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**Attachment Insecurity as a Vulnerability Factor in the Development of Chronic Whiplash
Associated Disorder – A Prospective Cohort Study**

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Abstract

Objectives: Attachment theory represents a dynamic model for understanding how pre-existing personality factors may contribute to the development of chronic pain and disability after whiplash injury. The aim of the present study is to investigate the impact of attachment insecurity on disability 6-months post-injury. It was hypothesized that: (1) levels of attachment insecurity assessed at baseline would predict levels of disability six months post-injury, and (2) both attachment dimensions (anxiety and avoidance) would moderate associations between pain and disability, and psychological distress and disability.

Methods: Questionnaire data were collected consecutively from a 1-year cohort of whiplash-injured. Data were collected from the emergency room within 1-month post-injury and at follow up 6-months post-injury (n=205).

Results: Both attachment dimensions were significantly associated with physical and psychosocial disability. Moreover, when attachment avoidance and attachment anxiety were at the mean value (0SD) and high (+1SD), there was a significant positive relationship between pain intensity and disability (physical and psychosocial), with the exception of attachment anxiety, that only moderated the association between pain intensity and psychosocial disability when high. Also, when attachment avoidance and attachment anxiety were high there was a significant positive relationship between depression and disability. Finally, when attachment avoidance was at the mean level and high there was a significant positive relationship between pain-catastrophizing and psychosocial disability.

Conclusion: Although the effects sizes for the moderations were small, the results support claims that attachment insecurity, measurable before onset of injury, represents a valuable pre-trauma vulnerability for less optimal recovery after whiplash injury.

Keywords:

Attachment; Disability; Pain; Recovery; Whiplash.

Introduction

Although most people recover from whiplash injury, a substantial subgroup (about 20%) follow a recovery pathway characterized by initial high levels of pain, pain-catastrophizing, and fear-avoidance beliefs with little or no recovery over time [1,2]. Evidence suggests that these persistent symptoms may relate to pre-trauma vulnerabilities, such as pre-collision psychological distress [3] and other comorbidities [4]. While attachment theory represents a dynamic model for understanding how pre-existing personality factors may contribute to the development of chronic pain and disability after whiplash injury, no studies have considered the longitudinal impact of attachment insecurity in this population.

Attachment orientations are relatively stable cognitive-emotional schemas shaped from early interactions with attachment figures [5]. Two attachment dimensions are recognized: *attachment anxiety*, associated with hyperactivating strategies such as catastrophizing and hypervigilance, and *attachment avoidance*, linked with deactivating strategies such as underestimation or avoidance of threats as a coping strategy [6].

According to the Attachment-Diathesis Model of Chronic Pain, insecure attachment (high levels of avoidance or anxiety) is a diathesis for: the development of chronic pain, maladaptive pain coping, and pain-related disability [7]. Evidence from both experimental [8] and clinical [9] studies offer support for this model. Insecure attachment has been associated with: pain-catastrophizing [10,11,12,13,14], low pain self-efficacy [12,15], and depression or anxiety [11,12,16,17].

Attachment insecurity has also been linked with maladaptive activity patterns (avoidance and over-activity), with associations mediated by pain-catastrophizing [18]. Moreover, attachment insecurity is more prevalent among patients with chronic pain compared to healthy adults [19,20,21].

The few studies investigating associations between attachment insecurity and pain-related disability support associations between attachment insecurity and disability in pain clinic patients [12,15,16,22]. Furthermore, low levels of comfort with closeness (corresponding to the avoidance dimension) was found to be the main moderator of the effects of anxiety and pain self-efficacy on disability [15].

The majority of studies investigating associations between attachment insecurity and pain are correlational, and no studies have longitudinally assessed the impact of attachment insecurity in relation to recovery after whiplash injury. The aim of the present study is to investigate the impact of attachment insecurity (avoidance and anxiety) on disability (physical and psychosocial) 1-6 months post-injury. It was hypothesized that: (1) levels of attachment insecurity assessed at baseline (< 1-month post-injury) would predict levels of disability six months later, and (2) both attachment dimensions would moderate associations between pain and disability, and psychological distress and disability.

Methods

Participants and procedures

A longitudinal cohort design was used to investigate hypotheses. Questionnaire data were collected consecutively from a representative 1-year cohort of whiplash injured in Denmark. The dataset has previously been used to assess longitudinal trajectories of pain [1] and the baseline data to assess the association between attachment insecurity, somatization and posttraumatic stress [23].

At the emergency room all patients were assessed for whiplash severity according to the Quebec Task Force classification of WAD [24]. WAD grade I is characterized by a neck complaint of pain, stiffness or tenderness only, without physical signs. WAD grade II is the most common WAD grade reported, characterized by neck pain, musculoskeletal signs, including decreased range of movement and point tenderness. WAD grade III is characterized by additional neurological

signs, and grade IV by fracture or dislocation [24]. Only patients between 18-70 years of age with WAD grade I-III were included in the study. Other injuries or unconsciousness caused by the injury were exclusion criteria.

Questionnaires were answered within one month post-injury (T1) and again six months post-injury (T2). The median time for participants answering the baseline questionnaire (T1) was 19.0 days (SD = 13.3). Only the dependent variables physical and psychological disability were assessed again at T2. Non-responder analyses were conducted on available data.

The study was approved by the Danish Data Protection Agency, and the review board of University of Southern Denmark approved the research protocol.

Measures

Attachment orientations were measured with the Revised Adult Attachment Scale (RAAS; [25]). The scale comprises an 18-item self-report scale on which patients rate how they function and feel in close relationships. Each item is rated on a 5-point Likert scale ranging from 1= not at all characteristic to 5 = very characteristic. The scale assesses the two dimensions attachment-avoidance and attachment-anxiety. In the present study, internal consistency measured by Cronbach's alpha at T1-T2 were as follows: attachment-avoidance, $\alpha = .77-.80$; attachment-anxiety, $\alpha = .78-.82$).

Pain intensity was measured as the average score of four 11-point Likert scales (NRS; [26]) each ranging from 0 (no pain) to 10 (the worst possible pain). Patients reported pain intensity corresponding to their pain now, highest level of pain, lowest level of pain, and finally average pain over the past week. In the present study, internal consistency measured by Cronbach's alpha was (T1-T2, $\alpha = .93-.94$).

The depression subscale of the Hospital Anxiety and Depression Scale (HADS; [27]) was used to assess the level of depressive symptoms. The HADS has satisfactory psychometric

properties used in non-psychiatric medical settings [27]. The depression scale consists of 7 items related to depression (HADS-D) with responses ranging from 0 (no symptoms) to 3 (maximum impairment). In the present study, internal consistency measured by Cronbach's alpha was (T1-T2, $\alpha = .89-.90$).

The Pain-Catastrophizing Scale (PCS; [28]) was used to measure the tendency to catastrophize about painful experiences. Reflecting on past painful experiences, patients were asked to indicate the degree to which they experienced each of 13 thoughts or feelings when experiencing pain, on a five-point Likert scale with 0 = not at all, 4 = all the time. A summed scale score was calculated from all items, with higher scores indicating high levels of pain-catastrophizing. In the present study, internal consistency measured by Cronbach's alpha was (T1-T2, $\alpha = .94-.95$). The Danish version of the PCS has recently been validated in both a clinical and non-clinical sample [29].

Fear-avoidance beliefs were measured using the three fear-avoidance items on the Örebro Musculoskeletal Pain Screening Questionnaire (Örebro; [30]). Each item was answered on an 11-point Likert scale with 0 = completely disagree, 10 = completely agree. The scale has good psychometric properties and has shown valuable as a predictor for the development of chronic pain. In the present study, internal consistency measured by Cronbach's alpha was (T1-T2, $\alpha = .85-.88$).

Pain-related disability was measured with the Pain Disability Questionnaire (PDQ; [31]). The scale was developed to measure pain-related disability related to chronic musculoskeletal conditions. Disability was measured on a 15-item numeric rating scale from 0 to 10 where 0 is no disability and 10 is the worst imaginable disability. The scale consists of two subscales measuring physical (9 items) and psychosocial (6 items) disability. The scale has good psychometric properties and is validated in numerous pain cohorts [31]. For the purpose of this study, the subscales were used as outcomes. Both the physical and psychosocial component were found to have good internal

consistency measured by Cronbach's alpha: physical component (T1-T2, $\alpha = .95-.97$), psychosocial component (T1-T2, $\alpha = .91-.94$).

Statistical analysis

All statistical analyses were conducted in SPSS version 25. Pearson's correlations were used to determine the relationship between the attachment dimensions and all outcomes at baseline. Predictors of physical and psychosocial disability were investigated using linear regression involving four steps. In step 1 covariates gender and age were entered. In step 2, pain intensity, and in step 3, attachment dimensions. Finally, in step 4, pain-catastrophizing, fear-avoidance beliefs, anxiety and depression. Moreover, significant predictors of disability were further assessed using moderation analysis. The moderating effect of T1 attachment dimensions (avoidance and anxiety) on the associations between significant predictors of T2 physical- and psychosocial disability were assessed using the Preacher and Hayes macro process (model 1) for SPSS based on maximum likelihood estimation and 5000 bootstrap draws [32]. The method is a bootstrapped regression-based method using mean centered multiple hierarchical regression analyses. Moderation is the effect of one variable on the relationship of two others. Moderation is present when the relationship between the independent and the dependent variable changes as a function of the moderator. Sex and age were entered as covariates in all models and also pain intensity in the models testing the association between the psychological variables and disability.

Results

Participants

Of 578 invitations, 327 baseline questionnaires (T1) were returned and $N = 205$ answered at six months follow-up (T2). Only patients answering at both time points were included in the study. For a more detailed description of the sample and the procedure see [1].

At baseline, the mean age for the patients was ($M = 36.79$, $SD = 12.61$). Of the total sample 61.6% were women. There were no difference between responders and non-responders with respect to WAD grade, age, educational level, or whether other injuries were sustained, indicating that the sample is representative of the total cohort of whiplash injured.

The stability of Attachment and Correlations between attachment and baseline outcomes

The patients' attachment orientations as measured on the two dimensions, attachment-avoidance and attachment-anxiety, remained stable from baseline (T1) to six-months follow-up (T2). Attachment-avoidance: T1, $M = 27.19$ ($SD = 7.73$) and T2, $M = 27.01$ ($SD = 7.85$); attachment-anxiety: T1, $M = 11.40$ ($SD = 4.93$) and T2, $M = 11.19$ ($SD = 5.13$). The results indicate that attachment orientations are stable traits.

Associations between the attachment dimensions, pain intensity, fear-avoidance beliefs, pain-catastrophizing, depression, anxiety and disability (physical and psychosocial) are presented in Table 1. The degrees of freedom for the correlations between attachment avoidance and attachment anxiety and all the outcomes was ($df = 203$) with the exception of the correlations between the attachment dimensions and disability ($df = 201$).

Significant correlations $p < .001$ were found between both attachment dimensions and all baseline outcomes with the exception of the correlations between attachment avoidance and fear-avoidance beliefs $p = .001$, and attachment anxiety and fear-avoidance beliefs $p = .003$ and finally between attachment anxiety and pain $p = .002$. The correlations were of small to moderate size (.21 - .47), with the strongest correlations found between both attachment dimensions and depression and anxiety. Both dimensions correlated similarly with all outcomes, attachment avoidance slightly more.

Predictors of disability at six months

Two separate hierarchical linear regression analyses were conducted assessing predictors of physical and psychosocial disability six months post-injury. Gender and age were entered as covariates in all regressions. Gender and age did not reach statistical significance in any of the regressions, $p = .406/.764$ (physical/psychosocial disability). Pain intensity at baseline was the strongest predictor of both physical and psychosocial disability six months post-injury, explaining 40-45% of the variance in disability. Adjusted for gender and age and pain intensity, the attachment dimensions also reached statistical significance, $p = .042$ (physical disability) and $p < .001$ (psychosocial disability), explaining 2-5% of the variance in disability. However, in the final regression models, only pain intensity $p < .001$, pain-catastrophizing $p = .038/.018$ (physical/psychosocial disability) and depression $p = .005$ (physical disability) and $p < .001$ (psychosocial disability) were significant predictors of disability. The regression models are presented in Table 2.

The moderating role of the attachment dimensions

To examine the potential moderating role of attachment anxiety and attachment avoidance in the relationship between pain, pain-catastrophizing and depression and disability (physical and psychosocial) we conducted a series of moderation analyses. Gender, age and baseline disability were entered as covariates in all models. In addition to baseline disability, baseline pain was entered as a covariate in the models assessing the moderating role of attachment in the relationship between pain-catastrophizing, depression and disability. First the moderating role of the attachment dimensions on the association between pain and disability were assessed. Secondly, the moderation of the attachment dimension on the associations between depression and disability and pain-catastrophizing and disability were assessed. The regression slopes (figure 1-5) describes the effects

of x on y at -1 SD (low level), 0 SD (mean level) and +1 SD (high level) of the moderator (attachment avoidance and anxiety).

Attachment dimensions as moderators in the association between pain and physical disability

Both attachment anxiety and attachment avoidance were found to be significant moderators in the association between pain intensity and physical disability. The interaction term between attachment avoidance and pain intensity explained a significant increase in variance in physical disability, $\Delta R^2 = .01$, $F(1, 199) = 5.63$, $p = .019$. Thus, attachment avoidance was a significant moderator of the relationship between pain intensity and physical disability. The three regression slopes for attachment avoidance as a moderator were interpreted as follows: When attachment avoidance was low, there was a non-significant positive relationship between pain intensity and physical disability, $b = 0.91$, 95% CI [-0.52, 2.34], $t = 1.26$, $p = .211$. At the mean value of attachment avoidance, there was a significant positive relationship between pain intensity and physical disability, $b = 1.78$, 95% CI [0.51, 3.05], $t = 2.77$, $p = .006$. Finally, when attachment avoidance was high, there was a significant positive relationship between pain intensity and physical disability, $b = 2.89$, 95% CI [1.29, 4.49], $t = 3.56$, $p = .001$.

The interaction term between attachment anxiety and pain intensity explained a significant increase in variance in physical disability, $\Delta R^2 = .01$, $F(1, 199) = 5.67$, $p = .018$. Thus, attachment anxiety was a significant moderator of the relationship between pain intensity and physical disability. The three regression slopes for attachment anxiety as a moderator were interpreted as follows: When attachment anxiety was low, there was a non-significant positive relationship between pain intensity and physical disability, $b = 0.99$, 95% CI [-0.46, 2.44], $t = 1.35$, $p = .179$. At the mean value of attachment anxiety, there was a significant positive relationship between pain intensity and physical disability, $b = 1.70$, 95% CI [0.43, 2.97], $t = 2.65$, $p = .009$. Finally, when

attachment anxiety was high, there was a significant positive relationship between pain intensity and physical disability, $b = 2.77$, 95% CI [1.29, 4.25], $t = 3.69$, $p = .001$.

The regression slopes for different levels of attachment avoidance and attachment anxiety and the relationship between pain intensity and physical disability are presented in Figure 1.

Attachment dimensions as moderators in the association between pain and psychosocial disability

Both attachment anxiety and attachment avoidance were found to be significant moderators in the association between pain intensity and psychosocial disability. The interaction term between attachment avoidance and pain intensity explained a significant increase in variance in psychosocial disability, $\Delta R^2 = .02$, $F(1, 199) = 9.49$, $p = .002$. Thus, attachment avoidance was a significant moderator of the relationship between pain intensity and psychosocial disability. The three regression slopes for attachment avoidance as a moderator were interpreted as follows: When attachment avoidance was low, there was a non-significant positive relationship between pain intensity and psychosocial disability, $b = 0.18$, 95% CI [-0.72, 1.09], $t = 0.40$, $p = .69$. At the mean value of attachment avoidance, there was a significant positive relationship between pain intensity and psychosocial disability, $b = 0.94$, 95% CI [0.12, 1.75], $t = 2.27$, $p = .024$. Finally, when attachment avoidance was high, there was a significant positive relationship between pain intensity and psychosocial disability, $b = 1.91$, 95% CI [0.84, 2.97], $t = 3.53$, $p = .001$.

The interaction term between attachment anxiety and pain intensity explained a significant increase in variance in psychosocial disability, $\Delta R^2 = .01$, $F(1, 199) = 6.84$, $p = .01$. Thus, attachment anxiety was a significant moderator of the relationship between pain intensity and psychosocial disability. The three regression slopes for attachment anxiety as a moderator were interpreted as follows: When attachment anxiety was low, there was a non-significant positive

relationship between pain intensity and psychosocial disability, $b = 0.26$, 95% CI [-0.70, 1.22], $t = 0.54$, $p = .591$. At the mean value of attachment anxiety, there was a non-significant positive relationship between pain intensity and psychosocial disability, $b = 0.78$, 95% CI [-0.50, 1.61], $t = 1.86$, $p = .064$. Finally, when attachment anxiety was high, there was a significant positive relationship between pain intensity and psychosocial disability, $b = 1.57$, 95% CI [0.61, 2.52], $t = 3.22$, $p = .002$.

The regression slopes for different levels of attachment avoidance and attachment anxiety and the relationship between pain intensity and psychosocial disability are presented in Figure 2.

Attachment dimensions as moderators in the association between depression and physical disability

Both attachment anxiety and attachment avoidance were found to be significant moderators in the association between depression and physical disability. The interaction term between attachment avoidance and depression explained a significant increase in variance in physical disability, $\Delta R^2 = .02$, $F(1, 198) = 8.22$, $p = .005$. Thus, attachment avoidance was a significant moderator of the relationship between depression and physical disability. The three regression slopes for attachment avoidance as a moderator were interpreted as follows: When attachment avoidance was low, there was a non-significant negative relationship between depression and physical disability, $b = -0.25$, 95% CI [-1.07, 0.58], $t = -0.59$, $p = .559$. At the mean value of attachment avoidance, there was a non-significant positive relationship between depression and physical disability, $b = 0.24$, 95% CI [-0.39, 0.88], $t = 0.76$, $p = .451$. Finally, when attachment avoidance was high, there was a significant positive relationship between depression and physical disability, $b = 0.87$, 95% CI [0.26, 1.49], $t = 2.79$, $p = .006$.

The interaction term between attachment anxiety and depression explained a significant increase in variance in physical disability, $\Delta R^2 = .01$, $F(1, 198) = 5.24$, $p = .023$. Thus, attachment-anxiety was a significant moderator of the relationship between depression and physical disability. The three regression slopes for attachment anxiety as a moderator were interpreted as follows: When attachment anxiety was low, there was a non-significant negative relationship between depression and physical disability, $b = -0.14$, 95% CI [-1.03, 0.75], $t = -0.30$, $p = .761$. At the mean value of attachment anxiety, there was a non-significant positive relationship between depression and physical disability, $b = 0.24$, 95% CI [-0.44, 0.92], $t = 0.69$, $p = .492$. Finally, when attachment anxiety was high, there was a significant positive relationship between depression and physical disability, $b = 0.80$, 95% CI [0.20, 1.41], $t = 2.62$, $p = .01$.

The regression slopes for different levels of attachment avoidance and attachment anxiety and the relationship between depression and physical disability are presented in Figure 3.

Attachment dimensions as moderators in the association between depression and psychosocial disability

Both attachment dimensions significantly moderated the association between depression and psychosocial disability. The interaction term between attachment avoidance and depression explained a significant increase in variance in psychosocial disability, $\Delta R^2 = .04$, $F(1, 198) = 20.17$, $p < .001$. Thus, attachment avoidance was a significant moderator of the relationship between depression and psychosocial disability. The three regression slopes for attachment avoidance as a moderator were interpreted as follows: When attachment avoidance was low, there was a non-significant negative relationship between depression and psychosocial disability, $b = -0.28$, 95% CI [-0.85, 0.29], $t = -0.96$, $p = .341$. At the mean value of attachment avoidance, there was a non-significant positive relationship between depression and psychosocial disability, $b =$

0.22, 95% CI [-0.23, 0.67], $t = 0.97$, $p = .334$. Finally, when attachment avoidance was high, there was a significant positive relationship between depression and psychosocial disability, $b = 0.86$, 95% CI [0.43, 1.28], $t = 3.96$, $p < .001$.

The interaction term between attachment anxiety and depression explained a significant increase in variance in psychosocial disability, $\Delta R^2 = .03$, $F(1, 198) = 12.44$, $p < .001$. Thus, attachment anxiety was a significant moderator of the relationship between depression and psychosocial disability. The three regression slopes for attachment anxiety as a moderator were interpreted as follows: When attachment anxiety was low, there was a non-significant negative relationship between depression and psychosocial disability, $b = -0.14$, 95% CI [-0.75, 0.47], $t = -0.45$, $p = .65$. At the mean value of attachment anxiety, there was a non-significant positive relationship between depression and psychosocial disability, $b = 0.24$, 95% CI [-0.24, 0.72], $t = 0.98$, $p = .33$. Finally, when attachment anxiety was high, there was a significant positive relationship between depression and psychosocial disability, $b = 0.80$, 95% CI [0.37, 1.23], $t = 3.69$, $p < .001$.

The regression slopes for different levels of attachment avoidance and attachment anxiety and the relationship between depression and psychosocial disability are presented in Figure 4.

Attachment dimensions as moderators in the association between pain-catastrophizing and psychosocial disability

Neither of the attachment dimensions were found to moderate the association between pain-catastrophizing and physical disability, and only attachment avoidance was a moderator of the association between pain-catastrophizing and psychosocial disability.

The interaction term between attachment avoidance and pain-catastrophizing explained a significant increase in variance in psychosocial disability, $\Delta R^2 = .01$, $F(1, 197) = 3.94$, $p = .048$.

Thus, attachment avoidance was a significant moderator of the relationship between pain-catastrophizing and psychosocial disability. The three regression slopes for attachment avoidance as a moderator were interpreted as follows: When attachment avoidance was low, there was a non-significant positive relationship between pain-catastrophizing and psychosocial disability, $b = 0.09$, 95% CI [-0.16, 0.34], $t = 0.72$, $p = .474$. At the mean value of attachment avoidance, there was a significant positive relationship between pain-catastrophizing and psychosocial disability, $b = 0.21$, 95% CI [0.02, 0.41], $t = 2.12$, $p = .035$. Finally, when attachment avoidance was high, there was a significant positive relationship between pain-catastrophizing and psychosocial disability, $b = 0.37$, 95% CI [0.14, 0.60], $t = 3.20$, $p = .002$.

The regression slopes for different levels of attachment avoidance and the relationship between pain-catastrophizing and psychosocial disability are presented in Figure 5.

Discussion

The first hypothesis, that levels of attachment insecurity assessed at baseline would predict levels of disability 6-months post-injury, was confirmed. Both attachment dimensions were significantly associated with physical and psychosocial disability explaining 2-5% of the variance in disability adjusted for baseline pain. The second hypothesis, that both attachment dimensions would moderate the associations between pain and disability and between psychological distress and disability was partially confirmed. The associations between pain and disability and between depression and disability were moderated by both attachment dimensions, while only attachment avoidance moderated the associations between catastrophizing and psychosocial disability.

Although the hypotheses were confirmed, the results should be interpreted with caution since the attachment dimensions only explained a small percentage of the variance in disability.

The findings are in accordance with the Attachment-Diathesis Model of Chronic Pain that characterizes an insecure attachment orientation (present before injury) as a diathesis for negative appraisals of pain and pain-related distress, ultimately leading to maladaptive coping and disability [7]. Hence, the direct effect of attachment insecurity on disability is small and most likely due to an interaction with psychological distress such as pain catastrophizing, depressive symptoms. In particular, attachment-avoidance measured soon after the injury was related to psychosocial disability six months later. The moderation results of the present study are in agreement with [15], who found attachment-avoidance to be the primary moderator in the associations between anxiety or low pain self-efficacy and disability. More indirectly, the results are in accordance with [20] who found that attachment-avoidance was the strongest predictor of past year medically unexplained pain. The emphasis of attachment avoidance as the major diathesis for disability may, according to [20], be related to a developmental history in which significant others have responded with less empathy for emotional distress and with more positive attention to reports of physical symptoms. Hence, the combination of high levels of attachment avoidance and emotional distress may have led to diminished support seeking behaviors, ultimately leading to psychosocial disability. In contrast, individuals with high levels of attachment anxiety may still utilize their social network, resulting in an experience of less psychosocial disability in spite of pain and emotional distress.

Although attachment anxiety and attachment avoidance are theoretically characterized by different attachment strategies (hyperactivating and deactivating strategies, respectively), individuals with high levels of avoidance may still experience high levels of pain-related distress in the absence of overt pain behaviors. To further complicate the picture, the impact of attachment insecurity on pain behaviors is affected by social context. Recently, [33] found that individuals with high levels of attachment avoidance showed less pain and pain behaviors compared to individuals with secure or anxious attachment. Interestingly, this group difference was only present in a high-

empathy setting and not in a setting with low empathy. The results indicated that high levels of attachment avoidance can negatively affect the impact of pain on psychosocial functioning.

Although T1 psychological distress had a significant impact on pain-related disability after six months, the major impact on disability was still T1 level of pain. Hence, better acute pain management after whiplash injuries is important. Also, early management of pain-related psychological distress is of importance. While most patients are discharged from the emergency ward within a few hours, general physicians can screen more systematically for elevated levels of psychological distress and refer to psychological pain management for preventive intervention. For patients with high levels of attachment avoidance, screening for psychological distress and referring for such preventive interventions may be even more important, since the nature of attachment avoidance is to downplay symptoms and avoid help-seeking [11]. The potential value of attachment-informed treatment approaches for the prevention and treatment chronic pain still need to be investigated. However, interventions aiming to support emotion regulation and adaptive coping with emotional distress may aid in recovery after whiplash injury for those with high levels of attachment insecurity. Also, more individually tailored interventions aiming to increase the quality of interpersonal relationships and utilization of social support may be of value.

Limitations

A number of limitations should be noted. In order to truly claim that attachment insecurity is a diathesis in the recovery from whiplash-injury, attachment insecurity should be measured pre-injury. However, since attachment orientations are relatively stable trait-like schemes, it may be argued that attachment is a diathesis. For this reason, it is most likely that attachment insecurity was not affected by the whiplash-injury. Indeed, it was found that levels of attachment security did not change from baseline T1 to six months follow up T2. Also, recently pain-catastrophizing has been suggested as a pre-trauma vulnerability factor that may be inherited [34]. Hence, it can be argued

that pain-catastrophizing precedes attachment insecurity. Another potential limitation is the high number of non-responders. Although the non-responder analysis showed that, compared to responders, the non-responders did not differ with respect to WAD grade, age, educational level, whether other injuries were sustained, they may have differed in relation to levels of attachment insecurity at T1. Finally, the use of self-report questionnaires is a limitation. More objective measures of pain and disability would have strengthened the study.

Conclusion

To our knowledge, this study is the first to longitudinally assess the impact of attachment insecurity on disability after whiplash injury. Both attachment avoidance and anxiety predicted disability six month post-injury. Moreover, attachment avoidance was a particularly consistent moderator in the associations between pain, psychological distress and disability. The results support claims that attachment insecurity, measurable before onset of injury, represents a valuable pre-trauma vulnerability for less optimal recovery after whiplash injury. However, the results should be interpreted with caution since the attachment dimensions only explained a small percentage of the variance in disability.

Conflict of interest statement:

The authors report no conflict of interest.

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Figure 1. Regression Slopes for Different Levels of Attachment and the Relationship between Pain and Physical Disability.

Figure 2. Regression Slopes for Different Levels of Attachment and the Relationship between Pain and Psychosocial Disability.

Figure 3. Regression Slopes for Different Levels of Attachment and the Relationship between Depression and Physical Disability.

Figure 4. Regression Slopes for Different Levels of Attachment and the Relationship between Depression and Psychosocial Disability.

Figure 5. Regression Slopes for Different Levels of Attachment and the Relationship between Pain-catastrophizing and Psychosocial Disability.

Table 1 *Correlations between Attachment Dimensions and Outcomes at Baseline*

	Pain	Fear-avoidance	Catastrophizing	Depression	Anxiety	Physical	Psychosocial
Attachment-	.28	.23	.37	.42	.47	.28	.34

avoidance							
Attachment-anxiety	.21	.21	.36	.40	.44	.27	.32

Note. All correlations are significant $p < .01$. Pain = pain intensity, fear-avoidance = fear-avoidance beliefs, catastrophizing = pain-catastrophizing, depression = depressive symptoms, anxiety = anxiety symptoms, physical = physical disability, psychosocial = psychosocial disability.

Table 2 Hierarchical Regressions with Baseline Predictors on Disability at Six Months

Predictors	Physical disability		Psychosocial disability	
	ΔR^2	β	ΔR^2	β
Step 1	.01		.00	
Gender		-.01		-.02
Age		.05		-.01
Step 2	.45***		.40***	
Pain intensity		.41***		.32***
Step 3	.02*		.05***	
Attachment-avoidance		.02		.07
Attachment-anxiety		.02		.03
Step 4	.06***		.10***	
Fear-avoidance		.05		.01
Pain-catastrophizing		.16*		.18*
Depression		.25**		.33***
Anxiety		-.06		-.04

Total R^2	.53***		.55***	
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Note. β = final beta. * p < .05, ** p < .01, *** p < .001.

Highlights:

- This is the first study to longitudinally assess the impact of attachment insecurity in relation to recovery after whiplash injury.
- Both attachment avoidance and anxiety predicted disability 6-month post-injury.
- Attachment avoidance was a particularly consistent moderator in the associations between pain, psychological distress and disability.
- The results support claims that attachment insecurity, measurable before onset of injury, represents a valuable pre-trauma vulnerability for less optimal recovery after whiplash injury.

Moderation by Attachment

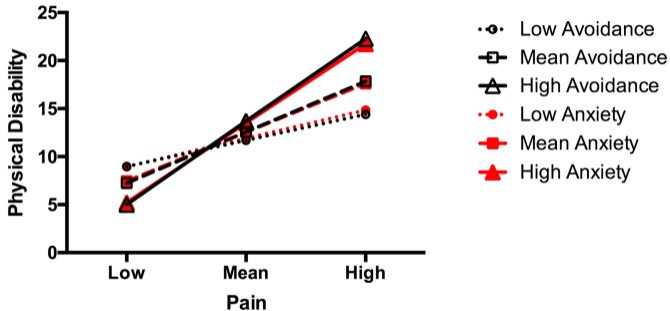


Figure 1

Moderation by attachment

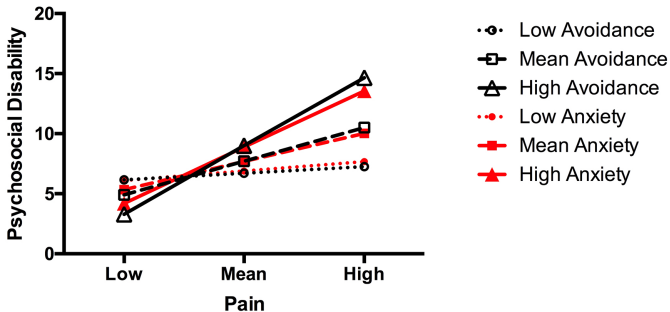


Figure 2

Moderation by attachment

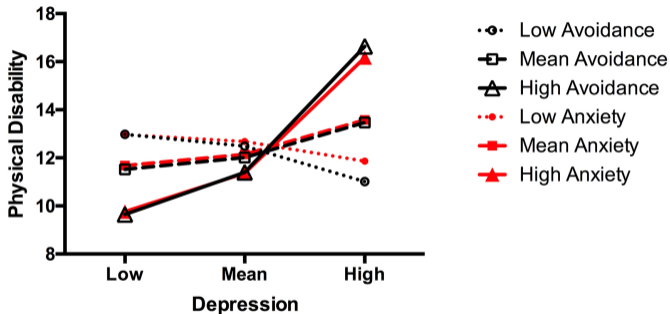


Figure 3

Moderation by attachment

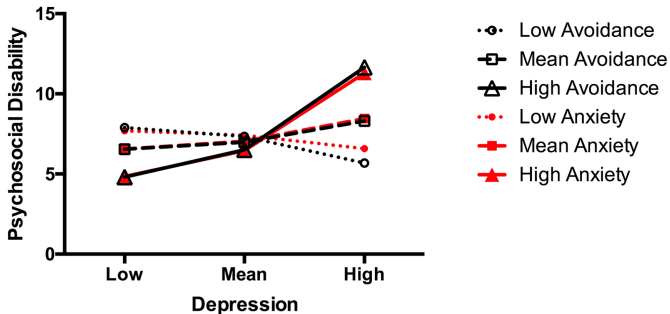


Figure 4

Moderation by attachment

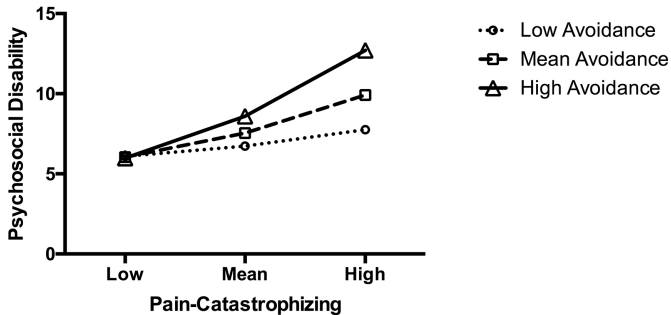
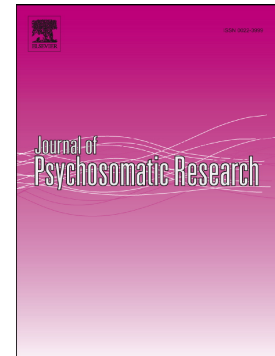


Figure 5

Accepted Manuscript

Attachment insecurity as a vulnerability factor in the development of chronic whiplash associated disorder – A prospective cohort study

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