Eur Spine J (2005) 14: 595–598
DOI 10.1007/s00586-004-0872-4

ORIGINAL ARTICLE

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Anthropometric measurements and growth as predictors of low-back pain: a cohort study of children followed up from the age of 11 to 22 years

Received: 27 July 2004
Revised: 31 October 2004
Accepted: 13 December 2004
Published online: 24 March 2005

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Abstract Body height is an alleged risk factor for low-back pain (LBP) in adulthood, but its importance is obscure during childhood and adolescence. We studied growth for its association with the incidence of LBP in a population study of 430 children who were examined five times: at the age 11,12,13,14 and 22 years. Body height and weight and the degrees of trunk asymmetry, thoracic kyphosis and lumbar lordosis were measured at every examination. The history of LBP was obtained by a structured questionnaire at the ages of 14 and 22 years. The incidence of LBP was defined as pain, which occurred on eight or more days during the past year among those 338 children who had been free from LBP until 14 years of age. Growth of body height between 11 years and 14 years of age predicted the incidence of LBP. Adjusted for sex, the odds ratio (with 95% confidence interval) per an increment of one SD (4.3 cm) was 1.32 (1.06–1.65), the *P* value for trend being 0.03. Growth after 14 years of age was inversely related to the incidence of LBP, but the association did not reach statistical significance (*P* for trend = 0.06). Other anthropometric measurements or their changes were not found to predict LBP. Our results are not compatible with the old myth that spinal growth actually contributes to LBP. But abundant growth in early adolescence may be a risk factor for subsequent LBP.

Keywords Adolescence · Anthropometry · Growth · Low-back pain · Spinal posture

Introduction

Body height is an alleged risk factor for low-back pain (LBP) in adulthood, but its importance is obscure during childhood and adolescence [1, 2, 4]. We have previously reported an association between body height and sitting height at 13 years and LBP at 14 years, whereas growth between 12 years and 13 years did not predict LBP [7].

As part of a comprehensive, population-based study programme, we focused mainly on determining predictors of adolescent idiopathic scoliosis, also the history of LBP was obtained by a structured questionnaire at the ages of 14 and 22 years [8, 9]. The children were examined five times: at the ages of 11, 12, 13, 14 and 22 years; body height and weight and the degrees of trunk asymmetry, thoracic kyphosis and lumbar lordosis were

measured at every examination [6, 8, 11]. In the present study, we report the incidence and predictors of LBP at the age of 22 years.

Materials and methods

The population of this study comprised all the fourth-grade school children of the western school district of Helsinki, Finland, in spring 1986. The sample, design and baseline results have been described earlier [10]. Body height and weight and the degrees of trunk asymmetry, thoracic kyphosis and lumbar lordosis in 1,060 children (515 girls and 545 boys) were assessed annually from the ages of 10.8 years to 13.8 years, the history of LBP was obtained by a structured questionnaire at the ages of 13.8 and 21.9 years.

A total of 855 children (80.7%) participated in the examination at the average age of 13.8 years. These children were invited to a re-examination at the average adult age of 21.9 years. Five participants had died during the follow-up period of 11 years and 45 did not have a permanent address. Of the 803 adults invited, 430 (208 women and 222 men; 53.5 % of those invited, 40.6% of the original cohort) accepted the invitation were examined by one the authors. The mean age of the 430 participants was 21.9 ± 0.3 years (range 20.8–23.3 years).

To obtain the history of LBP, the lower back region was pictured in the questionnaire and also shown by the investigator to the respondent. The duration of pain was defined by pain days in the previous year. The incidence of LBP was defined as pain occurring in eight or more days during the past year among those 338 children who had been free from LBP until 14 years of age.

Predictors of LBP were analyzed with a logistic regression model. The relative risks were expressed as adjusted odds ratios with 95% confidence intervals per an increment of one standard deviation in each independent variable. Both confounding and effect-modifying factors were entered into the models.

This study was conducted in accordance with the Helsinki Declaration and approved by the Ethics Committee of the University of Helsinki.

Results

The lifetime cumulative incidence of LBP increased fourfold during adolescence from 18.4 % in girls and 16.9% in boys to 78.9 % and 78.4 %, respectively. Of those having experienced LBP, a majority recalled less than 8 days with pain (Table 1).

Among the adolescents with no previous history of LBP, growth from 11 years to 14 years was found to predict the incidence of LBP until the adult age of 22 years (Table 2). However, the association did not reach statistical significance among women. The rest of the anthropometric measurements, including both cross-sectional heights at 11 and 14 years of age, showed no association with future LBP.

Table 1 Life-time cumulative incidence (%) of low-back pain, categorized by recall of days with pain, in a cohort of children at 14 and 22 years of age

Days with pain	Men		Women	
	14	22	14	22
None	73.1	21.2	71.6	22.4
1–7	19.0	56.2	15.9	42.9
8–30	5.5	13.5	7.1	23.6
>30	1.6	8.1	4.7	9.6
Daily	0.8	1.0	0.7	1.4

Discussion

A longitudinal design is the most accurate way to investigate risk determinants of diseases in a population. The anthropometric data in this study refer to the time before the development of LBP and thus enabled comparisons of anthropometry and growth between the young adults experiencing LBP and the rest of the population. To our knowledge, there are no previous cohort studies to detect predictors of LBP at young adulthood.

The design allowed comparisons between puberty and adulthood in the cohort representative of Finnish schoolchildren. A major limitation of this study involved the great loss of participants during the long follow-up period of 11 years. More than half of this cohort (59.4%; 323 boys and 307 girls) did not participate in the adult assessment. The lifetime prevalence of LBP increased in this cohort from 17 % at the average age of 14 years to 76% at the average age of 22 years in agreement with two national Finnish surveys [3, 7].

Self-reported pain is generally used as an outcome in epidemiological studies. We have not tested the reliability of our questionnaire, but there is no reason to suspect that it would substantially differ from that of other questionnaires. The risk of recollection bias is of course possible, but it is likely to result in conservative estimates (type 1 error) rather than false-positive associations (type 2 error). It is not probable that pubertal growth could affect the recollection of LBP at the age of 22 years.

Abundant growth in early adolescence carried a statistically significant risk for boys. In girls the effect of abundant growth seemed similar, but did not reach statistical significance.

Table 2 Odds ratio (*OR*) of low back pain at 22 years of age and 95% confidence interval (*CI*), per an increment of one standard deviation of the explanatory variable

Measurement	Men		Women		All	
	OR	95% CI	OR	95% CI	OR	95% CI
Body height at 11 years	0.94	0.69–1.28	0.76	0.55–1.05	0.85	0.68–1.06
Change of body height from 11 to 14 years	1.36	1.01–1.85	1.25	0.92–1.69	1.32	1.06–1.66
Body height at 14 years	1.00	0.73–1.36	1.08	0.79–1.48	1.03	0.83–1.29
Change of body height from 14 to 22 years	0.87	0.64–1.16	0.85	0.61–1.16	0.81	0.60–1.11
Sitting height at 11 years	0.95	0.69–1.31	0.98	0.72–1.34	0.97	0.77–1.21
Change of sitting height from 11 to 14 years	1.21	0.89–1.65	0.99	0.73–1.36	1.11	0.89–1.38
Sitting height at 14 years.	1.14	0.84–1.54	0.97	0.71–1.33	1.07	0.85–1.33
Change of sitting height from 14 to 22 years	0.87	0.64–1.19	0.87	0.64–1.19	0.84	0.63–1.11
Body mass index at 11 years	1.01	0.72–1.41	0.93	0.68–1.27	0.96	0.77–1.21
Change of body mass index from 11 to 14 years	0.99	0.72–1.36	1.15	0.80–1.67	1.07	0.83–1.36
Body mass index at 14 years	1.01	0.74–1.38	1.00	0.73–1.36	1.00	0.80–1.25
Change of body mass index from 14 to 22 years	1.03	0.77–1.37	1.16	0.83–1.60	1.09	0.88–1.36
Trunk asymmetry at 11 years	0.83	0.61–1.13	1.09	0.79–1.49	0.95	0.76–1.18
Change of trunk asymmetry from 11 to 14 years	1.03	0.77–1.38	1.07	0.77–1.49	1.05	0.84–1.31
Trunk asymmetry at 14 years	0.90	0.66–1.21	1.14	0.82–1.60	1.01	0.80–1.26
Change of trunk asymmetry from 14 to 22 years	0.96	0.72–1.27	0.86	0.62–1.19	0.91	0.74–1.14
Thoracic kyphosis at 11 years	1.00	0.72–1.39	0.87	0.63–1.20	0.94	0.75–1.17
Change of thoracic kyphosis from 11 to 14 years	1.10	0.81–1.50	0.96	0.70–1.33	1.03	0.83–1.29
Thoracic kyphosis at 14 years	1.10	0.82–1.47	0.89	0.63–1.25	1.00	0.81–1.25
Change of thoracic kyphosis from 14 to 22 years	1.07	0.82–1.41	1.15	0.81–1.64	1.10	0.89–1.37
Lumbar lordosis at 11 years	0.93	0.68–1.26	1.21	0.87–1.67	1.05	0.84–1.32
Change of lumbar lordosis from 11 to 14 years	1.06	0.79–1.42	0.93	0.68–1.29	1.00	0.80–1.24
Lumbar lordosis at 14 years	0.98	0.74–1.30	1.22	0.88–1.69	1.08	0.87–1.34
Change of lumbar lordosis from 14 to 22 years	1.04	0.77–1.41	1.07	0.78–1.47	1.06	0.85–1.14

"Good posture" was considered of utmost importance in the sixties [5]. In the present study, however, neither spinal sagittal posture nor trunk asymmetry predicted LBP.

As LBP is a multifactorial problem—probably also in adolescence—it cannot be predicted by anthropometric variables only, which is a drawback of this study. For socioeconomic status, one could expect a positive association but hardly a negative one with pubertal growth. Thus, socioeconomic status would suppress rather than confound the association that we found between growth and LBP. However, confounding due to unknown factors remains possible. Psychological distress, depression and sedentary lifestyle could also determine the occurrence of LBP at young adulthood. In theory, growth might be associated with such traits, but no evidence on this has been presented. Psychosocial factors and poor life coherence may have a strong impact on the experience of LBP also in young adulthood. The potential confounding of these factors was not controlled in this study.

In the present study, a multitude of anthropometric measurements and their changes were analyzed for their prediction of LBP. Since the change in body height proved to be the only significant predictor, we cannot rule out the possibility that this association was due to chance alone. Even if the finding could be replicated in future studies, its practical relevance is quite low.

To our knowledge the present study is the first one to show an association between growth and future LBP in a prospective design. It is premature to speculate about any causal inference or impact on public health, until our results are repeated.

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