Best Practice & Research Clinical Rheumatology 30 (2016) 1021–1036

Contents lists available at ScienceDirect

Best Practice & Research Clinical Rheumatology

journal homepage: www.elsevierhealth.com/berh

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The prevalence, risk factors, prognosis and treatment for back pain in children and adolescents: An overview of systematic reviews

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Keywords:
Back pain
Children
Adolescents
Paediatric
prevalence
Risk
Prognosis
Prevention
Treatment

A B S T R A C T

Emerging data suggest that back pain in adolescents is responsible for a substantial disability burden and consumes considerable healthcare services. Of further concern is the fact that back pain during this period of life may have health implications in adulthood. Given this, understanding the epidemiology and clinical evidence base relevant to clinicians and researchers in the field of musculoskeletal health is crucial. This chapter provides an overview and synthesis of systematic reviews that address important questions related to back pain in children and adolescents:

- What is the prevalence of back pain in children and adolescents?
- What are the risk factors?
- What is the clinical course and what are the prognostic factors?
- Which are the most effective preventative interventions and clinical treatments?

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http://dx.doi.org/10.1016/j.berh.2017.04.003
1521-6942/

Introduction

While the enormous disability burden of back pain in adults is well documented [1,2], the consequences of the condition in children are not so well acknowledged. Yet there is a good reason for concern about the effect of back pain in children and adolescents worldwide. In 2015, back and neck pain ranks 9th in years lived with disability in 10- to 14-year-olds and 4th in 15- to 19-year-olds (GBD data viz), in the latter case ahead of much higher high profile 'non-communicable' conditions such as cancer and anxiety disorders. In contrast to a perception that back pain in children is generally transient and trivial in terms of impact on individuals, evidence suggests that prevalence is high [3], and a substantial minority of children who report back pain are significantly impaired by their pain. A large number of children seek care for their back pain [4], miss school or work [5], or miss out on sport and physical activities [6].

Unsurprisingly, the high prevalence and care-seeking translate into a substantial financial burden for society. A study in the US estimated the annual cost of chronic pain in adolescents aged 10–17 years, of which musculoskeletal pain comprised the largest proportion, was $19.5 billion [7]. A large survey in Germany estimated a minimum figure for direct costs for the treatment of people under the age of 25 with back disorders of €100 million per year [8]. Although data documenting the costs associated with children's back pain are sparse, they appear to be substantial, meaning investigation into prevention and treatment is worthwhile from an economic perspective.

Of further concern are the links between back pain and lifestyle-related risk factors, including smoking [9], alcohol and substance use [10] and overweight [11]. The question of whether the relationships between back pain and these indicators of poor health are causal in one direction or in another direction has not been answered, but the links are of concern nonetheless. This evidence suggests that back pain may play a part in a picture of overall poor health and adverse health risk in adolescents. The concern is that just as health-related behaviours track from adolescence into adulthood [12], so will the experience of back pain and its associated disability burden.

Studies that examine the nature of back pain across the life-course point to the importance of understanding the condition as it presents in childhood. Epidemiological studies conducted in adult populations characterise back pain as a recurrent condition [13], and the most consistent risk factor for an episode of back pain is having had a previous episode [14]. In the few longer-term cohort studies conducted, the presence of long-term back pain in adolescents appears to increase the risk of chronic pain in adulthood [15,16]. On the basis of these considerations, it follows that exploring back pain at the time of its earliest presentation may be of value.

The conception of back pain in children and adolescents has undergone a large change on the past 15–20 years. Report of back pain in childhood was previously considered rare and a sign of serious underlying pathology, in fact several clinical practice guidelines include 'age under 20 years' as a red flag for back pain assessment [17]. However, more recent studies have indicated that the condition is common, and it is usually not possible to diagnose a specific patho-anatomical cause for the pain [18]. While popular clinical and media explanations portray back pain as a consequence of biomechanical or ergonomic influences, implicating backpacks, computer/device use and posture, research increasingly identifies a range of psychological and social risk factors as well [19]. To further advance the understanding of paediatric back pain, it is clear that a broader view of the influencing factors and management approaches is required. Drawing on paradigms such as the biopsychosocial model used in the adult field to frame understanding of paediatric back pain, particularly chronic pain, may be a useful initial step [20].

The aim of this article was to present a 'state-of-the-art' for back pain research in children, as represented by systematic reviews relevant to various aspects of the condition. The findings of published systematic reviews that addressed the questions below were synthesised to summarise the current understanding and identify gaps in knowledge.

- What is the prevalence of back pain in children?
- What are the risk factors?
- What is the clinical course, and what are the prognostic factors?
- Which are the most effective preventative interventions and clinical treatments?

Methods

MEDLINE, Embase and the Cochrane Database of Systematic Reviews were searched in January 2017 for systematic reviews that relate to the above questions. Search terms for back pain and paediatric studies were taken from two recent Cochrane systematic reviews [21,22]. These were combined with the Ovid filter for review articles (see Appendix 1 for search strategy).

Search results were screened, and full text copies were retrieved for those not clearly ineligible on the basis of title or abstract. The process was repeated with full text articles, and decisions were made regarding eligibility. Hand searches were conducted of the reference lists of all included reviews and records of the author team.

Studies were included if it was a systematic review published in a peer-reviewed journal, included people 18 years old or under (or reported separately on this age group), reported on non-specific back pain. Studies were excluded if they reported on back pain due to cancer, systemic, infectious or inflammatory disease, fracture, acute neurological condition, included subjects post-surgery, reported on patients with scoliosis or thoracic pain.

Quality of the included studies was rated using the AMSTAR instrument [23], and the quality rating was used in the data synthesis process to inform the conclusions of this review. Data relevant to the research questions were extracted from the included systematic reviews. Because of methodological and clinical heterogeneity, meta-analysis was not possible; therefore, the extracted data were synthesised qualitatively using the AMSTAR ratings to give greater weight to the findings from higher quality reviews.

Results

Included studies

Electronic searches identified 1887 articles, and hand searches identified further two records. After screening titles and abstracts, the full text of 63 articles were retrieved; of these, 27 studies were eligible. The results from these systematic reviews provided the source data for this paper (see Fig. 1). Most of the articles excluded at the full-text stage were not eligible because they were not systematic reviews.

The systematic reviews included between 5 and 63 primary studies; inclusion criteria and number of participants varied widely depending on the study question, for example population-based studies assessing prevalence and risk factors included total participant numbers >100,000 [11,24], and reviews of treatment studies included total numbers in the hundreds [25,26]. Most studies focused on participants above the age of 10 years, which means that the findings presented here are most applicable to adolescents, rather than to younger children. Selected characteristics of the included systematic reviews are presented in Table 1.

We defined thresholds for total AMSTAR scores to designate low (0–3), moderate (4–6) and high (7–11) quality reviews. The quality of the included studies was mixed; 11 reviews were low quality, seven moderate and nine scored high quality (Table 2). Sixteen of the included reviews were published in 2010 or later.

Prevalence and incidence

Studies

Nine systematic reviews reported estimates of prevalence of back pain in children [24,27–34]; among those nine reviews, two were high-quality, two were moderate quality and four were low-quality. Most of the primary studies were large cross-sectional studies, and the total number of participants in the included reviews ranged from 31,690 to 125,483 participants. Prevalence estimates were more commonly collected from adolescent populations (>10 years) than from younger children.

Results

Prevalence estimates ranged widely due to differences in study population, definition of back pain, study design and prevalence period. Point prevalence estimates ranged from 3 to 39%, although most

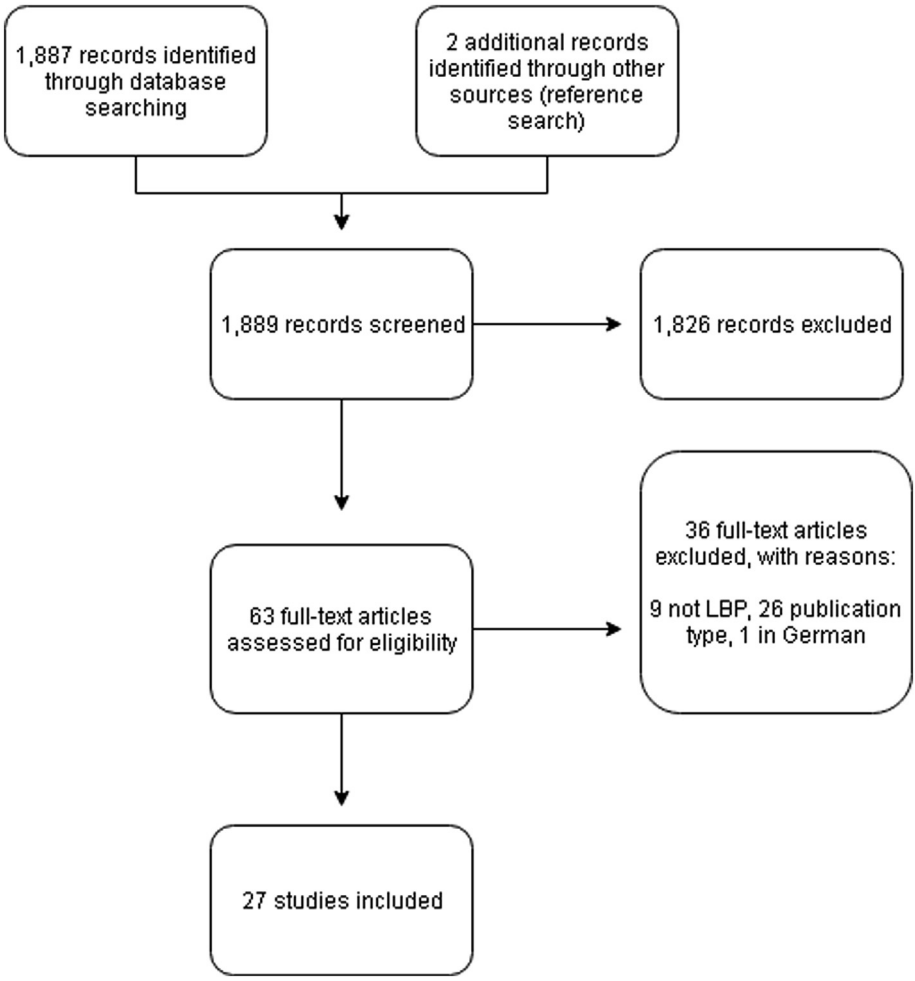

Fig. 1. Flowchart of the inclusion process.

estimates were in the range of 10–14%. Monthly prevalence ranged from 10 to 36%, with estimates in the range around 18–24% from high-quality reviews. Lifetime prevalence estimates ranged from 7 to 72%, the mean from the high-quality study was 40%. Two low-quality reviews reported annual incidence estimates of 15% and 12–33%, respectively.

There were also estimates of the prevalence of care-seeking in the range of 2–31% from two reviews, and estimates of chronic back pain in the range of 5–12% from one review.

Several of the reviews noted the pattern of increasing prevalence with age [24,29,32,34,35]. More specifically, the time of increase was noted at around 11–12 years of age [27–29,35] or after the onset of pubertal development [36,37]. It was noted that prevalence at the end of adolescence approaches that in adulthood [29,30].

Conclusions

As might be expected, reported prevalence estimates in primary studies and therefore systematic reviews covered a large range. In drawing our conclusions, we considered all the reported data but weighted those from the high-quality studies. The fact that doing so resulted in a sensible increase

Table 1
Characteristics of the included systematic reviews.

Included studies	Number of included studies	Type of included studies	Number of participants	Age in years	Inclusion criteria
Prevalence					
Balague 1999	17	15 x-sect 2 longit	NR	NR	NR
Calvo-Munoz 2013b	59	52 x-sect 7 longit	125,483	mean 13.6 range 9–18.4	- Observational studies, prevalence of LBP in participants (≤18 years) - Sample size with at least 50 participants - 1980–2011, in English, French, Italian, Spanish or Portuguese
Duggleby 1997	11	11 x-sect	NR	NR	NR
Hoy 2012	NR	NR	NR	NR	- Published from 1980 to 2009 - Prevalence LBP reported
Jeffries 2007	55	43 x-sect 12 longit	NR	range 4–19	- Any type of spinal pain
King 2011	32	NR	NR	range 0–18	NR
Louw 2007	27	23 x-sect 4 retrosp	31,690	range 11–19	- Epidemiological research - Conducted on the African continent, published in English or French - Prevalence of LBP in adolescents and adults (any race and any gender)
Smith 2007	15	NR	NR	NR	- Specific information on LBP
Hill 2009	35	23 x-sect 10 longit 1 retrosp 1 x-sect & longit	39,635	range 6–17	- Cross-sectional, retrospective or prospective methods in English - Participants aged 7–18 years from a general population - Data about the age of onset of LBP in children - Data about the prevalence of LBP in children - Report the number of participants at each age who experience LBP
Risk Factors					
Cardon 2004	risk: 44 intervention: 5	NR	NR	NR	- Studies investigating preventive interventions in schoolchildren or modifiable risk factors for LBP in schoolchildren
Dockrell 2013	18	18 x-sect	NR	range 6–18	- Schoolbag weight
Hill 2010	5	5 longit	2706	range 4–14	- Prospective cohort studies, RCTs or any longitudinal quantitative design - Participants aged 18 years or younger; - Outcomes: onset of LBP associated with a previously measured factor, LBP and any recall period are clearly defined, LBP does not develop as a result of serious pathology, as defined by red flags
Huguet 2016	36	21 longit	40,404	range 0–18	- Published prospective or retrospective longitudinal study with at least 3-month follow-up - Quantitatively investigated factors present at age 5–18 years associated with onset of MSK pain or the prognosis of MSK pain, defined in terms of persistence of pain or MSK pain-related disability
Lardon 2014	5 Studies	3 x-sect 2 longit	8034	range 11–17	- Longitudinal and cross-sectional studies, published in English or French - Children and/or adolescents below the age of 19 - Target condition was back pain
Lardon 2015	8	6 x-sect 1 longit 1 retrosp,	NR	NR	- Longitudinal, retrospective or cross-sectional design - In English or French - Study population below the age of 20, sample size >100 at baseline

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Table 1 (*continued*)

Included studies	Number of included studies	Type of included studies	Number of participants	Age in years	Inclusion criteria
Lauchlan 2005	17	NR	NR	NR	- RCTs, at least 80 subjects - Acute or recurrent LBP, at least 1 year follow-up, relevant to primary care
Lindstrom-Hazel 2009	63	NR	NR	NR	NR
Morton 2014	11	NR	NR	range 14–23	- Cricketers, any standard of cricket, any age, male or female, in English - LBP-relevant outcome measure, intrinsic factors (i.e. bowling technique/ physiology characteristics) linked to LBP or intervention studies aimed at treating and/or preventing LBP
Paulis 2014	40	33 x-sect 7 longit	1,109,055	range 2–19	- Association of BMI or weight status and MSK complaints - Children between 0 and 18 years of age, without systemic disorders - Cross-sectional or longitudinal, with a non-MSK complaints comparison - In English, French, German, Swedish or Dutch
Shiri 2010	40	27 x-sect 13 longit	362,579 (incl. meta-analysis)	range 11–79	- Cohort, case-control or cross-sectional design - Solely clinical populations, case-control studies with controls derived from the patient populations, sample size <30 and follow-up rate <60% or not reported were excluded
Sitthiporn 2011	17	12 x-sect 5 longit	NR	NR	- Cross-sectional or cohort study, published in English - Study samples were representative of a general population - Reported association between physical activity and neck or back pain
Trevelyan 2006	NR	NR	NR	range 11–14	NR
Balague 1999, Calvo-Munz 2013b, Duggleby 1997, King 2011, Louw 2007, Smith 2007					Described above
Course/Prognosis					
Huguet 2016, Lindstrom-Hazel 2009					Described above
Prevention and Treatment					
Calvo-Munoz 2012	23	NR	4423	mean 11.3	- Physical therapy treatment for prevention of LBP - Participants from a nonclinical population aged below 19 years - Include treatment and control groups, n > 5 per group - Report sufficient statistical data to calculate the effect sizes - In English, Spanish, French, Italian, Portuguese and Catalan
Calvo-Munoz 2013a	8	3 RCTs 3 non-RCTs 1 longit 1 case series	334	mean 14.1 range 11–18	- Physical therapy treatment for children aged 6–18 year with LBP - One or more treatment groups, with or without a control group - Report sufficient statistical data to calculate the effect sizes - In English, Spanish, French, Italian and Portuguese
Hestbaek 2010	4	2 RCTs 2 longit	NR	NR	- Randomized, quasi-randomized and non-randomized clinical studies - Participants 2–18 years of age, with musculoskeletal disorders; - Published in English, Danish, Swedish or Norwegian
Michaleff 2014	15	15 RCTs prevention: 11 treatment:4	3064 intervention: 364 prevention: 2700	Mean ~11.8	- RCTs that enrolled children or adolescents (0–18 years old) - Intervention outcomes: pain disability, global perceived effect or participation in daily activities - Prevention RCTs had to enrol children and adolescents with or without LBP and evaluate strategies to prevent the onset or development of LBP. Prevention outcomes: LBP prevalence, intensity or disability
Cardon 2004, Morton 2014, Steele 2006					Described above

*NR=Not reported; x-sect = cross-sectional; longit = longitudinal cohort; retrosp = retrospective; RCT = randomised controlled trial.

Table 2
Quality of the included systematic reviews according to the AMSTAR tool.

Included Studies	Total Score	Item 1 A priori design provided?	Item 2 Duplicate study selection and data extraction?	Item 3 Literature search performed?	Item 4 Status of publication used as an inclusion criterion?	Item 5 List of studies (included and excluded) provided?	Item 6 Characteristics of the included studies provided?	Item 7 Scientific quality of the included studies assessed and documented?	Item 8 Scientific quality of the included studies used appropriately in formulating conclusions?	Item 9 The methods used combine the findings of studies appropriate?	Item 10 The likelihood of publication bias assessed?	Item 11 Conflict of interest stated?
Balague 1999	0	−	−	−	−	−	−	−	−	−	−	−
Calvo-Munoz 2012	9	−	+	+	+	−	+	+	+	+	+	+
Calvo-Munoz 2013a	9	−	+	+	+	−	+	+	+	+	+	+
Calvo-Munoz 2013b	9	−	+	+	+	−	+	+	+	+	+	+
Cardon 2004	2	−	−	+	−	−	+	−	−	−	−	−
Dockrell 2013	2	−	−	+	−	−	+	−	−	−	−	−
Duggleby 1997	0	−	−	−	−	−	−	−	−	−	−	−
Hestbeak 2010	3	−	+	+	−	−	+	−	−	−	−	−
Hill 2009	4	−	−	+	−	−	+	+	+	−	−	−
Hill 2010	3	−	−	+	−	−	+	+	−	−	−	−
Hoy 2012	4	−	−	+	−	−	−	+	+	+	−	−
Huguet 2016	8	+	+	+	−	−	+	+	+	+	−	+
Jeffries 2007	3	−	−	+	−	−	+	−	−	−	−	+
King 2011	7	+	+	+	−	−	+	+	+	−	−	+
Lardon 2014	6	−	−	+	−	+	+	+	+	−	−	+
Lardon 2015	5	+	−	+	−	−	+	+	−	+	−	−
	1	−	−	+	−	−	−	−	−	−	−	−

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Table 2 (*continued*)

Included Studies	Total Score	Item 1 A priori design provided?	Item 2 Duplicate study selection and data extraction?	Item 3 Literature search performed?	Item 4 Status of publication used as an inclusion criterion?	Item 5 List of studies (included and excluded) provided?	Item 6 Characteristics of the included studies provided?	Item 7 Scientific quality of the included studies assessed and documented?	Item 8 Scientific quality of the included studies used appropriately in formulating conclusions?	Item 9 The methods used combine the findings of studies appropriate?	Item 10 The likelihood of publication bias assessed?	Item 11 Conflict of interest stated?
Lauchlan 2005												
Lindstrom-Hazel 2009	2	−	−	+	−	−	+	−	−	−	−	−
Louw 2007	4	−	−	+	−	−	+	+	+	−	−	−
Michaleff 2014	7	−	+	+	−	−	+	+	+	+	−	+
Morton 2014	5	−	−	+	−	−	+	+	+	+	−	−
Paulis 2014	8	−	+	+	−	−	+	+	+	+	+	+
Shiri 2010	7	−	−	+	−	+	+	+	−	+	+	+
Sitthiporn 2011	6	−	−	+	−	−	+	+	+	+	−	+
Smith 2007	0	−	−	−	−	−	−	−	−	−	−	−
Steele 2006	8	+	+	+	+	+	+	+	+	−	−	−
Trevelyan 2006	2	−	−	+	−	−	−	−	−	−	−	+

from point, through monthly to lifetime prevalence, is some cause for confidence in the conclusions. Point prevalence of back pain for children is likely to be around 12%, monthly prevalence approximately 20%, lifetime prevalence approximately 40% and annual incidence is likely to be about 15%. These are mean rates, and given that prevalence increases through adolescence, they probably somewhat underestimate the situation in older adolescents.

Methodological considerations

Accurate estimates of prevalence require large, representative and population-based samples. Well-conducted cross-sectional and cohort studies, and coordinated multinational cross-sectional surveys such as the Health Behaviours in School-aged Children study [3] serve the purpose. The existence of these studies means that reliable estimates of the back pain prevalence in children are available. Challenges to interpretation come from inconsistency in how the condition is defined and different sampling frames; the latter is an issue due to steadily increasing prevalence between the ages of 12 and 18 years.

Gaps in knowledge

Having an agreed definition of an episode of back pain is necessary for interpretable and comparable epidemiological research. While there have been efforts to propose standard outcome measures for pain in children [38], and moderately successful attempts to establish consensus in adult populations, there is no consensus on what constitutes 'back pain' in children. In adults, acute back pain often resolves quickly [39] and has limited impact for many people; thus, there is a reason to think that the same is true for children and adolescents. It is notable that few of the systematic reviews (and primary source studies) attempt to understand the prevalence or incidence of pain with important consequences, these might include missing school, interruption of day-to-day activities, interference with sport or physical activity, care-seeking or use of medications [5]. There are few estimates of back pain that have important consequences in children and adolescents.

Risk factors

Studies

Fifteen systematic reviews reported data on the associations between risk factors and back pain in children [11,27,28,32–36,40–46]. Among these 15 systematic reviews, four were high quality, three were moderate and eight were low quality. The total number of participants in the included reviews ranged from 2706 to 1,109,055 participants. Most reviews investigated a large range of factors, but some reviews searched only for specific risks such as backpacks [41], muscle function [36], overweight [11], smoking [45] or physical activity [46]. It is noted that there is an important distinction between risk factors that are simply predictive for back pain, and risk factors that play a causal role in the development of the condition. Cohort studies commonly describe risk factor–outcome relationships in causal terms despite regardless of whether the study design is suited to establishing such a relationship. Because many primary studies do not adequately address the issue in their design or interpretation, we could not draw a distinction between these two types of risk factor in this overview.

Results

Several reviews reported on the association between gender and back pain. Four reviews found that girls were more likely to report back pain [33–35,44], two reviews reported (one high quality) the same relationship but noted that not all primary studies were in agreement [27,32] and one high-quality review reported an unclear relationship [43].

Several reviews also investigated the relationship between anthropometric factors and back pain. Three low-quality reviews found that the relationship between height and back pain was unclear [27,28,35], but one high-quality review [43] found that taller children were at higher risk. Five reviews assessed weight or BMI; one high-quality review reported an association [11], two low-quality reviews reported an unclear relationship [27,40] and one low-quality and one high-quality reviews reported no relationship [42,43].

Six reviews, including one high quality [43], reported an association between psychosocial factors or psychological distress and back pain in children. In terms of physical factors, eight reviews assessed one or more of muscle strength, mobility/flexibility or posture [27,28,34–36,40,42,43]. Most reviews reported unclear associations with back pain, and the one high-quality review [43] reported no relationship with hypermobility.

With regard to health-related behaviours, three low-quality reviews [27,28,35] reported an association between competitive or high-level sport and back pain. Moderate quality reviews reported an unclear association with physical activity [46] and aerobic fitness [36], and a low-quality review [34] reported a relationship between sitting and back pain. The three low-quality reviews reached different conclusions regarding the relationship between screen time/TV and back pain: finding an association [34], an unclear relationship [35] and no relationship [42]. Five reviews, including two high quality [43,45], reported smoking to be a risk factor for back pain, and one low-quality review reported an unclear relationship.

Seven reviews [27,34,35,40–42,44] investigated the use, weight or type of school bag, particularly backpacks. These reviews most commonly reported that the association between backpacks and back pain in school children is unclear. Two low-quality reviews [27,28] reported that parental experience of back pain was a risk factor for children, and one moderate [33] and one low-quality [34] reviews found that a previous episode of back pain was a risk factor.

Conclusions

Findings regarding most of the risk factors for back pain in children were mixed. There is good evidence to show that psychological distress and psychosocial factors increase the risk of back pain in children. Girls appear to be at higher risk of reporting back pain than boys, but some inconsistency between primary studies is noted. Children who smoke are also at higher risk of experiencing back pain. Physical factors such as muscle strength, flexibility and posture do not seem to be related to back pain, but it is unclear whether taller children and those who engage in more or less physical activity are at greater risk. There is no good evidence that high-profile factors such as backpack use and weight, and increased screen time elevate the risk for back pain in children, and the association between overweight and back is unclear.

Methodological considerations

There are several issues that make synthesis of research investigating risk factors difficult. Researchers make choices on which risk factors they choose to include in their assessment protocol. Practical constraints mean that they may not necessarily include all relevant constructs. The lack of consensus on what are the most important factors to measure was noted by Huguet [43] who found that of 65 risk factors measured in the studies included in their review, 40 risk factors were measured in just one cohort; Hill [42] identified a similar problem. Possibly of greater impact is the unknown influence of reporting bias; of particular concern is the situation whereby authors report significant associations but do not report non-significant findings. Primary studies included in the systematic reviews also vary in terms of methods; an important example is the inclusion of both cross-sectional and longitudinal studies. Most of the primary studies in the systematic reviews involved the analysis of cross-sectional data, while only very few reviews specified longitudinal studies [42,43]. Data from cross-sectional studies are generally poorly suited to determining risk. Another example is heterogeneity with regard to the ways in which risk factors and outcomes are measured; this thus introduces imprecision in the systematic review.

Gaps in knowledge

The factors that predispose children to back pain remain quite unclear; a consequence of this is that we understand very little about the pathology of the condition itself. The methods for designing good quality studies to investigate risk factors are well established, but these studies are costly and logistically difficult. Many risk factor studies in paediatric back pain are conducted on cohorts (or cross-sectional samples) that are assembled for another purpose, e.g. general health or well-being studies [9,47,48]. This means that investigation of risk factors is dependent on methods and

measures designed for a different purpose. Comprehensive, long-term longitudinal studies in the area are needed.

Course/prognosis

Studies

Only one systematic review explored the literature related to prognosis of back pain in children [43], this was a high-quality review. The review identified only four primary studies that addressed this question (within a larger review of all musculoskeletal conditions). None of the studies provided data regarding the natural or clinical course of back pain in children.

Results

The review concluded that the quality evidence for prognostic factors was very low for all those studied. They reported that the influence of sex, high baseline disability levels and BMI was unclear.

Conclusions

There is too little published information to make confident conclusions regarding factors that influence prognosis of children with back pain.

Methodological considerations

Inception cohort studies that recruit children with back pain are needed to inform likely prognosis and prognostic factors. Such studies have been conducted in adult populations; for example, a systematic review published in 2012 included 11 cohorts with over 11,000 participants in total [39], but no equivalent body of work exists in children.

Gaps in knowledge

In the absence of good quality information regarding prognosis and prognostic factors, it is difficult to know who requires specific care and attention, as opposed to those likely to recover quickly and fully without intervention. Such information is needed because it is important that clinicians and researchers in the paediatric area do not 'medicalise' normal sensations that would otherwise have no significant functional, psychological or social impacts. Reliable prognostic information is arguably just as important as reliable diagnostic information [49]. Knowing when to act and when not to for back pain could have a profound impact on short and longer term outcomes.

Prevention and treatment

Studies

Three systematic reviews evaluated studies of preventative interventions [26,50,51], all were high-quality reviews; four systematic reviews evaluated treatments of children with back pain [25,26,40,52], of them two were high-quality reviews. A larger number of prevention studies were included than treatment studies, and the former typically included much larger sample sizes. For example, reviews by Calvo-Munoz [25,50] reported on 4423 participants in included prevention studies, and 334 in treatment studies, and Michaleff [26] reported on 2700 participants in included prevention studies, and 364 in treatment studies, respectively.

Results

A feature of the primary studies that assessed the effectiveness of preventative interventions was that most focussed on back care knowledge or observed behaviours as their primary outcome. Two high-quality reviews reported that school-based interventions involving education and postural advice improved knowledge and may have an effect on behaviours such as manual handling. The two high-quality reviews that assessed pain prevalence found that preventative interventions were either ineffective or marginally effective.

With regard to treatment studies, two high-quality reviews [25,26] found that interventions involving physical conditioning or exercise are effective in reducing back pain, and the effect sizes appear clinically meaningful. Two low-quality reviews found no evidence regarding the effectiveness of manual therapy interventions [52] and conflicting evidence for educational interventions [40].

Conclusions

The best available evidence suggests that educational interventions are effective in improving knowledge about back care, but probably do not have an effect in reducing back pain. Interventions for children with back pain that involve exercise and education are likely effective in reducing pain when compared to home exercise advice or no treatment. It is noted that the quality of this evidence is not strong mainly due to the small number of treatment studies that have been conducted in this population.

Methodological considerations

It is striking that very few studies aimed at reducing prevalence of back pain in children (prevention studies), actually measure pain prevalence as an outcome. Michaleff [26] included 11 RCTs of prevention in their review, and only four reported the effect on pain prevalence. Studies that do not measure critical, patient-relevant outcomes have very limited capacity to inform preventative efforts in this field.

Several of the systematic reviews assessing treatment interventions included non-randomised and, in several cases, uncontrolled studies. Uncontrolled studies do not provide good quality evidence regarding treatment effectiveness, and their inclusion introduces bias into effectiveness estimates. Of the RCTs included in the systematic reviews, only one had a sample size of more than 100; this means that estimates of the effectiveness of interventions will be imprecise.

Gaps in knowledge

The paucity of randomised trials evaluating the effectiveness of preventative and treatment interventions is a barrier to providing evidence-based care to children with back pain. Two recent, high-quality reviews of treatment identified only four RCTs with a total sample of 364 participants. The lack of research activity in this area is completely out of proportion with the prevalence and burden of the condition [53] and contrasts with the number of studies conducted on the condition in adults. This evidence gap means that clinicians responsible for treating children with back pain must rely on lower quality forms of evidence to guide their practice.

Ongoing research

To understand whether we can expect new developments in the field in the near future, we conducted a search of the WHO Clinical Trials Registry. The search aimed to identify new clinical studies investigating back pain in children and adolescents. The search used terms to identify studies in children and adolescents in the title field and terms to identify back pain in the condition field (see Appendix 1). It may be that clinical trials that are not registered are underway and hence missed in this search, but given that most high-quality journals will now only publish prospectively registered studies, it could be argued that all the best quality ongoing trials have been identified.

The search identified 12 registered studies; in six of these, the recruitment status was designated as 'Completed'. Studies included two large RCTs of prevention ($n = 750$ and $n = 700$), three treatment RCTs ($n = 237$; 185; 72), two longitudinal observational cohort ($n = 400$; 250), and five pilot studies with $n < 50$ participants. Although activity in the area is good news, seven currently and recently active clinical trials with the potential to inform practice is a very small number.

Discussion

Prevalence

This overview of systematic reviews paints a disappointing picture of the state of empirical data relevant to children and adolescents with back pain. A substantial body of research is available only for

defining prevalence. Prevalence is low in children under 10–12 years but begins to rise quickly from that point on; this increase coincides with the onset of puberty. By late adolescence, the prevalence of back pain approximates that in adults.

Risk

There are major issues with the research exploring risk factors for back pain in children and adolescents. Most of the published studies are of cross-sectional design; this is particularly problematic because plausible hypotheses can be made for causal relationships in both directions for many of the identified factors. Longitudinal cohorts have been assembled, but in most cases, back pain is not a primary focus; this means that choice of exposure variables, measurement instruments and timing of data collection are not optimal to untangle causal relationships. The problem is compounded by lack of consistency between studies in terms of which factors are explored; this means that initial hypotheses are rarely validated.

Understanding risk in children holds considerable promise in reducing the overall burden of back pain. Back pain typically follows a recurrent course throughout the lifespan [54], and the risk factor most consistently associated with the onset of back pain is having had a previous episode [14]. Given the high prevalence in adolescence, it is likely that a substantial proportion of people experience their first episode during this period; this being the case, it might be that intervention during adolescence offers the only opportunity for true primary prevention. This contention is reinforced by evidence which links back pain in adolescence with back pain in adulthood [16].

Prognosis

The volume of research that has been directed in understanding the prognosis of back pain in children is very small; there are only a handful of cohort studies, of which few were specifically designed to investigate this question. Consequently, we have little idea on the natural or clinical course of the condition or which factors are indicative of poor prognosis. The dearth of research on prognosis presents two critical problems for clinicians responsible for paediatric patients with back pain. They have little information to advise their patients on the likely course of symptoms, and there is no empirical basis for identifying who is at risk of poor outcome (and hence in need of treatment) and who will likely recover without extensive intervention.

Prevention and treatment

While there have been numerous RCTs that evaluate the effectiveness of preventative interventions, including reasonable samples, disappointingly few report pain prevalence. Recent decades have seen an increasing prioritisation of patient-relevant outcome in clinical research, but this is not reflected in the many prevention studies that specify back care knowledge, or manual handling skills as their primary outcome. Evaluation of the effectiveness of an intervention aimed at preventing back pain requires measurement of back pain. Recent systematic review evidence suggests that a combination of exercise and back-specific education may be effective in reducing back pain prevalence in adults [55], this appears the most promising option in children as well.

There are very few RCTs testing the effectiveness of treatments for back pain in children, this contrasts with the situation in adults where hundreds have been conducted. The limited evidence available suggests that exercise interventions hold promise, but the size of the effect is unclear and the quality of the evidence is low. Large, well-conducted trials of treatment effectiveness are urgently needed to assist clinicians in making management decisions.

Conclusion

Despite the fact that back pain in children and adolescents is unequivocally both burdensome in the present and indicative of a significant future health risk, research investment to date has been inadequate. The growth of US National Institutes of Health research funding in the paediatric area generally has not matched that for adult conditions [56] nor has the number of RCTs in paediatric populations published in the major general medical journals [57]. Our search of the WHO Clinical Trials Registry returned 20,848 entries when we specified paediatric terms, but only 12 when the back pain terms were added. There are no available data specifically applicable to back pain in children, but public research funding for musculoskeletal pain lags well behind that for other health conditions [58].

The findings of this review point to problems related to the volume and quality of research on back pain in children and adolescents. The deficiency in research on children with pain has been recognised previously, and numerous authors have called for more activity in the area [59–61]. It is not clear why the area is underserved, perhaps due to real or perceived difficulties regarding gaining ethical approval for research on children, perceptions about the lack of importance of pain in young people, or logistical issues concerning access and assent/consent. Regardless, it is apparent that research output is mismatched to the burden of the condition, and that clinicians working with children have little good quality research to inform their practice.

Practice points

- Back pain prevalence is low in children but rises quickly during adolescence
- Smoking and psychosocial factors are most consistently associated with back pain, but whether they are a cause or consequence is not certain
- Prevention and treatment interventions that include an exercise component are most likely to be successful, but there is little good quality evidence to support the effectiveness of any interventions

Research agenda

- Large-scale inception cohort studies are needed to chart the course of back pain in adolescents and identify prognostic factors
- Well-powered and conducted RCTs are needed to investigate the effectiveness of simple interventions in reducing the effects of back pain such as school absence, interference with daily activities and sport, and medication use. Ideally, these are targeted at adolescents at risk of poor outcome

Funding

No funding was received for this study.

Conflicts of interest

The authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.berh.2017.04.003.

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