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

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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 **1. Introduction**

2

3 The estimated prevalence of chronic pain, defined as pain lasting more than three
4 months, is between 35% and 50% worldwide (Elzahaf et al., 2012). Epidemiologic
5 studies of chronic pain have tended to centre on one joint, such as the foot, knee, low
6 back and shoulder (Freburger et al., 2009; Hiller et al., 2012; Hurley et al., 2012; Roh
7 et al., 2012). However, some individuals experience pain all over the body, and in
8 1990, the term “chronic widespread pain” (CWP) was defined as pain lasting longer
9 than 3 months, with pain being on the left and right sides of the body, above and
10 below the waist, and on the axial skeleton (Wolfe et al., 1990). With the formal 1990
11 definition of CWP, a recent review suggested the worldwide estimate of CWP ranges
12 from 10.6% to 11.8% (Mansfield et al., 2016).

13 CWP adversely affects quality of life, mobility and physical function (Nicholl
14 et al., 2009). Further, CWP is a common condition associated with fibromyalgia
15 syndrome (FMS) and is noted to be an early indicator of FMS (Forseth et al., 1999;
16 Toda 2011). CWP and FMS can place significant challenges onto the healthcare
17 system, and inconsistent messages exist within the literature with regard to the most
18 effective diagnosis and management strategies (Lee et al., 2014). Living with CWP
19 can have significant cost implications to not only the government but also the
20 individual patient in terms of lost work, benefits and medical costs (Barham 2012;
21 Gaskin and Richard 2012; Henschke et al., 2015). In Europe approximately 1.5-3.0%
22 of their annual gross domestic product (GDP) is spent on chronic pain (Barham 2012;
23 Gaskin and Richard 2012). In the United States (US), chronic pain costs between
24 \$560 and \$635 billion annually, a cost higher than heart disease (\$309b), cancer

25 (\$243b) and diabetes (\$188b). Further, direct and indirect annual costs of CWP per
26 patient in the US are estimated to be \$12,428 (Schaefer et al., 2015).

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

34
35

36 **2.0 Methodology**

37

38 *2.1 Search Strategy*

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

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

54

55 *2.2. Selection Criteria and Data Extraction*

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

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

69

70 *2.3 Assessment of Study Quality*

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

81

82

83

84 *2.4 CWP Study Contextual Data*

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

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

101

102 *2.5 Data Analysis*

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

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

114

115

116 **3.0 Results**

117

118 *3.1 Study Selection*

119 Implementation of the search strategy yielded 12,097 records, of which 5,768 were
120 duplicates (Figure 1). Screening of titles excluded 6,038 manuscripts, leaving 291
121 records for the abstract stage. At the abstract stage an additional 120 titles were
122 excluded, leaving 171 for the full-text stage. Full-text screening excluded 132
123 manuscripts, leaving 39 manuscripts (30 unique studies with 41 CWP population-
124 level estimates) with a total of 632,937 participants. Study sample size ranged from
125 361 (Santos et al., 2010) to 501,733 (Walker-Bone et al., 2016). Twenty-six studies
126 included both genders, whereas three studies included only women (Abusdal et al.,
127 1997a; Abusdal et al., 1997b; Schochat and Beckmann 2003; Topbas et al., 2005) and
128 one study included only men (Lee et al., 2010; Macfarlane et al., 2009b). Six studies
129 failed to report gender characteristics (Bergman et al., 2001; Gerdle et al., 2008;
130 Hagen et al., 2005; Lindell et al., 2000; Papageorgiou et al., 2002; Scudds et al., 2006;
131 Wolfe et al., 1995). Participants' age in the included studies ranged from 15-94 years.

132

133 Figure 1: Flow chart of included studies

134

135 *3.2 Study Characteristics*

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

141 et al., 2010; Dueñas et al., 2016; Dueñas et al., 2015; Lee et al., 2010; Macfarlane et
142 al., 2009b; Mas et al., 2008), Brazil (N=3) (Assumpção et al., 2009; Cabral et al.,
143 2014; Santos et al., 2010), Sweden (N=4) (Bergman et al., 2001; Dragioti et al., 2016;
144 Gerdle et al., 2008; Lee et al., 2010; Lindell et al., 2000; Macfarlane et al., 2009b),
145 US (N=2) (Riskowski 2014; Wolfe et al., 1995), France (N=2) (Bannwarth et al.,
146 2009; Branco et al., 2010; Perrot et al., 2011), Germany (N=2) (Bannwarth et al.,
147 2009; Branco et al., 2010; Schochat and Raspe 2003), Israel (N=2) (Ablin et al., 2012;
148 Buskila et al., 2000), Italy (N=2) (Bannwarth et al., 2009; Branco et al., 2010; Lee et
149 al., 2010; Macfarlane et al., 2009b), Norway (N=2) (Abusdal et al., 1997a; Abusdal et
150 al., 1997b; Hagen et al., 2005), Belgium (N=1) (Lee et al., 2010; Macfarlane et al.,
151 2009b), Canada (N=1) (White et al., 1999), Estonia (N=1) (Lee et al., 2010;
152 Macfarlane et al., 2009b), Hong Kong (N=1) (Scudds et al., 2006), Hungary (N=1)
153 (Lee et al., 2010; Macfarlane et al., 2009b), Netherlands (N=1) (Picavet and Schouten
154 2003), Poland (N=1) (Lee et al., 2010; Macfarlane et al., 2009b), Portugal (N=1)
155 (Bannwarth et al., 2009; Branco et al., 2010) and Turkey (N=1) (Topbas et al., 2005).

156 The included studies varied in terms of CWP definition, survey method and
157 measurement processes (Table S2). CWP was identified using the ACR criteria
158 (N=24) (Wolfe et al., 1990), the Manchester definition (N=3), and a study-specific
159 definition (N=5). CWP data were collected by postal survey (N=10) (Abusdal et al.,
160 1997a; Abusdal et al., 1997b; Bergman et al., 2001; Carnes et al., 2007; Croft et al.,
161 1993; Dragioti et al., 2016; Flüß et al., 2015; Gerdle et al., 2008; Hagen et al., 2005;
162 Lindell et al., 2000; Papageorgiou et al., 2002; Picavet and Schouten 2003), telephone
163 (N=1) (Dueñas et al., 2016; Dueñas et al., 2015) face-to-face interviews (N=2)
164 (Cabral et al., 2014; Mas et al., 2008), clinical examination (N=1) (Santos et al.,
165 2010), touch screen questionnaire (N=1) (Walker-Bone et al., 2016) or combined

166 methods (N=15) (Ablin et al., 2012; Assumpção et al., 2009; Bannwarth et al., 2009;
167 Benjamin et al., 2000; Branco et al., 2010; Buskila et al., 2000; Choudhury et al.,
168 2013; Hunt et al., 1999; Lee et al., 2010; Macfarlane et al., 1999; Macfarlane et al.,
169 2009a; Macfarlane et al., 2009b; Pang et al., 2010; Perrot et al., 2011; Riskowski
170 2014; Schochat and Raspe 2003; Scudds et al., 2006; Topbas et al., 2005;
171 Vandenberg et al., 2011; White et al., 1999; Wolfe et al., 1995).

172

173 *3.3 Chronic Widespread Pain Prevalence*

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

181

182 *3.4 Gender*

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

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

192 Where studies included data for both genders, the prevalence in men ranged
193 from 0.8% in Sweden (Dragioti et al., 2016) to 15.3% in Estonia (Lee et al., 2010;
194 Macfarlane et al., 2009b), and in women it ranged from 1.7% (Walker-Bone et al.,
195 2016) to 15.6% (Croft et al., 1993), with both study CWP estimates coming from the
196 UK. When combining the data for men (n=242,808), the estimated overall CWP
197 prevalence was 7.2% (5.5-8.9%), while in women, (n=291,129) the estimated overall
198 CWP prevalence was 11.2% (8.3-14.2%). Univariate regression analysis by gender
199 found women had a significantly higher CWP prevalence relative to men (p<0.01;
200 Table 3).

201

202 3.5 Age

203 Age-specific data was provided in 14 studies (Abusdal et al., 1997a; Abusdal et al.,
204 1997b; Bannwarth et al., 2009; Benjamin et al., 2000; Bergman et al., 2001; Branco et
205 al., 2010; Buskila et al., 2000; Carnes et al., 2007; Croft et al., 1993; Dragioti et al.,
206 2016; Dueñas et al., 2016; Dueñas et al., 2015; Gerdle et al., 2008; Hunt et al., 1999;
207 Lee et al., 2010; Lindell et al., 2000; Macfarlane et al., 1999; Macfarlane et al.,
208 2009b; Mas et al., 2008; Picavet and Schouten 2003; Walker-Bone et al., 2016). Due
209 to the variability in each of the available studies age bandings it was not possible to
210 combine the data for further analysis. Of studies evaluating CWP by age, nine
211 reported an increase in pain prevalence with age (Abusdal et al., 1997a; Abusdal et
212 al., 1997b; Benjamin et al., 2000; Bergman et al., 2001; Buskila et al., 2000; Croft et
213 al., 1993; Dueñas et al., 2016; Dueñas et al., 2015; Gerdle et al., 2008; Hunt et al.,
214 1999; Lindell et al., 2000; Macfarlane et al., 1999; Picavet and Schouten 2003), while

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

218

219 *3.6 Survey Method*

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

230

231 *3.7 Region*

232 By WHO regions (Figure 2), there were nineteen studies of CWP prevalence in
233 Europe, five of the Americas, and one in Western Pacific. Combining country data for
234 Europe and the Americas revealed overall CWP prevalence estimates were similar
235 (8.9% [6.9-10.9%] v 10.9% [5.1-16.7%], p=0.497).

236

237 Figure 2: Geographical spread of CWP prevalence

238

239

240 *3.8 Development status, HDI Index and GINI Index*

241 Contextual factors of socioeconomic position included the UN development status,
242 HDI and GINI Index. Based on the country's UN development status, there were 27
243 CWP estimates (n=620,214) from developed countries, and the CWP prevalence of
244 8.6% (6.9-10.3%). Three CWP estimates were from developing countries (n=1955),
245 and the CWP prevalence estimate for these countries was 14.5% (3.9-25.1%). The
246 meta-regression showed UN development status relating to CWP prevalence
247 (p=0.041), which was similar to the HDI results that countries with a higher the HDI
248 (i.e., more developed country) had a lower reported CWP prevalence (p=0.001).

249

250 *3.9 Methodological Quality*

251 Quality scores ranged from 6/12 to 12/12 (Table S3), with 10 manuscripts being noted
252 as having low quality ($\leq 8/12$) (Abusdal et al., 1997a; Abusdal et al., 1997b; Gerdle et
253 al., 2008; Pang et al., 2010; Papageorgiou et al., 2002; Perrot et al., 2011; Picavet and
254 Schouten 2003; Scudds et al., 2006; Vandekerckhof et al., 2011; White et al., 1999)
255 and 29 of high quality ($\geq 9/12$) (Ablin et al., 2012; Assumpção et al., 2009; Bannwarth
256 et al., 2009; Benjamin et al., 2000; Bergman et al., 2001; Branco et al., 2010; Buskila
257 et al., 2000; Cabral et al., 2014; Carnes et al., 2007; Cho et al., 2012; Choudhury et
258 al., 2013; Croft et al., 1993; Dragioti et al., 2016; Dueñas et al., 2016; Dueñas et al.,
259 2015; Flüß et al., 2015; Hagen et al., 2005; Hunt et al., 1999; Lee et al., 2010;
260 Leveille et al., 2001; Lindell et al., 2000; Macfarlane et al., 1999; Macfarlane et al.,
261 2009a; Macfarlane et al., 2009b; Mas et al., 2008; Riskowski 2014; Santos et al.,
262 2010; Schochat and Raspe 2003; Topbas et al., 2005; Walker-Bone et al., 2016;
263 Wolfe et al., 1995). Most of the included manuscripts (N=37) consistently identified
264 the CWP outcome measure and study eligibility criteria. Lack of appropriate reporting

265 was in reporting bias and providing detailed methodology. When addressing bias,
266 only five manuscripts identified their methods for controlling bias, 18 failed to
267 provide their adjusted estimates and precision (e.g., 95% confidence interval) for
268 CWP prevalence, and 27 did not report data collection methods and participant
269 recruitment. The high-quality studies (n=592,034) had a CWP prevalence of 9.7%
270 (7.4-12.1%), while the low-quality studies (n=30,135) had a similar ($p=0.242$) CWP
271 prevalence estimate of 7.5% (5.3-9.6%).

272

273

274 **4.0 Discussion**

275

276 The current review aimed to determine the global prevalence of CWP in the general
277 population. The review identified 30 studies with 41 estimates of CWP prevalence.
278 From these CWP studies, global CWP prevalence estimate was 9.6% (95% CI: 8.4-
279 11.2%). Women were found to have a higher CWP prevalence than men (11.2% v
280 7.2%). In identifying other factors associated with CWP prevalence, data collection
281 style of personal or non-personal approach showed no significant effect, but the
282 personal approach (i.e., face-to-face, telephone, examination) tended to increase CWP
283 prevalence compared to non-personal (9.9% v 7.6%). Additionally, countries with a
284 higher human development index (HDI) had a lower CWP prevalence compared to
285 lower HDI countries (8.6% v 14.5%). Results from this work suggest there is a
286 significant burden of CWP on the general population, particularly among women, and
287 that improving a country's standard of living, as indicated by the HDI, may influence
288 CWP prevalence.

289

290 *4.1 Diagnostic Criteria*

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

299 Hunt et al., 1999; Macfarlane et al., 1999) found CWP to be 4.7% with the
300 Manchester criteria and 12.9% with the ACR definition. Between these studies
301 sample sizes were different (n=1953 (Benjamin et al., 2000; Hunt et al., 1999;
302 Macfarlane et al., 1999) v n=7637 (Gerdle et al., 2008)), but these two studies also
303 differed in the number of pain sites the study participant could select in the pain chart.
304 The Manchester group (Benjamin et al., 2000; Hunt et al., 1999; Macfarlane et al.,
305 1999) had 26 pain sites available versus 17 in the Gerdle et al study (Gerdle et al.,
306 2008). The number of pain sites available to select could not only lead to participant
307 confusion, but it could also lead to participants under or over-reporting the number of
308 pain site depending on if their specific pain site is not provided. Research evaluating
309 style of pain reported has suggested that the most efficient method for assessing this is
310 through the completion of a body manikin (Croft 2002) or through the number of pain
311 sites rather than the location of pain (Beasley and Macfarlane 2014), which is what
312 the ACR 2010 definition does. As such, future research should aim to determine a
313 uniform diagnosis for CWP that utilises a body manikin with a set number of pain
314 sites to ensure prevalence figures are reliable and can be comparable across studies.

315

316 *4.2 Age and Gender*

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

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

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

332

333 *4.3 Geographical region*

334 Although there were no regional variations of CWP prevalence noted by the meta-
335 regression, these results should be viewed with caution, as regions other than Europe
336 and the Americas were not well represented. The prior CWP review (Mansfield et al.,
337 2016) noted differences between Europe and America, with Europe having a higher
338 CWP prevalence than the Americas (12.8% v 7.1%). These prior results are in
339 contrast with the current study where it shows a non-significant difference between
340 regions (8.9% in Europe v 10.9% in Americas). A possible explanation for this CWP
341 difference could be the variation in the studies included between the two reviews. For
342 example, this review included only general population studies, not studies of specific
343 populations within the larger population. As such, the prior meta-analysis (Mansfield
344 et al., 2016) included a CWP study of a Native American population (Jacobsson et al.,
345 1996), a small sub-population within the US general population, but did not include a
346 large population-based National Health and Nutrition Examination Survey
347 (NHANES) study (Riskowski 2014), suggesting the current and prior CWP
348 systematic review focused on different study populations.

349 *4.4 Socioeconomics Position and CWP*

350 The novelty of this meta-analysis was in the analyses of socioeconomic position
351 measures to CWP prevalence. The socioeconomic position contextual factors were the
352 HDI (HDR 2016), United Nations (UN) developed/developing country definition (UN
353 2012), and GINI index (HDR 2016). Although the HDI and UN definition of
354 developed/developing countries may appear similar, the HDI is a composite index
355 based on life expectancy, education level, and per capita income indicators, whereas
356 the UN definition of developed and developing countries is “intended to reflect basic
357 economic country conditions” rather than consideration of life within the country
358 (United Nations United Nations Department of Economic and Social Affairs (US
359 DESA) 2012).

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

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

374 2000; Roth and Geisser 2002). Extrapolating the individual-level measure of
375 socioeconomic position to the contextual population-level measure (e.g., HDI), poor
376 community and support structures that provide mechanisms to assist people in coping
377 with stress may explain the population-level association of CWP to lower
378 socioeconomic conditions. Given the low number of studies from developing and
379 lower socioeconomic countries, there is a need for epidemiological studies of chronic
380 pain in these regions to determine the global prevalence of CWP and to evaluate the
381 effect of the country's socioeconomic position with respect to CWP prevalence.

382

383 **4.5 Strengths and limitations**

384 Although there is a relatively recent review examining global prevalence of CWP
385 (Mansfield et al., 2016), this review adds to their results by examining a number of
386 contextual factors that may impact the CWP prevalence, such as the HDI, survey
387 method, and WHO region. However, other factors not accounted in this review were
388 race and ethnicity, due to the lack of reported data. Future studies, where appropriate,
389 should include race and ethnicity information of participants as some studies have
390 suggested it may impact risk of CWP (Allison et al., 2002; Macfarlane et al., 2005).
391 Along these same lines, studies have also suggested that class or socioeconomic
392 position may also be an individual factor that relates to risk of chronic pain (Rios and
393 Zautra 2011; Urwin et al., 1998), but within the systematic review there was one
394 study that evaluated CWP by class or social position. Thus, the surrogate markers of
395 HDI and the WHO development status were used to evaluate the effect of social
396 deprivation at the country-level, with results suggesting that with greater social
397 deprivation there is greater risk of CWP. However, the country-level marker may not
398 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

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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.