Epidemiology of Non-Specific Back Pain in Children and Adolescents: a Systematic Review of Observational Studies

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Abstract

Objectives: The aim of this study was to determine the prevalence and incidence of NSBP, and to identify its predisposing factors in children and adolescents. Study Design: Systematic review.

Materials and methods: A review of English articles was performed between 2005 and March 2012 using the following databases: PubMed, CINAHL and Web of Science. Inclusion criteria: published in peer-reviewed journals, written in English, samples aged between 6 and 18 years, with NSBP, and contained information of prevalence, incidence or predisposing factors. Two independent reviewers were involved in all phases. The methodological quality was assessed, using a standardized instrument.

Results: From the 1087 studies identified, only 35 fulfilled the inclusion criteria. Their methodological quality showed an average score of 10, 32 out of 15. Great variability’s in the definition of NSBP and in reported prevalence periods were found. Meta-analysis suggest NSBP prevalence’s of 24, 33% (95%CI: 18, 22%-31, 7%) – last month; between 17, 4% and 51, 3% - last 3 months; between 15, 6% and 61, 1% - last 6 months, between 17, 1% e 54, 1% - last year. The results regarding the incidence of NSBP were not conclusive, nor was it possible to identify consistent and conclusive evidence in the associations between NSBP and the different analyzed factors.

Conclusions: The results presented in this study indicate a relatively high prevalence of NSBP in young population. There is a scarcity of studies concerning predisposing factors and also disagreements in the results. Further research is required, using prospective cohort designs.

Keywords: Back pain; Children/adolescents; Prevalence; Incidence; Predisposing factors; Systematic review

Introduction

Non-specific back pain (NSBP), defined as pain without specific cause or pathology [1], is a common complaint among young people that has been related with low back pain in adults [2]. Several studies have reported that the first symptoms of NSBP took place during childhood and adolescence, and continue into adulthood [2,3], with established associations between back pain in children and adults [4-6]. Recent research findings also showed that a great percentage of adults who search for health care services due to back pain, refer to having had pain episodes in their adolescence [2,3]. Accordingly, the history of back pain appears in the literature as a strong indicator of back pain in adulthood.

In the last decade research studies indicated that the prevalence of NSBP in the early stages of life has increased significantly and is now close to the percentage found in adulthood [4,7-10]. The most recent review of the incidence and prevalence of low back pain in the children and adolescents (aged 7-18 years) included 35 studies, and founded that the prevalence of pain varied between 7 and 62% [11]. A meta-analysis conducted by McBeth and Jones [12], reported a prevalence of low back pain in adolescents of approximately 33%. Moreover, the prevalence may be underestimated due to the absence of a specific diagnosis [13].

However, the specific contribution of each factor for back pain, the way they interact, the multifactorial nature of the NSBP, and the methodological flaws associated with the study designs such as the lack of longitudinal studies, has limited the knowledge of the causal relationship between predisposing factors and back pain [15].

Therefore to better understand the epidemiology of NSBP in children and adolescents, this systematic review aimed to identify the prevalence and incidence of non-specific back pain in children and adolescents, and to identify predisposing factors for NSBP.

Materials and Methods

This review followed the Meta-analysis of Observational Studies in Epidemiology group (MOOSE) recommendations for reporting meta-analyses of observational studies [16].

Three electronic databases were searched (PubMed- MEDLINE, CINAHL and Web of Science) using the following combination of keywords: (child* OR adolescent* OR schoolchild* OR student*) AND (thoracic spine OR dorsal spine OR lumbar spine OR back OR cervical spine) AND (pain OR discomfort OR back pain OR musculoskeletal...
disorder) AND (causality OR cohort study OR cross-sectional study OR epidemiology OR epidemiologic factor* OR follow-up study OR incidence OR incidence study OR prevalence OR prevalence study OR prospective study OR risk OR risk factor* OR survey) NOT (arthritis OR fractures OR scoliosis OR rheumatic disorders).

Inclusion criteria included articles published in peer-reviewed journals, in English language, between January 2005 and March 2012 as well as their reference lists. Titles and abstracts of eligible articles were independently screened by two reviewers (LR; MJ) using the following inclusion criteria:

1. The study design had to be a cohort, case-control, or cross-sectional.
2. Study samples should be aged 6 to 18 years, withdrawn from the general population, with NSBP. Samples from specific populations (e.g., practicing a specific sport, obese population or others) were excluded.
3. Non-specific thoracic, dorsal, upper back, mid-back or low back pain had to be assessed in the study. Studies that comprised only individuals with cervical and shoulder pain were excluded. Studies reporting back pain characteristics among a cohort of individuals with known pathologies (e.g. osteoporosis, fractures) or diagnosed structural deformities (e.g. scoliosis) were also excluded.
4. Studies had to report data at least one of the following parameters: prevalence, incidence, predisposing factors for back pain. Studies reporting lifetime prevalence were excluded because children easily forget the episodes of back pain and therefore it is considered unreliable [17,18].
5. The outcome of the studies should include the examination of associations between predisposing factors and the presence of back pain. Outcomes could be self-reported or clinically evaluated.

Disagreements between reviewers were resolved by consensus. When disagreement persisted, a third independent reviewer (EC) was consulted and a final decision was made. The full text of potentially relevant papers was then assessed against the same criteria. A flowchart of the selection process is shown in Figure 1.

**Study quality assessment**

Selected articles were evaluated for methodological quality, by two independent reviewers (LR; EC), using the Critical Review Form – Quantitative Studies [19]. Based on 15 dichotomous quality appraisal criteria (yes - 1/no - 0), there were assessed methodological bias (including, selection, measurement and confounding bias), clinical importance of the results, conclusions and implications for clinical practice.

A quantitative score was obtained by summing the total of 15 criteria. Disagreements between the reviewers on individual items were identified and discussed and a third reviewer (CN) was consulted if necessary.

**Data extraction and analysis**

Two independent reviewers (LR; CN) extracted the data using a
customized form. The extracted data consisted of: authors, study design, study population, participation rate, sample characteristics (size, age, nationality), outcomes, data collection tools, and study’s results (prevalence rate, correlations values between predisposing factors and back pain; and risk estimations). Data extraction was separately conducted for incidence and prevalence rates and for predisposing factors for back pain.

To conduct the meta-analysis, studies were grouped according to time prevalence in 1-month, 3-months, 6-months and 1-year prevalence, respectively. In what regards to pain location, the prevalence was estimated on the basis of the prevalence values related to pain in the back or any pain in the spine/back.

For each period of prevalence (one, three or six months, and one year) the differences in the duration of pain, or age intervals were not considered. When the prevalence was presented by gender or age, a global weighting prevalence was computed. Since episodes of back pain are easily forgotten by the children [17,18], statistical analyses of the association between back pain and risk factors were limited to 1 month prevalence of pain.

Statistical analysis

Extracted data was analysed for prevalence, incidence and predisposing factors, grouped by different time periods (1-month, 3 and 6 month and 1-year). When possible, study results were pooled in statistical meta-analysis using the Comprehensive Meta Analysis software 2.0 [20]. Heterogeneity was assessed through the Q statistics in statistical meta-analysis using the Comprehensive Meta Analysis software 2.0 [20]. Heterogeneity was assessed through the Q statistics and the I2 index, with the I2 representing the percentage of degree of variation among studies (0 means that heterogeneity was absent, and larger I2 indicates a higher probability of heterogeneity).

Fixed effects models were used to compute mean prevalence rates and 95% confidence intervals (95%CI). When heterogeneity was present random effects models were used. Publication biases were tested by the Funnel Plot and Begg’s and Egger’s tests.

When Meta-Analysis was not possible, because of the absence of information or due to heterogeneity between studies, a narrative synthesis of the findings was carried out.

Results

The literature search resulted in 1087 citations, but only 35 studies met the inclusion criteria and were included for full review and data extraction.

Study characteristics

Twenty-one studies were conducted in Europe (60%), 7 were carried out in Oceania, 4 in Asia, 2 in Africa and 1 in North America, all including males and female and with ages between 6 to 18 years. Sample size ranged from 55 [21] to 34,423 participants [22].

There was considerable variation in the methods used to define back pain, ranging from pain location (any pain on the back or spine, low back, upper back, mid back, thoraco-lumbar back), pain duration and frequency of the episode, pain severity and prevalence period.

The most common prevalence periods were 1-month (22 studies) [8,21-41], 6-months (7 studies) [34,42-47], followed by 3-months [48-51] and 1-year prevalence [9,31,34,52] with four studies each. Table 1 summarizes the characteristics of the included studies (author/year, study design, sample characteristics, the pain definition used and measuring tools).

| Author/year | Design | Sample characteristics | Pain definitions (all self-reported) | Measures tools |
|-------------|--------|------------------------|-------------------------------------|----------------|
| Andersen, LB, et al. (2006)*[23] | 1 Danish | 9413 | 17,1 | Low or mid back pain in the present or during the last month | Questionnaire |
| Auvinen, J. et al. (2008) [42] | 1 Finish | 5999 | 15-16 | Low back pain during the last 6 months | Questionnaire |
| Auvinen, JP. et al. (2010) [43] | 2 Finish | 9215 | 16 and 18 | Low back pain during the last 6 months | Questionnaire |
| Auvinen, JP. et al. (2008) [44] | 1 Finish | 6945 | 16 | Low back pain during the past 6 months | Questionnaire |
| Ayanniyi, O. et al. (2011) [24] | 1 Nigerian | 3185 | 18-Oct | Present back pain | Questionnaire |
| Chiang, H. et al. (2006)*[21] | 1 American | 55 | 13-14 | Low back pain in the previous two weeks | Questionnaire |
| Cudre-Mauroux, N. et al. (2006)*[26] | 1 Swiss | 128 | 12-Aug | Low back and upper pain in the last week | Questionnaire/ drawing figure |
| Diepenmaat, ACM, et al. (2006)*[27] | 1 Dutch | 3485 | 16-Dec | Low pain 2 4 days in the last month | Questionnaire/ manikin pictures |
| Emé, C, and Elfering, A (2011) [27] | 1 Swiss | 189 | 13-Oct | Low back pain/upper back pain for 1 day or longer in the last 4 weeks | Questionnaire/ drawing figure |
| Geldhof, E. et al. (2007)*[28] | 1 Belgium | 105 | 8,5-12,5 | Occurrence of pain or discomfort, continuous or recurrent, in the thoraco-lumbar zone in the past week | Questionnaire/ drawing figure |
| Grimmer, K. et al. (2006a) [14] | 2 Australian | 434 | 13-17 | Low back pain in the previous week | Questionnaire/ body chart |
| Grimmer, K. et al. (2006b) [29] | 2 Australian | 436 | 13-17 | Upper back pain in the previous week | Questionnaire/ body chart |
| Hakala, PT. et al. (2006) [45] | 1 Finish | 6003 | 14, 16 and 18 | Low back pain during de past 6 months about once a month | Questionnaire/ body chart |
| Heaps, N. et al. (2011)*[30] | 1 Australian | 1608 | 14 | Back Pain in the past month | Questionnaire |
| Jordaan, R. et al. (2005)*[31] | 1 South African | 1123 | 13-18 | Low back pain or discomfort now | Questionnaire/ drawing figure |
| Kaspiris, A. et al. (2010) [52] | 1 Greece | 692 | 14-Jul | Low back pain in the last year | Questionnaire/ picture |
The stability of the results, sensitivity analysis was used and the stability publication bias (Begg’s test, p=0.67; Egger’s test, p=0.1). To measure model) is shown in Figure 2. Begg’s and Egger’s tests failed to identify (Q=5796.038; p<0.001; I² = 99.67%). Forest Plot (with Random Effect practice.

Strengths of the studies were related to appropriate report of the study design, statistical significance of the results and implications for clinical practice.

1-month back pain prevalence: Twenty-two studies reported 1-month prevalence. Assuming a fixed-effects model the NSBP prevalence estimated was 16.07% (95% CI: 15.81%; 16.33%; p<0.001). Based on Q statistics and I², homogeneity cannot be assumed (3-months: Q=104, 2425; p<0.001; I² = 97, 12%; 6- months: Q=3090, 801; p<0.001; I² = 97, 8%; 1-year: Q=435, 7774; p<0.001; I² = 99, 31). Stability problems were identified in all the analysed periods and they have remained with the removal of any of the included studies. Based on these results it has been decided to carry out a narrative synthesis of the prevalence estimates rather than the meta-analysis.

Narrative synthesis

In the 3-month period, the NSBP prevalence ranged from 17.4% [51] to 51.3% [49]. In the past 6 month the NSBP prevalence ranged from 15.6% [34] to 61.1% [44] and in the last year NSBP prevalence ranged from 17.4% [34] to 54.1% [31]. Table 2 shows the 3, 6 months and 1-year prevalence for NSBP according to the self-report period of back pain of NSBP assessed in each study and age.

Back pain incidence

Of the 35 studies analyzed only two studies reported incidence [15, 29]. Grimmer et al. followed a sample of 434 children during a period of 5 years (1999-2003), and found a percentage of new cases of 7.2% for males and 10.4% for females [15].

In another longitudinal study conducted by the same research group, the authors followed a sample of 436 children, aged 13, during 5 years and founded that incidence decreases in females between 14 and 17 years of age, but increases in males, who present a higher incidence at the age of 16 [29].

### Table 1: Characteristics of the included studies.

| Study                                | Country | Sample Size | Age | Back Pain Questionnaire |
|--------------------------------------|---------|-------------|-----|-------------------------|
| Kjaer, et al. (2011) [32]            | Greece  | 479         | 9,13 and 15 | Interview               |
| Korovesis, et al. (2010) [46]        | Greece  | 688         | 14-18| Questionnaire/Pain drawing manikin |
| Masiro, et al. (2008) [9]            | Italy   | 7442        | 13-15| Low back pain in the last year |
| Mikkonen, et al. (2008) [47]         | Finish  | 1987        | 16 and 18| Low back pain during the past 6 months |
| Mogensen, et al. (2007) [33]         | Danish  | 439         | 13-Dec| Back pain in the last month |
| Mohseni-Bandpei, MA, et al. (2007) [34]| Iran    | 4813        | 14-Nov| Low back pain within last month |
| Murphy, et al. (2007) [18]           | English | 679         | 14-Nov| Low back and upper back pain within last month for 1 day or more |
| O’Sullivan, et al. (2008) [35]       | Australian | 1608  | 14 | Back pain in the last month |
| Pellise, F. et al. (2009) [37]       | Spanish/ Swiss | 1470 | 15 | Low back pain within last month for 1 day or more |
| Perry et al. (2009) [46]             | Australian | 1608 | 14 | Back pain in the last month |
| Roth-Isigkeit, et al. (2005) [11]    | Germany | 751         | 18-Jun| Back pain in the preceding 3 months |
| Sato, et al. (2008) [21]             | Japan   | 34423       | 15-Sep| Low back pain (in the day of the study) |
| Sato, T. et al. (2011) [38]          | Japan   | 26786       | 15-Sep| Low back pain (in the day of the study) |
| Skoffler, (2007) [49]                | Danish  | 546         | 15-16| Low back pain in the preceding 3 months |
| Treveleny, and Legg, (2011) [40]     | New Zealand | 245  | 14-Nov| Experiencing back pain within last 7 days or last month for 1 day or more |
| Treveleny, and Legg, (2010) [39]     | New Zealand | 245  | 14-Nov| Experiencing back pain within last 7 days or last month for 1 day or more |
| Turk, et al. (2011) [50]             | Slovenia | 190  | 11-15, and17-18| Pain or discomfort in the lower back in the last 3 months for 1 day or more |
| Wedderkopp, et al. (2009) [41]       | Danish  | 364         | 9 and 12| Occurrence of pain or discomfort in the back in the last month |
| Yao, et al. Spine (2011) [51]        | China   | 2083        | 18-Oct| Back pain in the preceding 3 months |

*Studies included for the analysis of the results regarding predisposing factors for non-specific back pain.*
Predisposing factors for nonspecific back pain in children and adolescents

Fifteen studies investigated different predisposing factors for back pain in children and adolescents. The potential predisposing factors included a multitude of factors that for clarity were grouped into 5 categories: 1) physical/anthropometric factors (age, gender, body mass index and physical qualities); 2) psychological and emotional factors (depression, psychological distress, etc); 3) Social and family factors (parents educational level; parents self-reported pain; familiar structure); 4) Lifestyles factors (Alcohol and tobacco consumption, physical activity); 5) and mechanical factors (postural behavior, school posture, etc).
Discussion

The purpose of this systematic review was to determine the prevalence and incidence of non-specific back pain in children and adolescents and to identify its predisposing factors. A total of 35 studies specifically designed for children and adolescents with NSBP were included. Similar to previous reviews, this systematic review found considerable methodological heterogeneity between studies, particularly related to the prevalence period and case definition [11,15,17]. The absence of a clear specification of the minimum episode duration required for a case to be counted limited a more conclusive understanding of the pain prevalence among children and adolescents. Recently, an international Delphi study concluded that definitions for prevalence studies of back pain should include, at least, the location of back pain, symptoms observed, time frame of the measure, and severity [53].

Bag weight and transportation, time spending watching television, computer use).

In general, the inconsistency founded in the use of conceptual definitions and related measurement tools for the same variable and the multitude of variables of very different natures that have been explored, limited the comparison between studies. Moreover, the examination of the relationship between these factors and NSBP showed conflicting results among studies.

Eleven studies looked for significant correlations between the physical/anthropometric factors and the self-report of BP. The findings of these studies showed conflicting evidence for age [25,28,31,34], gender [23,25,26,28,30,31,34,36,38], body mass index [21,34,36] and physical qualities, such as muscle strength [23,36] or muscle endurance [23], muscle control [25] or the maximum level of VO2 [23].

Three studies reported findings of significant association between a range of psychosocial and emotional factors and BP [26,30,40]. Significant associations with NSBP were found for “Internalizing and externalizing behavior” (both sexes), “self-worth” and “Family functioning” (girls only) [30], emotional symptoms and hyperactivity [40], depressive symptoms [26,30] and stress experienced [26].

From the two studies that had explored the association between social and family factors and NSBP [8,26], none had reported statistically significant findings. Lifestyles factors were analyzed in seven studies [21,23,26,30,33,34,41]. Heaps et al. [30] founded statistically significant associations between alcohol and tobacco consumption and NSBP. There were conflicting evidence about the relationship between the level of physical activity and NSBP [21,26,34,41]. No association was found between the practice of physical activity or sports and NSBP [23,33].

Finally a number of mechanical factors were associated with NSBP. NSBP in children and adolescents has been shown to have a significant association with school bag carrying time [21], carrying the bag on one shoulder [40], twisting the back for more than 10 min during a class [8] and position and time spent watching television, or doing the homework [34]. Conflicting results have also been reported for the weight of the school bag [8,34,40] and time spending watching television [26,34]. No association was founded between postural behavior [28] and computer use [26,34] with NSBP.

In summary, it was not possible to identify consistent and conclusive evidence of the association between back pain and the different predisposing factors reported in the literature.

Predisposing factors for non-specific back pain

Of the 35 studies included in this review, 15 aimed to identify predisposing factors for back pain in children and/ or adolescents. From the 15 studies identified, 14 were based in cross-sectional studies. This constitutes a major limitation to the studies’ findings since this kind of design only allowed for the association between predisposing factors and NSBP to be examined. It is therefore not possible to establish any causal relationship between variables and outcome.

Another key finding of this review was the extent of heterogeneity in the potential predisposing factors and outcomes across studies. The variation of the type and definition of the potential predisposing factors examined across studies as well as the reduced number of articles identified which analyze the same factor (just one article in many cases), make the comparison between studies difficult and a meta-analysis impossible. Thus, it was not possible to reach consistent conclusions about the predisposing factors for back pain in children and adolescents.

Considering the physical/anthropometric factors, this review found conflicting evidence between age, gender, BMI and physical qualities. These findings confirmed the results reported in other studies/reviews [4,55] suggesting a lack of evidence to support the value of these factors in the study of NSBP in children and adolescents.

The same conclusion can be draw considering the association between lifestyles and behaviors and NSBP. The inconsistency in the findings found in this review for the level and duration of physical activity contradicts previous reviews that had suggested that physical activity level/time of practice was a predisposing factor for the development of NSBP. Moreover, no association was found between the practice of physical activity or sports and BP [23,33].

Like in previous reviews, new data confirmed that there is no association between the family/social factors studied and NSBP. Contrariwise, several psychological and emotional factors showed significant associations with BP in children and adolescents [26,30,40]. However, based on this review no definite conclusions can be drawn due to design limitations. Psychological and emotional factors of varying nature inhibit a more definitive conclusion about the potential relevance of these factors to the BP. Moreover, the studies were few in number and were of poor quality. Psychological and emotional factors require more rigorous investigations to determine their relationship with NSBP in this population.
Finally, this review’s findings founded that several different mechanic factors have showed statistically significant associations with NSBP, namely the school bag carrying time [21], carrying the bag on one shoulder [40], twisting the back for more than 10 min during the lesson/class [8] and the position and time spent watching television, or doing the homework [34]. However, these findings were based on one or two studies and no definitive conclusion can be draw.

In summary, the findings of this review emphasize a lack of evidence to support or refute the association between back pain and the different predisposing factors reported in the literature.

Conclusion and Implications for Clinical Practice

The results of this systematic literature support the high prevalence of NSBP in young population and corroborate the current idea that NSBP is an important clinical condition at this age.

The scarcity and conflicting evidence of the research findings about potential predisposing factors and the methodological flaws identified in the studies limited a more consistent conclusion of this review. Future research should concentrate both on case definition and on improving the methodological quality of the studies. The use of a standardized definition of NSBP is a recommendation endorsed by a recent international consensus [53,54] to enable better comparisons between countries, and ultimately lead to a deeper understanding of this clinical condition in children and adolescents. Prospective studies are also needed to further clarify these unclear and conflicting results especially on predisposing factors that can be used by the health professionals in preventing NSBP through health programs.

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