

Epidemiology of Adolescent Spinal Pain

A Systematic Overview of the Research Literature

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Study Design. Systematic literature review.

Objective. To explore the available research literature, and provide an up-to-date synthesis of the epidemiology of idiopathic adolescent spinal pain (IASP).

Summary of Background Data. IASP and its potential causes have been a concern to researchers for over 2 decades. Because it has been suggested that IASP is related to the incidence of adult spinal pain, it appears important to synthesize what is currently known about IASP.

Method. A systematic meta-synthesis approach was used to identify secondary review articles and primary epidemiological studies regarding any type of IASP (neck, upper back, or low back).

Results. A total of 56 primary epidemiological (cross-sectional or longitudinal) studies were identified. Spinal or back pain was the most commonly reported measure, with the lifetime prevalence figures ranging from 4.7% to 74.4%. The lifetime prevalence of low back pain had a similar range, 7% to 72%. The prevalence of pain in other areas of the spine (*i.e.*, thoracic spine and neck) was variably reported, as were incidence rates for all areas of the adolescent spine. IASP is thus a significant problem, and the prevalence figures approach those of adults. There is some evidence that IASP is a risk factor for spinal pain in adulthood. However, there was considerable variation in how back pain was defined, the areas of the spine that were reported on, the manner in which data were collected and reported, thus preventing any significant comparisons of prevalence or incidence rates across studies.

Conclusion. Although there is wide discrepancy in the manner in which adolescent spinal pain is reported, it is evident that lifetime prevalence rates increase steadily with age and approximate adult levels by around the age of 18 years. There is an opportunity for further longitudinal research, with standardized methodology, to be undertaken that builds on the findings from this large group of studies.

Key words: adolescent, spinal pain, back pain, low back pain, neck and shoulder pain, prevalence, incidence, epidemiology. *Spine* 2007;32:2630–2637

Since the 1980s, idiopathic adolescent spinal pain (IASP) and its potential causes have been a concern to researchers. It has been suggested that IASP is related to the inci-

dence of adult spinal pain, possibly by underpinning the establishment of psychosocial patterns, postures, experiences, attitudes, concepts, beliefs, and behaviors related to recurrent pain events.^{1–2} Although the incidence of depression, anxiety, drug addiction, and eating disorders significantly increases during adolescence, and the risk of death is much higher in this period than in any other stage of life,³ adolescence is generally considered a healthy time period from a musculoskeletal perspective.¹ Spinal pain, however, appears to be a “normal life experience”⁴ for many young people.

Improving our understanding of IASP, including its impact and potential causes, requires an understanding of earlier research findings, in particular the methodologic processes underpinning standardization of data recording. This article explores the currently available research literature regarding the epidemiology of IASP, using a systematic meta-synthesis approach and provides a synthesis of what is currently known about IASP prevalence and incidence, with suggestions for standardization of research methodology to facilitate comparison and synthesis of the literature in the future.

■ Methods

The aim of the review was to explore the available research literature, and provide an up-to-date synthesis of the epidemiology of IASP, including the methodology underpinning the research literature.

Studies included in this review were secondary review articles that used a systematic approach to data identification, and primary epidemiological studies (either cross-sectional or longitudinal). Any type of spinal pain was eligible for inclusion in the review [neck, upper back, and low back pain (LBP)].

Search Strategy. The search terms employed for this review were adolescent (teenager, young person), spinal pain (headache, neck pain, upper back pain, LBP), epidemiology, prevalence, incidence, cross-sectional and longitudinal.

Sources of Data. The library databases explored for this study included Medline, CINAHL, and AMED.

Data Extraction. A purpose-built data extraction sheet (Appendix 1, available online through Article Plus) recorded information on the country of study location, the age range of subjects, the location of data collection (school, home, *etc.*), type of epidemiological study design (cross-sectional, longitudinal), year(s) of data collection and the statistics reported (prevalence, incidence, *etc.*).

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Table 1. Spinal Pain Prevalence Data

Author	Age of Subjects	Point	1 Wk	1 Mo	3 Mo	1 Yr	Lifetime
Troussier <i>et al</i> ¹⁴	10–14	14.3–24					22.3–41.4
Viry <i>et al</i> ¹⁵	8th grade	27.6				82.9	
Balague <i>et al</i> ¹⁶	7–17		16				46
Balague <i>et al</i> ¹⁷	11–15		13				44
Balague <i>et al</i> ¹⁸	8–16		12				34.2
Balague <i>et al</i> ¹⁹	12–17						74
Wedderkopp <i>et al</i> ²⁰	8–10, 14–16			39			
Roth-Isigkeit <i>et al</i> ²¹	4–18				30.2		
Groholt <i>et al</i> ⁶	7–17						4.7
Romicka <i>et al</i> ²²	6–17						10.1
Petersen <i>et al</i> ²³	6–13						18
Ghandour <i>et al</i> ¹³	6–10th grade						23.6
Fairbank <i>et al</i> ²⁴	13–17						26
Kujala <i>et al</i> ²⁵	10–13						28
Brattberg ²⁶	8–17						29*
Troussier <i>et al</i> ²⁷	6–20						51.2
Sheir-Neiss <i>et al</i> ²⁸	12–18						74.4
Kristjansdottir ²⁹	11–12, 15–16						78.2†

*longitudinal study.

†Includes headache, stomach and back pain.

■ Results

Study Types

This search identified 3 distinct types of primary studies: cross-sectional (N = 43), longitudinal reporting prevalence data only (N = 6), and longitudinal reporting incidence data (which could include prevalence data) (N = 6).

Countries of Origin or Ethnicity

The studies were predominantly conducted in the western world as seen in Appendix 1 (available online through Article Plus).

Method of Data Collection

Data on spinal pain were collected in most instances by self-administered questionnaires. There was considerable variation, both between and within studies, in the methods used to administer questionnaires, as seen in Appendix 1 (available online through Article Plus).

Description of Spinal Pain

Spinal pain was variably reported in terms of “LBP,” “thoracic,” “upper back” or “dorsal pain,” “neck pain” (including various combinations of these areas *e.g.*, neck and thoracic pain), or generic “back pain.” Where generic “back pain” was measured, information was variably presented with regard to the specific sections of the spine (Appendix 1, available online through Article Plus).

Sampling Methodology

Most of the epidemiological studies on IASP sampled students from local schools, although Iwamoto *et al* (2004)⁵ used a group of athletes. Seven studies^{2,6–11} used a population approach to sampling by accessing national databases with sample numbers ranging from 335¹¹ to 189,894⁷ (Appendix 1, available online through Article Plus).

Age and Gender of “Adolescents”

All cross-sectional studies collected data from both genders, with the exception of 2 studies (boys only¹² and

girls only¹³). Inconsistent data reporting in the articles reviewed precluded comparison of prevalence data across all studies, by age and gender (Appendix 1, available online through Article Plus).

Prevalence

Prevalence data for IASP was provided by both cross-sectional and longitudinal studies (Appendix 1, available online through Article Plus).

Spinal Pain Prevalence. Table 1 presents data on the range of spinal pain prevalence data found in the literature. Spinal or back pain was most often reported as lifetime prevalence, with figures ranging from 4.7%⁶ to 74.4%²⁸ and 78.2%,²⁹ although the latter study included headache and stomach ache, in addition to back ache.

LBP Prevalence. LBP was typically reported in terms of lifetime prevalence (*i.e.*, “have you ever suffered from LBP?”) with figures ranging from 7%⁸ to 72%.³⁰ Prevalence rates for LBP in the last year ranged from 7%⁸ to 50.8%,³¹ as can be seen in Table 2.

We collated the prevalence figures for studies investigating adolescent LBP. Studies with subjects younger than 10 years of age, or who were vague in their description of LBP were excluded. Prevalence figures from 29 studies were extracted to form a picture of the variability of the adolescent LBP prevalence figures in the literature. Figure 1 demonstrates the spread of LBP prevalence data related to recall periods of up to 1 week, 1 month, and lifetime. The spread of data in the 1 week and 1 month data sets were less marked, (2.2%–38%, N = 12, and 2.4%–44.5%, N = 10, respectively) than that of lifetime prevalence (7%–84%, N = 19).

Neck, Thoracic and Shoulder Pain Prevalence. Pain prevalence data for the neck, thoracic spine and shoulder was variably reported (*i.e.*, neck and thoracic spine, neck

Table 2. Low Back Pain Prevalence Data

Author	Age	Point	1 Wk	2 Wk	1 Mo	3 Mo	6 Mo	1 Yr	Lifetime
Leboeuf-Yde and Kyvik ⁸	12–41	1–14						7–56	7–67
Burton <i>et al</i> ⁴	11–16	3.2–12.9*							11.6–50.4*
Ebrall ¹²	12–19 (males)	16.7							40.3
Shehab <i>et al</i> ³²	10–18	35							57.8
Staes <i>et al</i> ³³	15–21	38.5							47.8
Balague <i>et al</i> ¹⁶	7–17		11.4						35
Balague <i>et al</i> ¹⁷	11–15		9.5						33
Whitfield <i>et al</i> ³⁴	13, 16		35						
Balague <i>et al</i> ¹⁸	8–16								21
Balague <i>et al</i> ¹⁹	12–17				24.3				51
Murphy <i>et al</i> ³⁵	11–14		20		36				
Grimmer and Williams ³⁶	12–18			15.2–44.3					
Salminen <i>et al</i> ³⁷	14				10.8				30
Watson <i>et al</i> ³⁸	11–14				24				
Staes <i>et al</i> ³⁹	16–18				24.7				
Perquin <i>et al</i> ⁹	4–18					54			
Mierau <i>et al</i> ⁴⁰	14–18						33		
Hakala <i>et al</i> ⁷	12–18						8–13 (females) 7–17 (males)		
Nissinen <i>et al</i> ⁴¹	12–14				9.8			17.6	
Taimela <i>et al</i> ²	7–16							9.4 (females) 10.1 (males)	
Prista <i>et al</i> ⁴²	11–16							13.5	28
Kujala <i>et al</i> ²⁵	10–13							21	
Kujala <i>et al</i> ⁴³	10–16							12–38 (athletes)* 3–9 (nonathletes)	
Kujala <i>et al</i> ⁴⁴	10–17							10.7	
Hestbaek <i>et al</i> ¹¹	12–22							38 (females)* 32 (males)	
Kristensen and Ommundsen ⁴⁵	15							22	63
Olsen <i>et al</i> ⁴⁶	11–17							22	30.4
McMeekan <i>et al</i> ⁴⁷	9–27							35	50
Vikat <i>et al</i> ¹⁰	12–18								8
Fairbank <i>et al</i> ²⁴	13–17								8.5
Burton <i>et al</i> ⁴	11–16								11.6–50.4*
Feldman <i>et al</i> ⁴⁸	13–15								38*
Jones <i>et al</i> ⁴⁹	10–16	15.5							40.2
Cakmak <i>et al</i> ⁵⁰	University								40.9
Lebkowski ⁵¹	17 (mean)								60
Harreby <i>et al</i> ⁵²	School	19*						63*	70*
Harreby <i>et al</i> ³¹	13–16	5.3	13.9		30.6			50.8	58.9
Korovessis <i>et al</i> ³⁰	9–15								9–78 (females) 6–29 (males)

*longitudinal study.

and shoulder) as seen in Table 3. The lifetime prevalence of “neck pain” ranged from 3%¹⁶ to 8%.⁷ Thoracic pain lifetime prevalence varied from 9.5%¹⁶ to 72%.³⁰ Because of the paucity of literature pertaining to prevalence figures for adolescent neck, thoracic, and shoulder pain, it was not considered feasible to pool results to examine the spread of data.

Incidence

Spinal Pain Incidence. Table 4 presents pain incidence data for all regions of the spine.

Statistical Analyses in Longitudinal Studies. A number of studies used odds ratios (OR) to test the relationship between pain reports at baseline to pain reports at follow-up. Harreby *et al*,⁵² in a 25-year longitudinal study, found that genetic factors and LBP in the adolescent period were significantly associated with adult LBP (OR 2.81, $P = 0.00$; OR 2.23, $P = 0.03$). Hestbaek *et al*¹¹

reported a significant increase in the probability of having LBP in the previous year [OR 1.87, 95% confidence interval (CI) 1.52–2.32], as well as persistent LBP (>30 days in the previous year) (OR 1.43, 95% CI 1.18–1.73), at 8 years follow-up in the case of LBP for more than 8 days in a year during adolescence. Siivola *et al*⁵⁴ calculated the relative risk of having weekly neck and shoulder pain 7 years later (*i.e.*, adults aged 22–25 years of age) as significant (relative risk 2.5, 95% CI = 1.1–2.8) for the whole sample, and for females only, who had frequent neck and shoulder symptoms during adolescence.

Summary of Findings

Tables 1 to 4, and Appendix 1 (available online through Article Plus) provide a summary of the findings of this literature review. The prevalence of IASP varied widely across the literature, although there was a tendency for prevalence and cumulative incidence of the various spinal pains to increase as subjects age increased.

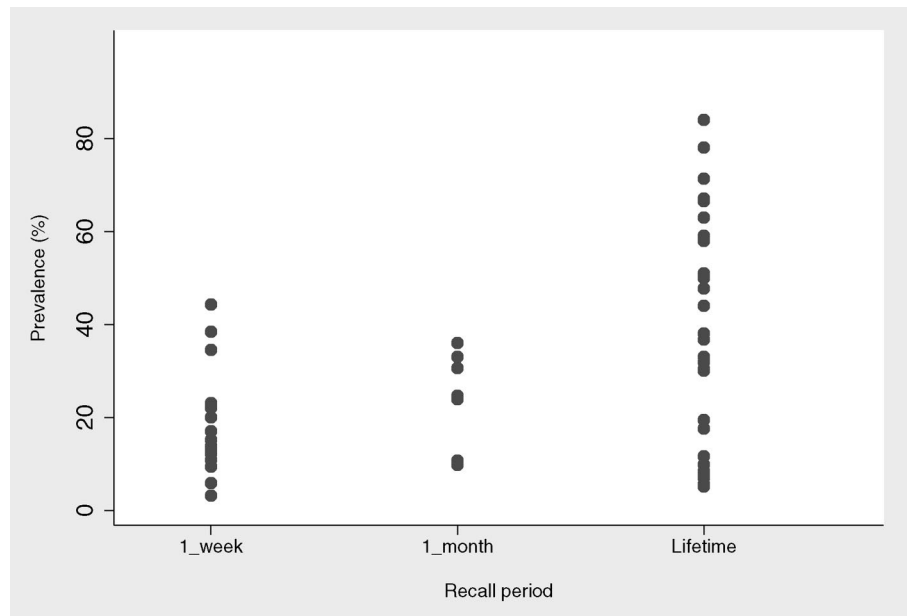


Figure 1. Spread of LBP prevalence data.

Discussion

This systematic review of the literature from 1984 onward confirms the high rates of childhood and adolescent LBP found in an earlier review by Duggleby *et al.*⁵⁸ Of concern is that a history of spinal pain has been reported as a strong predictor of future spinal pain.⁵⁹ Because the incidence of IASP is almost comparable to that of the adult population by the end of adolescence,¹⁷ it is perhaps not surprising that various authors have postulated on the likely link between adolescent and adult spinal pain.^{4,11,48}

Study Types

Despite the plausible rationale that IASP could progress to adult spinal pain, the literature is limited by small

numbers of longitudinal studies. Few studies^{7,11,52,54,55} have followed up subject samples for sufficiently long periods of time. Of these studies, all except one⁵⁵ found that the presence of spinal pain at baseline was a significant risk for spinal pain in adulthood. Furthermore, onset of pain early in life has been affirmed as predictive of chronicity.²⁶ Thus, the evidence from this small number of longitudinal studies lends support to the notion that adolescent spinal pain is an important predictor of adult spinal pain.

Countries of Origin or Ethnicity

Only 3 studies,^{32,42,50} focused on the epidemiology of IASP outside the developed countries. Inferences about the scope of this problem outside the developed coun-

Table 3. Neck, Thoracic and Shoulder Pain Prevalence Data

Author	Age of Subjects	Area Included	1 Wk	1 Mo	6 Mo	1 Yr	Lifetime
Kujala <i>et al</i> ²⁵	10–13	Neck				13	
Kujala <i>et al</i> ⁴⁴	10–17	Neck				18.6	
Hakala <i>et al</i> ⁷	12–18	Thoracic Neck			24–45 (females) 12–19 (males)	7.6	
Whitfield <i>et al</i> ³⁴	13, 16	Neck	44.3				
Murphy <i>et al</i> ³⁵	11–14	Upper back Neck	36.4 23	49			
Balague <i>et al</i> ³¹	7–17	Upper back Neck	17	30			3
Balague <i>et al</i> ¹⁷	11–15	Thoracic					9.5
Balague <i>et al</i> ¹⁸	8–16	Neck + thoracic	3.5				12
Balague <i>et al</i> ¹⁹	12–17	Neck + thoracic					13.2
Vikat <i>et al</i> ¹⁰	12–18	Neck, thoracic					8
Niemi <i>et al</i> ⁵³	High school students	Neck + shoulder					21
Korovessis <i>et al</i> ³⁰	9–15	Neck + shoulder					15
Siivola <i>et al</i> ⁵⁴	15–18 22–25	Dorsal (thoracic) spine					21 (females) 10 (males)
		Neck + shoulder					9–72 (females) 11–38.5 (males)
							17
							28*

*longitudinal study.

Table 4. Spinal Pain Incidence Data

Author	Area	Age at Baseline	Age at Follow-Up	6 Mo Incidence	1 Yr Incidence	2 Yr Incidence	Lifetime Incidence
Brattberg ²⁶	Back	8, 13, 15	10, 15, 17			20	
Brattberg ⁵⁵	Back	8, 11, 14	21, 24, 27				31
Burton <i>et al</i> ⁴	Low back	10, 13, 16	21, 24, 27		11.8		43
Feldman <i>et al</i> ⁴⁸	Low back	11	12		21.5		
Feldman <i>et al</i> ⁴⁸	Low back	13–15	+6 mo	12.7	17.2		
Nissinen <i>et al</i> ⁴¹	Low back	12–14	+12 mo		17.6		
Salminen <i>et al</i> ⁵⁶	Low back	15			32 (females)		42 (females)
Iwamoto <i>et al</i> ⁵	Low back	High school footballers			33 (males)		33 (males)
Feldman <i>et al</i> ⁵⁷	Neck and upper limb	13–15	+6 mo	19.9	28.4		54.1 RA+
Siivola <i>et al</i> ⁵⁴	Neck and shoulder	15–18	+12 mo	59			37.1 RA–

RA+ indicates radiological abnormalities; RA–, no radiological abnormalities.

tries, therefore, cannot be made. Only 1 study⁴⁶ considered the influence of ethnicity or race in pain reporting, and found that the only significant difference was that 15-year-old black adolescents reported higher prevalence rates of LBP than 15-year-old white adolescents (pp. 607).

Method of Data Collection

There was considerable variation in the method of data collection, and this may have been a significant contributor to the variation in prevalence and incidence figures reported in the literature. Although most questionnaires were self-administered, some studies used interviews^{4,20} and others used a mixed method of interview and questionnaire^{17,30,32,40,41} or weekly information from coaches about players with LBP with a follow-up physician assessment.⁵

Questionnaires were most commonly administered at school (24%) or at home (24%); however, some studies (16%) administered the questionnaires to older students at school, while younger students completed the questionnaires at home with parental assistance.^{2,9,16,18,21,23,26,27} It was often unclear to what extent parents assisted their children in completion of the questionnaires at home. The remaining studies did not clearly report location of administration.

The process by which data are collected is an important consideration when attempting to compare studies, and even within a study a change in methodology from self reported surveying to parental assisted reporting may introduce the potential for differences in prevalence rates to reflect an artifact of the varying methodology.⁹

It has been reported that although there is a correlation between adolescent and parent-reporting of pain, it is not recommended that they are used interchangeably.⁶⁰

Description of Spinal Pain

Areas of the spine were often grouped in various combinations (*i.e.*, “spinal pain” or “thoracic and neck pain”), making it difficult to extract the prevalence and incidence of pain for each region of the spine. Differences in defi-

nitions and delineations of pain made it difficult to contextualize results.

Lifetime prevalence and 1 year prevalence were the most commonly reported measures of IASP. These measures are, however, subject to “memory decay”⁶¹ (p. 1749) where episodes of pain are likely to be forgotten with the passage of time, and “forward telescoping of events,”⁶² where there is a “tendency to recollect events such as back pain as having happened more recently than they did” (p. 789). Support for the influence of “memory decay” was found in a Finnish study,⁶³ in which 26% of adult males who reported sciatica in 1 questionnaire denied it 3 years later. Given this significant rate of “memory decay” in adult subjects it is interesting to hypothesize the potential influence on adolescents. Burton *et al*⁴ found a high level of forgetfulness of previous LBP (12 month prevalence) in a group of 216 adolescents studied over the 5 years of their secondary schooling. Almost 60% of the students who reported LBP forgot at least 1 previous episode of spinal pain during annual questioning. It could be hypothesized that the greater spread of data in the longer recall periods (Figure 1) is a reflection of influences such as memory decay. Given this spread it appeared that the most reliable period for recall in prevalence data collection is up to and including 1 month as it minimizes the potential biases of recollection.⁶¹ This provides further support for Staes *et al*'s³⁹ concerns regarding the validity of longer term recall in the collection of history of LBP data from adolescents. Staes *et al*³⁹ limited their study recall period to 1 month because it was assumed that longer time recalls resulted in unreliable data. Similar concerns regarding longer time recall periods have been reported by Goodman and McGrath⁶⁰ (1 year prevalence) and Hestbaek *et al*¹¹ (lifetime prevalence).

Sampling Methodology

Most studies used a convenience sample made up of school students; however, it is unclear whether children who are absent or do not attend school are significantly different (and in which way) from those who regularly

attend school. Samples of convenience further restrict the extrapolation of results to the wider population.⁶⁰ National population based surveys are often the best sampling model as they facilitate large sample numbers, eliminate potential biases from studying a discrete sample group, and therefore enhance the applicability of results across different population groups.

Age and Gender of “Adolescents”

The World Health Organization⁶⁴ defines adolescence as the period between 10 and 19 years of age. The United Nations Population Fund⁶⁵ further divides the World Health Organization definition into early adolescence (10–14 years of age) and late adolescence (15–19 years of age). Up until the age of ~10 years of age the growth and development of males and females is remarkably similar.⁶⁶ Beyond the age of 10 years, as a by-product of the process of puberty, the growth patterns of males and females diverge significantly, both between genders, between individuals and even within individuals.⁶⁶ Puberty is considered to have stopped by at least 18 or 19 years of age. Given the potential influence of puberty-directed growth on the incidence or prevalence of adolescent spinal pain⁴⁸ it is important we ensure that the range of pubertal ages are considered in epidemiological studies.

Most of the longitudinal studies included in this review began collecting data from children during late primary school or early high school age (range, 8–15 years) and none of these studies considered or attempted to establish the onset or duration of puberty.

Conclusion

Our aim, to provide an overview of the incidence or prevalence of adolescent spinal pain was compromised by a lack of comparability between the studies reviewed. In particular we were frustrated by a lack of standardization of definitions, data collection processes, and data reporting formats.

We believe that there is considerable scope for standardization of methodologies to provide a more comprehensive picture of the problem associated with IASP. Currently there is no standard way in which spinal pain is defined, collected, or described and thus comparison between studies is constrained.

It seems however, despite significant variability in the way that pain is reported, that there is strong evidence that pain prevalence increases with age in the adolescent period, usually slightly earlier in girls, possibly corresponding with the time of puberty^{1,4,7,8,14,16,27,32,36,45,46} and there is some evidence that it is more common in girls than boys.^{7,14,16,20,26–28,32,36,38,49,52,54} The evidence presented here also demonstrates that the lifetime prevalence rates have reached adult levels by around the age of 18 years.^{4,8,16,45,57} Moreover, recent longitudinal studies indicate that adolescent spinal pain, including the “back,” “neck and shoulder,” and “low back,” in adolescence is significantly associated with spinal pain in adult life. There is an opportunity for further longitudi-

nal research to be undertaken that builds on the findings from this large group of studies.

Recommendations

1. Where possible longitudinal studies should be carried out to clearly demonstrate the changing prevalence of IASP with age, and allow a better understanding of the potential influences of pubertal growth and environmental factors on the risk of developing IASP.
2. Standardization of period prevalence measures between studies would help to ensure that studies are comparable. We recommend that the duration of the period prevalence should be minimized to ensure validity of the data collected, by minimizing the effects of “memory decay” and “forward telescoping of events.”
3. To reduce the potential for bias, and the possibility that any differences in prevalence rates reflect differences in methodology, the same process of data collection (*i.e.*, interviews or questionnaires administered at school or at home) should be used for all subjects within a sample.
4. Standardization of data reporting should be promoted by the peer reviewers of submitted articles. The reporting of prevalence or incidence data per spinal area, age and gender will facilitate the process of collating information about IASP in the community. Data should be presented in numerical format, not just as a graphs or bar charts, where exact data are impossible to identify.
5. National population based surveys should be used if at all possible to enhance the applicability of results across different population groups.
6. It is recommended that either the full age range of adolescents are used as subjects (*i.e.*, 10–19 years of age) or a measure of pubertal development is included in the research methodology to reflect the biologic age of the subject.

Key Points

- Idiopathic adolescent spinal pain (IASP) is a significant public health issue, with prevalence figures in adolescence approaching those in adults by around 18 years of age.
- IASP may be a risk factor for spinal pain as an adult.
- There is considerable variation in research methodology with regard to IASP.



Appendix available online through Article Plus.

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