Pain catastrophising, body mass index and depressive symptoms are associated with pain severity in tertiary referral orthopaedic foot/ankle patients

Matthew Holt1,2, Caitlin L. Swalwell1,3, Gayle H. Silveira4, Vivienne Tippett3, Tom P. Walsh1,3*, and Simon R. Platt1,2

Abstract

Introduction: Patients with chronic foot/ankle pain are often referred for orthopaedic assessment. Psychological vulnerabilities influence pain states (including foot and ankle), therefore this study aimed to establish the prevalence and relative importance of compromised psychological health to perceived foot/ankle pain severity in people referred to an orthopaedic foot and ankle clinic with non-urgent presentations.

Methods: Patients with triaged non-urgent foot/ankle referrals to the Department of Orthopaedics at Gold Coast University Hospital were recruited over a 12-month period and completed the Manchester-Oxford Foot and Ankle Questionnaire which was the primary measure. Participants also completed questionnaires assessing their anthropometric, demographic and health characteristics (Self-Administered Comorbidity Questionnaire) as well as measures of health-related quality of life (EuroQol-5-Dimensions-5-Level Questionnaire and EQ Visual Analogue Scale) and psychological health (Center for Epidemiological Studies-Depression scale, Pain Catastrophizing Scale and Central Sensitization Inventory). Descriptive statistics were used to summarise participant characteristics and a hierarchical multiple linear regression was employed to establish the extent to which psychological variables explain additional variance in foot/ankle pain severity beyond the effects of participant characteristics (age, sex, body mass index (BMI)).

Results: One hundred and seventy-two adults were recruited (64.0% female), median (IQR) age 60.9 (17.7) years and BMI 27.6 (7.5) kg/m²). Specific psychological comorbidities were prevalent including depressive symptoms (48%), central sensitisation (38%) and pain catastrophising (24%). Age, sex and BMI accounted for 11.7% of the variance in MOXFQ-index and psychological variables accounted for an additional 28.2%. Pain catastrophising was the most significant independent predictor of foot/ankle pain severity (accounting for 14.4% of variance), followed by BMI (10.7%) and depressive symptoms (2.3%).

* Correspondence: t20.walsh@qut.edu.au

1Queensland University of Technology (QUT), Faculty of Health, School of Clinical Sciences, Kelvin Grove, Queensland 4059, Australia

Full list of author information is available at the end of the article

© The Author(s). 2022. Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated in a credit line to the data.
Conclusions: This study demonstrated that specific psychological comorbidities and increased BMI are common in this cohort and that these factors are associated with the symptoms for which patients are seeking orthopaedic assessment. This knowledge should prompt clinicians to routinely consider the psychosocial components of patient presentations and develop non-operative and pre-operative treatment strategies which consider these factors with the goal of improving overall patient outcomes.

Keywords: Foot, Ankle, Mental health, Depression, Body mass index, Musculoskeletal pain

Introduction
Foot pain affects one in four, and ankle pain one in six, adults aged 45 years and over [1]. Both are associated with high burden of disease [2, 3]. Foot/ankle pain has been associated with fat and body mass index [4], increased age [5], female gender [5] and a range of psychosocial factors including depression and anxiety [6] as well as reduced health-related quality of life (HRQoL) [5]. In Australia, many people with foot/ankle pain will have initial assessment and treatment in community primary care. A substantial proportion will however be referred to specialist orthopaedic clinics for assessment. They are triaged based on clinical urgency with those considered non-urgent, despite often having chronic pain and/or some level of disability, often subjected to long waiting periods. It has been shown, that amongst patients triaged as non-urgent the proportion who are ultimately treated operatively is as low as 20% [7, 8]. Improving understanding of the clinical characteristics of this non-urgent group, including any non-surgical factors contributing to their pain, is important as it may offer the opportunity to institute early and targeted treatment strategies while they await an orthopaedic surgical assessment.

The reason for low surgical conversion rates in this group is likely multifactorial and may be in part related to the surgeons’ reluctance to operate on patients with discordance between orthopaedic pathology and pain severity. Patients referred to specialist clinics may believe that their pain is primarily generated mechanically in their foot/ankle and evidence suggests that patients tend to have higher expectations of the benefits of surgery than do surgeons [9]. However, research in recent decades has considerably improved clinicians’ understanding of pain as an output of the central nervous system, subject to modification by local and central mediators. Chronic musculoskeletal pain (including foot and ankle pain) is the product of a complex and reciprocal interplay between physiological factors and psychosocial factors including depression and anxiety, poor sleep, catastrophising, personality vulnerabilities, social isolation and occupational and/or socio-economic risk factors [9–15].

In many cases, the psychosocial elements of a patient’s pain presentation can be prognostic in the experience of pain and can negatively influence the likelihood of functional recovery [16, 17]. Clinically diagnosed major depression has a well-established relationship with chronic pain [18] and evidence suggests that depressive symptoms are a possible comorbidity for patients with foot/ankle conditions. For example, one recent study suggested that pre-operative depressive symptoms are associated with worse post-operative pain following total ankle arthroplasty [19] and patients with end-stage ankle arthroplasty demonstrate significantly worse mental component summary scores in the 36-Item Short Form Survey Instrument (SF-36) than those with end-stage hip arthroplasty, despite showing similar SF-36 physical component scores [2]. Treatment of comorbid depression has also been associated with improved clinical and social/occupational outcomes in a general chronic pain cohort [20]. However the prevalence and modifiability of depression in patients with foot/ankle pain is not yet well understood.

Other psychological features such as pain catastrophising and sensitisation have now also been linked to musculoskeletal pain and surgical outcomes [21]. In knee arthroplasty, for example, there is evidence that pain catastrophising may stand out amongst several possible psychological vulnerabilities as being associated with worse pain and physical function pre- and post-operatively [22] and predictive of poor surgical outcomes [23]. Catastrophising has also been previously associated with increased foot pain [24] and worse patient-reported outcomes (on the Foot and Ankle Outcome Score) including pain following foot/ankle surgery [25]. Pain catastrophising represents a negative mental schema which research suggests is modifiable [26, 27]. Measuring catastrophising, if it leads to interventions aimed at modifying catastrophising in patients pre-operatively, may therefore have potential to inform strategies for positively influencing post-operative outcomes.

This study aims to; (a) undertake an exploratory investigation of the prevalence of psychological health features that may be contributing to foot and ankle pain, and (b) to delineate the contribution and relative importance of these factors to foot and ankle pain presentations.

Methods
Study population
Patients referred to a tertiary referral hospitals’ Department of Orthopaedics at Gold Coast University Hospital
from May 2019 through April 2020 were invited to participate in this cross-sectional study. Upon receipt of referral, the foot and ankle orthopaedic consultants triage patients as Category 1 (urgent), Category 2 (semi-urgent) and Category 3 (non-urgent) which is the standard of practice for specialist hospital referrals in the Australian public health system. Category 1 and 2 is applied to patients triaged as having a condition which may deteriorate if not reviewed in an urgent (i.e. next available or within 30 days) or semi urgent (i.e. within 90 days) manner, respectively. Category 3 is applied to referrals for conditions considered not life or limb threatening and unlikely to deteriorate or have increased morbidity for which review in a specialist clinic/service is recommended within 365 days of being added to the waiting list.

**Participant recruitment**

All patients triaged to Category 3 during the study period were posted a letter of invitation to participate in the study, participant information sheet and each of the study questionnaires to complete at a single time point. The information sheet clearly outlined that return mailing of their responses in the stamped envelope provided within would constitute consent to participate in the study unless they specified otherwise. The responses were manually entered into an electronic numeric coding spreadsheet for data analysis. To determine the presence of self-selection bias, the age, sex, and socio-economic disadvantage were compared between the responders and non-responders. Gold Coast Hospital and Health Service Human Research Ethics Committee granted ethical approval (Study ID #45244) for this study.

**Inclusion and exclusion criteria**

All adults with Category 3 foot/ankle referrals were included in this study. Patients triaged as Category 1 or 2 by the foot and ankle orthopaedic consultants, or patients unable to provide consent (e.g unable to understand written English) or unwilling to provide consent were excluded.

**Anthropometry, demographics and general health**

Participants self-reported their age, sex, height, weight, duration of foot/ankle symptoms, current analgesic medication use (paracetamol, oral non-steroidal anti-inflammatory drugs, codeine/other opioids), and smoking status (current smoker, ex-smoker, non-smoker). Duration of foot/ankle pain was collected in year/months and analgesia use was specific for current foot/ankle pain. BMI was calculated by dividing self-reported weight (kg) by height (m²). Socio-economic disadvantage was estimated from each participant’s postcode using the Index of Relative Socio-economic Disadvantage (IRSD) from the Australian Bureau of Statistics [28]. Possible scores range from 1 to 10, where 10 is the least disadvantaged.

Current medical conditions were collected via a modified version of the **Self-Administered Comorbidity Questionnaire** (SACQ) [29]. The SACQ comprises 13 forced-choice items (each pertaining to common medical conditions) and one free response item (allowing patients to report additional medical complaints). The presence of comorbidities (defined as one or more medical conditions) was calculated by summing the total responses to all 13 forced-choice items and any free response items.

Overall HRQoL was assessed via the **EuroQol-5-Dimensions-5-Level Questionnaire** (EQ-5D-5L) and **EQ Visual Analogue Scale** (EQ-VAS). The EQ-5D-5L comprises five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). Participants indicated their health state across each dimension by ticking the most appropriate statement (from no problems to extreme problems). The EQ-VAS asks participants to self-report their HRQoL using a visual VAS with endpoints labelled ‘best imaginable health state’ (100) and ‘worst imaginable health state’ (0); thus, the EQ-VAS can be used as a quantitative measure (0–100) of a participant’s perceived health status.

**Pain and disability**

The MOXFQ was used to assess the region-specific impact of foot/ankle symptoms on pain, function and social interaction. This questionnaire comprises 16-items across three separate domains, walking/standing problems (seven items), foot/ankle pain (five items) and social interaction (four items); and has been found to be a reliable and valid assessment of foot/ankle pain severity [30]. The MOXFQ-index (an overall summary score ranging from 0 to 100, where 100 is the most severe) was used as the primary measure for all foot/ankle pain severity analyses. Individual domain scores have also been used to report level/type of disability. For participants with bilateral foot/ankle pain, MOXFQ questionnaires were completed twice (one for each limb), and to avoid violating the assumption of independence, only data for the more painful limb were used in the regression analysis. To determine the prevalence of bilateral foot pain in our sample, a MOXFQ-index score of 20 or above for each limb was considered to constitute clinically significant foot pain.

Participants were asked to identify the presence of pain at other joints (both hands, elbows, shoulders, hips, knees, along with the cervical and lumbar spine) that they have had on most days of the week during the past one-month. The total number of joints affected were...
ised (range 0–12). Multi-site pain was defined as pain at four or more joints.

Psychological health (depressive symptoms, pain catastrophising, central sensitisation syndrome)

Depressive symptom presence was assessed using the 20-item Center for Epidemiological Studies-Depression (CES-D) scale. Participants were asked to indicate how often they have experienced symptoms associated with depression (e.g., loneliness) over the past week. Items are scored using a 4-point Likert scale anchored 0 (rarely or none of the time / less than 1 day) to 3 (all of the time / 5–7 days). Total possible scores range from 0 to 60; and scores ≥16 were considered indicative of depressive symptom presence [31].

The influence of catastrophising on perceptions of painful experiences was established via the 13-item Pain Catastrophizing Scale (PCS). This questionnaire has participants reflect on prior painful experiences and indicate the extent to which they have experienced each of 13 thoughts/feelings during these episodes of pain. Responses are scored using 5-point Likert scale anchored 0 (not at all) to 4 (all the time) and items 8 and 12 were rescored as per a previous recommendation [32]. This yielded an overall catastrophising score (0–52), and three subscale scores: Rumination (0–16), magnification (0–12), and helplessness (0–24). In line with existing recommendations [33], a participant scoring ≥30 with the PCS was classified as exhibiting pain catastrophisation.

The two-part Central Sensitization Inventory (CSI) was used to establish the role of central mediation on participant pain. Only Part A was used in this study, which comprises 25-items relating to health-related symptoms common to central sensitisation syndromes. Each question is graded using a 5-point Likert scale anchored 0 (never) to 4 (always), with total possible scores ranging from 0 to 100. Participants who scored ≥40 were deemed to have clinically significant central sensitisation, and indicative of central sensitisation syndrome (CSS) [34].

Data analysis

Descriptive statistics were used to summarise the characteristics of the participants. All data distributions were explored for normality (visualisation and Shapiro-Wilk normality test) to determine the suitability of parametric or non-parametric statistical tests. Differences in age and IRSD between the participants and those that declined to participate were analysed using the Mann-Whitney U test as they were not normally distributed. Gender ratios were compared using the chi-squared test. If a questionnaire (MOXFQ, CES-D, CSI, PCS) was returned with >50% of the items missing it was excluded from the analysis. Missing items were scored as zero and missing data were not imputed.

Multivariable linear regression was used to determine whether the severity of foot pain as measured by the MOXFQ-index score is associated with various demographic/social (age, sex, BMI) and psychological (depressive symptoms, CSS, pain catastrophising) predictors. A hierarchical multiple linear regression model was employed to establish (a) the variance in MOXFQ-index than can be accounted for by demographic variables (all of which have existing, well-established relationships with musculoskeletal pain), and (b) the extent to which psychological variables explain additional variance in MOXFQ-index score (established relationships in the literature, but less so in this cohort) beyond the influence of demographic variables. Consequently, block 1 comprised age, sex and BMI, and block 2 added depressive symptoms, CSS, and pain catastrophising. Formal collinearity diagnostics were conducted, and standard homoscedasticity and normality checks of residuals were carried out for the final models to ensure validation, and zero-order correlations between predictor variables were also inspected to ensure no problematic collinearity emerged. In all analyses, a $p$-value (two-sided) less than 0.05 was deemed to be statistically significant. All data were analysed with SPSS v27.0 (IBM SPSS Statistics, Armonk, NY, USA).

Sample size calculation

Given the exploratory nature of this study, we did not specifically calculate a sample size a priori. However, we projected approximately 800 referrals over the 12-month and a 35–40% participation rate giving us approximately 280 participants. With this sample size we would be able to estimate the mean (MOXFQ)-index score with a precision (95% confidence interval) of ±2.8 and estimate the prevalence of the psychological comorbidities of interest with a precision of at least ±0.06. Further, we would be able to detect a predictor that accounts for as little as 3% of the variance in MOXFQ. These calculations were performed using the G*Power software and assuming a standard deviation of 24 in the MOXFQ.

Results

Study participants

Total outpatient numbers in public hospitals were lower than anticipated, particularly Category 3 referrals. However, of the 434 patients referred and sent questionnaires, 172 responded, rendering a response rate of 39.6%. The IRSD was not significantly different between the responder and non-responder groups, median (interquartile range (IQR)) 7 (1) versus 7 (2) $p = 0.253$, respectively. The sex distribution was also no different between-groups, with 106 (61.6%) and
159 (60.7%) women in the responder and non-responder groups, $\chi^2 = 0.039 \ p = 0.844$. The responder group, however, was significantly older than the non-responder group, median (IQR) 60.3 (18.3) years versus 48.0 (24.0) years, $p < 0.001$.

Per Table 1, participants had a median (IQR) BMI of 27.6 (7.5) kg/m$^2$, with 55 (32%) of the participants being classified as obese (BMI $\geq$ 30 kg/m$^2$). Nearly 75% of participants were taking some form of oral analgesia and 23% of participants reported taking an opioid for their foot complaint. The presence of chronic health conditions was high, with 78.2% of participants reporting one or more. Back pain (56.5%), osteoarthritis (47.9%) and hypertension (33.1%) were the most frequently reported conditions (Table 2). The median (IQR) of the EQ-VAS was 70.0 (30.0) points. A considerable proportion of participants reported moderate problems with mobility (44.7%) and usual activity (38.0%), and over three-quarters (77.8%) indicated either moderate or severe problems with pain or discomfort. Capacity for self-care appeared largely unaffected, with 65.5% of participants reporting no problems, and 42.6% reported no problems with anxiety or depression. Complete data for the five dimensions of the EQ-5D-5L are reported in Table 3.

### Table 1: Participant characteristics ($n = 172$)

| Characteristic               | Median (Q1, Q3) |
|-----------------------------|-----------------|
| Age, yrs                    | 60.9 (53.4, 71.7) |
| Sex, n female (%)           | 110 (64.0)      |
| Weight, kg                  | 79.0 (68.0, 93.0) |
| Height, m                   | 168.0 (160.0, 176.0) |
| BMI, kg/m$^2$               | 27.6 (24.4, 31.7) |
| Socio-economic disadvantage (IRSD) | 7.0 (6.0, 7.0) |
| Health-related quality of life (EQ-VAS) | 70.0 (50.0, 80.0) |
| Analgesia, n (%)            | 85 (50.3)       |
| Paracetamol                 | 62 (36.9)       |
| Oral NSAIDs                 | 40 (23.7)       |
| Codeine / other opioids     | 126 (74.1)      |
| Any analgesia, n (%)        | 10 (5.8)        |
| Smoking status, n (%)       | 56 (32.6)       |
| Current smoker              | 104 (60.5)      |

### Table 2: Most frequently reported comorbidities based on the SACQ ($n = 172$)

| Comorbidity                  | n (%) |
|------------------------------|-------|
| Heart disease                | 11 (6.5) |
| Hypertension                 | 56 (33.1) |
| Lung disease                 | 10 (5.9)  |
| Diabetes                     | 16 (9.4)  |
| Anaemia or other blood disease | 13 (7.7)  |
| Kidney disease               | 3 (1.8)  |
| Liver disease                | 2 (1.2)  |
| Depression                   | 29 (17.2) |
| Cancer                       | 7 (4.1)  |
| Stroke                       | 7 (4.2)  |
| Osteoarthritis               | 81 (47.9) |
| Back pain                    | 95 (56.5) |
| Rheumatoid arthritis         | 27 (16.8) |
| Other                        | 33 (19.4) |

Values are n and percentage of valid responses. Data missing from participants (n); heart disease (4), hypertension (3), lung disease (2), diabetes (2), anaemia or other blood disease (3), kidney disease (2), liver disease (2), depression (3), cancer (2), stroke (4), osteoarthritis (3), back pain (4), rheumatoid arthritis (1), other (2)

Abbreviation: SACQ Self-Administered Comorbidity Questionnaire

### Pain and disability

Foot/ankle symptoms had been present for a median of over two-years (28.5 months, IQR 46.3 months) prior to referral and bilateral foot pain was reported by 37.2% participants. Multi-site pain was present in 88 (51.2%) participants and 31 (18.8%) participants had no other joint pain throughout their body. Foot pain measured with the MOXFQ was high across the three measured domains and summary score. Median (IQR) scores of 67.9 (35.7) points for walking / standing, 70.0 (25.0) points for pain and 62.5 (37.5) points for social interaction were calculated, with a MOXFQ-index summary score of 65.6 (28.1) points.

### Psychological health

Depressive symptoms were present in 83 (48.3%) of the participants completing the CES-D questionnaire and 66 (38.4%) participants returned scores $\geq 40$ on the CSI, classifying them as having CSS. Of those participants who did complete this questionnaire, nearly one-quarter (24.4%) participants were classified as exhibiting pain catastrophisation on the PCS (Table 4).

### Multiple linear regression analysis

Collectively, age, sex, and BMI accounted for 11.7% of the variance in MOXFQ-index, $F ch. (3130) = 5.76, p < 0.001$. BMI was a significant independent predictor of MOXFQ-index: For every 1 kg/m$^2$ increase in BMI, MOXFQ-index increased by 1.18 points, $p < 0.001$, with
BMI accounting for 10.7% of the unique variance in MOXFQ-index. Age and sex were not significant independent predictors of MOXFQ-index. Shared variance between all predictors accounted for < 1% of the variance in MOXFQ-index.

Beyond the block 1 participant characteristics, the inclusion of pain catastrophising, depressive symptoms and CSS in block 2 accounted for an additional 28.2% of the variance in MOXFQ-index score, $F \text{ ch.} (3127) = 19.90, p < 0.001$. Catastrophising and depressive symptoms were significant independent predictors of MOXFQ-index, with catastrophising explaining 14.4% of the variance in MOXFQ-index score, and depressive symptoms explaining 2.3%. The presence of pain catastrophizing corresponded to an increase in MOXFQ-index of 20.07 points ($p < 0.001$), and depressive symptoms to an increase of 8.97 points ($p = 0.031$), while CSS was not a significant independent predictor of MOXFQ-index in block 2. Shared variance between significant catastrophizing, depressive symptoms and CSS accounted for 11.4% of the variance in MOXFQ-index.

Given the reported $\beta$ values (Table 5), the rankings of predictor importance from highest to lowest are significant catastrophising, BMI, and depressive symptoms; followed by age, CSS and sex. Overall, all six variables combined explained 40.0% of the variance in MOXFQ-index, $F(6,127) = 14.09, p < 0.001$. All variance inflation factors were less than 2, with depressive symptoms and CSS yielding the highest scores (1.91 and 1.79, respectively).

**Discussion**

This study is the first to explore the prevalence and nature of these specific psychological comorbidities as they relate to foot/ankle pain amongst a public hospital waiting-list cohort. Pain catastrophising, CSS and depressive symptoms were all demonstrated to be prevalent in this group. Our model found 40% of the variance in a patients’ foot/ankle pain can be explained prior to specialist evaluation and without a formal orthopaedic diagnosis.

Pain catastrophising had the most significant association with foot/ankle pain severity in our regression model. Catastrophising is a set of maladaptive beliefs which magnify the threat value of pain stimuli and the attention paid to these as well as the tendency to feel helpless to reduce the response in the face of repeated painful exposures [33, 35]. Research has demonstrated consistent associations between measures of catastrophising and pain-related clinical outcomes including severity, occupational-functional recovery and response to treatment which are maintained even when controlling for co-morbid depression [36–39]. The precise nature of factors that predispose to pain catastrophising are not yet clearly understood and are likely multifactorial, however it has been reported that pain frequency plays an influential role in moderating the effect of catastrophising on symptoms [40].

### Table 3 Health-related quality of life dimensions, as measured by the EuroQoL-5D-5L (n = 172)

| Dimension             | Level                      | No problems | Slight problems | Moderate problems | Severe problems | Extreme problems |
|-----------------------|----------------------------|-------------|-----------------|-------------------|-----------------|-----------------|
| Mobility              |                            | 19 (11.2)   | 36 (21.2)       | 76 (44.7)         | 37 (21.8)       | 2 (1.2)         |
| Self-care             |                            | 110 (65.5)  | 35 (20.8)       | 17 (10.1)         | 4 (2.4)         | 1 (0.6)         |
| Usual activity        |                            | 26 (15.5)   | 43 (25.6)       | 64 (38.0)         | 28 (16.7)       | 6 (3.6)         |
| Pain / discomfort     |                            | 2 (1.2)     | 26 (15.2)       | 73 (42.7)         | 60 (35.1)       | 10 (5.8)        |
| Anxiety / depression  |                            | 72 (42.6)   | 49 (29.0)       | 33 (19.5)         | 7 (4.1)         | 7 (4.1)         |

Values are n (%)

Data missing from participants (n); mobility (2), self-care (4), usual activities (4), pain / discomfort (1), anxiety / depression (3)

**Table 4 Pain- and psychological health-related measures**

| Pain Measures          | Median (Q1, Q3) |
|------------------------|-----------------|
| MOXFQ a                | 67.9 (50.0, 85.7) |
| Walking / standing     | 70.0 (55.0, 80.0) |
| Pain                   | 62.5 (37.5, 75.0) |
| Social interaction     | 65.6 (51.6, 79.7) |
| MOXFQ-index            | 83 (48.3)       |
| Depressive symptoms, n (%) | 66 (38.4)     |
| Central sensitisation syndrome, n (%) | 9.0 (4.0, 15.0)     |
| PCS                    | 42 (24.4)       |

aUnless otherwise indicated. *In cases of bilateral foot pain, data reported for more painful foot

Data missing from participants (n); MOXFQ-index (5), depressive symptoms (8), central sensitisation syndrome (6), pain catastrophisation (26)

Abbreviations: MOXFQ Manchester-Oxford Foot and Ankle Questionnaire, PCS Pain Catastrophizing Scale, Q1 = lower quartile, Q3 = upper quartile
is of interest, because-in-a-cohort-of-patients-referred-to-foot-and-ankle specialist clinics almost all have frequent pain experiences which meaningfully affect their quality of life. Understanding, measuring where possible, and intervening-in-pain-catastrophisation—should-therefore-be of interest to orthopaedic specialists, however research suggests that surgeons are not able to routinely identify the presence of pain catastrophising in their patients during initial consultation [41]. It is likely this is the case in the Australian public health system where patient numbers are high, resources-are-finite-and-consultations-may-be-brief-as-a-result. These results clearly suggest that pain catastrophising is related to reported symptom severity in patients referred with foot-and-ankle-pain. Although the directionality of the association between the foot/ankle pain and catastrophising association warrants further investigation, catastrophising could provide a useful -therapeutic target for non-operative and pre-operative interventions. Further, research is required to identify effective interventions catastrophising and their impact on patients’ foot/ankle pain.

The positive association of pain severity with BMI in this group is in keeping with a previous study investigating foot/ankle pain in patients on non-urgent waiting-lists [42]. This present study, however, found that the association persists even after adjusting for psychological health conditions which strengthens the already established, independent association between BMI and pain. The association of BMI with chronic musculoskeletal foot pain has been well described [43], and although the presumption has historically been that this is primarily related to mechanical loading (which does likely play a role) the non-mechanical relationship between increased adiposity and pain should not be discounted [44]. Elevated BMI may be related to pain via mechanisms related to chronic low-grade inflammation, comorbid psychological distress and even impaired sleep. Weight loss via bariatric surgery has been associated with a reduction in foot/ankle pain [45], although whether other forms of weight loss have similar effects on pain is yet to be investigated, but could be helpful for this group given the prolonged waiting times for appointments and may present an opportunity for such interventions to be applied.

Depressive symptoms as measured by the CES-D were highly prevalent (48.3%) and were significantly and independently associated with of pain severity (though with less strength than pain catastrophising) in our regression model. The concordance with previous research is also striking, other studies have found similarly high prevalence rates, between 21 and 30%, and that depressive symptoms are 2–4 times more likely to be present in conjunction with moderate to severe foot pain, as well as linearly related to symptom severity when controlling for other patient specific factors [46–48]. Clinical depression has a well described bidirectional relationship to pain [49, 50] and depressive symptoms have been associated with both higher patient expectations [48, 51] and worse patient reported outcomes following arthroscopic surgery [52], lower limb arthroplasty [38, 53–55] and foot and ankle surgery [19, 56]. The direction of effect with respect to depressive symptoms in this cohort cannot be inferred due to study design, though treatment of depression pre-operatively has been shown to not meaningfully affect the outcome of surgery in arthroplasty patients in previous research [57].

The findings are in keeping with the literature describing the complex reciprocal interplay of physiological and psychosocial factors influencing the presentation of musculoskeletal pain. Taken in context of the available literature, the results of this study suggest that a
A higher response rate may have been yielded by including reminder letters to non-responders. Despite this, our response rate and responder characteristics are consistent with those obtained by similar mail surveys of this group [42]. Finally, it should be noted that, whilst significant, our model could not account for 60% of the variance in patients’ foot/ankle pain. Future models could incorporate variables such as clinical diagnosis, multimorbidity and polypharmacy, as well as additional psychological variables (e.g., anxiety).

This study has several strengths. Firstly, it provides a previously unrecognised insight into the psychological distress patients entering public foot/ankle orthopaedic waiting-lists are under. Secondly, it uses validated measures of psychological health and foot/ankle pain. Furthermore, despite the response rate of 39.6% and proportionately lower response rate in younger patients, the cohort studied is comparable to those from previous studies of foot and ankle clinic waitlists in the public sector which constitutes a very large proportion of the total pool of patients seeking care [10, 11, 58]. Finally, this study provides further evidence of the complex, additive effect psychological comorbidities and obesity play in a person with chronic pain.

Conclusion
In conclusion, this study has given new insight into the prevalence and nature of specific and measurable psychological vulnerabilities in a cohort of foot and ankle patients on a public hospital waiting list. The results demonstrate that psychological comorbidity is common and that pain catastrophising, BMI and depressive symptoms continue to play an important role in pain perception. Interestingly, this study has found that 40% of foot/ankle pain can be explained by factors that orthopaedic surgery does not treat directly. Identifying people with pain catastrophisation, elevated BMI and depressive symptoms may be useful if they could be potential targets for inclusion in tailored non-operative or pre-operative management strategies to reduce pain and improve function.

Abbreviations
- SD-5L: 5-Dimensions-5-Levels
- BMI: Body mass index
- CES-D: Center for Epidemiological Studies-Depression
- CI: Confidence interval
- cm: Centimetre
- CSI: Central Sensitization Inventory
- CSS: Central sensitisation syndrome
- EQ: EuroQol
- HRQoL: Health-related quality of life
- IBM: International Business Machines
- IQR: Interquartile range
- IRSD: Index of Relative Socio-economic Disadvantage
- MOXFQ: Manchester-Oxford Foot and Ankle Questionnaire
- NSAIDS: Non-steroidal anti-inflammatory drugs
- NY: New York
- PCS: Pain Catastrophising Scale
- SACQ: Self-Administered Comorbidity Questionnaire
- SED: Socio-economic disadvantage
- SF-36: 36-Item Short Form Survey Instrument
- SPSS: Statistical Package for the Social Sciences
- USA: United States of America
- VAS: Visual analogue scale

Acknowledgements
The authors would like to thank Miss Ming Hui Tai for her assistance with data entry and Dr. Ian Hughes for his assistance with data analysis.

Authors’ contributions
TPW, GHS, VT and SRP conceived the idea for the study. MH, TPW and CLS collected and entered data, and CLS and TPW performed the data analysis. MH and CLS drafted the initial manuscript and all authors read and approved the final manuscript.

Funding
There was no funding associated with this study.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations
Ethics approval and consent to participate
This study was approved by the Gold Coast Hospital and Health Service Human Research Ethics Committee.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Author details
1Department of Orthopaedics, Gold Coast University Hospital, Southport, Queensland 4215, Australia.
2Griffith University, School of Medicine, Southport, Queensland 4215, Australia.
3Queensland University of Technology (QUT), Faculty of Health, School of Clinical Sciences, Kelvin Grove, Queensland 4059, Australia.
4Department of Orthopaedics & Trauma, Northern Adelaide Local Health Network, South Australia 5112, Australia.

The data that support the findings of this study are available from the corresponding author upon reasonable request.

The authors declare that they have no competing interests.

Holt et al. Journal of Foot and Ankle Research (2022) 15:32

Page 8 of 10
References

1. Thomas MJ, Roddy E, Zhang W, Menz HB, Hannan MT, Peat GM. The population prevalence of foot and ankle pain in middle and old age: a systematic review. Pain. 2011;152:2870–80.
2. Glazebrook M, Daniels T, Younger A, Foote CJ, Penner M, Wing K, et al. Comparison of health-related quality of life between patients with end-stage ankle and hip arthroplasty. J Bone Joint Surg Am. 2008;90:499–505.
3. Belati DA, Philkut P. Economic burden of foot and ankle surgery in the US Medicare population. Foot Ankle Int. 2014;35:334–40.
4. Walsh TP, Arnold JB, Gill TK, Evans AM, Yaxley A, Hill CL, et al. Foot pain severity is associated with the ratio of visceral to subcutaneous fat mass, fat mass index and depression in women. Rheumatol Int. 2017;37:1175–82.
5. Hill CL, Gill TK, Menz HB, Taylor AW. Prevalence and correlates of foot pain in a population-based study: the north west Adelaide health study. J Foot Ankle Res. 2007;1:2.
6. Shivarathre DG, Howard N, Krishna S, Cowan C, Platt SR. Psychological factors and personality traits associated with patients in chronic foot and ankle pain. Foot Ankle Int. 2014;35:103–7.
7. Bonanno DR, Medica VG, Tan DS, Spring AA, Bird AR, Gazarek J. Evaluating the outcomes of a podiatry-led assessment service in a public hospital orthopaedic unit. J Foot Ankle Res. 2014;7:45.
8. Walsh TP, Ferris LR, Cullen NC, Brown CH, Loughnay CJ, McCaffrey NM. The integration of a podiatrist into an orthopaedic department: a cost-consequences analysis. J Foot Ankle Surg. 2017;10:44.
9. MacMahon A, Cody EA, Caolo K, Henry JK, Drakos MC, Demetracopoulos CA, et al. Comparison of patients’ and surgeons’ expectations in foot and ankle surgery. Foot Ankle Int. 2020;41:173–80.
10. Edwards RR, Dworkin RH, Sullivan MD, Turk DC, Waden AS. The role of psychosocial processes in the development and maintenance of chronic pain. J Pain. 2016;17:770–92.
11. Crofford LJ. Psychological aspects of chronic musculoskeletal pain. Best Pract Res Clin Rheumatol. 2015;29:147–55.
12. Lee EJ, Wu MY, Lee GK, Cheing G, Chan F. Catastrophizing as a cognitive vulnerability factor related to depression in workers’ compensation patients with chronic musculoskeletal pain. J Clin Psychol Med Settings. 2008;15:182–92.
13. Park SJ, Yoon DM, Yoon KB, Moon JA, Kim SH. Factors associated with higher reported pain levels in patients with chronic musculoskeletal pain: a cross-sectional, correlational analysis. PLoS One. 2016;11:e0163132.
14. Paanen M, Auvrin JP, Taimela SP, Tammelin TH, Kantomaa MT, Ebeling HE, et al. Psychosocial, mechanical, and metabolic factors in adolescents’ musculoskeletal pain in multiple locations: a cross-sectional study. Eur J Pain. 2010;14:395–401.
15. Kroeke K, Wu J, Bair MJ, Krebs EE, Damush TM, Tu W. Reciprocal relationship between pain and depression: a 12-month longitudinal analysis in primary care. J Pain. 2011;12:964–973.
16. Chester R, Jerosch-Herold C, Lewis J, Shepstone L. Psychological factors are associated with the outcome of physiotherapy for people with shoulder pain: a multicentre longitudinal cohort study. Br J Sports Med. 2018;52:669–75.
17. Khabb Y, Madan A, Naylor JM, Harris JA, Do psychological factors predict poor outcomes in patients undergoing TKAs? A systematic review. Clin Orthop Relat Res. 2015;473:2630–8.
18. Ohayon MM, Schatzberg AF. Using chronic pain to predict depressive morbidity in the general population. Arch Gen Psychiatry. 2003;60:39–47.
19. Kim TP, Lee HW, Jeong BO. Influence of depressive symptoms on clinical outcomes of total ankle arthroplasty. J Foot Ankle Surg. 2020;59:59–63.
20. Teh CF, Zaslavsky AM, Reynolds CF 3rd, Cleary PD. Effect of depression treatment on chronic pain outcomes. Psychosom Med. 2010;72:621–7.
21. Ji RR, Nackley A, Huh Y, Terrando N, Maixner W. Neuroinflammation and central sensitization in chronic and widespread pain. Anesthesiology. 2018;129:343–66.
22. Auch S, Stirling M, Mechenburg I, Hansen TB. The association between pain catastrophizing, physical function and pain in a cohort of patients undergoing knee arthroplasty. BMC Musculoskelet Disord. 2019;20:421.
23. Riddle DL, Wade JB, Jiranek WA, Kong X. Preoperative pain catastrophizing predicts pain outcomes after knee arthroplasty. Clin Orthop Relat Res. 2010;468:798–806.
24. Cotchett M, Lennecke A, Medica VG, Whitaker GA, Bonanno DR. The association between pain catastrophizing and kinesiophobia with pain and function in people with plantar heel pain. Foot (Edinb). 2017;32:8–14.
25. Gagné O, Veljkovic A, Anderson L, Syms M, Abbas KZ, Penner MJ, et al. High patient catastrophizing score predicts poor outcome in the complex foot and ankle patient. Foot Ankle Orthop. 2019;4:2473011419000223.
26. Gibson E, Sabo MT. Can pain catastrophizing be changed in surgical patients? A scoping review Can J Surg. 2018;61:311–8.
27. Lape EC, Selzer F, Collins JE, Losina E, Katz JN. Stability of measures of pain catastrophizing and widespread pain following total knee replacement. Arthritis Care Res (Hoboken). 2020;72:1096–103.
28. Australian Bureau of Statistics. Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA) Australia cat. no. 2033.05:001. Canberra: ABS; 2016.
29. Sangha O, Stucki G, Liang MH, Fossei AH, Katz JN. The self-administered comorbidity questionnaire: a new method to assess comorbidity for clinical and health services research. Arthritis Care Res. 2003;49:156–63.
30. Morley D, Jenkinson C, Doll H, Lavis G, Sharp R, Cooke P, et al. The Manchester-Oxford foot questionnaire (MOXFQ): development and validation of a summary index score. Bone Joint Res. 2013;2:66–9.
31. Weissman MM, Sholomskas D, Pottenger M, Prussoff BA, Locke BZ. Assessing depressive symptoms in five psychiatric populations: a validation study. Am J Epidemiol. 1977;106:203–14.
32. Walton DM, Wideman TH, Sullivan MJ. A Rasch analysis of the pain catastrophizing scale supports its use as an interval-level measure. Clin J Pain. 2013;29:499–506.
33. Sullivan MJ, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess. 1995;7:524–32.
34. Sullivan MJ, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess. 1995;7:524–32.
35. Neblett R, Hartzell WM, Mayer TG, Cohen H, Gatchel RJ. Establishing clinically relevant severity levels for the central sensitization inventory. Pain Pract. 2017;17:166–75.
36. Quartana PJ, Campbell CM, Edwards RR. Pain catastrophizing: a critical review. Expert Rev Neurother. 2009;9:745–58.
37. Edwards RR, Bingham CO 3rd, Bathon J, Haythornthwaite JA. Catastrophizing and pain in arthritis, fibromyalgia, and other rheumatic diseases. Arthritis Rheum. 2006;55:325–32.
38. Edwards RR, Calahan C, Mensing S, Smith M, Haythornthwaite JA. Pain, catastrophizing, and depression in the rheumatic diseases. Nat Rev Rheumatol. 2011;7:216–24.
39. Sorell JC, Veltman ES, Honig A, Poolman RW. The influence of preoperative psychological distress on pain and function after total knee arthroplasty. Bone Joint J. 2019;101-B:7–14.
40. Lewis GN, Rice DA, McNair PJ, Kluger M. Predictors of persistent pain after total knee arthroplasty: a systematic review and meta-analysis. Br J Anaesth. 2015;114:551–61.
41. Kajge H, Zachariae R, Pfeiffer-Jensen M, Kasch H, Svaasand LO, Jensen TS, et al. Pain frequency moderates the relationship between pain catastrophizing and pain. Front Psychol. 2014;5:1421.
42. Sabo MT, Roy M. Surgeon identification of pain catastrophizing versus the pain catastrophizing scale in orthopedic patients after routine surgical consultation. Can J Surg. 2019;62:265–9.
43. Walsh TP, Ferris LR, Cullen NC, Bourke JL, Cooney MJ, Gooi CK, et al. Management of musculoskeletal foot and ankle conditions prior to public-sector orthopaedic referral in South Australia. J Foot Ankle Res. 2019;12:18.
44. Butterworth PA, Landorf KB, Smith SE, Menz HB. The association between body mass index and musculoskeletal foot disorders: a systematic review. Obes Rev. 2012;13:630–42.
45. Walsh TP, Arnold JB, Evans AM, Yaxley A, Damarell RA, Shanahan EM. The association between body fat and musculoskeletal pain: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2018;19:233.
46. Walsh TP, Gill TK, Evans AM, Yaxley A, Chisholm JA, Kow L, et al. Changes in foot pain, structure and function following bariatric surgery. J Foot Ankle Res. 2018;11:35.
47. Nakagawa R, Yamaguchi S, Kimura S, Sadasamu A, Yamamoto Y, Sato Y, et al. Association of anxiety and depression with pain and quality of life in patients with chronic foot and ankle diseases. Foot Ankle Int. 2017;38:1192–202.
48. Henry JK, Roney A, Hummel A, Cody E, Ellis S. Influence of depression and anxiety on satisfaction and expectation fulfillment in foot and ankle surgery. Foot Ankle Orthop. 2019;4:2473011419S00210.

49. Von Korff M, Simon G. The relationship between pain and depression. Br J Psychiatry. 1996;168(3):101–8.

50. Vadivelu N, Kai AM, Kodumudi G, Babayan K, Fontes M, Burg MM. Pain and psychology: a reciprocal relationship. Ochsner J. 2017;17:173–80.

51. Cody EA, Mancuso CA, Burket JC, Marinescu A, MacMahon A, Ellis SJ, et al. Patient factors associated with higher expectations from foot and ankle surgery. Foot Ankle Int. 2017;38:472–8.

52. Martin RL, Christoforetti JJ, McGovern R, Kivlan BR, Wolff AB, Niho SJ, et al. The impact of depression on patient outcomes in hip arthroscopic surgery. Orthop J Sports Med. 2018;6:2325967118806490.

53. Mollon B, Mahure SA, Ding DY, Zuckerman JD, Kwon YW. The influence of a history of clinical depression on peri-operative outcomes in elective total shoulder arthroplasty: a ten year national analysis. Bone Joint J. 2016;98-B:818–24.

54. Bistolfi A, Bettoni E, Aprato A, Milani P, Berchialla P, Graziano E, et al. The presence and influence of mild depressive symptoms on post-operative pain perception following primary total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2017;25:2792–800.

55. Belford K, Gallagher N, Dempster M, Wolfenden M, Hill J, Blaney J, et al. Psychosocial predictors of outcomes up to one year following total knee arthroplasty. Knee. 2020;27:1028–34.

56. Shakked R, McDonald E, Sutton R, Lynch M-K, Nicholson K, Raikin SM. Influence of depressive symptoms on hallux valgus surgical outcomes. Foot Ankle Int. 2018;39:795–800.

57. Halawi MJ, Gronbeck C, Savoy L, Cote MP, Lieberman JR. Depression treatment is not associated with improved patient-reported outcomes following total joint arthroplasty. J Arthroplast. 2020;35:28–31.

58. Homeming LJ, Kuipers P, Nihal A. Orthopaedic podiatry triage: process outcomes of a skill mix initiative. Aust Health Rev. 2012;36:457–60.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.