, respectively the absence of negative affect, and the perceived satisfaction with life (Keyes, 2002). The second component, psychological well-being (PW),

can be defined as the eudaimonic aspects of psychological functioning (Ryff, 2014). It includes six dimensions, which are autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance (Keyes, 2002; Ryff, 2014). Finally, the last component of mental health denominates social well-being (SW). It can be defined as how individuals evaluate their life regarding social criteria. It consists of five dimensions, i.e. social acceptance, social actualization, social contribution, social coherence, and social integration (Keyes, 2002).

Regarding the buffering effect of mental health against psychopathology (Keyes et al., 2010; Lamers et al., 2015) and due to the fact that chronic pain, as within pain interference, comprises a major psychological component (Kerns et al., 1985), it might be possible that mental health has also a buffering effect against negative pain experiences. Since chronic pain is a chronic neuropathic disease, it can be expected that the chronic pain, hence the pain intensity, will always remain to some extent (Cardosa et al., 2013). Since pain interference is dependent on the perceived pain intensity (Loeser & Melzack, 1999; Raspe & Kohlmann, 1994), also the pain interference will remain to some extent. But due to the fact that pain interference, as the psychological interpretation of the perceived pain intensity, has a major psychological component, it might be prone to the buffering effect of mental health.

Hence, it could be possible that, although the individual's pain intensity stays the same, the perceived pain interference would be decreased by its individual level of mental health. Thus, the perceived negative influence of the chronic pain might be reduced, due to the fact that the perceived pain interference is alleviated and decreased by the individual's level of mental health. Summarizing, it might be possible that mental health moderates the relationship of pain intensity and pain interference. Concluding, the research question of the current study is: does mental health moderate the relationship between pain intensity and pain interference? In order to be able to answer the research question, the following hypotheses are proposed:

H_1: Pain intensity positively correlates with pain interference.

H_2: Pain intensity and mental health account for a significant amount of variance in pain interference.

H_3: Adding the interaction effect of pain intensity and mental health to the variables pain intensity and mental health, does predict a greater variance in pain interference than pain intensity and mental health do predict alone.

H_4: Mental health has a buffering effect onto the relationship of pain intensity and pain interference.

Method

Research Design

The current study is a post-hoc analysis of the study of Trompetter, Bohlmeijer, Veehof, and Schreurs (2014). It followed a cross-sectional approach and a questionnaire survey design. Questionnaires from the study of Trompetter et al. (2014) were utilized to gather data regarding pain intensity, pain interference, and the mental health condition of chronic pain sufferers.

Participants

The sample of the current study was descended from the original convenient sample used in the Randomized Control Trial (RCT) of Trompetter et al. (2014) and comprised N = 238 participants. Due to the violation of the cut-off scores of Cook's measure and the Leverage values, one participant got removed from the dataset. Therefore, the sample size of the current study was N = 237. From a power analysis conducted with G*Power (Faul, Erdfelder, Lang & Buchner, 2007), a sample size from at least N = 77 participants was needed to find a medium effect size for the interaction. The majority of the participants was age M = 57.72 (SD = 12.36), female (76.4%), had an intermediate level of education (68.8%), was married, lived together or in a registered partnership (74.3%), and was not working (59.9%). Furthermore, the majority of the participants had their complaints for more than five years (60.9%), suffered from daily complaints (92.8%), and had the diagnosis of fibromyalgia (20.3%). Table 1 gives more detailed information about the demographic characteristics of the participants.

Table 1
Demographic Characteristics of the Participants (N = 237)

Demographic variables	Percentage (%)
Age[a]	52.72 (12.36)
Gender	
Male	23.6
Female	76.4
Educational level	
Low	19.8
Intermediate	68.8
High	11.4
Marital status	
Single	20.7
Married/registered partnership/living together	74.3
Living-apart-together	2.5
Other[b]	2.5
Employment status	
Yes, fulltime/part-time	40.1
No, household, unemployed	59.9
Pain duration	
< 5 years	37.1
> 5 years	62.9
7 days per week suffering from pain	92.8
Diagnosis	
Fibromyalgia	20.3
Back-pain	12.7
Rheumatism	9.7
Neuropathic pain	8.9
Joint pain	8.4
Other[c]	23.2

Note. [a]Scores in mean (SD); [b]widowed, living in a student house, divorced; [c]e.g. arthrosis, multiple diagnoses.

Procedure

The sample of the current study was descended from the original sample used in the RCT of Trompetter et al. (2014). Participants were recruited through advertisements in Dutch national newspapers and online patient platforms in February and March 2012. Inclusion criteria were (a) age ≥ 18 years, (b) a momentary pain intensity score of ≥ 4 on the 11-point Numeric Rating Scale (NRS) (Dworkin et al., 2005), (c) a self-reported duration of the chronic pain for ≥ 3 days per week, (d) which lasted > 6 months. Exclusion criteria were (a) a low degree of psychological inflexibility, defined by a score < 24 on the Psychological Inflexibility in Pain Scale (PIPS) (Wicksell, Lekander, Sorjonen, & Olsson, 2010), (b) a high degree of severe psychological distress, defined by a total score of > 24 on the Hospital Anxiety Depression Scale (HADS) (Zigmond & Snaith, 1983), (c) the participation in another treatment based on Cognitive Behaviour Therapy (CBT) at the current moment, (d) having no access to the internet or having

no e-mail address, (e) reading problems due to insufficient language skills in Dutch or illiteracy, and (f) being unwilling or not able to spend about 30 minutes per day. Before receiving an information letter and the informed consent, participants had to fill in their personal data on the study's website. After giving their consent, participants were screened by a computerized questionnaire due to the inclusion and exclusion criteria. If the inclusion criteria were met, the participants were allowed to fill in the baseline questionnaire. In the primary study of Trompetter et al. (2014) multiple assessments were conducted at different points in time. In the current study only the data of the baseline assessment was used.

Measures

The following measures were used to obtain data for this study:

Demographic variables were measured with a demographic questionnaire, which was derived from the original study of Trompetter et al. (2014). As core components age, gender, educational level, marital status, employment status, pain duration, the days per week on which the participants were suffering from pain, and the diagnosis were measured. Each of the components was measured with one item (e.g. 'What is your highest level of completed education?').

Pain intensity was measured with an 11-point Numeric Rating Scale (NRS) (Dworkin et al., 2005), measured as one factor, using four items measuring the participants' pain intensity at different moments in time (e.g. 'How intense is your pain at the current moment?', 'How intense was your pain in average over the last week?'). Items were scored on an eleven-point frequency rating scale ranging from 0 (no pain) to 10 (pain as bad as you can imagine). The used items were compiled from items of the long and the short form of the Brief Pain Inventory (BPI) (Cleeland, 2009). The more frequently used short form of the BPI has been validated in different countries and languages like for example in Italy (Caraceni et al., 1996), North India (Saxena, Mendoza, & Cleeland, 1999), Germany (Radbruch et al., 1999), and Brazil (Ferreira, Teixeira, Mendonza, & Cleeland, 2011). It has also been especially validated for non-cancer pain with reported Cronbach's alpha values of .85 for chronic, non-malignant pain in general (Tan, Jensen, Thornby, & Shanti, 2004) and .89 for arthritis and .82 for lower back pain in specific (Keller et al., 2004). The specific version of the NRS, which has been used in the current study, has been validated from Trompetter et al. (2014). They reported a Cronbach's alpha value of .81.

Pain interference was measured with the subscale pain interference of the Multidimensional Pain Inventory (MPI), measured as one factor, using nine items measuring to which degree the pain interferes with different domains of life, e.g. work, household work, and social activities (e.g. 'In how far does the pain affect the amount of satisfaction you receive from social activities?') (Kerns et al., 1985). Items were scored on a seven-point scale ranging from 0 (no change) to 6 (a lot of change). The MPI has been validated in different countries and languages like for example in Sweden (Bergström, Jensen, Bodin, Linton, Nygren, & Carlsson, 1998), Italy (Ferrari, Novara, Sanavio, & Zerbini, 2000), and the Netherlands (Lousberg et al., 1999). Lousberg et al. (1999) reported a Cronbach's alpha value of .89.

Mental health was measured with the Mental Health Continuum – Short Form (MHC-SF), measured as three factors, emotional, psychological, and social well-being (Keyes, 2002). Emotional well-being was measured with three items (e.g. 'In the past month, how often did you have the feeling of being happy?'), psychological well-being was measured by the means of six items (e.g. 'In the past month, how often did you have the feeling that you could deal with your everyday responsibilities?'), and social well-being was measured with five items (e.g. 'In the past months, how often did you have the feeling that you have contributed meaningfully to society?'). Items were scored on a six-point rating scale ranging from 1 (never) to 6 (every day). In this study, the total score of the MHC-SF was used for analyses. The MHC-SF has been validated in different countries and languages like for example in South Africa (Keyes et al., 2008), Poland (Karaś, Cieciuch, & Keyes, 2014), Italy (Petrillo, Capone, Caso, & Keyes, 2015), and the Netherlands (Lamers, Westerhof, Bohlmeijer, Ten Klooster, & Keyes, 2011). Lamers, Westerhof, Bohlmeijer, Ten Klooster, and Keyes (2011) reported a Cronbach's alpha value of .83 for emotional well-being, .83 for psychological well-being, .74 for social well-being, and .89 for the MHC-SF in total.

Statistical Analyses

All statistical analyses were executed with SPSS 22.0 (IBM SPSS Statistics). Previous to the main analysis, it was tested whether the requirements for a moderation analysis were met. After checking for the assumptions, the PROCESS macro for SPSS (Hayes, 2013) was used to apply linear regression models to determine, whether the selected moderator variable was functioning as a moderator or predictor of pain interference.

First, different measures of descriptive statistics were computed to create dimensions of the data. For every variable the measures of mean, standard deviation, skewness, and kurtosis were computed. As cut-off scores for the skewness measure -1 and +1 were used. The same cut-off scores were used for the kurtosis measure, as well. Furthermore, the Cronbach alpha coefficients were computed per scale. Regarding the alpha coefficients, it was aimed for an alpha value of $\alpha > .70$ (Nunnally & Bernstein, 1994).

Next, correlations were computed to determine the direction of the regression. A statistical significance level of $p < .01$ was used. Furthermore, .10 practically was seen as a small, .30 as a medium, and .50 as a high effect size (Cohen, 1992).

In the following regression analysis, it was tested whether a regression model with or without the interaction effect would significantly predict more variance in the dependent variable. Therefore, pain interference was entered as dependent variable. Pain intensity and mental health were entered as independent variables.

Finally, a moderation analysis was executed to determine whether the expected moderator variable indeed functioned as a moderator or predictor. Therefore, pain interference was entered as dependent variable and pain intensity as independent variable. Mental health was entered as a moderator variable. If a significant interaction effect occurred, the variable in question was interpreted as a moderator. If no significant interaction effect, but a significant main effect occurred, the variable in concern was interpreted as a predictor. In general, a significance level of $p < .05$ was used.

Results

Descriptive Statistics

Inspection of Table 2 shows that acceptable Cronbach alpha coefficients were obtained for all the scales. All alpha coefficients were higher than the guideline of $\alpha > .70$ (Nunnally & Bernstein, 1994). The scores on the Pain NRS, the MPI, and the MHC-SF are normally distributed. It therefore appears that all the measuring instruments have acceptable levels of internal consistency.

Table 2
Descriptive Statistics and Alpha Coefficients of the Measuring Instruments

Constructs	Mean	*SD*	Skewness	Kurtosis	α
Pain Intensity	6.33	1.39	-.48	-.15	.88
Pain Interference	3.62	1.09	-.55	-.01	.86
Mental Health	3.72	.86	-.13	-.17	.89

Correlations

The product-moment correlation coefficients between the constructs are reported in Table 3. Table 3 shows a statistically and practically (small effect) significant correlation coefficient between pain intensity and pain interference. Therefore, the first hypothesis is supported. Pain interference is also statistically and practically (small effect) significantly related to mental health.

Table 3
Correlation Coefficients between Pain Intensity, Pain Interference, and Mental Health

	1	2
1, Pain Intensity	-	-
2, Pain Interference	.27*+	-
3, Mental Health	.05	-.26*+

Note. * Correlation is significant at the .01 level.
+ Correlation is practically significant r > .10 (small effect).

Regression and Moderation Analysis

To test hypothesis two and three, a hierarchical multiple regression analysis was conducted. The results of the regression analysis with pain interference as dependent variable and pain intensity and mental health as independent variables are reported in Table 4.

Table 4
Multiple Regression Analysis with Pain Interference as Dependent Variable

Model		Unstandardized Coefficients		Standardized Coefficient	*t*	*p*	*F*	*R*	R^2	ΔR^2
		B	SE	Beta						
1	(Constant)	3.52	.41		8.62	.00**	19.75	.38	.14	.14
	Pain Intensity	.22	.05	.28	4.60	.00				
	Mental Health	-.35	.08	-.27	-4.51	.00				
2	(Constant)	4.44	1.44		3.08	.00*	13.28	.38	.15	.002
	Pain Intensity	.08	.22	.10	.35	.73				
	Mental Health	-.60	.39	-.48	-1.54	.12				
	PI x MH	.04	.06	.28	.665	.51				

Note. PI = pain intensity. MH = mental health.
* $p < .01$. ** $p < .001$.

In the first step, two variables were included: pain intensity and mental health. These variables accounted for a significant amount of variance in pain interference, $R^2 = .14$, $F(2, 234) = 19.75$, $p < .001$, which supports hypothesis two. To avoid potentially problematic high multicollinearity with the interaction term, the variables were centred and an interaction term between pain intensity and mental health was created (Aiken, West, & Reno, 1991). Next, the interaction term between pain intensity and mental health was added to the regression model, which accounted for no significant proportion of variance in pain interference, $\Delta R^2 = .002$, $\Delta F(1, 233) = .44$, $p = .51$, $b = .04$, $t(233) = .72$, $p = .47$. Therefore, no support was found for hypothesis three and four. Examination of the interaction plot visualizes the missing moderation effect of mental health (see Figure 2).

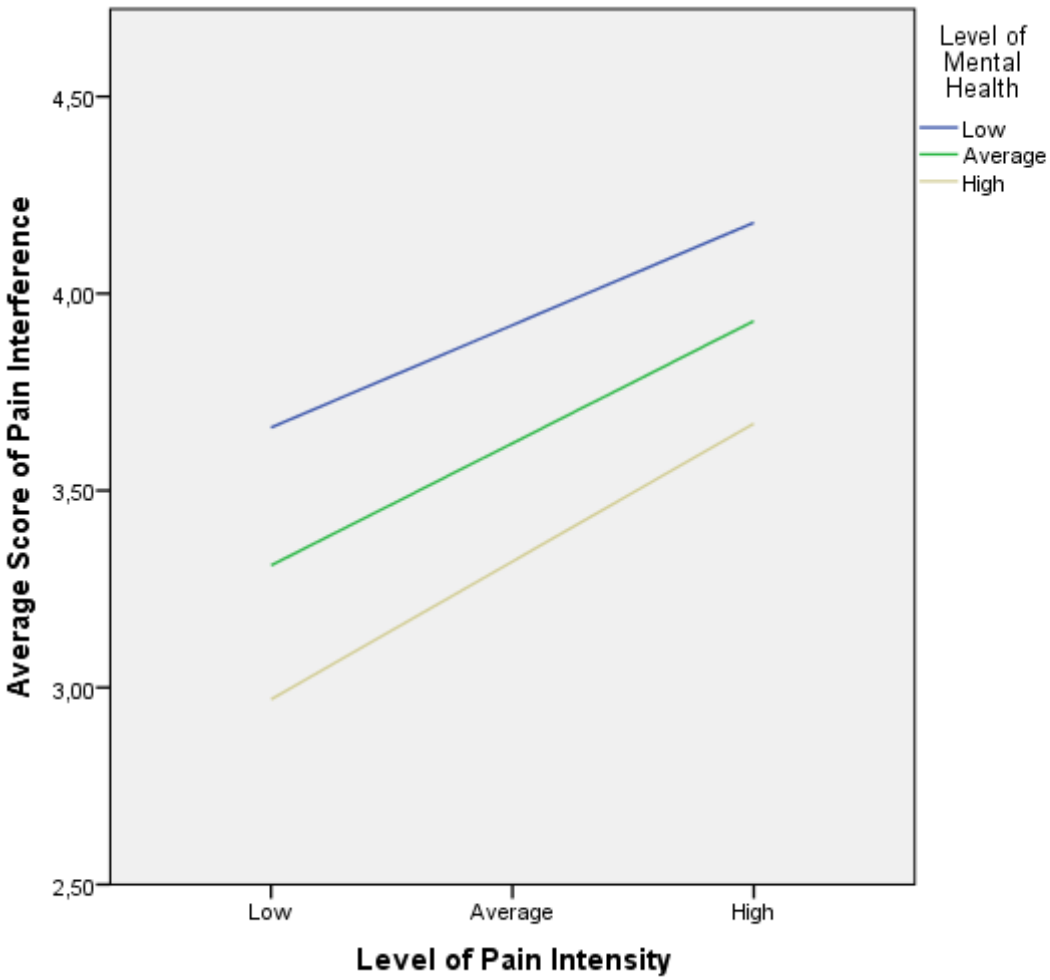

Figure 2. Line graph of the average level of pain interference per low, average, and high levels of pain intensity divided by a low, average, and high level of mental health.

Despite the missing moderation effect, mental health (b = -.35, $t(233)$ = -4.54, p < .001) and pain intensity (b = .22, t(233) = 4.56, p < .001) were found to constitute predictors of pain interference. This means that for every one unit increase in mental health, a .35 unit decrease in pain interference takes place, respectively that for every one unit increase in pain intensity, a .22 unit increase in pain interference occurs. The main effects and the interaction effect can be found in Table 5.

Table 5
Pain Interference Predicted from Mental Health and Pain Intensity

Predictor	β	*p*	95% CI
Mental health	-.35	.00**	[-.50, -.20]
Pain intensity	.22	.00**	[.13, .32]
Mental health x Pain intensity	.04	.47	[-.07, .15]

Note. CI = confidence interval.
* $p < .01$; ** $p < .001$.

Discussion

The aim of this study was to investigate, whether mental health has a buffering effect onto the relationship of pain intensity and pain interference. The results showed a statistically significant positive relationship between pain intensity and pain interference with a small effect. Similarly, a statistically significant negative relationship between pain interference and mental health with a small effect was found. However, the results showed that mental health could not act as a moderator on the relationship of pain intensity and pain interference within this sample.

From the literature, it was expected that pain intensity would positively correlate with pain interference (H_1). The found relationship between pain intensity and pain interference indicate that only a small effect was found, which means that pain intensity and pain interference might be related to each other. This is in line with Loeser's multifaceted model of pain (Loeser & Melzack, 1999; Raspe & Kohlmann, 1994). As pain intensity, which is part of the pain-layer in Loeser's model, causes pain interference, which is part of the suffering-layer in Loeser's model, a positive correlation was expected (Loeser & Melzack, 1999; Raspe & Kohlmann, 1994). The found relationship of a weak character can be explained by the fact that suffering can be understood as a negative response, which is only partly caused by pain (Loeser & Melzack, 1999). Additionally, suffering can also be caused by other psychological states like anxiety, fear, the loss of loved objects, and stress (Loeser & Melzack, 1999). Therefore, pain intensity might be only one cause of inducing pain interference and a relationship of a small effect between pain intensity and pain interference seems reasonable.

Furthermore, it was expected from the literature that pain intensity and mental health would account for a significant variance in pain interference (H_2). The tested regression model actually showed that pain intensity and mental health statistically significantly predict pain interference to some extent, which means that pain intensity and mental health might be related to pain interference. The amount of variance in pain interference, which was predicted by pain intensity and mental health, was rather small. This finding could be explained by the fact that on the one

hand the found relationship between pain intensity and pain interference was of a small effect, too. As named above, this weak relationship might be caused by the fact that pain intensity is only one factor, which might induce pain interference (Loeser & Melzack, 1999). On the other hand, this finding could be also explained by the likewise weak relationship between mental health and pain interference. From the literature a statistically significant correlation between mental health and pain interference of a great effect could have been expected. This was not the case. A possible explanation for this could be that mental health may only have an effect on the psychological component of pain interference, i.e. satisfaction with life (Kerns et al., 1985). On the rather physiological components, i.e. an individual's abilities and actions, mental health might have a weaker influence (Kerns et al., 1985). Thus, as mental health and pain intensity both seem to only partially affect pain interference, it might be explainable that they account just for a small amount of variance in pain interference.

Additionally, it was expected from the literature that adding the interaction effect of pain intensity and mental health to the previous regression model would predict a greater variance in pain interference than pain intensity and mental health alone (H_3). With the interaction effect added, the regression model did not significantly accounted for more variance in pain interference, which means that a significant moderation effect between mental health and pain intensity on pain interference probably might not exist. This second regression model with the interaction effect added non-significantly accounted for a slightly bigger amount of variance in pain interference than the first regression model did. Based on the fact that pain intensity and mental health both appeared just to be weakly related to pain interference, due to the reasons named above, the non-significant, weak additional effect of their interaction seems reasonable as well.

Finally, it was expected from the literature that mental health has a buffering effect onto the relationship of pain intensity and pain interference (H_4). In the present study, no support was found for hypothesis four, what implicates that no significant interaction effect between pain intensity and mental health was found. Furthermore, this means that mental health has no significant buffering effect on the relationship of pain intensity and pain interference. Despite, it was found that pain intensity and mental health constitute predictors of pain interference. The finding of pain intensity affecting pain interference, does not come completely unexpected. As it was assumed from the literature that pain intensity causes pain interference, the general

assumption of pain intensity affecting pain interference seems reasonable (Loeser & Melzack, 1999; Raspe & Kohlmann, 1994).

Furthermore, the finding of mental health affecting pain interference might be explained by the fact that well-being partly plays a role within pain interference. An individual could generally feel interfered within its activities and abilities, as well as in its satisfaction with life (Kerns et al., 1985). As mental health comprises different kinds of well-being, i.e. emotional, psychological, and social well-being, it might be possible that mental health affects the satisfaction with life component of pain interference in different ways (Keyes, 2002). Emotional well-being might have an influence regarding the hedonic aspects of satisfaction with life, while psychological well-being might have an influence on the eudaimonic components of satisfaction with life, and social well-being might have an influence regarding the social aspects of satisfaction with life (Keyes, 2002; Ryff, 2014). Thereby, higher levels of the different kinds of well-being, which go along with higher levels of mental health in general, might have a decreasing effect onto the perceived pain interference. The significant negative correlation of a small effect between mental health and pain interference, which was found in the present study, would support this explanation.

Another explanation for mental health affecting pain interference, which might come to one's mind, is a conflict between different psychological components. For example, on the one hand chronic pain sufferers might want to get rid of the pain and the pain interference, but on the other hand they might want to be supported from their social environment (Bokan, Ries, & Katon, 1981). Thereby, the need for being supported could be related to the social well-being component of mental health (Keyes, 2002). In order to receive this support, it is necessary to show of some suffering from the pain and actively allow the pain to interfere with one's life. Otherwise the pain sufferer is not taken serious in its pain (Jackson, 2005). Hence, being not interfered by the chronic pain, but feeling supported are two psychological components, which might conflict with each other. Thereby, the conflict can even pass off unconsciously to the chronic pain sufferer self (Bokan et al., 1981). Nevertheless, this possible explanation for mental health affecting pain interference is not fully in line with the findings of the current study. Following this explanation, the perceived pain interference would have to increase, if the need for social support increases. In contrast, the found negative correlation indicates that the perceived pain interference would decrease, if the need for social support increases. Therefore, a conflict between wanting to get rid of the pain interference and the need to feel supported can

be probably excluded as an explanation for the relationship between mental health and pain interference.

Implications for Chronic Pain

The findings of the current study indicate that mental does play a role within chronic pain, but not as a moderator of the relationship between pain intensity and pain interference. As mental health affects pain interference and possibly has a decreasing effect onto pain interference, it seems reasonable to support the promotion of mental health in chronic pain sufferers. As the current study was rather exploratory in nature, the implications, which can be given on the basis of the found results, are quite vague. More research is needed to figure out, which role mental health exactly plays in chronic pain, in order to be able to formulate more specific implications.

Limitations of the Present Study and Suggestions for Future Research

One important limitation of the current study is the fact that it was not powered a priori. Analyses were executed post-hoc and exploratory. Post-hoc computing of sample sizes indicated that the number of participants was sufficient (Faul et al., 2007). Nevertheless, the results of the current study should be interpreted with some caution and in accordance to its post-hoc character. To validate and extend the results of the current study, future research should focus on powering studies a priori to ensure a more explanatory character of the results.

Another important limitation of the current study is that it is based on cross-sectional data. Therefore, it is uncertain whether changes in mental health and in pain intensity cause pain interference or vice versa. Based on the cross-sectional data, it is only possible to state that a relationship between mental health and pain interference, as well as a relationship between pain intensity and pain interference exists. To be able to do a more precise statement about the cause-effect-relationship of mental health, pain intensity and pain interference, one starting point for future research would be to perform a longitudinal study.

Another limitation of the current study is the way, in which pain intensity was measured. In the current study, pain intensity was treated as if it is a pure physical sensation, which can be objectively measured. In fact, pain intensity as measured with the self-rated Pain NRS constitutes a subjective measure, which is highly influenced by the individual itself. As pain intensity is measured by a self-rated measure, it might be influenced by different psychological components. From the literature, it appears that mood and emotions have a great influence on

pain intensity. For example, Tang et al. (2008) found in a group of patients suffering from chronic back pain that inducing a depressed mood led to significantly higher ratings of pain at rest and a lower tolerance in pain, whereas a happy mood led to significantly lower ratings of pain at rest and a higher tolerance in pain. Hence, the induced mood highly influenced the perceived pain intensity, as well as the pain tolerance of the chronic pain patients. Furthermore, White et al. (2012) found in a population of patients suffering from knee osteoarthritis that although positive affect was not generally associated with an increase in daily walking, respondents with high positive affect walked 8.5% more steps in the presence of pain compared to respondents with negative affect and present pain. The findings of White et al. (2012) might suggest that positive affect buffers against the experienced pain intensity, so that individuals in the presence of positive affect and pain are capable of walking more steps, compared to individuals experiencing negative affect in the presence of pain.

Additionally, also mental health itself could have had an influence on the experienced pain intensity in the current study. As mental health, comprises different kinds of well-being, which are associated with emotions and mood, it might be possible that they had an influence onto the individual's perceived pain intensity, as well (Keyes, 2002). At the current moment, operationalizing pain intensity with the aid of a self-rated instrument is the only way to assess it. Nevertheless, it is important to keep the interdependence of pain intensity, mood, emotions, and mental health during the investigation of chronic pain in mind, because the entanglement of the different constructs might confound the results of a study. The interdependence of pain intensity and mental health might also be another explanation for not finding a significant moderation effect in the current study.

Another starting point for future research would be to further analyze if high, medium, or low levels of mental health in the sense of flourishing, moderate level of mental health, or languishing, have different effects on the experienced pain interference (Keyes, 2002). Furthermore, it would be interesting to analyze whether the different kinds of well-being, i.e. emotional, psychological, or social well-being, as they are comprised by mental health, affect pain interference in different ways (Keyes, 2002). Those information would give a more detailed insight into the working mechanism of different parts of mental health onto chronic pain.

Finally, another idea for future research would be to set up a study, in which participants of different ages are compared to each other. Maybe the effect of mental health does differ regarding different aging cohorts. The participants of the current study were of a middle age. As older people have in general more pain complaints, it might be possible that mental health is less effective against pain complaints like pain interference in older chronic pain sufferers (Kohlmann, 2001). Hence, it might be hypothesized that mental health is more effective in younger chronic pain sufferers, as they normally have less pain complaints. Thus, analyzing different aging cohorts might give a more differentiated insight into the working mechanism of mental health.

Conclusion

Overall, this study was a first attempt to assess, whether mental health has a buffering effect onto the relationship of pain intensity and pain interference in chronic pain sufferers. Concluding, it seems that mental health does not moderate the relationship between pain intensity and pain interference; it rather could affect pain interference directly. Nevertheless, more research is necessary to be able to indicate, which working mechanisms of mental health have the greatest influence onto pain interference and how those mechanism could be implemented into treatment.

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