Short Stature in a Population-Based Cohort: Social, Emotional, and Behavioral Functioning

WHAT’S KNOWN ON THIS SUBJECT: There is a paucity of data regarding potential differences in behavioral and social functioning for children of moderately short stature (height of <10th percentile).

WHAT THIS STUDY ADDS: This study found that short children did not differ from their nonshort peers in a range of social, emotional, and behavioral outcomes, which suggests that there is little, if any, association between short stature and social, emotional, or behavioral difficulties.

abstract

OBJECTIVE: The goal was to determine whether there were significant differences between children of normative versus short stature in behavioral functioning and peer relationships, according to teacher and child reports.

METHODS: The study included 712 boys and girls in the sixth grade, from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development. Main outcome measures included Achenbach Teacher’s Report Form internalizing, externalizing, and total scores; Children’s Depression Inventory scores (child report); Life Orientation Test-Revised scores (child report); Child Behavior with Peers questionnaire asocial with peers, excluded by peers, and peer victimization subscale scores (teacher report); peer social support and victimization scores (child report); and relationships with peers score (teacher report). In bivariate comparisons, these outcomes were compared for children of relatively short (height of <10th percentile) versus nonshort (height of ≥10th percentile) stature, and effect sizes were calculated. Multivariate linear regression models adjusted for maternal education, income/needs ratio, race, and gender.

RESULTS: Effect sizes ranged from 0.00 to 0.35. Short children reported marginally higher levels of self-perceived peer victimization, compared with their nonshort peers. There were no significant differences in the rest of the outcomes for children of short versus nonshort stature, in either unadjusted or adjusted models.

CONCLUSION: Although short children from a population-based sample reported marginally higher levels of self-perceived peer victimization, they did not differ from their nonshort peers in a range of social, emotional, and behavioral outcomes. Pediatrics 2009;124:903–910
Monitoring of linear growth during childhood represents one of the most important tasks for pediatric providers, with the American Academy of Pediatrics recommending measurement of a child’s height and weight ≥20 times from birth through middle childhood.1 Children with growth that falls outside the normative values for stature, particularly children with short stature, defined as a height ranging from <3rd percentile to <10th percentile,2 raise concerns for both pediatric providers and parents. When the child is healthy, parental concern about height often is rooted in the perception that shorter children experience more problems in social, emotional, and behavioral functioning. However, parents may be misattributing these difficulties to short stature when actually they are related to other stressors.3 Previous studies reported that short children have higher rates of behavioral difficulties and lower social competency, compared with children of normal stature.4–6 However, interpretation of those studies was limited by several factors. Some studies included children with growth hormone (GH) deficiency or other syndromes, which made it unclear whether the underlying pathologic condition or short stature are responsible for the difficulties in psychosocial adjustment.5–7 Other studies lacked details regarding subject recruitment and subject nonresponse rates,4,7 which led to uncertainty regarding the representativeness of the samples.8 More recent studies have suggested that short children have normal psychosocial adjustment and the behavioral or social difficulties identified might have been attributed inappropriately to the short stature.9–11 Behavioral and peer-relationship ratings from most studies were mostly self- or parent-reported10–12 or were based on populations from a single medical center.5,10,11 Finally, previous studies included cohorts of children with heights of <3rd percentile. Pediatric providers, however, are confronted more commonly with families concerned about their children with less-extreme short stature (eg, height of <10th percentile), a population that is seeking evaluation for short stature in the pediatric specialty clinic setting13,14 but for which there are relatively few data regarding potential differences in behavioral and social functioning.

We are unaware of studies that have evaluated the relationship between psychosocial adaptation and stature among children of diverse socioeconomic status drawn from a variety of geographic areas. Furthermore, few studies have used both teacher reports and child reports. We sought to test the hypothesis that there would be no significant differences in social, emotional, and behavioral functioning between children of short stature defined as <10th percentile) and those of nonshort stature in a recent, large, population-based cohort of children of diverse socioeconomic status drawn from 10 geographic regions in the United States.

METHODS

Study Group

We used the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development, a population-based, longitudinal study of child behavior and development.15 Recruitment procedures were described previously.

Predictor

The main predictor was height at sixth grade, as measured by trained research assistants.16 We focused on height at 11 years of age because children often present with concerns about height at this age,14 and adolescence is thought to be a period when psychosocial stress associated with short stature is increased.17 Height z scores adjusted for age and gender were calculated by using the 2000 Centers for Disease Control and Prevention growth charts.18 Short stature was defined as height of <10th percentile, nonshort stature as height of ≥10th percentile, and average stature as height between the 25th and 75th percentiles. Comparisons between children with heights of <5th and >5th percentile could not be performed because of the small number of children with heights of <5th percentile (n = 11).

Outcomes

Child Behavior Problems (Teacher Report)

Behavioral problems were assessed by using the Achenbach Teacher’s Report Form (TRF), as previous studies have evaluated potential differences in parent-reported internalizing and externalizing child behavioral difficulties on the basis of stature.4,6 The TRF is a validated standardized questionnaire that assesses behavioral problems among children.19 Scores are reported as T scores, with a mean of 50 and a SD of 10. Higher scores are indicative of more behavioral problems; a score >60 is considered borderline clinically significant.20

Childhood Depressive Symptoms (Child Report)

Because some studies examined potential differences in children’s risk for anxiety/depression on the basis of stature,7 we evaluated for depressive symptoms by using the Children’s Depression Inventory (Short Form), a 10-item questionnaire administered to children.21 Scores range from 0 to 20, with higher scores indicating more depressive symptoms. Scores of >8 for girls and >10 for boys are classified as well above average.
Optimism (Child Report)

Studies also evaluated potential differences in children’s self-concept on the basis of stature; therefore, we evaluated a measure of optimism by using the Life Orientation Test-Revised. Children were asked to respond to questions (Appendix) by using a 4-point scale (1 = not at all and 4 = a lot), with reverse coding as appropriate and with higher values indicating more optimism (actual scores in this sample ranged from 7 to 24).

Peer Relationships

Previous studies evaluated the potential influence of stature on children’s social withdrawal and social competence. Therefore, we assessed peer relationships by using teacher reports from the asocial with peers, excluded by peers, and peer victimization scales of the Child Behavior with Peers questionnaire. Questionnaire items were answered on a 3-point scale (0 = not true, 1 = sometimes true, and 2 = often true) (Appendix). Scores are calculated as the mean of component items, with a possible range of 0 to 2 and with higher scores indicating more problem behaviors.

Child reports of peer victimization and social support from peers were drawn from the Peer Victimization, Social Support, and Bullying Questionnaire. Children responded by using a 5-point scale (never, hardly ever, sometimes, most of the time, or always) (Appendix). Higher scores indicate greater peer victimization or social support.

Popularity

Previous studies tested for differences in children’s social relationships according to stature; therefore, popularity was assessed by using the Relationships with Peers scale. Teachers ranked the child’s popularity among same-gender children and a score was generated, accounting for the number of same-gender children in the class. Scores range from 0 to 1. For example, in a class of 10 same-gender children, the most popular child would have a score of 1 and the least popular child would have a score of 0.1.

Covariates

Gender (female versus male) was included as a covariate because studies have shown that more boys than girls are referred to specialist clinics for short stature. Additional covariates included race (other versus white), income/needs (ITN) ratio, and maternal education (in years). The ITN ratio is represented by total family income relative to the poverty line for a family of a particular size; families with ITN ratios of <1 are considered poor.

The initial sample was composed of 1364 children; by the sixth grade, 1077 families remained in the study. Seven hundred eighty-four children had complete data for height and TRF scores in the sixth grade. Children who were retained a grade (n = 62), skipped a grade (n = 5), or had missing information about their school status (n = 5) were excluded from the sample, because assessment of an association between stature and behavioral functioning or peer relationships could be biased by the inclusion of children who were not at the same stage of growth and development as their classmates. Those with complete data who were included in the analysis (N = 712) did not differ from those without complete data who were excluded from the analysis (n = 652) with respect to ITN ratio (P = .93) or height at first grade (P = .54). Compared with those who were excluded from the analysis, those who were included were more likely to be female (53.0% vs 43.3%; P = .0003), to be white (83.2% vs 77.5%; P = .01), and to have mothers with more years of education (14.5 vs 14.0; P = .0001).

Analyses

Analyses were performed by using SAS 9.1 (SAS Institute, Cary, NC), with separate analyses for each outcome measure (7 scores for the TRF results and raw scores for the other measures). Unadjusted linear regression analyses were performed to assess the associations between stature and each outcome, and effect sizes were calculated. Adjusted, multivariate, linear regression models for each of the behavioral outcomes included the main predictor, that is, stature (short versus nonshort), and the covariates gender, race, ITN ratio, and maternal education. Separate models evaluated the interactions between stature and gender, between stature and maternal education, and between stature and ITN ratio. Because our definition of nonshort stature included tall children at the upper end of the height spectrum and tall children are assumed to be at a particular advantage with regard to stronger peer relationships and behavior, we also performed analyses comparing short children with children of average height (height between the 25th and 75th percentiles), as well as analyses using height z score as a continuous variable.

Finally, logistic regression models were used to evaluate outcome measures dichotomized into abnormal versus normal groups. Adverse outcomes were defined as T scores of >60 for the TRF total and subscale scores and Children’s Depression Inventory scores of >8 for girls and >10 for boys. Scores in the highest quartile defined adverse outcomes for the asocial with peers, peer victimization (both teacher and child reports), and excluded by peers subscales. Scores in the lowest quartile defined adverse
outcomes for the optimism, social support from peers, and popularity scales. Our sample size provided 80% power, with an \( \alpha \) value of .05, to detect a 0.5-SD difference in the outcome measures between short and nonshort children, which we suggest provides adequate power to detect clinically significant differences. To assess whether the differences between short and nonshort groups were clinically meaningful, we calculated Cohen’s effect sizes for each of the outcome measures (Table 1). Cohen’s effect size does not depend on the sample size and often is used to show the magnitude of the differences between groups. The small effect sizes (effect sizes of 0–0.35) indicated that there was no clinically meaningful difference between the short and nonshort groups.

**RESULTS**

The sample (\( N = 712 \)) was 47.1% male and 83.2% white. The mean age was 11.9 years (SD: 0.3 years), the mean length of maternal education was 14.5 years (SD: 2.4 years), and the mean ITN ratio was 4.0 (SD: 2.9). There were no significant differences for short versus nonshort children according to gender, race, maternal education, or ITN ratio. Table 1 shows unadjusted bivariate comparisons for the outcome measures according to stature. The analyses failed to show any statistically significant differences between short and nonshort children. Effect sizes of stature on each outcome are shown in Table 1. The small effect sizes (effect sizes of 0–0.35) indicated that there was no clinically meaningful difference between short and nonshort groups.

Table 2 shows the relationships between stature and outcomes after adjustment for demographic characteristics. We detected a statistical trend suggesting that short versus nonshort children reported marginally higher levels of peer victimization (\( \beta = -0.25 \pm 0.13, P = .052 \)). When we dichotomized the outcome measure of peer victimization into normal versus abnormal groups, short children were more likely to fall into the abnormal group (odds ratio: 2.46 [95% confidence interval: 1.08–5.60]; \( P = .03 \)). Apart from this trend for a single measure, short stature was not a significant predictor of the other outcomes.

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**Table 1: Unadjusted Bivariate Associations Between Stature and Behavioral, Emotional, and Social Outcomes**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Height of ( \geq 10 )th Percentile (( N = 684 ))</th>
<th>Height of &lt;( 10 )th Percentile (( N = 28 ))</th>
<th>( P )</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRF T score, mean ( \pm SD )</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Externalizing</td>
<td>49.73 ( \pm 8.72 )</td>
<td>52.39 ( \pm 10.36 )</td>
<td>.18*</td>
<td>.028</td>
</tr>
<tr>
<td>Internalizing</td>
<td>49.87 ( \pm 8.83 )</td>
<td>50.75 ( \pm 9.56 )</td>
<td>.55*</td>
<td>.10</td>
</tr>
<tr>
<td>Total problems</td>
<td>49.54 ( \pm 9.25 )</td>
<td>51.61 ( \pm 10.78 )</td>
<td>.25</td>
<td>.19</td>
</tr>
<tr>
<td><strong>Children’s Depression Inventory score, mean ( \pm SD )</strong></td>
<td>1.39 ( \pm 2.15 )</td>
<td>1.61 ( \pm 2.45 )</td>
<td>.91*</td>
<td>.13</td>
</tr>
<tr>
<td><strong>Optimism score, mean ( \pm SD )</strong></td>
<td>18.84 ( \pm 2.89 )</td>
<td>19.82 ( \pm 2.44 )</td>
<td>.22*</td>
<td>.27</td>
</tr>
<tr>
<td><strong>Relationship with peers (teacher report)</strong> score, mean ( \pm SD )**</td>
<td>0.39 ( \pm 0.48 )</td>
<td>0.44 ( \pm 0.52 )</td>
<td>.71*</td>
<td>.06</td>
</tr>
<tr>
<td>Asocial behavior</td>
<td>0.32 ( \pm 0.51 )</td>
<td>0.40 ( \pm 0.58 )</td>
<td>.55*</td>
<td>.00</td>
</tr>
<tr>
<td>Exclusion by peers</td>
<td>0.16 ( \pm 0.32 )</td>
<td>0.26 ( \pm 0.48 )</td>
<td>.66*</td>
<td>.18</td>
</tr>
<tr>
<td>Peer victimization</td>
<td>1.71 ( \pm 0.66 )</td>
<td>1.93 ( \pm 0.77 )</td>
<td>.13*</td>
<td>.35</td>
</tr>
<tr>
<td><strong>Relationship with peers (child report)</strong> score, mean ( \pm SD )**</td>
<td>0.56 ( \pm 0.23 )</td>
<td>0.61 ( \pm 0.27 )</td>
<td>.83</td>
<td>.13</td>
</tr>
<tr>
<td>Social support from peers</td>
<td>2.49 ( \pm 0.65 )</td>
<td>2.63 ( \pm 0.83 )</td>
<td>.20*</td>
<td>.05</td>
</tr>
<tr>
<td>Popularity</td>
<td>0.8 ( \pm 0.23 )</td>
<td>0.9 ( \pm 0.27 )</td>
<td>.56</td>
<td>.22</td>
</tr>
</tbody>
</table>

* Nonparametric \( P \) value.

**Table 2: Linear Regression Models Evaluating Associations of Short Stature in Grade 6 With Behavioral and Peer Relationship Outcomes**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>( \beta ) Coefficient, ( \pm SD )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRF T score, mean ( \pm SD )</strong></td>
<td>-0.25 ( \pm 0.13 )</td>
</tr>
<tr>
<td>Externalizing</td>
<td>-0.17 ( \pm 0.14 )</td>
</tr>
<tr>
<td>Internalizing</td>
<td>-0.08 ( \pm 0.11 )</td>
</tr>
<tr>
<td>Total problems</td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
<tr>
<td><strong>Children’s Depression Inventory score, mean ( \pm SD )</strong></td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
<tr>
<td><strong>Optimism score, mean ( \pm SD )</strong></td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
<tr>
<td><strong>Relationship with peers (teacher report)</strong> score, mean ( \pm SD )**</td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
<tr>
<td>Asocial behavior</td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
<tr>
<td>Exclusion by peers</td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
<tr>
<td>Peer victimization</td>
<td>-0.02 ( \pm 0.06 )</td>
</tr>
</tbody>
</table>
Tests of interactions between stature and gender, between stature and maternal education, and between stature and ITN ratio did not achieve statistical significance (data not shown). We also evaluated short versus average stature and evaluated height z score as a continuous variable in these models and found no main effect of stature (data not shown).

**DISCUSSION**

Despite the statistical trend for short stature to be associated with increased self-perceptions of peer victimization, this was not associated with poorer adaptation, as we failed to find that short stature was otherwise associated with adverse behavioral outcomes or peer relationships, as reported by either teacher or child, even after adjustment for demographic co-variates. These findings are congruent with previous studies showing that short children may report higher rates of teasing or victimization but do not experience significant psychosocial problems attributable to their short stature.

Teasing is a normative experience for children; however, we speculate that teasing is a normative experience for problems attributable to their short stature, and evaluated height z score as a continuous variable in these models and found no main effect of stature (data not shown).

These data have clinical utility for pediatric providers confronted with short children in a variety of clinical scenarios. As the primary providers for children with chronic diseases such as attention-deficit/hyperactivity disorder or asthma, pediatric providers often prescribe medications that result in improved disease control but may have untoward adverse effects on growth. Although the data are mixed, some studies have shown that both stimulant use by children with attention-deficit/hyperactivity disorder and inhaled corticosteroid use by children with asthma can be associated with temporary growth deficits. The results of our study allow providers to reassure parents that temporary decreases in growth, leading to short stature, are unlikely to have a significant impact on their child’s quality of life.

Since the approval of GH therapy for idiopathic short stature by the Food and Drug Administration in July 2003, pediatric providers are likely encountering an increasing number of parents inquiring about GH therapy for their child. GH is currently approved only for short but otherwise healthy children in the bottom 1.2 percentile of the height distribution. However, it has been noted anecdotally that an increasing number of parents are seeking evaluation for off-label use of GH therapy, even for children of moderate short stature (eg, 5th to 10th percentile). The results of our study may reassure some parents of children with moderate short stature that such treatment is not warranted to improve their child’s quality of life.

Our inability to detect an association between stature and psychosocial adaptation contrasts with the findings of Stabler et al, who reported higher rates of internalizing and externalizing behavioral problems and lower social competency among 166 children who were referred to a large number of subspecialty pediatric endocrinology clinics for evaluation of short stature (height of <3rd percentile), including 80 children with idiopathic short stature. However, that study was based on a sample of children from the National Cooperative Growth Study, a postmarketing database of children treated with GH for which participating centers were self-selected. Furthermore, that study did not include information about subject recruitment and nonresponse rates for the sample, resulting in the potential for sampling bias.

Other studies based on clinical samples are more consistent with our findings. Sandberg et al evaluated a consecutively recruited cohort of 264 children of diverse racial/ethnic and socioeconomic status who were referred to a pediatric endocrinology clinic because of short stature, defined as height of ≤5th percentile. Those authors found that short stature was not associated with clinically significant psychosocial morbidity. In another clinic-based study, Zimet et al evaluated a sample of 41 consecutively recruited children who were evaluated for short stature (the majority of whom had height of <5th percentile), and they did not find significant psychosocial adjustment problems, compared with published, population-based normative values.

Previous population-based studies also lend support to our findings. In a cohort of 956 children in grades 6 to 12 in a public school district, Sandberg et
al\textsuperscript{17} found no significant differences in peer ratings of friendship, popularity, or reputation for children of short stature (height percentile of $\leq$5th percentile), compared with average stature (height between the 25th and 75th percentiles), and found no evidence for a moderating effect of gender. Given that clinical samples are characterized by overrepresentation of boys,\textsuperscript{14,32} increased referral rates for boys may be prompted more by negative stereotypes of short boys and men than by actual moderating effects of gender on the relationships between height and behavioral and peer outcomes.

We note that interpretation of the absence of significant interactions should be performed with caution, given the number of short children in this sample. We also evaluated height z score as a continuous variable, which would give additional power for examination of the associations. Finally, we examined whether short children were more likely to function in the abnormal ranges of these measures. With the sole exception of child report of self-perceived peer victimization, we did not find an association, which confirmed our findings of a lack of differences between short and nonshort children, even at the extremes of behavioral functioning.

Limitations of our study include the small number of children with height of $<1.2$st or $<5$th percentile and the narrow age range of the children; it is possible that outcomes between short and nonshort children may differ across the age spectrum from early childhood to late adolescence and adulthood. In addition, given that the timing of the pubertal growth spurt varies, we recognize that some children might have had only transient shortness and might be destined to reach a more-typical adult height. Provision of reassuring information regarding behavioral and social functioning to parents of these children remains important even if the short stature is transient. Finally, given the public policy ramifications of GH use for idiopathic short stature, we recognize that additional studies are needed to evaluate behavioral and psychosocial outcomes for children with heights in the bottom 1.2 percentile. Pediatric providers may reassure families that children with stature in the lower ranges of height from a population-based sample do not experience poorer social, emotional, or behavioral functioning, compared with their taller peers. Therefore, changes in management or pursuit of subspecialty evaluation purely on the basis of concerns about psychosocial adaptation seem to be unwarranted. The primary approach for otherwise-healthy children for whom concerns are raised regarding the social, emotional, or behavioral impact of short stature remains reassuring.

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**REFERENCES**


**APPENDIX**

Questions contributing to child report of optimism

In a new or unknown situation, I usually expect the best.
I think that things will go wrong for me.
I’m always positive about my future.
I expect things to go well for me.
I count on good things happening to me.
I expect more good things to happen to me than bad.

Questions contributing to teacher report of child’s behavior with peers

Asocial with peers
Likes to be alone
Keeps peers at a distance
Is a solitary child
Avoids peers
Withdraws from peer activities

Excluded by peers
Not chosen as a playmate by peers
Peers avoid this child
Is excluded from peers’ activities
Is ignored by peers

Peer victimization
Is ridiculed by peers
Is picked on by other children
Is called names by peers
Is pushed around by other children
Peers say negative things about him or her to other children
Is teased or made fun of by peers
Is hit or kicked by other children

Questions contributing to child report of self-perceived peer victimization score

Do any of the kids at school:
Pick on you?
Say mean things to you?
Say bad things about you to other kids?
Hit you?

Questions contributing to child report of social support from peers

Are there kids at your school who:
Tell you you’re good at doing things?
Make you feel better if you’re having a bad day?
Let you play with them?
Would explain the rules to a game if you didn’t understand them?
Make you feel happy?
Share things like books and games with you?
Would help you if you hurt yourself at school?
Tell you you’re their friend?
Help you if kids are being mean to you?
Ask you to play with them?
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