



Confirming Profiles of Comorbid Psychological Symptoms in Urban Youth: Exploring Gender Differences and Trait Mindfulness

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Abstract

Prior work has identified the need for replication of psychological research; however, validation efforts are rare. The purpose of the current study was to confirm latent profiles of comorbid psychological symptoms in an urban adolescent sample and examine differences in gender and trait mindfulness across these profiles. Cross-sectional data from 201 eighth grade students (63% female; $M_{age} = 13.24$; 86% Black) across nine Baltimore City public middle schools were analyzed. Confirmatory latent profile analyses showed that the previously-identified 3-profile solution with boundary constraints was the best fit for the data, and significant sex and trait mindfulness differences were identified. The current study supports the need for future replication studies using this methodology to improve theory and targeted interventions.

Keywords Latent profile analysis Validation · Comorbidity · Adolescents · Trait mindfulness

Introduction

Comorbidity of psychological symptoms is highly prevalent among youth in low-income, marginalized urban communities (Hogue & Dauber, 2013), largely due to their disproportionate exposure to stressors related to structural and economic disenfranchisement (Urban Institute, 2015). Prior research with a nationally-representative sample of adolescents found that 40% of adolescents with one disorder also met criteria for a second comorbid disorder (Merikangas et al., 2010), and a study with urban youth referred for mental health services found that 80% were diagnosed with more than one mental health disorder (Hogue & Dauber, 2013). Comorbid psychological symptoms in adolescence are associated with varied detrimental health outcomes, such as substance use (Cummings et al., 2014) and suicide (McManama O'Brien & Berzin, 2012). Studies that have used person-centered approaches to identify youth with comorbid symptoms, such as latent class analysis (LCA) or

latent profile analysis (LPA), are relatively few in number and have various findings due to differences in samples and measurements. Moreover, few studies incorporate adequate methods to validate their models of comorbid symptoms. The current study addresses this gap by validating a previous LPA of comorbid mental health symptoms in a sample of urban Baltimore City middle school students, and by extending this model to examine differences in gender and trait mindfulness.

Comorbidity Profiles

A small body of literature has focused on identifying subgroups of youth experiencing comorbid psychological symptoms (for a review of this literature see Webb et al., 2021). Subgroupings have differed across these studies due to the disorders being measured, the reporters of those symptoms, and the environments from which youth are sampled (i.e., youth from juvenile justice settings versus those in clinical care versus those in need of treatment from the community). The goal of this type of research is to group individuals based on their experienced/reported symptoms to better understand the heterogeneity of symptom types and severity, as well as inform policy and better allocate resources for prevention and intervention programming (Peiper et al., 2015). Given the relatively small size of the literature, there are key gaps that need to be addressed. Few studies have included PTSD or trauma symptoms in modeling comorbidity in adolescents, and

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studies with urban youth samples have primarily been sampled from juvenile justice or clinical settings. Moreover, few studies have included data from multiple raters (Webb et al., 2021).

To address these gaps, a prior cross-sectional study of 426 Baltimore City 8th grade students sought to identify subgroups of students with comorbid mental health symptoms (Webb et al., 2021). Based on the literature, it was hypothesized that three to four groups would be found, including a group with low mental health symptoms, and a group with overall high levels of symptoms, with the potential for groups with more specified types of symptoms (i.e., internalizing or externalizing symptoms). Three comorbidity groups were identified using latent profile analysis of student self-reported and teacher-reported symptoms: (1) low student-reported, high teacher-reported symptoms, (2) internalizing symptoms, and (3) overall high symptoms. The internalizing symptom group was characterized by high student self-reported depression, anxiety, and trauma symptoms, as well as elevated teacher-reported internalizing symptoms. Students in the overall high symptoms group had the highest self-reported and teacher-reported symptoms in all categories compared to students in the other profiles (Webb et al., 2021). Within the last decade, there has been increased attention paid to the issue of reproducibility in psychology research (Baucal et al., 2020). Confirming whether these same groups also characterize a different sample of Baltimore City students will contribute to evaluating the robustness of these groups among urban youth, an important step toward refining theory on psychological comorbidity in adolescents (Schmiege et al., 2018).

Gender Differences in Comorbidity

A large body of research has examined gender differences in the prevalence of mental health disorders among youth. Studies of adolescent mental health have found that girls are more likely than boys to be diagnosed with anxiety and affective disorders (Hamblin, 2016), as well as comorbid psychiatric diagnoses (Cummings et al., 2014). By contrast, boys have a higher prevalence of externalizing disorders than girls (Hamblin, 2016). These gender differences may be explained by differences in experiencing symptoms, reporting of symptoms, and/or observations of behavior by adults. Research indicates that gender roles and norms influence the experience and reporting of psychological symptoms (Van Droogenbroeck et al., 2018). For example, girls face a greater level of school pressure, are expected to be more socially sensitive, and are more likely to use rumination as a coping strategy than boys, all of which are associated with increased mental health symptoms (Van Droogenbroeck et al., 2018). However, socialization of boys teaches them not to express their emotions, which may lead to an underreporting of symptoms compared to girls (Hamblin, 2016). Compared to boys, girls are more likely to seek help for mental health disorders

(Hamblin, 2016). Research has shown that adults, including teachers, are better able to identify behavioral problems, such as externalizing symptoms, in boys compared to girls (Hamblin, 2016). Moreover, prior studies show that teachers tend to have higher academic expectations of female students than male students (Gershenson et al., 2016), and teachers are more likely to report negative temperament for their male students than their female students (Mullola et al., 2012). These factors may contribute, at least in part, to the gender differences seen in the prevalence of psychological symptoms and their comorbidity in adolescents.

Some studies using person-centered approaches have examined gender differences in comorbidity profiles among adolescents with mixed findings. One study among community-referred adolescents that identified five classes of psychological symptoms (adolescent distress, severely distressed, parental concern, basic externalizers, and comorbid externalizers) found significant gender differences. The severely distressed group had a greater proportion of females, while the comorbid externalizing group had an equal distribution of males to females (Hogue & Dauber, 2013). However, a second study that identified four classes of anxiety and depressive symptoms (comorbid moderate severity symptoms, comorbid high severity symptoms, high severity depressive symptoms, and moderate anxiety symptoms) found that there were more boys in the group characterized by more severe comorbid symptoms (Peiper et al., 2015). Finally, a study that identified three classes of comorbid symptoms (normative level of symptoms, comorbid emotional disorders, and comorbid behavioral disorders) found that girls were more likely to be in the group characterized by comorbid emotional disorders (Essau & de la Torre-Luque, 2019). Differences in the sample characteristics and measurements used may contribute to the disparate gender differences seen across these studies, supporting the need to further examine the role of gender in modeling comorbid symptoms in a sample of urban adolescents.

Trait Mindfulness and Mental Health

Trait mindfulness is defined as one's average level of mindfulness (Siegling & Petrides, 2014) or the frequency with which individuals are in a mindful state (Deng et al., 2020). Trait mindfulness is a complex construct that encompasses several components, including the ability to describe inner experiences, observe experiences, act with awareness, and be non-judgmental of and non-reactive to experiences (Calvete et al., 2017). In a longitudinal study with young adults, the trait mindfulness quality of non-judging served as a protective factor against depression (Petrocchi & Ottaviani, 2016). In adolescents, studies have found that trait mindfulness was associated with lower depressive symptoms (Royuela-Colomer & Calvete, 2016).

Moreover, a longitudinal study in adolescents found that acting with awareness attenuated the association between stress and externalizing symptoms, as well as self-injurious behavior (Calvete et al., 2017). However, little research has been conducted examining the associations between psychological symptoms (or their comorbidity) and trait mindfulness in racial minority, urban adolescents.

Current Study

The existing literature using person-centered approaches to model comorbid mental health symptoms in youth has some important gaps, including a lack of validation and reproducibility in research models, and divergent results around gender differences in comorbidity. Moreover, little research exists on associations between trait mindfulness and comorbid mental health symptoms, particularly within primarily racial minority, urban adolescent samples. To address these gaps, the first goal of the current study was to use the emerging methodology of confirmatory latent profile analysis to validate profiles of comorbid mental health symptoms found in a prior study of Baltimore City middle school students. The second goal was to explore gender differences in the comorbidity profiles. Based on the current literature on gender differences in adolescent mental health, it was hypothesized that the profile with low self-reported and high teacher-reported symptoms would include a greater proportion of boys than girls (Hypothesis 1), as boys are less likely to report their own symptoms, but teachers may better able to identify externalizing symptoms in boys than girls. Moreover, it was expected that the profiles with high internalizing symptoms and overall higher self-reported symptoms would contain a greater proportion of females than males (Hypothesis 2), given the higher prevalence of internalizing symptoms in girls and evidence showing girls are more likely to report and seek help for mental health symptoms. The associations between trait mindfulness and profile membership were also explored, with the expectation that higher trait mindfulness would be seen in the profile with low self-reported symptoms compared to the other two comorbidity groups (Hypothesis 3). Finally, the current study explored the moderating effect of gender on the associations between profile membership and trait mindfulness. As this was a novel study question, there were no specific hypotheses or expectations for this study goal.

Methods

Participants

The current study used baseline data from 201 eighth grade students ($M_{age} = 13.24$ years, $SD = 0.50$ years; 63%

female) across nine Baltimore City public schools. The sample was primarily Black/African American (86%). A large portion of the sample also reported Hispanic/Latinx ethnicity (24%). Students were recruited as part of a larger randomized controlled trial ($n = 618$) assessing a school-based mindfulness program (RAP Club) compared to an active control program focused on general health education. Overall, the trial recruited students from 29 Baltimore City public elementary/middle schools across four years, enrolling a new sample of students in a different set of schools each year. The sample for the current study included only the students that were enrolled in the fourth year of the study, as it was the only year that included measurement of trait mindfulness. Parental consent and student assent were collected for each participating student.

Measures

One week prior to randomized intervention assignment, students completed self-report measures assessing their psychological well-being and their trait mindfulness. Additionally, two 8th grade teachers from each school rated participating students' symptoms and behaviors. No data collected after the initiation of the interventions was used in the current study.

Self-report measures

Students were asked to report on their social and demographic characteristics, their current anxiety, depressive and trauma symptoms, social and behavioral problems, and trait mindfulness.

Social and demographic factors Students reported their gender (0 = female, 1 = male), Hispanic/Latinx ethnicity, and race (Black/African American, White, American Indian/Alaskan Native, Native Hawaiian/Other Pacific Islander, Multiracial).

Anxiety symptoms The *PROMIS Pediatric Anxiety Item Bank v2.0* (Pilkonis et al., 2011) measured anxiety symptoms over the past seven days. The four items asked students about their feelings of being nervous, worried, worried while at home, and feelings that something awful might happen (e.g., "In the past 7 days, I felt like something awful might happen"). Students rated each item on a Likert scale ranging from 1 (*Never*) to 5 (*Almost Always*). Raw sum scores of the four self-report items were converted to standardized t-scores. T-scores above the cutoff of 55 are indicative of elevated anxiety symptoms. The *PROMIS Pediatric Anxiety* measure has been tested and demonstrated its validity to measure the construct of anxiety (Irwin et al., 2010), as well as its internal consistency and test-retest reliability (Varni et al., 2014).

Depressive symptoms The *Children's Depression Inventory – Short Form* (CDI-S; Kovacs, 1992) was used to measure depressive symptoms in youth. The CDI-S is a 10-item self-report measure of depressive symptoms over the past two weeks, with a total score that ranges from 0 to 20. Items were rated on a 3-point Likert scale, with responses differing for each item (e.g., “0 = I feel like crying once in a while, 1 = I feel like crying many days, 2 = I feel like crying every day”). The measure showed adequate reliability in the current sample (see Table 1) and has been used in prior studies with students in urban school settings (Sibinga et al., 2016).

Trauma symptoms The *Child PTSD Symptom Scale* (CPSS; Foa et al., 2001) was used to measure youth trauma symptoms (e.g., “In the last two weeks, have you been having bad dreams or nightmares”). The measure consists of 17 self-report items that are rated on a 4-point Likert scale ranging from 0 (*not at all or only at one time*) to 3 (*5 or more times a week or almost always*). The original version of the measure includes an item that asks youth to report the most difficult experience they had ever endured, which was omitted in the current study to protect student privacy. Items were summed to create an overall symptom severity score. Prior research has established a cutoff of 17 or higher to indicate elevated trauma symptoms (Nixon et al., 2013). The measure showed adequate reliability in the current sample, and has been shown to have strong reliability and validity in samples of adolescent female sexual assault survivors (Gillihan et al., 2013) and adolescents exposed to trauma (Foa et al., 2018).

Social and behavioral problems Several subscales of the *Youth Outcome Questionnaire – Self Report* (YOQSR; Wells et al., 2003) were used to measure students' interpersonal relations, social problems, and behavioral dysfunction. Items on the YOQSR were rated on a 5-point Likert scale ranging from 0 (*never or almost never*) to 4 (*almost always or always*). Per scoring instructions, two interpersonal relations items, one social problems item, and two behavioral dysfunction items were recoded from -2 (*never or almost never*) to 2 (*almost always or always*). The interpersonal relations subscale ranges from -6 to 34, with higher scores indicating greater difficulty in interactions with family, peers, or other adults including verbal aggression or defiance (e.g., “I have physical fights (hitting, kicking, biting, or scratching) with my family or others my age”). The social problems subscale ranges from -2 to 26, with higher scores indicating more behaviors that violate social norms, including truancy, physical aggression, or vandalism (e.g., “I steal or lie”). Finally, the behavioral dysfunction subscale ranges from -4 to 40; higher scores indicate more attention difficulties and issues in managing

impulsive behaviors and organization (e.g., “I have a hard time sitting still [or I have too much energy]”). The subscales used in the current sample showed adequate reliability with the exception of the social problems subscale (Cronbach's $\alpha = 0.67$). However, the subscale was kept in the analysis as it was used in the original exploratory study, and it was close to the conventional cutoff of 0.70. The YOQSR has shown to have good internal consistency and test-retest reliability in prior samples of adolescents (Ridge et al., 2009).

Trait mindfulness The *Child and Adolescent Mindfulness Measure* (CAMM; Greco et al., 2011) was used to measure trait mindfulness. The measure is comprised of 10 items (e.g., “At school, I walk from class to class without noticing what I'm doing”), which are rated on a 5-point Likert scale ranging from 0 (*Never True*) to 4 (*Always True*). Items were reverse scored and summed to create an overall trait mindfulness score, with higher scores indicating greater trait mindfulness. Prior validation work has found the CAMM to be a reliable and valid measure of trait mindfulness for youth in low-income urban settings (Prenoveau et al., 2018).

Teacher Measures

Teachers were asked to report on their students' externalizing and internalizing symptoms, as well as their social and emotional competence.

Internalizing and externalizing symptoms Teachers completed the *Strengths and Difficulties Questionnaire* (SDQ; Goodman, 1997), a 25-item measure of students' behavior and potential difficulties that teachers rated on a 3-point Likert scale ranging from 0 (*not true*) to 2 (*certainly true*). The measure includes five subscales: emotional symptoms, conduct problems, peer problems, hyperactivity, and pro-social behavior. Two scores were calculated from the SDQ: externalizing symptoms, which is calculated by combining the 10 items from the conduct problems and hyperactivity subscales (e.g., “Often loses temper”), and internalizing symptoms, which is calculated by combining the 10 items of the emotion problems and peer problems subscales (e.g., “Often unhappy, depressed, or tearful”). These subscales showed adequate reliability in the current sample, and prior research has shown that the SDQ has strong psychometric properties (Stone et al., 2010).

Social and emotional competence The current study used the 7-item social and emotional competence subscales from the *Social Competence Scale* (SCS; Kam & Greenberg, 1998). The SCS measures students' behavioral symptoms (e.g., “Shows empathy and compassion for others”

Table 1 Student Demographics and Mental Health Symptoms in Overall Sample and by Gender

Characteristic	Females		Males		Total Sample				
	<i>(n = 126, 62.7%)</i>		<i>(n = 75, 37.3%)</i>		<i>(n = 201, 100%)</i>				
	M	Range	M	Range	M	Range			
Age in years	13.2	12–14	13.4	12–15	13.2	12–15			
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%			
Race									
AIAN	1	0.9	1	1.7	2	1.2			
African American	95	88.8	48	81.4	143	86.1			
NHOPi	0	0.0	1	1.7	1	0.6			
White	7	6.5	6	10.2	13	7.8			
Multiracial	4	3.7	3	5.1	7	4.2			
Hispanic/Latinx	26	21.3	21	28.8	47	24.1			
Mental Health Symptoms	Reporter	Cronbach's α	<i>p</i>	M	SD	M	SD	M	SD
Anxiety symptoms (PROMIS)	Student	0.84	0.006	59.2	10.2	55.1	10.2	57.6	10.4
Depression symptoms (CDI)	Student	0.85	0.002	4.6	4.2	2.8	3.5	4.0	4.1
Trauma symptoms (CPSS)	Student	0.91	0.03	19.3	11.8	15.4	12.0	17.8	12.0
Interpersonal Relations (YOQSR)	Student	0.74	0.38	5.5	6.7	4.6	6.5	5.1	6.6
Social Problems (YOQSR)	Student	0.67	0.02	2.1	3.5	3.4	4.1	2.6	3.8
Behavioral Dysfunction (YOQSR)	Student	0.79	0.86	10.9	6.3	10.7	8.5	10.8	7.2
Externalizing (SDQ)	Teacher	0.90	0.05	5.3	5.0	6.8	4.8	5.9	5.0
Internalizing (SDQ)	Teacher	0.85	0.34	2.7	3.2	3.2	3.8	2.9	3.4
Problems in Social and Emotional Competence (SCS)	Teacher	0.93	0.08	1.7	1.0	2.0	1.0	1.8	1.0
Trait Mindfulness (CAMM)	Student	0.88	<0.001	24.3	8.4	28.8	9.1	26.0	8.9

AIAN American Indian or Alaska Native, NHOPi Native Hawaiian or Other Pacific Islander, *p* *p*-value for independent samples t-tests by gender

Bolded values represent statistically significant independent samples t-tests by gender (*p* < 0.05)

feelings”) with teacher-rated items on a Likert scale ranging from 0 (*almost never*) to 5 (*almost always*). Items in the subscale were reverse scored and averaged to create a score where higher values indicated greater problems in social and emotional competence. The subscale showed adequate reliability in the current sample, and prior work has shown the SCS to have strong internal consistency and validity (Corrigan, 2003).

Statistical Analyses

The goal of the analysis was to validate a latent profile structure of comorbid psychological symptoms in urban middle school students and examine associations between profile membership, gender, and trait mindfulness. Student self-reported psychological symptoms (anxiety, depressive, and trauma symptoms) and behavior (interpersonal

relations, social problems, and behavioral dysfunction), and teacher-rated behavior (internalizing, externalizing, and problems in social and emotional competence) were each normally distributed, with skewness within the range of -2 to 2 (Kim, 2013). Preliminary analyses included independent samples t-tests to examine gender differences in mental health symptoms and analysis of missing data. Each variable was then z-scored for ease of latent profile interpretation (as each symptom score had its own range), and to base descriptions of elevated symptoms on the sample mean. A confirmatory latent profile analyses (CLPA) was first conducted using results from a prior study of Baltimore City middle school youth (Schmiege et al., 2018). The previous study found a 3-profile solution with a class-varying diagonal variance-covariance structure (Webb et al., 2021). Thus, 2-, 3- and 4-profile solutions with the same variance-covariance structure were tested, using various constraints

on thresholds and boundaries (Schmiege et al., 2018). The constraints were used to test for the presence of the three specific latent profiles that were found in the prior study, including low student-reported and high teacher-reported symptoms (LSHT), high internalizing symptoms (INT), and overall high symptoms (HIGH; Webb et al., 2021). The fit statistics for all models were compared using elbow plots to find the model that best fit the data, including Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Sample-Size Adjusted Bayesian Information Criterion (a-BIC; Masyn, 2013). Models were also compared using the parametric bootstrap likelihood ratio test, entropy, and class sizes (Masyn, 2013). While Lo-Mendell-Rubin adjusted likelihood ratio tests (LMR-LRT) are typically used to compare models in LPA studies, an LMR-LRT cannot be conducted in models with nonlinear constraints (i.e., models that include boundary constraints); thus, bootstrap likelihood ratio tests were estimated and compared in the current study (Masyn, 2013).

After class enumeration using CLPA was completed, individual students were assigned to their most likely profile, accounting for measurement error with BCH weights (Masyn, 2013). The most likely membership variable was used in two latent regression models predicting to (1) gender and (2) trait mindfulness using the BCH weights (Nylund et al., 2007). Finally, to examine gender as a moderator, two latent regression models were conducted to examine the associations between trait mindfulness and profile membership in (3) females and (4) males separately. All four models included race and ethnicity as covariates. Moreover, each of the models accounted for clustering of students within schools through the use of a post-hoc adjustment to the standard errors that account for the nesting of students within school. Stata Version 14 (StataCorp, 2015) was used for preliminary analyses and evaluation of missing data, and Mplus Version 8 (Muthen & Muthen, 2017) was used for the confirmatory latent profile analysis and the latent regressions.

Results

Preliminary Analyses

Sample demographics can be found in Table 1. In the total sample, 49% of students reported elevated trauma symptoms and approximately 69% reported elevated symptoms of anxiety. Independent samples t-tests indicated that females in the sample reported significantly greater levels of anxiety, depression, and trauma symptoms than males (see Table 1). However, males reported significantly greater levels of social problems and trait mindfulness than their female peers.

Missing Data

Analyses showed <1% missing data in each of the student-reported demographic variables. Student self-reported depression and anxiety symptoms, interpersonal problems, behavioral dysfunction, and trait mindfulness each had <5% missingness. However, student self-reported trauma symptoms and social problems had 6.9% and 11.9% missing data, respectively. Little's missing completely at random (MCAR) test for the two variables was not statistically significant ($\chi^2(2) = 4.91, p = 0.09$), indicating that the missingness in these two variables was not completely random. Follow-up analyses showed that missingness within these two variables was not statistically significantly associated with other demographic characteristics, such as gender, age, race, or ethnicity (all $r_s < 0.13$); thus, it was determined that data for the two variables was missing at random (MAR).

Analyses of teacher-reported data showed greater levels of missing data. Teacher-reported internalizing, externalizing, and social and emotional competence problems each had approximately 14% missing data. Low degrees of freedom prohibited the use of the Little's test exclusively on the three teacher-rated variables; however, when combined with the two previously-discussed student-reported variables (trauma symptoms and social problems), the Little's test was not statistically significant ($\chi^2(15) = 11.32, p = 0.73$). Follow-up analyses showed missingness within the teacher variables was not significantly associated with other demographic characteristics (all $r_s < 0.11$); thus, it was determined that the data was MAR. All following analyses used full-information maximum likelihood (FIML) estimation, which is robust when working with data that is not normally distributed and can derive estimates from missing data (Little et al., 2016).

Confirmatory Latent Profile Model

After comparing the fit indices and class sizes in the seven models (see Table 2), the 3-profile solution with boundary constraints was determined to be the best fit for the data. Elbow plots of the AIC, BIC and a-BIC suggested diminishing returns with subsequent models. Additionally, the smallest profile in the 3-profile solution with boundary constraints contained more than 5% of the sample, suggesting that the model was stable (Nylund-Gibson & Choi, 2018). The solution revealed the same 3 profiles as the initial study. Interpretation of the conditional profile response means in profile 1 showed that, compared to the overall sample means, students in this profile had lower self-reported symptoms and high teacher-reported externalizing and social and emotional competence problems; thus, the group was labeled as the low self-reported, high-teacher reported symptoms profile (LSHT). For profile 2,

Table 2 Model fit indices for class-varying, diagonal CLPA models

Model	Log Likelihood	# of free parameters	Bootstrap LRT	Entropy	AIC	BIC	a-BIC
3 profile, unconstrained	−1976.39	56	236.14***	0.868	4064.78	4390.39	4238.32
3 profile, fixed thresholds	−2162.16	2	1015.68***	0.886	4328.32	4274.69	4236.67
3 profile, boundary constraints	−1977.62	56	288.22***	0.862	4067.25	4406.44	4254.37
2 profile, unconstrained	−2094.46	37	524.29***	0.858	4262.92	4439.33	4318.94
2 profile, smallest class removed	−2180.42	1	1076.20***	0.879	4362.85	4508.93	4474.08
4 profile, unconstrained	−1914.60	75	123.58***	0.866	3979.21	4226.95	3989.34
4 profile, 3 profiles constrained	−1976.39	75	--	0.895	4102.78	4350.53	4112.92

The parametric bootstrap likelihood ratio test did not terminate normally for the solution with 4 profiles, 3 profiles constrained

Bootstrap LRT parametric bootstrap likelihood ratio test, *AIC* Akaike information criterion, *BIC* Bayesian information criterion, *a-BIC* sample-size adjusted Bayesian information criterion

n = 201

p* < 0.05; *p* < 0.01; ****p* < 0.001

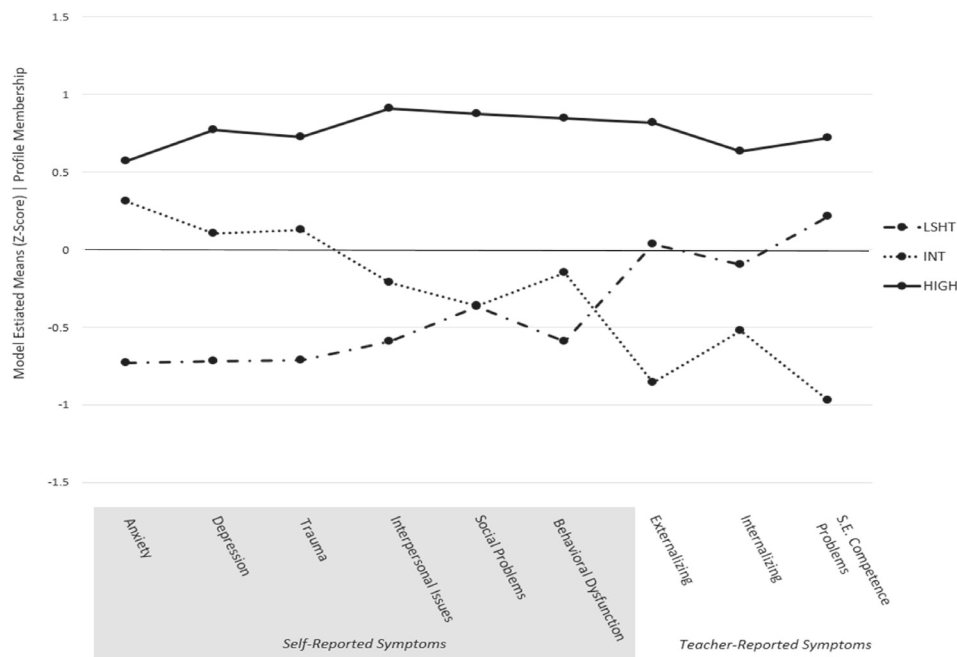


Fig. 1 Z-score conditional response means by comorbidity profile membership. LSHT low self-reported, high teacher-reported symptoms, INT internalizing symptoms, HIGH overall high symptoms, S.E. Competence social and emotional competence

conditional profile means indicated that students in the group had higher self-reported anxiety, depression, and trauma symptoms; thus, the profile was named the internalizing symptoms profile (INT). Finally, interpretation of the conditional profile means in profile 3 showed higher means for all symptoms compared to the sample mean; this profile was labeled as the overall high symptoms profile (HIGH). The profile structure and z-score model-estimated means can be seen in Fig. 1.

Gender Differences

When examining the gender composition of each group, the INT and HIGH groups were majority female, while the

LSHT group was evenly divided between males and females (see Table 3). Table 4 displays results of the latent regression analyses. The first model testing for gender differences showed that there was a significantly higher proportion of females in the INT profile compared to the LSHT and HIGH profiles. There was not a significant difference between the LSHT and the HIGH symptom profiles.

Trait Mindfulness

The second model examining trait mindfulness found several differences across comorbidity profiles (see Table 4), primarily that students in the LSHT class reported the highest level of trait mindfulness, followed by the INT and

Table 3 Model-Estimated, Class-Specific Means and Standard Deviations with Corresponding 95% Confidence Intervals Based on Class-Varying, Diagonal Three-Class Latent Profile Analysis with Boundary Constraints

Variable	Profile 1: LSHT (<i>n</i> = 79, 39.3%)		Profile 2: INT (<i>n</i> = 63, 31.3%)		Profile 3: HIGH (<i>n</i> = 59, 29.4%)	
	Mean	SD	Mean	SD	Mean	SD
Anxiety symptoms	-0.73 (-1.00, -0.47)	0.86 (0.73, 0.97)	0.31 (0.13, 0.50)	0.56 (0.29, 0.74)	0.57 (0.26, 0.88)	0.95 (0.73, 1.13)
Depression symptoms	-0.72 (-0.83, -0.60)	0.31 (0.20, 0.40)	0.10 (-0.14, 0.35)	0.74 (0.61, 0.85)	0.77 (0.40, 1.14)	1.14 (0.93, 1.32)
Trauma symptoms	-0.71 (-1.01, -0.41)	0.68 (0.31, 0.92)	0.12 (-0.20, 0.45)	0.91 (0.75, 1.05)	0.72 (0.49, 0.95)	0.80 (0.63, 0.94)
Interpersonal Relations	-0.60 (-0.60, -0.60)	0.60 (0.51, 0.68)	-0.21 (-0.46, 0.04)	0.76 (0.60, 0.90)	0.91 (0.55, 1.27)	0.94 (0.77, 1.09)
Social Problems	-0.37 (-0.50, -0.23)	0.47 (0.32, 0.58)	-0.36 (-0.52, -0.20)	0.54 (0.41, 0.64)	0.87 (0.44, 1.30)	1.30 (1.04, 1.52)
Behavioral Dysfunction	-0.59 (-0.81, -0.38)	0.71 (0.53, 0.86)	-0.15 (-0.34, 0.04)	0.61 (0.51, 0.70)	0.85 (0.48, 1.22)	1.02 (0.84, 1.18)
Externalizing	0.03 (-0.25, 0.32)	0.78 (0.66, 0.88)	-0.86 (-0.99, -0.72)	0.36 (0.22, 0.46)	0.82 (0.54, 1.10)	0.95 (0.78, 1.10)
Internalizing	-0.10 (-0.29, 0.10)	0.67 (0.51, 0.81)	-0.52 (-0.63, -0.41)	0.37 (0.26, 0.45)	0.63 (0.25, 1.01)	1.34 (1.10, 1.55)
Problems in S.E. Comp	0.21 (-0.07, 0.49)	0.73 (0.51, 0.89)	-0.98 (-0.98, -0.98)	0.60 (0.45, 0.72)	0.72 (0.48, 0.96)	0.82 (0.68, 0.93)
Trait Mindfulness	31.28	7.14	23.93	7.56	20.98	8.73
Females	29.55	7.44	23.32	7.79	19.41	7.05
Males	33.19	6.36	26.15	6.49	23.30	10.48
% Female	53.16%		77.78%		60.34%	

LSHT low self-reported, high teacher-reported symptoms, *INT* internalizing symptoms, *HIGH* overall high symptoms, *S.E. Comp* social and emotional competence

the HIGH symptom profiles, respectively. Latent regressions stratified by gender revealed more significant differences in trait mindfulness across profiles for females than males. Among females (Model 3), the LSHT group had significantly higher trait mindfulness than the INT and HIGH symptom groups, and students in the INT profile had higher trait mindfulness than those in the HIGH symptom profile. Among males (Model 4), the students in the LSHT symptom profiles had significantly higher trait mindfulness than the students in the INT and HIGH profiles. However, no significant differences were seen between the INT and HIGH groups among males (see Fig. 2).

Discussion

Experiencing comorbid mental health symptoms is a highly prevalent public mental health issue among adolescents that is associated with negative outcomes throughout the life course. While prior studies have used person-centered methods to identify subgroups of youth with comorbid symptoms, their findings have differed based on sample and measurement differences. This literature also has some key gaps; few studies have included trauma symptoms in modeling comorbid mental health symptoms or data from multiple informants, and studies with urban youth have not included general community samples (Webb et al., 2021). Moreover, prior studies examining gender differences have had divergent findings, little prior work has examined the association between trait mindfulness and comorbid symptoms among adolescents, and few studies include adequate validation efforts. The current study contributes to the literature on comorbid psychological symptoms in urban youth by validating a prior latent variable model of varied mental health symptoms with a sample of youth from the general population and by examining associations between profiles, gender, and trait mindfulness.

The current study contributes to the growing literature utilizing the novel methodology of confirmatory latent variable modeling. The analyses replicated the same three profiles of comorbidity reported in prior work (Webb et al., 2021) using boundary constraints. Of note, neither the original study nor the current validation study identified a group of students with overall low mental health symptoms. This finding may be an indication of the level of trauma experienced by students in low-income urban settings. In the randomized controlled trial from which the exploratory and validation samples were drawn, over 50% of the sample reported at least two adverse childhood experiences (ACEs). Additionally, over a third of the sample had experienced the incarceration of a parent or guardian, and over a quarter of the sample was a witness to or victim of neighborhood violence. This aligns with prior research

Table 4 Latent regression models of comorbidity profile membership with gender, trait mindfulness, and stratified analyses by gender

Variables	Global Wald Test <i>W</i> (<i>p</i>)	LSHT vs. INT (REF) β (<i>p</i>)	LSHT vs. HIGH (REF) β (<i>p</i>)	INT vs. HIGH (REF) β (<i>p</i>)
Model 1: Gender (0 = female, 1 = male)	8.09 (0.02)	0.29 (0.03)	0.06 (0.70)	-0.23 (0.04)
Model 2: Trait Mindfulness (CAMM)	35.05 (< 0.001)	5.95 (0.004)	10.96 (< 0.001)	5.01 (0.004)
Model 3 (females): Trait Mindfulness (CAMM)	48.20 (< 0.001)	4.98 (0.001)	10.81 (< 0.001)	5.83 (< 0.001)
Model 4 (males): Trait Mindfulness (CAMM)	19.69 (< 0.001)	8.81 (0.03)	12.81 (< 0.001)	4.00 (0.36)

LSHT low self-reported, high teacher-reported symptoms, INT internalizing symptoms, HIGH overall high symptoms

Bolded values represent statistically significant independent samples t-tests by gender (*p* < 0.05)

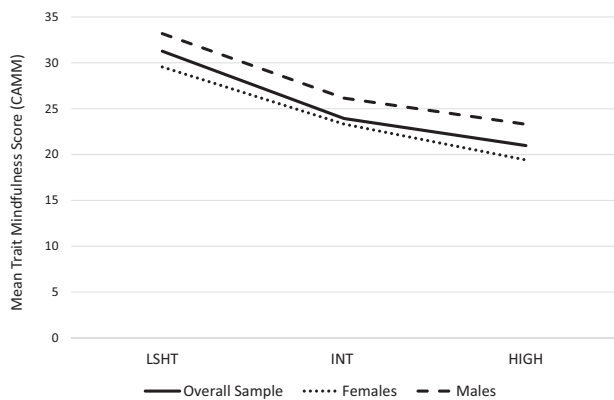


Fig. 2 Mean trait mindfulness across comorbidity profiles for overall sample and stratified by gender. LSHT low self-reported, high teacher-reported symptoms, INT internalizing symptoms, HIGH overall high symptoms, CAMM Child and Adolescent Mindfulness Measure

showing that low-income Black and Hispanic populations have higher rates of ACEs than white and economically advantaged populations (Merrick et al., 2018), and the negative impact of ACEs on mental health outcomes (McLaughlin, 2017). Further validation work is needed to determine whether a group of students with overall low symptoms can be identified in other samples of low-income urban youth.

As hypothesized, and consistent with prior prevalence research (Hamblin, 2016), the comorbidity profile characterized by high internalizing symptoms (INT) contained more females than in the other profiles. While the profile with high self- and teacher-reported symptoms (HIGH) had more females than males, the INT group still had a significantly higher proportion of females. This larger proportion of females in the HIGH symptom group is consistent with previous research on gender differences in mental health; female youth are more likely to report symptoms of psychological disorders than males (Hamblin, 2016). The study results did not find a greater number of males in the profile with low self-reported and higher

teacher-reported symptoms (LSHT) as expected. In fact, this profile was evenly divided between males and females. This may indicate a more equitable distribution of behavioral symptoms across boys and girls in this urban sample than in some other student samples. Prior research with low-income, urban African American youth found no gender differences in the association between exposure to violence and aggressive behavior, suggesting that aggression may be perceived as beneficial or adaptive for prevention of victimization for both males and females (Sanchez et al., 2013). Similarly, adolescents in the current sample have a high level of exposure to trauma, including violence, thus potentially explaining the lack of gender differences seen in the LSHT profile. Moreover, a previous study of youth in Chicago found that boys and girls at age 12 had similar levels of externalizing symptoms; however, as they got older (ages 15 and 18) boys began to report higher levels of externalizing symptoms than girls (Jun et al., 2015). It may be that because the current sample was comprised of 8th grade students exclusively, there may be fewer differences in externalizing symptoms (most noticeable by teachers) during this point in development. However, further research is needed to understand the potential lack of gender differences within this group.

As hypothesized, trait mindfulness was higher in the comorbidity group with low self-reported and high teacher-reported symptoms (LSHT) than the profiles with high self-reported symptoms (INT and HIGH). With the LSHT group having overall lower symptoms than the HIGH symptom group, this finding is consistent with prior literature demonstrating that higher levels of trait mindfulness are associated with lower mental health symptoms, such as depression and anxiety (Calvete et al., 2017). However, the majority of research on trait mindfulness and mental health has relied on self-reported mental health symptoms (Calvete et al., 2017), while the current study included reports from teachers as well. Findings from the current study could be interpreted in multiple ways. The first is that there may be an issue in the

measurement of trait mindfulness. Trait mindfulness is an internal state and relies on self-report to be accurately measured. Students in the LSHT group, while self-reporting high trait mindfulness, may not be aware of their behavioral symptoms that are being reported by their teachers. This suggests a potential lack of insight into their own behavior and perhaps lower mindfulness. Alternatively, study findings could be suggesting that the symptoms reported by teachers may not have the same associations with trait mindfulness as students' self-reported symptoms. This suggests potential issues with relying on teachers alone to refer students for targeted school-based mindfulness programming. As seen in the study, internalizing symptoms reported by teachers in the INT group was lower than the internalizing symptoms reported by the students. However, students in the INT group had lower trait mindfulness than the LSHT group, which teachers identified as having more noticeable symptoms. If interventionists were to rely on teacher-reported symptoms alone, students in need of mindfulness programming may be overlooked.

Results of the current study revealed significant associations between gender, trait mindfulness, and comorbid mental health symptoms. Overall, males had higher levels of trait mindfulness than females. Studies examining gender differences in trait mindfulness have focused on samples of undergraduate students (Wang & Chopel, 2017) and adults (Thirumaran et al., 2020); however, a dearth of literature exists examining this question with adolescent samples. Moreover, findings on gender differences in trait mindfulness are inconsistent, supporting the need for further research to understand the development of trait mindfulness across gender identities. Greater variations in trait mindfulness were seen across profiles for female students than male students in the current study. Internalizing disorders, such as depression, have been associated with rumination and with having a negative cognitive bias (i.e., a focus on negative content in memories, or interpretation of the environment; Paul et al., 2013), whereas higher levels of trait mindfulness have been found to be protective against rumination (Raes & Williams, 2010) and negative cognitive bias (Paul et al., 2013). Internalizing disorders (Hamblin, 2016) and rumination coping strategies (Johnson & Whisman, 2013) are more common in females than males, which might account for the stronger negative association between trait mindfulness and psychological symptoms for girls as compared with boys in this sample. Research on gender differences in the response to mindfulness programming is in an early stage; however, some preliminary studies in adults (Rojjani et al., 2017) and adolescents (Kang et al., 2018) suggest that mindfulness programming may have different benefits for females versus males. If trait mindfulness has a stronger link to psychological functioning for predominantly Black girls in urban contexts as compared with boys, then it is important for future studies to explore if

mindfulness-based programs have differential impacts by gender on mental health in this adolescent population.

Interpretation of the results should be done with consideration of the study's limitations. Data for the current study were cross-sectional, so it was not possible to determine the temporal ordering of the associations between trait mindfulness and comorbidity profile membership. Moreover, the self-report nature of the measure of trait mindfulness may contribute to the stronger associations with self-reported psychological symptoms seen in the current study.

Conclusion

Given the high prevalence of comorbid mental health symptoms in adolescents and their long-term detrimental effects, understanding comorbidity among urban adolescents is key in designing and implementing effective interventions. This study supports the need for future research to continue using validation methods to replicate latent groupings of comorbid symptoms to improve theory and targeted interventions. Further research utilizing longitudinal data is needed to better understand the temporal relationship between trait mindfulness and comorbid psychological symptoms. By establishing temporality, researchers may be able to determine whether trait mindfulness is a potential causal or protective factor in the development of comorbid symptoms, or if trait mindfulness might be acting as a mediator between trauma experiences and psychological functioning in urban youth. Finally, the current study's findings can inform future research examining the effects of mindfulness programming on the mental health of urban minority youth, including a focus on potential gender differences in the impact of mindfulness programming with adolescents.

Authors' Contributions L.W. conceived of the study, participated in study design, conducted analyses, and drafted the manuscript; E.S. participated in study design; R.M. participated in study design and interpretation of the data; L.C. assisted in data interpretation and manuscript drafting; T.M. participated in study design and drafting of the manuscript. All authors read and approved the final manuscript.

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Data Sharing Declaration The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval The parent randomized controlled trial received approval from the Baltimore City Public Schools Institutional Review Board. Both the randomized controlled study and the current study were approved by the Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health.

Informed Consent Informed consent was obtained from the parents/guardians of participating adolescents. Assent was obtained from all participating adolescents.

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