Title: Mental defeat and Suicidality in Chronic Pain: a prospective analysis

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Abstract

Living with chronic pain has been identified as a significant risk factor for suicide. Qualitative and cross-sectional studies have reported an association between mental defeat and suicidal thoughts and behavior in patients with chronic pain. In this prospective cohort study, we hypothesized that higher levels of mental defeat would be associated with increased suicide risk at a 6-month follow-up. A total of 524 patients with chronic pain completed online questionnaires measuring variables related to suicide risk, mental defeat, sociodemographic, psychological, pain, activity, and health variables. At 6 months, 70.8% (n=371) of respondents completed the questionnaires again. Weighted univariate and multivariable regression models were run to predict suicide risk at 6 months. The clinical suicide risk cutoff was met by 38.55% of participants at baseline and 36.66% at 6 months. Multivariable modeling revealed that mental defeat, depression, perceived stress, head pain, and active smoking status significantly increased the odds of reporting higher suicide risk, while older age reduced the odds. Receiver operating characteristic (ROC) analysis showed that assessment of mental defeat, perceived stress, and depression is effective in discriminating between 'low' and 'high' suicide risk. Awareness of the prospective links from mental defeat, depression, perceived stress, head pain, and active smoking status to increased suicide risk in patients with chronic pain may offer a novel avenue for assessment and preventative intervention.

Perspective: Results from this prospective cohort study suggest that mental defeat is a significant predictor of increased suicide risk among patients with chronic pain, along with depression, perceived stress, head pain, and active smoking status. These findings offer a novel avenue for assessment and preventative intervention before risk escalates.

Keywords: Chronic pain, mental defeat, suicide risk, predictor, prospective associations

1. Introduction

Chronic pain is a risk factor for suicide, with rates of suicidal ideation ranging from 18% to 50% among patients with chronic pain [1–4]. Even after accounting for mental health disorders and co-morbidities, chronic pain remains a significant risk factor [5–7]. International suicide prevention guidelines recognize chronic pain as a risk factor for suicide [8–11], and a US study found that 8.8% of suicide deaths involved chronic pain. Over half of those individuals noted pain as a factor in their suicide notes [12]. However, this figure may have discounted the other risk factors at play [12] and does not fully reflect the distress individuals experience before considering suicide.

Studies have identified various risk factors for suicide in patients with chronic pain, including a family history of suicide, previous suicide attempts, being female, and comorbid depression, as well as pain-specific risk factors such as pain type, intensity, duration, and pain-related insomnia. [4,7,13,14]. A recent study applying multivariable modeling has showed that chronic pain, opioid use disorder, mental defeat, pain catastrophizing and depression increase the likelihood of elevated suicide scores[15]. This finding is consistent with the wider psychopathology literature that has identified mental defeat as a potential contributing factor for suicide, even when comorbid depression is considered [16–19]. In chronic pain literature, there is also initial evidence that mental defeat is more strongly associated with elevated suicide risk than other psychological factors such as anxiety, depression, hopelessness, self-efficacy, and pain catastrophizing[15,20].

The concept of mental defeat originated from the trauma literature and has been extensively studied in the context of depression [21,22] PTSD [23–26] and psychosis [27].The concept was first applied to the study of chronic pain in 2007 with mental defeat defined as negative appraisals of self in relation to pain [28]. Qualitative research has found that individuals with chronic pain may experience specific catastrophic thoughts related to their physical condition, such as "The pain is so bad that I will soon be permanently confined to a wheelchair", but that they may also experience a more pervasive catastrophic sense of mental defeat, such as "The pain makes me feel destroyed as a person." [29] and “I just felt everything had beaten me and there’s nothing I could do. I couldn’t fight anymore.”[30]. These negative appraisals of self are conceptualized as mental defeat, which is characterized by the perceived loss of autonomy due to uncontrollable traumatic events, resulting in the person giving up efforts to retain identity and self-will[29,31].

Mental defeat is different from pain catastrophizing in that mental defeat focuses on negative self-appraisals regarding pain, whereas pain catastrophizing amplifies pain symptoms. mental defeat is a 1-factor construct [29], while pain catastrophizing has a 3-factor construct consisting of rumination, magnification, and helplessness [32]. Mental defeat should not be confused with hopelessness [33] or helplessness either, as these constructs refer to different timeframes and experiences [24,34]. Mental defeat is not just about feeling unable to respond to uncontrollable situations but also encompasses loss of autonomy, identity, and self-will as a human. Studies have shown that mental defeat is more strongly associated with affective pain ratings than other factors such as anxiety, depression, catastrophizing, and hopelessness[35]. Although mental defeat and pain catastrophizing are moderately correlated, mental defeat is linked to depression, anxiety, pain, and global function even after accounting for pain catastrophizing[35].

At present, no study has examined the prospective association between mental defeat and suicide risk or has explored the importance of mental defeat as a unique and independent predictor of suicide risk in chronic pain patients. The present study aims to examine the prospective association between mental defeat and future suicide risk in patients with chronic pain while assessing its contribution beyond frequently studied risk factors such as depression, pain catastrophizing, perceived stress, and other general and pain-related predictors. The study will explore the importance of mental defeat as a unique and independent predictor of suicide risk in chronic pain patients. Based on cross-sectional findings, the hypothesis is that mental defeat is a significant predictor of suicide risk in chronic pain when considered alongside generic and pain-specific risk factors.

2. Methods

3. Participants

Participants were recruited through charities, via digital advertisements on social media and recruitment sites, peer-led support groups, National Health Service (NHS) specialty pain clinics, and local private physiotherapists as well as local engagement events. Participants who were interested in taking part and provided informed consent were screened for eligibility through an online screening questionnaire. Inclusion criteria for recruitment were that participants should be: UK-based, aged between 18 and 65 years, have experienced chronic non-cancer pain for at least 3 months, and were on a stable treatment regimen. Participants were excluded if they had any severe comorbid medical, neurological, or psychiatric condition (e.g. cancer pain, Parkinson's disease, schizophrenia, bipolar disorder, or dementia) which, in the opinion of the chief investigator, prevented them from fulfilling informed consent requirements or could contribute considerably on the pain experience as part of the disease process. Furthermore, participants were excluded if they had scheduled elective surgery or other procedures requiring general anaesthesia during the study or had participated in another research study involving an investigational product in the last 12 weeks.

Procedure

Ethical approval was gained from West Midlands-Solihull Research Ethics Committee on 26/06/2017 (reference: 17/WM/0053, IRAS project ID: 223190). This study was part of the *Warwick Study of Mental defeat in Chronic Pain* ("WITHIN" study), a wider research program aimed at understanding the role of mental defeat in explaining symptom severity, distress, and disability in chronic pain. Here, we examine factors related to suicidal risk. In this study, we employed a self-report online questionnaire completed at two time points, 6 months apart. The questionnaires included validated measures of suicide risk as well as pain-specific, psychological variables (including mental defeat), and physical activity patterns. Safeguarding measures were included due to the sensitive nature of some of the questions, in particular, the inclusion of the 4-item Suicidal Behaviors Questionnaire-Revised [36] in the main questionnaire. More specifically, an automatic email alert was set up to alert researchers when any person scored highly on the SBQ-R, allowing researchers to follow up via email to check on the participant's well-being and direct them to relevant mental health support lines/local services. Furthermore, participants were given the option to request a telephone appointment with one of the researchers at any point, to discuss how to access relevant support services.

Measures

1. Sociodemographic variables

Participants with chronic pain completed an online screening questionnaire to assess eligibility and to gather relevant demographic information such as age, gender, ethnicity, height, and weight (to calculate BMI), current employment status, and smoking and drinking habits using self-report measures. We also collected baseline information on pain etiology such as diagnoses, pain duration, and pain location via a body map and to calculate the existence of widespread pain, medical histories such as any medical or psychiatric diagnoses as well as any treatment plan changes in the next six months and concomitant medication. Pain duration was measured in years up to a maximum of 30+ years. The presence of widespread pain was calculated based on self-reported pain locations and defined according to the IASP Classification of chronic pain for the International Classification of Diseases (ICD-11) as pain present in the axial skeleton, above and below the waist and in the left and right sides of the body [37]. Pain medication use was quantified into a single score by using the Medication Quantification Scale-III (MQS-III)[38] . This validated scoring system was adapted by the research team, including an NHS-registered clinician specializing in chronic pain, to include and reflect current prescription procedures in the UK. We also added a category for beta blockers as this was not previously included in the MQS-III.

1.1. Questionnaire

The questionnaire measures consisted of pain-specific, psychological variables, and activity pattern-related variables that were hypothesized risk factors for suicidality in chronic pain. The survey was conducted using the online survey tool, Qualtrics, at baseline and 6 months. The different scales included in the questionnaire are briefly described below.

1.2. Primary outcome: Suicide risk

Suicide risk was measured using the Suicidal Behaviors Questionnaire-Revised (SBQ-R) [36], which is a measure consisting of four items. The SBQ-R scale is widely used to measure suicidality in various populations, including those with chronic pain, veterans, students, autistic people, and the general population [39–42] Importantly, each item taps into a different dimension of suicidality, therefore providing a comprehensive measure of suicide risk. In terms of psychometric properties, the SBQ-R has shown acceptable sensitivity (greater than 0.882) and specificity (greater than 0.875) in effectively distinguishing between individuals at risk of suicide and those who are not, utilizing both the first item of the SBQ-R and total scores [41,43]. Furthermore, the evidence for internal consistency of the SBQ-R is strong with an acceptable Cronbach's alpha (0.80) for the entire scale, indicating good internal reliability [41]. The scale's one-dimensionality has been confirmed through factor analysis, suggesting that the items effectively measure a single construct [41].Furthermore, this measure was chosen due to its briefness, ease of administration and extensive usage and availability in both clinical practice and research.

The questionnaire evaluates lifetime suicide ideation, frequency of ideation (in the past 12 months), the threat of suicidal behavior, and self-reported likelihood of suicidal behavior. The total score ranges from 3-18 and the risk of suicide is considered high if the total score is ≥7 for the general population and ≥8 for clinical/inpatient populations [36] In line with previous research[43], we used the cutoff of ≥7 to dichotomize participants into low-risk and high-risk as this cutoff has demonstrated the best balance between sensitivity (ranging from .83 to .93) and specificity (ranging from .95 to .96) with an outstanding Area Under the Curve (AUC) of .96 to .98 [36].

1.3. Psychological states

The key predictor of interest was mental defeat, measured by the 24-item Pain Self-Perception Scale (PSPS) [29]. The PSPS consists of 24 items, 11 of which were adapted from the PTSD mental defeat scale [25,26] and the remaining 13 items were adapted from the depression defeat scale [21] to ensure its relevance to the chronic pain population. Example statements include: “Because of the pain - I felt that I had sunk to the bottom of the ladder”, I felt destroyed as a person”, ‘‘I felt humiliated and that I was losing my sense of inner dignity” and ‘‘I felt there was no fight left in me”. Items are scored on a 0-4 Likert scale, where 0= “Not at all/Never” and 4= “Very strongly”, generating a total score ranging from 0-96 where a higher score indicates a heightened sense of mental defeat.

The tendency to catastrophize about pain was measured using the 13-item Pain catastrophizing Scale (PCS) [44]. An example statement is “I become afraid that the pain will get worse”. Items are scored on a 0-4 Likert scale, where 0= “Not at all” and 4= “All the time”, generating a total score ranging from 0-52, where higher scores indicate higher levels of pain catastrophizing.

Pain related-efficacy was measured using the 10-item Pain Self-Efficacy Questionnaire (PSEQ) [45]. An example statement is: “I can enjoy things, despite the pain”. Items are scored on a 7-point Likert scale (0-6), where 0= “Not at all confident” and 6= “Completely Confident”, generating a total score ranging from 0-60. A higher score indicates higher pain self-efficacy.

The 14-item Hospital Anxiety & Depression Scale (HADS) [46] was used to measure the overall severity of anxiety and depression symptoms. Example statements include: “I still enjoy the things I used to enjoy” and “I get a sort of a frightened feeling like “butterflies” in the stomach for depression and anxiety respectively. Items are scored on a 4-point Likert scale, with different anchors for each item. There are seven items each measuring anxiety (HADS-A) and depression (HADS-D) with scores ranging from 0-21 for each subscale, with a higher score indicating worsened symptoms.

The 10-item Perceived Stress Scale (PSS) [47] was used to determine the amount of stress experienced in the past month. An example statement is "In the last month, how often have you been upset because of something that happened unexpectedly?". Items are scored on a 5-point Likert scale, where 0=" Never" and 4=" Very often" with some items reversed scored. A total stress score is calculated by summing all items with scores ranging from 0-40. A higher score indicates more stress.

The 16-item Pain Vigilance & Awareness Questionnaire (PVAQ) [48] was used to assess attention to pain in the last 2 weeks. An example statement is: "I am very sensitive to pain". Items are scored on a 6-point Likert scale, where 0= "Never" and 5= "Always". Two items are reversed scored. The total score ranges from 0-80 where a higher score indicates higher pain vigilance and awareness.

The 11-item Tampa Scale of Kinesiophobia (TSK-11*)* [49] was used to assess pain-related fear of movement. An example statement is: "I'm afraid that I might injure myself if I exercise". Items are scored on a 4-point Likert scale where 1= "strongly disagree" and 4= "Strongly agree". The total fear of painful movement and injury score is calculated by summing all the items with scores ranging from 11-44. A higher score indicates being more fearful.

1.4. Pain related measures

In addition to pain diagnosis, pain duration, pain location, and calculated presence of more than one pain location and widespread pain (y/n), we used the Brief Pain Inventory-Short Form (BPI-sf)[50] to measure pain severity and interference at baseline and 6-month. The BPI-sf consists of four pain severity items and seven pain interference items rated on 0-10 scales. The BPI: Pain severity measures pain at its "worst," "least," "average," and "now", where 0=no pain and 10=pain as bad as you can imagine. The BPI: Interference assesses the extent to which pain interferes with seven daily life activities including general activity, walking, work, mood, enjoyment of life, relations with others, and sleep. Items are scored on a 0–10 scale, where 0 = ''does not interfere" and 10= ''interferes completely", generating a total score ranging from 0 to 70.

Participants were also asked to localize their pain on a Body Pain Map [50] to determine the primary location(s) of persistent pain using a front and back hot-spot style body map detailing 42 areas, as well as indicating which area hurts the most and the spread of pain by the total number of areas affected by pain. A Body-map index was calculated by adding up the total amount of selected body areas out of 42.

1.5. Activity & health variables

To capture the psychosocial impact of pain on functioning, we included a battery of measures related to sleep, social and physical functioning. This is relevant to the discussion of suicide risk, as chronic pain and its associated impact can contribute to a lower quality of life and increase the risk of suicidal thoughts and behaviors [51].

The 7-item Insomnia Severity Index (ISI) [52] was used to measure the severity of insomnia in the last 2 weeks. Statements include asking participants to rate "Difficulty falling asleep" or "How satisfied/dissatisfied are you with your current sleep pattern?". Items are scored on a 5-point Likert scale, where 0= "None" or "Not at all" and 4= "Very Severe" or "Very much" depending on the question. The total summed score ranges from 0-28 where higher scores indicate more severe insomnia. The score can be interpreted into 4 categories with the absence of insomnia (0 to 7), mild (8 to 14), moderate (15 to 21), and severe insomnia (22 to 28).

The International Physical Activity Questionnaire (IPAQ)[53] was used to assess physical activity levels in the past 7 days. The IPAQ can be reported either in categories (low activity levels, moderate activity levels, or high activity levels) or as a continuous variable (MET minutes a week). We included the categories in our descriptive statistics. Each activity is scored based on activity levels equating to a certain amount of MET minutes. For example, to fall into the high activity category, one must engage in either "vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET minutes a week" or "7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET minutes a week." To calculate the MET values, we used a spreadsheet

made freely available online [54]. We report the frequency of participants in the IPAQ low-activity group as a demographic variable.

The 15-item Social Activity Log (SAL) [55] was used to assess the amount of social activity in the past month. The first two questions are used to provide context. Other example statements include asking participants to indicate how many times in the past month they "Went shopping with friends or family you do not live with" or "Sent emails, letters, cards, or notes to people you know but do not live with". Items are scored on a 7-item scale with 0= "0 times" and 6= "6 or more". The total score ranged from 0-91 where higher scores indicated more social activity.

The 30-item Patterns of Activity Measure for Pain (POAM-P) [56] questionnaire was used to measure three activity patterns: avoidance, overdoing, and pacing as a consequence of ongoing pain. Example statements include: "I stop what I am doing when my pain starts to get worse" and "When I'm doing an activity I don't stop until it is finished". Items are scored on a 5-point scale where 0= "Not at all" and 4= "All the time". The total score for each subscale ranges from 0-50 (150 in total), where a higher score indicates more avoidance, pacing, or overdoing respectively.

1.6. Statistical analyses

Descriptive statistics were used to characterize the sample based on information from the screening and the baseline questionnaires. Means, standard deviations, and 95% confidence intervals are reported for continuous variables, whereas frequencies and percentages are used for reporting categorical variables.

The dependent variable was the SBQ-R score. A dichotomized cutoff score of 7 was used, which is appropriate in research studies to categorize non-hospital patients at higher/lower risk of suicide [36]. T-tests for continuous variables and Chi-square tests for categorical variables were used to test if SBQ-R no/lower risk vs higher risk differs in demographics and pain characteristics at baseline. Effect sizes were computed using Cohen's d effect size measure for independent T-test and ϕc = Cramer's V for Chi-square.

One common approach to addressing missing data in surveys is to restrict the analysis to complete cases. However, this approach often induces bias. Inverse probability weighting can be utilized to adjust for this bias while preserving the whole sample size [57,58]. First, a model was created representing the probability that someone has completed a follow-up (propensity score). We used a logistic regression model to estimate the propensity score that was used to form the stabilized weights using the baseline characteristics of age, sex, ethnicity, education level, employment status, alcohol consumption, smoking status, and pain medication use. Stabilized weights were then calculated by dividing the baseline probability of completing follow-up at 6 months (estimated from a model with no covariates) by the probability of completing follow-up at 6 months given the covariates. The stabilized weight (or attrition weight) was used as a weight in our subsequent regression analyses.

Weighted single variable logistic regression models were constructed to examine the association between both baseline demographic and clinical characteristics and the odds ratio of participants' reporting an SBQ-R score of ≥7 at follow-up. A weighted multivariable model was constructed by adding only factors that were observed to be significant predictors in the logistic regression model with SBQ-R score at 6 months as the dependent variable. Variance Inflation Factors (VIF) were calculated to check for multicollinearity. Model fit was determined using Akaike Information Criteria (AIC) [59,60] and Bayesian Information Criteria (BIC) [61].

A ROC analysis was used to evaluate and compare the predictive accuracy of multivariable psychological predictors and define an optimal cutoff value to classify people presenting with an SBQ-R score of ≥7. Analyses were conducted in JASP [62] and SPSS. The optimal cutoff was determined using Youden's index, defined as Sensitivity+Specificity-1[63]. The positive (PPV) and negative predictive values (NPV), were calculated based on the optimal cutoff and the overall prevalence of people presenting with an SBQ-R score of ≥7 at baseline using the following equations: PPV = (Sensitivity × Prevalence)/[(Sensitivity × Prevalence) + ((1 - Specificity) × (1 - Prevalence))] and NPV =(Specificity × (1 - Prevalence))/[((1 - Sensitivity) × Prevalence) + (Specificity × (1 - Prevalence))] [64].

4. Results

1.7. Demographic characteristics

A total of 524 adults with chronic pain completed the Suicide Behaviors Questionnaire-Revised (SBQ-R[36]) at baseline along with an online battery of measures on mental defeat, pain, distress, disability, and (social) activity levels. Of these, 371 (70.8%) repeated the survey at 6 months. **Table 1** summarizes the demographic characteristics collected at baseline. The total sample of participants at baseline consisted of 80.15% women, 18.7% men, and 1.15% other gender identities. The ethnical composition was 89.89% White, 4.39% Asian/Asian British, 3.24% Multiple ethnic groups, and 2.10% Black/African/Caribbean/Black British. Eighty-eight percent of the participants reported having education beyond secondary school. Over one-third (39.69%) of participants reported they were not at work. Just over seventeen percent (17.94%) of participants were active smokers/vapers and 13.74% reported frequent alcohol use more than 3 times a week. The mean MQS score was 3.81 (SD=6.53) and of those taking medications, 15% reported taking opioids.

1.8.

1.9. Pain-specific characteristics at baseline/ pain assessments

Table 1 summarizes the pain-specific characteristics at baseline. The mean duration of pain was 9.97 years (SD= 8.34 years, min=3 months, max=30+ years). Most participants (74.6%) reported having more than one pain location and more than one-third of participants (36.26%) experienced widespread pain.

1.10. Description of suicide risk

At baseline, 38.55% (n=202) participants met the adult general population clinical cutoff ($\geq$7) for high suicide risk, with 36.66% (n=136) participants meeting the clinical cutoff at 6 months. Of those who completed both time points, 19.7% (n=104) met the clinical cutoff on both occasions, 6.3% (n=33) reported remission, and the incidence at 6 months was 5.7% (n=30). Of those who were below the SBQ-R cutoff at baseline, 39.12% (n=205) reported no change. After 6 months 2.4% (n=9) of participants reported a new suicide attempt based on their response to item 1 of the SBQ-R (e.g. “I have attempted to kill myself, but did not want to die/and really hoped to die“). In terms of suicide plans, 5.4% (n=20) of individuals newly reported having a suicide plan based on their response to item 1 of the SBQ-R (e.g. “I have had a plan at least once to kill myself but did not try to do it/and really wanted to die“).

Levels of mental defeat, measured by the PSPS, were significantly higher in those meeting the clinical cutoff for high suicide risk at baseline (M=47.49, SD=25.71) compared to those below the SBQ-R cut-off (M=28.01, SD=21.40). T-test and Chi-squared results on group differences between high and low SBQ scores at 0m are displayed in **Table 1**.

1.11. Univariate findings

The univariate logistic model indicated that several factors increased the odds of meeting the SBQ-R cutoff for suicide risk, whereas several other factors reduced the odds. Identifying as non-white, individuals not working, smoking/vaping, experiencing head pain, widespread pain, elevated pain severity, elevated pain interference, elevated mental defeat, elevated pain catastrophizing, anxiety, depression, elevated perceived stress, fear of movement, insomnia, and pain vigilance, were all significant predictors of meeting the SBQ-R cutoff for suicide risk at 6-month ($p<.01$). Older age and higher self-efficacy, were found to reduce the risk of meeting the SBQ-R cutoff for suicide risk at 6-month ($p<.01$) (see **Table 2).**

1.12. Multivariable findings

In a multivariable model, mental defeat, depression, perceived stress, head pain, and active smoking status significantly increased the odds of suicide risk at 6 months. The elevated mental defeat was associated with increased suicide risk when adjusting for depression, perceived stress, head pain, and smoking status, evident by an OR of 1.02 (95% CI: 1.00, 1.04). Specifically, each 1-point increase in PSPS scores assessing mental defeat was associated with a 2% increase in the OR for suicide risk.

For depression, ORs were: 1.14, 95% CI: 1.04, 1.25. Each 1-point increase in HADS-D scores assessing depression was associated with a 14% increase in the OR for suicide risk. For perceived stress, ORs were: 1.05, 95% 1.00-1.11. Each 1-point increase in PSS scores assessing perceived stress was associated with a 5% increase in the OR for suicide risk. For Age ORs were: 0.97, 95% CI: 0.95, 1,00; for active smoker/vaper ORs were: 1.94, 95% 1.00, 3.75 and for head pain ORs were: 1.96, 95% CI: 1.1, 3.58 (all p=>.05). In the multivariable model, none of the other pain-specific variables (such as pain severity or widespread pain) and none of the other psychological constructs (such as pain catastrophizing and pain self-efficacy) were significant predictors of suicide risk at 6-month follow up (see **Table 2**).

1.13. ROC analysis

A ROC curve was constructed to examine the performance of the significant multivariable predictors of PSPS, HADS-D, and PSS in classifying SBQ-R scores >7. PSPS had the highest AUC compared to PSS and HADS-D.

PSPS cutoff score of 36.5 provided a sensitivity value of 0.707 and a 1-specificity value of 0.307. As presented in **Fig. 1**, this cutoff score demonstrated an acceptable ability to predict participant classification as SBQ-R score >7. The AUC was =.740 (95% CI: .688 - .792) and statistically significant (p<.001). Based on the optimal cut-off of 36.5 and the final multivariable model from this analysis, an individual meeting this cutoff score is estimated to have an odds ratio of 73% higher than individuals with no symptoms of mental defeat (e.g., a score of 0 on the PSPS). Using the PSPS cutoff of 36.5, the PPV value was 56.12% and the NPV was 76.57%.

A HADS-D score of 8 (rounded down from 8.5) provided a sensitivity value of 0.632 and a 1-specificity value of 0.345. As presented in **Fig. 1**, this cutoff score demonstrated an acceptable ability to predict participant classification as SBQ-R score >7. The AUC was =.699 (95% CI: .643 - .765) and statistically significant (p<.001). The PPV was 54.07% and the NPV was 77.95%.

A third ROC curve was constructed to examine the performance of the PSS in classifying SBQ-R scores >7. For the PSS. A cutoff score of 21 (rounded down from 21.5) is suggested which provides a sensitivity value of 0.684 and a 1-specificity of 0.387. As presented in **Fig. 1**, this cutoff score demonstrated an acceptable ability to predict participant classification as SBQ-R score >7. The PPV was 53.45% and the NPV was 73.29%.

5. Discussion

This study demonstrated that the presence of mental defeat alongside depression, perceived stress, experiencing pain in the head, and active smoking significantly increased the likelihood of elevated suicide risk after six months. Older age was associated with reduced odds. Compared to depression and perceived stress, mental defeat - measured using the PSPS - had higher sensitivity to identifying participants with suicide risk at follow-up. To our knowledge, this is the first study to examine the multivariable, prospective relationship between mental defeat and subsequent suicide risk in people with chronic pain compared with other established demographic and psychological risk factors.

Expanding on previous cross-sectional findings [20] and consistent with several theories, our results suggest that mental defeat and perceived stress as prospective psychosocial risk factors, add to the generic demographic and pain-specific risk factors. Although the odds ratios for mental defeat

predicting suicide risk may appear small, they were statistically significant and relatively precise compared with other predictors. Individuals meeting the clinical cut-off for high suicide risk had significantly higher PSPS scores at baseline. A 1-point increase in PSPS score (range 0-96; SD= 25.01) corresponded to a 1.9% increase in the odds ratio for suicide risk. Meeting the cut-off score of 36.5 increased the odds ratio by 74% compared to those with no symptoms of mental defeat, according to the final multivariable model.

The finding that levels of defeat play a role in suicide risk is perhaps not surprising, as it is in line with previous findings in the suicide literature more generally. Indeed, several prominent theories on suicide feature defeat as a key motivating factor. One such theory is the Cry of Pain Model of Suicidal Behaviour, which proposes that the perception of defeat, entrapment, and no escape or rescue are the three main risk factors for suicide [19,65]. These components are derived from observations in animal research known as "arrested flight', where one is 'defeated' or 'closed in' with no prospect of escaping or being rescued[21].

These findings, in tandem with the large body of research indicating that mental defeat is linked to increased suicide risks, underscore the need for clinicians working in clinical settings where patients living with chronic pain seek care to consider implementing routine screening for mental defeat to guide care planning. Apart from depression and perceived stress, none of the other psychological or pain-related risk factors was significant when considered jointly in the multivariable model. Our findings, furthermore, support the notion that mental defeat is functionally distinct from other psychological constructs [35,66].

Unlike previous studies, multivariable analyses did not show pain duration [67,68] or pain severity [2,69–71] to be significant predictors. However, in line with previous research, our findings demonstrate a strong relationship between head pain and suicide risk [72–75]. Chronic headaches are linked to reduced quality of life and Years of Life Lost to Disability (YLDs). Several studies have shown that living with chronic headaches including migraines and chronic tension-type headaches increases suicide risk [76–78]. Further research should investigate the relationship between headaches and suicide risk, and the role of mental defeat.

This study also adds to previous research by demonstrating that active smokers were at increased risk of suicide up to 6 months later. In the Integrated Motivational Volitional Model of Suicidal Behaviour, particular importance is given to impulsivity, fearlessness of death, and reduced pain sensitivity which are seen as volitional moderators that govern the step from suicidal ideation to suicidal behavior [79,80]. These factors have in turn been theorized to explain the relationship between smoking and suicide [81]; smoking is associated with risk-taking behavior [82], enhanced impulsivity [7,64,] and a tendency to favor immediate rewards [82]. A review of the biological explanations for this relationship is beyond the scope of this paper (see e.g. [85]); however, central and peripheral mechanisms have been suggested. These findings have prompted clinical attempts to include smoking as a risk factor in suicide assessment [81]. The interaction between chronic pain and smoking is complex and most likely bi-directional; lifetime smoking has been noted as a risk factor for developing persistent pain and pain may act as a motivator for smoking [86,87]. It is important to note, however, that the majority of studies assessing the relationship between smoking and suicide or smoking and pain have been cross-sectional and few have investigated the relationship between smoking, suicide, and chronic pain [88]. To our knowledge, this study is the first to demonstrate the prospective relationship between smoking status and elevated suicide risk among people with chronic pain.

The presence of depression was also associated with higher suicide risk in our study. Depression is a known general risk factor for suicide and one that has frequently been identified in chronic pain populations [4,7,89]. The perception of defeat is strongly correlated with depression, even after controlling for feelings of hopelessness [21]. Due to multicollinearity, only depression but not anxiety was included in the final multivariable model as depression was the stronger univariate predictor. Sensitivity analyses indicated that when anxiety, but not depression was considered in the multivariable model, anxiety did not add to the prediction of suicide risk. Our results furthermore show that depression does not constitute a single predisposing factor to suicide among chronic pain sufferers and emphasizes the need to look beyond the traditional risk factors known to be associated with elevated suicide risk in individuals with chronic pain.

Our findings have important clinical implications. Despite their widespread use, clinical scales that directly assess suicide risk have a high rate of false positives and tend to overclassify low-

risk patients as high-risk, putting their clinical utility into question [90]. While the PSPS may not be as concise as the four-item SBQ-R, it arguably provides a more detailed and nuanced (i.e., indirect) assessment of suicide risk which may help identify individuals who are at risk but may not be overtly expressing suicidal ideation or behavior. This can be particularly important for individuals who may be struggling with depression or other mental health issues but are not comfortable or able to express their suicidal thoughts or intentions directly. Furthermore, the PSPS provides the opportunity to monitor and assess changes over time and for targeted psychological intervention and allows mental health professionals to develop tailored treatment plans before risk escalates into suicide [91]. A cutoff score of 36 for PSPS was selected to have an acceptable ability to predict participant classification with SBQ-R scores ≥ 7 meaning high suicide risk. In this study, the PSPS had the highest PPV (56.12%) using the optimal cutoff scores compared to HADS-D and PSS; with PSS having the highest NPV (77.95%). In terms of future research, it would be useful to extend the current findings by examining whether mental defeat is susceptible to change. If so, mental defeat could serve as a new treatment target, and there is a need for research to explore possible clinical approaches to restore the healthy and non-eroding sense of self in the context of pain. mental defeat has already emerged as a treatment target for other health conditions in the context of cognitive-behavioral interventions in patients with psychosis [91], major depressive disorder [47,] and panic disorder [93], and has shown promising results for the reduction of mental defeat.

Our study has several limitations. First, our study consisted of predominantly white participants suggesting that the findings may not be generalizable to a more heterogeneous population. Our findings, therefore, warrant replication in more heterogeneous chronic pain groups using longer timeframes. Second, individuals with severe psychiatric comorbidities that could potentially hinder informed consent or significantly impact their pain experience as part of their disease process were excluded from the current sample. As a result, we may have eliminated the most high-risk individuals, a practice that may be typical for most research studies. It is reasonable to presume that individuals who are considering suicide may not be inclined to participate in research studies. The exclusion of individuals with severe psychiatric comorbidities is essential for ethical and safety purposes. Nevertheless, it is important to acknowledge that this exclusion may affect the generalizability and comprehensiveness of our findings. Consequently, our results may represent the mild to severe range of suicidal risk rather than the most severe cases. Third, experimental evidence is needed to examine the direct effect of mental defeat on pain sensitivity and suicidality. Furthermore, research is needed to further elucidate the mechanisms of translating mental defeat into suicidal thoughts and behaviors (e.g. motivational factors; threat to self, social support and volitional factors; acquired capability, access to means, impulsivity). Despite these limitations, this prospective study provides novel insights into the temporal relationship between mental defeat and subsequent risks for suicide in a large ambulatory sample.

In conclusion, the results of this prospective study provide further insight into the risk factors for suicide in chronic pain. Psychosocial risk factors, such as mental defeat and perceived stress, add to generic demographics and pain-specific risk factors such as depression that predict suicide risk, which is consistent with theories on suicide. mental defeat and perceived stress as well as awareness of the link between depression, active smoking status, and suicide risk may provide novel clinical avenues for assessing and reducing suicide risk in chronic pain patients.

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Fig 1. Combined ROC curves to show relative predictive powers of PSPS (mental defeat), PSS (perceived stress), and HAD-D (depression) for independently classifying SBQ-R scores ≥ 7.

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