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Offspring of Parents with Chronic Pain: A Systematic Review and Meta-Analysis of Pain, Health, Psychological, and Family Outcomes

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Abstract

Offspring of parents with chronic pain may be at risk for poorer outcomes than offspring of healthy parents. The objective of this research was to provide a comprehensive mixed-methods, systematic synthesis of all available research on outcomes in offspring of parents with chronic pain. A systematic search was conducted for published articles in English examining pain, health, psychological, or family outcomes in offspring of parents with chronic pain. Fifty-nine eligible articles were identified (31 population-based, 25 clinical, 3 qualitative), including offspring from birth to adulthood and parents with varying chronic pain diagnoses (e.g., mixed pain samples, arthritis). Meta-analysis was used to synthesize the results from population-based and clinical studies, while meta-ethnography was used to synthesize the results of qualitative studies. Increased pain complaints were found in offspring of mothers and of fathers with chronic pain, and when both parents had chronic pain. Newborns of mothers with chronic pain were more likely to have adverse birth outcomes, including low birthweight, preterm delivery, caesarean section, intensive care admission, and mortality. Offspring of parents with chronic pain had greater externalizing and internalizing problems and poorer social competence and family outcomes. No significant differences were found on teacher-reported externalizing problems. The meta-ethnography identified six key concepts (developing independence, developing compassion, learning about health and coping, missing out, emotional health, and struggles communicating with parents). Across study designs, offspring of parents with chronic pain had poorer outcomes

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than other offspring, although the meta-ethnography noted some constructive impact of having a parent with chronic pain.

Keywords

chronic pain; parents; offspring; children; systematic review; meta-analysis; meta-ethnography

Chronic pain tends to aggregate in families [37,72], and vulnerability to chronic pain is thought to be the result of complex interactions between both environment and genetics [37,46,50,77,91]. It is known that parental mental and physical health conditions generally put offspring at risk for poorer outcomes. For example, children of mothers with depression are more likely to experience depression and other mental health problems compared to children of mothers without depression [22,31,54,71], and children of parents with cancer have higher levels of anxiety, depression, and behaviour problems than children of parents without cancer [74]. Fewer studies have been conducted to examine the effects of parental chronic pain on their offspring.

Previous studies that have examined offspring of parents with chronic pain have studied the effects of parental chronic pain on the offspring's own pain complaints [37], other aspects of their physical health [51,53], their psychological health [44], and variables related to family relationships [75]. While several studies have found that offspring of parents with chronic pain have poorer pain [37], health [51], and psychological [44] outcomes than other offspring, other studies have found no between-group differences on pain complaints [43], and psychological and family outcomes [75]. Additionally, few studies have explored possible differences in the effects of maternal versus paternal chronic pain on offspring, although at least one study has found such differences [37], and other research has explored differences in mothers' and fathers' interactions with children during child pain [32,60]. These conflicting results highlight the need for a comprehensive review of the literature including studies conducted in various disciplines looking at a variety of outcomes in offspring of parents with chronic pain.

One prior narrative review described 18 studies of children of parents with chronic pain [82]. The review concluded that children and adolescents whose parents have chronic pain are at risk for more pain complaints (particularly those similar to their parents), and more internalizing and externalizing symptoms than children and adolescents of parents without chronic pain. However, the previous review [82] contained several critical limitations, including an overly narrow search strategy, lack of meta-analysis, and lack of inclusion of population-based and qualitative studies. It is important to conduct a mixed methods review of the literature on offspring of parents with chronic pain in order to better understand the conflicting results found in the literature. In particular, qualitative research may offer a different perspective on this topic, as participants may address topics that researchers had not previously considered. Better understanding the effects of parental chronic pain on offspring may identify opportunities to provide interventions to improve outcomes in offspring of parents with chronic pain.

The aim of the present study was to improve on previous work by conducting a rigorous mixed-methods systematic review, employing both meta-analysis and qualitative synthesis of the full range of empirical research (population-based, clinical, and qualitative studies) examining the relationship between parental chronic pain and pain, health, psychological, and family outcomes in their offspring.

Method

Search Strategy

The electronic databases searched included PubMed, PsycINFO, CINAHL, and EMBASE. PubMed was chosen over Web of Science as it has been shown to be an optimal biomedical database [30]. Databases were searched from inception to August 2014. The search strategy included combinations of terms for parent (e.g., parent, mother, father, caregiver, family), pain (e.g., pain, arthritis, fibromyalgia, headache, neuropathy), child (e.g., infant, child, adolescent, young adult), and association (e.g., risk, influence, predictor, association), and was developed in consultation with a librarian specializing in systematic searches. The particular pain conditions included in the search strategy were decided upon through consensus with expert adult and pediatric pain researchers and clinicians. Medical Subject Headings (MeSH) terms and other key terms were included where possible; text terms were searched in all databases for entries including these terms in the title or abstract. See Appendix A for the complete search strategy for each database. Additional hand searching of previous relevant research was also conducted.

Eligibility Criteria

Eligible studies were empirical studies (population-based, clinical, or qualitative) examining the relationship between parental pain and offspring pain, health, psychological, or family outcomes. Studies had to include measures of offspring outcomes (e.g., not just measures of the parent's parenting abilities). Studies including offspring of any age from infancy to adulthood were eligible. Only published articles written in English were included, given that research suggests that this does not significantly affect meta-analysis results [59]. Included studies had to have parent(s) as the identified pain patient(s) in their samples (rather than offspring).

Study Selection and Data Extraction

Study selection and data extraction were completed following accepted standards for systematic review procedures [34,47,81]. The titles of all of the citations generated in the systematic search were reviewed for relevance by the first author (KH). For titles that were identified as relevant, abstracts were retrieved and reviewed to determine whether they met the review inclusion criteria. For any studies where there was uncertainty about exclusion, input was sought from a co-author (KB). Full articles identified for inclusion were retrieved and coded using data extraction sheets designed for the present review. Data extraction sheets were developed by the first author (KH) with consultation from co-authors. Characteristics of the parent and offspring samples and outcome measures were recorded, and data was extracted for all outcomes measured in each study by the first author (KH). A subset of approximately 20% of identified studies was coded by an additional coder and

disagreements were solved with consensus. The outcomes measured in the population and clinical studies were grouped into four core domains (pain, health, psychological, family) and other outcomes to assist in the analysis of the wide variety of outcomes measured across studies. For continuous variables, means and standard deviations were extracted from each study; for dichotomous variables, odds ratios with 95% confidence intervals or frequencies and group sizes were recorded.

Meta-Analysis

Meta-analyses were completed following accepted procedures for using this method [34,52]. Outcome data extracted from population and clinical studies were grouped by domain (pain, health, psychological, family, other). Within each core domain, similar constructs were grouped together for meta-analysis. At least two studies measuring the same outcome were required in order to conduct a meta-analysis on the outcome. Studies were only combined in meta-analyses if their measurement of the outcome was similar enough that the combining of data in a meta-analysis would result in an interpretable construct [34]. Psychological outcomes were grouped into internalizing problems (including scales measuring general internalizing symptoms and symptoms of depression, anxiety, and obsessive-compulsive disorders) and externalizing problems (including scales measuring general externalizing problems, child behaviour problems, delinquency and hyperactivity). Given the lack of agreement between measures completed by different informants in previous studies [1,67], outcomes were additionally grouped based on the source reporting on the measure (parent-, child-, and teacher-reported outcomes). Analyses were conducted using RevMan 5.3 software. Random effects analyses were used for all analyses, as this statistic is appropriate for meta-analyses in which the true effect size is thought to differ across studies [34]. This is the case in the present review given the variety of parental pain conditions studied and the variety of measures used for each outcome. In order to perform a meta-analysis for a particular outcome, at least two studies providing appropriate data on the outcome were required. Heterogeneity amongst studies was measured using the I^2 statistic, and was interpreted using the following recommended guidelines: 0%–40% indicates that heterogeneity might not be important, 30%–60% may represent moderate heterogeneity, 50%–90% may represent substantial heterogeneity, 75%–100% represents considerable heterogeneity [34].

Continuous outcomes were analyzed using standardized mean difference. This is considered an appropriate statistical test for meta-analyses in which outcomes are measured on different scales across studies and when comparing mean scores across groups which are not randomly assigned [34,52], which is the case in the present review. Data were entered in the analysis such that higher scores for each variable were indicative of greater levels of problems. Consequently, a positive standardized mean difference with both limits of the confidence interval being positive indicates that children in the parental chronic pain group had higher scores (poorer functioning) for the outcome compared to children of control parents. When the same outcome was rated by both the offspring's mother and father, data were pooled using the following formulas: mean = [(mean1*N1)+(mean2*N2)]/(N1+N2) and pooled SD = square root of [(SD1^2(N1-1)+SD2^2(N2-1))/(N1+N2-2)].

For dichotomous data, odds ratios were calculated using random effects generic inverse variance analyses. This type of analysis weights study effect estimates using the inverse variance of the effect estimate, which allows effect sizes to be combined across studies in which frequencies and group sizes were not reported [34]. Given that many studies reported odds ratios and 95% confidence intervals, but did not provide the frequency data necessary to calculate them, this analysis was considered most appropriate. In studies where odds ratios were not reported, frequency data were used to calculate odds ratios in RevMan to be included in the generic inverse variance analyses. Subgroup analyses were conducted using a chi-square test in RevMan 5.3 software.

Qualitative Synthesis

Qualitative studies identified in the systematic search were synthesized using meta-ethnographic techniques. Meta-ethnography is a well-accepted form of qualitative synthesis that involves translating the results of primary studies into one another, in order for overarching themes or concepts to be generated across studies [15,61,64]. This process involves seven steps: 1) Getting started (determining research questions); 2) Deciding what is relevant to the initial interest (determining the scope of the synthesis); 3) Reading the studies; 4) Determining how the studies are related; 5) Translating the studies into one another; 6) Synthesizing translations; and 7) Expressing the synthesis [61]. These steps were followed for the qualitative studies identified in the search. Each study was read three times and the key concepts identified in each study were recorded independently by two coders, with disagreements resolved through consensus. Key concepts were reviewed across studies to determine those that commonly occurred across studies. Upon identification of these concepts, a table was created describing each concept in each primary study ("translating" studies into one another). Translations were synthesized by reading each study and concept definition and describing the relationship between the studies based on the concepts. The synthesis is expressed in the results section of the present review. These methods are consistent with suggested methods for using meta-ethnographic techniques [9,15,16].

Results

Search Results

The screening process is illustrated in a flow diagram in following the PRISMA model [58] in Figure 1. The systematic search identified 16,450 unique citations after removal of duplicates. Titles of all identified articles were screened for relevance to the topic, resulting in 117 articles for possible inclusion. Abstracts of the 117 articles were reviewed for meeting the eligibility criteria. From this, 59 articles were identified for inclusion. Abstracts were excluded for several reasons, including not published articles (e.g., conference abstracts; $n = 19$), not examining parental pain ($n = 12$), focusing on offspring with chronic pain rather than parents with chronic pain ($n = 9$), not measuring offspring outcomes ($n = 8$), not empirical studies (e.g., topical reviews; $n = 5$), not written in English ($n = 4$). Additionally, one study was excluded because it included case data from only one offspring of a parent with chronic pain. The 59 studies identified for inclusion fell into three categories. Two categories utilized quantitative methodology: population-based studies (studies in which outcomes were measured quantitatively and a population-based sample

was used; that is, participants were not specifically recruited to be part of a parental pain group or control group) and clinical studies (studies in which outcomes were measured quantitatively and a parental pain group was specifically recruited; a control group may or may not have been recruited). The third category of identified studies was qualitative studies (studies conducting qualitative analyses; e.g., grounded theory analysis). Thirty-one population-based studies, 25 clinical studies, and three qualitative studies were included in the review. Table 1 shows the studies included in the systematic review, along with the parental pain samples used and types of outcomes measured.

Population-based studies—Thirty population studies reported on a total of 4,626,806 offspring (sample size not reported in [38]). Fourteen (45.16%) examined the relationship between maternal chronic pain and offspring outcomes, while the remaining 17 studies (54.84%) examined pain in either parent in relation to offspring outcomes. Population studies examined mixed forms of parental chronic pain (n = 13, 41.94%) and parental arthritis (n = 6, 19.35%), headaches (n = 6, 19.35%), migraines (n = 4, 12.90%), and back pain (n = 2, 6.45%). The offspring examined varied in age across studies, including newborns (defined as ages 1–30 days; n = 10, 32.26%), infants (1–23 months; n = 3, 9.68%), preschoolers (ages 2–5 years; n = 4, 12.90%), children (ages 6–12 years; n = 10, 32.36%), adolescents (ages 13–18 years; n = 13, 41.94%), and adult offspring (> 18 years; n = 5, 16.13%).

Clinical studies—Twenty-three clinical studies reported on a total of 1,610 offspring of parents with chronic pain (sample size not reported in [66,76]). Eighteen (72.00%) included control groups, with a total of 1,305 offspring of parents without chronic pain being included. Seven (28.00%) clinical studies examined offspring of mothers with chronic pain while 17 (68.00%) examined offspring of either parent with chronic pain and one (4.00%) examined offspring of fathers with chronic pain. Similarly to the population studies, clinical studies (n = 25) included mixed parent pain samples (n = 9, 36.00%), as well as parent samples with arthritis (n = 5, 20.00%), fibromyalgia (n = 3, 12.00%), headaches (n = 2, 8.00%), irritable bowel syndrome (n = 2, 8.00%), migraines (n = 1, 4.00%), inflammatory bowel disease (n = 1, 4.00%), back pain (n = 1, 4.00%), and temporomandibular pain (n = 1, 4.00%). These studies also included offspring of a range of ages, including newborns (n = 1, 4.00%), infants (n = 3, 12.00%), preschoolers (n = 5, 20.00%), children (n = 16, 64.00%), adolescents (n = 14, 56.00%), and adult offspring (n = 7, 28.00%). One study did not report on the age of included offspring [66].

Qualitative studies—Three qualitative articles describing two participant samples were identified in the systematic search. One study [29] interviewed 21 children (ages 6–12) of mothers with various chronic pain diagnoses regarding their understanding of their mothers' pain and health, their feelings about their mothers' pain, and their own health. The remaining two studies described the same sample of participants [83,84]. This sample comprised 30 young adults (18–21 years) with either a mother or father with a variety of chronic pain disorders. Participants were interviewed and asked to reflect on their experiences as an adolescent growing up with a parent with chronic pain, including the strategies they used to manage these experiences.

Meta-Analysis

Pain outcomes

Population-based studies: Sixteen population studies [5,7,8,13,24,33,37,43,48,49,63,65,72,79,89,90] examined offspring pain outcomes, although not all provided data sufficient for inclusion in the meta-analysis. Meta-analysis of six studies [13,24,33,37,43,72] (N = 9965 offspring) providing appropriate data for meta-analysis found that offspring of mothers with chronic pain were more likely to report pain complaints compared to offspring of control mothers (OR = 1.59, 95% CI [1.37, 1.85], Z = 6.00, $p < 0.00001$, I^2 = 44%). The same pattern was revealed in offspring-reported pain complaints in five studies [13,24,33,37,43] (N = 6453) of offspring of fathers with chronic pain (OR = 1.30, 95% CI [1.08, 1.57], Z = 2.77, p = 0.006, I^2 = 30%) and in four studies [13,24,37,43] (N = 2380) of offspring with both parents having chronic pain (OR = 1.61, 95% CI [1.29, 2.01], Z = 4.22, $p < .0001$, I^2 = 0%). Additionally, a similar pattern was found in five studies [24,33,37,43,63] (N = 7034) that examined offspring with any one parent having chronic pain (regardless of sex) compared to control offspring (OR = 1.59, 95% CI [1.32, 1.92], Z = 4.90, p < 0.00001, I^2 = 57%). A test of subgroup differences revealed no significant differences in odds of pain complaints between offspring of mothers versus fathers with chronic pain (X^2 = 2.60, p = 0.11, I^2 = 61.5%).

The remaining population studies measuring offspring pain outcomes could not be combined for meta-analysis. One study examining mother-reported offspring pain complaints found that offspring of mothers with chronic daily headaches were more likely to have chronic daily headaches compared to offspring of mothers with no lifetime history of headaches [7]. The remaining studies used dissimilar parental pain or control definitions and could not be combined with the other studies [8,48,65], did not report associations between parental pain and offspring pain despite measuring these variables [5,49,90], or reported data in a format that could not be combined with the other meta-analyzed studies (e.g., regression coefficients that could not be combined with the OR data in the generic inverse variance analysis)[79,89].

Clinical studies: Thirteen clinical studies reported on various offspring pain outcomes that could not be appropriately grouped for meta-analysis. These studies found significant between-group differences in the outcomes they measured, including offspring-reported number of pain sites [26], teacher-reported presence of offspring pain complaints [27], parent-reported frequency of stomachaches or abdominal pain [41], number of tender points determined using dolorimetry assessment [17], fibromyalgia diagnosis [70], self-reported presence of headaches [56], mean frequency of headaches [57], and pain-related responses to hypothetical scenarios [68]. Two studies [2,39] reported on pain outcome analyses in groups of relatives including offspring, but did not report the offspring results separately.

The remaining three clinical studies examined relationships between parental pain and offspring pain outcomes but did not include control groups of unrelated healthy parents and their offspring. One study [18] found a prevalence rate of fibromyalgia of 28% in offspring of parents with fibromyalgia (reported as higher than the prevalence in the general population), while another [45] found prevalence rates of irritable bowel syndrome of

12%-20% in offspring of parents with irritable bowel syndrome (reported as comparable with the general population prevalence). A third study [19] found that 16.67% of their sample of offspring of parents with chronic pain had pain complaints themselves.

Health outcomes

Population-based studies: Eight population studies [11,12,20,21,51,62,87,88] examined birth outcomes in newborns of women with chronic pain conditions and provided appropriate data for meta-analysis. Results of these meta-analyses are shown in Table 2. Significant group differences were found for low birthweight, being small for gestational age, preterm delivery, caesarian section, perinatal mortality or stillbirth, and admission to neonatal intensive care unit (NICU), with newborns of mothers with chronic pain being more likely to experience these adverse birth outcomes. Significant group differences were not found for Apgar score below seven at five minutes after birth, congenital abnormalities, and instrument assisted delivery.

Four population studies examined other health outcomes that could not be appropriately combined for meta-analysis. Two studies found that children of parents with chronic pain had increased self-reported medication use for headache [3] and increased odds of emergency department visits and hospitalizations [53] compared to control children. Two other studies found no significant group differences when measuring author-defined newborn risk categories [4] and parent-reported use of over-the-counter analgesics by children [42].

Clinical studies: Four clinical studies examined measures of offspring general health [26–28] and were combined within meta-analyses. Significant group differences were found for offspring-reported (*SMD* = 0.79, 95% CI [0.38, 1.19], $Z = 3.80$, $p = 0.0001$, $I^2 = 44\%$; $N = 241$) [26–28] and parent-reported (*SMD* = 0.51, 95% CI [0.18, 0.84], Z = 3.05, $p = 0.002$, $I^2 = 0\%$; $N = 153$) [25–27] general health scales, with offspring of parents with chronic pain having poorer scores on these measures. Two clinical studies [57,80] ($N = 132$) examined parent-reported questionnaire measures of somatization, and meta-analysis revealed no significant group differences (*SMD* = 0.30, 95% CI [-0.10, 0.69], $Z = 1.46$, $p = 0.15$, $I^2 = 18\%$). Other clinical studies found that parental pain groups had offspring with lower birthweight [14], increased medication use for gastrointestinal symptoms [41], and more illnesses and injuries [66] compared to control groups, but found no differences regarding daily physical activity or sleep habits [80].

Psychological outcomes

Population-based studies: Three population studies examined offspring psychological outcomes but could not be appropriately combined for meta-analysis. One study [44] found that adolescents with both parents having chronic pain had increased risk of experiencing anxiety and depressive symptoms than adolescents of control parents, while this was not seen in children with only one parent with chronic pain. They also found an increased risk of conduct problems in girls whose mothers had chronic pain. Another study [6] found that maternal headache status predicted clinical-range scores on parent-reported general behaviour measures in children without migraines, but not in children with migraines. A

third study [38] did not report on offspring psychological outcomes for parental pain groups separately from other parental condition groups (e.g., cancer, mental health diagnoses).

Clinical studies: Fourteen clinical studies reported on offspring psychological outcomes. The combined results of seven studies [23,25–28,57,75] (N = 502) revealed that offspring of parents with chronic pain scored higher on parent-rated measures of externalizing problems compared to control offspring (SMD = 0.58, 95% CI [0.31, 0.85], Z = 4.23, $p < 0.0001$, I^2 = 47%). However, two studies [23,27] (N = 106) measuring teacher-reported child externalizing problems revealed no difference between groups on this variable (SMD = 0.63, 95% CI [-0.12, 1.37], Z = 1.64, p = 0.10, I^2 = 71%). Meta-analysis of five studies [26–28,57,75] (N = 428) found increased levels of parent-reported internalizing problems in offspring of parents with chronic pain (SMD = 0.60, 95% CI [0.39, 0.81], Z = 5.62, p < 0.00001, I^2 = 7%). Five studies [25–28,35] (N = 469) found the same pattern of results for offspring-reported internalizing problems (SMD = 1.13, 95% CI [0.85, 1.41], Z = 7.83, $p <$ 0.00001, I^2 = 40%). Offspring-reported internalizing problems included measures of anxiety [25–27,35], depression [25,27,28,35], and obsessive compulsive disorder symptoms [35].

Six studies [23,25,27,28,57,80] (N = 413) examined parent-reported offspring social competence and meta-analysis revealed a significant difference between groups on this variable, with offspring of parents with chronic pain having poorer social abilities (SMD = 0.47, 95% CI [0.27, 0.67], Z = 4.62, p = 0.00001, I^2 = 0%). Two studies [23,27] (N = 106) examining teacher-reported child social competence found a similar pattern of results (SMD = 0.76, 95% CI [0.23, 1.28], Z = 2.83, p = 0.005, I^2 = 41%). One study reported that adolescents of parents with chronic pain had lower self-esteem than control adolescents [35], while others measured offspring self-concept [69] and internalizing problems [19,92] without control groups.

Family outcomes

Population-based studies: No population studies examined family outcomes.

Clinical studies: Three clinical studies [28,57,75] (N = 232) measured parent-reported family functioning and meta-analysis indicated that family functioning was poorer in families with parental chronic pain compared to healthy control families (SMD = 0.47, 95% CI [0.20, 0.74], Z = 3.46, p = 0.0005, I^2 = 0%). One study did not provide sufficient data for meta-analysis [25].

Other Outcomes

Population-based studies: No population studies examined offspring outcomes other than the pain, health, psychological, and family outcomes described above.

Clinical studies: Eight clinical studies examined offspring outcomes not falling into any of the other categories (pain, health, psychological, family). Two studies examined offspring days absent from school during one school year [23,25] (N = 45) and meta-analysis revealed no significant differences between groups (SMD = 0.36, 95% CI [-0.42, 1.14], Z = 0.90, p = 0.37, I^2 = 34%). The outcomes measured in the remaining clinical studies were not

sufficiently similar to be combined in meta-analyses. These studies examined physiological [80], school related (e.g., school activity participation) [35,41,68], and peer-relationship variables [36]. An additional study examined children's behaviours in response to their parent's pain (e.g., keeping distance, rubbing parent's neck) [76]. Two of these studies did not include control groups [41,76]; the remaining studies did not find group differences on these variables.

Qualitative Synthesis

The three identified qualitative studies were synthesized using meta-ethnographic techniques. One study [29] described a sample of 21 children ages 6–12 of mothers with various chronic pain diagnoses, while the remaining two studies [83,84] described one sample of 30 young adults (ages 18–21) who reflected on their adolescence with either a mother or father having various chronic pain diagnoses. A thorough literature review revealed no recommendations for handling overlapping samples in meta-ethnography; thus, both samples were included given that they presented analyses of separate data collected from the group of participants. A summary of the key study characteristics and results of the meta-ethnography is provided in Appendix B. Six key concepts regarding the effects of parental chronic pain were identified across studies. The six concepts were: (1) development of children's independence at an early age; (2) development of compassion or empathy for others; (3) learning about health and coping; (4) missing out on normal activities or aspects of childhood or adolescence; (5) effects on participants' emotional health; (6) struggles with communication.

All three studies discussed the *development of children's independence at an early age*, and this was viewed both positively and negatively by participants. Many mothers and children in Evans and de Souza [29] reported that children were independent and caring, and while mothers typically viewed this as positive, some children did not enjoy being left alone or unsupervised. Participants in Umberger et al. [83] described hardships relating to developing independence at a young age, and one of the "life lessons" that emerged from the study was "growing up too fast is not a good thing". Some participants in Umberger et al. [84] used independence from their parent as a strategy for coping with their parent's pain. Participants also discussed the difficulty of having to take care of their parents physically and emotionally.

The second key concept that emerged across studies was the *development of compassion or empathy for others*. Children in Evans and de Souza [29] were reported to be caring and helpful with household tasks, and most children reported enjoying being able to help their mothers. In Umberger et al. [84], some young adults reported being able to empathize with their parents as adolescents and consider the complexity of their pain problems. They also reported learning the life lesson that "it is important to look beneath the surface" and being able to empathize with others [83].

The third key concept that emerged across studies was *learning about health and coping*. Children learned about health, illness, their own bodies, and strategies for coping with stress because of their mother's pain [29]. Many young adults in Umberger et al. [83] reported the positive experience of having learned "life lessons" as adolescents because of growing up

with a parent with chronic pain. Learning about health and coping did not emerge as a key concept from Umberger et al. [84].

The fourth key concept was *missing out* on normal activities or aspects of childhood and adolescence because of living with a parent with chronic pain. Children reported missing out on social activities because of their mother's pain, and some expressed anger because of this [29]. Some young adults reported intense feelings of grief as adolescents regarding the loss of their normal childhood and questioned whether their parents loved them [84], while some learned to accept missing out on certain aspects of life because of parental chronic pain [83].

The fifth key concept that emerged was *effects on participants' emotional health*. Participants in all samples indicated that they had suffered emotionally at times due to the experience of living with parental chronic pain. Children were described as "clingy" and showing anxiety and sadness related to parental pain [29]. Young adults reported experiencing negative emotions as adolescents including sorrow, anger, frustration, and fear, both because of the difficulties of having a parent with chronic pain and the worry that their parent would not be around for important future events [84]. Some young adults also described worrying during their adolescence about whether their parent's pain was life threatening and whether they would experience chronic pain themselves in the future, as well as experiencing guilt when they questioned whether their parents were truly in as much pain as they described [83].

The final key concept that emerged was *struggles with communication*. Across studies, children tended to hide their true thoughts and feelings from their parent with pain and avoided communicating their needs. In Evans & de Souza [29], several children reported anxiety about their mother's pain, of which their mother was not aware. Some young adults reported distancing themselves from their parents both physically and emotionally in their adolescence, and did not discuss their feelings regarding their parent's pain with anyone [84]. However, those who were able to share their feelings with their parents as adolescents experienced an increased closeness in the relationship [84]. Some participants explained that they avoided initiating conversations with their parent about pain for fear that it would cause their parent additional pain and suffering [83]. Few participants across studies described receiving clear information about their parent's pain.

One main difference in results emerged between the three qualitative studies; namely, the effects of parental chronic pain on offspring pain experiences. Evans and de Souza [29] reported that one of the most profound effects of maternal chronic pain was on the children's physical health, as many children reported experiencing pain complaints and discussed the positive aspects of having pain (e.g., receiving special attention from parents). This concept was not described in either of the other two included qualitative studies examining the young adult sample. While some participants in Umberger et al. [83] reported worrying about whether or not they would experience chronic pain problems in the future, they did not discuss effects of their parents' pain on their own pain or other aspects of physical health.

Discussion

This comprehensive and rigorous mixed-methods systematic review and syntheses indicates that overall, offspring of parents with chronic pain have poorer outcomes in the areas of pain, health, psychological, and family functioning as compared to offspring of parents without pain. Thirty-one population-based studies, 25 clinical studies, and three qualitative studies were included, representing parents with a variety of pain conditions and offspring from newborns to adulthood. Population studies indicated that offspring of parents with chronic pain were more likely to have pain complaints than other offspring, including when either one or both parents had chronic pain. No differences were found for maternal versus paternal chronic pain. They also indicated that newborns of mothers with chronic pain had increased rates of many, but not all, adverse birth outcomes, including low birthweight, small for gestational age, preterm birth, caesarian section, perinatal mortality, and admission to neonatal intensive care. These analyses included large sample sizes and comparison groups, suggesting strong conclusions.

Clinical studies found that offspring of parents with chronic pain had poorer scores on general health measures, psychological outcomes, and family functioning than other offspring, including higher levels of parent-reported externalizing and internalizing problems and parent- and teacher-reported social competence. Differences were not found for teacher-reported externalizing problems, parent-reported somatization, or days absent from school.

Synthesis of the included qualitative studies also revealed negative effects of parental chronic pain on offspring, including a sense of missing out on a normal childhood or adolescence, negative effects on emotional health, and struggles with parent-child communication. However, the qualitative synthesis also uniquely identified positive outcomes associated with having a parent with chronic pain, including developing independence, developing compassion or empathy, and learning about health and coping. This may have revealed positive outcomes associated with having a parent with chronic pain because qualitative studies were designed such that participants could discuss any of their experiences related to parental chronic pain, whether positive or negative, while the quantitative studies (population and clinical) focused on outcomes that were hypothesized to be poorer in children of parents with chronic pain.

This review synthesized findings regarding the relationship between parental pain and offspring outcomes. A relationship between maternal chronic pain and several adverse birth outcomes was found, and the meta-analysis of outcomes based on the informant assessing the outcome (e.g., parent, offspring, teacher) highlighted important findings. Offspring of parents with chronic pain had greater parent-reported externalizing problems, but not teacher-reported externalizing problems. This suggests that future studies should take into account different informants when studying the effects of parental chronic pain on offspring. This review also synthesized results that are generally consistent with the previous narrative review completed in this area [82]; offspring of parents with chronic pain were more likely to have pain complaints and internalizing and externalizing problems compared to other offspring.

While it has been established that offspring of parents with chronic pain have poorer outcomes than offspring of healthy parents, it is unclear whether this finding is directly related to parental pain per se, or to other characteristics commonly associated with chronic pain, such as comorbid mental health issues, medication use, and/or pain-related disability. For example, parental depression is associated with poorer outcomes in offspring [22,31,54,71] and the prevalence of major depressive disorder is higher among adults with chronic pain than in the general population [55]. Two studies included in our review [35,36] controlled for parental mental health by including a comparison group of parents with depression in addition to chronic pain. These studies reported poorer outcomes for offspring of parents in both clinical groups compared to healthy control groups, but were inconsistent in observed differences between clinical groups. Two other studies found mixed results regarding correlations between parental mental health and child outcomes [57,66]. Similarly, medication use in mothers could have influenced birth outcomes in newborns, although this was not controlled for in any of the included population studies. Moreover, studies included in our review focused primarily on the impact of the presence of parental chronic pain on offspring outcomes. However, individuals with chronic pain can have highly variable levels of associated pain-related disability and interference [73,85] and therefore the impact of level of impairment as a result of pain on offspring outcomes will be an important focus for future work. Only two studies in our review included parental pain-related disability in their analyses of offspring outcomes [75,80]. Attempts are needed to disentangle the unique contribution of parental chronic pain relative to other associated parental factors in influencing outcomes in offspring.

The present systematic review, meta-analysis, and qualitative synthesis has many strengths. Firstly, a broad search strategy was used, which was successful in identifying a large number of relevant articles including a variety of study designs and samples (population, clinical, and qualitative studies). The inclusion of population studies is important because these studies are more representative of the general population of families dealing with chronic pain than matched control group studies. Completing a synthesis of qualitative studies allowed for the incorporation of the rich data gained in qualitative research in the review and for the discussion about both positive and negative self-perceived effects of having a parent with chronic pain. Secondly, this review is unique in its inclusion of both meta-analysis and meta-ethnographic techniques. Completing formal syntheses allowed for conclusions to be drawn from combinations of studies that would not have been possible in a narrative synthesis. In particular, the meta-analysis allows for estimates of the effect sizes of the studied relationships to be calculated. The use of a mixed methods approach to knowledge synthesis is innovative in the field of pain research and provides a richer basis for understanding the state of the research in this topic area.

A limitation of this work is that an evaluation of the quality of the primary studies included in the review was not possible given that existing quality assessment tools could not be applied across the different types of studies (e.g., Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria [10,40]). Furthermore, application of the GRADE criteria require that prognostic studies must use longitudinal designs, and only two of 31 population studies [5,65] and two of 25 clinical studies [66,80] employed longitudinal designs. The meta-ethnographic synthesis of qualitative studies may have been limited by

the small number of included studies. Furthermore, several of the quantitative meta-analyses included small numbers of studies.

This review addresses an important knowledge synthesis gap and identifies areas in need of further exploration in the study of offspring of parents with chronic pain. Future studies should use prospective, longitudinal designs to examine parental pain as a prognostic factor in the development of chronic pain in offspring and to further examine the processes by which parental pain may transfer to offspring. While prior studies have examined other prognostic factors in pain development [86], few studies have used longitudinal designs to examine the role of parental chronic pain in offspring outcomes. Additionally, future studies should include multiple measures of outcomes and multiple informants, as relying only on parent reports of offspring pain may be biased by the parents' own pain experiences. Another gap in this area is the role of particular aspects of parental pain such as specific pain parameters (e.g., pain frequency, onset, and duration), pain-related disability, and parent mental health in the relationship between parental pain and offspring outcomes. No studies have examined the timing of onset of parent pain with respect to offspring age or developmental stage. While no differences in outcomes of offspring of mothers versus fathers with chronic pain were found in this review, few included studies provided data separated by parent sex for meta-analysis. Future studies should examine possible differences in this area, given that at least one well-powered study has found such a difference [37].

Thus far, population-based and clinical studies have established that in general, offspring of parents with chronic pain tend to have poorer outcomes in terms of pain, health, psychological, and family functioning as compared to offspring of parents without pain. However, as revealed in the qualitative synthesis, there are at least some perceived positive offspring outcomes of having a parent with chronic pain. Future research should move beyond simply comparing offspring with and without parental chronic pain, instead, focusing on possible predictors of *which* offspring of parents with chronic pain are at greatest risk for poorer outcomes. Employing a risk-resilience framework [78] to understanding possible offspring, parent, dyadic, and family variables involved in predicting poorer and, conversely, better offspring outcomes will be important. A greater focus on the mechanisms involved in the relationship between parental chronic pain and offspring outcomes is also needed (i.e., *why* and *how* these differences occur). Researchers should also consider the strengths of qualitative methodology when designing future studies, and consider whether this methodology may be appropriate for answering their particular research questions. While additional research is needed, the results of this review highlight the impact of parental chronic pain on offspring outcomes and the need for clinicians to incorporate this factor in routine chronic pain assessment and management.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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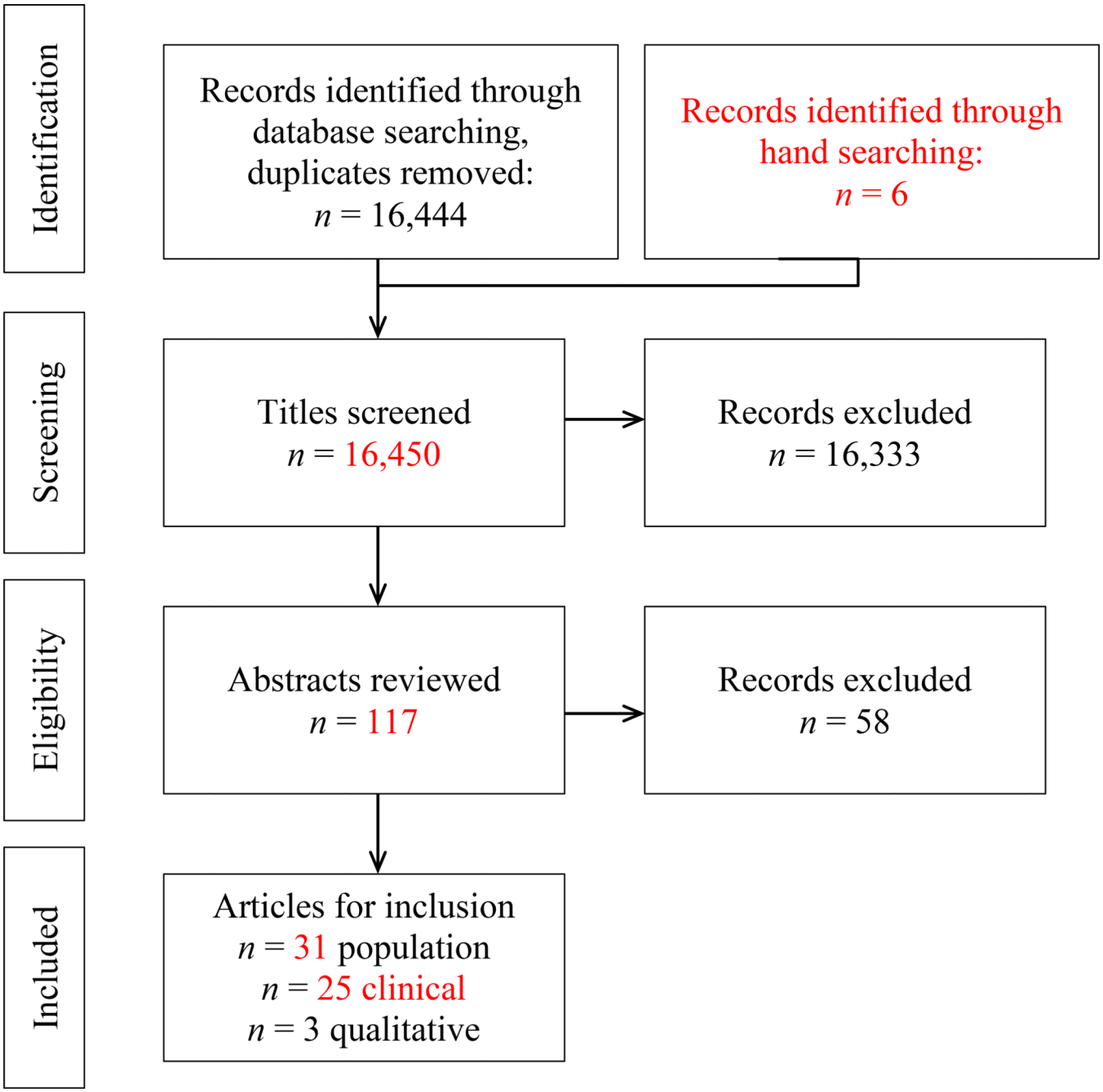

Figure 1.
PRISMA flow diagram of identification and screening process for systematic review.

Table 1

Characteristics of Studies Included in the Systematic Review

First Author & Year	Parent with Pain	Type of Parental Pain	Offspring Age Range	Number of Offspring	Offspring Outcomes Measured				
					Pain	Health	Psych	Family	Other
Population									
Andersen 2012 [3]	Either	Headaches	2–17 years	8256		x			
Aromaa 1996 [4]	Mother	Headaches	Newborn	1443		x			
Aromaa 1999 [5]	Either	Headaches	6 years	908	x				
*Arruda 2010 [7]	Mother	Headaches	5–12 years	1994	x				
Arruda 2012 [6]	Mother	Headaches	5–12 years	1856			x		
Assadi 2013 [8]	Either	Headaches	14–18 years	272	x				
*Banhidy 2007 [11]	Mother	Migraine	Newborn	38151		x			
*Blair 2011 [12]	Mother	Migraine	Newborn	660		x			
*Borge 2000 [13]	Either	Mixed	13–15 years	229	x				
*Chen 2010 [20]	Mother	Migraine	Newborn	29466		x			
*Chen 2013 [21]	Mother	Arthritis	Newborn	941574		x			
*Deubner 1977 [24]	Either	Migraine	10–20 years	232	x				
*Hasvold 1996 [33]	Either	Mixed	20–70 years	1939	x				
*Hoftun 2013 [37]	Either	Mixed	13–18 years	5370	x				
Holmes 2003 [38]	Either	Arthritis	> 18 years	NR			x		
Jensen 2014 [42]	Mother	Mixed	6–11 years	131		x			
*Jones 2004 [43]	Either	Mixed	12–15 years	1293	x				
Kaasboll 2012 [44]	Either	Mixed	13–18 years	3227			x		
Koutantji 1998 [48]	Either	Mixed	18–51 years	180	x				
Kovacs 2003 [49]	Either	Back pain	13–15 years	7361	x				
*Lin 2010 [51]	Mother	Arthritis	Newborn	11472		x			
Logan 2008 [53]	Either	Mixed	0–17 years	258313		x			
*Norgaard 2010 [62]	Mother	Arthritis	Newborn	871579		x			
*O'Sullivan 2008 [63]	Either	Back pain	14 years	1608	x				

First Author & Year	Parent with Pain	Type of Parental Pain	Offspring Age Range	Number of Offspring	Offspring Outcomes Measured				
					Pain	Health	Psych	Family	Other
Ramchandani 2006 [65]	Either	Mixed	6 years	8272	x				
*Saunders 2007 [72]	Mother	Mixed	11–17 years	2466	x				
Thomas 1992 [79]	Either	Mixed	> 18 years	141	x				
*Wallenius 2011 [88]	Mother	Arthritis	Newborn	1800827		x			
*Wallenius 2014 [87]	Mother	Arthritis	Newborn	627138		x			
Wilson 2014 [89]	Either	Mixed	11–14 years	173	x				
Wolff 2009 [90]	Mother	Mixed	14 months	275	x				
Clinical									
Aguas 2011 [2]	Either	IBD	> 18 years	n_p = 74	x				
Bowden 2001 [14]	Mother	Arthritis	0–8 months	n_p = 133, n_c = 103		x			
Buskila 1996 [18]	Mother	FM	5–46 years	n_p = 58	x				
Buskila 1997 [17]	Mother	FM	> 8 years	n_p = 67, n_c = 310	x				
Chaturvedi 1988 [19]	Either	Mixed	10–15 years	n_p = 36	x		x		
*Chun 1993 [23]	Either	Mixed	6–16 years	n_p = 35, n_c = 29			x		x
*Dura 1988 [25]	Mother	Mixed	7–13 years	n_p = *7* n_c = *14*		x	x	x	x
*Evans 2007 [26]	Either	Mixed	6–12 years	n_p = 24, n_c = 12	x	x	x		
*Evans 2007 [27]	Mother	Mixed	6–12 years	n_p = 55, n_c = 48	x	x	x		
*Evans 2006 [28]	Mother	Mixed	6–12 years	n_p = 55, n_c = 48		x	x	x	
*Hirsch 1985 [35]	Either	Arthritis	12–18 years	n_p = 16, n_c = 16			x		x
Hirsch 1985 [36]	Either	Arthritis	12–18 years	n_p = 16, n_c = 16					x
Hudson 2004 [39]	Either	FM	> 18 years	n_p = 109, n_c = 53	x		x		
Jamison 1992 [41]	Either	Mixed	6–18 years	n_p = 42,	x	x			x

					Offspring Outcomes Measured				
First Author & Year	**Parent with Pain**	**Type of Parental Pain**	**Offspring Age Range**	**Number of Offspring**	**Pain**	**Health**	**Psych**	**Family**	**Other**
				n_c = 55					
Kalantar 2003 [45]	Either	IBS	> 18 years	n_p = 97	x				
Messinger 1991 [56]	Either	Headaches	> 18 years	n_p = 247, n_c = 279	x				
*Mikail 1990 [57]	Either	Mixed	9–17 years	n_p = *24* n_c = *30*	x	x	x	x	
Raphael 1990 [66]	Mother	TMPDS	NR	n_p = *NR* n_c = *NR*		x			
Rickard 1988 [68]	Father	Back pain	8–12 years	n_p = *21* n_c = *21*	x		x		x
Roy 1994 [69]	Either	Mixed	5–18 years	n_p = 31			x		
Saito 2010 [70]	Either	IBS	18–70 years	n_p = 357, n_c = 195	x				
Smith 1998 [76]	Either	Migraine	0–17 years	NR					x
*Smith 2006 [75]	Either	Headaches	8–15 years	n_p = 52, n_c = 23			x	x	
*Turner Cobb 1998 [80]	Either	Arthritis	4–16 years	n_p = 25, n_c = 53		x	x		x
Zelkowitz 2013 [92]	Either	Arthritis	1.5–18 years	n_p = 29			x		
Qualitative									
*Evans 2008 [29]	Mother	Mixed	6–12 years	n_p = 21					
*Umberger 2013 [84] *Umberger 2014 [83]	Either	Mixed	18–21 years	n_p = 30					

Note. indicates that the study was included in the meta-analyses or meta-ethnography. IBD = inflammatory bowel disease; FM = fibromyalgia; IBS = irritable bowel syndrome; NR = not reported; n_p = number of offspring in parental pain group; n_c = number of offspring in control group; TMPDS = temporomandibular pain and dysfunction syndrome.

Table 2

Results of Meta-Analyses of Newborn Birth Outcomes

Outcome	Studies	Number of Participants	*OR*	95% CI	I^2
Low birthweight	5	672408	1.35	[1.13, 1.60]	59%
Small for gestational age	6	2447410	1.24	[1.08, 1.42]	63%
Preterm delivery	8	2486221	1.59	[1.28, 1.97]	83%
C-section	6	2447410	1.51	[1.25, 1.83]	90%
Apgar score below 7 at 5 minutes	3	2071095	1.16	[0.82, 1.62]	0%
Perinatal mortality/stillbirth	3	1464898	2.03	[1.29, 3.20]	0%
NICU admission	3	1534893	1.69	[1.01, 2.81]	75%
Congenital abnormalities	3	1464898	1.22	[0.91, 1.64]	18%
Instrument assisted delivery	3	1534893	1.55	[0.82, 2.92]	88%

Note. *OR* = odds ratio; CI = confidence interval