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Community-Based Prevalence of Externalizing and Internalizing Disorders among School-Aged Children and Adolescents in Four Geographically Dispersed School Districts in the United States

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Abstract

The Project to Learn About Youth-Mental Health (PLAY–MH; 2014–2018) is a school-based, two-stage study designed to estimate the prevalence of selected mental disorders among K-12 students in four U.S.-based sites (Colorado, Florida, Ohio, and South Carolina). In Stage 1, teachers completed validated screeners to determine student risk status for externalizing or internalizing problems or tics; the percentage of students identified as being at high risk ranged from 17.8% to 34.4%. In Stage 2, parents completed a structured diagnostic interview to determine

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whether their child met criteria for fourteen externalizing or internalizing disorders; weighted prevalence estimates of meeting criteria for any disorder were similar in three sites (14.8%–17.8%) and higher in Ohio (33.3%). PLAY–MH produced point-in-time estimates of mental disorders in K-12 students, which may be used to supplement estimates from other modes of mental disorder surveillance and inform mental health screening and healthcare and educational services.

Keywords

Mental disorders; Children; Adolescents; Population-based; Screening

Background

Mental disorders are common among children and adolescents, and can hinder healthy development and lead to negative outcomes in childhood, adolescence, and adulthood, particularly when symptoms and impairment are not addressed with appropriate treatment [1]. Prior research indicates that nearly 20% of children have an impairing mental disorder [2–4], that mental disorders are a leading cause of disability globally [5], and that the prevalence of any diagnosed neurodevelopmental or mental disorder among children in the United States increased by 21% from 2001 to 2011 [6]. Mental disorders have an impact on not only the health and success of the child and the health and stability of the child's family [1, 7], but also the healthcare industry, education system, and economy [8–15]. The increasing awareness that mental disorders have serious public health and economic implications has highlighted the need for accurate prevalence estimates to inform research, policies, and healthcare and education services. However, the prevalence of mental disorders among children can be difficult to measure, as differences in sample characteristics, data collection methods, and mental health indicator types and case definitions lead to substantial variability in estimates produced by different surveillance systems [16–18].

National survey data have been routinely used in the United States to monitor national and state-level prevalence of specific childhood mental disorders [19–21]. While these surveys produce geographically representative estimates of prevalence and trends over time, the resulting estimates are typically based on parent report of whether their child has ever received a diagnosis of a given mental disorder. Use of a single question to assess mental disorder diagnosis status allows for a relatively efficient method of surveillance compared to conducting full diagnostic assessments, but the single question about diagnosis receipt is subject to bias related to parent recall and variability in diagnostic decision-making across providers. The parent-reported indicator of diagnosis receipt also does not capture youth who meet criteria for a disorder but who have not yet been diagnosed.

Another approach to producing population-level estimates of mental disorders is to collect data on symptoms and impairment in a population-based sample to identify individuals who meet criteria for specific disorders. Studies that use criteria-based case definitions do not depend on interaction with the healthcare system for identification and are thus not susceptible to variability in diagnostic practice or reporting bias. The Diagnostic and

Statistical Manual of Mental Disorders (DSM) provides standardized criteria for individual mental disorders [22], and a number of epidemiological studies of mental disorders use tools that assess presence of symptoms and impairment as outlined in the DSM, such as the 2001–2004 U.S. National Comorbidity Survey Replication Adolescent Supplement (NCS-A) and the 1999–2004 National Health and Nutrition Examination Survey (NHANES) [3, 4, 23, 24]. These seminal studies allowed for national point-in-time estimates of mental disorder prevalence among U.S. children and adolescents, but the results from these studies are over 15 years old and may not reflect current mental disorder prevalence. Other ongoing U.S. national surveys, such as the National Survey of Drug Use and Health [25] and the National Health Interview Survey [26], include questions about emotional and behavioral symptoms for children and adolescents, but rely on a single respondent and do not contain full diagnostic interviews to determine which children and adolescents meet diagnostic criteria for most mental disorders.

Community-based epidemiological research can provide the opportunity to gather more detailed data on mental disorders and outcomes (e.g. specific symptoms and impairment, previously received diagnoses and treatment, academic outcomes), and to collect information from multiple sources (e.g. parents, children, teachers). Although community-based research does not typically yield nationally representative estimates, estimates based on diagnostic criteria provide critical information for policymakers, healthcare providers, and educators to understand the prevalence of mental disorders in the community. As an example, the U.S.-based Project to Learn about ADHD in Youth (PLAY) used screening and interview phases of data collection to gather information from teachers and parents to estimate the prevalence of attention-deficit/hyperactivity disorder (ADHD) in elementary school-aged children based on DSM-IV criteria [27].

The Project to Learn About Youth–Mental Health (PLAY–MH) builds upon the methodology used in PLAY to estimate the prevalence of a larger set of mental disorders in school-aged children and adolescents in four geographically dispersed school districts. PLAY–MH was conducted to determine: (1) the prevalence of mental disorders using DSM-IV criteria among students from kindergarten to 12th grade, (2) how frequently these disorders occur together, and (3) what types of treatments children and adolescents are receiving for these disorders. This manuscript describes the methodology of PLAY–MH and reports prevalence estimates of externalizing and internalizing disorders in school-aged children and adolescents.[1] The diagnostic criteria-based estimates from this study may be used to supplement estimates of externalizing and internalizing disorders from other surveillance systems to inform public health strategies in healthcare, education, and policy settings to reduce the impact of mental disorders in childhood, adolescence, and adulthood.

[1]The prevalence of tic disorders (due to use of a newly developed assessment tool to identify school-aged children and adolescents who meet diagnostic criteria for tic disorders), co-occurrence of disorders, and associated treatment will be reported in separate upcoming manuscripts.

Methods

Study Population and Procedures

PLAY–MH was conducted through a cooperative agreement from the Centers for Disease Control and Prevention's National Center on Birth Defects and Developmental Disabilities and the Disability Research and Dissemination Center, and was comprised of four school district-level sites in four states (Colorado, Florida, Ohio, South Carolina). Across sites, the school districts included urban, suburban, and rural areas, and the school district population sizes ranged from approximately 6000 to 126,000 students. Table 1 provides details on site characteristics and study methodology. Study procedures including informed consent were reviewed and approved by the respective Institutional Review Board associated with each site's project team (Colorado Multiple Institutional Review Board, University of Florida, Ohio University, University of South Carolina).

We used a two-stage design and stratified sampling for data collection, and data were collected from 2014 to 2018. In the first stage, participating teachers completed a brief screener on externalizing behaviors, internalizing symptoms, and tics in their students. The target population for Stage 1 screening included all students in the Ohio and South Carolina site school districts. The Florida site pre-selected nine schools (three elementary, three middle, and three high schools) which collectively had population characteristics similar to the full school district population; nearly all students in the pre-selected schools in the Florida site were eligible for Stage 1 screening (see Table 1 for exclusion criteria). The Colorado site sampled students from 30 schools whose principals chose to participate in the study. The Colorado Stage 1 sampling frame was further stratified by student sex, race, ethnicity, and special education status, and no more than six students were selected per teacher for screening to limit the burden on teachers.

In all sites, parents or guardians (hereinafter referred to as parents) were notified about the Stage 1 data collection and offered the opportunity to opt their child(ren) out of screening; between 1 and 9% of students were opted out of Stage 1 by their parents. For each site's elementary school sample, the screener was completed by the student's primary teacher. In the middle and high school samples, the student's teacher for a designated classroom period or time of day completed the screener. Teacher incentives for completion of individual screeners were offered in three sites (Florida, Ohio, and South Carolina). The Stage 1 completion rate for eligible students not opted out ranged from 75% (Florida) to 78% (Ohio). Students were identified as being at high risk or low risk for a mental disorder based on the teacher screener (see below for risk criteria), stratified based on risk status, sex, and grade level (K–5th grade, 6th–12th grade), and randomly sampled for participation in a Stage 2 interview. For Stage 2, parents of sampled students were invited to participate in telephone interviews (Colorado) or in-person parent interviews (Florida, Ohio, South Carolina); in-person interviews included child interviews for students aged 8 years and older. Informed consent was obtained from all participating parents and assent was obtained from all participating children included in the study. Among those sampled and contacted for participation in Stage 2, the response rate for completing an interview ranged from 3.5%

(Ohio) to 22.6% (Colorado), and the median time between the Stage 1 screener and Stage 2 interview ranged from 7 months (South Carolina) to 21 months (Florida).

Measures and Case Definitions

Each site used one or two screening tools to identify students at high risk for having an externalizing or internalizing disorder: the BASC-2 Behavioral and Emotional Screening System (BASC-2-BESS) Teacher Form and/or the Strengths and difficulties questionnaire (SDQ). The BASC-2-BESS Teacher Form is a 27-item instrument intended to measure behavioral and emotional strengths and weaknesses of students in kindergarten through 12th grade [28]. The teacher form of the BASC-2-BESS has high internal consistency (median across age groups = 0.96), high test–retest reliability (r = 0.91), and moderate interrater reliability (r = 0.70) [28]. The teacher SDQ is a 31-item questionnaire that measures general behavior and associated functioning designed for children and adolescents aged 3–16 years [29]. The teacher SDQ has high internal reliability (α = 0.87), high test–retest correlation (r = 0.80), moderate sensitivity (43%) and high specificity (95%) for the detection of any DSM-IV disorders [29]. Both screening tools for externalizing and internalizing disorders were used for all Stage 1 participants in Florida and Ohio; teachers in South Carolina completed the SDQ for each student, and teachers in Colorado completed the BASC-2-BESS for each sampled student and the SDQ for a subset of sampled students. To identify students at high risk for having tics, all four sites used the Proxy Report Questionnaire (PRQ) [30], a screener that provides a brief description of tics followed by two questions asking about the presence of lifetime and current tics. Based on teacher-report alone, the PRQ has a sensitivity of 40% and specificity of 74% for identifying tic disorders [31]. Students were considered to be in the high risk group for Stage 2 sampling if their BASC-2-BESS score was in the Elevated or Extremely Elevated range (t-score > 60), if their SDQ total score was in the borderline or abnormal range (total score > 11), or if their teacher reported that the student ever or currently displayed tics using the PRQ; students meeting none of these criteria comprised the low risk group. Teachers also reported on selected student-level demographic indicators (e.g. sex, grade level).

In order to determine whether students met DSM-IV criteria for externalizing or internalizing disorders in the past year, parents completed selected modules of the Diagnostic Interview Schedule for Children, IV (DISC-IV[2]). Externalizing disorders included ADHD, oppositional defiant disorder (ODD), and conduct disorder; internalizing disorders included generalized anxiety disorder, social phobia, separation anxiety, panic disorder, obsessive–compulsive disorder, agoraphobia, post-traumatic stress disorder (PTSD), major depressive disorder, dysthymic disorder, mania, and hypomania [32]. Sites could include additional DISC-IV modules beyond those listed above (see Table 1). Parents also completed a demographic questionnaire, and some reported demographic indicators (child sex, grade, race/ethnicity) were cross-checked or supplemented by teacher-reported Stage 1 responses and/or data provided by the site school district.

[2]Although at the time of the study, the DSM-IV-TR was published, the DISC assessment tool was based on DSM-IV criteria rather than DSM-IV-TR. The disorders included in this study did not change between versions.

A specific case definition for each disorder was established based on the Stage 2 diagnostic interview and DSM-IV criteria [33] (Supplemental Table 1); the case definitions relied on information from the parent DISC-IV unless otherwise indicated. Students were considered to have panic disorder or obsessive–compulsive disorder if they met symptom criteria for either disorder; to be consistent with criteria in DSM-IV, associated impairment was not incorporated into the case definition for these two disorders. Report of impairment on the DISC-IV was taken into account for the following disorders to align with DSM-IV criteria: social phobia, separation anxiety, agoraphobia, generalized anxiety disorder, PTSD, major depression/dysthymia, mania/hypomania, ODD, and conduct disorder. Students were considered to meet impairment criteria for these disorders if they had at least two moderate or at least one severe rating of impairment among the six question sets on impairment for a given disorder. The case definition for ADHD required that students met both symptom and impairment criteria on the DISC-IV and had at least two teacher-reported ADHD symptoms on the BASC-2-BESS or SDQ in Stage 1; the combination of information from multiple reporters was intended to address DSM-IV criteria requiring impairment in multiple settings [33].

Statistical Analysis

The unweighted percentages of students meeting high risk criteria overall and by demographic subgroup (sex, race/ethnicity, whether the student received free or reduced-price lunch, grade level) by site were calculated using SAS v.9.4 (SAS Institute, Inc.; Cary, NC) and compared using chi-square tests ($\alpha = 0.05$). In order to account for the complex sampling design for estimates using Stage 2 data, sample weights were calculated for each site using a post-stratified propensity score approach [34] and raking [35] to produce prevalence estimates that were representative of the participating school districts. Sample weights accounted for differential probability of selection in Stage 1 (Colorado site only) and Stage 2 non-response based on demographic characteristics (child sex, race/ethnicity, grade level, and Stage 1 risk status); additional detail on weighting procedures is available from the authors upon request. Weighted prevalence estimates and Clopper-Pearson 95% confidence intervals (95% CI) were calculated using SAS-callable SUDAAN v.11.0.3 (RTI International; Cary, NC) for each site for any disorder, any externalizing disorder, and any internalizing disorder, and by sex, age group, race/ethnicity, insurance status, parent educational status, relationship of household income to federal poverty level, and high-risk status. Prevalence estimates across demographic subgroups within each site were compared using prevalence ratios and 95% confidence intervals. Prevalence ratio confidence intervals that exclude 1 represent statistically significant differences. Estimates for individual disorders were also pooled across sites using a random effects model that was fit with the rmeta package [36] in R version 3.4.4 (R Core Team, 2018). Students were excluded from disorder prevalence analyses if they had missing data for the parent-reported DISC (n = 3–8 per site).

Results

Sample Characteristics

Overall, the number of students who were screened at each site for Stage 1 ranged from 4198 (Colorado) to 7207 (South Carolina), and the number of Stage 2 interviews at each site ranged from 160 (Ohio) to 293 (Florida, Table 1). The distribution of demographic characteristics of the Stage 1 and Stage 2 samples at each site are presented in Supplemental Table 2. For three sites, the school level with the highest percentage of students was elementary school; however, in Florida, an equal number of elementary, middle, and high schools participated in PLAY–MH, resulting in a higher percentage of high school students in the study population. In the Florida and South Carolina sites, most students were non-Hispanic white or non-Hispanic black. In Colorado, over half of the students were Hispanic, and in Ohio, most students were non-Hispanic white. In Ohio and South Carolina, about half of students had Medicaid insurance, compared to 61.6% in Colorado and 38.2% in Florida. In three sites, approximately three quarters of the students had at least one parent with more than a high school education, while in Colorado, only about half of the students had a parent with more than a high school education. Of the three sites for which the relationship of household income to the federal poverty level could be calculated, Florida had the highest percentage (58.7%) of students living in households at or above 200% of the federal poverty level, while Colorado had the lowest percentage (23.0%).

Screening Stage

Across sites, between 17.8% and 34.4% of students screened high for externalizing and/or internalizing problems and/or tics based on teacher report in Stage 1 (Table 2). The percentage of boys who screened high was consistently higher than the percentage of girls at each site. The school level with the highest percentage of students identified as high risk was elementary school in South Carolina, middle school in Florida, and high school in Ohio; in Colorado, a similar percentage of students were in the high-risk group in each school level. In Colorado, Florida, and South Carolina, the non-Hispanic black group had the highest percentage of students screened as high risk, compared to other racial or ethnic groups. A higher percentage of students receiving free or reduced-price lunch were identified as high risk compared to students who did not receive free or reduced-price lunch in Florida, Ohio and South Carolina, while there was little difference between these groups in Colorado.

Mental Disorder Prevalence Estimates

Based on the parent DISC-IV interview in Stage 2, the weighted prevalence estimates of meeting criteria for any disorder in the past year were relatively similar in three sites (Colorado: 14.8%, South Carolina: 17.6%, Florida: 17.8%) and higher in the Ohio site (33.3%; Table 3). Between 10.1% (Colorado) and 24.3% (Ohio) of students met criteria for an externalizing disorder; ODD and ADHD were the individual disorders with the highest prevalence at each site. Between 8.7% (Colorado) and 14.7% (Ohio) of students met criteria for any internalizing disorder; 7.9–11.2% of students met criteria for an anxiety disorder and 1.5–3.7% of students met criteria for a depressive disorder. Each site had relatively few students who met criteria for generalized anxiety, panic disorder, obsessive–compulsive disorder, agoraphobia, PTSD, and mania/hypomania, resulting in unstable estimates;

therefore, estimates for these disorders are not presented individually. Supplemental Table 3 shows site-level weighted prevalence estimates for disorders without the impairment requirement to allow for comparison with other mental disorder prevalence studies that did not require impairment in the case definition. Supplemental Table 4 provides pooled estimates for each disorder type across the four sites.

Site-level prevalence estimates of any disorder by demographic subgroups are presented in Table 4. A higher percentage of students who were identified in Stage 1 as high risk for externalizing or internalizing problems or tics met criteria for at least one externalizing or internalizing disorder than students in the low risk group in all four sites. Otherwise, no demographic differences were detected across multiple sites in the percentage of students who met criteria for any disorder. Prevalence estimates of any externalizing disorder and any internalizing disorder by demographic subgroups are presented in Supplemental Tables 5–6.

Discussion

The PLAY–MH study provides point-in-time prevalence estimates for a set of mental disorders among school-aged children and adolescents in four communities based on screening information from teachers and parent-reported diagnostic interviews. Taken together, the results suggest that between 15 and 33% of students in the four school districts met criteria for an externalizing or internalizing disorder, with substantial variability of estimates between communities. Any anxiety disorder, ODD, and ADHD were the most common disorders at each site. The PLAY–MH study also showed that up to one out of three K-12 students may be at high risk for externalizing or internalizing problems or tics based on teacher-reported screening data, with over a quarter of students identified in each site's high-risk group meeting diagnostic criteria for at least one externalizing or internalizing disorder.

The point estimates for meeting criteria for any disorder in the four PLAY-MH sites are each higher than published point estimates of any mental disorder with at least some impairment (11.3%, 95% CI: 9.5, 13.1) from a U.S.-based nationally-representative sample in 2001–2004 [3] and two U.S. community-based studies of children and adolescents from a similar time period [37, 38]. Likewise, the worldwide pooled estimate of mental disorders with impairment among children and adolescents from a 2015 meta-analysis was also lower (14.0%, 95% CI: 11.1, 16.9) than each of the PLAY-MH site point estimates [39]. However, the confidence intervals for most of these previously published estimates overlap with the confidence intervals for three of the PLAY-MH site estimates, making it difficult to discern whether the PLAY-MH estimates are consistent with or significantly higher than estimates from other studies that used data collected during an earlier time period and with different study methodologies. The estimate from the fourth site (Ohio) was higher than the other three sites and may provide evidence of variation in the estimated prevalence of mental disorders in children and adolescents across communities, despite the use of a similar approach to study design and methods in each PLAY-MH site. However, it should be noted that the Ohio site estimate is based off of a smaller sample size with a lower response rate than the estimates from the other three sites, and therefore should be interpreted with caution.

There were notable demographic differences in the percentage of students who were considered to be in the high risk group in the screening stage. A higher percentage of boys, non-Hispanic black students, and students receiving free or reduced price lunch were in the high risk group than their peers in all or most sites. However, there were not pronounced demographic differences in the estimated percentage of students who met criteria for externalizing and internalizing disorder across sites based on Stage 2. Students in the high risk group were more likely than students in the low risk group to meet diagnostic criteria for any disorder in all four sites, but there were no differences consistently detected across sites for any of the other demographic characteristics considered in this analysis. These results are consistent with other studies of disorder prevalence based on diagnostic criteria that also found little difference in disorder prevalence by age group [3], race/ethnicity [4], and poverty status [4, 38], though differences by sex [3, 37, 38] and parental education level [4] have been found in other studies.

The results from the four PLAY–MH sites can be used in several ways. Community-based estimates of mental disorder prevalence provide complementary information to other epidemiological methods used to estimate the prevalence of externalizing and internalizing disorders among school-aged children and adolescents [17]. Surveillance of childhood mental disorders in the United States typically relies on parent report of diagnosed disorders on national surveys [19–21, 40–43] or the identification of care received for mental disorders in healthcare claims data [44–50]. However, neither of these types of data sources generally contain symptom and associated impairment indicators that can be evaluated against diagnostic criteria. Community-based data collections that include diagnostic interviews, such as PLAY–MH, are uniquely able to identify children who meet criteria for a mental disorder but have not yet received a diagnosis, do not receive medical care related to a diagnosed disorder, or do not have health insurance. Therefore, community-based studies using direct assessment can more completely capture the percentage of children in the target population who meet criteria for mental disorders and provide essential supplemental information to augment the surveillance of mental disorders over time using other data sources.

Additionally, the Stage 1 screening data may inform school-based universal mental health screening initiatives, providing examples to illustrate how many students may be identified as potentially needing additional support and services. Screening for mental health problems has been shown to help identify children who currently meet criteria for a disorder, but also provides an early indicator of later mental health or school functioning problems [51–54]. The methodology for screening in PLAY–MH can be used as a model or adapted by other school districts to implement school-based mental health screening [55, 56], as teachers can provide valuable information to help identify children with mental health problems [57–59] or to help clinicians make a diagnosis [60–65]. Schools may also use these estimates of externalizing and internalizing disorders as a starting point to anticipate service needs for the portion of the student population affected by these disorders, particularly to identify service gaps for students who might benefit from preventive interventions or special education services [66]. School-based interventions have been shown to increase utilization and accessibility of mental health services [67], have an evidence base for effectiveness [68–73],

and have been recommended as effective in decreasing symptoms of anxiety and depression [74, 75].

Finally, prevalence estimates of externalizing and internalizing disorders from school communities also can be useful for healthcare systems. These estimates can be used to inform pediatric and family medicine clinics on expected caseloads related to childhood mental disorders and to address associated referral and treatment needs. Epidemiological study results such as those from PLAY–MH can also be used as contributing benchmarks for nomograms in diagnostic decision-making [76], to inform evaluations of diagnostic practice [77–80] and for the consideration of adaptations to clinical practice, service delivery, and reimbursement models that may improve outcomes for children with externalizing and internalizing disorders [67, 81–85].

This study is subject to a number of limitations. First, the results presented are representative of the four school districts that participated in PLAY-MH and may not be generalizable to the population of students not attending public schools, living in other communities, or to larger geographic areas. Second, these results are primarily based on report of symptoms and impairment by one parent and may only account for behaviors and emotions that the respondent parent had observed or been told about. Incorporation of child self-reported information may have led to identification of additional students meeting criteria for different disorders, particularly among adolescents or for internalizing disorders where symptoms may not be as outwardly observable by parents or teachers [60, 86, 87]. Relatedly, students who met the case definition for any disorder were not evaluated clinically; a comprehensive clinical evaluation may have resulted in a different diagnostic outcome [88]. Third, effective treatment may have reduced reported symptoms and impairment for students who had received a previous diagnosis of one of the disorders included in this study, therefore leading to an underestimate of the proportion of school-aged children and adolescents affected by externalizing and internalizing disorders. However, the cross-sectional nature of this study does not allow for distinctions to be made between children adequately treated for previously diagnosed disorders who now fall below the symptom and impairment threshold and children who have received an inappropriate diagnosis. Fourth, despite the publication of DSM-5 in May 2013 [22], this study relied on DSM-IV criteria to determine whether children and adolescents met criteria for the set of disorders of interest. Finally, this study had relatively low response rates among families sampled for participation in Stage 2, which may have led to non-response bias. Sample weights were developed and incorporated in the analyses in part to address potential non-response bias, but prevalence estimates may be sensitive to model specifications used to construct sample weights and any unmeasured factors related to non-response cannot be empirically addressed by the sample weights. Estimates based on smaller sample sizes may be more susceptible to non-response bias and sensitive to weight model specifications. This limitation is particularly notable for the descriptive comparison of the site-level prevalence estimates, as the site with the estimate that was the highest and the most different than the other three sites (Ohio) is also the site with the smallest Stage 2 sample size. The relatively small sample sizes in Stage 2 was also a limiting factor in the report of prevalence for some individual disorders, as there were too few participants who met criteria for some disorders to produce stable estimates. Limitations

related to low response rates are widely recognized in the statistical literature [89] and are cause for caution in the interpretation of prevalence estimates.

Summary

The PLAY–MH study provides point-in-time estimates of externalizing and internalizing disorders among students in four school districts in geographically-dispersed U.S. communities. These estimates add to the body of community-based epidemiological literature on mental disorders in school-aged children and adolescents, supplement estimates from other modes of mental disorder surveillance, and may provide evidence for geographical variability in the prevalence of mental disorders when consistent methodology is used. The estimates from PLAY–MH can be used as examples to plan for healthcare and school service needs of children and adolescents with externalizing and internalizing disorders, and to describe the population of children and adolescents who might benefit from secondary prevention efforts to avoid or diminish negative outcomes that are often associated with childhood mental disorders.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Overview of site-level characteristics and study methodological details for Stage 1 and Stage 2, Project to Learn About Youth-Mental Health

	Colorado	Florida	Ohio	South Carolina[a]
Site characteristics				
Urbanicity	Suburban/urban	Urban/suburban	Rural/suburban	Suburban/rural
School district population	34,382	125,611	6022	10,443
School district composition	28 elementary schools	104 elementary schools	6 elementary schools	11 elementary schools
	6 kindergarten-8th grade schools	2 kindergarten-8th grade schools	2 junior high schools	4 middle schools
	7 middle schools	24 middle schools	1 high school	3 high schools
	8 high schools	2 6th–12th grade schools		2 alternative/vocational schools
		19 high schools		
		42 charter, alternative, virtual or exceptional center schools		
Stage 1				
Screener data collection	April–May 2014	April–June 2015	HS: April–May 2015 ES/MS: fall 2015	September–October 2014
Screening instruments	BASC-2 -BESS, PRQ (and SDQ for approximately 20% of sample)	BASC-2-BESS, SDQ, PRQ	BASC-2-BESS, SDQ, PRQ[b]	SDQ[c], PRQ
Screener administration	Paper and pencil	Paper and pencil	Web-based	Web-based
Screening population	Six or fewer students per teacher for all teachers in participating schools	All students in nine pre-selected schools who did not meet exclusion criteria[d]	All students in school district	All students in school district
Screening n	4198 (of 5521 sampled; population in participating schools: 21,418)	5744 (of 7902 eligible students)	4634 (of 6022)	7207 (of 10,443)
% parent opt out	3%	3%	1%	9%
Stage 1 completion rate[e]	78.0% (4198/5379)	74.8% (5744/7682)	78.1% (4634/5934)	76.2% (7207/9452)
Respondent teacher[f]	ES: primary teacher	ES: primary teacher	ES: primary teacher	ES: primary teacher
	MS/HS: teacher for a designated period	MS/HS: teacher for a designated period	MS/HS: teacher at a designated time of day	MS: 1st period teacher HS: 2nd block teacher
Teacher incentives	No direct individual teacher incentives; schools were provided with gift cards to local restaurants to purchase breakfast or lunch for participating teachers	$5 gift card per student screened	$5 per student screened	$4 per student screened
Stage 2				
Data collection period	October 2014–February 2016	January 2016–January 2018	June 2015–December 2016	January–December 2015

	Colorado	Florida	Ohio	South Carolina[a]
Response rate among those sampled for Stage 2	22.6% (239/1058)	11.4% (293/2571)	3.5% (160/4634)	18.3% (276/1506)
Estimated[g] median and interquartile interval (IQI) for number of months between Stage 1 screener and Stage 2 interview	12 (IQI: 9–15)	21 (IQI: 17–26)	8 (IQI: 7–10)	7 (IQI: 5–10)
Completed interviews	239	293	160	276
Respondents	Parent only[h]	Parent and child[i]	Parent and child[i]	Parent and child[i]
Interview type/location	Telephone	In-person at participant home (secondary locations: library, University of Florida office)	In-person at school	In-person at 1 designated school
Interview language	English and Spanish[j]	English only	English only	English only
Diagnostic assessments	DISC: Core modules[k], social phobia, trichotillomania, substance use disorders Description of Tic symptoms (DoTS)[l]	DISC: Core modules[k,m], social phobia Description of Tic Symptoms (DoTS)[l] K-SADS[n]	DISC: core modules[k,m] Description of Tic Symptoms (DoTS)[l]	DISC: core modules[k], social phobia, trichotillomania, substance use disorders Description of Tic symptoms (DoTS)[l]
Incentives for participating families	$50 gift card	Parents: $50 gift card Children aged 8–17 years: $25 gift card Children aged 18 +years: $50 gift card	$50	$50

BASC-2-BESS BASC-2-behavioral and emotional screening system, *PRQ* proxy response questionnaire, *SDQ* strengths and difficulties questionnaire, *ES* elementary school, *MS* middle school, *HS* high school, *DISC* diagnostic schedule for children, *K-SADS* kiddie schedule for affective disorders and schizophrenia

[a]The South Carolina site was selected to replicate the PLAY-MH data collection methodology in the same school district during the 2015–16 school year to evaluate the stability of prevalence estimates in the same community over time. The results presented in the current manuscript are from the first data collection period, and results from the replication study will be published separately

[b]Junior high and high school students in the Ohio site also completed the youth version of the SDQ and the Motor tic, Obsessions and compulsions, Vocal tic Evaluation Survey (MOVES). Youth-reported screening information was not incorporated into determination of risk status in Stage 1 for the Ohio sample to be consistent with the other three sites

[c]The South Carolina site also included the BASC-2-BESS as part of the Stage 1 screener, but due to a technical problem in the data collection, the BASC-2-BESS data for the elementary school portion of the sample were deemed to be unusable. Students in the South Carolina site were categorized as high risk or low risk for a mental disorder based on the SDQ and PRQ only to maintain methodological consistency across all school levels within the site for stratification and sampling

[d]Students attending the selected schools in the Florida site were excluded from Stage 1 screening population if their date of birth was before June 15, 1997 to ensure they were younger than 18 years during screening period, if they were in moderate to severe developmental/intellectual delay classes, or if they lived outside of the school's neighborhood zone and were attending emotional/behavioral special programs, in self-contained special education classrooms, or in mild developmental disorder/intellectual delay classes

[e]Completion rate is the number of students screened divided by number of students in site's screening population who were not opted out of screening by their parent(s). Examples of reasons for screening not to have been completed included teacher absence or refusal, or that the student left the school district after the screening population was identified or sampled

[f] In limited circumstances, if the selected teacher for a sampled student did not complete the screener, project staff attempted to identify and recruit another teacher who knew the student well to complete the screener

[g] Time between Stage 1 screener completion and Stage 2 interview data was calculated using an approximate midpoint date of the Stage 1 screening at each site (Colorado: April 15, 2014; Florida: April 29, 2015; Ohio: April 15, 2015 for the high school sample and September 15, 2015 for the elementary and junior high school samples; and South Carolina: September 26, 2014) and the actual date of Stage 2 interview completion

[h] Child data were not collected in the Colorado site because the telephone interview method was not suitable to ensure privacy and lack of distraction to allow for valid responses

[i] Child interviews were completed for students aged 8 years and older in Florida, students aged 9 years and older in South Carolina, and students aged 11 years and older in Ohio

[j] 34% of Colorado site interviews were conducted in Spanish

[k] Core DISC modules: demographics, separation anxiety, panic disorder, agoraphobia, generalized anxiety, obsessive–compulsive disorder, post-traumatic stress disorder, major depression/dysthymia, mania/hypomania, attention-deficit/hyperactivity disorder, oppositional defiant disorder, conduct disorder

[l] A newly developed instrument for tic disorder criteria was used because the DISC module for tic disorders has been shown to have poor agreement with expert diagnosis [90]

[m] Child-reported DISC interviews were collected in addition to the parent interview in the Florida and Ohio sites, though the child-reported data is not incorporated into the disorder case definitions presented in this manuscript

[n] A subset of Stage 2 participants in the Florida site were invited for a Stage 3 clinical interview assessment to determine case status for tic disorders, bipolar disorder, and disruptive mood dysregulation disorder. Results from this portion of the PLAY-MH study will be reported separately

Table 2

Percentage of K-12th grade students who screened as high risk for externalizing and/or internalizing problems and/or tics based on teacher report in Stage 1, Project to Learn About Youth-Mental Health, 2014–2018

	Colorado (n = 4198)			Florida (n = 5744)			Ohio (n = 4634)			South Carolina (n = 7207)		
	Stage 1 n	Unweighted % (95% CI)	Chi-square p-value	Stage 1 n	Unweighted % (95% CI)	Chi-square p-value	Stage 1 n	Unweighted % (95% CI)	Chi-square p-value	Stage 1 n	Unweighted % (95% CI)	Chi-square p-value
Overall	4198	30.0 (28.6, 31.4)		5744	34.4 (33.2, 35.7)		4634	26.2 (25.0, 27.5)		7207	17.8 (17.0, 18.7)	
Sex												
Male	2229	37.5 (35.5, 39.5)	<0.0001	2868	38.7 (36.9, 40.5)	<0.0001	2468	28.7 (27.0, 30.6)	<0.0001	3742	24.0 (22.6, 25.4)	<0.0001
Female	1968	21.6 (19.8, 23.5)		2876	30.2 (28.5, 31.9)		2166	23.4 (21.6, 25.2)		3465	11.2 (10.2, 12.3)	
Grade level												
K-5th (elementary school)	2140	30.0 (28.1, 32.0)	0.98	1443	28.4 (26.1, 30.8)	<0.0001	1736	27.0 (24.9, 29.1)	<0.0001	3691	20.6 (19.4, 22.0)	<0.0001
6th–8th (middle school)	1414	30.1 (27.7, 32.6)		1417	45.0 (42.4, 47.7)		1299	18.4 (16.3, 20.6)		1740	17.1 (15.4, 19.0)	
9th–12th (high school)	644	29.7 (26.2, 33.4)		2884	32.2 (30.5, 34.0)		1599	31.8 (29.5, 34.1)		1776	12.7 (11.2, 14.3)	
Race/ethnicity[a]												
Non-Hispanic white	697	33.6 (30.1, 37.2)	<0.0001	2506	25.5 (23.8, 27.3)	<0.0001	4405	26.0 (24.7, 27.3)	0.09	4620	15.9 (14.9, 17.0)	<0.0001
Other race/ ethnicity	3496	29.3 (27.8, 30.8)		3238	41.3 (39.6, 43.0)		229	31.0 (25.1, 37.4)		2587	21.3 (19.7, 22.9)	
Non-Hispanic black	781	36.0 (32.6, 39.5)		2326	47.0 (45.0, 49.1)					1953	23.7 (21.8, 25.6)	
Hispanic	1890	28.8 (26.8, 30.9)		533	27.6 (23.8, 31.6)					340	12.1 (8.8, 16.0)	
All other race/ethnicity	825	24.2 (21.4, 27.3)		379	25.6 (21.3, 30.3)					294	16.0 (12.0, 20.7)	
Free/reduced price lunch												
Yes	2978	30.0 (28.3, 31.6)	0.83	2554	43.8 (41.9, 45.8)	<0.0001	2167	34.1 (32.2, 36.2)	<0.0001	4145	21.8 (20.6, 23.1)	<0.0001
No	1215	30.3 (27.7, 33.0)		3190	26.9 (25.4, 28.5)		2467	19.3 (17.7, 20.9)		3062	12.4 (11.3, 13.7)	

[a]For the chi-square test comparing the distribution of children who were identified as high risk for externalizing and/or internalizing problems and/or tics and race/ethnicity, the test considered a four-level race/ethnicity variable for Colorado, Florida, and South Carolina (non-Hispanic white, non-Hispanic black, Hispanic, and all other race/ethnicity) and a two-level race/ethnicity variable for Ohio (non-Hispanic white and other race/ethnicity)

Table 3

Weighted prevalence estimates of any externalizing or internalizing disorders[a] in the past year, overall and by disorder type by site, Project to Learn About Youth-Mental Health, 2014–2018

	Colorado (n = 236)		Florida (n = 289)		Ohio (n = 152)		South Carolina (n = 270)	
	Weighted %	**95% CI**	**Weighted %**	**95% CI**	**Weighted %**	**95% CI**	**Weighted %**	**95% CI**
Any externalizing or internalizing disorder[a]	14.8	(10.3, 20.3)	17.8	(12.8, 23.8)	33.3	(24.3, 43.3)	17.6	(12.8, 23.3)
Any externalizing disorder	10.1	(6.6, 14.7)	11.1	(7.5, 15.7)	24.3	(16.4, 33.7)	10.9	(7.4, 15.2)
ADHD	5.6	(3.1, 9.4)	5.1	(2.9, 8.3)	9.4	(5.3, 15.3)	6.7	(4.0, 10.4)
Any disruptive behavioral disorder[b]	6.9	(4.0, 11.0)	8.5	(5.2, 12.8)	17.9	(10.7, 27.3)	6.2	(3.7, 9.8)
ODD	6.8	(3.9, 10.8)	6.9	(4.1, 10.8)	17.3	(10.2, 26.7)	5.7	(3.3, 9.2)
Conduct disorder	1.5[c]	(0.4, 4.0)	2.4[c]	(0.9, 5.2)	*d*		2.1[c]	(0.7, 4.6)
Any internalizing disorder	8.7	(5.1, 13.7)	10.0	(6.0, 15.3)	14.7	(8.7, 22.7)	10.7	(6.9, 15.6)
Any anxiety disorder[e]	7.9	(4.4, 12.9)	8.6	(4.9, 13.9)	11.2	(5.9, 18.7)	8.9	(5.4, 13.7)
Social phobia	5.2[c]	(2.3, 10.0)	3.4[c]	(1.5, 6.7)	*f*		5.4[c]	(2.6, 9.9)
Separation anxiety	2.9[c]	(1.2, 5.9)	3.0[c]	(1.0, 7.0)	6.1[c]	(2.3, 12.9)	3.3[c]	(1.4, 6.4)
Any depressive disorder[g]	1.5[c]	(0.4, 4.1)	2.4[c]	(0.8, 5.5)	3.7[c]	(1.0, 8.9)	2.0[c]	(0.6, 4.8)

[a]Externalizing disorders include attention-deficit/hyperactivity disorder (ADHD), conduct disorder, and oppositional defiant disorder (ODD). Internalizing disorders include generalized anxiety disorder, social phobia, separation anxiety, panic disorder, obsessive–compulsive disorder, agoraphobia, post-traumatic stress disorder, major depressive disorder, dysthymic disorder, mania and hypomania

[b]Includes children who met study case definition for ODD or conduct disorder

[c]Relative standard error (RSE; standard error/estimate × 100%) is between 30 and 50%; estimate is unstable and may be unreliable, therefore it should be interpreted with caution

[d]Suppressed due to fewer than 5 respondents meeting criteria for this disorder

[e]Includes children who met study case definition for generalized anxiety disorder, social phobia, separation anxiety, panic disorder and/or agoraphobia

[f]Module not administered by site

[g]Includes children who met study case definition for major depressive disorder or dysthymic disorder

Table 4

Weighted prevalence estimates of any externalizing or internalizing disorder in the past year by demographic subgroup and site, Project to Learn About Youth-Mental Health, 2014–2018

	Any externalizing or internalizing disorder[a]							
	Colorado		Florida		Ohio		South Carolina	
	Weighted % (95% CI)	PR (95% CI)	Weighted % (95% CI)	PR (95% CI)	Weighted % (95% CI)	PR (95% CI)	Weighted % (95% CI)	PR (95% CI)
Overall	14.8 (10.3, 20.3)		17.8 (12.8, 23.8)		33.3 (24.3, 43.3)		17.6 (12.8, 23.3)	
Sex								
Male	17.3 (10.8, 25.7)	1.44 (0.73, 2.85)	16.9 (10.0, 26.1)	0.91 (0.50, 1.66)	41.4 (27.6, 56.3)	1.68 (0.96, 2.92)	22.1 (14.5, 31.4)	1.75 (0.96, 3.20)
Female	12.0 (6.3, 20.2)	Ref	18.6 (11.8, 27.1)	Ref	24.7 (14.7, 37.2)	Ref	12.6 (7.2, 20.0)	Ref
Age (years)								
5–11	15.3 (9.7, 22.5)	1.06 (0.56, 1.98)	23.8 (17.1, 31.7)	1.47 (0.91, 2.37)	36.3 (25.7, 47.9)	1.19 (0.68, 2.09)	19.4 (12.7, 27.7)	1.22 (0.68, 2.17)
12 +	14.4 (8.2, 22.9)	Ref	16.2 (10.3, 23.7)	Ref	30.5 (16.9, 47.0)	Ref	15.9 (9.6, 24.3)	Ref
Race/ethnicity								
Non-Hispanic white	20.1[b] (7.8, 38.7)	Ref	16.1 (8.8, 26.1)	Ref	28.0 (19.6, 37.8)	Ref	18.1 (11.8, 26.0)	Ref
Other race/ethnicity	13.9 (9.0, 20.0)	0.69 (0.32, 1.50)	19.0 (12.6, 27.1)	1.18 (0.63, 2.22)	67.8 (40.2, 88.5)	2.42 (1.50, 3.91)	16.8 (9.8, 26.1)	0.93 (0.51, 1.69)
Non-Hispanic black	22.4[b] (9.9, 39.9)	1.11 (0.44, 2.78)	17.9 (10.5, 27.5)	1.11 (0.56, 2.20)			20.7 (11.7, 32.5)	1.14 (0.62, 2.12)
Hispanic	11.3 (5.8, 19.5)	0.56 (0.23, 1.37)	19.2[b] (7.2, 37.9)	1.19 (0.47, 3.02)			*c*	
All other race/ethnicity	15.6[b] (5.5, 32.1)	0.77 (0.29, 2.05)	24.7[b] (6.6, 53.5)	1.53 (0.53, 4.46)			15.3[d] (3.9, 36.4)	0.85 (0.29, 2.49)
Insurance type								
Non-Medicaid insurance	15.2[b] (7.2, 27.0)	Ref	14.0 (8.2, 21.8)	Ref	18.8 (10.1, 30.4)	Ref	13.5 (6.9, 22.8)	Ref
Medicaid insurance	15.7 (9.8, 23.3)	1.03 (0.49, 2.18)	24.0 (15.1, 35.0)	1.71 (0.93, 3.16)	44.7 (30.4, 59.7)	2.38 (1.30, 4.38)	21.9 (15.0, 30.3)	1.63 (0.84, 3.15) (0.8, 2.9)
No insurance	*c*		*c*		*c*		*c*	
Highest level of parent education								
High school diploma or less	12.1 (6.3, 20.3)	0.69 (0.35, 1.37)	15.1[b] (7.2, 26.4)	0.81 (0.40, 1.62)	48.8 (29.0, 68.9)	1.64 (0.95, 2.81)	23.3 (12.7, 37.2)	1.46 (0.79, 2.71)

	Any externalizing or internalizing disorder[a]							
	Colorado		Florida		Ohio		South Carolina	
	Weighted % (95% CI)	PR (95% CI)	Weighted % (95% CI)	PR (95% CI)	Weighted % (95% CI)	PR (95% CI)	Weighted % (95% CI)	PR (95% CI)
At least some college or technical school	17.6 (11.0, 25.9)	Ref	18.7 (12.6, 26.1)	Ref	29.8 (20.0, 41.2)	Ref	16.0 (10.8, 22.4)	Ref
Federal poverty level[e]								
< 200%	15.4 (10.0, 22.1)	1.09 (0.48, 2.48)	21.7 (14.0, 31.1)	1.83 (0.95, 3.53)			20.1 (13.7, 27.8)	1.27 (0.68, 2.38)
≥ 200%	14.1[b] (5.7, 27.5)	Ref	11.8 (6.3, 19.6)	Ref			15.8 (8.5, 25.8)	Ref
Screening status								
High risk	32.5 (23.5, 42.5)	4.34 (2.03, 9.28)	27.2 (18.5, 37.5)	2.17 (1.19, 3.96)	53.9 (37.0, 70.2)	2.15 (1.26, 3.65)	46.3 (38.0, 54.7)	4.04 (2.42, 6.76)
Low risk	7.5[b] (3.1, 14.6)	Ref	12.5 (7.0, 20.2)	Ref	25.1 (14.9, 37.8)	Ref	11.5 (6.2, 18.9)	Ref

CI Confidence interval, *PR* prevalence ratio (unadjusted)

[a] Externalizing disorders include attention-deficit/hyperactivity disorder, conduct disorder, and oppositional defiant disorder. Internalizing disorders include generalized anxiety disorder, social phobia, separation anxiety, panic disorder, obsessive–compulsive disorder, agoraphobia, post-traumatic stress disorder, major depressive disorder, dysthymic disorder, mania and hypomania

[b] Relative standard error (RSE; standard error/estimate × 100%) is between 30 and 50%; estimate is unstable and may be unreliable, therefore it should be interpreted with caution

[c] Suppressed due fewer than five respondents meeting criteria for any disorder in this subgroup

[d] Relative standard error (RSE; standard error/estimate × 100%) is larger than 50%; estimate is unreliable and should not be used except for inferential statistics (e.g. comparisons with other estimates)

[e] Ohio site did not collect information used to calculate relationship of household income to federal poverty level

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