We estimated the prevalence of recurrent leg pains, often described as “growing pains” in children 4 to 6 years of age in South Australia. We used a survey of the parents of children 4 to 6 years of age, using a validated questionnaire previously developed for this purpose. The sample was systematic and randomized across rural and urban regions, with a total of 1445 valid responses achieved. Frequency statistics were used to obtain the prevalence estimate. The prevalence estimate obtained was 36.9% (95% CI, 32.7-41.1). This study estimated the prevalence of growing pains in a well-designed sample by using a validated instrument of measure. Previous studies have not addressed this age range discretely. The prevalence estimate demonstrates the community impact of this often disregarded condition.

The prevalence of “growing pains” has been reported in 9 separate studies since 1928. The prevalence estimates from these studies range widely from as little as 2.6%1 to 49.4%.2 The discordance of these results is explained by closer examination of these studies, where there was disparity of sample sizes,1,3,4 age ranges,1,5,6 and often either not controlled or unspecified population sampling.1,3,5-7 In addition, previous research has not clearly defined what has constituted “growing pains”8 or how this has been confirmed in study subjects.9 The current study has used a clear and consistent definition to identify growing pains within all subjects and includes sample size calculation and randomized sampling selection and addresses an age group who have not been previously examined.

In clinical practice, “growing pains” continues to be a widely recognised entity. The context of “growing pains” remains elusive, and there is a need to estimate the prevalence and community impact of the condition. Although previous research has been undertaken, Table I shows the prevalence estimates to date, and it is notable that young children have not ever been examined as a specific cohort.

One of the obstacles to research of this enigmatic condition has been a lack of definition. There is no single, definitive test to diagnose growing pains; hence it continues to be diagnosed more by exclusion than inclusion. Peterson10,11 has provided the best definition, with a summary that guides clinicians. The inclusion criteria for diagnosis of growing pains are intermittent (nonarticular) pains in both legs that generally occur late in the day or at night. The exclusions are the reverse of the inclusions with the addition of physical (swelling, redness, trauma, reduced joint range, limping) and objective (blood tests, imaging) signs. Peterson’s definition was used in this study and is found in Table II. Hence, the aim of this study was to investigate the prevalence of growing pains in children 4 to 6 years of age in a sample from South Australia, through the use of a validated parental questionnaire.

METHODS

Data were collected during school terms in 2002 through the use of a validated questionnaire administered once to parents of children 4 to 6 years in both metropolitan and rural areas of South Australia. The development of this questionnaire has been reported previously.12 A process of triangulation was undertaken to gather information and develop concepts from 3 important sources: the medical literature, parent interviews, and a focus group for children. To examine the internal validity of the questionnaire, themes were identified from transcripts of the interviews and focus group by independent experts and converted to the instrument scales. The questionnaire demonstrated good internal consistency (93% agreement) and good reliability (82.4% agreement).
The questionnaire contains 3 questions that reflect the definition of growing pains used in this study.12 These questions define growing pains within this study and hence confirm that affected children were consistently identified.

**Sampling**

The sample was derived from all schools and child care centers in South Australia by systematic randomized selection.

Children living in rural regions were sourced from schools selected at random from two regional areas. The two regional areas selected were chosen to include variable distance and location from the city of Adelaide: northern and more temperate location versus southern and colder location. Urban children were sourced from schools selected at random from quadrants (north, south, east, west) of the city of Adelaide and surrounding metropolitan areas. The number of schools selected per urban strata were proportional to the population of 4- to 6-year-old children within each strata as obtained and were sent an explanatory letter. Two schools declined to participate. An incentive package consisting of sticker packs were given to children by their teachers upon return of their completed parental questionnaire. An optional “lucky dip” draw for one child to win a prize (brand-name socks, T-shirt, water-bottle, shoes, cap) if the class responses exceeded 80%; if the class response rate exceeded 90%, a class prize of a basketball was awarded and simultaneously a teacher prize (brand-name T-shirt) was also dispensed. Reply envelopes were numbered to identify the school or child center, but individual responses were not identifiable to preserve anonymity.

Upon receipt of completed questionnaires, each questionnaire was numbered to correspond to the class and school identifier used to preserve anonymity.

The population of interest that is children 4 to 6 years of age in South Australia was estimated as 77,132, which was subsequently rounded up to 78,000 for sample size calculations.

Using a sample size and confidence interval calculator,14 a population approximated as 78,000 with 95% CIs set at ± 4% yielded a sample size requirement of 596 children.

**Table I. Summary of the nine published prevalence estimates of growing pains**

<table>
<thead>
<tr>
<th>Prevalence (%)</th>
<th>Sample size</th>
<th>Age (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Williams, 1928</td>
<td>44.4</td>
<td>216</td>
</tr>
<tr>
<td>Brenning, 1960</td>
<td>13.6</td>
<td>257</td>
</tr>
<tr>
<td>Brenning, 1960b</td>
<td>19.8</td>
<td>419</td>
</tr>
<tr>
<td>Oster and Neilsen, 1972</td>
<td>15.5</td>
<td>2178</td>
</tr>
<tr>
<td>Abu-Arafeh and Russell, 1996</td>
<td>2.6</td>
<td>2165</td>
</tr>
<tr>
<td>Mikkelsson et al, 1997</td>
<td>19.8</td>
<td>1626</td>
</tr>
<tr>
<td>Oberklaid et al, 1997</td>
<td>11.5</td>
<td>183</td>
</tr>
</tbody>
</table>

Discordance of estimates is self-evident, with results ranging from 2.6% to 49.4%.

**Table II. Definition of “growing pains,” modified after Peterson (1977, 1986)**

<table>
<thead>
<tr>
<th>Inclusions</th>
<th>Exclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of pain</td>
<td>Persistent; increasing intensity</td>
</tr>
<tr>
<td>Unilateral or bilateral</td>
<td>Unilateral</td>
</tr>
<tr>
<td>Location of pain</td>
<td>Joint pain</td>
</tr>
<tr>
<td>Onset of pain</td>
<td>Pain still present</td>
</tr>
<tr>
<td>Physical examination</td>
<td>Swelling, erythema, tenderness; local trauma or infection; reduced joint range of motion; limping</td>
</tr>
<tr>
<td>Laboratory tests</td>
<td>Objective findings, eg, ESR, radiograph, bone scan</td>
</tr>
</tbody>
</table>

The first four of these criteria were adopted to ensure that children with growing pains were identified with equivalence. Whereas the use of a questionnaire denied access to physical and laboratory information, questions were included to address these areas, albeit with limitation. It is notable that children with growing pains are usually diagnosed clinically and without objective testing being performed.

**Questionnaire Distribution and Returns**

Approval for the study was received from the Human Research Ethics committee at the University of South Australia. School principals/child care center directors were approached by telephone call to explain the study and to seek agreement for the questionnaire to be distributed to the parents of 4- to 6-year-old children in their institution. All schools agreed to participate and were sent an explanatory letter. Two schools declined to participate. An incentive package consisting of sticker packs were given to children by their teachers upon return of their completed parental questionnaire. An optional “lucky dip” draw for one child to win a prize (brand-name socks, T-shirt, water-bottle, shoes, cap) if the class responses exceeded 80%; if the class response rate exceeded 90%, a class prize of a basketball was awarded and simultaneously a teacher prize (brand-name T-shirt) was also dispensed. Reply envelopes were numbered to identify the school or child center, but individual responses were not identifiable to preserve anonymity.

Upon receipt of completed questionnaires, each questionnaire was numbered to correspond to the class and school being surveyed. This number became the identity number used for data entry. Returns not received within 3 weeks of distribution were followed up by telephone inquiry.

**Data Management**

All data were entered into a Microsoft Excel 2000 (Microsoft Inc, Seattle, Wash) spreadsheet. The Excel data sets
were exported to SPSS version 11 (SPSS Inc, Chicago Ill) for construction of an overall data set and subsequent statistical analyses. Data analysis consisted of frequency statistics for the prevalence estimate. Descriptive statistics were used to explore the sample characteristics (means for age/weight/height).

RESULTS

The questionnaire contains 3 questions reflecting the definition of growing pains used in this study. Specifically, the questions ask parents to indicate whether their child has had growing pains and to select description of their child’s pain experiences.

The mean age of subjects was 5.28 (SD, 0.7) years (47% girls). The average weight and height were 21.4 (SD, 4.2) kg and 116.8 (SD, 10.8) cm, respectively.

For 2456 questionnaires, 1544 responses were received, which constituted a 63% response rate across all regions surveyed. When incomplete returns were eliminated, 1445 responses remained for analysis. Although such a response rate is considered to be good in survey research, it was low for a rigorous prevalence estimate. To manage this situation, data were analyzed at >90% response rate for each class group within every school or child center. This approach was used to reduce the strong possibility of responder bias, for example, that parents of children with “growing pains” would be more likely to respond. The >90% response rate data revealed a prevalence estimate of 36.9%.

Setting such stringent response rate levels had the effect of reducing the sample size and hence widened the 95% CIs, which were thus recalculated with the sample size set at 517 (>90% response rate returns).

95% CI equation: ±1.96 \sqrt{\frac{1-\hat{p}}{n}}

[n= sample size (>90% response, n = 517); \hat{p} = sample proportion (36.9% of children with leg pain)]

Hence: ±1.96 \sqrt{\frac{0.369(1-0.369)}{517}}

= 0.0418 ie, 4.2%

Hence, the prevalence estimate (>90% response rate) was calculated to be 36.9% (95% CI, 32.7–41.1).

DISCUSSION

Growing pains were discussed in Maladies de la Croissance some 180 years ago by the French Physician Marcel Duchamp and are still associated with frequent health professional consultations. Three theories have been advanced to explain growing pains: fatigue (an overuse response in active children), anatomic factors (knock-knees, flat feet), or psychologic (part of a wider pain cycle including headache and abdominal pain). Although there is preliminary evidence for the efficacy of muscle stretching and suggestion that in-shoe wedges may be helpful, these approaches are not widely used.

This study estimated the prevalence of “growing pains” in a well-defined and randomized sample of children through the use of a validated questionnaire. The findings of this study are more valid than previous studies because of the large sample size and random selection but also because of the use of a specifically designed and validated survey instrument (Table I).

From reviewing the earlier prevalence estimate origins, it becomes evident that comparison with our current study is difficult. No other study has used a validated questionnaire, which was specifically developed for the purpose of identifying children with “growing pains,” and no other study has sampled in terms of age and generalizability with such definition and randomization. Hence, the prevalence of “growing pains” as defined by Peterson (see Table II) in children 4 to 6 years of age is best estimated within the bounds of this study as 36.9%.

There were limitations to this study. All data were self-reported by the children’s parents, and although the same validated questionnaire was used in all cases, we cannot assume the same clarity of response from all parents due to factors beyond our knowledge and control, for example, interruption while completing the questionnaire. The sample size was reduced and the confidence intervals widened because of the stringency of a 90% response rate being set. An alternative to accepting the widened confidence intervals would have been to extend the data collection and increase the number of valid responses. Considering the additional resources that would be required and that this prevalence estimate is still found within an 8.4% range of 95% confidence, it was decided to use the current sample. It is notable that the very lowest confidence margin of this prevalence estimate is still considerable, at 32.7%.

Recently, the problem of chronic pain in children and adolescents has been reported to have a prevalence of at least 15%, peaking at 14 years of age. This article describes a “diagnostic vacuum” for children in pain while doctors investigate so as not to miss a serious underlying cause. Unhelpful diagnoses such as “psychosomatic” can do little to support the child and family while pain goes unabated. When considering growing pains, one wonders how young children with intermittent pain can be taken seriously or treated effectively when older children with chronic pain are at times dismissed and treated ineffectively because of the paucity of evidence available to guide clinical practice. Eccleston and Malleson discuss the issue of children with untreated chronic pain progressing to adults who are limited by chronic pain and the associated social costs. Similar questions are pertinent with respect to young children who have growing pains and the possible effects on their quality of life in both the short and longer terms. Quality-of-life issues for young children with growing pains are as yet an unresearched area, with preliminary associations being only recently identified. Given the now disclosed and significant prevalence of this childhood complaint, there is cause for further investigation into quality-of-life issues for children and their families who have growing pains, often over many years, and yet whose treatment will be largely home-based.

The existence and community impact of “growing pains” in young children is demonstrated as 36.9% (95% CI,
and hence the need to clarify the underlying cause and subsequently develop effective management practice is supported. Primary health care providers need to be more aware of this too-often-dismissed childhood complaint. Further research into this long-standing and frequently presenting childhood complaint is required.

We thank Brenton Dansie, PhD, for advice regarding statistical analyses; Linda Lang, PhD, for constructive comments; Schools and Child Centers, Staff and Parents within the city of Adelaide at rural regions for helping to administer the survey and for the invaluable responses.

REFERENCES