Results | In this study of 11 878 children, no sex differences in DEBs were found. Advanced pubertal maturation was associated with elevated odds of ever engaging in compensatory behaviors to prevent weight gain (Table). Children with higher BMI had elevated odds of compensatory behaviors to prevent weight gain (ever or at least once per week for 3 months) or ever vomiting. The prevalence of ever binge eating was 5.0% (weighted, 5.5%) and of binge eating at least once per week for 3 months was 2.2% (weighted, 2.5%). The association of pubertal maturation (measured by the Pubertal Development Scale [PDS]) with binge eating differed by weight status. Weight status–stratified models found that, among children with BMI ranging from the 5th percentile to less than the 85th percentile, advanced pubertal maturation was associated with elevated odds of ever binge eating (OR, 1.88; 95% CI, 1.35-2.60; $P < .001$) or binge eating at least once per week for 3 months (OR, 2.13; 95% CI, 1.21-3.76; $P = .01$). Among children whose BMI ranged from the 85th to less than 95th percentile, advanced pubertal maturation was associated with elevated odds of ever binge eating (OR, 1.55; 95% CI, 1.04-2.33; $P = .03$).

Discussion | Sex differences in DEBs were minimal in children aged 9 to 10 years, consistent with full-threshold eating disorder diagnoses at these ages.[6] Children with higher BMIs were at elevated risk for DEBs. Although advanced pubertal maturation was associated with greater report of compensatory behaviors to prevent weight gain, the association of pubertal maturation with binge eating differed by weight status. Parents might interpret eating behaviors differentially in the context of their child's weight and development, such that overeating in the context of advanced pubertal maturation may be perceived as binge eating among children with lower BMI but not among similarly developed children with BMIs in the 95th percentile or greater. Findings underscore the importance of parental education around discerning DEBs. Limitations of the study include reliance on parental report and the relatively low prevalence of DEBs, which may impact the statistical power in discerning smaller yet meaningful consequences.

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Deliberate Self-injury in Children and Associations With Negative Adjustment

The onset of self-injury is thought to occur in adolescence, typically around 12 to 14 years.[1] However, to our knowledge, there are no longitudinal survey publications that assess children's self-reported self-injury behaviors.[2] We assessed whether age is associated with the consistency of self-injury over time and the association between self-injury and adjustment difficulties (depressive symptoms, emotion dysregulation, social anxiety). Parental knowledge of child self-injury also was investigated.

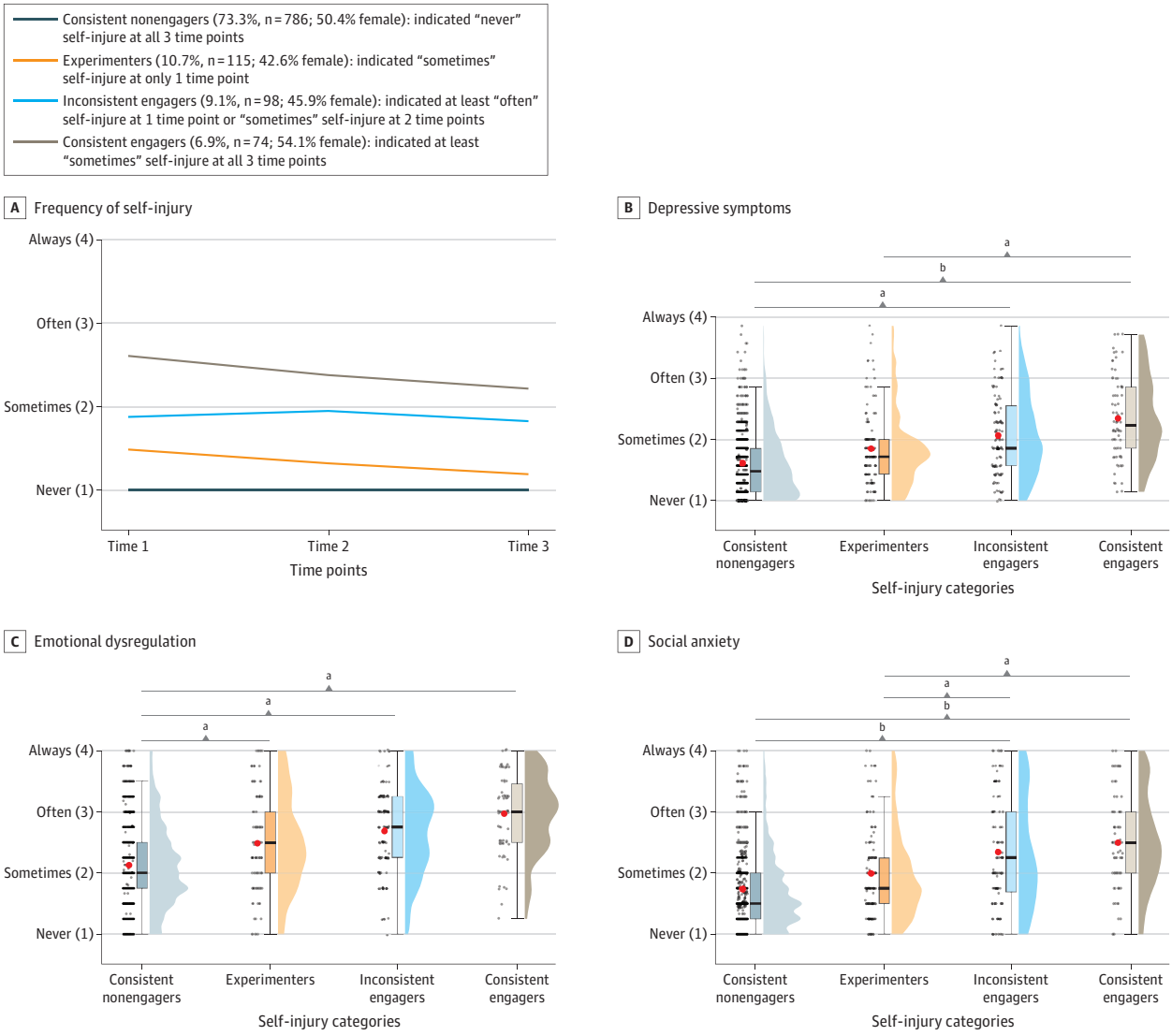
Methods | Children and adolescents from an Ontario, Canada, region (N = 1073; 50.6% male; mean age at year 1, 10.8 years; range, 8-14 years) were surveyed in their classroom annually for 3 years beginning in 2017. Year 1 measures included age, sex, adjustment difficulties,[3-5] and parent report of their own education level and whether their child engages in self-injury (talks about hurting self without wanting to die; harms self on purpose without wanting to die).

At all 3 time points, participants were asked what they usually do when they experience a lot of stress. One item ("I do something to hurt myself on purpose [ie, hurt my body]") was used to measure self-injury. Participants then were asked what they did to hurt themselves on purpose and why they did these

behaviors. Questions were open-ended for children in grades 3 through 5, given ethical constraints. Participants in grade 6 and above responded to a list of self-injury behaviors (eg, cutting) and reasons for engagement (eg, self-anger) from the Inventory of Statements about Self-injury (ISAS).[6] University Ethics Board approved the study. Parents and participants provided written consent or assent. Missing data were imputed through multiple imputation.

Results | Self-injury responses across the 3 years were coded into 4 categories: consistent nonengagers, experimenters, inconsistent engagers, and consistent engagers (**Figure**). A multinomial logistic regression was conducted to investigate whether age, sex, parental education, adjustment difficulties, and interactions between age and each adjustment difficulty were associated with self-injury categories. The model was significant (χ^2_{27} = 228.24; P < .001). Only sex (χ^2_3 = 10.34;

Figure. Patterns of Self-injury and Their Association With Adjustment Difficulties



A shows the frequency of self-injury across the 4 categories. Self-injury was measured on a 4-point scale from 1 = "never" to 4 = "almost always." B-D show a box plot and the distribution of year 1 adjustment difficulties for each of the categories. Gray dots represent raw scores (appear black when overlapping). Means are depicted as red dots. On average, 11.6% of the younger children and 17.8% of adolescents reported engaging in self-injury. Missing data occurred because some participants did not complete all the survey questions (3.1% across the 3 years), and because some participants were absent during data collection (17.7% in year 2 and 24.0% in year 3). Older age (P < .001; η_p^2 = .03) and higher depressive symptoms (P = .001; η_p^2 = .01) were associated with missingness at year 2, and older age (P < .001; η_p^2 = .03) and lower parental education (P = .03; η_p^2 = .01) were associated with missingness at year 3. Older age was likely associated with missingness because absenteeism is more common among high school students than elementary school students. Absenteeism has been found to be associated with self-injury; thus, our results may underestimate the prevalence of self-injury. Furthermore, the biases associated with violating missing-at-random assumptions are minimized when all study variables are included in the multiple imputation analyses,[7] as they were in this study.

[a] P < .01.

[b] P < .001.

Table. Representative Sample of Child (Grades 3-5) Qualitative Responses[a]

Grade	Sex	Child behavior	Child reason
3	Male	Scratch	idk [*sic*]
3	Female	Punch or bite	Because I was frustrated
3	Male	Hit myself	Because I was mad
3	Male	Hit my head	Because I did something stupied [*sic*]
3	Female	I punch myself	
4	Male	Bite myself in the arm	because
4	Male	Smack my head	I was so stressed I coulden't [*sic*] help myself
4	Male	Punched myself in the arm	because my brother tickes [*sic*] me off
4	Female	Bit	I was frustrated
5	Female	I cut myself	Because some people want me to commit suicide
5	Male	Scratched myself hard and for a long time	To get my stress away
5	Female	I tryed [*sic*] to cut myself	I was bullied
5	Female	I cate [*sic*] my self [*sic*]	Because when im [*sic*] mad
5	Male	I slaped [*sic*] myself in the face hard	Because I was upset and mad
5	Male	Punched myself in the face	I did this because I was really mad
5	Female	I hit myself in the head and squeeze my arm hard	Because i hate my life
5	Female	Draw on my self [*sic*] with sicsors [*sic*]	Because i did'nt [*sic*] want to deal with my deppresion [*sic*]
5	Male	Bite myself on my hand	Because it calms me
5	Male	I have banged my head against walls multiple time but not to the point were it eally [*sic*] hurts. I have banged my head with medal [*sic*] pretty light though so i didnt really hurt. i have pluged [*sic*] my nose and mouth with my hands to sto [*sic*] myself from breathing before. And etc.	I do it only when im [*sic*] mad or upset
5	Female	Yes and i mae [*sic*] a thin cut on my hand	Because everyone was making fun of md [*sic*] at school

[a] Self-injury questions were open-ended for children in grades 3 to 5, given ethical constraints.

P = .02) and each adjustment difficulty (depression [χ^2_3 = 18.66; P < .001], emotion dysregulation [χ^2_3 = 18.65; P < .001], social anxiety [χ^2_3 = 32.00; P < .001]) were associated with self-injury.

Girls had lower odds of being experimenters (95% CI, 0.63-0.96) and inconsistent engagers (95% CI, 0.61-0.96) than consistent nonengagers. Participants with higher scores on depressive symptoms, emotion dysregulation, and social anxiety had greater odds of being inconsistent engagers (95% CI, 1.08-1.77; 95% CI, 1.12-1.95; 95% CI, 1.36-2.13, respectively) and consistent engagers (95% CI, 1.36-2.45; 95% CI, 1.19-2.39; 95% CI, 1.38-2.39, respectively) than consistent nonengagers. Those with higher emotion dysregulation had greater odds of being experimenters (95% CI, 1.13-1.89) than consistent nonengagers. Those with higher social anxiety had greater odds of being inconsistent engagers (95% CI, 1.07-1.89), and consistent engagers (95% CI, 1.10-2.10) than experimenters, and those with higher depressive symptoms had greater odds of being consistent engagers (95% CI, 1.12-2.24) than experimenters. Importantly, age and interactions between the adjustment difficulties and age were not significant.

The **Table** shows examples of children's (grades 3-5) responses to the open-ended self-injury questions, demonstrating that children understand what self-injury means and can identify what behaviors they engage in and why. The behaviors that children reported (hitting, cutting, etc) and reasons for engagement (self-anger, to calm down, etc) are consistent with the ISAS[6] behaviors and reasons that adolescents responded to. Few parents of the participants (5.9%) reporting self-injury indicated that their child engaged in self-injury.

Discussion | Age was not associated with patterns of self-injury over time. The link between self-injury and adjustment difficulties also was consistent across age, suggesting that children engaging in self-injury are as much at risk as adolescents. Self-injury clearly occurs earlier than often thought, which might explain why parents were largely unaware of their child's self-injury behaviors. Study limitations are that suicidal intent was not assessed and that prevalence of self-injury may be underestimated because the self-injury questions only asked about behaviors when students felt stressed and because of 17.7% to 24.0% absenteeism (a risk factor for self-injury) during data collection.

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Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: All authors.
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Trends in Metabolic Syndrome Among US Youth, From 1999 to 2018

Metabolic syndrome is a cluster of risk factors for cardiometabolic diseases, including heart disease, stroke, and diabetes.[1] In the US, more than one-third of adults have metabolic syndrome.[2,3] However, data are limited among youth. Examining trends in prevalence of metabolic syndrome and its subcomponents among youth overall and by subgroups can guide prevention strategies, especially those at higher risk for early-onset cardiometabolic diseases.

Supplemental content

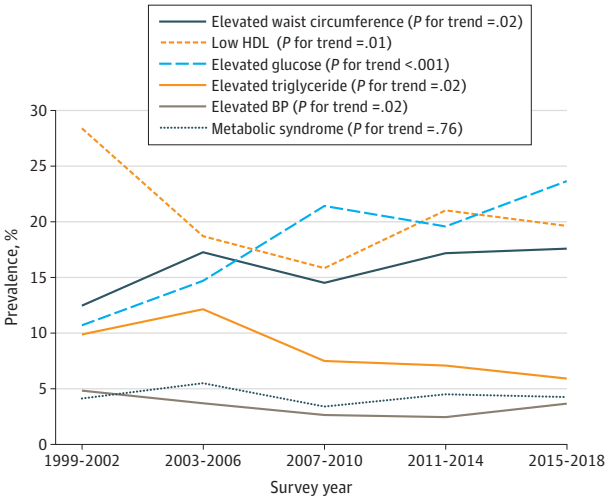
Methods | All participants provided written informed consent. This survey study was deemed exempt from review by the Mount Sinai Institutional Review Board because it used publicly deidentified data. We followed the AAPOR reporting guideline.

Using data from 10 cycles of the National Health and Nutrition Examination Survey from 1999 to 2018, we examined trends in prevalence of metabolic syndrome and its individual components and associated differences by subgroups among youth aged 12 to 19 years. The International Diabetes Federation consensus definition[4] of metabolic syndrome is the presence of central obesity and 2 or more other risk factors, including high blood pressure, elevated plasma glucose, high triglycerides, and low high-density lipoprotein cholesterol (eMethods in the Supplement). We evaluated prevalence in population subgroups according to sex, age, race and ethnicity, parental educational level, household income (poverty income ratio), food security status, and body mass index categories (eMethods in the Supplement). Race and ethnicity data were collected by trained interviewers using fixed categories from National Center for Health Statistics.

Survey analysis procedures were used to account for complex sampling design to derive nationally representative estimates. Prevalence estimates of metabolic syndrome and its subcomponents and 95% CIs were calculated overall and by subgroups. Logistic regression was used to estimate trends by treating survey cycle as a continuous variable. Two-sided $P < .05$ indicated statistical significance. No statistical adjustments were made for multiple comparisons. Statistical analyses were performed from November 8, 2021, to December 18, 2022, using Stata, version 16 (StataCorp LLC).

Results | We included 6289 youths (mean [SD] age, 15.5 [2.74] years; 3044 girls [48.4%] and 3245 boys [51.6%]). From 1999 to 2018, the prevalence of metabolic syndrome remained stable at 4.36% (95% CI, 3.65%-5.20%), whereas prevalence trends of subcomponents were heterogenous (**Figure**). Prevalence increased for elevated waist circumference from 12.47% (95% CI, 10.47%-14.78%) to 17.59% (95% CI, 15.07%-20.43%; *P* for

Figure. Trends in Estimated Prevalence of Metabolic Syndrome and Its Subcomponents Among US Youth Aged 2 to 19 Years From 1999 to 2018



Data were adjusted for National Health and Nutrition Examination Survey survey weights to be nationally representative. BP indicates blood pressure; HDL, high-density lipoprotein.