Developmental trajectories of depressive symptoms from early childhood to late adolescence: gender differences and adult outcome

Marielle C. Dekker, Robert F. Ferdinand, Natasja D.J. van Lang, Ilja L. Bongers, Jan van der Ende, and Frank C. Verhulst

Department of Child and Adolescent Psychiatry, Erasmus MC – Sophia Children’s Hospital, Rotterdam, The Netherlands

Background: Limited information is available on gender differences and young-adult poor outcome in children and adolescents following distinct developmental trajectories of depressive symptoms. Methods: Parent information on depressive symptoms of 4- to 18-year-olds from an ongoing Dutch community-based longitudinal multiple-cohort study (N = 2,076) was used to estimate trajectories from semi-parametric mixture models. The identified trajectories were used to predict depressive problems, general mental health problems, referral to mental health care, and educational attainment in young adulthood. Results: In both genders six distinct developmental trajectories were identified. Gender differences existed not only in level, but also in shape and timing of onset of depressive problems. Only in girls was a chronic trajectory of early childhood-onset depression identified. In both boys and girls a group with increasing levels of depressive symptoms was identified that reached a high level around adolescence, although boys showed an earlier onset. Two decreasing trajectories were found in boys, one reaching normative levels of depressive symptoms around late childhood and one around mid-adolescence, while none was found for girls. Individuals who followed elevated trajectories during their whole childhood or starting at adolescence had significantly more depressive and other mental health problems in young adulthood compared to those who followed normative trajectories. Boys in these elevated trajectories showed lower educational attainment, while girls were more likely to have been referred to mental health care. Conclusions: This study shows the value of estimating growth-mixture models separately for boys and girls. Girls with early childhood or adolescence-onset depressive problems and boys with depressive problems during childhood or starting in adolescence are especially at risk for poor outcome as young adults and should be considered candidates for intervention. Keywords: Depressive symptoms, growth mixture model, developmental trajectories, depression, child development, sex differences, longitudinal studies, Child Behavioral Checklist (CBCL), adolescence, adult outcome. Abbreviation: BIC: Bayesian Information Criterion.

Many studies on depression in childhood and adolescence use a static approach to identify a priori defined distinctive subtypes. Groups are, for example, based on DSM-IV diagnostic criteria (APA, 1994). General conclusions based on such studies are that about one-third of the children and adolescents with elevated levels of depressive symptoms continue to show similar levels of problems later in life. These studies also showed that during adolescence, girls start having more depressive problems than boys (Angold, Erkanli, Silberg, Eaves, & Costello, 2002; Fleming & Offord, 1990; Hankin et al., 1998; Twenge & Nolen-Hoeksema, 2002; Wade, Cairney, & Pevalin, 2002). Other studies use dimensional depressive symptom scores. A meta-analysis of 310 samples of 8- to 16-year-olds revealed that females’ depression scores start to increase from age 12 on, while males’ scores remain stable after age 13 (Twenge & Nolen-Hoeksema, 2002). Angold et al. (2002) unexpectedly found that boys’ depression scores showed a fall in mid- to late childhood. The limitations of these types of studies are that they cannot address development over time of depressive symptoms, that some of them use categorical criteria for depression, and that they cannot address developmental heterogeneity across gender and age groups.

Another line of research uses a more dynamic perspective on the development of depressive symptoms by identifying normative growth curves that show how children develop over time regardless of clinical diagnosis (Achenbach & Rescorla, 2001; Garber, Keiley, & Martin, 2002; Kim & Cicchetti, 2006). The studies by Garber et al. (2002) and Ge et al. (2001) both showed that the development of depressive symptoms was best characterized by a U-shaped pattern, with declining depressive symptoms from early adolescence and an increase starting around age 14. Girls generally had more symptoms and an earlier onset. Kim and Cicchetti (2006) found decreasing depressive
symptoms from age 6 to 11 years. The limitation of these studies is that they do not distinguish relatively homogenous subgroups of individuals who follow distinct longitudinal courses of depressive symptoms (Nagin, 1999). This information is of great clinical value, because it can help the search for possible different causes and consequences as a function of differential development over time.

Only three recent studies on depression (Brendgen, Wanner, Morin, & Vitaro, 2005; Rodriguez, Moss, & Audrain-McGovern, 2005; Stoolmiller, Kim, & Capaldi, 2005) have empirically identified subgroups with distinct longitudinal profiles of depressive symptoms. Stoolmiller et al. (2005) studied the depressive symptoms of 206 15- to 24-year-old males from higher crime areas, while Brendgen et al. (2005) studied 414 males and females aged 11 to 14 years. Rodriguez et al. (2005) investigated 925 9th- to 12th-grade high school students. All three studies found four distinct longitudinal trajectories of depressive symptoms when modeling without covariates. The first two studies identified a consistently low and a consistently high depressive symptoms group. However, the direction of the other two profiles differed. Stoolmiller et al. (2005) identified a moderate decreasing and a high decreasing profile, while Brendgen et al. (2005) found a moderate persistent and an increasing profile. Unfortunately, the study by Rodriguez et al. (2005) only presented the shapes of a final three-trajectory model after including covariates, such as lifetime smoking and alcohol use, so direct comparisons were not possible.

These findings strongly suggest the need for studying developmental trajectories of depressive symptoms in boys and girls separately, as well as the need to include a wider temporal window. In addition, the use of a general population sample instead of a high-risk sample is needed, as developmental profiles might be different due to bias caused by selection by comorbidity. For example, disruptive behavior was related to lifetime depression in adolescents and to current depression in adolescent boys (Rohde, Lewinsohn, & Seeley, 1991).

The present study investigated different developmental trajectories of parent-reported depressive symptoms in a large group of community individuals from age 4 to 18 years using a semi-parametric growth-mixture modeling method developed by Nagin (1999).

Based on previous research we expected to find four distinct trajectory groups, with a persistently high and a persistently low group in both boys and girls, but with a higher level of depressive symptoms scores in girls and/or more girls than boys in a high symptom level group. In boys we also hypothesized an increasing-moderate group and a moderate- or high-decreasing group. In girls we expected to find an additional increasing-high group, with a later onset than in boys and a higher end level, and a persistent group with moderate levels of depressive symptoms.

Another goal was to examine the predictive power of each developmental trajectory. We expected children who follow a trajectory that ends at a high level of depressive symptoms in late adolescence to have the highest mean scores on depressive outcome in young adulthood. Furthermore, we assumed that individuals whose development of depressive problems followed a persistent high trajectory were most likely also to have the highest mean scores on other mental health problems and to have a lower educational level, due to the impact of early-onset chronic depressive problems on general adaptive and social functioning (Kessler, Foster, Saunders, & Stang, 1995). Finally, we expected children who follow an elevated trajectory to be much more likely to have received mental health care at any point in their lives compared to normative group(s).

**Methods**

**Participants and procedure**

The present study is part of an ongoing longitudinal multiple-cohort study in the Dutch general population. The original sample of 2,600 children from 13 birth cohorts aged 4–16 years was drawn from the Dutch province of Zuid-Holland in 1983, using municipal registers that list all residents (response = 84.8%). The province encompasses more than 3.2 million inhabitants (about 20% of the Dutch population) in rural to highly urbanized environments. A random sample was drawn of 100 children of each age and gender who had Dutch nationality. Of the 2,447 parents reached, 2,076 responded and provided usable data about their children (84.8%). For details of the initial data collection, see Verhulst, Akkerhuis, and Althaus (1985). Respondents were interviewed at 2-year intervals until 1991, and again in 1997. The Committee for Medical Ethics, Erasmus MC, approved the protocol of this study at each phase. Informed consent was obtained from all participants. In waves 1 to 5 (1983–91), information about behavioral and emotional problems was assessed with the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001).

All children who were at any of the 5 assessments points between 4 and 18 years old were included in this study (Table 1). For 77.1% of the children a completed CBCL was available from at least two assessment waves; 68.3% from at least 3 waves; 50.3% from at least 4 waves; and 38.1% of the wave 1 participants filled out the CBCL at all subsequent waves.

Selective attrition was addressed by comparing the number of waves each respondent participated in to the mean level of wave 1 CBCL Affective Problems and Total Problem score corrected for cohort using analysis of covariance (ANCOVA). No significant differences in the mean level of wave 1 Affective Problems ($F_{(4,2070)} = 2.95, p = .881$) and Total Problems Score($F_{(4,2070)} = .330, p = .858$) were found.

Next, the effect of gender and parental SES on the mean number of waves participated in, controlling for cohort, was assessed using ANCOVA. Parental SES was
scored on a six-step scale of parental occupation (Van Westerlaak, Kropman, & Collaris, 1975), with 1 indicating lowest and 6 highest SES. The average number of waves parents participated in did not significantly differ between boys and girls ($F_{1(2073)} = .827, p = .363$), but was significantly less in children from families with lower SES ($F_{1(5,2062)} = 6.427, p < .0001$).

An upward extension of the CBCL and its related self-report version was used to assess depressive problems at wave 6. For 1,615 18- to 30-year-olds self-reported information was available (response rate = 77.8% of all wave 1 participants). ANOVA showed that no significant mean differences (all $p > .05$) between participants and non-participants were found for wave 1 CBCL Affective Problems and Total Problems. Chi-square tests showed no significant differences for SES, but females were overrepresented ($\chi^2(1) = 18.2, p < .001$; 81.6% participating females versus 73.8% males). For 1,424 young adults at wave 6, parent-reported information was available (response rate = 68.6%). There were no significant differences in the average wave 1 CBCL Affective Problems score between participants and non-participants. However, the mean wave 1 CBCL Total Problems score was somewhat lower ($F_{1(2073)} = .827, p = .021$; mean of 20.2 versus 21.9) and family SES was less likely to be low in participants ($\chi^2(1) = 18.1, p < .001$; 71.8% middle-high SES versus 62.7% low SES). Girls were slightly overrepresented in wave 6 ($\chi^2(1) = 6.5, p < .011$; 71.1% girls versus 65.9% boys).

**Measures**

The DSM-IV scale Affective Problems of the CBCL. The DSM-oriented CBCL scale Affective Problems is constructed from CBCL items (Achenbach & Rescorla, 2001). The CBCL is a standardized parent evaluation of their child’s emotional and behavioral problems in the preceding 6 months. It contains 120 problem items that are scored on a 3-point scale (0 = not true, 1 = somewhat or sometimes true, 2 = very or often true). The good reliability and validity of the American version of the CBCL were confirmed for the Dutch version (de Groot, Koot, & Verhulst, 1994). The Affective Problems scale assesses depressive symptoms that are closely related to DSM-IV major depressive disorder. It includes 10 items proven to have good sensitivity and specificity in relation to DSM-IV criteria of major depression in a Dutch clinical sample (Krol, De Bruyn, Coolen, & van Aarle, 2006). Furthermore, it has been shown to have good test-retest reliability ($r = .84$), internal consistency (Cronbach’s alpha = .84), and criterion-related validity (percent explained variance of referral status $r = .29$; $r = .63$ with DSM-IV checklists filled out by professionals (Achenbach & Rescorla, 2001). The present study used a former CBCL version that did not include item 5 (enjoys little).

Trajectories were considered to have elevated levels of Affective Problems when a mean score exceeded 4 (from age 4–11) or 5 (from age 12–18) at any point in time, which corresponds with the cut-off scores for the borderline/clinical range (Achenbach & Rescorla, 2001).

**Young-Adult Behavior Checklist (YABCL) and the Young-Adult Self-Report (YASR).** The YABCL is a parent-report upward extension of the CBCL, and the YASR is its self-report version for young adults (Achenbach & Rescorla, 2003). The raw scores of the DSM-IV-oriented Depressive Problems scale and the Total problem scale were used. The Depressive Problems scale is based on expert ratings of convergence of items with DSM-IV classifications. Good test–retest reliability, internal consistency, and criterion-related validity (referral status effect) for self-reported ($r = .86, x = .89$, and 22% explained variance, respectively) and parent-reported Depressive Problems ($r = .83, x = .84$, and 9% explained variance, respectively) were found. For the Total Problems scale reliability measures were above .90 and referral status explained 8% (parent-report) and 13% of the variance (self-report) (Achenbach & Rescorla, 2001).
Mental healthcare use. Participants were asked at wave 6 whether they had ever been referred to out- or inpatient mental health care.

Educational level. At wave 6 the participant’s highest completed educational level was used to form two groups: those with a lower educational level (school dropout to lower vocational level) versus those with an intermediate to higher educational level (completed high school or higher).

Analysis

The semi-parametric group-based method developed by Nagin (1999) was used to test whether distinct trajectories exist and to provide an empirical basis for determining the number of classes and the shapes of the trajectories (TRAJECTORIES macro in SAS; Jones, Nagin, & Roeder, 2001). The censored normal distribution was applied to our psychometric scaled data that was skewed toward the scale minimum. All available values from each case were used to estimate an individual’s timeline, making case-wise deletion unnecessary. The Bayesian Information Criterion (BIC) formed an empirical basis for determining the number and shapes of the latent trajectories. The model with the lowest BIC was favored (Nagin, 1999), and a BIC score difference of more than 3 was considered strong evidence for two models to be different, while a BIC difference larger than 5 is proof of a very strong difference between two models (Raftery, 1995). We determined the optimal number of trajectories by choosing the lowest BIC score of 3- to 7-class full quadratic models for males and females separately. Next we trimmed the quadratic growth factors to either linear growth or to no change over time. Using backward elimination of higher-order trajectories, a more parsimonious model was maintained whenever a specific higher-order growth coefficient did not reach statistical significance and the BIC value decreased (see also Brendgen et al., 2005). We assessed the robustness of the best solution by comparing the shape and level of the trajectories with those found in models with more or fewer classes (Hipp & Bauer, 2006). Whenever unstable solutions or extremely large standard errors were found, alternative starting values were used to see whether the log-likelihood would increase to prevent the trajectories with those found in models with more or fewer classes (Hipp & Bauer, 2006). Whenever unstable solutions or extremely large standard errors were found, alternative starting values were used to see whether the log-likelihood would increase to prevent

Results

Choosing the optimal number of trajectories

The BIC scores for the quadratic 3-, 4-, 5-, 6-, and 7-class models for males were −5242.02, −5521.86, −5218.72, −5204.84, and −5213.69, respectively. The model solutions for females showed the following BIC scores: −5909.47, −5890.86, −5895.18, −5887.44, and −5892.00. For both genders the lowest BIC score was found for a 6-class model, with a BIC score difference with the 5-class model of 7.74 for males, and 13.88 for females. In general, the trajectories within and between the various class solutions were robust. The average class probabilities for the trimmed best models ranged from .73–.96 for males, and from .61–.90 for females (Table 2). Most 95% confidence intervals for the fitted means showed no or little overlap (Figures 1 and 2), though a more than 4-year overlap was found in males between trajectories 1 and 4 (13–18 years) and in females between trajectories 1 and 2 (10–15 years), 1 and 5 (6–12 years), and 2 and 5 (4–12 years).

Gender differences in the development of depressive symptoms

The best male model had a very low decreasing group. This group included 439 subjects. Furthermore, a low stable (n = 407), a moderate increasing (n = 132), a high decreasing (n = 10), a high childhood peak (n = 12), and an increasing high (n = 16) group were found (see Figure 1). The best female model consisted of a low decreasing group, which included 260 subjects from the present sample. In addition, a very low increasing group (n = 98), a low stable (n = 584), a moderate stable (n = 94), an adolescence-onset increasing high (n = 10), and a high increasing (n = 14) group (Figure 2) were found. All corresponding parameter estimates and estimated population prevalence estimates are shown in Table 2.

When comparing the 95% confidence intervals of the fitted means of elevated but similar male and female trajectories we found that the moderate stable females had a higher level of Affective Problems from age 4 to 12 compared to the moderate increasing male group. The high increasing trajectory in girls had a higher level of Affective Problems from age 8 to 13 compared to the increasing high trajectory in boys, and was in the borderline/clinical from age 4 on, while this was true for boys from age 10. The shapes of the other elevated trajectories showed even clearer evidence of gender differences. The high childhood peak (normal range from age 15) and the high decreasing trajectory (normal range from age 10) were unique for males, as was the adolescence-onset increasing high trajectory for females (border-
line/clinical range from age 15). Males in the high childhood peak group overlapped with the increasing high females until age 12.

Depressive problems and overall emotional and behavioral problems in young adulthood

Overall mean differences in self- and parent-reported Depressive and Total Problems scores in young adulthood between the trajectories were found for both genders (Table 3). Pair-wise comparisons showed that, in general, elevated trajectories predicted higher mean Depressive and Total Problem scores compared to the low trajectories in both genders. The increasing high and the high childhood peak male groups and the high increasing and the adolescent-onset female groups differed most often from any of the normative trajectories.

Mental healthcare utilization and educational level in young adulthood

Young women in the high increasing trajectory showed most differentiation with other trajectories on mental healthcare use, while educational level

Table 2 Parameter estimates of best trimmed 6-class male and female model

<table>
<thead>
<tr>
<th>Classes (average posterior probability; % estimated population)</th>
<th>$\beta_0$ (constant)</th>
<th>p</th>
<th>$\beta_1$ (linear)</th>
<th>p</th>
<th>$\beta_2$ (quadratic)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 1. Very low decreasing (.79; 39.6)</td>
<td>-0.57</td>
<td>0.1000</td>
<td>-0.12</td>
<td>0.0003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Low stable (.73; 39.8)</td>
<td>-0.77</td>
<td>0.0009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Moderate increasing (.75; 14.7)</td>
<td>2.34</td>
<td>&lt;0.0001</td>
<td>0.07</td>
<td>0.0526</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. High decreasing (.75; 2.3)</td>
<td>8.86</td>
<td>&lt;0.0001</td>
<td>-0.92</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. High childhood peak (.96; 1.6)</td>
<td>7.09</td>
<td>0.0002</td>
<td>0.77</td>
<td>0.1040</td>
<td>-0.09</td>
<td>0.0010</td>
</tr>
<tr>
<td>6. Increasing high (.87; 1.9)</td>
<td>1.74</td>
<td>0.0260</td>
<td>0.51</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females 1. Low decreasing (.61; 19.1)</td>
<td>1.03</td>
<td>0.0165</td>
<td>-0.41</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Very low increasing (.70; 13.9)</td>
<td>-7.04</td>
<td>&lt;0.0001</td>
<td>0.54</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Low stable (.84; 53.5)</td>
<td>1.12</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Moderate stable (.84; 10.8)</td>
<td>4.04</td>
<td>&lt;0.0001</td>
<td>0.85</td>
<td>&lt;0.0182</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Adolescence onset increasing high (.90; 1.5)</td>
<td>-14.6</td>
<td>&lt;0.0001</td>
<td>1.93</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. High increasing (.78; 1.2)</td>
<td>5.58</td>
<td>0.0001</td>
<td>0.35</td>
<td>&lt;0.0182</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 Fitted mean trajectories (bold face lines) and 95% Confidence intervals (dotted lines) of CBCL Affective Problems for males

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showed few significant differences. In contrast, young men who followed the high childhood peak trajectory were significantly more likely to end up with a lower educational level than found in the three lowest trajectories, while little differentiation was found for mental healthcare use.

Figure 2 Fitted mean trajectories (bold face lines) and 95% Confidence intervals (dotted lines) of CBCL Affective Problems for females

Table 3 Predicting young-adult mean YABCL and YASR outcome and percentage of mental healthcare use (ever) and low educational level by class in males and females

<table>
<thead>
<tr>
<th>Outcome by model</th>
<th>Means or percentages by class¹</th>
<th>Partial² ( \eta^2 )</th>
<th>Significant class differences³,⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 011112</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YABCL Depressive</td>
<td>1.2 2.2 3.8 2.6 5.5 5.4</td>
<td>0.14</td>
<td>6,5,3 &gt; 1; 2 &gt; 1</td>
</tr>
<tr>
<td>YABCL Total Problems</td>
<td>10.7 16.4 25.7 20.8 31.6 36.3</td>
<td>0.16</td>
<td>6,5,3 &gt; 1; 2 &gt; 1</td>
</tr>
<tr>
<td>YASR Depressive</td>
<td>2.1 2.7 3.5 3.9 3.6 5.3</td>
<td>0.04</td>
<td>6 &gt; 1; 3 &gt; 1</td>
</tr>
<tr>
<td>YASR Total Problems</td>
<td>22.1 27.3 32.8 34.6 32.3 45.8</td>
<td>0.07</td>
<td>6 &gt; 1,2</td>
</tr>
<tr>
<td>Mental healthcare use (%)</td>
<td>3.0 8.0 10.6 14.9 14.3 22.9</td>
<td>–</td>
<td>6,3,2 &gt; 1</td>
</tr>
<tr>
<td>Low educational level (%)</td>
<td>28.3 41.7 42.3 50.0 87.5 58.3</td>
<td>–</td>
<td>5 &gt; 1,2,3; 6,3,2 &gt; 1</td>
</tr>
<tr>
<td>Females 111001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YABCL Depressive</td>
<td>1.4 1.5 2.7 5.2 8.5</td>
<td>0.16</td>
<td>6 &gt; 1,2,3,4; 5,4 &gt; 1,2,3; 3 &gt; 1</td>
</tr>
<tr>
<td>YABCL Total Problems</td>
<td>10.8 10.1 17.4 30.0 35.5 54.4</td>
<td>0.20</td>
<td>6 &gt; 1,2,3,4; 5,4 &gt; 1,2,3; 3 &gt; 1</td>
</tr>
<tr>
<td>YASR Depressive</td>
<td>3.0 3.9 4.2 5.5 8.0 6.5</td>
<td>0.05</td>
<td>5 &gt; 1,2,3; 4 &gt; 1,3; 6,3 &gt; 1</td>
</tr>
<tr>
<td>YASR Total Problems</td>
<td>24.2 30.1 29.4 37.2 47.9 40.2</td>
<td>0.05</td>
<td>4 &gt; 1,3; 5,3 &gt; 1</td>
</tr>
<tr>
<td>Mental healthcare use (%)</td>
<td>5.3 4.1 9.3 18.8 20.0 62.5</td>
<td>–</td>
<td>6 &gt; 1,2,3,4; 4,3 &gt; 1</td>
</tr>
<tr>
<td>Low educational level (%)</td>
<td>43.8 60.5 54.7 47.4 33.3 66.7</td>
<td>–</td>
<td>3,2 &gt; 1</td>
</tr>
</tbody>
</table>

¹VLD = Very low decreasing; LS = Low stable; MI = Moderate increasing; HD = High decreasing; HCP = High childhood peak; IH = Increasing high; LD = Low decreasing; VLI = Very low increasing; MS = Moderate stable; AOIH = Adolescence onset increasing high; HI = High increasing. ²All class effects (only given for significant mean differences) were significant (\( p < .05 \)). ³Pairwise mean differences are based on Bonferroni post hoc test and pair-wise comparisons of percentages are based on Fisher exact-test (all \( p < .05 \)).
Conclusion and discussion

This study’s main goal was to assess gender differences in depressive symptoms in a large prospective multiple-birth cohort of children in a wide age range randomly sampled from the general Dutch population, while assuming heterogeneity in the distribution of depressive symptoms. Previous studies could not address gender differences or could only address them in a limited way, or in a much smaller age range or in a non-random risk group.

Overall, we can conclude that we did not only find evidence of more and different trajectories than the four we hypothesized based on previous studies. We also showed that gender differences existed not only in the level, but also in shape and timing of onset of deviant levels of depressive problems. This underlines the importance of addressing gender differences by separate estimation of both number and shape of the latent trajectories, instead of using gender as a time-invariant covariate.

There was a group of girls with chronic early-childhood-onset deviant depressive symptoms that increased even more over time instead of following a stable course, as was found in Bendgen et al.’s study (2005). No hypothesized high stable trajectory was found in boys for the whole age range, although the high childhood peak trajectory showed a stable high mean level of affective problems until age 14.

Another group of girls showed a steep increase in depressive symptoms in early adolescence, reaching a deviant level of problems around mid-adolescence. Bendgen et al. (2005) could not detect this trajectory due to their limited age range (11–14 years). Our study showed that there was also a group of boys that showed late-childhood-onset deviant depressive symptoms. Stoolmiller et al. (2005) did not find an increasing trajectory in boys. The study by Bendgen et al. (2005) included an increasingly depressed trajectory that also included boys, although they were less likely than girls to follow this trajectory.

Many interesting risk and resource factors could help explain why adolescence is related to onset of depressive problems, especially in girls. Challenges and stressors during adolescence (e.g., changes in: hormonal balances, relationship with parents and peers, school) might make vulnerable (e.g., genetic make-up, comorbid disorders, family history of depression, negative family environment, reactive temperament, negative attributional style) individuals more likely to develop depressive problems (Boomsma, van Beijsterveldt, & Hudziak, 2005; Bendgen et al., 2005; Ge, Conger, & Elder Jr., 2001; Hankin et al., 1998; Kim & Cicchetti, 2006; Rohde et al., 1991; Steiner, Dunn, & Born, 2003; Stoolmiller et al., 2005). This might especially be true for adolescent girls as the onset of menarche may not only signal an increased vulnerability to mood dysregulation due to increases in estrogens, but also might cause a change in the reactivity of the stress system in girls who are genetically predisposed (Steiner et al., 2003). Also, the neuroendocrine effects of traumata might be more pronounced in girls (Shea, Walsh, Macmillan, & Steiner, 2005).

Some boys followed a bell-shaped trajectory, with early-childhood-onset deviant depressive symptoms that started to decrease around late childhood to reach a normal level of depressive symptoms around mid-adolescence. This shape of trajectory has not been observed in previous mixed growth curve studies (Bendgen et al., 2005; Rodriguez et al., 2005; Stoolmiller et al., 2005). Another group of boys with early-childhood-onset deviant depressive symptoms showed a steep decrease from early childhood while reaching normal levels of depressive symptoms around age 10. Again, such a steep decreasing trajectory has not been found before. Like in other studies, girls did not show any trajectory with a decreasing (to normative) level of depressive symptoms.

Angold et al. (2002) suggested that attention needed to be paid to their unexpected finding of declining depression scores in boys, which has now been replicated in Stoolmiller et al.’s (2005) study and in this study. Declining trajectories at a later age might be related to the distance in time from the original risk factors (e.g., negative life events) or decreased influence of or exposure to risk factors (e.g., parental risk factors due to increased independence of adolescent) (Stoolmiller et al., 2005). However, the question remains why only boys and not girls show these declining trajectories. Perhaps hormonal changes in girls during puberty have a more lasting effect on the sensitivity of the neurotransmitter systems and the reactivity of the stress system. Also, the fall in depressive scores in late childhood in boys might be related to elevations in adrenal androgens (adrenarch), which starts in boys around age 6 (Angold et al., 2002).

Another goal was to investigate whether trajectories differentially predicted young-adult poor outcome. In general, regardless of gender, following an elevated trajectory predicted higher mean levels of mental health problems in young adulthood.

The highest male (increasing high and high childhood peak) and female trajectories (adolescence-onset increasing high and high increasing) most often differed from (more) lower-level trajectories on measures of poor outcome. In particular, the high increasing trajectory in women showed significantly higher levels of parent-reported depressive and general mental health problems, as well as mental healthcare use compared to all but the adolescence-onset increasing high trajectory. The male trajectories showed somewhat less distinction in the prediction of young-adult outcome. The high decreasing trajectory showed no significant difference from any other trajectory on any outcome measure. Apparently, boys who have a deviant level of affective problems only in early childhood have a
similar favorable outcome to those who follow normative trajectories.

Direct comparisons of differences in young-adult poor outcome among the elevated trajectories themselves were, however, not significant, indicating that mainly quantitative rather than qualitative differences between the elevated trajectories could be detected in this study. Our hypothesis about higher levels of overall problem behaviors and lower educational attainment in subjects following a more chronic trajectory of elevated depressive symptoms could not be confirmed. Although it was shown that women in the chronic trajectory, compared to women in normative trajectories, more often had a poorer prognosis than women in the adolescent-onset increasing high group, pair-wise comparison of these two elevated groups did not show a significant difference. This finding might be related to the lingering nature of vulnerability following episodes of depressive problems regardless of the current depression status, but might also be caused by reduced power of the pair-wise post hoc analyses (see Limitations). Boys who followed a chronic trajectory during childhood and early adolescence were more likely to end up with a lower educational level compared to more normative trajectories than the increasing high trajectory. In girls educational attainment was not related to chronic high levels of depressive symptoms. Perhaps these findings are related to the higher likelihood of co-occurring conduct problems in boys, which have been related to low educational attainment (Kessler et al., 1995). However, anxiety in girls has also been associated with low educational attainment (Kessler et al., 1995), and also often occurs with depressive symptoms, suggesting that more research is needed on this topic.

Mental healthcare use was only related to differences between trajectories in girls. As we did not have information on the type of problems for which mental health care was sought, a possible explanation might be that (younger) boys are more likely to be referred to mental health care for externalizing problems, while (older) girls are most likely to end up in care for internalizing problems (Zwaanswijk, Verhaak, Bensing, van der Ende, & Verhulst, 2003), resulting in less differentiation between affective problems trajectories on mental healthcare use in boys.

Individuals who followed a moderate trajectory of affective problems also often differed from normative trajectories on measures of depressive and general mental health problems and service use. This suggests that mental healthcare providers should not ignore sub-clinical levels of depressive symptoms that remain present or even increase while growing up. It would be interesting to investigate to what extent co-morbid mental health problems play a role in these moderate trajectories by increasing their overall risk of or vulnerability to poor outcome later in life. Future studies that analyze the connections between distinct but related developmental trajectories (e.g., depression and anxiety; see Jones & Nagin, 2006) might shed more light on this question.

One can also wonder why for both genders more than one normative trajectory was found, containing over three-quarters of all subjects. This finding is quite robust. Even in a full quadratic three-class solution, two low trajectories remained separated. Future studies that follow subjects up into later life phases are needed to see whether these low trajectories end up being of clinical interest.

Limitations

Although information about depressive symptoms was not available for all individuals over the five assessments, no significant differences were found in the mean of (wave 1) CBCL Affective Problems, the variable of main interest in this study, in relation to the number of waves participated in. This increases our confidence that the maximum-likelihood estimations will not exhibit large sample bias (Duncan & Duncan, 1994). Also, sample attrition in wave 6 was not related to significant differences in wave 1 CBCL Affective Problems and Total Problems scores. Because separate analyses for males and females were performed, overrepresentation of females in wave 6 was not considered a problem. Generalizability of this study’s results might be somewhat restricted due to overrepresentation of families with medium to high SES.

Reduced power due to the small sample sizes of most elevated groups only made it possible to find significant differences in outcome measure for quite large effect sizes (Cohen, 1988). Future studies with larger total sample sizes and/or including high-risk children are needed to test whether our 6-class growth curve models can be replicated and to examine whether predictive and outcome variables can be related to these trajectories to help explain the potential mechanism underlying the different developmental paths of elevated depressive symptoms. Although reduced power might explain the limited differentiation between the elevated groups, our findings might also be a reflection of the vulnerability of the children in these elevated trajectories for future episodes or (sub-clinical) levels of affective problems and other poor outcome.

Our findings might also suggest that perhaps a simpler or lower class solution is preferable, as some researchers (e.g., Delucchi, Matzger, & Weisner, 2004) have used a pragmatic decision rule of only accepting trajectory groups that include at least 5% of the subjects of the total sample. However, even the most elevated trajectory in 4-class male and female solutions incorporated an estimated population prevalence of 2.2 to 3.7%. Increasing the sample size or including more high-risk children seems the best solution to increase the power to detect moderate to small differences in explanatory or prognostic variables between the elevated trajectories.

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We did not investigate the developmental trajectories of both parent- and self-reported depressive symptoms, as our main goal was also to investigate 4- to 11-year-olds. However, it is known that the cross-informant agreement between parents and adolescents yields different rates of symptoms, which might result in different developmental patterns (Garber et al., 2002). Achenbach and Rescorla (2001) found a moderate parent-adolescent agreement for the Affective Problems scale of $r = .44$. Also, the agreement between mothers and fathers is not perfect ($r = .69$) (Achenbach & Rescorla, 2001). Trajectory groups are known to differ on measures of parental depression (Stoolmiller et al., 2005). This might be a consequence of reporter-bias or of a true risk factor (e.g., genetic, direct learning). The present study only used information from one parent (mainly mothers) and unfortunately no information was available on the mental health status of the parent.

Clinical implications

The use of latent growth curve analysis can be an important tool for early detection of likely membership in a problematic class. Monitoring children’s affective problems (prospectively or retrospectively) can help to discover children who are most at risk for a deviant development of affective problems and/or most at risk for poor outcome as a young adult.

This study underscores the importance of taking early-childhood onset of high levels of depressive problems in girls seriously, because their depressive problems are most likely to keep increasing over time and their prognosis is worse compared to girls in normative trajectories and relative to boys. Onset of or increasing high levels of depressive symptoms during adolescence, in both males and females, also constitute a risk factor for poor outcome compared to normative groups. In males, decreasing trajectories of depressive symptoms are also found, suggesting that boys tend to have a more favorable development of affective problems than girls. However, boys who follow elevated but decreasing trajectories also have significantly more mental health problems and a lower educational level later in life compared to normative groups, except for boys with only high affective problems during early childhood. This finding suggests that a poor prognosis in boys is most likely when deviant levels of affective problems last until late childhood or become deviant in adolescence. Finally, boys with high affective problems during childhood seem to have a need for extra monitoring and care at school to stimulate higher educational attainment.

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Correspondence to

Marielle C. Dekker, Erasmus MC – Sophia Children’s Hospital, Department of Child and Adolescent Psychiatry, P.O. Box 2060, 3000 CB Rotterdam, The Netherlands; Tel: +31 10 4636671; Fax: +31 10 4636803; Email: m.c.dekker@erasmusmc.nl

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