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Behavioral and Psychosocial Factors Associated with Elevated Symptoms of Depression and Anxiety in Middle School Students: Building Resilience for Healthy Kids

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Abstract

Objective: To identify potentially modifiable behavioral and psychosocial factors associated with elevated symptoms of depression and anxiety in middle school students.

Method: A total of 285 students (53% girls, 18% Hispanic, 68% White, mean 11.4 years of age) completed the baseline assessment for the program, Building Resilience for Health Kids. Students were stratified as elevated versus low symptoms of negative affectivity based on scores on the PROMIS Emotional Distress Anxiety and Depressive Symptoms assessment. Multivariable logistic regression models were used to examine demographic, health behavior, and psychosocial predictors for elevated negative affectivity at baseline in a cross-sectional analysis.

Results: Thirty-nine percent of students reported elevated negative affectivity. In multivariable models, girls had 3.16 (95% CI 1.78-5.62) higher odds of reporting elevated symptoms compared to boys. Students who did not have regular family meals (OR 2.11; 95% CI 1.17-3.83), obtained less physical activity (OR 2.59; 95% CI 1.40-4.79), reported poor sleep (OR 2.67; 95% CI 1.37-5.18), or endorsed higher academic pressure (OR 1.06; 95% CI 1.02-1.11) had higher odds for reporting elevated negative affectivity. Self-efficacy was found to protect students from negative affectivity (OR 0.94; 95% CI 0.91-0.97).

Conclusion: Students who reported elevated negative affectivity were found to have worse health behaviors (unhealthy diet behaviors, less physical activity, poor sleep), lower self-efficacy, and higher academic pressure. Future mental health interventions need to consider health behaviors including diet, physical activity, and sleep in future strategies to improve negative affectivity with the ultimate goal of preventing worsening depression and anxiety in later adolescence.

Keywords: Anxiety; Depression; Mental health; School-based; Youth

Introduction

Mental health diagnoses, including depression, anxiety, and suicidal ideation are common among today's youth. Children are increasingly diagnosed with anxiety before age ten, and youth with anxiety have a higher risk for depression, engagement in risky behaviors, and higher rates of suicide during mid- and late-adolescence and young adulthood [1,2]. Onset of anxiety and depression (i.e., negative affectivity) typically occurs in early-to-mid adolescence (ages 11-15 years) [1,3] and, if untreated, tracks into adulthood [4,5]. Efforts to address negative affectivity in middle school age youth are therefore integral for improving psychosocial health in later adolescence and young adulthood. In order to design a mental health intervention that is effective, a better understanding of how symptoms of anxiety and depression are influenced by nonmodifiable (i.e., demographics), and modifiable including health behaviors and psychosocial (i.e., resilience, grit, self-efficacy, academic pressure) parameters during early adolescence is needed.

Modifiable behaviors such as health behaviors have been shown to impact symptoms of both depression and anxiety. Having regular family meals together (i.e., dinner) has been shown to be predictive of a child's well-being [6]. The impact of dietary intake on mental health risk is less clear. A few studies have linked low quality diets (i.e., low intake of fruits and vegetables) to increased depression and anxiety risk among adolescents and young adults [7-11]. However, these findings were attenuated after controlling for individuals' weight status, socioeconomic status, and paternal care [7,8,12]. Physical activity and low amounts of screen time have been found to be associated with more positive mood outcomes, such as decreased stress and depression symptoms, during adolescence [13-17]. Sleep health has also been shown to be related to mental health outcomes. Sleep duration, specifically, has been suggested to be a moderator for symptoms of both depression and anxiety among youth. Observational and experimental studies have shown that short sleep is negatively associated with psychosocial health, including worsening anxiety, depression, and suicidal ideation, during childhood and adolescence [18-24].

Major life changes, stress, physical health conditions, and personal or family history of mental health disorders have been identified as risk factors for anxiety and depression in youth [25,26]. However, when designing effective interventions, risk factors that are easily modifiable (i.e., sleep, screen time, dietary behaviors) are needed in order to target children who are at risk for developing these disorders early in life. While previous studies have identified risk factors for mental health disorders among adolescents, to our knowledge there is little known about how negative affectivity is related to demographic variables, health behaviors, and psychosocial parameters among middle school children. Therefore, our goal was to estimate the proportion of students with negative affectivity and identify factors that could be used to target or tailor future primordial prevention efforts.

Methods

Participants

The Building Resilience for Healthy Kids Program (i.e., Healthy Kids) was a school-based universal intervention conducted in an urban middle school in Colorado Springs, Colorado (January-March 2020). All 6th grade students were selected to participate. Parents and students were allowed to "Opt Out" of the study at any time. Baseline data, collected prior to the intervention, was used for this analysis. Intervention details have been published previously, see Lee, et al. The Colorado Multiple Institutional Review Board (COMIRB) approved the study. The program is registered at clinicaltrials.gov (NCT04202913).

Study Variables

Students completed the study survey using the electronic REDCap software at baseline (January 2020). The survey was distributed to the student's school email address and dedicated class time was given to the students to complete the survey during the school day.

Demographics and Health Behaviors

The students self-reported their age, gender, race, and ethnicity via the survey. Students also answered questions related to their health behaviors over the past week, including eating behaviors (frequency of breakfast consumption, family dinners), dietary intake (daily consumption of sugar sweetened beverages, fruits, and vegetables), physical activity (days of at least 60 minutes of moderate-vigorous physical activity), screen time (hours per school day of watching screens and hours per day of computer and video games), and bed and wake times on school nights and weekends (calculated time in bed). These health behavior variables were categorized as either meeting or not meeting the health behavior recommendations outlined by the American Academy of Pediatrics (AAP) [27]. These recommendations include consuming breakfast most days of the week (5+ days/week), eating dinner as a family meal most days of the week (5+ days/week), avoiding sugar-sweetened beverages (0 servings/day), consuming three servings a day of both fruits and vegetables, participating in at least 60 minutes of moderate-to-vigorous activity most days of the week (5+ days/week), using screens (TV, computer, video games not related to school work) less than two hours per day, and getting adequate sleep (9-11 hours per night) [28-30].

Psychosocial Parameters

Negative Affectivity

The Patient-Reported Outcomes Measurement Information System Emotional Distress Anxiety and Depression Symptoms (PROMIS) scales were used to assess mood symptoms over the past 7 days [31]. Each item response included a 5-point scale ranging from “Never” to “Always.” Higher scores reflect more severe anxiety and depression symptoms. forms have been shown to be reliable in children aged 8-17 years [31].

Academic Pressure

The Educational Stress Scale for Adolescents was used to assess academic pressure [32]. This measure has been validated in youth aged 12-18 years [32]. This measure uses a 5-point Likert-type scale (from “Strongly Disagree” to “Strongly Agree”) with higher total scores reflecting more academic pressure.

Grit

The Grit Scale, validated by Duckworth et al., was used to assess grit, which is essentially characterized by perseverance and motivation towards future goals [33]. This 12-item tool utilizes a 5-point Likert-like scale ranging from “Very much like me” to “Not like me at all.” Higher total scores reflect higher (more positive) levels of grit.

Self-Efficacy

The Self-Efficacy Questionnaire for Children was used to assess self-efficacy [34]. This 24-item survey has been validated among adolescents aged 12-19 years [34]. Each response is scored on a 5-point Likert-like scale ranging from “Not at all” to “Very well.” For this study, total self-efficacy was reported as the sum of three domains of self-efficacy: social self-efficacy, or the perceived capability for assertiveness and peer relationships; emotional self-efficacy, or the perceived capability of coping with negative emotions; and academic self-efficacy, referring to the perceived capability to meet academic expectations and manage one’s own learning. A higher score indicates more self-efficacy and higher/more positive valence.

Resilience

The Child and Youth Resilience Measure using Rasch analysis (CYRM-R) was used to assess social-ecological resilience, or the ability to adapt when faced with adversity [35]. The CYRM-R has been validated among youth aged 11-19 years [35], and it uses a 5-point Likert-like scale ranging from “Not at all” to “A lot.” Two subdomains are assessed: personal resilience and relationship-based resilience. All items are summed to obtain a total resilience score, with higher scores indicating higher levels of resilience.

Analysis

Analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC, USA). Students were stratified by negative affectivity (i.e., elevated versus low depression and/or anxiety symptoms). Students who reported at least moderate symptoms for depression and anxiety using the PROMIS criteria (T-score ≥ 60.0) were categorized as “elevated,” while students who reported less than moderate symptoms of depression or anxiety (T-score < 60.0) were categorized as “Low” [31]. Groups were compared using independent sample t-tests for continuous data (mean \pm standard deviation) and chi-square for categorical variables (frequency (%)). To identify predictors of a student’s negative affectivity status, three separate logistic regression models using both univariate and multivariable approaches were examined. In model 1, all demographic variables were first examined via univariate analyses. All significant predictors ($p < 0.05$) were then included in the multivariable analysis for model 1. A similar approach was followed for model 2 (health behaviors) and model 3 (psychosocial parameters) in which first the univariate associations were tested and then all significant predictors were included in a multivariable analysis. The alpha value < 0.05 was considered for statistical significance.

Results

Preliminary Analyses

A total of 285 of the 330 6th grade students invited to participate assented to join our program in January 2020, while 45 (14%) chose to “Opt Out.” For privacy, the research staff did not collect any demographic details for these students nor were given reasons for why families or the student chose not to participate. The 285 students that joined the program were an average of 11.4 (0.53) years of age, 53% were girls, 15% identified as Hispanic ethnicity, and 14% identified as a minority race (Table 1).

| | Total Cohort N=285 | Negative Affectivity Status Low Symptoms n=173 | Elevated Symptoms n=112 | p-value |
|---|-----------------------|--|----------------------------|---------|
| Demographic | | | | |
| Gender | | | | <0.001 |
| Boys | 133 (47%) | 96 (55%) | 37 (33%) | |
| Girls | 152 (53%) | 77 (45%) | 75 (67%) | |
| Age (years) | 11.4 ± 0.5 | 11.4 ± 0.5 | 11.3 ± 0.5 | 0.44 |
| Ethnicity | | | | |
| Hispanic | 51 (18%) | 29 (17%) | 22 (20%) | 0.73 |
| Race | | | | |
| White | 194 (68%) | 119 (69%) | 75 (68%) | 0.87 |
| Black | 11 (4%) | 6 (3%) | 5 (4%) | |
| Asian | 11 (4%) | 6 (3%) | 5 (4%) | |
| Other | 17 (6%) | 12 (8%) | 5 (4%) | |
| Not Reported | 55 (18%) | 30 (17%) | 22 (20%) | |
| Health Behaviors (% meeting recommendations) | | | | |
| Diet Behaviors | | | | |
| Eat Breakfast (5+ days/week) | 193 (68%) | 130 (75%) | 63 (57%) | 0.002 |
| Eat Dinner as Family (5+ days/week) | 150 (53%) | 101 (59%) | 49 (45%) | 0.02 |
| Dietary Intake | | | | |
| SSB (0 servings/day) | 30 (11%) | 24 (14%) | 6 (6%) | 0.02 |
| Fruits (3+ servings/day) | 168 (60%) | 102 (60%) | 66 (60%) | 0.99 |
| Vegetables (3+ servings/day) | 89 (32%) | 57 (33%) | 32 (29%) | 0.51 |
| Physical Activity | | | | |
| 60 minutes per day (5+ days/week) | 151 (53%) | 105 (61%) | 46 (41%) | 0.002 |
| Screen Time | | | | |
| (<2 hours/day) | 197 (70%) | 132 (78%) | 65 (59%) | <0.001 |
| Screen Time | | | | |
| (<2 hours/day) | 207 (74%) | 136 (80%) | 71 (64%) | 0.002 |
| Sleep | | | | |
| Time in Bed (≥9 hours/night) | 207 (74%) | 136 (80%) | 71 (64%) | 0.002 |

Notes: Sugar sweetened beverage (SSB)

Table 1: Characteristics of Middle School Students Stratified by Negative Affectivity Status.

In general, over two-thirds of students reported meeting the AAP recommendation for eating breakfast (68%), and over half met the AAP recommendations for having dinners as a family (53%) or participating in physical activity (53%) most days per week. Furthermore, over half of the students reported meeting recommendations for eating at least 3 fruits per day (60%), and the majority reported using less than two hours of screen time per day (70%) and obtaining 9 hours of time in bed per night (74%). Much fewer students reported eating 3 servings of vegetables per day (32%), and a minority (11%) reported no daily servings of sugar sweetened beverages. Meeting the AAP recommendations for health behaviors was examined by students' negative affectivity status in unadjusted analyses. Compared to students with low symptoms of depression and anxiety, students with elevated negative affectivity were found to be less likely to meet recommendations for breakfast (57% vs 75%; p=0.002), family dinners (45% vs 59%; p=0.02), and sugar sweetened beverages (6% vs 14%; p=0.02). Furthermore, students with elevated negative affectivity were less likely to meet AAP recommendations for physical activity (41% vs 61%; p=0.002), screen time (58% vs 78%; p<0.001), and sleep (64% vs 80%; p=0.002).

Psychosocial parameters also were examined by students' negative affectivity status (Table 2). Students with elevated depression/anxiety symptoms had lower relationship-based resilience (31.6 vs 32.4; $p=0.03$), total self-efficacy (70.3 vs 86.4; $p<0.0001$), and each subdomain of self-efficacy, including social (25.0 vs 29.0; $p<0.0001$), emotional (21.0 vs 27.7; $p<0.0001$), and academic (24.7 vs 29.5; $p<0.0001$). Lastly, compared to students with low negative affectivity, students who reported elevated negative affectivity perceived significantly higher academic pressure (48.3 vs 36.7; $p<0.0001$).

| | Total Cohort N=285 | Negative Affectivity Status Low Symptoms n=173 | Elevated Symptoms n=112 | p-value |
|------------------------------|-----------------------|---|-------------------------------|---------|
| Psychosocial Characteristics | | | | |
| Symptoms of Anxiety | 18.3 ± 7.9 | 13.3 ± 4.3 | 25.9 ± 5.7 | <0.0001 |
| Symptoms of Depression | 15.7 ± 8.6 | 11.0 ± 5.2 | 23.0 ± 7.6 | <0.0001 |
| Resilience | | | | |
| Total | 75.6 ± 6.9 | 76.0 ± 6.5 | 75.0 ± 7.4 | 0.24 |
| Personal | 43.7 ± 4.5 | 44.0 ± 4.2 | 43.2 ± 4.9 | 0.17 |
| Relationships | 32.1 ± 3.1 | 32.4 ± 2.4 | 31.6 ± 3.8 | 0.03 |
| Academic Pressure | 41.3 ± 13.1 | 36.7 ± 11.4 | 48.3 ± 12.6 | <0.0001 |
| Grit | 2.9 ± 0.5 | 3.0 ± 0.4 | 2.6 ± 0.4 | <0.0001 |
| Self-efficacy | | | | |
| Total | 80.1 ± 15.2 | 86.4 ± 13.6 | 70.3 ± 12.2 | <0.0001 |
| Social | 27.5 ± 6.1 | 29.0 ± 5.6 | 25.0 ± 6.0 | <0.0001 |
| Emotional | 25.1 ± 6.0 | 27.7 ± 5.1 | 21.0 ± 4.8 | <0.0001 |
| Academic | 27.6 ± 6.1 | 29.5 ± 5.7 | 24.7 ± 5.5 | <0.0001 |

Table 2: Psychosocial Characteristics of Middle School Students Stratified by Negative Affectivity Status.

Regression Models: Health Behaviors

To examine predictors of a student's negative affectivity status, multivariable logistic regression analyses were conducted (Table 3). Girls were found to have three times higher odds (OR 3.16; 95% CI 1.78-5.62) of having elevated negative affectivity compared to those with low symptoms for negative affectivity. A student's age, race, or ethnicity were not significantly related to negative affectivity risk. In univariate regression analyses, not meeting AAP recommendations for health behaviors was associated with an increased odds for elevated negative affectivity. Specifically, not consuming breakfast regularly (OR 2.06; 95% CI 1.16-3.66), fewer family meals (OR 2.05; 95% CI 1.19-3.53), daily consumption of sugar sweetened beverages (OR 3.42; 95% CI 1.13-10.36), using two or more hours of electronic devices per day (OR 2.41; 95% CI 1.34-4.34), inactivity (OR 2.02; 95% CI 1.17-3.49), and insufficient sleep (OR 2.87; 95% CI 1.57-5.24) were associated with elevated symptoms for negative mood.

| | | Univariate | Multivariable |
|-----------------------------------|---|-------------------|------------------|
| Model 1: Demographics | Age | 1.06 (0.65-1.73) | |
| | Gender (Ref: Boys) | 3.16 (1.78-5.62) | 3.16 (1.78-5.62) |
| | Race (Ref: White) | 1.02 (0.56-1.87) | |
| | Ethnicity (Ref: Non-Hispanic) | 1.08 (0.53-2.20) | |
| Model 2: Health Behaviors | Eating Behaviors | | |
| | Eat Breakfast (Ref: 5+ days/week) | 2.06 (1.16-3.66) | |
| | Eat Dinner as Family (Ref: 5+ days/week) | 2.05 (1.19-3.53) | 2.11 (1.17-3.83) |
| | Dietary Intake* | | |
| | Sugar-sweetened beverages (Ref: 0 servings/day) | 3.42 (1.13-10.36) | |
| | Fruits (Ref: 3+ servings/day) | 0.99 (0.57-1.72) | |
| | Vegetables (Ref: 3+ servings/day) | 1.19 (0.67-2.14) | |
| | Physical Activity | | |
| | 60 minutes per day (Ref: 5+days/week) | 2.02 (1.17-3.49) | 2.59 (1.40-4.79) |
| | Screen Time | | |
| | (Ref: <2 hours/day) | 2.41 (1.34-4.34) | |
| | Sleep | | |
| (Ref: ≥9 hours/night) | 2.87 (1.57-5.24) | 2.67 (1.37-5.18) | |
| Model 3: Mental Health Parameters | Resilience | | |
| | Total | 0.98 (0.94-1.02) | |
| | Personal | 0.97 (0.91-1.03) | |
| | Relationships | 0.93 (0.85-1.01) | |
| | Academic Pressure | 1.11 (1.07-1.14) | 1.06 (1.02-1.11) |
| | Grit | 0.14 (0.06-0.29) | |
| | Self-efficacy | | |
| | Total | 0.91 (0.88-0.94) | 0.94 (0.91-0.97) |
| | Social | 0.88 (0.83-0.93) | |
| | Emotional | 0.77 (0.71-0.83) | |
| Academic | 0.85 (0.80-0.90) | | |
| Note: Reference category (Ref) | | | |

Table 3: Demographic, Health Behaviors, and Psychosocial Characteristics Associated with Middle School Students’ Risk for Elevated Negative Affectivity.

In a multivariable analysis that included all significant univariate health behavior predictors, the health behavior characteristics that remained uniquely associated with an increased odds of negative affectivity included fewer family meals (OR 2.11; 95% CI 1.17-3.83), not meeting physical activity recommendations (OR 2.59; 95% CI 1.40-4.79), and insufficient sleep (OR 2.67; 95% CI 1.37-5.18).

Regression Models: Psychosocial Characteristics

Lastly, we examined psychosocial parameters that were predictive of students’ risk for elevated negative affectivity. In univariate analyses, reporting higher academic pressure (OR 1.11; 95% CI 1.07-1.14) was predictive of greater odds of elevated depression/anxiety symptoms. On the other hand, higher grit (OR 0.14; 95% CI 0.06-0.29), greater total self-efficacy (OR 0.91; 95% CI 0.88-0.94), and all subdomains of self-efficacy (social: OR 0.88, 95% CI 0.83-0.93; emotional: OR 0.77, 95% CI 0.71-0.83; and academic: OR 0.85, 95% CI 0.80-0.90) were found to be protective and associated with a reduced odds of elevated negative affectivity.

In the multivariable analyses examining all univariate significant psychosocial predictors simultaneously, academic pressure (OR 1.06; 95% CI 1.02-1.11) and total self-efficacy (OR 0.94; 95% CI 0.91-0.97) remained significant predictors of students’ risk for having elevated negative affectivity.

Discussion

More than one-third of students in a public middle school representative of the Western United States reported at least moderate symptoms of depression and anxiety (i.e., negative affectivity). Students with elevated negative affectivity were more often girls and were students who had worse health behaviors including lack of family meals, less physical activity, and insufficient sleep. Furthermore, these students reported greater perceived academic pressure and lower total self-efficacy. These associations could serve to inform future interventions aimed at improving mental health in youth by identifying students that may benefit most from such programs, as opposed to conducting universal programs for all students. By using such strategies, financial resources could be used more efficiently, and the focused attention on these at-risk students could more effectively produce improved results in mental health outcomes.

With respect to demographic characteristics, a substantial amount of literature supports the observation that girls, beginning in early adolescence, start to experience more depression [36-38] and anxiety [39,40] symptoms than boys. This finding is likely due to a complex array of biopsychosocial factors, but partially may be explained by greater stressors and more ineffective coping skills among girls [41]. In addition, our data support prior work showing that minority race and ethnicity are not necessarily associated with increased negative affectivity, specifically for lifetime prevalence [42-44]. However, the available data on minority youth are somewhat limited and demonstrate inconsistencies [37,45,47]. Given the limited representation of racial and ethnic diversity in our sample (82% non-Hispanic, 68% White), it is possible that we did not observe an association due to a lack of diversity. Age was not a predictor of poor mental health for our middle school students. While this finding contradicts prior literature [48], our lack of association between age and mental health was most likely due to the focus on sixth grade students, which limited our age range to 11 to 12 years. Finally, our findings are consistent with prior studies indicating that girls are at a highest risk for negative affectivity at the transition to middle school. The baseline assessment was conducted in January, at the start of the second semester, alluding to the fact that even after a “washout” period of the immediate transition to middle school, girls continue to be more likely than boys to be at risk for negative affectivity beginning in middle school.

Our findings highlight that an array of health behaviors may be novel, modifiable correlates of elevated negative affectivity in early adolescents. For the current sample of middle school students, skipping breakfast, infrequent family mealtimes, consuming sugar sweetened beverages, limited physical activity, excessive screen time, and insufficient sleep all related to greater odds of negative affectivity. When all of these variables were included simultaneously in the same model, only infrequent family meals, physical inactivity, and insufficient sleep remained significantly associated with negative affectivity risk status. Eating dinner as a family has previously been recognized as one family-level component related to youths’ mental wellbeing. For instance, youth who eat dinner with their families five or more times per week are more likely to have better coping strategies [49], fewer depression symptoms [48-50] and a lower likelihood of attempting suicide [6,48,51,52]. It has been theorized that family meals promote ongoing conversations where parents can learn about their children’s lives and develop a line of open communication [52]. Conversely, it also is possible that families who have better communication tend to eat together as a family unit more regularly. There is extensive evidence suggesting that increased physical activity and decreased screen time are associated with mental health during adolescence [13-17]. This association is likely bidirectional, such that increased activity promotes better mood and healthier stress management, and, likewise, higher negative affectivity also likely contributes to withdrawal from physical activities [53-55]. Additionally, sleep qualities are increasingly being recognized as a contributor to adolescent mental health. In the current middle school sample, insufficient sleep (<9 hours per night) was predictive of greater risk of elevated negative affectivity. We previously identified in this same sample that students who participated in Healthy Kids who were getting insufficient sleep (<9 hours per night) did not experience the same intervention effect as those getting sufficient sleep (≥ 9 hours per night) [56]. Observational and experimental studies have shown that short sleep is negatively associated with psychosocial health, including worsening anxiety, depression, and suicidal ideation, during childhood and adolescence [18-24]. Thus, improving sleep health at this young age could be vital in the efforts to lower the risk of mental health symptoms among U.S. youth.

Lastly, we examined psychosocial characteristics that may be predictive of negative affectivity. In our analysis, higher academic pressure, lower grit, and lower self-efficacy were predictive of students reporting elevated symptoms of depression and anxiety. Due to the interrelated nature of each of these variables, we propose a new conceptual model for mental health interventionists to consider when developing prevention strategies to decrease youths’ risk for depression and anxiety (Figure 1). The pathway towards elevated symptoms of depression and anxiety may not be linear, so future research should examine the potentially cyclic relationship between these variables that together lead to negative affectivity using longitudinal study designs. With growing evidence supporting an association between poor sleep and worse mental health outcomes [20-22], sleep needs to be considered as a key target for improving youth mental health and well-being. Insufficient sleep has been documented to lead to maladaptive eating and decreased physical activity [57-59], which in turn have been reported to disrupt circadian rhythm in both adult and pediatric populations [20-22]. Disruption in one’s circadian rhythm has been shown to lead to hormonal and metabolic changes in the brain and a decreased ability to regulate emotions [56,60,61]. Although we did not have a measure in our current study to assess emotional regulation, others have found that a decrease in emotional regulation can lead to lower reported scores of self-efficacy and grit. Upon encountering a stressful event, such as academic pressure in youth, this could lead to increased symptoms of depression and anxiety [18,25,26], contributing to poor sleep and, again, maladaptive eating and decreased physical activity, thereby re-starting the cycle. Interventions need to be designed with this viscous cycle in mind, and strategies must be created that incorporate all of these components in order to most effectively impact mental health in today’s youth.

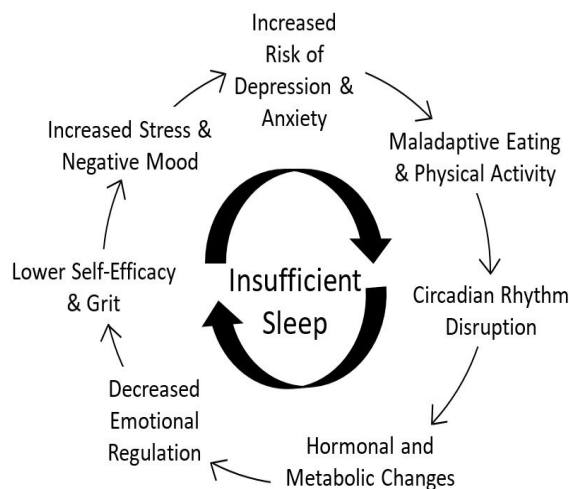


Figure 1: Proposed conceptual framework for the cyclic relationship that stems from insufficient sleep, leading to decreased emotion regulation through hormonal and metabolic changes, to increased negative affectivity and stress, resulting in a risk of exacerbated depression and anxiety symptoms.

Our current study has several strengths; however, it is not without limitations. Regarding strengths, our analysis of health behaviors was based on the AAP guidelines for children and adolescents. These guidelines are considered the gold standard recommendations for pediatricians to prevent obesity and improve overall wellbeing. We also were able to assess a wide range of potential factors associated with anxiety and depression symptoms, including demographic variables, health behaviors, and psychosocial parameters. This provided us with a deeper understanding of which variables may contribute to symptoms of negative mood in youth. However, as this pilot study was conducted in one school and this school was predominately White, middle class families, our findings may not be generalizable to other populations. As we recruit additional schools to examine the efficacy of our intervention, we will have a greater opportunity to address this important question. Timing of year could also play a role in the responses we received regarding negative mood; as we assessed in winter months and with news of a pandemic on the forefront of minds. Although all of our measures have been validated in this population and to be delivered via self-report, self-report measures are limited. Future studies should consider adding objective measures such as having a clinical psychologist further screen students who endorse high symptoms of anxiety or depression. Lastly, there are important confounders that we were not able to collect from students due to the school-based design of our study. Future research programs should consider collecting data on family socio-economic status, parent education, family history of mental health, and student history regarding diagnosis of mental health issues including possible medication or treatment plans.

In conclusion, students who reported elevated negative affectivity were found to have worse health behaviors (lack of family meals, lack of physical activity, poor sleep), lower self-efficacy, and higher academic pressure. When attempting to effectively allocate resources for youth mental health programs, these factors could be easily utilized to recognize who is most likely to have symptoms of depression and anxiety as they can be self-reported. In addition, future mental health interventions should consider targeting health behaviors, including diet, physical activity, and sleep, to prevent and/or treat depression and anxiety symptoms in youth. Considering the increasing number of mental health diagnoses among youth, early identification, and intervention is key.

Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflicts of interest to disclose.

Ethical Approval: The Colorado Multiple Institutional Review Board approved the study and the program is registered at clinicaltrials.gov (NCT04202913). The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed Consent: Informed consent was obtained from all students who participated in the study.

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