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Andrews, Pamela; Steultjens, M.; Riskowski, J.

Published in:
European Journal of Pain

DOI:
10.1002/ejp.1090

Publication date:
2018

Document Version
Peer reviewed version

Chronic Widespread Pain Prevalence in the General Population: A Systematic Review

P. Andrews[1], M. Steultjens[1], J. Riskowski[1],

1. Institute for Allied Health Research, Glasgow Caledonian University, Glasgow, UK

Correspondence

Pamela Andrews

Room A262

Cowcaddens Road, G4 0BA

Email: pamela.andrews@gcu.ac.uk

Category: review

Funding Sources: None

Conflicts of Interest: None

Abstract word count: 250

Discussion word count: 1538

Number of Tables: 3

Number of Figures: 2

Abstract

Background and Objective: Chronic widespread pain (CWP) is a significant burden in communities. Understanding the impact of population-dependent (e.g., age, gender) and context-dependent (e.g., survey method, region, inequality level) factors have on CWP prevalence may provide a foundation for population-based strategies to address CWP. Therefore, the purpose of this study was to estimate the global prevalence of CWP and evaluate the population and contextual factors associated with CWP.

Databases and Data Treatment: A systematic review of CWP prevalence studies (1990-2016) in the general population was undertaken. Meta-analyses were conducted to determine CWP prevalence, and study population data and contextual factors were evaluated using a meta-regression.

Results: Thirty-nine manuscripts met the inclusion criteria. Study CWP prevalence ranged from 1.4%-24.0%, with CWP prevalence in men ranging from 0.8%-15.3% and 1.7%-22.1% in women. Estimated overall CWP prevalence was 9.6% (8.0-11.2%). Meta-regression analyses showed gender, United Nations country development status, and human development index (HDI) influenced CWP prevalence, while survey method, region, methodological and reporting quality, and inequality showed no significant effect on the CWP estimate.

Conclusion: Globally CWP affects one in ten individuals within the general population, with women more likely to experience CWP than men. HDI was noted to be the socioeconomic factor related to CWP prevalence, with those in more developed countries having a lower CWP prevalence than those in less developed countries. Most CWP estimates were from developed countries, and CWP estimates from

countries with a lower socioeconomic position is needed to further refine the global estimate of CWP.

What does this study add? This systematic review and meta-analysis updates the current global CWP prevalence by examining the population-level (e.g., age, gender) and contextual (e.g., country development status; survey style; reporting and methodologic quality) factors associated with CWP prevalence. This analyses provides evidence to support higher levels of CWP in countries with a lower socioeconomic position relative to countries with a higher socioeconomic position.

Key Words: Chronic widespread pain, general population, class, socioeconomic position, systematic review, epidemiology.

1. Introduction

The estimated prevalence of chronic pain, defined as pain lasting more than three months, is between 35% and 50% worldwide (Elzahaf et al., 2012). Epidemiologic studies of chronic pain have tended to centre on one joint, such as the foot, knee, low back and shoulder (Freburger et al., 2009; Hiller et al., 2012; Hurley et al., 2012; Roh et al., 2012). However, some individuals experience pain all over the body, and in 1990, the term “chronic widespread pain” (CWP) was defined as pain lasting longer than 3 months, with pain being on the left and right sides of the body, above and below the waist, and on the axial skeleton (Wolfe et al., 1990). With the formal 1990 definition of CWP, a recent review suggested the worldwide estimate of CWP ranges from 10.6% to 11.8% (Mansfield et al., 2016).

CWP adversely affects quality of life, mobility and physical function (Nicholl et al., 2009). Further, CWP is a common condition associated with fibromyalgia syndrome (FMS) and is noted to be an early indicator of FMS (Forseth et al., 1999; Toda 2011). CWP and FMS can place significant challenges onto the healthcare system, and inconsistent messages exist within the literature with regard to the most effective diagnosis and management strategies (Lee et al., 2014). Living with CWP can have significant cost implications to not only the government but also the individual patient in terms of lost work, benefits and medical costs (Barham 2012; Gaskin and Richard 2012; Henschke et al., 2015). In Europe approximately 1.5-3.0% of their annual gross domestic product (GDP) is spent on chronic pain (Barham 2012; Gaskin and Richard 2012). In the United States (US), chronic pain costs between $560 and $635 billion annually, a cost higher than heart disease ($309b), cancer

($243b) and diabetes ($188b). Further, direct and indirect annual costs of CWP per patient in the US are estimated to be $12,428 (Schaefer et al., 2015).

Since the inception of the ACR definition in 1990, researchers have estimated CWP at the local and country level in order to determine burden of CWP in the population (Mansfield et al., 2016). While this prior study of global CWP prevalence addressed a significant gap, the current review and analyses aims to build upon it to update the CWP estimate and to evaluate study population (e.g., age, gender) and contextual (e.g., country development status; survey style; methodology and reporting quality) factors associated with CWP prevalence.

2.0 Methodology

2.1 Search Strategy

A primary literature search of electronic databases was performed to extract epidemiological studies of the global prevalence of chronic widespread pain (CWP) in the general adult population (1st January 1990 to 5th April 2017). The lower year limit of 1990 was applied to align with the seminal publication defining CWP (Wolfe et al., 1990).

Electronic databases included in the study were PSYCinfo, MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), The Allied and Complementary Database (AMED), Cochrane library, PubMed and OVID. To identify publications related to the prevalence of CWP, there were three criterion components of the search strategy: (1) outcome, (2) methodology, and (3) population, which were combined using Boolean operators. Outcome search terms were associated with 'chronic pain,' and methodology search terms were associated with 'prevalence,' and to limit the likelihood of sub-populations a 'NOT' operator of 'cancer' or 'diabetes' was used to reduce publications that were not focused on the general population. No language restrictions were applied.

2.2. Selection Criteria and Data Extraction

Set inclusion and exclusion were specified a priori and applied in three steps (Table 1). In the first step, studies were eliminated if it was evident from the title that criteria regarding outcome, methodology, and population were not satisfied. At this title stage, one reviewer (PA) eliminated publications, with a second reviewer (JLR) verifying these results. In the second step, two reviewers (PA and JLR) independently

reviewed abstracts to determine if inclusion criteria were met. From the abstract stage, full-texts of the manuscripts were obtained and reviewed for inclusion, with study methods evaluated against the set criteria. Manuscripts written in languages other than English were included and were reviewed by others comfortable with the language. Prevalence data was recorded for CWP in the general population along with separate figures for gender and age as well as weighted and unweighted where applicable. If data from the same manuscript were reported in multiple publications, data are reported as one study.

2.3 Assessment of Study Quality

Two reviewers (JLR and PA) independently evaluated the included studies based on the criteria in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (Von Elm et al., 2007), a reliable method for reporting observational studies (Tate and Douglas 2011). For this analysis, the STROBE was modified to include 12 items. Each item was scored independently as either 'Identified' (1 point) or 'Not Identified' (0 point), and scoring was discussed to reach consensus. The points from the modified STROBE were summed (Table S1), and studies were considered as having low risk of bias if they were found to be of high quality (≥9/12) and high risk of bias if they were found to be of low quality (≤8/12), with this cut-point near the 80% quality cut-point (Slavin 1995).

2.4 CWP Study Contextual Data

Additional contextual data was added to evaluate factors associated to the CWP prevalence. Contextual data included were the country's United Nations (UN) development status (i.e., developed and developing country) (UN 2012), World Health Organisation (WHO) region (WHO 2017), Human Development Index (HDI) (HDR 2016), and Gini index (TWB 2017).

The HDI is a composite measure of three basic dimensions: life expectancy, education, and per capita income, and it is an indicator of the country's support systems and its citizen's health, personal, social, and political freedom, and well-being. The GINI index is a measure of statistical dispersion used to represent the net income distribution within a country, and it can define a country's level of rich-to-poor inequality. GINI index values can range between 0 and 1, with 0 representing perfect equality and 1 representing perfect inequality, but in practice, it ranges from approximately 0.2 to 0.7 (TWB 2017). The HDI and Gini values and the country's development status were based on the year of the data collection, and when an estimate was not available for the study year, the closest year to the study collection period was used.

2.5 Data Analysis

A meta-analysis combined the CWP prevalences of the individual studies to estimate the prevalence of CWP for the overall population sample as well as by gender, age, WHO region and survey method. Univariate meta-analyses were performed on all individual and contextual variables to determine if there was a significant effect of the variable on CWP prevalence. Statistical significance was set to $p<0.05$. There was no multiple testing correction, which may increase the likelihood of false positive;

however it is a valid means for exploring value of each variable in regression modelling (Bender and Lange 2001). I^2 statistical calculations were conducted to examine the heterogeneity between all studies and subgroups. The 95% confidence intervals were calculated using the Wilson score method with continuity corrections. All statistical analyses were performed using R version 3.3.1.

3.0 Results

3.1 Study Selection

Implementation of the search strategy yielded 12,097 records, of which 5,768 were duplicates (Figure 1). Screening of titles excluded 6,038 manuscripts, leaving 291 records for the abstract stage. At the abstract stage an additional 120 titles were excluded, leaving 171 for the full-text stage. Full-text screening excluded 132 manuscripts, leaving 39 manuscripts (30 unique studies with 41 CWP population-level estimates) with a total of 632,937 participants. Study sample size ranged from 361 (Santos et al., 2010) to 501,733 (Walker-Bone et al., 2016). Twenty-six studies included both genders, whereas three studies included only women (Abusdal et al., 1997a; Abusdal et al., 1997b; Schochat and Beckmann 2003; Topbas et al., 2005) and one study included only men (Lee et al., 2010; Macfarlane et al., 2009b). Six studies failed to report gender characteristics (Bergman et al., 2001; Gerdle et al., 2008; Hagen et al., 2005; Lindell et al., 2000; Papageorgiou et al., 2002; Scudds et al., 2006; Wolfe et al., 1995). Participants' age in the included studies ranged from 15-94 years.

Figure 1: Flow chart of included studies

3.2 Study Characteristics

Country CWP prevalence data (Table 2) is from the UK (N=9) (Benjamin et al., 2000; Carnes et al., 2007; Choudhury et al., 2013; Croft et al., 1993; Flüß et al., 2015; Hunt et al., 1999; Lee et al., 2010; Macfarlane et al., 1999; Macfarlane et al., 2009a; Macfarlane et al., 2009b; Pang et al., 2010; Papageorgiou et al., 2002; Vandenkerkhof et al., 2011; Walker-Bone et al., 2016), Spain (N=4) (Bannwarth et al., 2009; Branco

et al., 2010; Dueñas et al., 2016; Dueñas et al., 2015; Lee et al., 2010; Macfarlane et al., 2009b; Mas et al., 2008), Brazil (N=3) (Assumpção et al., 2009; Cabral et al., 2014; Santos et al., 2010), Sweden (N=4) (Bergman et al., 2001; Dragioti et al., 2016; Gerdle et al., 2008; Lee et al., 2010; Lindell et al., 2000; Macfarlane et al., 2009b), US (N=2) (Riskowski 2014; Wolfe et al., 1995), France (N=2) (Bannwarth et al., 2009; Branco et al., 2010; Perrot et al., 2011), Germany (N=2) (Bannwarth et al., 2009; Branco et al., 2010; Schochat and Raspe 2003), Israel (N=2) (Ablin et al., 2012; Buskila et al., 2000), Italy (N=2) (Bannwarth et al., 2009; Branco et al., 2010; Lee et al., 2010; Macfarlane et al., 2009b), Norway (N=2) (Abusdal et al., 1997a; Abusdal et al., 1997b; Hagen et al., 2005), Belgium (N=1) (Lee et al., 2010; Macfarlane et al., 2009b), Canada (N=1) (White et al., 1999), Estonia (N=1) (Lee et al., 2010; Macfarlane et al., 2009b), Hong Kong (N=1) (Scudds et al., 2006), Hungary (N=1) (Lee et al., 2010; Macfarlane et al., 2009b), Netherlands (N=1) (Picavet and Schouten 2003), Poland (N=1) (Lee et al., 2010; Macfarlane et al., 2009b), Portugal (N=1) (Bannwarth et al., 2009; Branco et al., 2010) and Turkey (N=1) (Topbas et al., 2005).

The included studies varied in terms of CWP definition, survey method and measurement processes (Table S2). CWP was identified using the ACR criteria (N=24) (Wolfe et al., 1990), the Manchester definition (N=3), and a study-specific definition (N=5). CWP data were collected by postal survey (N=10) (Abusdal et al., 1997a; Abusdal et al., 1997b; Bergman et al., 2001; Carnes et al., 2007; Croft et al., 1993; Dragioti et al., 2016; Flüß et al., 2015; Gerdle et al., 2008; Hagen et al., 2005; Lindell et al., 2000; Papageorgiou et al., 2002; Picavet and Schouten 2003), telephone (N=1) (Dueñas et al., 2016; Dueñas et al., 2015) face-to-face interviews (N=2) (Cabral et al., 2014; Mas et al., 2008), clinical examination (N=1) (Santos et al., 2010), touch screen questionnaire (N=1) (Walker-Bone et al., 2016) or combined

methods (N=15) (Ablin et al., 2012; Assumpção et al., 2009; Bannwarth et al., 2009; Benjamin et al., 2000; Branco et al., 2010; Buskila et al., 2000; Choudhury et al., 2013; Hunt et al., 1999; Lee et al., 2010; Macfarlane et al., 1999; Macfarlane et al., 2009a; Macfarlane et al., 2009b; Pang et al., 2010; Perrot et al., 2011; Riskowski 2014; Schochat and Raspe 2003; Scudds et al., 2006; Topbas et al., 2005; Vandenkerkhof et al., 2011; White et al., 1999; Wolfe et al., 1995).

3.3 Chronic Widespread Pain Prevalence

The included 30 studies provided 41 prevalence estimates of CWP. From the included manuscripts, overall CWP sample prevalence, ranged from 1.4% in the UK (Walker-Bone et al., 2016) to 24.0% in Brazil (Assumpção et al., 2009). In combining the studies where sample prevalence data was available and excluding any studies with single gender analysis, a total of 622,169 participants across 26 studies were included in the analysis, and the estimated overall CWP prevalence was 9.6% (95% confidence interval [CI]: 8.0-11.2%).

3.4 Gender

Four studies were of a single gender, one of men only (Lee et al., 2010; Macfarlane et al., 2009b) and three of women only (Abusdal et al., 1997a; Abusdal et al., 1997b; Schochat and Raspe 2003; Topbas et al., 2005), while eleven studies provided estimates from both genders in the general population. In the single gender studies, CWP prevalence in men was estimated at 8.3%, with data only available from a CWP study in Europe (Lee et al., 2010; Macfarlane et al., 2009b), while in women CWP prevalence ranged from 13.5% in Germany (Schochat and Raspe 2003) to 22.1% in

Norway (Abusdal et al., 1997a; Abusdal et al., 1997b). When combining women-only studies (n=6805), the CWP prevalence in women was 17.3% (16.4-18.1%).

Where studies included data for both genders, the prevalence in men ranged from 0.8% in Sweden (Dragioti et al., 2016) to 15.3% in Estonia (Lee et al., 2010; Macfarlane et al., 2009b), and in women it ranged from 1.7% (Walker-Bone et al., 2016) to 15.6% (Croft et al., 1993), with both study CWP estimates coming from the UK. When combining the data for men (n=242,808), the estimated overall CWP prevalence was 7.2% (5.5-8.9%), while in women, (n=291,129) the estimated overall CWP prevalence was 11.2% (8.3-14.2%). Univariate regression analysis by gender found women had a significantly higher CWP prevalence relative to men ($p<0.01$; Table 3).

3.5 Age

Age-specific data was provided in 14 studies (Abusdal et al., 1997a; Abusdal et al., 1997b; Bannwarth et al., 2009; Benjamin et al., 2000; Bergman et al., 2001; Branco et al., 2010; Buskila et al., 2000; Carnes et al., 2007; Croft et al., 1993; Dragioti et al., 2016; Dueñas et al., 2016; Dueñas et al., 2015; Gerdle et al., 2008; Hunt et al., 1999; Lee et al., 2010; Lindell et al., 2000; Macfarlane et al., 1999; Macfarlane et al., 2009b; Mas et al., 2008; Picavet and Schouten 2003; Walker-Bone et al., 2016). Due to the variability in each of the available studies age bandings it was not possible to combine the data for further analysis. Of studies evaluating CWP by age, nine reported an increase in pain prevalence with age (Abusdal et al., 1997a; Abusdal et al., 1997b; Benjamin et al., 2000; Bergman et al., 2001; Buskila et al., 2000; Croft et al., 1993; Dueñas et al., 2016; Dueñas et al., 2015; Gerdle et al., 2008; Hunt et al., 1999; Lindell et al., 2000; Macfarlane et al., 1999; Picavet and Schouten 2003), while

four reported a decrease or levelling out of pain prevalence from 50-60 years only to increase again from 60 years (Croft et al., 1993; Dragioti et al., 2016; Lee et al., 2010; Macfarlane et al., 2009b; Mas et al., 2008).

3.6 Survey Method

Methods of data collection varied between studies, with sixteen studies using a single style of data collection (i.e., telephone, face-to-face or clinical/physical exam) and fourteen using a combined method (postal or telephone with clinical/physical examination). The method of survey was further grouped into a personal (face-to-face, telephone and clinical examination) and non-personal (postal survey) approach for further analysis. Seventeen studies with 21 CWP estimates (n=546,553) were included in the personal group, while nine studies (n=75,616) were included in the non-personal survey method. Random-effects CWP prevalence estimates between personal and non-personal were similar (9.9% [7.5-12.3%] v 7.6% [4.7-10.4%,], p=0.981).

3.7 Region

By WHO regions (Figure 2), there were nineteen studies of CWP prevalence in Europe, five of the Americas, and one in Western Pacific. Combining country data for Europe and the Americas revealed overall CWP prevalence estimates were similar (8.9% [6.9-10.9%] v 10.9% [5.1-16.7%], p=0.497).

Figure 2: Geographical spread of CWP prevalence

3.8 Development status, HDI Index and GINI Index

Contextual factors of socioeconomic position included the UN development status, HDI and GINI Index. Based on the country's UN development status, there were 27 CWP estimates (n=620,214) from developed countries, and the CWP prevalence of 8.6% (6.9-10.3%). Three CWP estimates were from developing countries (n=1955), and the CWP prevalence estimate for these countries was 14.5% (3.9-25.1%). The meta-regression showed UN development status relating to CWP prevalence (p=0.041), which was similar to the HDI results that countries with a higher the HDI (i.e., more developed country) had a lower reported CWP prevalence (p=0.001).

3.9 Methodological Quality

Quality scores ranged from 6/12 to 12/12 (Table S3), with 10 manuscripts being noted as having low quality (≤8/12) (Abusdal et al., 1997a; Abusdal et al., 1997b; Gerdle et al., 2008; Pang et al., 2010; Papageorgiou et al., 2002; Perrot et al., 2011; Picavet and Schouten 2003; Scudds et al., 2006; Vandenkerkhof et al., 2011; White et al., 1999) and 29 of high quality (≥9/12) (Ablin et al., 2012; Assumpção et al., 2009; Bannwarth et al., 2009; Benjamin et al., 2000; Bergman et al., 2001; Branco et al., 2010; Buskila et al., 2000; Cabral et al., 2014; Carnes et al., 2007; Cho et al., 2012; Choudhury et al., 2013; Croft et al., 1993; Dragioti et al., 2016; Dueñas et al., 2016; Dueñas et al., 2015; Flüß et al., 2015; Hagen et al., 2005; Hunt et al., 1999; Lee et al., 2010; Leveille et al., 2001; Lindell et al., 2000; Macfarlane et al., 1999; Macfarlane et al., 2009a; Macfarlane et al., 2009b; Mas et al., 2008; Riskowski 2014; Santos et al., 2010; Schochat and Raspe 2003; Topbas et al., 2005; Walker-Bone et al., 2016; Wolfe et al., 1995). Most of the included manuscripts (N=37) consistently identified the CWP outcome measure and study eligibility criteria. Lack of appropriate reporting

was in reporting bias and providing detailed methodology. When addressing bias, only five manuscripts identified their methods for controlling bias, 18 failed to provide their adjusted estimates and precision (e.g., 95% confidence interval) for CWP prevalence, and 27 did not report data collection methods and participant recruitment. The high-quality studies (n=592,034) had a CWP prevalence of 9.7% (7.4-12.1%), while the low-quality studies (n=30,135) had a similar (p=0.242) CWP prevalence estimate of 7.5% (5.3-9.6%).

4.0 Discussion

The current review aimed to determine the global prevalence of CWP in the general population. The review identified 30 studies with 41 estimates of CWP prevalence. From these CWP studies, global CWP prevalence estimate was 9.6% (95% CI: 8.4-11.2%). Women were found to have a higher CWP prevalence than men (11.2% v 7.2%). In identifying other factors associated with CWP prevalence, data collection style of personal or non-personal approach showed no significant effect, but the personal approach (i.e., face-to-face, telephone, examination) tended to increase CWP prevalence compared to non-personal (9.9% v 7.6%). Additionally, countries with a higher human development index (HDI) had a lower CWP prevalence compared to lower HDI countries (8.6% v 14.5%). Results from this work suggest there is a significant burden of CWP on the general population, particularly among women, and that improving a country's standard of living, as indicated by the HDI, may influence CWP prevalence.

4.1 Diagnostic Criteria

CWP diagnosis originally came from the ACR 1990 criteria of FMS. However, recently the Manchester criteria, which requires pain to be found in two locations of two contralateral limbs and also in the axial skeleton (Okifuji and Hare 2014), is gaining traction. Although, the ACR 1990 and Manchester definitions allow standardisation and comparisons to be made (Okifuji and Hare 2014), results of CWP prevalence by these two definitions are not similar. Gerdle et al (Gerdle et al., 2008) found CWP to be 7.4% when applying the Manchester criteria, while they only recorded 4.8% with ACR. In contrast the Manchester cohort (Benjamin et al., 2000;

Hunt et al., 1999; Macfarlane et al., 1999) found CWP to be 4.7% with the Manchester criteria and 12.9% with the ACR definition. Between these studies sample sizes were different (n=1953 (Benjamin et al., 2000; Hunt et al., 1999; Macfarlane et al., 1999) v n=7637 (Gerdle et al., 2008)), but these two studies also differed in the number of pain sites the study participant could select in the pain chart. The Manchester group (Benjamin et al., 2000; Hunt et al., 1999; Macfarlane et al., 1999) had 26 pain sites available versus 17 in the Gerdle et al study (Gerdle et al., 2008). The number of pain sites available to select could not only lead to participant confusion, but it could also lead to participants under or over-reporting the number of pain site depending on if their specific pain site is not provided. Research evaluating style of pain reported has suggested that the most efficient method for assessing this is through the completion of a body manikin (Croft 2002) or through the number of pain sites rather than the location of pain (Beasley and Macfarlane 2014), which is what the ACR 2010 definition does. As such, future research should aim to determine a uniform diagnosis for CWP that utilises a body manikin with a set number of pain sites to ensure prevalence figures are reliable and can be comparable across studies.

4.2 Age and Gender

The current review found no significant difference in CWP by age group. However, part of the lack of effect may be due to few studies reporting CWP prevalence by similar age group bandings. Given the inconsistencies in age group reporting it is difficult to determine accurate CWP prevalence estimates, and future studies should aim to report specific prevalence estimates for age using consistent age banding.

Studies have consistently shown that women experience more pain than men (Bartley and Fillingim 2016; Fillingim et al., 2009; Pieretti et al., 2016). This review

found similar results, with the meta-analysis showing CWP was higher in women compared to men (11.4% v 7.2%). Reasons for the gender differences in pain are often hypothesised to be biological, but studies have also suggested that differences in pain may relate to psychological or social factors (Wiesenfeld-Hallin 2005) as some men may fear they will appear weak if they express their pain (Fillingim et al., 2009). Researchers hypothesise that while women score higher on pain, they are often encouraged to talk about their feelings and may be more comfortable than men at indicating they are experiencing pain (Fillingim et al., 2009).

4.3 Geographical region

Although there were no regional variations of CWP prevalence noted by the meta-regression, these results should be viewed with caution, as regions other than Europe and the Americas were not well represented. The prior CWP review (Mansfield et al., 2016) noted differences between Europe and America, with Europe having a higher CWP prevalence than the Americas (12.8% v 7.1%). These prior results are in contrast with the current study where it shows a non-significant difference between regions (8.9% in Europe v 10.9% in Americas). A possible explanation for this CWP difference could be the variation in the studies included between the two reviews. For example, this review included only general population studies, not studies of specific populations within the larger population. As such, the prior meta-analysis (Mansfield et al., 2016) included a CWP study of a Native American population (Jacobsson et al., 1996), a small sub-population within the US general population, but did not include a large population-based National Health and Nutrition Examination Survey (NHANES) study (Riskowski 2014), suggesting the current and prior CWP systematic review focused on different study populations.

4.4 Socioeconomics Position and CWP

The novelty of this meta-analysis was in the analyses of socioeconomic position measures to CWP prevalence. The socioeconomic position contextual factors were the HDI (HDR 2016), United Nations (UN) developed/developing country definition (UN 2012), and GINI index (HDR 2016). Although the HDI and UN definition of developed/developing countries may appear similar, the HDI is a composite index based on life expectancy, education level, and per capita income indicators, whereas the UN definition of developed and developing countries is "intended to reflect basic economic country conditions" rather than consideration of life within the country (United Nations United Nations Department of Economic and Social Affairs (US DESA) 2012).

Within the work presented, the dichotomised UN-defined developed versus developing country showed higher CWP prevalence within the developing countries ($p=0.04$). The results of less developed countries having greater prevalence of CWP aligned to results of the continuous HDI variable, which showed countries with a higher HDI (more developed countries) having a lower CWP prevalence. The results of a higher HDI (e.g., developed countries) associated with lower prevalence of pain aligns with other studies evaluating socioeconomic position with chronic pain (Urwin et al., 1998) and adds further evidence that socioeconomic position is associated with health (Braveman et al., 2010b) and pain (Riskowski 2014).

Studies have suggested that financial strain and lower socioeconomic conditions can result in stress-induced muscular tension and pain (Soares and Jablonska 2004). At the individual-level, poor coping strategies to stress, leading to muscular tension, is believed to play a role in the higher rates of chronic pain in those in a lower socioeconomic position relative to their higher counterparts (Ridder De

2000; Roth and Geisser 2002). Extrapolating the individual-level measure of socioeconomic position to the contextual population-level measure (e.g., HDI), poor community and support structures that provide mechanisms to assist people in coping with stress may explain the population-level association of CWP to lower socioeconomic conditions. Given the low number of studies from developing and lower socioeconomic countries, there is a need for epidemiological studies of chronic pain in these regions to determine the global prevalence of CWP and to evaluate the effect of the country's socioeconomic position with respect to CWP prevalence.

4.5 Strengths and limitations

Although there is a relatively recent review examining global prevalence of CWP (Mansfield et al., 2016), this review adds to their results by examining a number of contextual factors that may impact the CWP prevalence, such as the HDI, survey method, and WHO region. However, other factors not accounted in this review were race and ethnicity, due to the lack of reported data. Future studies, where appropriate, should include race and ethnicity information of participants as some studies have suggested it may impact risk of CWP (Allison et al., 2002; Macfarlane et al., 2005). Along these same lines, studies have also suggested that class or socioeconomic position may also be an individual factor that relates to risk of chronic pain (Rios and Zautra 2011; Urwin et al., 1998), but within the systematic review there was one study that evaluated CWP by class or social position. Thus, the surrogate markers of HDI and the WHO development status were used to evaluate the effect of social deprivation at the country-level, with results suggesting that with greater social deprivation there is greater risk of CWP. However, the country-level marker may not truly represent the participants in the study, and future work should evaluate health

399 status along social strata in addition to racial and ethnic categories (Braveman et al.,
400 2010a).
401
402 **4.6 Conclusion**
403 Results of this systematic review indicate that CWP affects one in ten individuals
404 globally within the general population. In 30 studies across 19 countries women were
405 found to have a higher CWP prevalence than men, and those in countries with a lower
406 HDI tended to be more likely to experience CWP than those in a high HDI country.
407 To further evaluate CWP, research is needed by other individual-level factors (e.g.,
408 race, ethnicity) with a greater range of developing and developed countries.
409
410 Authors Contributions
411 PA prepared the search strategy, and ran the initial search, which was confirmed by
412 JLR, both PA and JLR performed the search with MS resolving any issues in
413 decision. The manuscript was written and proofed by all three authors.
414
415 Acknowledgements
416 None.

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Supporting Information

Table S1: Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist.

Table S2: Additional study characteristics

Table S3: STROBE quality assessment for each included study

Figure F1: Search Strategy.