

# Half of 12-15-year-olds with knee pain still have pain after one year

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## ABSTRACT

**INTRODUCTION:** Adolescent knee pain is considered benign and presumed to disappear without treatment. However, this has never been investigated. The purpose of this study was to 1) compare leisure time sports participation, health-related quality of life (HRQoL) and body mass index between adolescents with and without self-reported knee pain, 2) investigate how many adolescents still have knee pain after one year and 3) identify risk factors for one-year persistence of knee pain.

**MATERIAL AND METHODS:** The design was a prospective cohort study and a nested case-control study. In September 2011, a total of 768 adolescents between 12-15 years of age from schools in the municipality of Aalborg answered a questionnaire on demographics, sports participation, current pain and HRQoL. After one year, adolescents who reported knee pain at first contact were again contacted by telephone and asked if they experienced knee pain.

**RESULTS:** At first contact, 215 adolescents reported knee pain. Adolescents with knee pain had a significantly higher leisure time sports participation level and a lower HRQoL than adolescents without knee pain. 48.8% (n = 80) still reported knee pain after one year. Female gender, taking part in sports more than twice weekly, lower HRQoL and daily knee pain increased the risk of reporting knee pain after one year.

**CONCLUSION:** Adolescents with self-reported knee pain participate in more leisure time sports and have a lower HRQoL than adolescents without knee pain. 50% had persistent long-lasting knee pain, and a higher frequency of leisure time sports participation increased the risk of reporting knee pain after one year.

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**TRIAL REGISTRATION:** Ethical approval was obtained from the local ethics committee in the North Denmark Region (N-20110020).

Adolescent self-reported pain is prevalent and the knee is one of the regions of the body in which pain is most often reported [1]. In Denmark, 25% of adolescents report having knee pain with patellofemoral pain being one of the most common knee conditions [2, 3]. These

25% represent knee pain with different aetiologies and varying severity [4]. Adolescent knee pain is usually considered benign and self-limiting, although few prognostic studies have been conducted to confirm this assumption [5].

Only one single population-based study has been performed among adolescents [6]. The study investigated the long-term prognosis for pre-adolescent lower limb pain among third graders (ten years of age) and fifth graders (12 years of age). The study reported that 33% still experienced pain after one year. However, the study investigated un-specific lower limb pain, and the long-term prognosis of adolescent knee pain and risk factors for persistent knee pain therefore remain unknown.

The purpose of this study was to 1) compare leisure time sports participation, health-related quality of life (HRQoL) and body mass index (BMI) between adolescents with and without self-reported unspecific knee pain, 2) investigate how many adolescents still have knee pain after one year and 3) identify risk factors for one-year persistence of knee pain.

## MATERIAL AND METHODS

### Study design

The study design was a prospective cohort study and within this, a nested case-control study was conducted. The study was approved by the local ethics committee of the North Denmark Region (N-20110020). The ethics committee did not require individually signed consent, but required that the schools informed the parents about the study and that participation in the study was voluntary. The reporting of the study follows the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.

### Recruitment

In September 2011, eight lower secondary schools in the municipality of Aalborg were invited to answer an online questionnaire and to be part of the Adolescent Pain in Aalborg 2011 (APA2011) cohort [7]. The APA2011 cohort includes almost 4,000 adolescents aged 12 to 19 years, but in this study we only included adolescents aged 12-15 years of age.

The online questionnaire contained demographic

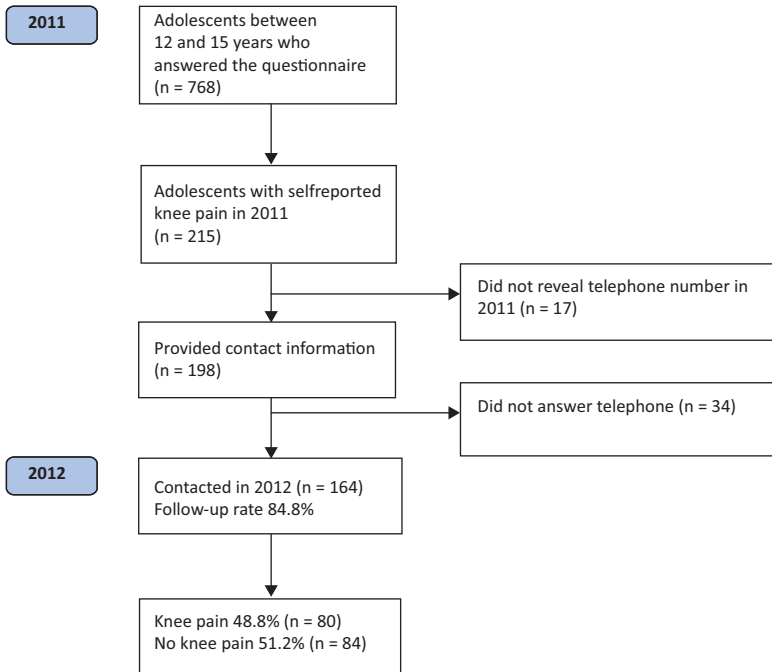
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**FIGURE 1**

Flow chart showing recruitment of adolescents and how many still had knee pain after one year.



questions on age, sex, height, weight, and which school the adolescent attended. After answering the initial demographic questions, the adolescents were presented to a pain mannequin and they were instructed to mark the regions where they currently experienced pain [8, 9]. The mannequin was shown with a frontal and posterior view of the human body. Next to the mannequin, all the body regions were written in letters. Adolescents had the option of clicking on the name of the region, or pressing the specific region of the body where they were experiencing pain. After they had selected a region, it became grey so that they could see which regions of the body they had selected. Afterwards, they were asked separately about the pain frequency of the selected regions. The frequency of pain was chosen as a simple measure of pain severity, as higher frequency of pain has been associated with higher pain intensity [10]. Pain frequency was divided into the following five categories: rarely; monthly; weekly; more than once per week; almost daily. Following the pain mannequin and pain frequency questions, the adolescents were asked about leisure time sports participation (sports activity besides the mandatory physical education classes during school hours) (yes/no), and how many times they participated each week. No questions were asked regarding the origin of the knee pain (traumatic or non-traumatic). The

last page of the questionnaire contained the youth version of the EuroQoL-5 dimensions (EQ-5D) measuring HRQoL [11].

### Participants

In all, 768 out of the 1,161 potential responders (response rate of 66%) between 12-15 years answered the online questionnaire in September 2011. After one year, adolescents who reported knee pain at first contact were again contacted by telephone and asked if they experienced knee pain, **Figure 1**. The follow-up interviews were conducted in a structured manner during which the interviewer followed a pre-defined, standardised protocol.

### Statistical analysis

Wilcoxon signed rank test and test of proportion was used to compare leisure time sports participation, HRQoL and BMI of adolescents between 12-15 years with and without knee pain. The number of adolescents who were still having knee pain after one year was described as a percentage. A logistic regression model with robust variance estimates that adjusts for within-cluster correlation within schools was used to investigate if gender, age, leisure time sports participation, HRQoL and frequency of pain were associated with the risk of reporting knee pain in 2012. The results were reported as an odds ratio. The model construction followed the recommendations from Hosmer and Lemeshow's purposeful selection of variables.

*Trial registration:* Ethical approval was obtained from the local ethics committee in the North Denmark Region (N-20110020).

### RESULTS

From the total sample of 768 adolescents, 215 reported knee pain at baseline in September 2011 (corresponding to a point prevalence of knee pain of 28%, 95% confidence interval (CI): 25-31%). Adolescents with or without knee pain were similar regarding age, gender and BMI. However, adolescents with knee pain had a significantly higher leisure time sports participation level and a lower HRQoL than adolescents without knee pain (**Table 1**).

After one year, all adolescents who reported knee pain at baseline were contacted to determine how many still had knee pain (**Figure 1**). A total of 164 adolescents who reported knee pain in 2011 were successfully contacted in 2012 (follow-up rate 84.8%). The results showed that 48.8% (95% CI: 41.2-56.5) (n = 80) still reported knee pain after one year. The multiple logistic regression analysis showed that female gender, a high leisure time sports participation level (more than two times



TABLE 1

	Knee pain	No knee pain	Difference (95% CI)	p-value
<i>Demographic data</i>				
Age, yrs, mean (interquartile range)	14 (12-14)	14 (12-15)	0 <sup>a</sup>	0.28
Female gender, %	57	51	6 (-1-14)	0.11
Height, cm, mean	166	167	1 (-1-2)	0.34
Weight, kg, mean	54	54	0 (-2-2)	0.85
BMI, kg/m <sup>2</sup> , mean (interquartile range)	18.7 (17.5-19.6)	19.2 (17.3-20.9)	0.5 <sup>a</sup>	0.16
<i>Leisure time sports participation</i>				
%, mean	79	68	11 (4-18)	0.003
Times per week, mean (interquartile range)	3 (1-4)	2 (0-4)	1 <sup>a</sup>	< 0.00001
<i>EQ-5D</i>				
Index score, mean (interquartile range)	0.82 (0.77-0.84)	1 (0.82-1)	0.18 <sup>a</sup>	< 0.00001
Visual analogue scale, mean (interquartile range)	80 (68-89)	85 (75-91)	5 <sup>a</sup>	< 0.00001

Demographic data, sports participation and quality of life are shown for 768 adolescents with and without knee pain.

BMI = body mass index; CI = confidence interval; EQ-5D = EuroQol-5 dimensions.

a) Non-parametric test was performed and therefore no 95% confidence intervals are available and interquartile ranges are presented.



TABLE 2

	Univariate analysis <sup>a</sup>		Multivariate analysis		
	OR <sup>b</sup>	p-value	adjusted OR <sup>b</sup>	p-value	95% CI for adjusted OR <sup>b</sup>
Older age per year increase with 12 years being the referent	1.14	0.30	1.45	0.01	1.07-1.95
Female gender	3.24	0.02	3.66	0.04	1.09-12.33
BMI per point increase in BMI	0.90	0.10	0.95	0.40	0.83-1.08
<i>EQ-5D index score compared to 0-25% quartiles: 0.321-0.771</i>					
25-50th percentiles: 0.771-0.824	0.29	< 0.001	0.33	0.001	0.17-0.65
50-75th percentiles: 0.824-0.919	0.11	0.10	0.12	0.13	0.01-1.82
75-100th percentiles: 0.919-1.000	0.08	< 0.001	0.13	< 0.001	0.07-0.23
Leisure time sports participation per week: 3-7 times per week compared to 0-2 times per week	1.36	0.29	2.01	0.008	1.20-3.36
<i>Frequency of knee pain compared to rarely</i>					
Monthly	1.28	0.85	1.36	0.82	0.09-20.33
Weekly	3.10	0.36	3.20	0.26	0.42-24.40
Several times per week	4.25	0.24	5.04	0.12	0.67-37.70
Daily	8.53	0.04	6.31	0.03	1.21-33.01

Results from the multiple logistic regression analysis among the 164 adolescents who were successfully contacted in September 2012.

BMI = body mass index; EQ-5D = EuroQol-5 dimensions; OR = odds ratio.

a) The univariate coefficient shows the result from the univariate linear regression analysis between the odds of persisting knee pain and each of the six explanatory variables.

b) OR > 1 indicates that the variable is associated with a higher risk of persistent knee pain, whereas an OR < 1 indicates that the variable is associated with a lower risk of persistent knee pain.

per week), a lower HRQoL and a higher frequency of knee pain increased the odds of having knee pain after one year (Table 2).

## DISCUSSION

This is the first study to investigate leisure time sports participation, HRQoL, BMI and the one-year prognosis of adolescents with self-reported knee pain recruited from a large population-based cohort. We demonstrated that adolescents between 12-15 years with or without self-reported knee pain were similar regarding age, height, weight and BMI. However, adolescents with knee pain

had a higher level of leisure time sports participation and a lower self-reported HRQoL than those who suffered no knee pain. Furthermore, almost 50% of the adolescents between 12-15 years still reported knee pain after one year. Female gender, a high level of leisure time sports participation, high baseline frequency of knee pain and low HRQoL increased the risk of having knee pain after one year. These findings are important as they suggest that knee pain is associated with poor general health reports during adolescence, and that a significant proportion of adolescents continue to report knee pain which suggests that the long-term prognosis

Adolescent knee pain is highly prevalent and 50% continue to report knee pain after a year.



of adolescent knee pain is not always favourable. The population-based recruitment method gives a unique possibility to study adolescent knee pain without the potential selection bias that occurs as a result of recruitment through general practitioners or specialized sports medicine clinics [4].

#### **Knee pain is prevalent among adolescents**

We found a high prevalence of self-reported knee pain similar to that observed in a previous study [3]. Our results also confirm previous results which indicate that adolescents with lower limb pain have a higher level of leisure time sports participation [6, 12] and that adolescents with knee pain have a lower HRQoL [13] than those who do not experience knee pain.

After one year, 50% of the adolescents still reported knee pain. In 2005, El-Metwalley et al investigated adolescent lower limb pain in a population-based cohort Finland and found that 33% of adolescents still experienced lower limb pain after one year [6]. This is a lower proportion than that reported in the present study, but it does suggest that neither unspecific lower limb pain nor knee pain is a benign and self-limiting condition [6]. These results are supported by Nimon et al who conducted a study among a group of young females diagnosed with idiopathic anterior knee pain [14]. A total of 3.8 years after the initial diagnosis, they discovered that

50% still had knee pain. A follow-up after 16 years showed that 27% still reported knee pain, which further strengthens the assumption that some knee conditions among adolescents are not benign and should be taken seriously [14]. However, not all knee conditions among adolescents have a poor long-term prognosis. Morbus Osgood-Schlatter, which has a population prevalence of 10%, generally has a good prognosis with an expected recovery rate of more than 90% [15, 16].

#### **Risk factors for persistent knee pain**

Three important risk factors for persistent, self-reported unspecific knee pain were identified: leisure time sports participation, frequency of pain and gender. Participation in leisure time sport more than two times per week was associated with an increased risk of reporting knee pain at the one-year follow-up. This is similar to the findings reported by El-Metwalley et al who found that the only prognostic factor for persistent lower limb pain after one year was a high physical activity level [6].

A high physical activity level is a strong predictor of physical activity four years later [17]. These findings are supported by an earlier cross sectional study that also showed a positive association between frequency of physical exercise and lower limb pain [6].

Increasing frequency of pain has previously been associated with an increased risk of persistent pain [18]. These findings were replicated in the present study, and we demonstrated a dose-response relationship between increasing frequency and increasing risk of knee pain at the one-year follow-up. However, the confidence intervals are wide which suggests that other unknown factors also influence the risk of knee pain. Besides high leisure time sports participation and a high frequency of pain, female gender is a consistent prognostic factor for long-term knee pain. Our results support previous studies and show that females have a four times higher risk of persistent knee pain than males [19]. It is unknown if the increased prevalence among females is the result of biomechanics, sensorimotor control, a physiologically altered pain perception or bio-psycho-social factors.

#### **Strengths and limitations**

One of the strengths of this study is that it is based on the recruitment of a population-based sample, which makes the results generalizable to the broader adolescent population. The prospective design with a population-based recruitment is a valid method of assessing both the prevalence and natural course of adolescent knee pain. Even though the adolescents confirmed their knee pain at a one-year interval, we do not know if they had constant knee pain in the period separating the two assessment points. No clinical examination was performed on the 80 adolescents reporting knee pain at



both time points. The clinical diagnosis and the aetiology, including traumatic or non-traumatic origin, of the self-reported knee pain therefore remain unknown. The leisure time sports participation level was only recorded at baseline in September 2011 and the physical activity level at follow-up is therefore unknown.

### Clinical implications

These findings may have important implications for clinical practice. As 50% still reported knee pain at the one-year follow-up, our results do not support the notion that adolescent knee pain is a benign and self-limiting condition. Adolescents with knee pain had a higher level of leisure time sports participation, and high leisure time sports participation furthermore increased the odds of reporting knee pain after one year. This may suggest that modification of leisure times sports participation is a relevant treatment option. However, the effect of activity modification on adolescent knee pain is unknown. Careful consideration is therefore essential before recommending a decreased activity level, as physical activity is highly important during adolescence and has positive effects on weight, physical fitness and HRQoL [20]. Since this cohort likely included adolescents with both insidious and traumatic onset of knee pain, the results suggest that both activity modification and improved rehabilitation may be considered when treating adolescents with knee pain.

### CONCLUSION

Adolescents with unspecific, self-reported knee pain differed from those without knee pain in that they had a higher leisure time sports participation level and lower HRQoL. 50% had persistent and long-lasting knee pain, and a higher leisure time sports participation level increased the risk of reporting knee pain after one year. These results do not support the assumption that all adolescent knee pain is benign and disappears without treatment.

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