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# Reducing Adolescent Anxiety Using a Spiritually Integrated Mobile Health Intervention: A Quasi-Experimental Study

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**ABSTRACT**

**Introduction:** Anxiety is a prevalent psychological issue among adolescents, which, if not properly managed, can negatively impact their mental well-being. This study aims to assess the impact of the Go-Soul application on adolescent anxiety levels, providing an alternative intervention that incorporates spirituality.
**Methods:** A quasi-experimental study with a non-equivalent control group design was conducted. The study involved 50 participants from SMP Muhammadiyah Kasihan, Bantul Regency, Yogyakarta. Participants were assigned to either an intervention group using the Go-Soul application or a control group without intervention. The Taylor Manifest Anxiety Scale (T-MAS) was used to measure anxiety levels before and after the intervention. Data were analyzed using the Wilcoxon Signed Rank Test.
**Results:** Pre-test results indicated that 68% of participants in the intervention group and 64% in the control group exhibited high anxiety levels. After the intervention, 56% of the intervention group displayed moderate anxiety, demonstrating a significant reduction ($p = 0.014$), whereas the control group showed no significant change ($p = 0.564$).
**Conclusion:** The Go-Soul application effectively reduces adolescent anxiety levels. Spiritual interventions delivered through digital platforms can serve as a promising strategy to improve adolescent mental health. More broadly, the integration of culturally grounded elements—such as Qur'anic recitation in this context—demonstrates how digital mental health tools can be tailored to align with local values, beliefs, and practices. Such culturally sensitive approaches not only enhance user engagement and acceptability but also expand the relevance and impact of digital health innovations in diverse populations.

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## INTRODUCTION

Adolescence, derived from the Latin word meaning "to grow up," is a transitional phase from childhood to adulthood, marked by significant physical, cognitive, and emotional development (1,2). According to the World Health Organization, adolescents are individuals aged 10 to 19 years (3). This period plays a crucial role in identity formation and emotional regulation, impacting various aspects of adolescent life (4–6). However, adolescents are particularly vulnerable to emotional disturbances such as anxiety, which can compromise psychological functioning when not properly managed (7).

Anxiety is an emotional response to real or perceived threats and may manifest adaptively through problem-solving or maladaptively through avoidance or withdrawal (8–10). Common physical symptoms include increased heart rate, frequent urination, excessive sweating, and restlessness (11). Globally, anxiety disorders affect an estimated 264 million people and are ranked as the sixth largest contributor to disability. In Southeast Asia, approximately 60.4 million individuals are affected, while in Indonesia, anxiety disorders impact more than 81 million people, or 3.3% of the population (11). Beyond these figures, cross-national research highlights important variations in prevalence and intervention approaches.

Adolescents with persistent anxiety may experience sleep disturbances, academic challenges, and emotional dysregulation (12–16). Cahyani and Putri (17) found that anxiety negatively affects social relationships, immune function, and multiple physiological systems. These effects not only reduce quality of life but also strain family and social support systems (18). Mental health, as defined by WHO, includes psychological and social well-being, not merely the absence of illness (19). Multiple factors influence adolescent anxiety, including family dynamics, academic stress, peer relationships, and biological predispositions (17).

Among various protective factors, spirituality has been shown to enhance resilience and emotional well-being (20,21). It promotes a sense of purpose, optimism, and adaptive coping strategies (22). In the digital era, mobile technology presents a promising platform for mental health promotion, particularly among adolescents (23,24). Android-based applications offer flexibility, accessibility, and user-driven engagement, making them suitable for large-scale interventions (25–27). In response to this, the Android-based app Spiritual Guardian of Your Soul (Go-Soul) was developed. Integrating spiritual content and interactive features, Go-Soul aims to address adolescent anxiety by combining the benefits of spirituality and digital technology in a culturally relevant format.

## METHOD

### Study Design

This study adopted a quasi-experimental design with a non-equivalent control group to evaluate the impact of the Android-based spiritual application, Guardian of Your Soul (Go-Soul), on anxiety levels among adolescents. The participants were divided into two groups: the intervention group, which used the Go-Soul application, and the control group, which did not receive any intervention.

### Participants and Sampling

The study was conducted at Muhammadiyah Kasihan Junior High School, Bantul Regency, Yogyakarta, Indonesia. Participants were selected using purposive sampling. The inclusion criteria were as follows: students in the seventh grade, aged between 12 and 14 years, Muslim, owners of an Android smartphone with at least version 6.0 and a minimum of 500 MB of free storage, able to operate the smartphone independently, and willing to participate by providing informed consent (supplemented by parental or guardian authorization). Participants were excluded if they had a history of mental disorders or substance abuse, or if they did not complete the intervention. In total, 50 students met the eligibility criteria and were assigned to either the intervention group or the control group, with 25 students in each.

### Intervention

Participants in the intervention group were instructed to use the Go-Soul application, which was developed by the researcher to enhance spiritual awareness through daily Qur'anic recitation and audiovisual engagement. The app included selected verses of the Qur'an chosen for their relevance to themes such as peace, hope, forgiveness, and divine compassion. These verses were reviewed by Islamic scholars to ensure their spiritual and semantic

appropriateness. Each verse was accompanied by murrotal audio recordings by Sheikh Mishary Rashid Al-Afasy, known for his clear pronunciation and emotionally expressive tone. The application also featured supporting visuals, including thematically relevant backgrounds and text, designed using CorelDRAW. The integration of audio, Arabic script, and translation was completed using Adobe Premiere. The app was designed for offline use and tested on Android devices with minimum specifications of version 6.0 and at least 500 MB of free space.

The Go-Soul application offered ten daily sessions, each consisting of 17 to 19 Qur'anic verses and lasting approximately nine minutes. To ensure proper use and adherence, participants were required to access the app daily for ten consecutive days. Each session had to be played at least three times before the next session could be unlocked. A scoring system was embedded in the app, requiring a minimum total score of 537 to be classified as compliant. Participants who failed to meet the usage criteria were considered dropouts and excluded from further analysis. A user guide was provided at the beginning of the intervention to help participants understand how to use the application correctly.

**Data Collection and Measurements**

Anxiety levels were measured using the Taylor Manifest Anxiety Scale (T-MAS), which includes 50 yes-or-no statements. Based on the total scores, anxiety levels were categorized into three groups: mild anxiety for scores below 7, moderate anxiety for scores between 7 and 21, and high anxiety for scores above 21. To evaluate the effectiveness of the Go-Soul application in reducing adolescent anxiety, the Wilcoxon Signed-Rank Test was employed to compare pre- and post-intervention scores. In addition to significance testing, an effect size analysis was conducted using the formula $r = Z / \sqrt{N}$, based on the obtained Z-value and sample size, to assess the magnitude of the intervention's impact.

**Data Analysis**

The collected data were analyzed using univariate analysis to describe participant characteristics and bivariate analysis using the Wilcoxon Signed Rank Test to assess the effectiveness of the intervention. Homogeneity testing was also conducted using ANOVA to ensure that the variances between the groups were equal. A p-value of less than 0.05 was considered statistically significant.

**Ethical Approval**

Ethical approval for this study was granted by the Health Research Ethics Committee (KEPK) of the Faculty of Medicine and Health Sciences at Universitas Muhammadiyah Yogyakarta, with reference number 190/EC-KEPK FKIK UMY/IX/2019. All participants provided.

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## RESULTS

This study involved 50 participants, randomly divided into intervention and control groups, each with 25 individuals. Most participants in both groups were 13 years old—64% in the intervention group and 60% in the control group. Female participants were the majority in both groups, with 64% in the intervention group and 68% in the control group.

**Table 1.** Distribution of Characteristics Subject

| Characteristics | | Intervention Group | | Control Group | |
|---|---|---|---|---|---|
| | | n | % | n | % |
| Age | 12 years | 6 | 24 | 3 | 12 |
| | 13 years | 16 | 64 | 15 | 60 |
| | 14 years | 3 | 12 | 7 | 28 |
| | Total | 25 | 100 | 25 | 100 |
| Gender | Male | 9 | 36 | 8 | 32 |
| | Female | 16 | 64 | 17 | 68 |
| | Total | 25 | 100 | 25 | 100 |

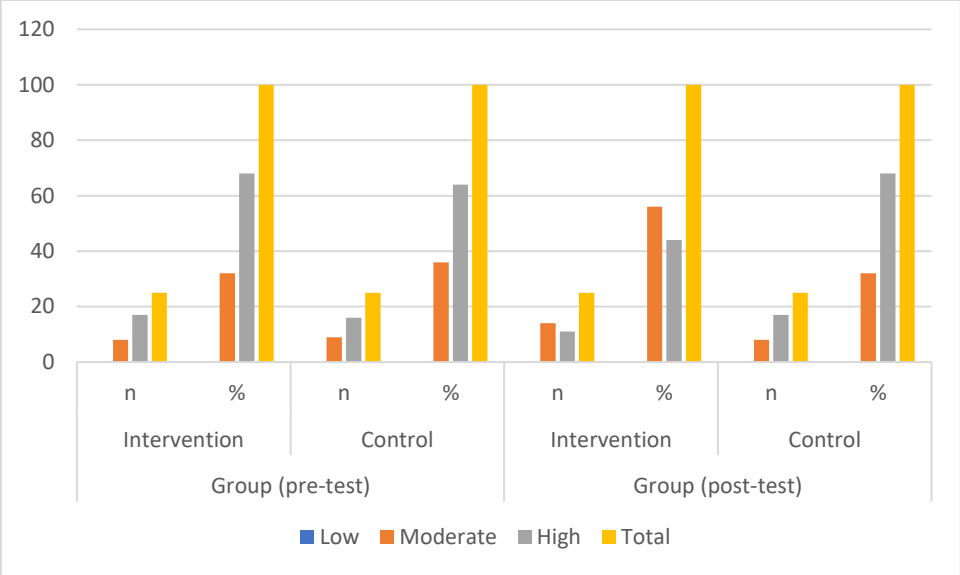


**Diagram 1.** Subjects' Anxiety Level Before Intervention (pre-test) and after intervention (post-test)

Diagram 1 showed that prior to the intervention (pre-test), the majority of respondents in both the intervention and control groups exhibited high anxiety levels. In the intervention group, 68% (17 individuals) were categorized as having high anxiety, while 64% (16 individuals) in the control group also fell into the same category. To assess whether the two groups had comparable baseline characteristics, a homogeneity test was conducted using ANOVA. The result showed a significance value of 0.910, indicating that the data were homogeneous, as the p-value exceeded 0.05. Following the intervention (post-test), a shift in anxiety levels was observed, particularly in the intervention group. The proportion of participants in the intervention group with moderate anxiety increased to 56% (14 individuals), suggesting a reduction in anxiety severity. Conversely, the control group continued to exhibit high anxiety levels, with 68% (17 individuals) remaining in the high category. These findings suggest a potential effect of the intervention, as further analysed and presented in Table 2.

**Table 2.** Influence of the Go-Soul Spiritual Application on Anxiety Levels

| Group | Anxiety Level | Pre-test | | Post-test | | *p |
|---|---|---|---|---|---|---|
| | | n | % | n | % | |
| Intervention | Low | 0 | 0 | 0 | 0 | 0,014 |
| | Moderate | 8 | 32 | 14 | 56 | |
| | High | 17 | 68 | 11 | 44 | |
| Control | Low | 0 | 0 | 0 | 0 | 0,564 |
| | Moderate | 9 | 36 | 8 | 32 | |
| | High | 16 | 64 | 17 | 68 | |

*The analysis utilized the Wilcoxon test (significance $p<0.05$).

According to the results in table 2, anxiety levels in the intervention group decreased after using the Go-Soul application. Before the intervention, 68% (17 individuals) had high anxiety, while after the intervention, 56% (14 individuals) showed moderate anxiety. This indicates a reduction in anxiety levels. In contrast, the control group showed no improvement. The proportion of participants with high anxiety increased from 64% (16 individuals) in the pre-test to 68% (17 individuals) in the post-test. The Wilcoxon Signed Ranks Test showed a significant difference

in anxiety levels in the intervention group ($p = 0.014$, $p < 0.05$), but no significant change in the control group ($p = 0.564$, $p > 0.05$). These findings suggest that the intervention effectively reduced anxiety.

To complement the significance testing, an effect size analysis was conducted to evaluate the magnitude of the Go-Soul application's impact on adolescent anxiety levels. The effect size was calculated using the Z-value obtained from the Wilcoxon Signed-Rank Test ($Z = -2.449$) and the sample size of the intervention group ($N = 25$). The effect size (r) was computed using the formula $r = Z / \sqrt{N}$, resulting in $r = 2.449 / \sqrt{25} = 0.49$. According to Cohen's criteria (1988), this value represents a large effect size. A considerable effect size in an applied context indicates that the observed decrease in anxiety is both statistically significant and practically meaningful. The intervention significantly enhances teenagers' emotional well-being, underscoring the potential effectiveness of spiritual, Android-based applications as accessible and impactful tools for anxiety management. This suggests that the spiritual Android-based application had a strong and impactful role in improving the emotional well-being of adolescents.

## DISCUSSION

The findings of this study indicate that adolescents aged 12 to 14 experienced high levels of anxiety before the intervention, with scores ranging from 22 to 50. These scores reflect a clinically significant level of anxiety, which manifested through a constellation of symptoms including excessive worry, poor concentration, feelings of worthlessness, insomnia, palpitations, excessive sweating, and muscle tension. These symptoms align closely with the diagnostic criteria for generalized anxiety disorder as outlined by the National Alliance on Mental Illness (28), affirming the validity of the self-reported anxiety experiences among the participants.

From a theoretical standpoint, the anxiety responses observed in this age group can be further understood through the multidimensional framework proposed by Chand & Marwaha (29) who conceptualized anxiety symptoms within three primary domains: behavioral, cognitive, and emotional. In our findings, these domains were not only identifiable but also interrelated. For instance, behavioral symptoms such as restlessness and avoidance of social interaction were often accompanied by cognitive symptoms like persistent rumination and diminished academic concentration, suggesting that maladaptive thought patterns may reinforce avoidant behaviors. Similarly, participants who reported emotional symptoms such as persistent fear and irritability frequently demonstrated parallel behavioral withdrawal, underscoring the reciprocal relationship between affective distress and social disengagement. By mapping the observed symptoms onto this tripartite framework, the analysis underscores how adolescent anxiety manifests as a constellation of interconnected behavioral, cognitive, and emotional processes, providing a more rigorous and nuanced understanding of its complexity during this transitional developmental stage.

Furthermore, the role of both physical and psychological components in influencing anxiety severity, as emphasized by Mendoza et al. (30) provides additional context to these findings. The frequent reports of somatic symptoms such as muscle tension, insomnia, and palpitations among participants suggest that physical manifestations of anxiety are deeply intertwined with mental distress in adolescents. This reinforces the argument that interventions targeting adolescent anxiety must adopt an integrated approach, addressing not only cognitive and emotional factors but also physiological responses to stress.

Taken together, the findings support existing literature on adolescent anxiety and underscore the necessity for early, multidimensional intervention strategies. The use of a spiritual, Android-based mobile application in this study represents a novel approach that could align with adolescents' technological preferences while potentially engaging the emotional and cognitive domains implicated in anxiety, a point further elaborated in the subsequent section on post-intervention outcomes.

Age and gender were notable factors influencing anxiety levels. Adolescents aged 13 showed the highest anxiety across both groups, supporting Kaplan & Sadock (31) view that early adolescents are more susceptible to anxiety due to emotional and developmental transitions. Similarly, Suyamti & Hastuti (32) reported that 73.8% of adolescents aged 12–14 experienced significant anxiety symptoms. This stage coincides with identity formation and evolving self-concept, which plays a key role in how adolescents process stress and regulate emotions (33,34).

Gender-based differences were evident, with female students displaying higher anxiety levels. This aligns with Nur Irmayanti et al. (35), who reported that women are twice as likely to suffer from anxiety compared to men. Emotional responsiveness in females tends to heighten vulnerability to stress Stuart et al. (36), and physiological

changes during puberty, such as fluctuating estrogen and low progesterone levels are linked to increased anxiety symptoms including mood swings, palpitations, and digestive issues (37,38).

After using the Go-Soul application, participants in the intervention group showed a notable reduction in anxiety levels. As mentioned by Merve Dilgul (39), virtual reality–based treatment can alleviate anxiety, a finding consistent with Babaii et al. (40), who reported that Qur'anic recitation reduced anxiety in patients undergoing medical procedures. The rhythmic murrotal sound embedded in Go-Soul functioned as a form of spiritual and auditory therapy, stimulating neurochemical pathways associated with decreased cortisol levels and increased endorphin release, thereby fostering calmness and physical relaxation (41–43). In addition, murrotal has been shown to activate alpha brain waves and regulate emotional centers such as the amygdala and hypothalamus (44–48).

Beyond physiological benefits, Qur'anic recitation supports emotional resilience and spiritual well-being. Listening to and reflecting on the Qur'an helps adolescents develop a sense of trust in God, optimism, and coping capacity (41,49,50). These outcomes align with Adami Adami & Sulisyorini (51), who found that spiritual individuals tend to have stronger problem-solving abilities. The digital format of Go-Soul fits the growing trend of mobile health (mHealth) tools. Keles et al. (52) emphasized that digital interventions with interactive features improve anxiety outcomes. Go-Soul meets this criterion while also addressing cultural and religious needs, as suggested by De Diego-Cordero et al. (22). This study supports Sulmasy (53) bio-psycho-social-spiritual model and contributes to evidence showing that spiritually integrated mHealth interventions improve emotional well-being, particularly among adolescents in religious communities (20).

The effectiveness of the Go-Soul application in reducing adolescent anxiety can be explained not only through spiritual and psychological perspectives but also through a robust biological framework. Psychologically, spirituality enhances adaptive coping and helps individuals find meaning in life events. This, in turn, reinforces psychological resilience and mitigates emotional distress. De Diego-Cordero et al. (22) reported that individuals with higher spirituality levels tend to experience less anxiety due to strong value systems and a greater sense of control over stressful situations. Spirituality also fosters a sense of coherence, a belief that life is meaningful, comprehensible, and manageable. This belief reduces maladaptive anxiety responses by promoting a positive perception of stressors. This belief also improves emotional well-being and reduce the psychosomatic symptoms of mental health patient undergoing treatment. Spiritual practices integrated in Go-Soul, such as Qur'anic recitation and reflection, create meditative and calming experiences that facilitate emotional regulation and psychological detachment from distressing thoughts.

Biologically, spiritual practices influence the autonomic nervous system and neuroendocrine pathways. Listening to Qur'anic murrotal and engaging in spiritual contemplation has been shown to elevate alpha brain waves, which are associated with relaxation, and to reduce amygdala activation and cortisol levels, key indicators of physiological stress (41–43). Furthermore, regular spiritual engagement can enhance activity in the prefrontal cortex, responsible for emotional regulation, decision-making, and impulse control and promote neuroplasticity, which supports psychological flexibility. Thus, spiritual approaches have both subjective emotional and objective physiological effects that help reduce anxiety.

Adolescent anxiety closely intertwined with cognitive emotional processing and self-concept which make adolescent have a distorted view of how others are perceiving them and a decline in their academic performance (54). Go-Soul provides spiritual engagement that may help enhance resilience and reducing anxiety by shifting the adolescent focus from external a valuation to inner spiritual grounding. Go-Soul integrates spirituality into digital interventions which in accordance with Indonesia's society where religiosity is high. Go-Soul reflects the user's religious beliefs, therefore it increase receptivity and reduce the stigma, especially among adolescent. Compared to conventional therapy, Go-Soul offers a novel, acceptable, and accessible alternative.

Recent studies also suggest that digital spiritual interventions, such as Go-Soul, may modulate gene expression by upregulating immune-regulatory genes and downregulating pro-inflammatory markers typically elevated in chronic stress. Mobile applications designed for mental health, such as Go-Soul, which combine with user engagement strategies and behavior changes technique, have a moderate to high efficacy in reducing anxiety symptoms (52). Consequently, spiritually-integrated digital tools like Go-Soul offer holistic benefits for both mental and physical health.

This study has several limitations that should be acknowledged. The sample was limited to adolescents aged 12 to 14 from a single cultural and religious context, which may limit generalizability of the findings to broader populations. Additionally, the use of self-report measured anxiety measures may be influenced by individual interpretation, recall bias, or social desirability, potentially affecting the accuracy of the data. The absence of physiological or behavioral assessments restricts a more comprehensive understanding of the participants' anxiety levels. Furthermore, the study did not include a follow-up period, so it remains unclear whether the positive effects of the Go-Soul application are sustainable over time.

Future studies should consider implementing a longitudinal design with multiple follow-up assessments to evaluate long-term effects. Expanding the research to include diverse cultural, religious, and geographic backgrounds will improve generalizability and help adapt the intervention for various populations. Researchers are also encouraged to examine which specific features of the Go-Soul application such as the murrotal audio or interactive elements have the greatest therapeutic impact. Including physiological measures such as heart rate variability or cortisol levels could offer a more objective assessment of anxiety reduction. Lastly, future work should explore how gender, spiritual orientation, and digital literacy may influence engagement with the application and shape its effectiveness.

The effect size analysis revealed a value of r=0.490r, which corresponds to a large effect according to Cohen's guidelines. This finding suggests that the Go-Soul application did not merely produce statistically significant outcomes, but also had a practically meaningful impact on adolescent anxiety. In psychological interventions, a large effect size denotes a substantial change in behavior or emotional state, indicating that the magnitude of the intervention's benefit is both observable and relevant in real-world settings. Given the short intervention period (10 days), this effect size further underscores the strength and efficiency of spiritually integrated digital tools in modulating emotional states such as anxiety. It also supports the feasibility of incorporating culturally relevant spiritual components into mobile health applications to enhance engagement and therapeutic outcomes. Thus, the Go-Soul application can be considered not only statistically effective but also clinically promising for anxiety reduction among adolescents.

## CONCLUSION

The study demonstrates that the Android-based spiritual application, Go-Soul, significantly reduces anxiety levels among adolescents. Compared to the control group, participants who engaged with the application exhibited a marked improvement in anxiety scores, highlighting the app's potential as a spiritually-based digital intervention. Integrating spirituality into accessible, adolescent-friendly mobile platforms represents a promising avenue for mental health promotion. We recommend the development and dissemination of similar applications tailored to the needs and characteristics of adolescents to support emotional regulation and psychological resilience.

## AUTHOR'S CONTRIBUTION STATEMENT

All authors have the same contribution

## CONFLICTS OF INTEREST

All authors declare no conflict of interest.

## DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

AI tools have been employed to support language refinement of the manuscript.

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