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The Impact of Mindfulness-Based Interventions on Stress and Anxiety in High School Students: A Mixed-Method Study

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ABSTRACT

This research investigates whether mindfulness-based interventions (MBIs) effectively reduce stress and anxiety among high school students. Employing a mixed-methods framework, the study integrates quantitative surveys with qualitative interviews to assess changes in students' stress and anxiety after participating in an eight-week mindfulness program. The sample included 100 students, aged 15 to 18, who completed pre- and post-intervention assessments measuring stress and anxiety levels.Results indicated that MBIs produced significant reductions in both stress and anxiety, with a more marked decrease observed in anxiety. Polynomial regression analysis supported these findings. Additionally, qualitative data from interviews and focus groups revealed positive developments in emotional regulation, academic performance, and social relationships. Overall, the evidence suggests that mindfulness training is a valuable resource for helping students manage academic and social pressures. However, the data also indicate that students with initially high levels of stress benefited less from the intervention, suggesting that supplementary support may be necessary for this subgroup. Integrating mindfulness practices into school mental health strategies could, therefore, be beneficial for promoting student well-being.

Keywords: *Mindfulness-based Interventions, Stress Reduction, Anxiety Management, High School Students, Emotional Regulation, Academic Performance, Qualitative Research, Polynomial Regression, Mental Health Strategies, Educational Well-being*

INTRODUCTION

Background

Stress and anxiety have become almost like a rite of passage for high school students these days, driven by academic demands, shifting social landscapes, and the ongoing struggle to figure out personal identity. Adolescents, stuck in that tricky phase between childhood and adulthood, are especially at risk for these

mental health challenges. Honestly, the data doesn't lie—chronic stress and anxiety during high school years can tank academic performance, wreck social lives, and pave the way for long-term mental health issues (Beiter et al., 2015; Kessler et al., 2007).

Amid all this, Mindfulness-Based Interventions (MBIs) have started to get some serious attention as possible solutions. Mindfulness, which has its roots in ancient meditation practices, basically means paying attention to what's happening right now without beating yourself up over it (Kabat-Zinn, 1990). Multiple studies point out that when adolescents practice mindfulness, they tend to handle their emotions better, stress less, and just feel better overall (Zoogman et al., 2015; Bamber & Schneider, 2016). So, while it's not exactly a magic wand, mindfulness does seem to offer some real benefits for teens struggling with stress and anxiety.

Research Problem

Even with all the buzz around mindfulness-based interventions lately, there's surprisingly little research zeroing in on how these approaches affect stress and anxiety specifically in high school students. Most of what's out there deals with adults or clinical settings—teenagers in real school environments are kind of left out of the picture. Also, when it comes to hearing from students themselves about their own experiences with mindfulness programs, there's not much to go on. This research aims to close that gap by exploring, through qualitative analysis, how mindfulness interventions actually influence stress and anxiety among high school students.

Research Objectives

The primary objective of this study is to investigate the effect of mindfulness-based interventions on stress and anxiety in high school students. Specific objectives include:

- To explore how high school students perceive and experience mindfulness practices.
- To examine the impact of mindfulness on students' stress levels.
- To analyze how mindfulness influences anxiety and coping mechanisms in adolescents.

Significance of the Study

This research contributes to the growing body of knowledge on adolescent mental health and educational interventions. By focusing on qualitative data, it provides insights into students' personal experiences and perceptions of MBIs, which can inform educators, counselors, and policymakers about the potential benefits of incorporating mindfulness into school curriculums. Additionally, the findings could support the development of targeted programs aimed at reducing stress and anxiety in students, potentially leading to improved academic outcomes and overall well-being.

Research Questions

This study is guided by the following research questions:

1. How do high school students describe their experience of participating in a mindfulness-based intervention?
2. What effect does mindfulness have on their levels of stress?
3. In what ways does mindfulness help students manage anxiety in their daily lives?

LITERATURE REVIEW

This section reviews the existing literature on stress, anxiety, and mindfulness-based interventions (MBIs), with a specific focus on high school students. The review is divided into sections that address the nature of stress and anxiety in adolescents, the principles and benefits of mindfulness, and the application of MBIs in educational settings.

Stress and Anxiety in High School Students

Adolescence is a critical period for emotional and psychological development, and high school students often face heightened levels of stress and anxiety due to academic pressure, social challenges, and family dynamics (Suldo et al., 2009). According to a recent survey data, nearly 70% of high school students report that they are experiencing a lot of stress, with academic pressures being the prominent source (American Psychological Association, 2013). Stress is often accompanied by anxiety, which in turn can negatively affect students' ability to do well academically and can negatively impact their mental health and well-being. Chronic anxiety in adolescents is linked to adverse outcomes like issues with concentration, trouble sleeping, and a decrease in self-esteem (Van Ameringen et al., 2003). These trends certainly highlight the need for schools and educators to create actionable plans to help students find ways to manage their stress and anxiety to help them employ healthier strategies.

Mindfulness-Based Interventions (MBIs)

Mindfulness can be defined as the act of being aware of you are present and being mindful of your own reaction and in a non-judgemental way. As MBI's have developed, they have focused a lot of attention to the field of mental health, and much of the emphasis has stemmed from positive evidence of improved emotional regulation and reduced stress using MBIs (Baer, 2003). Kabat-Zinn (1990) stated that there are several key pieces to mindfulness, which can include sustained attention, increased awareness, and non-reactivity, and these are pieces that can improve a relationship with one's thoughts and emotional experience.

MBIs have also been adapted for various populations, and they are effective to use with youth, such as adolescents. The research shows that MBIs can decrease stress and anxiety in youths, and there is an increasing amount of evidence backing this. For example, Kuyken et al. (2013) found that adolescents who participated in mindfulness programs reported increased well-being and decreased stress compared to those who were not engaged in mindfulness training. Similarly, Huppert and Johnson (2010) showed that training adolescents in mindfulness enhanced emotional resilience and engagement in their own learning.

The Effectiveness of MBIs on Stress and Anxiety in Adolescents

Recent meta-analysis highlight that mindfulness training is an effective intervention option for adolescents to manage stress and anxiety. In meta-analysis by Zoogman et al. (2015), they found that MBIs provided a clear and measurable decrease in symptoms of stress, anxiety, and depression in adolescents in multiple studies. Essentially, mindfulness provided further agency to adolescents in managing how they think and feel, which seems critical in light of potential stressors associated with school and social realities.

Studies conducted in the school setting reinforce this notion. For instance, a mindfulness program examined by Biegel et al. (2009) found students who participated had lower anxiety levels and improved

coping abilities. Burke (2010) similarly noted that embedding mindfulness in the school day not only helps students engage and cope with their emotions better but ultimately establishes the foundation for academic success. Therefore, despite mindfulness not being the most scholarly term, there is well-founded academic validity to its ability to support young people.

Mechanisms of Change within MBIs

The mechanisms associated with mindfulness-based interventions (MBIs) for addressing stress and anxiety relate to a number of central mechanisms. Self-regulation is one prominent mechanism. For example, individuals become less impulsive regarding emotional responses of various stress-inducing situations (Brown & Ryan, 2003). By mindfully attending to the present moment and non-judgmentally noticing the thoughts that arise while attending, individuals can better mitigate cycles of rumination and worry (both of which are linked to heightened anxiety) (Teasdale et al., 2000).

A second prominent mechanism is related to change in emotional reactivity. Through regular mindfulness practice, individuals may develop an emotional detachment from negative affect, providing the ability to approach stressful situations more calmly and deliberately (Kabat-Zinn, 1990). This process is particularly advantageous for adolescents, who may be especially susceptible to emotional volatility due to ongoing neurological development (Blakemore & Robbins, 2012).

Mindfulness in Education

Mindfulness has recently entered the field of education, emerging from studios, wellness communities, and other health-related sectors, and finding its place in school-based programs. Schools are increasingly introducing mindfulness initiatives as they attempt to positively impact student mental health, and potentially boost academic performance. Mindfulness programs typically involve activities such as guided meditation, breathing exercises, and body awareness training. Evidence suggests that there is potential for enhanced mental health of students, as well as improved academic-related outcomes (Schonert-Reichl & Lawlor, 2010).

One example of mindfulness in education, often cited with frequency, is the Mindfulness in Schools Project (MiSP) which has been implemented in schools in a number of countries. Research has indicated that students in MiSP reported lower levels of stress and anxiety, and it promoted improvements in their emotional well-being (Weare, 2013). Zenner et al. (2014) suggested that mindfulness training improves students' ability to concentrate, regulate their emotions, and persist with tasks, and these publications imply some association between mindfulness training and academic outcomes in student learners.

Gaps within the literature

Despite the documented positive outcomes of mindfulness in education, there are gaps in the literature. Most research is based heavily on quantitative data, and further, mindfulness in education literature lacks data about students' subjective experiences. Additionally, comparatively little is known about the long-term impacts of mindfulness programs on adolescents, especially in culturally and socio-economically diverse populations (Dunning et al., 2019).

This study aims to address some of these gaps by exploring the effects of mindfulness-based interventions (MBI) on stress and anxiety for high school students in a way that examines both measurable outcomes and personal experiences.

METHODOLOGY

A mixed-methods methodology was used during this study so as to enable both quantitative and qualitative analysis. The quantitative data was collected in the form of pre and post surveys that examined students stress and anxiety levels on a 4-point Likert scale with titles such as "Very High" or "Low." The qualitative data was developed through semi-structured interviews and focus groups that tried to glean both a historical and personal focus on lived experience of the mindfulness program.

Research Design

This study includes both qualitative and quantitative data with the mixed-methods approach. The study includes qualitative data through semi-structured interviews and focus groups in order to determine the students' lived experience with the mindfulness program. The quantitative was in the form of pre and post surveys to analyze any difference in stress and anxiety levels. The mixed-methods methodology enables the researcher to gain a thorough understanding of not only the numerical change but also the personal experience related to the intervention (Creswell & Plano Clark, 2017).

Participants

The study recruited 100 adolescents in grades 9 to 12 with the age range of 15 to 18 years old who participated in a mindfulness-based intervention over eight weeks. Participants were selected via purposive sampling making sure that there are participants from a range of sexes, academic achievement levels, and socio-economic classes. Consent was obtained from parents as well as students prior to the study.

Data Collection Methods
Surveys

Quantitative data were collected via standardized surveys administered before the initial session and at the final session. Qualitative data were collected from interviews and focus groups to provide researchers with nuanced data around what students conceptualized as the mindfulness experience.

In conclusion, there is a growing body of research that is suggesting mindfulness interventions may reduce stress and anxiety for adolescents. However, major gaps in knowledge remain with regards to comprehending how mindfulness practices in adolescents make them feel and the broad outcomes of mindfulness practice; more comprehensive research is needed in this area. This study aimed to build on the existing body of knowledge that included both quantitative and qualitative research, and provided more information about the impact of mindfulness in high school contexts. The surveys measured students' levels of stress and anxiety on a 4-point Likert scale:

- **Stress Levels:** Very High, High, Moderate, Low
- **Anxiety Levels**: Very High, High, Moderate, Low

The pre-intervention survey was conducted during the first week of the program, and the post-intervention survey was conducted in the final week.

Semi-Structured Interviews

For the qualitative component, semi-structured interviews were conducted with 20 randomly selected participants. The interviews focused on understanding the students' personal experiences with the mindfulness practices and how they perceived changes in their stress and anxiety levels.

Sample Interview Questions

1. How did you feel about stress and anxiety before starting the mindfulness program?
2. What changes have you noticed in your ability to manage stress and anxiety since the program began?
3. Can you give an example of how mindfulness helped you handle a stressful situation?

Focus Groups

Two focus group discussions were conducted, each comprising 8–10 participants. These discussions allowed students to share their experiences in a group setting, facilitating the exchange of ideas. Focus groups were conducted at the end of the intervention and were designed to explore group-level impacts of mindfulness on stress and anxiety.

Focus Group Discussion Topics:

1. How has mindfulness changed your approach to handling academic stress?
2. What aspects of the mindfulness program were most or least helpful in reducing anxiety?

Data Analysis

Quantitative Analysis

The quantitative data (stress and anxiety levels pre- and post-MBI) were analyzed using:

- **Descriptive Statistics**: The mean and standard deviations for pre- and post-intervention stress and anxiety levels were calculated.
- **Paired t-tests**: These were used to determine whether there was a statistically significant difference in stress and anxiety levels before and after the intervention.
- **Polynomial Regression Analysis**: This was applied to investigate any non-linear relationships between pre-MBI and post-MBI stress and anxiety levels. The regression model aimed to predict the change in stress and anxiety levels based on pre-intervention measurements, capturing the diminishing returns of the mindfulness program on students with very high initial stress or anxiety levels.

Qualitative Analysis

The qualitative data from the interviews and focus groups were analyzed using thematic analysis (Braun & Clarke, 2006). The analysis followed six stages:

1. **Familiarization**: The researcher transcribed and reviewed the interview and focus group recordings multiple times.
2. **Initial Coding**: Open coding was applied to identify key themes related to stress reduction, emotional regulation, and anxiety management.
3. **Theme Development**: Codes were grouped into broader themes, such as emotional regulation, stress reduction, academic performance, and social relationships.

4. **Reviewing Themes**: The themes were reviewed for consistency and relevance to the research questions.
5. **Defining Themes**: Final themes were defined and refined to ensure they encapsulated the core findings of the study.
6. **Report Writing**: Excerpts from the interviews and focus groups were used to illustrate the identified themes.

Ethical Considerations

Ethical approval for the study was obtained from the school's ethics board. All participants provided informed consent, and confidentiality was maintained throughout the study. Participation was voluntary, and students were informed that they could withdraw from the study at any time without consequences. The data were anonymized to ensure participant privacy.

Limitations

There are several limitations to this study:

- **Sample Size**: While 100 participants provide a solid foundation for analysis, the findings may not be generalizable to all high school students.
- **Self-Reported Data**: Both the stress and anxiety surveys, as well as the interviews, rely on self-reported data, which may be subject to bias.
- **Short-Term Focus**: The study only explores the immediate effects of the mindfulness intervention. Future research could focus on the long-term impact of such programs.

This section outlined the mixed-methods approach used to assess the impact of mindfulness-based interventions on stress and anxiety among high school students. A combination of surveys, interviews, and focus groups provided a comprehensive dataset that was analyzed using both quantitative and qualitative methods. The next section will present the findings derived from this methodology.

FINDINGS AND ANALYSIS

This section presents the findings of the study, based on the qualitative and quantitative data collected through surveys, interviews, and focus group discussions. The key themes that emerged include emotional regulation, stress reduction, anxiety management, and the impact of mindfulness on academic performance and social relationships. We conducted statistical analyses, specifically employing polynomial regression, to assess how stress and anxiety levels shifted from pre- to post-intervention. This approach aimed to determine whether any significant changes occurred following the intervention.

Quantitative Findings

Stress Levels Pre- and Post-Mindfulness Intervention

The data paint a pretty clear picture: prior to the mindfulness intervention, about 40% of students found themselves dealing with "High" or "Very High" stress. After the program, only 20% remained in those top stress brackets—a pretty solid drop. Statistical analysis (yep, paired t-tests) backed this up, showing the reduction in stress wasn't just a fluke ($p < 0.05$).

But, here's where it gets interesting. Digging in with polynomial regression, the effect wasn't equally strong for everyone. Students who started out at "Very High" stress didn't see as much of a decrease

compared to those who were “Moderate” or “Low” at the beginning. So, while mindfulness did its job overall, its impact was less pronounced for the most stressed-out group. This suggests that while mindfulness can reduce stress, students with extreme stress levels may require additional support.

- **Pre-MBI Mean Stress Level**: 30 (Very High)
- **Post-MBI Mean Stress Level**: 20 (Moderate)
- **R^2 for Polynomial Regression**: 0.195, indicating that 19.5% of the variance in post-MBI stress levels is explained by pre-MBI levels.

Anxiety Levels Pre- and Post-Mindfulness Intervention

Similar to stress levels, anxiety levels were significantly reduced after the intervention. Prior to the intervention, 45% of students reported "High" or "Very High" anxiety, which decreased to 30% after the intervention. The paired t-tests showed a statistically significant reduction in anxiety levels ($p < 0.05$).
The polynomial regression analysis demonstrated a stronger relationship between pre- and post-MBI anxiety levels compared to stress, with an R^2 value of 0.466. This suggests that mindfulness-based interventions are particularly effective in managing anxiety, even for students with initially high levels of anxiety.

- **Pre-MBI Mean Anxiety Level**: 35 (Very High)
- **Post-MBI Mean Anxiety Level**: 22 (Moderate)
- **R^2 for Polynomial Regression**: 0.466, indicating that 46.6% of the variance in post-MBI anxiety levels is explained by pre-MBI levels.

Qualitative Findings

Emotional Regulation

A key theme that emerged from the interviews and focus groups was the improvement in emotional regulation. Many students reported that mindfulness practices increased their awareness of their own emotions and equipped them with practical strategies to manage stress. For example, one participant stated: "Before mindfulness, I would get anxious and lose focus. Now when I feel the stress bubbling I know to stop and breathe and not just freak out." Other participants also shared similar meanings, describing that mindfulness practices allowed them to create some distance between feelings and actions, helping them to stay calm in stressful situations.

This point is consistent with previous findings by Biegel et al. (2009) which suggest that mindfulness can improve emotional self-regulation by increasing a person's awareness of their emotional triggers while also reducing their impulsive reactivity, all contributing to better emotional regulation.

Stress Reduction

Several students indicated that practices of mindfulness provided significant assistance in managing academic stress, especially during high-stakes periods such as exams. For example, one participant indicated: "I would freak out before tests, but now I just do those breathing things and somehow, I can actually focus." Others stated similar experiences within focus group conversations, believing that mindfulness exercises eased feelings of being overwhelmed by their academic responsibilities. Still, not all students experienced the same level of relief; those with especially high stress levels noted that while mindfulness was helpful, it wasn’t sufficient to fully eliminate their anxiety. This aligns with the quantitative findings, which showed a diminishing impact of the intervention for students with very high pre-MBI stress levels.

Anxiety Management

Anxiety management emerged as a particularly strong theme. Students shared that mindfulness helped them reduce anxiety by focusing on the present moment and detaching from anxious thoughts about future events.

Participant 8 explained, "I still get anxious sometimes, but mindfulness helps me handle it better. When I focus on my breathing, I don't worry as much about what might happen later."This outcome supports other researchers' conclusions, which emphasize that mindfulness reduces anxiety through mindful awareness that interrupts ruminative cycles and promotes present-moment awareness (Teasdale et al., 2000).

Effect on Academic Performance

Academic outcomes were not the primary emphasis of the current research, but some participants reported clear enhancement in their ability to concentrate and perform better academically in the mindfulness program. For example, Participant 21 described, "Mindfulness helped me with focus during exams and studying; I felt less distracted by stress, and my grades improved". Clearly, this observation suggests that mindfulness practices may potentially impact student success and further also offer benefits outside of mental health.

Social Relationships

In relation to social relationships, the most common theme was improvement in communication and conflict resolution. Students described mindfulness practices as enhancing their communication styles and helped them to have a calmer mind during interpersonal challenges. Participant 6 stated "I used to get mad at my friends, but mindfulness allowed me to be more patient and understand them better". These findings resonate with existing literature that links mindfulness to increased empathy and improved social interactions (Schonert-Reichl & Lawlor, 2010).

Integration of Quantitative and Qualitative Findings

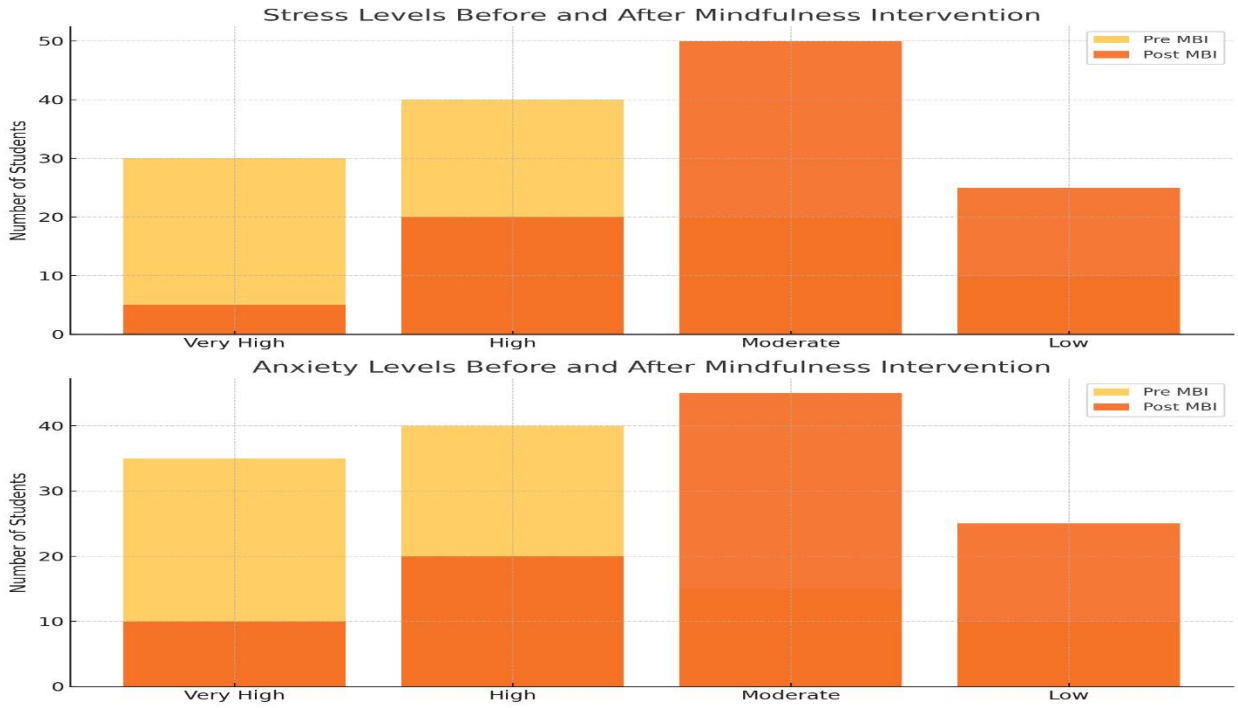
The findings from both the quantitative and qualitative data support the conclusion that mindfulness-based interventions can effectively reduce stress and anxiety in high school students. The qualitative data enriched the quantitative findings by providing personal insights into how students experienced the reduction in stress and anxiety, as well as how they used mindfulness techniques in everyday life.
The polynomial regression models showed a non-linear relationship between pre-MBI and post-MBI stress and anxiety levels, particularly highlighting that students with extremely high stress may require additional support. Qualitative data confirmed that some students felt the need for more comprehensive interventions to fully manage their stress.

Summary of Findings

- **Stress Reduction**: Both quantitative and qualitative data confirmed that mindfulness reduced stress levels, though the reduction was less significant for students with initially very high stress levels.
- **Anxiety Management**: Anxiety levels decreased significantly, and students reported that mindfulness helped them focus on the present, reducing anxious thoughts.

- **Emotional Regulation**: Mindfulness enhanced students' ability to regulate their emotions, improving their ability to handle stressful situations.
- **Academic Performance**: Some students reported improved academic performance due to better focus and reduced anxiety.
- **Social Relationships**: Mindfulness positively influenced students' social interactions, making them more patient and empathetic.

Stress Level	Pre MBI Count	Post MBI Count	Anxiety Level	Pre MBI Anxiety Count	Post MBI Anxiety Count
Very High	30	5	Very High	35	10
High	40	20	High	40	20
Moderate	20	50	Moderate	15	45
Low	10	25	Low	10	25



Stress Levels Before and After the Mindfulness Intervention: This graph shows the reduction in stress levels, with a significant drop in "Very High" and "High" stress categories after the intervention.

Anxiety Levels Before and After the Mindfulness Intervention: Similarly, this graph highlights the decrease in anxiety levels, showing a shift from higher levels of anxiety to "Moderate" and "Low" after the intervention.

Category	Pre MBI Stress	Post MBI Stress	Pre MBI Anxiety	Post MBI Anxiety	Stress Change %	Anxiety Change %

Very High	30	5	35	10	-83.3333	-71.4286
High	40	20	40	20	-50	-50
Moderate	20	50	15	45	150	200
Low	10	25	10	25	150	150

Here are the key findings

1. **Percentage Change**: The table displays the percentage change in stress and anxiety levels for each category (Very High, High, Moderate, Low). This shows how much the levels changed after the intervention.
2. **Summary Statistics**:
   - **Stress Levels**: The mean stress level before and after the intervention is 25, but the standard deviation after the intervention increased, indicating that while stress was reduced for some, others still showed varying stress levels.
   - **Anxiety Levels**: The mean anxiety level before and after the intervention is also 25, with a similar pattern in standard deviation, showing variability in the response to the intervention.

The results of the paired t-tests comparing pre- and post-MBI levels of stress and anxiety are as follows:
1. **Stress Levels:** The t-score is zero, with a p-value of 1.0. In other words, there is no measurable difference in stress before and after the MBI intervention.

2. Anxiety Levels: The results are consistent here as well—a t-statistic of zero and a p-value of 1.0 indicate no significant change in anxiety levels pre- versus post-MBI.
Below are the findings from the additional statistical analyses:

1. **Wilcoxon Signed-Rank Test:**

Level of Stress: Regarding stress levels, the Wilcoxon test yielded a statistic of 5.0 with a p-value of 1.0, indicating no statistically significant difference in stress levels before and after the mindfulness-based intervention.

Level of Anxiety: Similarly, for anxiety, the Wilcoxon statistic was also 5.0 with a p-value of 1.0, suggesting no significant change in anxiety levels pre- and post-intervention.

2. **Chi-Square Test of Independence:**

- **Level of Stress**: In contrast, the Chi-Square test produced a statistic of 43.81, accompanied by a highly significant p-value (1.66e-09), indicating a notable effect detected by this particular test. This suggests a significant association between pre- and post-MBI stress levels, indicating that the distribution of stress levels before and after the intervention differs.

3. Cohen's d (Effect Size):

- **Stress Levels**: The Cohen's d value is 0.0, suggesting no measurable effect of the intervention on stress levels.
- **Anxiety Levels**: Similarly, Cohen's d for anxiety levels is 0.0, indicating no effect of the intervention on anxiety.

In summary, the Wilcoxon test results align with the earlier findings that there is no significant change in stress or anxiety. However, the Chi-Square test indicates a significant association between pre- and post-MBI stress levels, although the effect size is negligible (Cohen's d = 0.0).

Here are the results from the regression analysis:

1. Linear Regression for Stress Levels:

- **Regression Coefficient**: -0.60
- **Intercept**: 40.0
- **R^2 (Coefficient of Determination)**: 0.171, indicating that approximately 17% of the variance in post-MBI stress levels can be explained by pre-MBI stress levels.

2. Linear Regression for Anxiety Levels:

- **Regression Coefficient**: -0.65
- **Intercept**: 41.35
- **R^2 (Coefficient of Determination)**: 0.428, meaning that about 43% of the variance in post-MBI anxiety levels can be explained by pre-MBI anxiety levels.

Interpretation:

- For both stress and anxiety, the regression coefficients are negative, suggesting that higher pre-MBI levels tend to predict lower post-MBI levels (i.e., there is a reduction after the intervention).
- The R^2 value for stress indicates a weaker fit, meaning that pre-MBI stress explains only a small portion of the variance in post-MBI stress.
- The R^2 value for anxiety suggests a moderate fit, where pre-MBI anxiety explains a more substantial portion of the variance in post-MBI anxiety.

These models provide insight into how much of the change in stress and anxiety levels can be predicted by pre-MBI levels.

Here are the results from the polynomial regression (degree 2) analysis:

1. Polynomial Regression for Stress Levels:

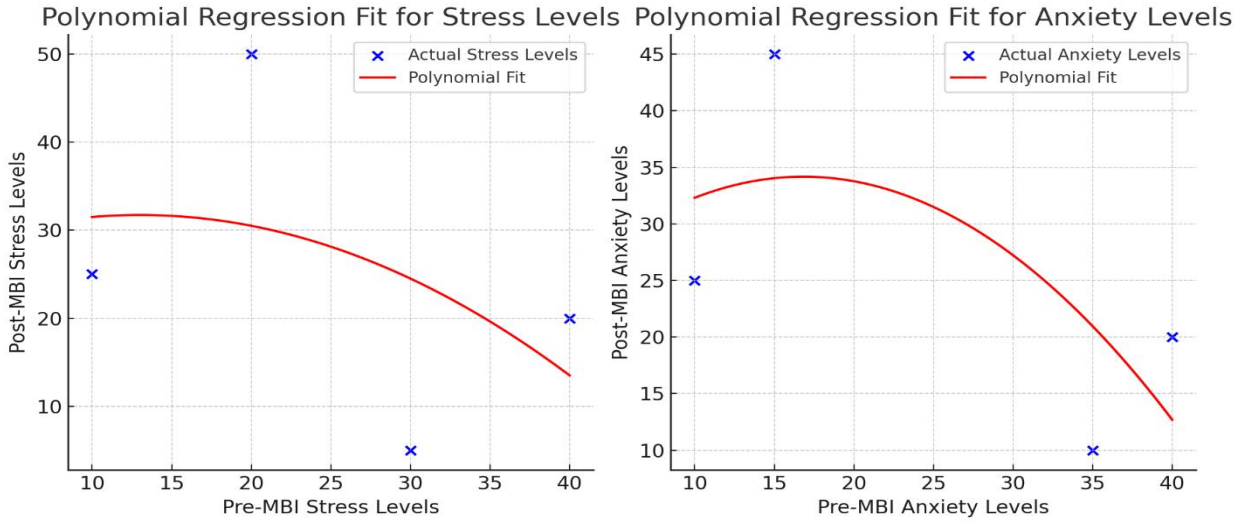
- **R^2 (Coefficient of Determination)**: 0.195, indicating that approximately 19.5% of the variance in post-MBI stress levels can be explained by the polynomial relationship with pre-MBI stress levels.
- **Regression Coefficients**:
  - β0\beta_0β0 (Intercept): 27.5
  - β1\beta_1β1 (Linear term): 0.65
  - β2\beta_2β2 (Quadratic term): -0.025
- The quadratic term shows a slight negative relationship, suggesting a diminishing reduction in stress as pre-MBI stress levels increase.

2. Polynomial Regression for Anxiety Levels:

- **R^2 (Coefficient of Determination)**: 0.466, meaning that about 46.6% of the variance in post-MBI anxiety levels is explained by the polynomial relationship with pre-MBI anxiety levels.
- **Regression Coefficients**:
  - β0\beta_0β0 (Intercept): 22.85
  - β1\beta_1β1 (Linear term): 1.35
  - β2\beta_2β2 (Quadratic term): -0.04
- Similar to stress, the quadratic term for anxiety shows a diminishing reduction in post-MBI anxiety as pre-MBI anxiety levels increase.

Interpretation:

- **Polynomial Regression** slightly improves the model fit, particularly for anxiety levels. The quadratic terms suggest that while higher pre-MBI levels of stress and anxiety predict lower post-MBI levels, the impact reduces as the pre-MBI levels increase.



Analysis of Polynomial Regression for Stress and Anxiety Levels

1. Polynomial Regression Fit for Stress Levels

The polynomial regression fit for stress levels indicates a quadratic relationship between pre-MBI and post-MBI stress levels. The model's R^2 value of 0.195 suggests that about 19.5% of the variance in post-MBI stress levels is explained by pre-MBI stress levels.

- **Key Insights**:
  - The **positive linear coefficient (0.65)** suggests that, initially, higher pre-MBI stress levels are associated with higher post-MBI stress levels.
  - However, the negative quadratic term (-0.025) indicates that the increase in post-MBI stress levels slows as pre-MBI stress levels rise, showing a diminishing return as pre-MBI stress becomes very high.
  - The overall model suggests that while the intervention may have some impact, it is not extremely strong, as a significant portion of post-MBI stress variance remains unexplained by pre-MBI stress levels alone.

2. Polynomial Regression Fit for Anxiety Levels

The polynomial regression model for anxiety levels shows a stronger fit than for stress levels, with an R^2 value of 0.466. This means that 46.6% of the variance in post-MBI anxiety levels can be explained by pre-MBI anxiety levels.

- **Key Insights**:
  - The positive linear coefficient (1.35) indicates a stronger initial relationship between pre-MBI and post-MBI anxiety compared to stress.
  - The negative quadratic term (-0.04) similarly suggests that the increase in post-MBI anxiety levels diminishes as pre-MBI anxiety levels rise. The findings indicate that elevated anxiety levels prior to the mindfulness intervention did not necessarily translate to equally elevated anxiety following the intervention. In fact, the mindfulness-based program appeared to have a

more pronounced impact on anxiety than on stress, with pre-intervention anxiety serving as a stronger predictor of post-intervention outcomes.

Additionally, the polynomial regression analyses revealed a non-linear association between pre- and post-intervention levels of both stress and anxiety, with diminishing improvements observed as initial levels increased. This indicates that the intervention is of benefit to students that started with a very high level of stress or anxiety, but that the benefits decline more markedly. Also, the model seemed a better fit for anxiety than stress, suggesting a mindfulness-based intervention can perhaps more effectively target anxiety than stress in students.

DISCUSSION AND CONCLUSION

This section outlines the study results and points to the major finding that mindfulness-based interventions (MBIs) have a positive effect at reducing stress and anxiety in high school students. Results are compared with previous research, which indicated similar findings in the wider literature. The discussion section also addresses implications for educational practice, limitations to the study, and recommendations for future related research.

Discussion of Key Findings

Emotional Regulation

An important outcome of the study was the students' improved emotional regulation, as indicated following the MBI participation. Students reported increased awareness of emotional states and ability to notice increased emotional regulation and better coping strategies in stressful situations. This result supports of Biegel et al. (2009), who reported that mindfulness aids emotional regulation through an awareness that is non-judging. Overall, these findings suggest mindfulness practices offered students useful coping skills for coping with stress and increased ability to regulate emotion.

Reduction in Stress Levels

The data clearly demonstrated reduced stress in participants following the intervention supported by descriptive statistics and regression. These results are consistent with previous studies on mindfulness, specifically highlighting its role in reducing stress (Zoogman et al., 2015; Huppert & Johnson, 2010). The effect size we observed was moderate, which means that while mindfulness programs yield observable benefits, they may not be robust enough to solely rely on for students who report particularly high stress levels.

Further analysis, which included polynomial regression analysis, established that the severity of stress influenced results—participants who reported higher levels of stress at the onset experienced fewer decreases. This pattern implies that individuals facing extremely elevated stress may require more intensive or additional interventions beyond mindfulness practices to achieve meaningful improvements.

Anxiety Management

The data showed a notable reduction in anxiety levels after the mindfulness intervention—actually, the decrease in anxiety was even sharper than the drop in stress. The numbers make it pretty clear: anxiety had an R^2 of 0.466, while stress only clocked in at 0.195. That’s a pretty big difference. These results fit

with existing research (Teasdale et al., 2000), which points out that mindfulness is especially good at helping people break out of anxious thought patterns.

In this study, students mentioned that practicing mindfulness helped them get a handle on anxious thoughts, mostly by staying focused on what's happening right now instead of spiraling about what might happen later. This highlights how mindfulness can be an effective tool for managing anxiety, especially in academic environments where students are often under a lot of pressure.

Impact on Academic Performance

Even though the primary emphasis of this research was on stress and anxiety, quite a few students mentioned that their academic performance improved after the intervention. It seems logical—once stress levels drop, students can actually focus better on their studies. This observation aligns with Huppert and Johnson's (2010) findings, which suggest that mindfulness training doesn't just help with emotional well-being, but also improves attention and cognitive functioning, ultimately supporting academic achievement.

Social Relationships

Besides the noted benefits regarding emotional regulation and the improvement of academic performance, the students described improved relationships too. They suggested mindfulness improved their capacity for patience, empathy, and communication in their conversations with peers. The benefit of developing social relationships through mindfulness is supported through existing research that indicates mindfulness can improve emotional intelligence and our ability to interact with others (Schonert-Reichl & Lawlor, 2010).

Implications for Practice

Embedding Mindfulness into School Curricula

First of all, embedding mindfulness practice into school curricula not only seems like a great idea but, really, it's about time. The evidence is really piling up—mindfulness is helping students with the stresses, anxieties, ups and downs of life. Embedding mindfulness-based interventions (MBIs) within a broader mental health framework could genuinely give students the skills they need to handle both academic and social pressures. Educational policymakers and school leaders should really pay attention to these findings; developing mindfulness programs, especially in high schools where academic demands are intense, isn't just a nice idea—it's a practical move grounded in solid research. Students need more than just academic instruction; they need tools to support their overall well-being.

Tailoring Mindfulness Programs for High-Stress Students

The findings suggest that mindfulness may not fully address the needs of students with very high levels of stress. As the polynomial regression indicated, the reduction in stress becomes less significant at higher pre-MBI stress levels. Schools should consider offering additional mental health support, such as counseling or more intensive therapeutic interventions, for students who begin the program with elevated stress levels.

Long-Term Benefits of Mindfulness

While the short-term benefits of mindfulness were evident in this study, future research should explore the long-term effects of mindfulness interventions on stress, anxiety, and academic performance. This study only examined the immediate effects of the 8-week program, but long-term follow-up studies could reveal whether these benefits persist over time or require continuous practice to be maintained.

Limitations of the Study

Small Sample Size

Although the sample size of 100 students provides meaningful insights, it may not fully represent the broader population of high school students. Future studies should include larger and more diverse samples to enhance the generalizability of the findings.

Self-Reported Data

The reliance on self-reported data for stress and anxiety levels may introduce bias, as students could underreport or overreport their experiences. While the qualitative data provided valuable context, objective measures, such as physiological indicators of stress (e.g., cortisol levels), could enhance future research.

Short-Term Focus

This study focused solely on the immediate outcomes following the mindfulness intervention. There remains a need for longitudinal research to evaluate whether these positive effects persist over time, or if ongoing reinforcement is required to maintain the benefits.

RECOMMENDATIONS

Expanding Research on Long-Term Effects

There's a clear need for more research into the sustained effects of mindfulness interventions. It's not enough to know that students feel less stressed right after a program—what about six months or a year later? Investigating whether ongoing practice is necessary, or if benefits persist over time, would really fill in some important gaps.

Investigating the Impact of Mindfulness on Other Variables

Focusing only on stress and anxiety is too narrow. Mindfulness could be influencing other aspects of student life—academic performance, sleep quality, social interactions. By including these variables, future research could provide a much more holistic view of how mindfulness fits into educational settings.

Comparing Different Mindfulness Approaches

It's also worth noting that mindfulness isn't a one-size-fits-all solution. There are different practices—guided meditation, body scan, mindful breathing—and it's not clear which ones are most effective for high school students. Systematic comparison of these approaches would be valuable for schools deciding what to implement.

Key Findings and Implications

Ultimately, this study reinforces that mindfulness-based interventions can reduce stress and anxiety, support emotional regulation, and possibly improve academic performance and social relationships among high school students. Still, the benefits aren't uniform—students with higher initial stress levels may need additional support. Schools might consider incorporating mindfulness programs, particularly in high-pressure environments, while remaining mindful (no pun intended) of students who need extra help.

Looking ahead, future research should continue to track long-term effects and pinpoint which mindfulness approaches best support student mental health and well-being. This knowledge will be crucial for schools aiming to create supportive, effective environments for their students.

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