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Effectiveness of a CERDAS App-Based Peer-Counselor Intervention in Improving Adolescent Mental Health: A Randomized Controlled Trial

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Abstract: *Mental health problems in adolescents continue to increase, while interest in seeking professional help remains low due to stigma, limited access, and low openness to guidance and counseling teachers. This condition indicates the need for a more appropriate approach for adolescents, such as peer counselors who are considered more equal, safe, and able to encourage openness. To support this, the CERDAS application was developed as a peer counseling medium that facilitates initial screening and provides promotive-preventive intervention techniques to improve adolescent mental health. The purpose of this study was to identify the effectiveness of the use of the CERDAS application, which utilizes a peer-counselor approach, in improving adolescent mental health status. The research design was an experiment with a pre- and post-test control group design. The population in this study were all second-grade students at MAN 3 Banda Aceh City and SMAN 13 Banda Aceh City. Sampling was taken by simple random sampling with a sample of 116 respondents, then divided into two groups: a control group of 58 respondents and an intervention group of 58 respondents. The intervention will be provided by peer counselors who have received counseling training and are not included in the study respondents. Meanwhile, the control group only received counseling services from the guidance counselor. Pre-tests and post-tests were conducted on both groups to identify the mental health status of adolescents. Data analysis using Mann-whitney u tests showed that there were differences score in the mental status of adolescents in the control group and the intervention group before and after the intervention. The results of the study found that the CERDAS application with a peer-counselor approach was effective in improving the mental health status of adolescents including anxiety, stress, and depression (p-value 0.001; 0.021; 0.014). It is hoped that the CERDAS application can be implemented more widely in school health services as a promotional and preventive effort for adolescent mental health.*

Keywords: Adolescents; Cerdas app; digital intervention; mental health; peer-counselor

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INTRODUCTION

The World Health Organisation (WHO) defines adolescents as individuals aged 10-19 years. At this time, it is often considered a critical period of development for adolescents, encompassing various developments including hormonal, physical, psychological, and social (Adhyka et al., 2023). Adolescents face various pressures, life demands, and dilemmas during the transition phase of their development. The demands of life that lead to excessive stress will affect poor mental health disorders (Nurnitasari & Haromaini, 2021). Therefore, the challenging and stressful period of adolescence makes teenagers more vulnerable to mental health disorders (World Health Organization, 2021). Stress among secondary school-aged adolescents has emerged as a significant mental health concern. A study conducted by Anjum et al., (2022) found that 73.5% of junior and senior high school students aged 12–

17 years experienced stress-related problems, suggesting that stress is highly prevalent among adolescents and warrants greater attention. Center for Reproductive Health et al., (2022) reported that one-third of Indonesian adolescents experienced symptoms of mental health conditions, with anxiety and depression accounting for approximately 32% of cases.

Mental and physical health stability are interconnected. Mental health is very important for supporting productivity and the quality of physical health. If mental health is impaired, it will make life less comfortable, such as by being easily stressed, tired, and bored (Rahmawaty et al., 2022). Mental health encompasses a good emotional, psychological, and social balance that can affect a person's feelings, thinking patterns, and behaviour or actions. Adolescents with mental health conditions often face difficulties in accessing the support they need, partly due to the persistent stigma and taboo surrounding mental health issues in Indonesian society (Putri et al., 2021). Center for Reproductive Health et al., (2022) reported that approximately one-third of adolescents experienced psychological distress, yet only about 2% sought or utilized mental health support services. These findings indicate that a substantial proportion of adolescents have not received adequate support or intervention for their mental health concerns. Therefore, a comprehensive understanding of adolescents' mental health support needs is essential for developing effective and accessible mental health services.

Ignoring mental health can worsen conditions and lead to negative stigma, while a lack of understanding regarding early detection, symptoms, and treatment also contributes to mental health issues not being properly addressed (Jayanti & Dharmawan, 2018; Rachmawaty, 2020). Good mental health in adolescents is important for supporting their readiness to face challenges, make decisions, and maintain social relationships, while untreated disorders can hinder development and reduce quality of life (Yulia et al., 2024). Schools play a strategic role in supporting adolescent mental health because of the significant amount of time students spend in that environment and the influence of the socio-emotional climate on their development (Adhyka et al., 2023; Santrock, 2018). Therefore, early detection and management of adolescent mental health problems need to be strengthened, especially through interventions in schools.

Counselling programmes at schools are generally facilitated by guidance counsellors, but the process is often less effective because adolescents find it difficult to open up and feel a psychological distance from teachers (Karjuniwati et al., 2024). This is exacerbated by some guidance counsellors' low awareness of their professional responsibilities, leading to a decline in service quality and making students reluctant to consult (Rahim et al., 2024). This condition encourages adolescents to prefer sharing problems with peers who are considered more understanding, equal, respectful of others' perspectives, and capable of providing motivation and problem-solving assistance (Astiti, 2019; Nurmala et al., 2020; Baharudin et al., 2023).

Research shows that peers play a significant role in helping adolescents cope with problems. Kaligis et al., (2021) found that peers were the most preferred source of support among adolescents when facing mental health problems (70.5%), followed by psychologists (49.9%) and family members (39.2%). Additionally, 23.7% of respondents identified healthcare professionals and 21.9% identified counselors as sources of support. In contrast, only a small proportion of adolescents considered religious leaders (18.8%), teachers (4.6%), or other individuals (4.6%) as potential sources of help for mental health-related concerns. Peer counsellors also serve as a link between students and professionals (Febriana & Rochmawati, 2023), but they need to be equipped with foundational skills, such as active listening, empathy, and helping skills, to effectively provide psychological support to their peers. Peer counseling training has been proven to enhance students' understanding of the peer counselor's role, active listening skills, and the capacity to provide emotional support (Hamidah et al., 2024; Oktari et al., 2026). Furthermore, the peer counseling approach emphasizes mutually respectful relationships, emotional support, and positive decision-making processes. Numerous studies demonstrate that peer support and peer counseling programs can improve psychological well-being, mental health, and adolescents' ability to cope with various developmental challenges (Solihudin et al., 2025; Brinsley et al., 2025). This program has been proven to assist adolescents in recognizing their personal potential and enabling them to make positive decisions (Yuliasari, 2020).

Although previous studies have demonstrated the effectiveness of peer counseling and peer support programs in improving adolescents' psychological well-being, mental health, and coping abilities (Yuliasari, 2020; Solihudin et al., 2025; Brinsley et al., 2025), most interventions have primarily relied on conventional face-to-face approaches. At the same time, the rapid development of digital mental health interventions has provided new opportunities to improve mental health literacy, self-awareness, and access to psychological support among adolescents. However, existing digital interventions are often implemented as stand-alone tools and have limited integration with school-based peer support systems. Furthermore, while the CERDAS application has been developed as a digital platform to support mental health education, early detection, and self-management of mental health problems among adolescents (Septiana et al., 2025), its effectiveness when integrated with a peer-counselor approach has not yet been empirically examined. Therefore, there remains a need for research that combines technology-based mental health interventions with peer support mechanisms within the school setting. This study addresses this gap by evaluating the effectiveness of the CERDAS application integrated with a peer-counselor approach in improving adolescents' mental health status. The integration of a digital mental health platform with trained peer counselors represents a novel approach that may enhance adolescents' accessibility to mental health support, promote early identification of psychological problems, and strengthen mental health promotion efforts in schools. Therefore, this study aimed to identify the effectiveness the CERDAS app which uses a peer-counselor approach in improving the mental health status of adolescents.

METHODS

Study design

This study employed a quantitative experimental design using a two-arm cluster randomized controlled trial (cluster RCT) with a pretest–posttest control group design. Cluster randomization was performed at the school level using a lottery method to allocate the schools to either the intervention or the control group. Participants in the intervention group received the CERDAS application combined with peer-counselor support, whereas those in the control group received the usual guidance and counseling services provided by school counselors (Figure 1).

Population and Sample

This study utilized a two-arm cluster randomized controlled trial (cluster RCT) design, consisting of an intervention group and a control group. The research was conducted in Banda Aceh. Schools were purposively selected based on specific criteria: having Guidance and Counseling (BK) facilities with low service utilization and lacking an established peer counselor program. Based on these criteria, MAN 3 Banda Aceh and SMAN 13 Banda Aceh were selected as the study sites. Subsequently, a lottery method was used to randomize the two schools into their respective groups, assigning MAN 3 Banda Aceh to the intervention group and SMAN 13 Banda Aceh to the control group.

Subsequently, participants from each school were selected through simple random sampling among students who met the following inclusion criteria: (1) being 11th-grade students, (2) owning a smartphone, (3) providing informed consent and agreeing to participate throughout the study, and (4) exhibiting mild to severe levels of anxiety, stress, or depression based on the initial mental health screening. The sample size was determined using Cohen's (1988) table for a two-tailde test, with assuming a test power (1-β) of 0.95, a significance level (α) of 0.05, and an effect size (d) of 0.50, a total of 116 respondents was required, consisting of 58 respondents each for the intervention and control groups. A list of students meeting the inclusion criteria at each school served as the sampling frame. Each student was assigned an identification number, and respondents were randomly selected using a random number generator until 58 respondents were obtained for each group. Respondents in the intervention group received an intervention combining the use of the CERDAS application with a peer counselor program, while those in the control group received routine guidance and counseling services provided by the school's counseling teachers."

Data Collection Procedure

The study began with the recruitment of six students to serve as peer counselors under the supervision of the school guidance and counseling (BK) teacher. The selected students participated in a structured peer-counselor training program consisting of two sessions conducted over two weeks, with each session lasting approximately 2 hours. The training covered adolescent mental health education, orientation to the CERDAS application, mental health first-aid techniques, including the butterfly hug, expressive writing, guided imagery, positive affirmations, and 4–7–8 breathing exercises, as well as basic peer-counseling communication skills through role-playing activities to improve participants' ability to respond appropriately to peers experiencing emotional distress. The trained peer counselors were excluded from the study sample.

Next, the researcher conducted mental health screening using the CERDAS application on the entire population, including both the control and intervention groups. Students who showed signs of mental health issues such as mild to severe anxiety, depression, and stress were selected as research respondents. Participants in the intervention group received the CERDAS intervention over a two-week period, consisting of three structured sessions facilitated by trained peer counselors under the supervision of the research team. Each session lasted approximately 60 minutes. The first session focused on adolescent mental health education, introduction to the CERDAS application, and mental health screening using the application. The second session involved demonstrations and guided practice of mental health first-aid techniques available within the CERDAS application, including the butterfly hug, guided imagery, expressive writing, positive affirmations, and 4–7–8 breathing exercises. The third session emphasized reinforcement of coping skills, discussion of participants' experiences using the application, and encouragement to continue practicing the self-help techniques independently. Throughout the intervention period, participants were encouraged to access the CERDAS application independently to review educational materials, monitor their mental health status, and practice the coping strategies introduced during the sessions.

During the third week, a school-based peer-support service called "POSKO SEJIWA" (Mental Health Support Post) was established in collaboration with peer counselors, student organization (OSIS) representatives, guidance counselors, and school administrators. The support post provided a safe environment where students could voluntarily seek emotional support and enabled peer counselors to apply the communication and mental health first-aid skills acquired during training in a supervised setting. In the fourth week, researchers conducted a follow-up through a focus group discussion (FGD) with the peer counselors to explore their experiences, identify challenges encountered while assisting their peers, and obtain feedback regarding the implementation of the intervention. The control group received routine counseling services provided by the school's guidance and counseling teacher without peer-counselor training, structured peer-support activities, or access to the CERDAS intervention. Post-test assessments were conducted in both groups during the sixth week using the same instruments administered at baseline.

Research Instrument

The questionnaire utilized in the CERDAS application is the Indonesian version of the Depression Anxiety Stress Scales (DASS-21), comprising 21 items scored on a Likert scale to identify the mental health status of adolescents—namely anxiety, stress, and depression—before and after the intervention. The DASS-21 instrument has been declared valid and reliable, with an item reliability value of .99, sufficient person reliability (.89), and a Cronbach's alpha/KR-20 value of .91, indicating that the quality of the items is very good for assessing depression, anxiety, and stress (Ifdil et al., 2020). Additionally, the CERDAS application has undergone feasibility testing and scored in the 'highly feasible' category across four aspects: ease of use (84.4%), customization (89.3%), download delay in retrieving information (86.9%), and content suitability for viewing and reading (89.9%) (Septiana, Liza, & Kamaly, 2025).

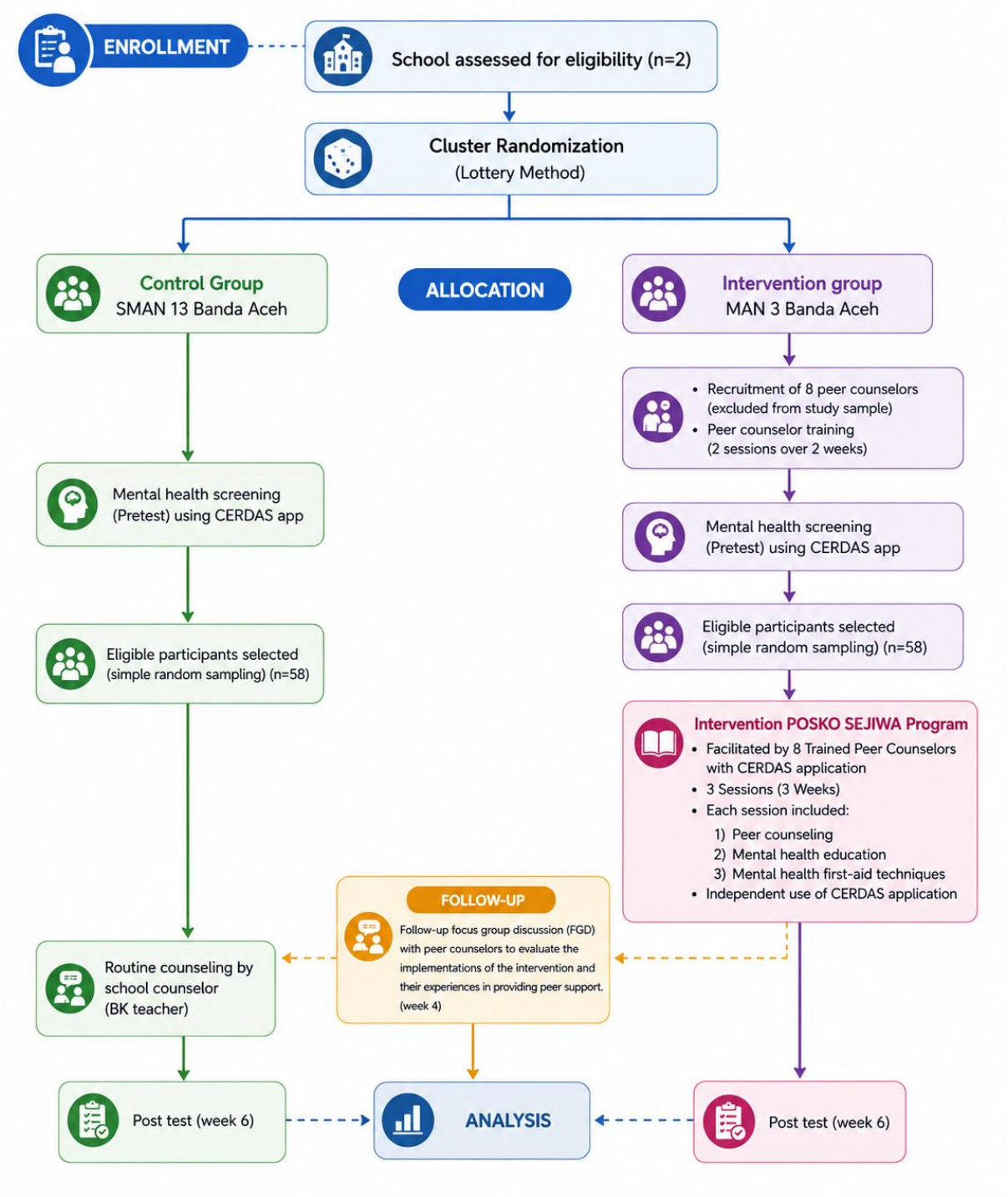

Figure 1. CONSORT flow diagram of participant enrollment, intervention, and analysis

Data Analysis

Data were analyzed using IBM SPSS Statistics. Both univariate and bivariate analyses were performed. Univariate analysis was conducted to describe the participants' characteristics and the distribution of adolescent mental health status (normal, mild, moderate, and severe), which were presented as frequencies and percentages. In addition, the mental health subscale scores (anxiety, stress, and depression) were summarized using means and standard deviations. Data normality was assessed using the Kolmogorov–Smirnov test because the sample size exceeded 50 participants. The results indicated that the data were not normally distributed ($p < 0.05$). Therefore, the Mann–Whitney

U test was used to compare post-intervention mental health scores between the intervention and control groups following the peer-counselor intervention.

Ethical Considerations

This study was conducted in accordance with ethical principles of health research. Ethics approval was obtained from the Ethics Committee of the Faculty of Nursing, Universitas Syiah Kuala, with approval number 113003060825. All participants were informed about the purpose, procedures, potential risks, and benefits of the study, and written informed consent was obtained before data collection. Participant confidentiality and anonymity were strictly maintained throughout the study.

RESULTS

The study findings are presented in three sections: (1) participants' demographic characteristics, including age and sex; (2) the distribution of adolescents' mental health status according to anxiety, stress, and depression severity levels; and (3) the comparison of post-intervention mental health outcomes between the intervention and control groups.

Characteristics of Adolescents by Age and Gender

Table 1. Participant Demographics (n=116).

Characteristics of Adolescents	Control Group		Intervention group	
	n	%	n	%
Age				
- Early adolescence	38	65.5	46	79.3
- Late adolescence	20	34.5	12	20.7
Gender				
- Male	23	39.7	12	20.7
- Female	35	60.3	46	79.3

Based on Table 1, it was found that the most frequent age in both the control and intervention groups fell into the early adolescent category, with percentages of 65.5% and 79.8%, respectively. The majority were female, at 60.3% and 79.3%.

Level of mental health status of adolescents in the control group and the intervention group before and after the intervention using a peer counsellor approach.

Mental health status among adolescents was assessed based on three domains: anxiety, stress, and depression. Table 2 presents the distribution of participants according to mental health status categories in the intervention and control groups before and after the intervention. Table 2 also presents the distribution of adolescent mental health status before and after the intervention in the control and intervention groups. For anxiety, the proportion of participants with normal anxiety increased from 1.7% at pre-test to 82.8% at post-test in the intervention group. In contrast, the proportions of participants with moderate and severe anxiety decreased to 0%, while the proportion with mild anxiety declined from 46.6% to 17.2%. In the control group, the proportion of participants with normal anxiety also increased from 13.8% to 55.2%; however, mild (15.5%), moderate (17.2%), and severe (12.0%) anxiety remained at post-test.

Table 2. Level of mental health status of adolescents in the control group and the intervention group before and after the intervention using a peer counsellor approach (n=116).

Mental health status of adolescents	Control Group				Intervention Group			
	Pre-test		Post-test		Pre-test		Post-test	
	n	%	*n*	%	*n*	%	*n*	%
Anxiety								
Normal	8	13.8	32	55.2	1	1.7	48	82.8
Mild	17	29.3	9	15.5	27	46.6	10	17.2
Moderate	22	37.9	10	17.2	25	43.1	0	0
Severe	11	19.0	7	12	5	8.5	0	0
Stress								
Normal	30	51.7	51	87.9	31	53.4	57	98.3
Mild	19	32.8	5	8.6	23	39.7	1	1.7
Moderate	9	15.5	2	3.4	4	6.9	0	0
Severe	0	0	0	0	0	0	0	0
Depression								
Normal	37	63.8	43	74.1	25	43.1	52	89.7
Mild	15	25.9	11	19.0	25	43.1	6	10.3
Moderate	6	10.3	3	5.2	7	12.1	0	0
Severe	0	0	1	1.7	1	1.7	0	0

A similar pattern was observed for stress. In the intervention group, the proportion of participants with normal stress increased from 53.4% to 98.3%, accompanied by reductions in mild stress from 39.7% to 1.7% and moderate stress from 6.9% to 0%. In the control group, the proportion of participants with normal stress increased from 51.7% to 87.9%; however, mild (8.6%) and moderate (3.4%) stress remained at post-test. For depression, the proportion of participants with normal mental health status increased from 43.1% at pre-test to 89.7% at post-test in the intervention group. The proportion with mild depression decreased from 43.1% to 10.3%, whereas moderate and severe depression were no longer observed after the intervention. In the control group, the proportion of participants with normal mental health status increased from 63.8% to 74.1%; however, mild (19.0%), moderate (5.2%), and severe (1.7%) depression remained at post-test.

Differences in mental health status between the intervention and control groups after the CERDAS application and peer counselor intervention

Tabel 3. Differences in mental health status between the intervention and control groups after the CERDAS application and peer counselor intervention

Variable	Timepoint	Control Group (Mean ± SD)	Intervention group (Mean ± SD)	P-value
Anxiety	Pretest	11.26 ± 4.13	10.97 ± 3.31	
	Posttest	8.00 ± 5.04	4.76 ± 2.67	0.001
Stress	Pretest	12.95 ± 5.81	12.52 ± 4.38	
	Posttest	7.34 ± 5.29	6.72 ± 3.74	0.021
Depression	Pretest	7.21 ± 5.13	9.72 ± 4.52	
	Posttest	6.09 ± 5.006	4.90 ± 3.478	0.014

As shown in Table 3, there were significant differences in anxiety, stress, and depression scores between the intervention and control groups following the intervention. Participants in the intervention group who received the CERDAS application with peer-counselor support demonstrated greater reductions in the mean scores of anxiety, stress, and depression than those in the control group. These differences were statistically significant for anxiety ($p = 0.001$), stress ($p = 0.021$), and depression ($p = 0.014$).

DISCUSSION

The findings of this study indicate that the CERDAS application intervention, implemented through a peer-counselor approach, was effective in reducing symptoms of depression, anxiety, and stress among adolescents. These improvements were consistently observed across all measured dimensions, with the majority of adolescents in the intervention group demonstrating a reduction in symptom severity from moderate-to-severe levels to mild or normal levels. The observed reductions in depression, anxiety, and stress are consistent with the findings of Smith and Carter (2022), who reported that peer support plays a crucial role in preventing and reducing the risk of mental health problems, particularly anxiety and depression, among adolescents facing academic and social pressures.

Peer support is widely recognized as an important protective factor in promoting adolescent mental health. Empirical evidence suggests that peer support enhances psychological well-being, facilitates psychological help-seeking behaviors, and reduces the risk of mental health problems among adolescents (Kholiq et al., 2025; Ni'matuzzakiyah & Masykur, 2026). Furthermore, school-based peer support interventions have been shown to effectively improve adolescent mental health by providing accessible psychosocial support and strengthening adolescents' capacity to manage psychological distress (Solihudin et al., 2025). These interventions have also been associated with enhanced psychological well-being, stronger emotional support, and improved psychological recovery, further highlighting the value of peer-based approaches in adolescent mental health promotion and intervention efforts (Cooper et al., 2024). Interactions with peers provide a safer, more egalitarian, and less intimidating emotional environment, enabling adolescents to express their emotions more openly and discuss the challenges they encounter (Santrock, 2018). The effectiveness of peer-counselor interventions suggests that peers exert a substantial influence on adolescents' attitudes, behaviors, and psychological help-seeking processes. Shared experiences, emotional closeness, and more egalitarian interactions make adolescents more receptive to support, guidance, and information provided by their peers than by authority figures such as teachers or parents (Shastri & Nair, 2024; Hoagwood et al., 2025).

In addition to peer support, this study incorporated digital technology to facilitate peer-based support and enhance the effectiveness of mental health interventions for adolescents. The findings demonstrated significant reductions in symptoms of depression, anxiety, and stress, which are consistent with the results reported by Garrido et al., (2019), who found that app- and web-based digital interventions were effective in improving adolescent mental health outcomes. This consistency suggests that digital platforms can serve as effective tools for increasing access to psychological support. However, unlike the study by Garrido et al., (2019), which focused solely on digital interventions, the present study integrated a peer-counselor approach, thereby fostering stronger social support throughout the intervention process. Similar findings were reported by Hollis et al., (2021), who demonstrated that the use of digital technology in adolescent mental health services can enhance access to psychological assistance while reducing barriers to help-seeking. The present study extends these findings by showing that the integration of a mental health application with a peer-counselor approach not only facilitates access to mental health information and emotion-regulation skills but also strengthens adolescents' engagement throughout the intervention process. Furthermore, the reductions in depression, anxiety, and stress observed in this study are consistent with the findings of Ebert et al., (2023), who reported that digital interventions based on self-help and cognitive-behavioral strategies contribute positively to adolescents' psychological well-being. Notably, the greatest improvement in the present study was observed in anxiety symptoms. This finding suggests that peer-based social support may play a particularly important role in alleviating anxiety-related symptoms compared with depressive symptoms, which are often influenced by more complex and persistent psychological processes and may therefore require more intensive interventions.

Peer-counselor programs represent an effective strategy within educational settings for promoting mental health awareness and reducing psychological distress among adolescents. Peer-counselors can play a critical role in the early identification of mental health problems through screening skills, the provision of initial emotional support, and the facilitation of referrals to professional mental health services when necessary (Topping, 2022; Saputro et al., 2023; Zhan et al., 2023). Furthermore, peer-

counselor training programs offer a range of positive outcomes, including enhancing adolescents' ability to establish and maintain strong social support networks among their peers, fostering empathy and concern for others, and strengthening self-confidence (Shohib et al., 2016; Ridha, 2019; Sura et al., 2022; Kusumawaty et al., 2020; Handayani et al., 2025). In addition, the development of psychological skills, such as psychological first aid, equips individuals with the competencies necessary to provide effective initial psychological support within school environments (Martinez & Richards, 2022).

The findings of the present study are also consistent with those reported by King et al., (2024), who demonstrated that peer-counseling programs can enhance psychological well-being, reduce stigma associated with mental health problems, and increase adolescents' willingness to seek professional help. Their findings suggest that the egalitarian relationship between the provider and recipient of support is a key factor distinguishing the effectiveness of peer-counseling from that of formal support services. Similarly, peer-based interventions have been shown to increase adolescents' engagement in mental health programs by fostering a sense of shared experience and psychological safety when discussing personal concerns (Hoagwood et al., 2025). Within the context of the present study, the involvement of peer-counselors likely contributed to the creation of a more supportive environment in which adolescents felt comfortable discussing their emotional difficulties. This supportive atmosphere may help explain why participants in the intervention group demonstrated greater improvements than those in the control group, who received only conventional school counseling services.

Peer-counseling and psychological first aid training were found to be effective in improving participants' understanding, as evidenced by the significant differences between pretest and posttest scores. Furthermore, the pretest–posttest analysis comparing the intervention and control groups revealed significant improvements in anxiety outcomes following the intervention. These findings suggest that the CERDAS intervention, supported by peer-counselors, had a greater impact on anxiety symptoms than on depression and stress. Notably, the largest reduction was observed in anxiety symptoms. This finding may indicate that anxiety is more responsive to social support and emotion-regulation strategies delivered throughout the intervention. Peer support has been identified as an important protective factor associated with lower levels of anxiety and psychological distress among adolescents (Fitzpatrick et al., 2024). Moreover, anxiety symptoms are often more amenable to direct social support, particularly when such support is provided by trusted peers (Yulia et al., 2024). Previous research has also demonstrated that improvements in emotion-regulation abilities represent a key mechanism for reducing emotional difficulties among adolescents, especially anxiety-related symptoms (Haag et al., 2024; Tamir et al., 2024). Therefore, the involvement of peer-counselors, combined with the emotion-regulation techniques incorporated into the CERDAS application, may have operated through mechanisms that more rapidly influence emotional responses than the cognitive processes that typically underlie depressive symptoms.

The control group also demonstrated positive changes in anxiety and stress levels, although these improvements were not as substantial as those observed in the intervention group. This finding suggests that school counseling services continue to provide benefits for adolescents; however, their effectiveness may be constrained by various psychological barriers. Previous studies have identified several factors that hinder adolescents' engagement in counseling services, including difficulties in self-disclosure, fear of being judged, and the perceived authority gap between teachers and students (Karjuniawati et al., 2023; Rahim et al., 2024). These findings support the notion that incorporating peer-counselors into school-based mental health services may strengthen and enhance the effectiveness of conventional counseling programs. Nurmala et al., (2020) reported that adolescents tend to feel more valued, understood, and accepted when interacting with peers of a similar age, which in turn increases their motivation to participate in psychological support programs. Therefore, the greater improvements observed in the intervention group may be attributed, at least in part, to the presence of peer support, which likely facilitated greater openness, engagement, and responsiveness throughout the intervention process.

The effectiveness of the intervention was influenced not only by the quality of interpersonal relationships but also by the utilization of the CERDAS application as a digital support platform.

Previous studies on digital mental health interventions have demonstrated that applications integrating psychoeducational content with self-help and emotion-regulation components can enhance adolescents' psychological well-being, self-efficacy, and capacity for self-management of emotional difficulties (Babbage et al., 2022; Moltrecht et al., 2022). In the present study, techniques such as the butterfly hug, guided imagery, 4-7-8 breathing, positive affirmation, and expressive writing may have contributed to the improvement of mental health symptoms by promoting relaxation responses and facilitating emotion regulation through activation of the parasympathetic nervous system. Furthermore, the CERDAS application provides not only cognitive-behavioral guidance but also an initial screening feature based on the DASS-21, enabling adolescents to identify and monitor their mental health conditions more objectively. This approach is consistent with the recommendations of the World Health Organization (WHO, 2021), which emphasize the importance of early detection and the use of digital technologies in strengthening mental health promotion and prevention efforts among young people.

The findings of this study suggest that the effectiveness of the intervention was derived not only from the use of a digital application or peer support independently, but also from the interaction between these two components. The CERDAS application provides access to mental health information, self-screening tools, and emotion-regulation techniques that can be used independently, while peer counselors offer social support, motivation, and guidance in applying these skills. The integration of these components enables adolescents to receive support that is both personalized and easily accessible, thereby enhancing participant engagement and the overall effectiveness of the intervention. Despite the promising findings, several limitations should be considered when interpreting the results. First, the study involved only two schools, resulting in a relatively limited sample that may not fully represent the broader adolescent population. Second, the sampling technique employed may restrict the generalizability of the findings to schools with different social, cultural, and academic characteristics. Future research is therefore recommended to include a larger number of schools and extend the duration of the intervention through longitudinal designs with longer follow-up periods. Such approaches would allow researchers to better evaluate the sustainability of behavioral and mental health improvements associated with the CERDAS application and the peer-counselor approach over time.

The integration of peer-counselors and the CERDAS application creates a comprehensive intervention approach that enhances direct support for adolescents through the combination of self-help capabilities, peer support, and a supportive school environment. The use of technology in mental health interventions is likely to be more effective when accompanied by strong social relationships. The findings of this study indicate that the CERDAS intervention, implemented through a peer-counselor approach, has broad practical implications for adolescent mental health promotion and prevention. Sustainable implementation through the establishment of a "Posko Teman Jiwa" and the integration of peer-counselor training into school programs may serve as effective promotive and preventive mental health strategies. Furthermore, the innovative combination of technology, education, and peer relationships has the potential to foster a supportive environment that equips adolescents with the resources and resilience needed to navigate psychosocial challenges during their developmental years. Unlike most previous studies that have examined the effectiveness of digital interventions and peer-counselor programs separately, the present study demonstrates that integrating a digital mental health application with a peer-counselor approach can generate synergistic and mutually reinforcing effects in reducing symptoms of depression, anxiety, and stress among adolescents. These findings provide new empirical evidence for the development of school-based mental health intervention models that integrate digital technology with peer social support.

CONCLUSION

Mental health interventions for adolescents using the CERDAS application with a peer counselor approach have been proven effective in improving mental health literacy and mental health status in adolescents. This intervention significantly reduced levels of anxiety, stress, and depression, as

evidenced by an increased proportion of adolescents in the normal category and a decrease in mild to severe categories in the intervention group compared to the control group. Therefore, the peer counselor approach has the potential to be an effective promotive and preventive strategy in efforts to improve adolescent mental health. It is hoped that application-based interventions with this approach can be implemented sustainably in adolescent health programs within school and community settings to improve adolescent mental health literacy and well-being.

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ETHICAL STATEMENT

The study approval was obtained from the Ethical Committee of Faculty of Nursing, Universitas Syiah Kuala, with approval number 113003060825.

AUTHOR CONTRIBUTION

NS: Supervision, conceptualization, methodology, software, project administration, validation, formal analysis, data curation, writing-original draft, writing-review & editing, visualization, funding acquisition. SZL: Data collection, data analysis and interpretation, writing-original draft, resources, & investigation. NK: software, resources, & data collection.

STATEMENT CONFLICTS OF INTEREST

We declare there is no conflict of interest in this study.

DATA AVAILABILITY STATEMENT

The data utilised in this research to derive conclusions is not publicly accessible due to its confidentiality by privacy or ethical rules, but are available from the corresponding author upon reasonable request.

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