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Precision in School Mental Health Investment: Heterogeneous Effects Across Dual-Factor Subgroups

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Research Article

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Abstract

Background

Adolescent mental health has declined internationally, prompting increased investment in school-based services. However, whether such investments benefit all students equally remains unclear. We examined whether municipal spending on school mental health services is differentially associated with dual-factor mental health profiles, which distinguish psychiatric symptoms from subjective well-being, among Swedish adolescents.

Methods

Data were drawn from Stockholmsenkäten (the Stockholm Survey), a biennial population-based survey of 9th-grade students (approximately 15 years) in Region Stockholm, Sweden. The analytic sample comprised 63 190 students across 26 municipalities surveyed between 2006 and 2024. Latent profile analysis identified four mental health profiles based on psychiatric symptoms and school well-being: Complete Mental Health, Troubled (high symptoms, low well-being), Vulnerable (low symptoms, low well-being), and Symptomatic but Content (high symptoms, adequate well-being). Municipal spending on school health services (per student, lagged two years) was decomposed into within-municipality (year-to-year change) and between-municipality (stable differences) components. Multilevel multinomial logistic regression estimated associations between spending and profile membership, controlling for gender and secular trends.

Results

Complete Mental Health declined from 55.6% (2006) to 45.4% (2024), while the Troubled profile more than doubled (3.4% to 7.2%). The Vulnerable profile remained stable at approximately 17%. Within-municipality spending increases were associated with 16% lower odds of the Troubled profile (OR = 0.84, 95% CI 0.73–0.95, p = .007) but showed no significant association with the Vulnerable profile (OR = 1.08, 95% CI 0.99–1.17, p = .084). Spending was associated with 9% higher odds of the Symptomatic but Content profile (OR = 1.09, 95% CI 1.01–1.17, p = .026), possibly reflecting transitions from Troubled to Symptomatic.

Conclusions

Increased investment in school mental health services appears protective for students with visible psychiatric symptoms but does not reach those whose struggles manifest as low well-being without psychiatric symptoms. From a precision public health perspective, current service models may require

reorientation to identify and support the Vulnerable subgroup, who comprise one in six adolescents and remain unaffected by spending increases.

Background

The mental health of children and adolescents has emerged as a critical public health concern internationally. Recent epidemiological data reveal a marked decline in mental health among youth, with increasing rates of psychiatric service utilization and self-reported psychological distress (1–4). These trends carry substantial implications for educational systems, with mental health problems associated with reduced academic achievement, school absence, and impaired social functioning (5, 6). With the decreasing mental health in youth, public expenditure on school health services has increased (7, 8). In line with research on precision in public health and psychological theory about mental health, we apply a heterogeneity perspective to the effectiveness of school health service expenditures. Children's mental health must be understood both as the absence of psychiatric symptoms and as the presence of enough well-being to support learning and social participation because these are distinct dimensions that each uniquely predict developmental outcomes (9, 10). Using both perspectives allows schools to identify problems earlier and support students who struggle functionally even before clinical symptoms appear. A dual conceptualization of children's mental health implies that school mental-health systems must address both diagnosable symptoms and impairments in well-being since each dimension independently predicts academic, social, and long-term psychiatric outcomes. Effective investments must support not only clinical services but also preventive initiatives that enhance well-being and functioning at the student population level.

With data from 63 190 students from 2006 to 2024 in the Stockholm region, we test whether higher municipal spending on school health services increases mental health in youth. We do not test for this in terms of general psychiatry or well-being, but in terms of four mental health profiles, stemming from the dual factor model of mental health. Although our analyses are situated in a Swedish municipal context, the heterogeneity perspective we apply, distinguishing students whose distress is symptomatic from those whose struggles manifest as diminished well-being, is portable to any educational system in which school-based mental health services operate as a primary point of contact for adolescents, including most high-income and many middle-income countries.

School Health Expenditure Effectiveness

A growing body of evidence suggests that school-based and community interventions can improve adolescent mental health outcomes (5, 11, 12). In a systematic review of cost-effective mental health interventions by Le et al. (13), the school-based screening and psychological interventions were the most cost-effective strategy for preventing mental disorders amongst children and adolescents. Meanwhile, parenting- and workplace interventions presented good evidence to be effective for promotion of mental health and well-being. Importantly, targeted interventions rather than general ones were likely to be more

cost-effective. This suggests that we also need targeted evaluations to understand if mental health expenditure has subgroup recipients or if it prevents mental health problems in all students. However, the distinction between targeted and universal approaches may also adhere to an understanding of schools as a social context of children and youth that is significant to students with mental health problems. A meta-analysis of whole-school interventions found that programs addressing the social and emotional development of all students, rather than selectively targeting those with identified problems, produced meaningful improvements in well-being and reduced emotional difficulties (14). This aligns with conceptual work positioning school well-being as a distinct construct, shaped by the school environment's capacity to meet students' needs for safety, belonging, and meaningful participation (15, 16). If school health services operate primarily through symptom detection and clinical referral, they may effectively reach students whose distress is visible while failing to support those whose diminished well-being has not yet become symptomatic. Given that intervention effectiveness may depend on the match between service model and student profile, the present study takes a heterogeneity perspective, which considers how spending may differentially affect students across distinct mental health profiles.

Subgroup analysis is fundamental to precision public health (5, 17, 18). In this study, subgroups emerge from a theoretical model of psychological functioning. The dual-factor model classifies individuals into four subgroups derived from the cross-classification of psychological distress and subjective well-being (10, 19, 20).

The Dual Factor Model of Mental Health

Traditional approaches to youth mental health have predominantly focused on the presence or absence of psychopathology. However, this unidimensional perspective fails to capture the full complexity of mental health. The dual-factor model of mental health, proposed by Greenspoon and Saklofske (19) and further developed by Keyes (9) and Suldo and Shaffer (10), conceptualizes mental health as comprising two related but distinct dimensions: psychopathology (the presence of psychiatric symptoms) and subjective well-being (the presence of positive psychological functioning). This framework aligns with the definition adopted by WHO's (2021) definition of mental health as “a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn and work well, and contribute to their community” (21). National authorities recognizes both well-being and mental illness as constituent elements of mental health.

The dual-factor model identifies four distinct mental health profiles based on individuals' standings on both dimensions (20, 22). Children and adolescents classified as having *Complete Mental Health* exhibit high well-being and low psychopathology. The *Troubled* group presents with both low well-being and elevated psychiatric symptoms. Critically, the model reveals two additional profiles that remain invisible in traditional symptom-focused assessments: *Vulnerable* youth who report low well-being despite the absence of psychiatric symptoms, and *Symptomatic but Content* individuals who maintain adequate well-being despite experiencing psychiatric symptoms. Research demonstrates that vulnerable youth exhibit

academic outcomes comparable to those with clinical symptomatology (10, 23), underscoring the importance of assessing both dimensions.

A key question in dual-factor research concerns the stability and variability of mental health profiles over time. A recent cross-sectional community study in the Gotland region of Sweden found a very high (47.5%) rate of Vulnerable and Troubled (13.9%) students among 1 833 surveyed students in grades 7–12. However, other studies indicate that many adolescents do not maintained stable profile membership over time, suggesting substantial potential for change (24). This instability may reflect both developmental processes and environmental influences, including school-related factors. Indeed, recent research indicates that schools account for a small but significant proportion of variance in student mental health outcomes (25, 26), and that school climate represents a modifiable protective factor (27). These findings suggest that educational environments may differentially shape the manifestation of dual-factor profiles among students.

In Sweden, school health services represent a key point of contact for monitoring and supporting student mental health (28). School health teams, comprising school nurses, physicians, psychologists, counselors, and special educators, are mandated to work preventively and health-promotively. Effectiveness of such health-promoting efforts depends not only on resources, but also on how school leadership organizes and prioritizes this work (29). However, resources allocated to school health services vary considerably across municipalities. In the Stockholm region, per-student expenditure on school health care teams differs substantially between municipalities and over time, creating natural variation in the availability of mental health support. Whether such resource differences are associated with the distribution and stability of dual-factor mental health profiles remains unexplored.

Despite growing evidence for the utility of the dual-factor model in understanding youth mental health, we know of no studies that have examined whether resource allocation, specifically investment in school health care teams, is associated with the prevalence, distribution, or temporal stability of mental health profiles among students. This gap is significant from a public health perspective, as school health services represent a modifiable and potentially scalable intervention target (30). Understanding whether differential resource allocation is associated with mental health profile variability could inform evidence-based decisions about school health investments.

The Present Study

The present study addresses this gap by examining associations between per-student expenditure on school health care teams and the distribution of dual-factor mental health profiles among students in Stockholm municipalities. Using lagged spending data (spending at year $t - 2$ predicting profiles at year t), we distinguish within-municipality effects (changes in spending over time) from between-municipality effects (stable differences in average spending), providing a stronger basis for causal inference.

Specifically, we: (1) characterize the prevalence and temporal trends of dual-factor mental health profiles in a population-based sample of 9th-grade students from 2006 to 2024; (2) examine whether within-municipality changes in school health care expenditure are associated with the distribution of mental health profiles, controlling for time trends and stable between-municipality differences; and (3) assess whether the association between spending and profile membership differs across the four profiles-specifically, whether spending differentially affects the Troubled profile (characterized by visible psychiatric symptoms) versus the Vulnerable profile (characterized by low well-being without symptoms).

Methods

Participants and Design

This study used data from The Stockholm survey, a biennial population-based survey administered to students in the greater Stockholm region in Sweden. The survey is coordinated by City of Stockholm and has been conducted since 2002, with consistent mental health items available from 2006 onwards. The analytic sample comprised 63 190 students in Grade 9 (approximately 15 years of age) across 26 municipalities, surveyed between 2006 and 2024 (10 waves). The sample was approximately balanced by gender, with 49.3% boys, 48.5% girls, and 0.8% identifying as non-binary (the latter category available from 2018 onwards). Stockholm municipality constituted approximately 90% of the sample (n = 56 813), with remaining municipalities contributing between 10 and 1 103 students each across the study period.

Measures

Mental Health Indicators

Mental health was operationalized using the dual-factor model (10, 19), which conceptualizes mental health as comprising two related but distinct dimensions: psychopathology (psychiatric symptoms) and subjective well-being.

Psychiatric symptoms were measured using four items assessing frequency of: feeling sad without knowing why, feeling anxious or afraid without knowing why, feeling worthless, and feeling sluggish or listless. Items were rated on a 5-point scale (1 = *never* to 5 = *always*). A fifth item assessing sleep problems was initially considered but excluded from the final analysis due to poor differentiation across latent profiles and a temporal trend (improvement over time) inconsistent with other symptom indicators.

School well-being was measured using three items from a school satisfaction scale: thriving at school, finding schoolwork meaningful, and looking forward to lessons. Items were rated on a 4-point scale (1 = *strongly disagree* to 4 = *strongly agree*). One item (finding schoolwork meaningful) was reverse-coded.

Items were recoded so that higher scores consistently indicated more frequent symptoms and higher well-being, respectively. All seven items were used as continuous indicators in the latent profile analysis.

School Mental Health Spending

Municipal spending on school mental health services per student was obtained from the Swedish Agency of Education's annual public accounts. This standardized measure captures actual expenditures reported in municipal financial statements and includes costs for school nurses, school physicians, school psychologists, school counselors, and special educators. Spending data was available for all years from 2002 to 2024.

To establish temporal precedence and reduce the risk of reverse causality (i.e., municipalities increasing spending in response to observed mental health problems), spending was lagged by two years relative to the survey year. This two-year lag aligns with the biennial survey administration and allows time for resource investments to plausibly influence student outcomes.

Covariates

Gender was included as a covariate (female = 1, male = 0; non-binary students were excluded from the regression analysis due to small cell sizes, n = 532). Survey year was included as a continuous variable to control for trends in adolescent mental health.

Statistical Analysis

Latent Profile Analysis

Latent Profile Analysis (LPA) (31) was conducted in Mplus version 9 (32) to identify distinct subgroups of students based on their patterns of psychiatric symptoms and school well-being. A four-class solution was specified *a priori* based on the dual-factor model's theoretical framework, which posits four profiles: Complete Mental Health (low symptoms, high well-being), Troubled (high symptoms, low well-being), Vulnerable (low symptoms, low well-being), and Symptomatic but Content (high symptoms, high well-being) (10).

Model estimation used maximum likelihood with robust standard errors (MLR), which is robust to non-normality. Due to the large sample size (N = 63 190) and potential for local maxima, initial analyses were conducted on a 20% random subsample (n = 12 642) to identify optimal starting values. The best-fitting solution from the subsample was then applied to the full sample to ensure stable convergence.

Model fit was evaluated using entropy, with values above 0.80 indicating good classification accuracy (33). The final four-class solution demonstrated good classification quality (entropy = 0.853). Students were assigned to their most likely latent class based on posterior probabilities.

Multilevel Regression Analysis

To examine associations between municipal spending and mental health profile membership, we estimated a multilevel multinomial logistic regression model using generalized structural equation modeling (gsem) in Stata version 18 (34). The model accounted for the hierarchical structure of the data, with students (Level 1) nested within municipalities (Level 2). A random intercept was specified for municipality to account for unobserved heterogeneity across municipalities.

To disentangle within- and between-municipality effects of spending (35), we decomposed the lagged spending variable into two components: (1) *between-municipality spending*, the municipality's mean spending across all study years (time-invariant), representing stable differences between municipalities in resource allocation; and (2) *within-municipality spending*, the deviation of each year's spending from the municipality's own mean (time-varying), representing year-to-year fluctuations in spending within municipalities.

This decomposition addresses a key limitation of observational studies: municipalities that spend more may differ systematically from those that spend less in ways that also affect student mental health. The within-municipality effect controls for these stable confounders by asking whether changes in spending within a given municipality over time are associated with changes in mental health profiles. This provides a stronger basis for causal inference than the between-municipality effect (36).

Spending was scaled to 1 000 Swedish krona (approx. €100) units for interpretable coefficients. Complete Mental Health was specified as the reference category; thus, coefficients represent log-odds of belonging to each at-risk profile (Vulnerable, Troubled, or Symptomatic but Content) relative to Complete Mental Health.

Missing Data

Missing data on individual survey items were handled using full information maximum likelihood (FIML) in the LPA, which uses all available data and provides unbiased estimates under the assumption that data are missing at random (37). For the multilevel regression analysis, cases with missing data on gender were excluded (n = 879, 1.4%), resulting in a final analytic sample of 62 311 students. The merge between survey data and municipal spending data resulted in complete matching for all students.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the authors used Claude Sonnet 4.6 in order to assist with language editing and refinement of manuscript text. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Results

Latent Profile Analysis

A four-class solution demonstrated good classification quality (entropy = 0.853), exceeding the recommended threshold of 0.80 (33). The four profiles aligned with the theoretical expectations of the dual-factor model and were labeled accordingly (10). Table 1 presents the indicator means and class sizes for each profile.

Complete Mental Health (51.1%, n = 32 264) was the largest class, characterized by low psychiatric symptoms (all means < 2.0 on the 5-point scale) and high school well-being (all means > 2.5 on the 4-point scale). *Symptomatic but Content* (25.9%, n = 16 388) showed moderate-to-elevated psychiatric symptoms alongside moderate school well-being. *Vulnerable* (17.1%, n = 10 825) exhibited moderate symptoms of sadness (M = 3.38), worthlessness (M = 2.95), and sluggishness (M = 3.12), but notably low anxiety (M = 1.01); this group reported the lowest school well-being across all indicators. *Troubled* (5.9%, n = 3 713), the smallest class, showed uniformly high psychiatric symptoms, including the highest anxiety levels (M = 4.40).

An important distinguishing feature was anxiety: Vulnerable students reported anxiety levels nearly identical to the Complete Mental Health group (M = 1.01 vs. 1.05), while Troubled students reported dramatically elevated anxiety (M = 4.40). This pattern suggests that anxiety may differentiate students who are struggling but under the radar (Vulnerable) from those with more acute, visible distress (Troubled).

Table 1: *Latent Profile Indicator Means and Class Sizes (N = 63 190)*

Indicator	**Complete MH**	**Symptomatic**	**Vulnerable**	**Troubled**
	(n = 32 264)	*(n = 16 388)*	*(n = 10 825)*	*(n = 3 713)*
Psychiatric symptoms (1–5)				
Feeling sad	1.78	3.50	3.38	4.11
Feeling afraid/anxious	1.05	2.46	1.01	4.40
Feeling worthless	1.56	2.91	2.95	3.58
Feeling sluggish	1.83	2.94	3.12	3.50
School well-being (1–4)				
Thriving at school	3.53	3.08	2.96	2.78
Schoolwork meaningful	3.12	2.67	2.43	2.41
Looking forward to lessons	2.52	2.11	1.79	1.98

Note. Higher scores on psychiatric symptoms indicate more frequent symptoms. Higher scores on well-being indicate better well-being. Entropy = 0.853. Complete MH = Complete Mental Health; Symptomatic = Symptomatic but Content.

Temporal Trends in Mental Health Profiles

Profile distributions changed substantially over the 18-year study period (see Table 2). The proportion of students classified as Complete Mental Health declined from 55.6% in 2006 to 45.4% in 2024, a decrease of 10.2 percentage points. Conversely, the Troubled class more than doubled in prevalence, from 3.4% in 2006 to 7.2% in 2024. The Symptomatic but Content class also increased, from 23.1% to 29.5%.

Notably, the Vulnerable class remained remarkably stable throughout the study period, fluctuating narrowly between 14.9% and 18.6% across all waves of measurement. This stability indicates that the proportion of students experiencing low well-being without clinical symptoms has remained constant even as overall mental health has deteriorated.

The trajectory of decline accelerated around 2014–2016, with the steepest decreases in Complete Mental Health occurring between 2018 and 2022.[1] The 2022 wave showed the lowest proportion of Complete Mental Health (41.9%) and highest proportion of Troubled (8.6%), with a partial recovery observed in 2024.

Table 2: *Mental Health Profile Distribution by Year (%)*

Year	n	Complete MH	Troubled	Vulnerable	Symptomatic
2006	5 739	55.6	3.4	18.0	23.1
2008	6 425	55.8	4.5	16.2	23.5
2010	6 465	58.4	4.0	14.9	22.7
2012	6 150	56.4	3.5	17.0	23.1
2014	5 120	52.1	5.5	17.0	25.5
2016	6 350	51.8	6.7	15.8	25.7
2018	5 416	50.4	7.1	17.7	24.8
2020	6 368	46.2	7.5	17.9	28.4
2022	7 341	41.9	8.6	18.6	30.9
2024	7 816	45.4	7.2	18.0	29.5
Change		−10.2	+3.8	0.0	+6.4

Note. Complete MH = Complete Mental Health; Symptomatic = Symptomatic but Content. Change = 2024 minus 2006.

Gender Differences

Substantial gender differences were observed in profile distributions (see Table 3). In 2024, 59.3% of boys were classified as Complete Mental Health compared to only 31.4% of girls, a difference of 27.9 percentage points. Girls were overrepresented in all at-risk categories: approximately 2.8 times more likely to be classified as Troubled (10.3% vs. 3.7%), 1.2 times more likely to be Vulnerable (20.0% vs. 16.2%), and 1.9 times more likely to be Symptomatic but Content (38.4% vs. 20.7%).

The gender gap widened over the study period. In 2006, the difference in Complete Mental Health between boys (68.8%) and girls (42.8%) was 26.0 percentage points; by 2024, this gap had grown to 27.9 percentage points. The increase in the Troubled category was more pronounced among girls (from 4.7% to 10.3%) than among boys (from 2.1% to 3.7%).

Students identifying as non-binary (assessed from 2018 onwards) showed the highest rates of distress. In 2024, only 29.6% of non-binary students were classified as Complete Mental Health, and 20.4% were classified as Troubled, nearly six times the rate observed among boys.

Table 3: *Mental Health Profile Distribution by Gender in 2024 (%)*

Gender	n	Complete MH	Troubled	Vulnerable	Symptomatic
Boys	3 930	59.3	3.7	16.2	20.7
Girls	3 723	31.4	10.3	20.0	38.4
Non-binary	152	29.6	20.4	13.8	36.2
Gap (Girls − Boys)		−27.9	+6.6	+3.8	+17.7

Note. Complete MH = Complete Mental Health; Symptomatic = Symptomatic but Content. Non-binary response option available from 2018 onwards.

Municipal Variation

Profile distributions varied across municipalities. Among municipalities with adequate sample sizes (n > 200), the proportion of students classified as Complete Mental Health ranged from 42.3% to 54.1%. Mean spending on school mental health services ranged from 2 160 to 3 683 krona per student across Stockholm region municipalities. Within Stockholm municipality, which comprised 90% of the sample, spending increased from 2 390 to 4 490 krona between 2006 and 2024, an increase of 88%.

Association Between School Mental Health Spending and Profiles

Descriptive Associations

Raw associations between spending and profiles showed a counterintuitive pattern: students in the Troubled class were in municipality-years with higher mean spending (M = 2 879 krona) compared to Complete Mental Health students (M = 2 675 krona). However, spending was highly correlated with survey year (r = .89), reflecting a secular increase in both spending and mental health problems over time. This confounding necessitated the decomposition of spending into within- and between-municipality components.

Multilevel Multinomial Regression

Results from the multilevel multinomial logistic regression are presented in Table 4 and summarized in Table 5. Complete Mental Health served as the reference category; coefficients represent odds ratios for membership in each at-risk profile relative to Complete Mental Health.

Within-municipality spending effects. The within-municipality spending effect, representing the association between year-to-year changes in spending within a municipality and student profiles, showed a significant protective effect for the Troubled class only. A 1 000 krona (roughly €100) increase in spending above a municipality's own average was associated with 16% lower odds of being classified as Troubled versus Complete Mental Health (OR = 0.84, 95% CI [0.73, 0.95], p = .007).

The effect on the Vulnerable class was not significant (OR = 1.08, 95% CI [0.99, 1.17], p = .084), indicating that increased spending did not differentiate Vulnerable from Complete Mental Health students. Unexpectedly, the Symptomatic but Content class showed a small positive association with within-municipality spending (OR = 1.09, 95% CI [1.01, 1.17], p = .026), possibly reflecting a partial compositional shift from the Troubled class as student well-being improves with greater service access.

Between-municipality spending effects. Between-municipality differences in mean spending were largely non-significant, except for the Symptomatic but Content class, where municipalities with higher average spending had fewer Symptomatic students (OR = 0.84, 95% CI [0.72, 0.99], p = .033). This effect should be interpreted cautiously as it may reflect confounding by unmeasured municipal characteristics.

Covariates. Female gender was strongly associated with all at-risk profiles relative to Complete Mental Health: Vulnerable (OR = 2.22, 95% CI [2.12, 2.32], p < .001), Troubled (OR = 4.01, 95% CI [3.72, 4.32], p < .001), and Symptomatic but Content (OR = 3.52, 95% CI [3.38, 3.66], p < .001). Survey year was also significant across all comparisons, confirming the temporal trend toward poorer mental health.

Table 4: *Multilevel Multinomial Logistic Regression: Predictors of Mental Health Profile Membership*

	Vulnerable		Troubled	
Predictor	**OR**	**95% CI**	**OR**	**95% CI**
Within-municipality spending	1.08	[0.99, 1.17]	0.84**	[0.73, 0.95]
Between-municipality spending	1.06	[0.84, 1.33]	1.10	[0.82, 1.49]
Female	2.22***	[2.12, 2.32]	4.01***	[3.72, 4.32]
Survey year	1.02***	[1.01, 1.03]	1.09***	[1.08, 1.11]

Notes. Reference category = Complete Mental Health. Spending variables scaled to 1 000 krona. Within-municipality spending = deviation from municipality mean; between-municipality spending = municipality mean across years. N = 62 311 students in 26 municipalities. OR = odds ratio; CI = confidence interval. Symptomatic but Content results: within-municipality OR = 1.09* [1.01, 1.17]; between-municipality OR = 0.84* [0.72, 0.99]; female OR = 3.52*** [3.38, 3.66]; survey year OR = 1.03*** [1.02, 1.04].

*p < .05. **p < .01. ***p < .001.

Table 5 Summary*: Effect of 1 000 krona Increase in Within-Municipality Spending on Mental Health Profiles*

Profile	OR	% Change	p	Interpretation
Vulnerable	1.08	+8%	.084	No significant effect
Troubled	0.84	−16%	.007	Protective effect
Symptomatic	1.09	+9%	.026	Compositional shift from Troubled

Note. Within-municipality spending represents the effect of a municipality increasing spending above its own average, controlling for stable between-municipality differences. Reference category = Complete Mental Health. OR = odds ratio; Symptomatic = Symptomatic but Content.

Robustness Analyses. Sensitivity analyses examined whether results were robust to sample composition. As seen in Table 6, the protective effect on the Troubled profile was replicated when excluding small municipalities (OR = 0.82, 95% CI [0.72, 0.93], p = .003). In Stockholm alone, which comprised 90% of the sample, the effect was stronger (OR = 0.72, 95% CI [0.61, 0.86], p < .001). However, when Stockholm was excluded, the effect was no longer significant (OR = 0.97, 95% CI [0.79, 1.21], p = .813), though statistical power was limited (n = 6 265). Across all specifications, the Vulnerable profile showed no significant association with spending.

Table 6. *Robustness Analyses: Within-Municipality Spending Effects on Mental Health Profiles*

Model	N	Vulnerable		Troubled		Symptomatic	
		OR [95% CI]	p	OR [95% CI]	p	OR [95% CI]	p
Main model	62 311	1.08 [0.99, 1.17]	.084	0.84 [0.73, 0.95]	.007	1.09 [1.01, 1.17]	.026
Stockholm only	56 046	1.07 [0.96, 1.19]	.200	0.72 [0.61, 0.86]	<.001	1.03 [0.93, 1.13]	.597
Excluding Stockholm	6 265	1.06 [0.92, 1.22]	.446	0.97 [0.79, 1.21]	.813	1.14 [1.00, 1.29]	.045
Excluding small municipalities	61 838	1.07 [0.99, 1.17]	.104	0.82 [0.72, 0.93]	.003	1.09 [1.01, 1.18]	.023

Notes. Reference category = Complete Mental Health. Within-municipality spending represents the effect of a 1 000 krona increase above a municipality's own mean, controlling for between-municipality differences, gender, and survey year. Stockholm only: single-level multinomial logistic regression (random intercept not estimable with one municipality). Excluding Stockholm: multilevel model with 25 municipalities. Excluding small municipalities: excludes 11 municipalities with n < 100 (478 students). OR = odds ratio; CI = confidence interval.

The sensitivity of results to lag length was also examined. Models were re-estimated using spending lagged one, three, and four years prior to the survey, in addition to the primary two-year lag. The protective association between municipal spending and Troubled profile membership was statistically significant across all four lag specifications, with odds ratios ranging from 0.737 to 0.888, corresponding to reductions in odds of 11% to 26%. The effect was most pronounced at the two-to-three-year lag window, with the three-year lag yielding the largest reduction (OR = 0.737, 26%), followed by the primary two-year specification (OR = 0.836, 16%), with the effect somewhat weaker at the shortest and longest windows examined. A cumulative spending measure, defined as the equal-weighted mean of spending across the preceding four years, also yielded a significant protective effect (OR = 0.760, 24% reduction in odds), meaning that sustained investment amplifies the protective association. The Symptomatic but Content profile showed a positive association with spending consistent with the main analysis across individual lag specifications and in the cumulative model (ORs ranging from 1.016 to 1.131). For the Vulnerable profile, no significant association was observed at any lag length or in the cumulative model, with odds ratios close to 1.0 and confidence intervals spanning both sides of the null throughout. These findings indicate that the differential pattern, that spending reduces risk of the most severe profile while leaving the hidden at-risk group unaffected, is not contingent on the two-year specification used in the primary analysis.

Summary of Key Findings

The results can be summarized in five main findings. First, approximately half (51%) of the 9th-grade students demonstrated Complete Mental Health, but this proportion declined by 10 percentage points from 2006 to 2024. Second, the Troubled profile (acute distress) more than doubled in prevalence over the study period, while the Vulnerable profile (low well-being without symptoms) remained stable at approximately 17%. Third, girls were substantially more likely than boys to be in all at-risk categories, and this gender gap widened over time. Fourth, increased municipal spending on school health services was associated with reduced odds of the most severe profile (Troubled; OR = 0.84, p = .007), but showed no significant effect on the Vulnerable profile. Fifth, anxiety emerged as a differentiator between the Vulnerable and Troubled profiles, suggesting that students in the Vulnerable group may not be detected by symptom-based screening approaches.

[1]In contrast to many other school systems, Swedish compulsory schools (including 9th grade) remained open during the pandemic, while upper-secondary schools shifted to remote teaching .

Discussion

This study examined whether municipal investment in school health services is associated with the distribution of dual-factor mental health profiles among Stockholm adolescents. Three principal findings emerged. First, we documented a substantial deterioration in adolescent mental health over the 18-year study period, with the proportion of students exhibiting Complete Mental Health declining by 10 percentage points and the Troubled profile more than doubling in prevalence. Second, increased municipal spending on school health services was associated with reduced odds of the Troubled profile, characterized by both psychiatric symptoms and low well-being, but showed no significant association with the Vulnerable profile, characterized by low well-being without clinical symptoms. Third, spending was associated with increased odds of the Symptomatic but Content profile, suggesting that some students with severe symptomatology may experience improved well-being with greater service access, changing their profile classification rather than their symptom burden.

Interpretation of Main Findings

The protective effect of school health spending on the Troubled profile (OR = 0.84 per 1 000 krona increase) is consistent with the symptom-focused orientation of most school-based mental health services. School nurses, psychologists, and counselors are trained to identify and respond to students presenting with psychiatric symptoms such as anxiety, sadness, and behavioral difficulties. When municipalities increase resources for these services, capacity for early identification and intervention expands, plausibly reducing the proportion of students progressing to the most severe mental health states. This interpretation aligns with evidence that school-based screening and psychological interventions represent cost-effective approaches to preventing mental disorders in young people (13).

However, the null effect on the Vulnerable profile (OR = 1.08, p = .084) is equally important. These students, comprising 17% of the sample and remaining stable across the study period, report low well-

being and poor school satisfaction but do not present with the psychiatric symptoms that typically trigger clinical attention. From a precision public health perspective (17), this finding suggests that current resource allocation strategies may systematically overlook a substantial subgroup of struggling students. The Vulnerable profile is not merely a milder form of distress; prior research demonstrates that these students show academic outcomes comparable to those with clinical symptomatology and may be at elevated risk for future mental health deterioration (10, 23).

The positive association with the Symptomatic but Content profile (OR = 1.09) is consistent with a partial compositional shift from the Troubled profile. Increased resources may help some students with severe symptomatology to sustain or recover a degree of well-being, moving them from the Troubled to the Symptomatic but Content category. This interpretation is consistent with the simultaneously observed protective effect on the Troubled profile and with evidence that school-based interventions can buffer emotional distress even when symptoms persist.

Temporal Trends and Gender Disparities

The marked decline in adolescent mental health observed in this study mirrors international trends (1). The acceleration of decline around 2014–2016, with the nadir occurring in 2022, suggests cohort-specific exposures that warrant further investigation. Potential contributors include increased social media use, academic pressure, international conflicts, climate anxiety, and, for the most recent waves, the COVID-19 pandemic and its aftermath.

The substantial gender gap, with girls nearly three times more likely than boys to be classified as Troubled by 2024, represents a critical public health challenge. That this gap widened over the study period suggests that whatever factors are driving the overall decline in adolescent mental health are affecting girls disproportionately. However, as adolescent boys are less likely to seek help for mental health problems, school health services may need to consider gender-specific approaches in both prevention and detection work (12, 38).

The stability of the Vulnerable profile across the study period, fluctuating narrowly between 15% and 19% even as other profiles shifted dramatically, is noteworthy. This consistency suggests that low well-being without psychiatric symptoms may represent a distinct developmental phenomenon rather than a prodromal state that inevitably progresses to clinical disorder. It also may indicate that the factors driving the overall mental health decline are primarily operating through the symptom pathway rather than the well-being pathway.

Implications for Policy and Practice

These findings carry several implications for the allocation of school mental health resources. First, the differential effects across profiles support a precision approach to school mental health investment (5). Rather than asking whether spending "works" in aggregate, policymakers should consider which student subgroups benefit and which remain underserved. Our results suggest that current service models effectively reach students with visible psychiatric symptoms but fail to identify or support those whose

struggles manifest primarily as diminished well-being. A challenge here is to strike the right balance between supporting ‘Vulnerable’ students, without overmedicalizing normal ebbs and flows of adolescence.

Second, the persistence of the Vulnerable profile despite increasing investment points to a potential gap in service design. School health teams in Sweden and many other countries are mandated to work both preventively and health-promotively. Yet, the rapid decrease in negative mental health symptoms among school children may in practice tilt schools’ mental health services toward reactive, symptom-triggered intervention. Expanding the focus to include systematic assessment of well-being, and not merely the absence of symptoms, could help identify Vulnerable students who are likely to ‘fall through the cracks’.

Third, municipalities should anticipate that the apparent increase in the Symptomatic but Content profile may reflect a meaningful intermediate outcome: students whose distress has been partially ameliorated rather than a new or newly identified group. This reframes how to read prevalence shifts following investment increases; apparent growth in moderate-symptom categories may signal recovery from more severe states rather than rising need.

Fourth, the magnitude of effect, i.e., a 16% reduction in Troubled classification per €100 increase in per-student spending, provides a benchmark for cost-effectiveness considerations. If these patterns generalize nationally with roughly 6% classified as Troubled, even modest shifts in this proportion represent substantial numbers of adolescents. However, a full cost-effectiveness analysis would require data on downstream outcomes (healthcare utilization, educational attainment, labor market participation) that were beyond the scope of this study.

Finally, the finding that spending effects were concentrated in the central city of Stockholm warrants consideration. The greater Stockholm region comprises 26 municipalities and city-districts, with a diverse population and a comprehensive school health infrastructure that may enable more effective translation of resource investments into student outcomes. The stronger protective effect observed in central Stockholm city (OR = 0.72) compared to the full sample (OR = 0.84) suggests that the relationship between spending and mental health profiles may depend on organizational capacity to deploy resources effectively. In smaller municipalities, where school health teams may be more thinly spread and administrative structures less developed, additional funding may not yield the same benefits, or effects may be harder to detect given smaller student populations and less variation in spending over time. This interpretation aligns with research indicating that the effectiveness of health-promoting efforts depends not only on resource levels but also on how school leadership organizes and prioritizes this work (29). From a policy perspective, these findings suggest that increasing school health budgets may be necessary but not sufficient; attention to implementation capacity and service organization may be equally important for translating investments into improved student mental health (28, 30).

Limitations and Future Research

The current study has strengths such as the large, population-based sample (N = 63 190) drawn from a consistent survey methodology over 18 years, the within-between decomposition of spending effects controlling for stable municipal characteristics that might confound the spending-outcome association, and the two-year lag between spending and outcomes reducing concerns about reverse causality. Yet, several limitations should be acknowledged. First, the observational design precludes causal inference. Although the within-municipality analysis controls for time-invariant confounders, time-varying confounders, such as changes in municipal socioeconomic composition or concurrent policy reforms, could bias estimates. Second, the spending measure captures aggregate municipal expenditure and cannot distinguish between different service components (e.g., nursing vs. psychology) or service quality. Two municipalities with identical per-student spending may deliver very different services. Third, the well-being items in this study were school-specific (e.g., "I thrive at school") rather than assessing global life satisfaction. While school well-being is highly relevant for school-based services, the Vulnerable profile as identified here may not fully correspond to the construct as defined in broader dual-factor research. Fourth, Stockholm municipality comprised 90% of the sample, and robustness analyses revealed that the protective effect on the Troubled profile was primarily driven by this municipality. The Stockholm-only analysis showed a stronger effect (OR = 0.72, $p < .001$) than the full sample, while the effect was not significant when Stockholm was excluded (OR = 0.97, $p = .813$). This pattern may reflect limited statistical power in the non-Stockholm subsample (n = 6 265), genuine heterogeneity in spending effects between large urban and smaller suburban municipalities, or differences in how school health services are organized and delivered across municipal contexts. The findings may therefore be most applicable to large urban municipalities with similar service structures to Stockholm. Future research should examine whether spending effects generalize to other Swedish regions with different demographic and organizational characteristics. Fifth, we could not examine precise theoretical mechanisms, i.e., the pathways through which spending might influence profiles, nor potential moderators such as gender or socioeconomic background.

Several directions for future research emerge from these findings. First, studies examining underlying mechanisms are needed: does school spending operate through increased screening, more counseling hours, faster referral to specialist services, or improved school climate? Second, research should examine whether schools' spending on mental health services differ across student subgroups defined by e.g., gender, socioeconomic background, or ethnic background. Third, intervention studies specifically targeting the Vulnerable profile – perhaps through universal well-being promotion rather than selective symptom-based programs – could test whether this group is amenable to school-based support. Fourth, longitudinal designs tracking individual students across time could examine whether school spending on mental health services influences transitions between student profiles (e.g., preventing movement from Vulnerable to Troubled). Finally, cost-effectiveness analyses incorporating longer-term outcomes would inform resource allocation decisions.

Conclusion

This study provides the first evidence that municipal investment in school mental health services is differentially associated with distinct mental health profiles among adolescents. Increased spending appears protective against the most severe profile: students with both psychiatric symptoms and low well-being, but does not seem to benefit students whose struggles manifest as diminished well-being without clinical symptoms. From a public health perspective, these findings suggest that current service models, while valuable, may require reorientation to address the full spectrum of adolescent mental health needs. As policymakers respond to the ongoing decline in youth mental health, attending to heterogeneity in treatment effects, asking not just "does it work?" but "for whom?", will be essential for efficient and equitable resource allocation.

Abbreviations

CI	Confidence interval
FIML	Full information maximum likelihood
gsem	Generalized structural equation modeling
LPA	Latent profile analysis
M	Mean
MLR	Maximum likelihood with robust standard errors
MH	Mental health
N	Total sample size
n	Subsample size
OR	Odds ratio
r	Pearson correlation coefficient
WHO	World Health Organization

Declarations

Clinical trial number: not applicable.

Ethics approval and consent to participate

The study was assessed by the Director of Research at the Stockholm School of Economics, acting under delegated authority from the Faculty and Program Board, who determined that the project does not fall within the scope of the Swedish Act concerning the Ethical Review of Research Involving Humans (2003:460) and therefore does not require ethical review or approval by the Swedish Ethical Review Authority; reference number DR 2026–8. This determination reflects that the study is based exclusively on secondary analysis of two anonymized datasets: publicly available municipal expenditure

data from the Swedish National Agency for Education (Skolverket), and anonymized survey data from Stockholmsenkäten, obtained from the City of Stockholm following an application procedure. The data contain no direct personal identifiers, no sensitive personal data within the meaning of Article 9.1 of the General Data Protection Regulation, and no information regarding violations of law. No new data collection, interventions, or contact with research participants was conducted for this study. As the data were collected by the City of Stockholm for public health surveillance purposes and provided to the research team in fully anonymized form, individual informed consent was not applicable. All analyses were conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The Stockholm survey data analyzed during the current study are not publicly available due to data protection regulations governing anonymized survey data collected from minors but are available from the City of Stockholm on reasonable request, subject to a data-sharing agreement. Municipal spending data on school health services are publicly available from the Swedish National Agency for Education (Skolverket) at https://www.skolverket.se. The Stata and Mplus code used to construct analytical variables and produce the reported analyses is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

The first and the second author conceived and designed the study. The first author performed the statistical analysis and wrote the original draft of the manuscript. The second author supervised the study and contributed to manuscript revision. Both authors read and approved the final manuscript.

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References

1. Cosma A, Abdrakhmanova S, Taut D, Schrijvers K, Catunda C, Schnohr C. A focus on adolescent mental health and wellbeing in Europe, central Asia and Canada: Health Behaviour in School-aged Children international report from the 2021/2022 survey World Health Organization; 2021.
2. Benton TD, Boyd RC, Njoroge WF. Addressing the global crisis of child and adolescent mental health. JAMA pediatrics. 2021;175(11):1108-10.
3. Potrebny T, Wiium N, Haugstvedt A, Sollesnes R, Wold B, Thuen F. Trends in the utilization of youth primary healthcare services and psychological distress. BMC Health Services Research. 2021;21(1):115.
4. Befus E-G, Mølland E, Helseth S, Hagen M, Stea TH, Nolte S, et al. The use of youth healthcare services and its association with health-related quality of life, physical and mental health and over-the-counter analgesics use in 13–19-year-old adolescents: a cross-sectional study. BMC Public Health. 2024;24(1):104.
5. Das JK, Salam RA, Lassi ZS, Khan MN, Mahmood W, Patel V, et al. Interventions for adolescent mental health: an overview of systematic reviews. Journal of Adolescent Health. 2016;59(4):S49-S60.
6. Riglin L, Petrides K, Frederickson N, Rice F. The relationship between emotional problems and subsequent school attainment: a meta-analysis. Journal of Adolescence. 2014;37(4):335-46.
7. Rathmann K, Pförtner T-K, Osorio AM, Hurrelmann K, Elgar FJ, Bosakova L, et al. Adolescents' psychological health during the economic recession: does public spending buffer health inequalities among young people? BMC Public Health. 2016;16(1):860.
8. Montgomery P, Knerr W, Ross DA, Patterson J. The effectiveness and acceptability of comprehensive and multicomponent school health services: a systematic review. Journal of Adolescent Health. 2022;70(2):192-207.
9. Keyes CL. The mental health continuum: From languishing to flourishing in life. Journal of health and social behavior. 2002:207-22.
10. Suldo SM, Shaffer EJ. Looking beyond psychopathology: The dual-factor model of mental health in youth. School Psychology Review. 2008;37(1):52-68.
11. McPhail L, Thornicroft G, Gronholm PC. Help-seeking processes related to targeted school-based mental health services: systematic review. BMC Public Health. 2024;24(1):1217.
12. Helland Lindborg T, Kristensson Hallström I, Synnøve Litland A, Åvik Persson H. Adolescent boys' experiences of mental health and school health services - an interview study from Norway. BMC Public Health. 2024;24(1):1464.
13. Le LK-D, Esturas AC, Mihalopoulos C, Chiotelis O, Bucholc J, Chatterton ML, et al. Cost-effectiveness evidence of mental health prevention and promotion interventions: A systematic review of economic evaluations. PLoS medicine. 2021;18(5):e1003606.
14. Goldberg JM, Sklad M, Elfrink TR, Schreurs KM, Bohlmeijer ET, Clarke AM. Effectiveness of interventions adopting a whole school approach to enhancing social and emotional development: a meta-analysis. European Journal of Psychology of Education. 2019;34(4):755-82.

15. Konu A, Rimpelä M. Well-being in schools: a conceptual model. Health Promotion International. 2002;17(1):79-87.
16. Baric VB, Yngve M, Holmefur M, Feldman I, Wilder J, Johansen K, et al. Partnering for change (P4C) in Sweden- a study protocol of a collaborative school-based service delivery model to create inclusive learning environments. BMC Public Health. 2023;23(1):2219.
17. Khoury MJ, Iademarco MF, Riley WT. Precision public health for the era of precision medicine. American Journal of Preventive Medicine. 2015;50(3):398-401.
18. Rasmussen SA, Khoury MJ, Del Rio C. Precision public health as a key tool in the COVID-19 response. JAMA. 2020;324(10):933-4.
19. Greenspoon PJ, Saklofske DH. Toward an integration of subjective well-being and psychopathology. Social indicators research. 2001;54(1):81-108.
20. Hermann V, Söderqvist F, Karlsson A-C, Sarkadi A, Durbeej N. Mental health status according to the dual-factor model in Swedish adolescents: A cross sectional study highlighting associations with stress, resilience, social status and gender. PLoS One. 2024;19(3):e0299225.
21. World Health Organization. Mental Health and Substance Abuse. Geneva: World Health Organization; 2011. Report No.: 9789240113817.
22. Suldo SM, Thalji-Raitano A, Kiefer SM, Ferron JM. Conceptualizing high school students' mental health through a dual-factor model. School Psychology Review. 2016;45(4):434-57.
23. Antaramian SP, Huebner ES, Hills KJ, Valois RF. A dual-factor model of mental health: Toward a more comprehensive understanding of youth functioning. American Journal of Orthopsychiatry. 2010;80(4):462.
24. Moore SA, Dowdy E, Nylund-Gibson K, Furlong MJ. A latent transition analysis of the longitudinal stability of dual-factor mental health in adolescence. Journal of School Psychology. 2019;73:56-73.
25. Plenty S, Östberg V, Almquist YB, Augustine L, Modin B. Psychosocial working conditions: An analysis of emotional symptoms and conduct problems amongst adolescent students. Journal of Adolescence. 2014;37(4):407-17.
26. Granvik Saminathen M, Brolin Låftman S, Almquist YB, Modin B. Effective schools, school segregation, and the link with school achievement. School Effectiveness and School Improvement. 2018;29(3):464-84.
27. Kidger J, Araya R, Donovan J, Gunnell D. The effect of the school environment on the emotional health of adolescents: a systematic review. Pediatrics. 2012;129(5):925-49.
28. Biermann O, Claeson M, Derko M, Mikaelsdotter C, Nordenstam A, Swartling Peterson S. Political economy of adolescent mental health and well-being in Sweden: how to overcome barriers to effective financing and youth-centered collective action. BMC Public Health. 2025;25(1):1509.
29. Adams D, Lok Tan K, Sandmeier A, Skedsmo G. School leadership that supports health promotion in schools: A systematic literature review. Health Education Journal. 2023;82(6):693-707.

30. Budisavljevic S, Arnarsson A, Hamrik Z, Roberts C, Godeau E, Molcho M, et al. Improving adolescent health: translating health behaviour in school-aged children evidence into policy. Journal of Adolescent Health. 2020;66(6):S9-S11.
31. Nylund-Gibson K, Choi AY. Ten frequently asked questions about latent class analysis. Translational Issues in Psychological Science. 2018;4(4):440.
32. Muthén LK, Muthén B. Mplus user's guide: Statistical analysis with latent variables, user's guide. Los Angeles: Muthén & Muthén; 2017.
33. Celeux G, Soromenho G. An entropy criterion for assessing the number of clusters in a mixture model. Journal of classification. 1996;13(2):195-212.
34. StataCorp. Stata statistical software: release 18. College Station: StataCorp; 2023.
35. Raudenbush SW, Bryk AS. Hierarchical linear models: Applications and data analysis methods. London: Sage; 2002.
36. Allison PD. Fixed effects regression models: Sage; 2009.
37. Enders CK. Applied missing data analysis. New York: Guilford; 2022.
38. Kristiansen L, Boman N, Olofsson N. Strengthening adolescent well-being—controlled feasibility from two Swedish upper secondary schools. BMC Public Health. 2026;26(1):1245.