Eur Spine J (1999) 8 : 429–438

REVIEW

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Non-specific low back pain in children and adolescents: risk factors

Received: 9 June 1999
Revised: 13 August 1999
Accepted: 18 August 1999

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Abstract Low back pain (LBP) among children and adolescents has become the subject of an increasing amount of literature over the last 15 years. This topic, which was considered almost insignificant less than two decades ago, was the focus of a recent international meeting organised in Grenoble (France) in March 1999. This review paper is the result of an literature update search performed by members of three groups which have been active in this field for many years. Current epidemiological data on LBP is summarized as well as the role of the major risk factors according to studies published in the principal peer reviewed journals interested in the topic.

Key words Non-specific low back pain · Schoolchildren · Risk factors · Epidemiology

Introduction

Backache in children and adolescents has traditionally been considered a rare and serious condition, causing one to suspect an organic, infectious, inflammatory or neoplastic origin. Several surveys, however, have revealed a high prevalence of backache, and particularly of lumbar pain, in these age groups, indeed sometimes similar to that reported for adults. The purpose of this article is to review the recent literature, published since 1992 [6], on this topic.

Epidemiological data

The prevalence of back pain in children varies according to the age of the population studied and, particularly, according to the methodology of the studies themselves, viz.:

1. Cross-sectional studies by means of a questionnaire, with or without the participation of an investigator, looking at subjective morbidity [4, 5, 8, 9, 13, 18, 26, 35, 41, 48, 50, 59, 62, 64, 69].
2. Cross-sectional studies based on physical examination of the subjects, to evaluate the measurable morbidity [4, 13, 35, 48, 50, 69].
3. Longitudinal studies (cohort studies) to measure the yearly incidence of spinal pain [12, 15].

Moreover, studies differ in terms of the definition of backache selected (any localisation of spinal pain versus pain limited to the lumbar area, radicular pain), and also according to the type of prevalence studied (lifetime prevalence or point prevalence of back pain). Several approaches are used in evaluating the intensity of pain: relapsing or permanent pain, need for medical care, or disability due to pain. Furthermore, in studying risk factors, it is important from a methodological point of view to distinguish cross-sectional studies without either a control group or multiple analysis of variance [2, 9, 13, 18, 22, 24, 48, 69] from those which include a logistic regression analysis [4, 8, 9, 17, 26, 35, 50, 56, 57, 62, 68], or again from those studies which include a control group [17, 23, 28, 31, 42, 44, 47, 49, 52, 60, 61, 66, 70]. Finally, longitudinal studies, with [29, 31, 51] or without [12, 15, 37, 39, 40] a control group, make it possible to study the exposure of the subjects to the selected risk factors, and therefore the predictive value of such factors.

In this review we have only reported risk factors that remain statistically significant after confounders have been excluded by multiple analysis of variance. The odds ratio associated with exposure to the risk factor under study is reported at a 95% confidence interval.

In studies covering populations of 300 children and more, the lifetime prevalence of back pain varies between 30% and 51%, probably as a result of the heterogeneity of the studies [5, 8, 9, 26, 41, 48, 64]. The same figure varies between 14% and 43% in studies involving a physical examination of the participants [18, 56, 69]. Across the various studies, point prevalence ranges from 12% to 33% [5, 8, 39, 41, 48, 59, 69]. Of this, severe back pain, relapsing or permanent, accounts for 3% to 15% [12, 26, 48, 59, 62, 64, 69]. The prevalence of pain necessitating medical consultation varies between 4% and 31% [2, 4, 5, 8, 9, 12, 18, 37, 39, 41, 69], and of pain interfering with everyday activities between 2% and 12.4% [4, 5, 8, 37, 41, 48, 50, 64, 69].

Burton et al. carried out a longitudinal study [12] of 216 adolescents over a 5-year period, from the age of 12 to 16 years. The annual incidence of lumbar pain increased from 12% at the age of 12 to 21.5% at 15 years, and the percentage of subjects with relapsing pain increased from 44% in the 1st year to 59% in the 5th year of the survey. Medical care was sought by 15.6% of the children, but only a small percentage of all subjects reported that their pain got worse during the 5-year period. Nissinen et al. [39] performed a 1-year longitudinal study surveying 859 children aged 12.8 years at the beginning of the study. They found an annual incidence of LBP of 17.6% and an annual need of medical care of 4.4%.

Brattberg [11] carried out a 2-year longitudinal study on 471 children and found a 20% incidence of back pain during this period of time. In a recent 1-year survey in Canada, the annual incidence of substantial LBP was found to be 17.2% among a cohort of 377 adolescents aged 13.8 years [15]. A cohort study performed in Denmark (n = 640) showed that subjects who had suffered from LBP during their adolescence showed significantly higher cumulated prevalence and point prevalence of LBP, a higher number of hospital admissions and reduced work capacity due to LBP when they were surveyed as adults (25 years later) [21]. The results of this study suggest that there is a positive correlation between a history of LBP during adolescence and presence of lumbar pain as an adult.

Moreover, other cross-sectional studies performed among adults and adolescents confirm the beginning of lumbar pain in adolescence, particularly at the time of the pubertal growth spurt [14, 32, 33]. This topic was reviewed in a recent publication [63].

Non-specific risk factors

Age

A review of the literature shows that both prevalence and incidence of back pain increase with age. Mierau et al. [35] reported an increase in the lifetime prevalence of lumbar pain from 23% among children aged 6–13 years, to 33% among those aged 14–18 years ($P < 0.05$). Salminen [50] showed that adolescents aged 15 years complained of pain more often than those aged 13 or 11, regardless of gender ($P < 0.01$). In a group of 1242 subjects aged 11 to 17 years, Olsen et al. [41] found a linear increase in the prevalence of low back pain with age; among subjects aged 15 the prevalence was twice as high as among 12-year-olds. Moreover, lifetime prevalence of relapsing back pain and of medical visits also increased with age: the former from 6.2% at 10 years to 15.5% at 14 years ($P < 0.001$), and the latter from 11% at 10 years to 47% at 14 years ($P < 0.05$). Similar results are reported by others [26, 37, 59].

In the longitudinal study by Burton et al. [12], both the lifetime prevalence and the point prevalence of back pain, as well as the annual incidence, increased between the ages of 11 and 15 years. In the study by Troussier et al. [64], the odds ratio of back pain increased with age even after multivariate analysis: from 2.79 (1.79–4.34) in the age group 10–12 years to 16.5 (9.9–27.47) in the age group 16–20 years ($P < 0.001$). Balagué et al. [8] found an increase in the odds ratio, after logistic regression, of 1.82 (1.61–2.07) per year from the age of 12 onwards.

Gender

The prevalence of back pain appears to be higher among girls than among boys.

Salminen [50] described an increased prevalence of spinal pain among girls (24.2%) compared with boys (15.2%) ($P < 0.05$) between the ages of 11 and 17 years. The same author [48] found a higher prevalence of back pain among girls (33.9%) compared with boys (27%) ($P < 0.01$) in a study of 1503 adolescents aged 14 years; and among those reporting permanent or recurrent low back pain (7.8% of the whole sample), girls reported more disability than boys ($P < 0.001$). The data of Balagué et al. [5], Brattberg [11], Davoine [13], Fairbank [18], and Viikari-Juntura [68] confirm these findings. Female gender remains a significant risk factor even after logistic regression, with an odds ratio of 2.43 (1.83–3.24), in the study by Troussier et al. [64] ($P < 0.001$). Similar results were found by Balagué in his studies of 1994 [8], with an odds ratio of 1.89 (1.38–2.59) and of 1995 [9], with an odds ratio of 1.61 (1.1–2.34). Burton et al. [12], in contrast, reported a prevalence of back pain of 52.6% among boys and 34.3% among girls ($P < 0.01$). In this study, boys who were involved in sports activities complained of back pain more often than those practising no sport. Newcomer and Sinaki also reported an increased prevalence of lumbar pain among boys (57%) compared with girls (44%). However, this difference did not reach statistical significance [37]. Finally, Olsen et al. [41] found almost the same frequency of low back pain among boys (30.7%) as among girls (30.0%).

Family history and heredity

Non-specific low back pain among parents and among their children has been found to be significantly associated in several cross-sectional studies. This association evokes the possible role of genetic, environmental and/or psychosocial factors.

A familial incidence has been described for disc herniation [20, 34, 36, 66], spondylolysis [2] and non-specific low back pain. Salminen [50] showed that children with at least one parent complaining of back pain reported pain twice as often as other children ($P < 0.05$).

Balagué [8, 9] found a significant association between parents' history of low back pain and that of their children: life time prevalence of low back pain was 14% among schoolchildren whose parents were both healthy, 21% among those with a parent who had already been treated for low back pain, and 24% among those whose parents had both already been treated for low back pain ($P < 0.001$). Logistic regression analysis showed an odds ratio of 2.1 for subjects with a positive parental history. However, no association at all was found between parental history of treated low back pain and children's point prevalence of low back pain [8]. Moreover, although 29.1% of children reported a history of low back pain among their siblings, multivariate analysis did not show this to be significantly associated with the child's own history.

Another approach to the study of familial factors and heredity is the comparison of twins. Studies performed on a Finnish twin cohort showed interesting findings [10, 67]:

1. At mean age of 49.4 years, the effects of genetic and shared early environmental influences explained nearly 75% of the variability in disc degeneration scores in the upper lumbar region and nearly 50% in the L4-S1 levels [10].
2. Two intragenic polymorphisms of the vitamin D receptor gene were found to be associated with disc degeneration. MRI signal intensities of T6-S1 discs were decreased in men with the Taql tt genotype (12.9%) and in men with the Tt genotype (4.5%) compared with men with the TT genotype. Similarly, men with the Fokl ff and Ff genotypes had mean signal intensities respectively 9.3% and 4.3% lower than men with the FF genotype [67].

In their review of the literature about rheumatic disorders in twins, Järvinen and Aho [25] stated that "environmental factors account for more than 80% of the etiology of sciatica. However, genetic factors were relatively more significant in individuals under 40 years of age".

Another way of looking at the relationship between family history and lumbar pain could be to study the consequences to family life of the presence of a sufferer of chronic low back pain resulting in disability [65]. In this case, the disturbance to the parental function in chronic low back pain sufferers can be such that it can play a role in the etiology of lumbar pain among their own children [65].

Anthropometric parameters

A review of the literature shows that an association between back pain and anthropometric parameters (weight, height, body mass index) is still unproved.

Salminen et al. [47, 50] and Nelson et al. [36] found no correlation between these parameters and the prevalence of back pain. Conversely, Fairbank et al. [18] reported an association between the increase in the length of a child's trunk ($P < 0.05$), as well as the increase in a child's weight ($P < 0.05$), and the presence of back pain, compared to a control group. In a 3-year longitudinal study, comparing adolescents complaining of permanent or recurrent low back pain initially at 15 years of age with a matched control group, Salminen [51] noted a significantly increased height ($P < 0.05$) in boys among the low back pain sufferers. In addition, weight had increased ($P < 0.05$) more during 3-year follow-up in subjects with initial recurrent low back pain [51]. However, these factors were not predictors of future low back pain [51]. Nissinen et al. [39] reported on 859 children aged 11 years at the inclusion and followed during 3 years. These authors found a significantly increased sitting height among LBP sufferers with an odds ratio of 1.24 (1.03–1.46). In this study BMI was not significantly associated with LBP [39].

Spinal mobility, and flexibility of muscles and joints

A review of the literature with regard to the existence of back pain and the mobility of the lumbar spine and muscular and articular flexibility reveals significant associations for some of these parameters.

Burton et al. [12] did not find any correlation between lumbar spine flexion-extension and pain. They noted that lumbar sagittal mobility, particularly in flexion, increased with age from 11 to 15 years, but only among boys ($P < 0.01$). Fairbank et al. [18] studied 446 adolescents aged 12 to 18 years, and reported an association between back pain and decreased mobility of the hips and knees ($P < 0.05$). Salminen [50] found a decrease in lumbar spine flexion with age ($P < 0.001$); however, lumbar spine mobility remained greater among 15-year-old boys than among girls and was not related to back pain. The same author [47], comparing 38 adolescents aged 15 years suffering from recurrent low back pain with the same number of subjects free of low back pain, showed that there was decreased extension of the lumbar spine ($P < 0.05$), increased mobility in flexion ($P < 0.01$) and decreased flexibility of the posterior muscles of the thigh ($P < 0.05$) in the low back pain group. In a subgroup of adolescents complaining of sciatica (n = 7), he found decreased lumbar flexion ($P < 0.01$) and side bending ($P < 0.05$), compared with the chronic low back pain sufferers without sciatica. At 3-year follow-up the same factors still differentiated the baseline groups. However, although consistency of low mobility was considered, it was not predictive of future low back pain [51]. Mierau et al. [35] found an association of back pain with decreased flexibility of the posterior muscles of the thigh among boys aged 14 to 18 years ($P < 0.05$); however, no difference was found either among girls or among children aged 6–13 years. Moreover, the tightness of the hamstrings was more pronounced among adolescents aged 14–18 years than among children aged 6–13 years ($P < 0.001$). Boys showed more tightening of the muscles than girls in both age groups ($P < 0.001$). In her longitudinal study, Ehrmann Feldman found no association between incidental LBP (among 377 adolescents with no previous history of pain) and flexibility measured by Schober and sit and reach tests [15]. Only decreased flexibility of the quadriceps was significantly associated with an increased risk of future LBP by general estimating equation analysis [15].

In conclusion, back pain seems to be correlated with tightness of the thigh muscles. The correlation with the sagittal mobility of the lumbar spine remains debatable.

This topic was reviewed recently [7].

Spinal posture

A complete study of postural faults was made by Salminen [50] in 1984: among 370 children aged 11–17 years the author found 29% of the subjects had some functional postural faults in the sagittal plane (mainly long round-back), and 1.4% (all boys) of the sample showed a fixed thoracic kyphosis. After adjustment for age and gender, adolescents presenting a hyperlordosis, in isolation or associated with thoracic kyphosis, and a weakness of the abdominal muscles and/or tightness of the hamstrings, reported low back pain more often ($P < 0.01$). On the other hand, neither thoracic kyphosis nor isolated tightness of the hamstrings was a significant associated factor. In the study by Wagenhauser [69], adolescents complaining of back pain showed a trend towards a radiological increase in thoracic kyphosis or in lumbar lordosis; however, this study did not include any statistical analysis. In a study of 257 children aged 10 years and 317 adolescents aged 14 years, Davoine [13] did not find any significant association between the lifetime prevalence of back pain and a fixated kyphosis, nor was the pain history associated with global or segmental tightness (respectively evaluated by the distance between hands and feet in sitting position and by an equivalent of the Lasègue manoeuvre). In Nissinen et al.'s [39] longitudinal study, 859 children aged 11 years, were followed for 2 years. In this study there was a significant association of LBP with trunk asymmetry at the bending test, with an odds ratio of 1.19 (1.00–1.39). However, there was no correlation between LBP and increased lumbar lordosis nor between LBP and thoracic kyphosis.

More studies are necessary to clarify the relationships between postural faults and spinal pain.

Muscle strength

Despite reservations about the methodologies of the published papers, non-specific low back pain in adolescents can not just be attributed in a simplistic way to muscle weakness.

In a study of 370 children aged 11–17 years, after adjustment for age and gender, Salminen [50] found a correlation between weakness of the abdominal muscles, tightness of the hamstring muscles and back pain ($P < 0.01$). However, there was no relationship between these parameters and the children's physical activity. On the other hand, in another study [52] performed with adolescents of both genders aged 15 years, the same author found a correlation between lower physical activity (≤ 2 days/week) and decreased endurance of the spinal muscles ($P < 0.05$). Balagué et al. [4] did not show any correlation between isokinetic trunk muscle strength (in flexion-extension, measured in upright position) and low back pain history. In a cross-sectional study of 100 athletes and controls aged 10–13 years, Kujala et al. [28] did not find any association between abdominal and back muscle endurance and low back pain. In his longitudinal case control study of adolescents, aged initially 15 years and followed for 3 years, reporting permanent or recurrent low back pain, Salminen found decreased isometric endurance of the abdominal muscles ($P < 0.05$) and lumbar muscles ($P < 0.01$) [51], as well as atrophy of the paraspinal lumbar muscles in girls ($P < 0.01$) by MRI [61] among low back pain sufferers at the age of 15 years. At this point there was no difference in terms of dynamic strength of the abdominal muscles [52]. During a 3-year follow-up [51], the measures of muscle strength and the atrophy of the paraspinal muscles did not seem to be predictors of the appearance of low back pain. The authors of this article raised the possibility that these differences in muscle performance could be the consequences of pain rather than its cause. In a longitudinal study including 116 subjects whose ages ranged from 11 to 19 years, Newcomer and Sinaki [37] found a significant increase in the strength of the trunk flexor muscles among LBP sufferers without any modification of the strength of the extensor muscles. Therefore, a decreased ratio of the strength of the extensors/ strength of the flexors was found; however, this parameter was statistically insignificant [37].

The literature concerning this topic was recently reviewed [7].

Physical and sports activities

In this section we will look respectively at the role of physical activity, spinal trauma, competitive sports, particularly among athletes, and at the relationship between physical and radiological signs and back pain in athletes.

In Salminen's first study [50] as well as in Brattberg's [11] the level of physical activity (leisure or sports) was not associated with low back pain. However, in a cross-sectional case-control study among 38 adolescents aged 15 years, the same author found a correlation between a low frequency of physical activity (≤ 2 days/week) and permanent or recurrent low back pain ($P < 0.01$) [52]. However, although consistency of low physical activity was considered it did not appear to be predictive of the appearance of low back pain at 3-year follow-up [51]. In their longitudinal study, Newcomer and Sinaki [38] did not find any correlation between LBP and a low frequency of physical activity. However, the cumulated prevalence of LBP was correlated with a high level of physical activity. Taimela et al. [59] found a similar association between LBP and high level of physical activity in a sample of 1171 schoolchildren aged 7–16 years.

A history of spinal trauma, related or not to sports activities, was associated with a high prevalence of back pain in another study by Salminen et al. [48] (46.2% of cases, 84.5% of which were sports injuries), as well as in the study by Troussier et al. [64] with an odds ratio of 5.40 (2.97–9.8) ($P < 0.001$).

In two cross-sectional studies, each one surveying more than 1700 children aged 8–16 years, Balagué et al. [5, 8] showed an association between competitive sports and prevalence of low back pain ($P < 0.01$). After multivariate analysis the odds ratio was 1.73 (1.21–2.48). Playing volley ball was associated with an increased prevalence of pain [5, 8] as was "body-building", "aerobics" [5], playing tennis and cycling [8]. However, in a similar survey, Troussier [64] did not find any correlation between the intensity of physical activity (leisure or competitive) and the prevalence of back pain. After a multivariate analysis, only volley ball ($P < 0.001$) was found to be associated with back pain, with an odds ratio of 3.21 (1.48–6.99). In Burton et al.'s longitudinal study [12], 216 children aged 12 were included and followed for 5 years. Among boys, the risk of reporting LBP at 15 years of age was significantly increased for those involved in extracurricular sports activities.

The prevalence of back pain appears to be greater among young athletes compared to the general population of the same age [24, 29, 57], suggesting a causal relationship with competitive sport. Several factors seem to play a role, e.g. the type of sport [57], the level of competition [19], the intensity of physical training [28, 31] and acute spinal trauma [29]. Kujala et al. [31], in a longitudinal study over 1 year among 86 athletes and controls aged 10–13 years, showed that among girls the prevalence of low back pain during the previous year was correlated with the intensity of sports work-outs during the last 12 months ($P < 0.01$), despite not finding any correlation with the lifetime cumulative incidence of low back pain. The same correlation was found in a cross-sectional case-control study ($P < 0.001$) [28]. Kujala et al. performed a 3-year longitudinal study among 65 athletes and 33 controls aged 10–13 years at the inclusion. The incidence of lumbar pain was significantly increased among athletes (45%) compared with controls (18%) [30]. During the 3-year period, acute spinal trauma was reported by 89% of subjects in the LBP group versus 3% in the painfree subgroup [30].

In a cross-sectional study among 142 athletes aged 17–25 years, Swärd et al. [57] showed that male gymnasts suffered more often from low back pain (84.6%) than other athletes ($P < 0.05$) (wrestlers 69%, female gymnasts 65%, footballers 58% and tennis players 50%). In a cross-sectional case-control study, the same authors [58] showed that the frequency of low back pain was higher among male gymnasts (79%) than among males not involved in sports (38%) ($P < 0.001$).

The relationship between low back pain and clinical findings among competitive athletes remains controversial. For instance, in a longitudinal case-control study, Kujala et al. [31] showed that only a reduction of lumbar flexion and a tightness of the flexor muscles of the hip in boys ($P < 0.05$), after multivariate analysis, were predictors of the development of low back pain during the 1-year follow-up. Among girls two factors were predictors: being overweight ($P < 0.01$) and having a previous history of low back pain ($P < 0.001$). At 3-year follow-up in the same study, low maximal lumbar extension mobility at baseline in girls was predictive ($P < 0.05$) [30]. In this study it was also shown that training does not increase maximal lumbar extension in healthy adolescents. However, repeated attempts put strain on low back tissues and probably contributed to producing pain in girls [27].

In a study of 116 male athletes, Swärd et al. [56] did not find any correlation between pain and factors such as:

age, weight, BMI, flexibility of the lumbar spine and tightness of the hamstring muscles. Young athletes show an increased frequency of radiographic or MRI abnormalities of the thoraco-lumbar spine in several cross-sectional case-control studies [19, 23, 58]; however, the correlation between radiological signs and low back pain remains controversial [29, 57, 58, 60]. In the study by Hellstrom et al. [23], the prevalence of multiple radiological abnormalities was higher among athletes, particularly male gymnasts, than among non-athletes ($P < 0.01$). Among 33 female gymnasts and controls, Goldstein et al. [19] found a correlation between the frequency of abnormalities seen by MRI (spondylolysis and signs of disk degeneration) and the competitive level of the athletes ($P < 0.01$), as well as their age ($P < 0.01$) and the average number of hours of physical training per week ($P < 0.001$). In a cross-sectional study of 142 athletes aged 17–25 years, Swärd et al. [57] found a correlation between the severity of low back pain (defined by the interruption of competitive sport or of training) and the presence of multiple radiological abnormalities ($P < 0.01$), particularly non-apophysial Schmorl's nodes ($P < 0.05$). Among 20 gymnasts and controls, the same authors [58] showed that signs of disk degeneration visible by MRI are more frequent among athletes (73%) than among controls (31%) ($P < 0.01$). The same was true concerning the number of degenerated disks ($P < 0.05$) and the degree of reduction of disk signal intensity ($P < 0.01$). A significant relationship between MRI signs and low back pain was only found for modifications to the shape of the vertebral body ($P < 0.01$) and the intensity of disk signal ($P < 0.01$), without any relationship to the rest of the identified abnormalities (Schmorl's nodes, disk protrusion, intervertebral space narrowing). However, studying 35 gymnast-controls, Tertti et al. [60] did not find any correlation between low back pain and the signs of disk degeneration by MRI. In a longitudinal study, Kujala et al. [29] found an increased prevalence of MRI abnormalities among adolescent girls having reported a spinal injury (75%) compared with those without injury (23%).

In conclusion, competitive sports activities are associated with an increased risk of low back pain, particularly among young athletes. The risk depends on the type of sport, the level of competition, the intensity of physical training and acute spinal trauma. However, the relationship with the findings of a physical examination still remains controversial. Moreover, it appears that the frequency of radiological or MRI abnormalities is higher among athletes, but their relationship with lumbar pain still remains uncertain.

Early disk degeneration

An interesting topic recently explored is that of degenerative changes in disks of adolescents. In a recently completed Finnish study, early degenerative findings were investigated by MRI at 15 and 18 years of age in subjects with recurrent LBP and in control subjects. Disk protrusion was associated with pain at baseline ($P < 0.05$) [61] and predicted recurrent LBP at 3-year follow-up ($P < 0.01$) [51]. One or more degenerated disks was found in 15 LBP subjects (38%) and in 10 control subjects (26%) at baseline, but the difference was not statistically significant [61]. However, at 3-year follow-up degeneration at baseline predicted significantly both LBP in the previous 12 months ($P < 0.05$) and recurrent pain ($P < 0.05$) [51]. A subgroup representing 35% of the subjects of the original LBP group, still reported recurrent pain both at 18 and 23 years of age. Participants with disk degeneration at 15 years of age were exposed to a significant risk (RR 16.0, 95%CI 2.2–118.8) of persistently recurrent low back pain [46]. Disk protrusions at 15 years of age and MRI findings at 18 years were less significant in predicting persistently recurrent LBP. It is concluded from this study [46] that subjects with disk degeneration soon after the phase of rapid physical growth not only have an increased risk of recurrent LBP at this age, but also a long-term risk of recurrent LBP up to early adulthood. A recent review was focused on this topic [16, 45].

School performance

The cross-sectional surveys published about this topic have not really established a causal relationship between school performance and low back pain, despite the fact that they do seem to be significantly associated.

In his first survey, involving 370 Finnish schoolchildren, Salminen [50] found poorer school performances among those subjects reporting cervical and/or lumbar pain at the time of the inquiry than among those who were asymptomatic ($P < 0.05$). In 1987, Porter et al. [43] found a significant correlation between the size of the spinal canal and the score at the General Certificate of Education ($P < 0.01$).

In a survey of 1755 schoolchildren, Balagué et al. [8] found an association between lumbar pain and school grade-point average ($P < 0.001$). However, this is of limited interest, since the association was not corrected for age, nor were the questionnaires anonymous. Among 501 pupils aged 10 and 14 years Davoine [13] found an association between back pain and lack of pleasure in going to school ($P < 0.05$); this was, however, unrelated to the risk of having to repeat a year. Finally, a recent study [1] about recurrent lower limb pain in 1754 school children aged 5–15 years, shows that children complaining of such pain also report an absenteeism rate (regardless of its cause) higher than their asymptomatic classmates.

Smoking

Very few studies have addressed the correlation between tobacco consumption and back pain in children.

Among 1715 children, Balagué [5] found a correlation between pain and smoking ($P < 0.001$). In a study of 1178 children, Troussier et al. [64] showed a correlation of borderline significance, after multivariate analysis, between smoking and pain ($P = 0.07$). The odds ratio was 1.64 (0.95–1.27). In Brattberg's survey [11] (n = 1245 children), the odds ratio was 3.35 (1.28–8.97) among smokers compared with non-smokers. Smoking was also significantly associated with future LBP in a recent longitudinal study among adolescents (RR 2.43, 95%CI 1.26–5.96) [15].

Television

Two cross-sectional studies have shown that there is a significant correlation between time spent watching television and back pain. This association could be due to the prolonged sitting position and/or to bad posture and/or to a lack of physical activity. One can not, however, conclude that low back pain sufferers prefer this type of leisure to more physically demanding ones.

Balagué et al. [5, 8] found a correlation between time spent watching television and pain, with an odds ratio of 1.23 (1.0–1.52) after multivariate analysis. Among 1178 children Troussier et al. [64] found a prevalence of back pain of over 50% in the group of children watching television for more than 1 h/day ($P < 0.001$). The odds ratio was 1.71 (1.27–2.30).

Sitting position

Several studies have found an association of back pain with sitting.

In his first study of 370 children aged 11–17 years, Salminen [50] reported a prevalence of current neck and/or back symptoms of 20%, with 58.9% of those reporting pain whilst sitting. A significant difference was found between prevalence of low back pain in the sitting position compared with the standing position ($P < 0.05$), lying ($P < 0.001$) or walking ($P < 0.001$). In another study, with 1503 children aged 14 years, the same author [48] found that 38.9% of subjects with recurrent LBP considered sitting troublesome for over 30 min at school and 28% at home. Moreover, a significant difference was reported between the frequency of low back pain in the sitting position and the same type of pain in the standing position ($P < 0.01$), when walking ($P < 0.01$) or in the lying position ($P < 0.001$). Balagué et al. [5], Nissinen et al. [39], Tesnière [62], Troussier [64] and Wagenhauser [69], all have reported an increased frequency of back pain whilst sitting, with figures ranging from 23% to 42%. Actually, sitting was the most common factor associated with back pain for all these authors.

Psychosocial factors

Cross-sectional studies have shown associations between musculoskeletal pains and psychological factors. We can not establish a causal relationship between the two elements due to the limitations of the studies available and of the information we have about the psychological development of "normal" adolescents.

Childhood psychological trauma is correlated with an increased level of unsuccessful lumbar spine surgery [54] and with an increased risk of chronic low back pain [53]. A study showed that children suffering from idiopathic musculoskeletal pain self-reported a lower level of wellbeing than children suffering from rheumatoid arthritis [55]. In the study by Balagué et al. [9], psychological factors labelled "positive" were associated with a reduction of lumbar pain whilst those factors considered "negative" were accompanied by an increase of this kind of pain. The odds ratio associated with each of these factors by multivariate analysis was 0.84 (0.73–0.96) and 1.43 (1.23–1.66) respectively. Similar associations were found between the psychological factors and two consequences of low back pain: need for medical care and disability in daily activities due to low back pain. Finally, surveyed children reported a low back pain history among their siblings with a frequency that increased with the negative psychological score, whilst it decreased as the positive psychological score increased. However, a Finnish study [68] showed that psychosocial factors (intelligence, alexithymia, social confidence, hobbies, verbal and motor development, parents' education level and economic income) evaluated at 13 years of age are only minor predictors of the appearance of low back pain in adults (37 years). In Brattberg's cross-sectional study, 1245 children and adolescents aged 8–17 years were surveyed. The results showed that psychosocial and emotional factors were more important than physical parameters [11].

A recent review was focused on this topic [3].

Other factors

Several other factors that have been studied have not been significantly associated with back pain, viz. means of transport (moped) [5, 64], type of school satchel [64], premature birth [50], familial education level [50] and inequality of leg length [50].

Conclusions

Epidemiological surveys among children and adolescents carried out in the general population evaluate the cumulated (lifetime) prevalence of low back pain at between 30% and 51%. This figure quantifies subjective morbidity. In studies involving a physical examination, morbidity has been estimated to be between 14% and 43%. In a study that is probably the best available about this topic [12], the average annual incidence of low back pain was estimated to be 15.6%. This lumbar pain was often recurrent (50% on average) [12]. Some cases (8%) already had a chronic evolution [48]. Similar figures of incidence have been reported by other authors [15, 39, 48].

Most of the studies carried out to investigate risk factors have the major disadvantage of being cross-sectional. For this reason it is not always possible to distinguish etiologic from prognostic factors. Moreover, the studied populations have not always been controlled for possible confounders.

Increase in age (odds ratio 35), history of spinal trauma (OR = 5), family history of back pain and/or LBP, trunk asymmetry, increased height, smoking, female gender, competitive sports, high level of physical activity, depression and emotional or stress factors (OR = 1–3) are factors that have been found to be significantly associated with low back pain. One study indicates the significance of early degenerative findings of the lower lumbar disks [46].

The role of certain factors still remains controversial, namely: reduced flexibility of the posterior muscles of the thigh, poor school performance, low level of physical activity and reduced sagittal mobility of the lumbar spine. Other factors do not seem to be significantly associated with LBP, namely being overweight, sagittal postural faults and strength of the anterior and posterior trunk muscles. Finally, sitting is recognised as being the main aggravating factor of low back pain.

In future the importance of methodological questions should be given greater emphasis. Unfortunately, there is currently a lack of agreement between authors in terms of definitions of LBP, associated factors, consequences of pain, etc. We definitely need a consensus concerning the above-mentioned variables as well as about the way to evaluate outcomes in these age groups. Moreover, longitudinal epidemiological studies are mandatory in order to better comprehend the natural history of low back pain and the risk factors involved in the long term as well as to advance our understanding of the transition process between benign and chronic low back pain, and between adolescents' and adults' low back pain.

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