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Sex-Specific Depressive Symptom Trajectories Among Adolescents in Los Angeles County, 2013 to 2017

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Abstract

Objective: After remaining stable for many years, the prevalence of depression among adolescents increased over the past decade, particularly among girls. In this study, we used longitudinal data from a cohort of high school students to characterize sex-specific trajectories of depressive symptoms during this period of increasing prevalence and widening gender gap in adolescent depression.

Method: Using data from the Health and Happiness Cohort, a longitudinal 8-wave study of high school students residing in Los Angeles County from 2013 to 2017 (N = 3,393), we conducted a multiple-group, latent class growth analysis by sex to differentiate developmental trajectories

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in depressive symptoms scores measured by the Center for Epidemiological Studies– Depression (CES-D) scale (range, 0–60).

Results: A 4-class solution provided the best model fit for both girls and boys. Trajectories among girls included low stable (35.1%), mild stable (42.8%), moderate decreasing (16.2%), and high arching (5.9%). Trajectories among boys included low stable (49.2%), mild increasing (34.7%), moderate decreasing (12.2%), and high increasing (3.9%). Average scores consistently exceeded or crossed the threshold for probable depression (≥16). Across comparable sex-specific trajectory groups, the average CES-D scores of girls were higher than those of boys, whose average scores increased over time.

Conclusion: In a diverse cohort of students in Los Angeles County, depressive symptom trajectories were comparable to prior time periods but with a higher proportion of students in trajectories characterized by probable depression. Trajectories differed by sex, suggesting that future research should consider differential severity and onset of depression between boys and girls.

Keywords

adolescent mental health; adolescent development; depressive symptoms; symptom trajectories; depression

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Adolescent depression contributes to a significant and growing public health burden in the United States. Between 2013 and 2019, as many as 1 in 5 adolescents reported major depressive episodes,[1] and youth who express depressive symptoms in this critical developmental period are at a heightened risk for significant morbidity and mortality during adolescence as well as later in life.[2] Although secular trends in adolescent depression were relatively stable, and even declining, through the late 1990s and early 2000s,[3] evidence has emerged that the prevalence of depression among adolescents in the United States has risen significantly during the past decade, particularly among girls. National survey data indicate that the prevalence of past-year major depressive episodes was stable among adolescents through 2009, subsequently increasing from 8.1% to 15.8% by 2019.[4,5] The increase was markedly higher among girls (11.4% to 23.4%), representing a significant and widening gender gap in the experience of depression among adolescents in the United States. Results from other nationally representative surveys have documented similar trends with a range of aligned outcomes including mood symptoms and suicidal behavior.[6–8]

Documented increases in the prevalence of depressive symptoms and disorders are drawn largely from repeated cross-sectional studies, and thus do not capture developmental trajectories for which longitudinal cohort data are needed. Although prevalence, defined as the proportion of a target population with a given health status, provides a population-based estimate of illness burden, characterizing the individual-level course of mental health symptoms is also important for understanding the onset and severity of psychiatric disorders over key developmental periods. Methods such as latent class analysis, group-based trajectory modeling, and growth mixture models with data from prospective cohort studies have been applied in past literature to characterize discrete trajectories of mental health symptoms during adolescence. Within these approaches, trajectories typically describe

the longitudinal pattern in the frequency or severity of 1 or more psychiatric symptoms over a period of time, and identify subgroups of individuals within a sample who tend to follow similar longitudinal patterns.[9] A systematic review and meta-analysis identified common trajectories of depressive symptoms across 20 studies from 8 countries published between 2005 and 2015, reporting that approximately 56% of adolescents exhibited low or no depressive symptoms, whereas 26% belonged to groups characterized by moderate symptoms, and 12% were classified as being in high, increasing, or decreasing trajectories. Consistently across studies, female adolescents were more likely to be in high or increasing symptom groups compared with their male counterparts.[10] Although these findings represent a significant contribution to adolescent mental health research, they largely predate recent population-level trends in adolescent depression, and more data are needed to explain recent increases and divergent patterns in depressive symptoms between boys and girls.

Two crucial research gaps in this body of literature must be addressed to understand more recent secular trends in US adolescent depression. First, studies examining developmental trajectories of depressive symptoms have predominantly used data collected prior to the recent increase in prevalence and gender disparities in adolescent depression. Indeed, all of the studies from the United States in the systematic review by Shore *et al.* used data collected prior to 2010. Therefore, it is not known whether prior empirical evidence on depression symptom trajectories generalize across more recent years, and updated studies of depressive symptom trajectories are needed among adolescents with data collected during this recent period of rapidly increasing prevalence. Second, although recent studies consistently show accelerated increases in the prevalence of depression among girls compared with boys, there is little consensus around whether and how developmental symptom trajectories differ by sex or gender, as most prior studies have pooled data from both male and female adolescents when generating symptom trajectories. Studies that have modeled the growth of depressive symptoms using methods that allow the number and shape of growth curves to vary by sex have been rare and have provided heterogenous results, resulting in a call for more research on sex-specific symptom trajectories.[10–12]

The present study aimed to address the current research gaps by describing sex-specific trajectories of depressive symptoms, measured with the Center for Epidemiological Studies Depression (CES-D) scale, among adolescents from a prospective cohort of high school students residing in Los Angeles County from 2013 to 2017. First, we hypothesized that trajectories would diverge by sex: specifically, that allowing model parameters to vary by sex would improve model fit and evidence more severe or sustained depressive trajectories among a larger subset of girls than boys. Second, as recent changes in the population-level prevalence of adolescent depression may reflect patterns of individual-level depressive symptom onset and development that differ from what has been historically observed, we hypothesized that trajectory groups would deviate from prior studies that used data collected prior to 2010. Finally, we examined whether membership in the resulting trajectory classes varied by race, ethnicity, or socioeconomic status.

METHOD

Study Design

The study sample consisted of participants from the Happiness and Health (H&H) study, a longitudinal prospective cohort of public high school students from Los Angeles county that aimed to assess adolescent substance use and related factors, including mental health. A total of 40 demographically diverse public schools were originally recruited into the study, of which 10 agreed to participate. All ninth-grade students from these schools were eligible for inclusion in the study, of whom 83% provided dual personal and parental consent via written or verbal communication required for enrollment. In the fall of 2013, a total of 3,396 ninth-grade students were enrolled in the H&H study and were followed-up for 8 waves every spring and fall semester until the spring of 2017. Overall retention in the sample was 99.3%. Outcome measures and covariates were self-reported. Additional details on the H&H study methodology have been published previously.[13] The data collection protocols were approved by the University of Southern California Institutional Review Board, and researchers may request data access through the USC Center for Population Health.[14] The present study was approved by the Columbia University Institutional Review Board. We excluded students with incomplete data on sex as well as those missing responses to the CES-D instrument for all waves, for a final sample size of 3,393.

Measures

Depressive Symptoms.—Adolescent depression was measured by the Center for Epidemiological Studies–Depression scale (CES-D).[15] The CES-D is a 20-item measure that captures the severity of feelings and experiences related to depression over the past week as self-reported by the participant. Responses for each item ranged from 0 (rarely or none of the time [less than 1 day]) to 3 (most or almost all of the time [5–7 days]), for a maximum possible score of 60 per assessment. Four items were reverse coded such that a higher total score corresponded with a greater expression of depressive symptoms. Table S1, available online, includes a full list of items and responses. For those assessments missing 1 to 2 items on the CES-D, person-mean imputation was used, substituting the mean score of the completed items for the missing items, a method that has been shown to be comparable to other imputation techniques as well as complete case analysis of the CES-D.[16] Overall, 86% of all scores were based on full item completion, and 92% of scores were missing no more than 2 items. Missing CES-D sum scores were accounted for in latent class growth analysis (LCGA) using full information maximum likelihood (FIML) methods.[17] The CES-D has previously been validated in adolescents,[18] with a sum score ≥16 indicating 1 well-supported recommended cutoff for depression.[19] The Cronbach alpha ranged between 0.81 and 0.85 across waves in our sample.

Demographic Characteristics

Depressive symptoms are heterogenous among adolescent demographic subgroups, including sex, race/ethnicity, and socioeconomic status.[4,8,12,20] Given this information, we produced descriptive statistics and tested for differences in the demographic composition of classes within sex using the χ^2 test and analysis of variance. Sex (male or female), race and ethnicity (Asian, Black/African American, Hispanic/Latino, White, multiracial/

multiethnic, or the following collapsed into a single category because of small cell sizes: American Indian/Alaska Native, Native Hawaiian/Pacific Islander, other), and highest parental education (eighth grade or less, some high school, high school graduate, some college, college graduate or advanced degree) were measured at baseline. Starting in wave 3, receipt of free or reduced-cost school lunch (reduced-cost lunch, free lunch, or neither) was also reported. We considered parental education and school lunch assistance as indicators of socioeconomic status.[21] Table S2 includes a full list of covariate question and response options.

Statistical Analyses

Latent class growth analysis was used to distinguish classes of CES-D trajectories among adolescents. LCGA is a semiparametric method of growth mixture modeling (GMM) developed by Nagin and Land.[22,23] By assuming fixed variances within classes, LCGA identifies distinct latent trajectories while facilitating model convergence and reducing the computational burden associated with GMM.[24] Models included significant quadratic terms ($p < .05$) and all lower-level terms, which were permitted to vary between classes.[25]

Given marked differences in adolescent depression by sex,[8] we compared LCGA models that allowed parameters (ie intercept, linear, and quadratic slope terms) to vary by sex with models that fixed parameters across sex. Differences between these sets of models were assessed via likelihood ratio tests.[26,27] Findings indicated that models fit significantly better when parameters were allowed to vary by sex ($p < .001$), and thus LCGA models in the main analysis were subject to multiple-group analysis (MGA), which allowed class membership and model terms to vary by sex (4-class model: likelihood ratio test [LRT] $\chi^2 = 1196.8$, df = 6, $p < .001$).[28]

To determine the number of trajectory classes that provided the optimal balance of fit and parsimony, model fit was iteratively assessed using multiple criteria, including entropy, the Bayesian information criterion (BIC), and log-likelihood comparing each model to a model with 1 fewer class.[24,27,29] As these statistics may prioritize fit improvement at the expense of parsimony, elbow plots of both BIC and log-likelihood values were visually examined. An elbow plot is a graphical tool used to assess the optimal number of latent classes. It displays the successive change in a fit statistic for each addition of 1 latent class, to help identify the point at which inclusion of additional classes increases model complexity without a proportional improvement to model fit, signaled by a joint in the curve.[30] Better-fitting models generally exhibit lower BIC scores, higher entropy (with values >0.8 indicating adequate class distinction), and class memberships greater than 1%. We also considered parsimony and interpretability, as quantitative criteria may serve only as guidelines.[24]

The resulting sex-specific latent classes were then described according to the parameters included in the model, including intercept (low, mild, moderate, or high) as well as linear or quadratic slope (stable, increasing, decreasing, or arching).

All analyses were conducted in MPlus version 8[31] and R version 4.2.2.[32]

RESULTS

Descriptive statistics of the sample stratified by sex are featured in Table 1. Overall, 53.7% of the sample identified as female. Female adolescents most commonly identified as Hispanic or Latino (49.5%), did not receive lunch assistance (50.4%), and had at least 1 parent who achieved a college degree or higher (49.0%) at baseline. Similarly, the plurality of male adolescents identified as Hispanic or Latino (44.2%), did not receive lunch assistance (52.9%), and had a parent who received at least a college degree (52.4%). Students' ages averaged from 14.6 years at wave 1 to 17.9 years at wave 8. Average CES-D scores at wave 1 were higher for female adolescents (17.4, SD = 12.7) than for male adolescents (11.3, SD = 9.6), whereas male adolescents' scores increased to 14.1 (SD = 11.9) by wave 8 and female adolescents' scores remained stable (17.7, SD = 12.8).

Table 2 presents model fit statistics for multiple-group LCGA models. Log-likelihood and BIC continued to decrease with increasing class solutions, indicating that model fit improved with the inclusion of more classes. Nonetheless, as shown in Figure S1, available online, elbow plots of these 2 statistics against an increasing number of classes indicated that the joint in the curve aligned with the 3-class solution, suggesting that less information was to be gained from the addition of further classes for both female and male adolescents. Guidelines for entropy, however, indicated adequate class distinction in the 4-class model, remaining above the 0.8 threshold at 0.84, but not in the 5-class model (entropy = 0.79). Furthermore, class membership remained above 1% for all classes in the 4- and 5-class models. Taking all of these suggested fit statistics into account while also weighing the importance of a balance between model granularity and parsimony, a 4-class solution was selected to best represent the data.

Figure 1 provides a visualization of latent class trajectories by sex, featuring predicted mean CES-D score estimates from multiple-group LCGA models and corresponding observed mean scores, with model estimates recorded in Table 3. Four distinct classes emerged, with variations in intercept, slope, and quadratic terms by sex. Comparing like classes across sexes, intercepts for female adolescents were consistently higher than those for male adolescents.

Class 1 was labeled low stable for both sexes. This was the most common class among male adolescents (49.2%) and included just over one-third (35.1%) of female adolescents. Adolescents assigned to this class were predicted to have little to no increase in depressive symptoms across waves and remained below the threshold for probable depression (≥16). Quadratic terms were positive, resulting in slightly concave trajectories. Notably, quadratic terms were negative and trajectories were convex for all other classes.

Class 2 was labeled mild stable among female adolescents and mild increasing among male adolescents. This was the most common class among female adolescents (42.8%) and the second most common among male adolescents (34.7%). The slopes were divergent by sex, and female adolescents were also predicted to have a higher intercept (16.9, SE = 0.79) than male adolescents (11.2, SE = 0.60). The average CES-D score for female adolescents was above the threshold for probable depression in all survey waves, but the average CES-D

score for male adolescents started below the threshold at the beginning of the study and crossed into probable depression between waves 4 and 5, corresponding to the period between sophomore and junior year ($\beta = 0.31$, SE = 0.05). Class 2 trajectories for the 2 sexes converged over time, resulting in CES-D scores relatively close to 19 at wave 8 for both male and female adolescents.

Class 3 was labeled moderate decreasing for both sexes. Intercepts were higher for this class compared with classes 1 and 2 (female: 30.9, SE = 1.76; male: 24.3, SE = 1.80), comprising 16.2% of female adolescents and 12.2% of male adolescents. Adolescents in this class experienced an average decrease in CES-D scores of 5.6 and 2.6 points among female and male adolescents, respectively.

Class 4 was labeled high arching for female adolescents and high increasing for male adolescents. This class accounted for the smallest number of adolescents across sexes (5.9% of female and 3.9% of male adolescents). This class also had the highest intercepts (female: 37.7, SE = 1.46; male: 26.8, SE = 2.69). The trajectory for female adolescents had a convex shape ($\beta = 0.60$, SE = 0.14, quadratic $\beta = -0.01$, SE =0.00), describing a peak in symptoms at wave 4 (CES-D = 43.79) before returning to slightly above the intercept at wave 8. For male adolescents, CES-D scores in this class increased by over 10 points, plateauing around wave 5 and ending at 37.52 ($\beta = 0.75$, SE = 0.23, quadratic $\beta = -0.01$, SE = 0.01).

Table 4 and Table 5 present demographic differences by class membership in female and male adolescents, respectively. CES-D class group was minimally different by parental education among female ($p = .09$) and male (p = 0.49) adolescents, with adolescents with at least 1 parent with a college degree comprising the majority of each class. Race and ethnicity differed by latent class trajectory for male ($p = 0.02$) but not female ($p = 0.19$) adolescents. Although adolescents across sex and class were most likely to identify as Hispanic or Latino, a larger proportion of male adolescents in the moderate decreasing class identified as Asian (25.8%) than in other classes (range, 16.3%–16.9%). Conversely, lunch assistance differed by latent class trajectory for female ($p = 0.001$) but not for male (p = 0.74) adolescents. In particular, female adolescents in the low stable class were more likely to receive no assistance (57.6%) than any assistance (42.3%), compared to the high arching class, for which the inverse was true (no assistance = 42.0%, any assistance = 58.0%).

DISCUSSION

Increasing secular trends in adolescent depression over the past decade in the United States indicate a growing public health crisis most acutely affecting girls.[1,4,8] There is a dearth of research, however, into concurrent developmental trajectories in adolescent depression that could provide valuable context for the evidence produced from repeated cross-sectional data. To address this gap, we identified sex-specific trajectories of depressive symptoms in a diverse cohort of adolescent high school students in Los Angeles County using data collected during this recent shift in national trends. We found that both male and female students tended to fall into 4 distinct trajectory classes, characterized by the average severity of symptoms (low, mild, moderate, or high) and change over time (decreasing, stable, increasing, or arching) over a 4-year follow-up period. The resulting trajectories were

described as low stable, mild stable, moderate decreasing, and high arching for female adolescents and low stable, mild increasing, moderate decreasing, and high increasing for male adolescents. Trajectories diverged by sex (Figure 1), with intercepts and average CES-D scores consistently higher among female adolescents, who reported more elevated and sustained periods of depressive symptoms throughout high school compared to their male counterparts. Male adolescents, on the other hand, exhibited larger increases in depressive symptoms than female adolescents, as was particularly apparent when comparing the mild and high classes across sex. This suggests that whereas female adolescents may be more likely to endure sustained levels of depressive symptoms throughout high school, subsets of male adolescents are at an increased risk for developing depression or experiencing worsening symptoms during this period. This supports our first hypothesis on divergent trajectories by sex, with higher initial and sustained depressive symptoms among girls, and is consistent with previous research on gender and depression across the lifecourse, specifically that the gender gap in depression prevalence observed in adulthood is already apparent in adolescence.[33]

Our results partially support our second hypothesis that recent longitudinal trajectories in adolescent depression would differ from historic trajectories. We found 4 classes each among both male and female students, consistent with studies using data prior to 2010, most of which resulted in 3 to 4 trajectory groups.[10] The proportion of adolescents in classes representing CES-D scores above the probable threshold for depression, however, was higher in our study compared with some prior studies. The systematic review and meta-analysis by Shore *et al.* documented that across the 20 included studies, 67% of adolescents were classified into “no or low” depressive symptom trajectories, whereas in our study the comparable low stable trajectory included only 42% of adolescents surveyed. Similarly, whereas only 3% of adolescents in previous research were classified as having “high” or “increasing” symptom trajectories, in our study comparable trajectory classes represented 6% of female adolescents and 4% of their male counterparts. Thus, although the number of trajectories and average depressive symptom scores were within the range of individual studies included in the meta-analysis, a higher proportion of students in the present study were classified in trajectory groups that crossed the threshold for probable depression, consistent with the high adolescent depression prevalence observed in recent national cross-sectional studies.

We additionally found some preliminary evidence that trajectory groups were associated with socioeconomic status and race/ethnicity in ways that differed between male and female students. Female students of lower socioeconomic status, measured by parental education and school lunch assistance, were more likely to belong to trajectory groups characterized by higher mean depressive symptoms, a pattern not observed among male students. On the other hand, there was some indication that trajectory group membership varied by race/ethnicity in male students, whereas this was not observed in female students. Although these findings suggest a key area of future research, we encourage caution in their interpretation, given small cell sizes and missing data. Notably, these results are not concordant with prior nationally representative research that found strong and consistent associations of race/ethnicity with depressive symptom trajectories in both male and female subjects throughout adolescence and adulthood.[12]

Importantly, our findings did align with evidence of recent increasing cross-sectional trends in adolescent depression.[1,4–8] Most of the adolescents in this study belonged to trajectory groups characterized by mean CES-D scores above the threshold for probable depression for the entire study period. These results provide evidence that although there is a subset of adolescents who are unlikely to express depressive symptomology at any point during high school years, most adolescents likely follow a trajectory characterized by probable depression during most of this life stage. This has potential significant public health implications, as adolescent depression is strongly associated with subsequent suicidality.[34] An increase in the number of adolescents who express elevated depressive symptomology during some or all of their teenage years could contribute to increases in suicidal ideation and attempts, highlighting the importance of monitoring symptom trajectories in addition to secular trends in point prevalences.[6]

Strengths of this study included using data collected from 2013 to 2017 to assess longitudinal trends in adolescent depression coinciding with rapid secular increases in adolescent depression beginning around 2010. In addition, a large sample size, high participation rates, low attrition, and completeness of data during 4 years of follow-up facilitated using data-driven approaches to describe longitudinal phenotypes with a relatively low risk of bias from differential selection, loss to follow-up, or missing data.

Limitations of this study included the self-report nature of CES-D, which may not reflect clinical diagnoses of depression and in which sub-threshold depression may not be captured.[35] A lack of information on the clinical onset of depression and receipt of mental health treatment similarly precluded a more nuanced understanding of symptom trajectories. In addition, although our sample included a diverse group of adolescents, it was conducted in a single urban county in California, and therefore findings may not be generalizable to other adolescent populations in the United States. Divergences in our results from previous studies may be due to true changes in symptom trajectories among recent cohorts of adolescents, but also may, at least in part, be attributable to compositional sample differences. Indeed, the H&H cohort is not a nationally representative sample and includes more Hispanic youth than the overall US population, limiting generalizability when compared with national samples. Replication of these results in similar contemporary populations may help resolve whether these results reflect recent changes in depressive symptom trajectories generally, or whether they are unique to this study population. Furthermore, although depression risk is known to vary across the full spectrum of gender expression, including increased prevalence among transgender and gender non-conforming youth,[36–38] our study data were limited to self-reported binary sex. Finally, our modeling approach assumed fixed variances within classes that may not fully capture the clinical heterogeneity of adolescent mental health experiences within trajectory classes. Despite this, existing research supports our findings of 4 latent growth classes, suggesting robust model specification.

Our findings have implications for future research. First, as gender differences in depressive symptoms are widening, so too are developmental trajectories of depressive symptoms between boys and girls. The majority of female students in the study belonged to a trajectory group characterized by probable depression during their entire high school tenure, indicating

potential onset prior to adolescence. On the other hand, we found that one-third of the boys belonged to a trajectory class that had mean scores under the probable threshold of depression at the beginning of high school but crossed the threshold during the study, indicating that high school may be a period of depression onset for a significant subset of male adolescents. Second, although our study measured biological sex, it is important for future research in adolescent mental health to include data on gender identity to be inclusive of transgender and nonbinary youth. Third, our descriptive results provide preliminary evidence that the identified trajectory groups may differ by race, ethnicity, and socioeconomic status. Although we were underpowered to make robust conclusions about these differences, future longitudinal research on depressive symptomology during adolescence may prioritize examining how these social factors affect the incidence and experience of adolescent mood disorders. Finally, although our study was exploratory in nature and did not examine risk factors associated with the observed trajectory classes or downstream outcomes later in life, future research on how and why adolescents express unique longitudinal depressive symptom trajectories across the life course is warranted. As the most recent wave of data collection for the H&H study was in 2021, subsequent research with this cohort could examine whether these trajectory groups in adolescence are associated with health outcomes in early adulthood and during the COVID-19 pandemic.

Although this study provides recommendations for future research, the implications for public health practice are less clear. The United States Preventive Services Task Force (USPSTF) does not recommend differential screening practices in adolescents according to sex or gender, or screening prior to age 11 years.[39] Although the onset of depression differs between male and female adolescents, as found in the present study as well as others, these results may not be generalizable to all adolescents in the United States. Furthermore, recent research finds that although routine depression screening among school-aged youth results in more diagnoses of major depressive disorder, it may not result in uptake in mental health treatment services.[40] Almost 20% of adolescents received mental health care from 2005 to 2018, yet usage declined among those covered by Medicaid/Children's Health Insurance Program (CHIP), highlighting an inequity in care for those with fewer financial resources.[41] Although many public schools employ counselors to address student mental health, they are often understaffed and ill-equipped to manage the growing prevalence and severity of adolescent mental health disorders, leading to an imbalance in care among those who must rely on school services.[42] As the USPSTF recommends screening in conjunction with adequate systems of treatment and follow-up, any recommendations for depression screening as a public health practice should take into consideration the availability of mental health resources for teens, which is outside the scope of this study.

In conclusion, our study of 3,396 high school students from Los Angeles County found that adolescents tend to cluster into 4 distinct classes of depressive symptom trajectories, with a substantial proportion of youth in moderate, high, and increasing symptom trajectories relative to previous studies, particularly among female adolescents. These results suggest that developmental trajectories of depressive symptoms among adolescents in the United States, characterized by severity, age of onset, and change over time, may be different between boys and girls, and may be deviating from past cohorts of adolescents. These findings corroborate evidence of increasing prevalence and widening gender disparities

in adolescent depression, highlighting a significant public health concern and providing direction for future research in adolescent mental health research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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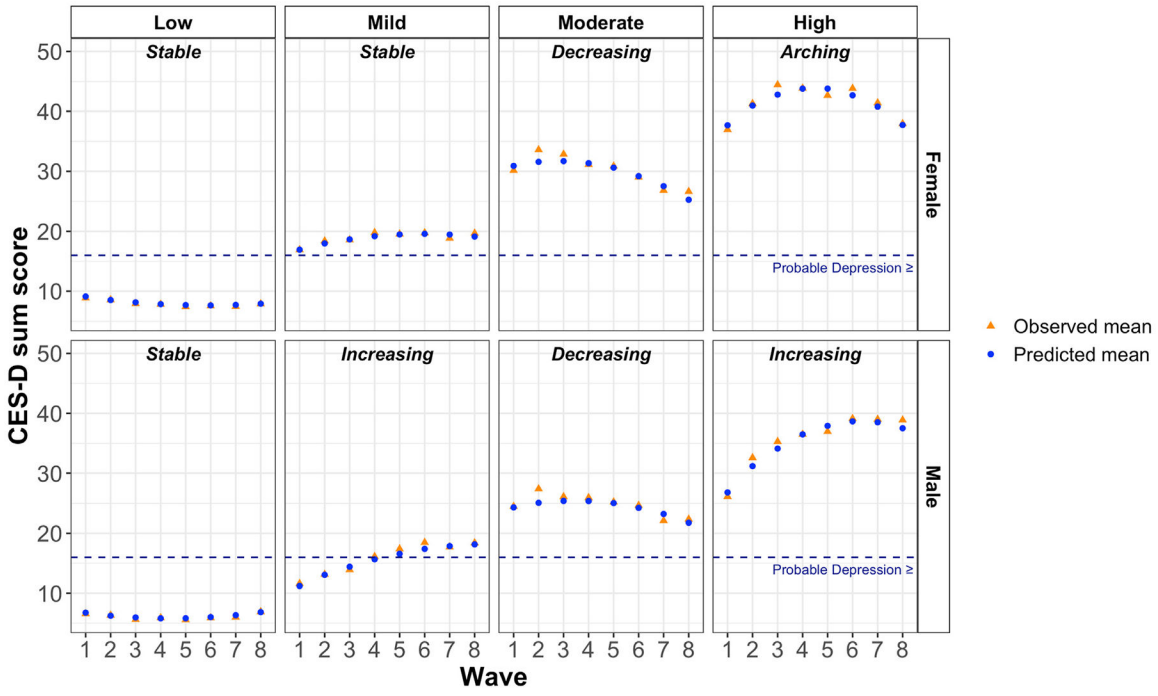

FIGURE 1.

Observed and Predicted Mean Center for Epidemiological Studies–Depression (CES-D) Scale Sum Scores by Latent Class Among Adolescents Residing in Los Angeles County From 2013 to 2017

TABLE 1

Characteristics of Adolescents Residing in Los Angeles County From 2013 to 2017, Stratified by Sex

	Female n = 1,813 (%)	Male n = 1,580 (%)	Total N = 3,393 (%)	*p* [a]
Race/ethnicity				
Asian	263 (14.8)	272 (17.8)	535 (16.2)	.006
Black or African American	87 (4.89)	79 (5.16)	166 (5.0)	
Hispanic or Latino	881 (49.5)	676 (44.2)	1557 (47.0)	
White	285 (16.0)	235 (15.4)	520 (15.7)	
American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Other	174 (9.8)	158 (10.3)	332 (10.0)	
Multiracial/multiethnic	90 (5.1)	110 (7.2)	200 (6.0)	
Parental education				
Less than high school degree	220 (13.9)	163 (12.1)	383 (13.1)	.034
High school degree	255 (16.1)	238 (17.7)	493 (16.8)	
Some college	335 (21.1)	238 (17.7)	573 (19.6)	
College degree or more	778 (49.0)	703 (52.4)	1,481 (50.5)	
Lunch assistance				
Free lunch	661 (43.5)	520 (39.8)	1,181 (41.8)	.106
Reduced-cost lunch	93 (6.1)	95 (7.3)	188 (6.7)	
No assistance	766 (50.4)	690 (52.9)	1,456 (51.5)	
CES-D wave 1				
Mean (SD)	17.4 (12.7)	11.3 (9.64)	14.6 (11.8)	<.001
CES-D wave 8				
Mean (SD)	17.7 (12.8)	14.1 (11.9)	16.1 (12.5)	<.001

Note: Percentages do not sum to 100% because of missing data. Female total missing: race/ethnicity (33), parental education (“Don’t know” 225), lunch assistance (“Don’t know” 123, missing 170), CES-D wave 1 (35), CES-D wave 8 (200). Male total missing: race/ethnicity (50), parental education (“Don’t know” 238), lunch assistance (“Don’t know” 111, missing 164), CES-D wave 1 (67), CES-D wave 8 (271). Race/ethnicity and parental education measured at wave 1. Lunch assistance measured at wave 3. CESD = Center for Epidemiological Studies–Depression scale.

[a]p *Values at* $\alpha = 0.05$ *from* χ^2 *test for categorical variables and 1-way analysis of variance for continuous variables.*

TABLE 2

Model Fit Statistics Comparing Class Solutions for Multiple Group Latent Class Growth Analysis (LCGA) of Center for Epidemiological Studies–Depression Scale (CES-D) Sum Scores by Sex Among High School Students Residing in Los Angeles County From 2013 to 2017

Model	Female n (%)	Male n (%)	Entropy	BIC	Log-likelihood (p^a)
1-Class	C1: 1,813 (100)	C1: 1,580 (100)	–	200559.73	−100247.35
2-Class	C1: 1,230 (67.8)	C1: 1,087 (68.8)	0.87	191926.79	−95902.42 (<.001)
	C2: 583 (32.2)	C2: 493 (31.2)			
3-Class	C1: 702 (38.7)	C1: 578 (36.6)	0.85	189135.10	−94478.13 (<.001)
	C2: 817 (45.1)	C2: 828 (52.4)			
	C3: 294 (16.2)	C3: 174 (11)			
4-Class	C1: 636 (35.1)	C1: 777 (49.2)	0.84	188474.25	−94119.25 (<.001)
	C2: 776 (42.8)	C2: 548 (34.7)			
	C3: 294 (16.2)	C3: 193 (12.2)			
	C4: 107 (5.9)	C4: 62 (3.9)			
5-Class	C1: 184 (10.1)	C1: 151 (9.6)	0.79	187897.33	−93802.335 (<.001)
	C2: 302 (16.7)	C2: 218 (13.8)			
	C3: 598 (33)	C3: 603 (38.2)			
	C4: 109 (6)	C4: 82 (5.2)			
	C5: 620 (34.2)	C5: 526 (33.3)			

Note: BIC = Bayesian information criterion.

[a]Likelihood ratio test comparing model to nested model with 1 fewer class.

TABLE 3

Estimates From the 4-Class Multiple Group Latent Class Growth Analysis (LCGA) of Center for Epidemiological Studies–Depression Scale (CES-D) Sum Scores by Sex Among Adolescents Residing in Los Angeles County from 2013 to 2017

	Female			
	Low, stable	**Mild, stable**	**Moderate, decreasing**	**High, arching**
N (%)	636 (35.1)	776 (42.8)	294 (16.2)	107 (5.9)
	β (SE, *p*)	***β*** (SE, *p*)	***β*** (SE, *p*)	***β*** (SE, *p*)
Intercept	9.12 (0.37, <.001)	16.94 (0.79, <.001)	30.90 (1.76, <.001)	37.67 (1.46, <.001)
Slope	−0.10 (0.03, <.001)	0.18 (0.04, <.001)	0.15 (0.09, .107)	0.60 (0.14, <.001)
Quadratic term	0.002 (0.00, .004)	−0.003 (0.00, .001)	−0.007 (0.00, .001)	−0.014 (0.00, <.001)
	Male			
	Low, stable	**Mild, increasing**	**Moderate, decreasing**	**High, increasing**
N (%)	777 (49.2)	548 (34.7)	193 (12.2)	62 (3.9)
	β (SE, *p*)	***β*** (SE, *p*)	***β*** (SE, *p*)	***β*** (SE, *p*)
Intercept	6.76 (0.24, <.001)	11.20 (0.60, <0.001)	24.31 (1.80, <0.001)	26.80 (2.69, <.001)
Slope	−0.10 (0.02, <.001)	0.31 (0.05, <.001)	0.15 (0.13, .245)	0.75 (0.23, .001)
Quadratic term	0.002 (0.00, <.001)	−0.003 (0.00, .009)	−0.005 (0.00, .051)	−0.012 (0.01, .009)

TABLE 4

Characteristics of Female Adolescents Residing in Los Angeles County From 2013 to 2017 Stratified by Predicted Center for Epidemiological Studies–Depression Scale (CES-D) Trajectory Class

	Low, stable n = 636 (%)	Mild, stable n = 776 (%)	Moderate, decreasing n = 294 (%)	High, arching n = 107 (%)	*p* [a]
Race/ethnicity					
Asian	103 (16.5)	112 (14.6)	28 (9.86)	20 (19.0)	.187
Black or African American	27 (4.3)	36 (4.7)	20 (7.0)	4 (3.8)	
Hispanic or Latino	300 (47.9)	395 (51.6)	140 (49.3)	46 (43.8)	
White	109 (17.4)	114 (14.9)	43 (15.1)	19 (18.1)	
American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Other	56 (8.9)	69 (9.0)	39 (13.7)	10 (9.5)	
Multiracial/multiethnic	31 (4.9)	39 (5.1)	14 (4.9)	6 (5.7)	
Parental education					
Less than high school degree	66 (11.6)	103 (15.3)	38 (15.1)	13 (14.1)	.090
High school degree	75 (13.2)	114 (16.9)	49 (19.4)	17 (18.5)	
Some college	121 (21.2)	136 (20.2)	57 (22.6)	21 (22.8)	
College degree or more	308 (54.0)	321 (47.6)	108 (42.9)	41 (44.6)	
Lunch assistance					
Free lunch	201 (36.5)	305 (47.4)	106 (44.4)	49 (55.7)	.001
Reduced-cost lunch	32 (5.8)	44 (6.8)	15 (6.3)	2 (2.3)	
No assistance	317 (57.6)	294 (45.7)	118 (49.4)	37 (42.0)	
CES-D wave 1					
Mean (SD)	8.86 (7.59)	16.9 (9.4)	30.2 (11.6)	37.0 (12.1)	<.001
CES-D wave 8					
Mean (SD)	7.89 (7.4)	19.7 (10.0)	26.6 (11.3)	37.9 (11.6)	<.001

Note: Percentages do not sum to 100 because of missing data. Total missing: Race/ethnicity (33), parental education (“Don’t know” 225), lunch assistance (“Don’t know” 123, missing 170), CES-D wave 1 (35), CES-D wave 8 (200). Race/ethnicity and parental education measured at wave 1. Lunch assistance measured at wave 3.

[a]p *Values at* $\alpha = 0.05$ *from* χ^2 *test for categorical variables and 1-way analysis of variance for continuous variables.*

TABLE 5

Characteristics of Male Adolescents Residing in Los Angeles County From 2013 to 2017 Stratified by Predicted Center for Epidemiological Studies–Depression Scale (CES-D) Trajectory Class

	Low, stable (n = 777)	Mild, increasing (n = 548)	Moderate, decreasing (n = 193)	High, increasing (n = 62)	*p* [a]
Race/ethnicity					
Asian	128 (16.9)	86 (16.3)	48 (25.8)	10 (16.4)	.020
Black or African American	40 (5.3)	30 (5.7)	8 (4.3)	1 (1.6)	
Hispanic or Latino	353 (46.6)	226 (43.0)	66 (35.5)	31 (50.8)	
White	128 (16.9)	76 (14.4)	23 (12.4)	8 (13.1)	
American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Other	61 (8.06)	65 (12.4)	24 (12.9)	8 (13.1)	
Multiracial/multiethnic	47 (6.21)	43 (8.17)	17 (9.14)	3 (4.92)	
Parental education					
Less than high school degree	87 (12.9)	49 (10.9)	22 (13.5)	5 (9.43)	.488
High school degree	121 (17.9)	75 (16.7)	33 (20.2)	9 (17.0)	
Some college	117 (17.3)	75 (16.7)	37 (22.7)	9 (17.0)	
College degree or more	352 (52.0)	250 (55.7)	71 (43.6)	30 (56.6)	
Lunch assistance					
Free lunch	264 (39.4)	186 (42.2)	54 (37.8)	16 (31.4)	0.737
Reduced-cost lunch	48 (7.2)	32 (7.3)	12 (8.4)	3 (5.9)	
No assistance	358 (53.4)	223 (50.6)	77 (53.8)	32 (62.7)	
CES-D wave 1					
Mean (SD)	6.58 (5.61)	11.6 (6.95)	24.5 (10.5)	26.1 (13.1)	<.001
CES-D wave 8					
Mean (SD)	6.90 (7.12)	18.4 (9.93)	22.3 (10.3)	38.9 (9.40)	<.001

Note: Percentages do not sum to 100 because of missing data. Total missing: race/ethnicity (50), parental education (“Don’t know” 238), lunch assistance (“Don’t know” 111, missing 164), CES-D wave 1 (67), CES-D wave 8 (271). Race/ethnicity and parental education measured at wave 1. Lunch assistance measured at wave 3.

[a] *p at* $\alpha = 0.05$ *from* χ^2 *test for categorical variables and 1-way analysis of variance for continuous variables.*