Promoting Positive Thinking and Reducing Perceived Stress Using the Be Aware of Stress Smartphone Application among At-risk Adolescents: A Quasi-experimental Study

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Abstract: It is estimated that globally, millions of adolescents experience mental health problems, especially anxiety and depression. Adolescents with high perceptions of stress often encounter mental issues, have negative thoughts or are dissatisfied with daily life events. This study employed a quasi-experimental design with two groups and repeated measures to test an innovative nursing intervention, the Be Aware of Stress Smartphone Application. This application aims to increase positive thinking and reduce perceived stress among at-risk adolescents aged 13 to 16, and we sought to determine their satisfaction with its usability. The study was conducted with 44 junior high school students from an opportunity expansion high school in Eastern Thailand, who were randomly assigned to experimental and comparison groups (22 each). Data were collected between December 2023 and February 2024 using the General Information Questionnaire, Positive Thinking Test, Perceived Stress Questionnaire, and Satisfaction of Application Usability scale. The outcomes were measured at baseline, after completing the program at week 4, and at week 8 after using the application. The chi-square test and repeated measures analysis of variance were used to analyze the data.

The results of this study have important implications for future research. They indicate a significant improvement in positive thinking and a reduction in perceived stress within the experimental group, compared to the comparison group, at weeks 4 and 8. Moreover, the experimental group reported high satisfaction with the application's usability. These findings suggest that the Be Aware of Stress application is beneficial for community nurses and others to prevent adolescent stress. The study also highlights the need for future research to enhance the application's functionality and compatibility with various phone operating systems to ensure widespread and effective use.

Keywords: Adolescents, Acceptance and commitment therapy, Application software, Junior high school students, Perceived stress, Positive thinking, Quasi-experimental

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Introduction

A UNICEF report has estimated that 166 million adolescents globally experience mental disorders, especially depression and anxiety.[1] In Thailand, the location for this study, adolescents have the second-highest proportion of mental health problems from stress and anxiety and the third-highest number of deaths from suicide among the entire population.[1] It was found that 28% of the country's

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1,589,653 students perceived high stress. The main sources of stress were related to education, financial problems in the family, and family relationships.[2] However, the management patterns that adolescents mainly use to relieve their stress feelings do not address dealing with the cause of that stress, such as modifying their thoughts and perception towards stress appropriately.[2] Adolescence is a period of physical and social change. During this period, many transitions occur, such as transferring from childhood into young adulthood.

In the era of digital technology, a mobile health application (mHealth App) is appropriate to promote adolescents' competency in managing stress; 99.7% of junior high school students use smartphones in their daily lives.[3] Both public and private agencies in Thailand have developed a mHealth App to provide mental health care services. Application platforms such as School Health HERO are widely used for screening at-risk students. This platform is not specific to stress management and was limited to screening general mental health deviations.[4,5] For the private sector, OOCA developed a smartphone application (hereafter called an app) that connects users with a network of healthcare professionals, but it is difficult for these junior high school students to access the service because the developer requests a fee for each consultation.[1]

On other platforms, UNICEF created an online chat room called LoveCare Station, which provides counseling services and referrals for continuity of care. This platform has not yet been evaluated for its effectiveness in reducing mental health problems.[1] Consistent with the depisNet-Thai website platform, the users had non-significant changes in stress and depression after the trial. Besides, the smartphone website platform was not easy to use, as considered by the dissatisfaction and poor retention rate of users.[6] Interestingly, the platforms built upon a theoretical framework effectively reduce mental health problems. A study conducted by Rungrojwatanasiri et al.[7] is an example of one that applied the concept of Internet-based cognitive behavioral therapy (CBT) to determine the functionality of an Internet-based program for reducing depression among high school students. The outcomes indicated a significant decrease in depression levels over time. This program should be monitored long-term to determine its effectiveness and sustainability.[7]

Previous innovations through mental health technology platforms were developed for adolescents in general.[1,5,6] Nevertheless, these are not developed based on a specific group of junior high school students considered at-risk. Some platforms still need to incorporate an effective psychological theoretical framework for stress management with short- and long-term follow-ups focusing on both primary (positive thinking) and secondary (perceived stress) outcomes.[6,7] In fact, evaluating the feasibility and usability of the app is an equally crucial secondary outcome.[8] Therefore, the Be Aware of Stress app was developed to integrate psychological concepts suitable with junior high school students to increase positive thinking and reduce perceived stress.

Literature Review and Conceptual Framework

This intervention study was based on acceptance and commitment therapy (ACT), developed by Steven C. Hayes. The original version was created in 1999 and updated in 2013.[9] The theory was a new wave of cognitive behavioral therapy (CBT), promoting mindfulness-based positive thinking. Evidence demonstrated that ACT improved positive thinking toward problems through metacognitive awareness. This process is the awareness of negative thoughts and feelings as a mental state, focused on mindfulness to recognize what is happening in the present without making judgments and reduce obsessive thoughts about things that happened in the past or worry about the future, which is a cause of depression and anxiety.[9]

The six core principles of ACT consist of two critical processes with three steps each, detailed as

follows: Part 1: Mindfulness and acceptance process, focuses on developing the ability to recognize the reality of the situation mindfully. It is divided into three steps: Firstly, acceptance, the ability to accept thoughts, emotions, feelings, and situations that arise without trying to escape by developing exposure skills. Secondly, cognitive diffusion is the observation and classification of thoughts and language processes the subject interprets while reducing the emphasis on the assumptions that arise from the language process that causes suffering. Thirdly, being present means being aware of the present by reducing obsessive thoughts and distorted thoughts. Part 2: Commitment and behavior-change process focuses on developing a way of life associated with the person's values and goals and consists of three steps: Firstly, self as context is being conscious and aware of changes in thoughts to increase awareness of changes happening. Secondly, defining valued directions is finding ideas or beliefs a healthy person needs and setting direction goals. Finally, committing to action means bringing values to create goals and planning actions step by step.[10]

Various studies found that the six core principles of ACT effectively increase self-resilience to deal with stress among adolescents.[11,12] By encouraging them to accept and adjust their perspectives on stressful situations without escaping and avoiding them but creating positive thoughts towards unwanted events while practicing mindfulness or mindfulness-based stress reduction (MBSR) to relieve emotional distress.[11,12] A systematic review and meta-analysis of ACT for improving psychological well-being among children with special health care needs between 2000-2021 found that ACT is more effective in reducing depressive symptoms, perceived stress, avoidance, and fusion.[11] Because stressors that at-risk adolescents encounter in daily life might be due to their perception that stress is dangerous, threatening, and beyond their abilities to handle. Therefore, thoughts or perceptions shaped by the individuals' beliefs and past experiences are considered a dynamic cycle that affects inappropriate emotion and ineffective stress management behavior.[13]

The six interrelated processes of ACT mutually enhance psychological flexibility by improving adolescents' ability to stay with the present moment and their inner thoughts and feelings without defense but acceptance with mindfulness. Acceptance of thoughts and feelings influences the reduction of the perception of stress in adolescents; this process induces individuals to reflect on themselves realistically and understand that stress is the usual moment.[11] Similarly, a literature review of 187 randomized and quasi-randomized control trials on stress reduction therapeutic programs found that the ACT principles significantly reduced stress, and a meta-analysis supported that ACT is an effective intervention to reduce stress in adolescence.[12]

A phenomenological analysis of adolescents' experiences of depression found that after completing ACT sessions, they experienced a more positive shift in thinking. They defined this experience as "spaces to explore and experience," which meant moving while consciously aware of negative feelings by training themself to have a broader perspective for healing their mind.[14] Further, the adolescent believed that doing essential things, as defined by their values, goals, and determination, was vital in experiencing more positive thinking.[14] The acceptance principle helped these adolescents to understand desire or undesirable events that happen to them with an open mind and gather information to decide whether to change or maintain the same behavior. The committed action principle helps encourage adolescents to set personal life values and live a meaningful life. This is consistent with another study,[15] in which adolescents who received the online Strength-informed Acceptance and Commitment Therapy (SACT) had positive attitudes toward obstacles that arose in daily life. This is the most obvious characteristic of people who can manage stress well, including positive thinking.[15] Adolescents with high positive thinking are able to recognize and interpret the meaning of the situation more positively and change their negative perspectives, beliefs, and feelings.[16] They know how to take advantage of the positive aspects

hidden in such things. Adolescents often cannot avoid unpleasant situations in everyday life. However, they can think and perceive that a situation can motivate them to deal positively with problems.[17]

The current school mental health care system in Thailand was developed by the Ministry of Public Health and the Office of the Basic Education Commission and aims to monitor behavioral, emotional, and social problems in children and adolescents. This system is called Health and Educational Reintegrating Operation, commonly known as School Health HERO, and it works through an app platform. The system's operation starts with classroom teachers screening students using nine questions (9SQ), and then at-risk students receive individual mental health care advice following basic care guidelines by classroom teachers.[18,19]

The outcome reported by the School Health HERO system in 2022 was that 203,891 students screened with 9SQ from 2,189 schools; 5,526 students were classified as high-risk groups requiring care, and 69.34% received care until their symptoms improved.[19] However, this app was developed for teachers as the primary users and students were not able to access the self-service system.[4,5]

Therefore, we created the Be Aware of Stress app that specifically focuses on managing stress by developing positive thinking for adolescents, and the development of this will be described in another article. The app was built using the ADDIE model development framework (Analysis-Design-Development-Implementation-Evaluation), which covered the creation, development, and evaluation process.[20,21]

Study Aim

Considering the above evidence, this study aimed to determine the effects of the Be Aware of Stress app on positive thinking and perceived stress among at-risk adolescents in a high school in an eastern Thailand province and their satisfaction with the app's usability.

Methods

Design: This study used a quasi-experimental, two-group with repeated measures design. This report was written following the TREND Statement Checklist (Transparent Reporting of Evaluation of a Non-Randomized Controlled Study).

Sample and Setting: The sample size was calculated from G*Power version 3.1.9.4. with the formula for testing of F-tests, ANOVA: repeated measures, within-between interaction. Based on a meta-analysis,[11] ACT programs positively reduced stress among children with special healthcare needs, with a large effect size (standardized mean difference: SMD = -2.51, 95% CI -5.37, 0.36). However, this was not statistically significant due to high heterogeneity among included studies. With this, the researchers decided to lower its effect by taking a medium effect size to ensure it would capture the actual effects. Using a one-tailed test with a significance level of 0.05 and a power of 0.90,[22] the required sample size was 36 participants, with an additional 20% added to compensate for possible dropouts. Thus, the total number of participants required was 22 in each group.

The inclusion criteria were 1) male and female adolescents aged 13 to 16 years old, according to the World Health Organization's definition,[23] 2) studying at the junior high school level, 3) having moderate or higher levels (score range between 5-15) of a 5-item stress test (ST-5),[24] which indicates a risk of mental health problems, 4) willingness to participate in this study, 5) using a smartphone with an Android operating system, and 6) having received parents' consent to participate in the study.

Those who were excluded from this study had mental health illnesses such as specific developmental disorders affecting scholastic skills, depression, or anxiety. For discontinuation, the criteria were: 1) lack of recording of stress monitoring for more than 20% of the intervention period; 2) inability to follow up on study results over the intervention period; and 3) having dropped out of school.

The setting was an opportunity expansion school in a province in eastern Thailand. This type of school originally offered only primary education. Later, such schools were organized to teach at the junior high level to support the increasing number of students in the area. Compared with other general secondary schools, there may not be any readiness regarding specialist teachers, locations, or other facilities. This junior high school is divided into three levels: levels 1, 2, and 3, which are equivalent to grades 7, 8, and 9 in other countries, respectively.

Adolescent enrollment was conducted by publicizing information through classroom teacher announcements. Students who met the inclusion criteria could register to participate with the guidance teacher until the sample size was reached (n = 44). The guidance teacher grouped the students according to their year and classroom and randomly assigned them into experimental or comparison groups.

Ethical Considerations: This study was approved by the Institutional Review Board of Burapha University, Thailand (Code IRB1-070/2565). Participants who met the criteria received information regarding the study's objective and processes, including their rights as participants. The researcher informed their parents via phone about the research project details. After that, adolescents and their parents signed informed consent forms indicating they voluntarily participated. Code names were used to protect their privacy, and all data were kept private. After enrollment, they had the autonomy to withdraw from the study anytime. In cases of severe stress, the researchers collaborated with classroom teachers and parents to arrange additional support and treatment.

Instruments: Four instruments for data collection comprised the General Information Questionnaire, the Positive Thinking Test (PTT), the Perceived Stress Questionnaire (PSQ), and the Satisfaction of Application Usability Scale. Three education and mental health experts reviewed the overall instruments to determine the item objective congruence index (IOC). In addition, the PTT and PSQ were pilot-tested with 30 participants with the same characteristics to calculate Cronbach's alpha coefficients.

The General Information Questionnaire (7 items) included age, gender, education level, cumulative GPA, underlying diseases, living arrangements, and history of substance use.

The Positive Thinking Test was developed by Thepmong and Prachanban[25] based on the concept of a person's positive thinking characteristics by Ventrella[26] and literature reviews. This instrument was developed for Thai student adolescents. It comprises 42 items with six subscales: self-confidence (6 items), self-control (6 items), optimism (7 items), earnestness (9 items), confrontation with problems and obstacles (7 items), and open-mindedness and hospitality (7 items). An example of an item is, "When in a critical situation, I believe that I will always be able to solve problems and find the right solution." A 5-point Likert scale was used for responses ranging from strongly agree = 5 to strongly disagree = 1. The scores range from 42-210, with a higher score indicating higher positive thinking.[25] The IOC of the instrument was 0.84. The Cronbach alpha reliability in the pilot study was 0.97, and in the actual research, 0.96.

The Perceived Stress Questionnaire was developed by Levenstein et al.[27] based on the concept of an individual perception of stress. The original English version was back-translated into Thai by Wachirawat et al.[28] It comprises 30 items, divided into 22 negative items (e.g., "you fear that you may not manage to attain your goals.") and eight positive items (e.g., You feel that you're doing things you really like). A 4-point Likert scale was used for responses in negative statements, from never = 1 to always = 4. The scores on the positive items were reversed before summing the total score. The scores range from 30-120, with higher scores indicating higher stress.[28] The IOC of the instrument was 0.90. The Cronbach alpha was 0.87 in both the pilot and main studies.

The Satisfaction of Application Usability Scale was developed by the Health Care Information and Management Systems Society[29] to assess the usability of mHealth applications. The original version was in English and adapted to Thai using back-translation by Lapponampai and Pamonsinlapatham.[30] The scale comprises 25 items with four components: system usability (7 items), efficiency (6 items), effectiveness (6 items), and user satisfaction (6 items). For example, "Using the app helps me create a positive mindset and self-manage stress." The responses were rated on a 5-point Likert scale ranging from strongly agree = 5 to strongly disagree = 1. They are scored between 1.00-5.00. A score of 4.51-5.00 means a very high level of satisfaction; 3.51-4.50 means a high level of satisfaction; 2.51-3.50 means moderate satisfaction; 1.51-2.50 satisfaction is at a low level while 1.00-1.50 means that satisfaction is at a shallow level.[30] The IOC of the instrument was 1.00. Cronbach's alpha reliability in the actual study was .86.

Be Aware of Stress Smartphone Application (BeWS-SPA) Intervention

This BeWS-SPA is an 8-week innovative nursing approach, which we developed based on six core principles of the ACT concept and the literature review of smartphone apps designed for stress management. The app has six functions for assessing stress, providing self-care methods according to the severity of stress, and promoting positive thinking. The user interface of each function is described in an **Appendix**, **Table A**, and **Figures A-C.** The participants performed all the assigned activities in the app every day. It took about 15-20 minutes per day after school.

The three experts who approved this app were a psychiatrist, a psychologist of ACT counseling, and a program developer. They agreed on each app function by rating the IOC with a value between 0.78-1.00. This app was pilot-tested for its feasibility with ten at-risk adolescents to evaluate its retention rate, which indicated the possibility of app usability in daily life, its effects on the perception of positive thinking and perceived stress, and its usability satisfaction. Focus group interviews were conducted to examine the app's validity based on user feedback. The pilot test revealed that the program was feasible with a 100% retention rate. After using this app, participants in the pilot study had significantly higher positive thinking scores and lower perceived stress scores. In addition, user satisfaction with this app was high.

Usual Support: When requested, all participants received the usual support from the classroom teacher, which consisted of advice, encouragement, and stress monitoring.

Data Collection: Data were collected between December 2023 and February 2024. Participants in each group were asked to complete the same questionnaires for primary outcomes, including positive thinking and perceived stress. Participants in the experimental group were also asked to complete the Satisfaction of Application Usability Scale, which indicated secondary outcomes. The data collection was performed at the pretest (week 0), during the app trial (week 4), and after the trial (week 8) by a research assistant, a guidance teacher trained by the researchers for data collection and the use of app before the intervention program started. At the first meeting, the researchers explained the details and methods to participants in each group. In the experimental group, the researchers instructed and taught them how to use the BeWS-SPA according to the user manual. They invited them to a LINE group for advice on app problems. In contrast, the comparison group did not participate in this process.

Statistical Analysis: Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS), Version 29.0, with descriptive statistics to illustrate the demographic characteristics of at-risk adolescents. Independent sample t-tests, chi-square statistical analyses, and Fisher's exact test were employed to compare the differences between these two groups

at baseline. Subsequently, this study utilized a one-way repeated measures ANOVA to analyze the variances in total scores for positive thinking and perceived stress between these two groups, opting to use repeated measures ANOVA for testing the variances within groups for each point of measurement. There were no missing data or outliers. Statistical assumptions were examined. Mauchly's tests of sphericity for positive thinking and the PSQ were violated ($p < .05$), indicating no compound symmetries. Therefore, the researcher used the Greenhouse-Geisser correction to report the results of repeated measures ANOVA.

Results

Characteristics of the at-risk adolescents

As indicated in **Table 1**, most adolescents in both groups were aged 13-16. The mean ages were 15.05 years (SD = 0.10) and 14.18 years (SD = 1.0) in the experimental and comparison groups, respectively. No significant differences between the groups were found at baseline regarding socio-demographic characteristics, except the education level. Most participants in the experimental group (68.2%) were in grade 9, while 59.5% were in grade 7 in the comparison group.

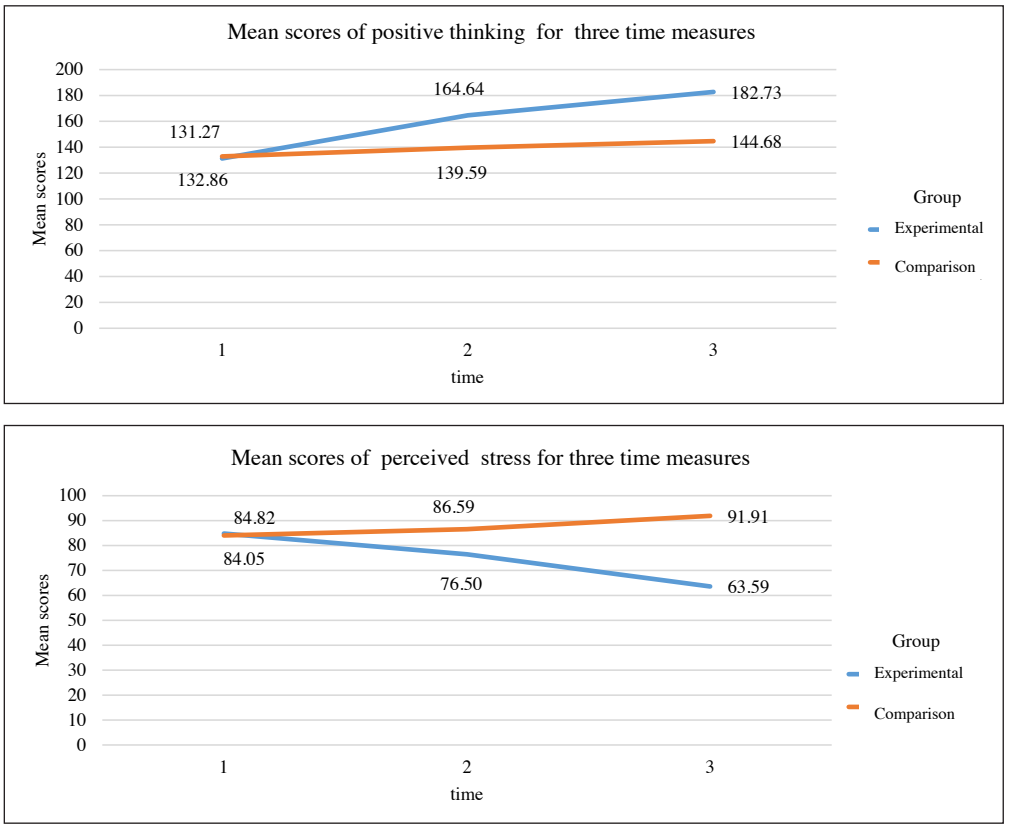
Table 1. Characteristics of at-risk adolescents in two groups (n = 44)

Characteristics	Experimental n = 22		Comparison n = 22		t	p-value
	n	%	n	%		
Age (years)	M = 15.05 (SD = 0.10, range = 13-16)		M = 14.18 (SD = 1.0, range = 13-16)		7.632	0.054[a]
Gender						
Male	7	31.8	2	9.1	3.640	0.162[c]
Female	12	54.5	17	77.3		
Transperson	3	13.6	3	13.6		
Education level						
Secondary 1	3	13.6	12	54.5	8.197	0.017[c]
Secondary 2	4	18.2	2	9.1		
Secondary 3	15	68.2	8	36.4		
Cumulative GPA						
1.00-2.00	1	4.5	2	9.1	0.758	0.860[c]
2.01-3.00	9	40.9	9	40.9		
3.01-3.50	7	31.8	5	22.7		
3.51-4.00	5	22.7	6	27.3		
Underlying diseases						
No	19	86.4	22	100.0	3.220	0.073[b]
Yes	3	13.6	-	-		
Living arrangements						
With parents	15	68.2	16	72.7	2.123	0.547[c]
With sibling	-	-	1	4.5		
With relatives	6	27.3	5	22.7		
With partners	1	4.5	0	0		
History of substance use						
No	21	95.5	20	90.9	0.358	0.550[b]
Yes	1	4.5	2	9.1		

Note. [a] = independent t-test, [b] = chi-square, [c] = Fisher's exact Test

Effectiveness of the BeWS-SPA Program

Table 2 shows no significant differences between the groups' baseline scores for positive thinking, perceived stress, and stress screening. However, at weeks 4 and 8 after using this app, the positive thinking scores were significantly higher in the experimental group compared to the comparison group, while perceived stress scores and stress screening scores were substantially lower. Furthermore, there were noteworthy alterations in positive thinking and perceived stress over time, and the interaction between time and group was statistically significant, as outlined in **Table 3**. Multiple pairwise comparisons employing the Bonferroni test were conducted between each measurement point, revealing significant increases in positive thinking scores for the experimental group from baseline to week 4 and week 8 after using this app. There were significant decreases from week 4 to week 8 after the program trial for perceived stress. Conversely, within the comparison group, no statistically significant difference was found in the positive thinking scores across three time measurements. Perceived stress decreased significantly from week 4 to week 8 after the trial (**Table 4**). Moreover, the graph line that connected each variable between each time point of the experimental group showed a dramatic increase over time regarding their positive thinking mean scores, while the perceived stress mean scores decreased across the three time periods, as illustrated in **Figure 1**.



Note. Time 1 = Baseline (before using application), Time 2 = Week 4 (during using for 4 weeks), Time 3 = Week 8 (after using for 8 weeks)

Figure 1. Change in positive thinking and perceived stress between each group at each time point

Table 2. Comparisons of estimated marginal mean differences of positive thinking and perceived stress between 2 groups at each time point

Variables	Experimental group M(SD)	Comparison group M(SD)	M_{diff} (SE)	t	p-value
Positive thinking					
Time 1	131.27(26.66)	132.86(29.81)	-1.59(8.53)	-0.187	0.853
Time 2	164.64(20.79)	139.59(22.66)	25.05(6.56)	3.820	0.001
Time 3	182.73(16.39)	144.68(16.99)	38.05(5.03)	7.558	0.001
Perceived stress					
Time 1	84.82(12.25)	84.05(9.99)	0.77(3.37)	0.229	0.820
Time 2	76.50(15.49)	86.59(11.96)	-10.09(4.17)	-2.419	0.020
Time 3	63.59(13.49)	91.91(9.41)	-28.32(3.51)	-8.078	0.001
Stress screening (ST-5)					
Time 1	10.23(2.67)	10.18(2.59)	0.05(0.79)	0.057	0.995
Time 3	9.45(4.39)	11.77(1.85)	-2.32(1.02)	-2.281	0.028

Note. Time 1 = Baseline (before using application), Time 2 = Week 4 (during using for 4 weeks), Time 3 = Week 8 (after using for 8 weeks)

Table 3. Repeated measures ANOVA of positive thinking and perceived stress scores

Source of variation	Type III sum of squares	df	Mean square	F	p-value
Positive thinking					
Within group					
Time	22543.091	1.628	13846.814	43.323	0.001
Group* Time	8981.636	1.628	5516.859	17.261	0.001
Error	21854.606	68.377	319.617		
Between groups					
Group	13868.250	1	13868.250	13.453	0.001
Error	43297.894	42	1030.902		
Perceived stress					
Within group					
Time	988.288	1.488	664.254	7.507	0.001
Group*Time	4753.955	1.488	3195.256	36.112	0.001
Error	5529.091	62.488	88.482		
Between groups					
Group	5193.818	1	5193.818	16.232	0.001
Error	13439.091	42	319.978		

Table 4. Pairwise comparison using Bonferroni for the mean differences in total scores between each pair of time differences in groups

Variable	Time	Time	Mean difference	SE	p-value
Positive thinking					
Experimental	Time 1	Time 2	-33.364	4.880	0.001
		Time 3	-51.455	4.398	0.001
	Time 2	Time 3	-18.091	2.357	0.001

Table 4. Pairwise comparison using Bonferroni for the mean differences in total scores between each pair of time differences in groups (Cont.)

Variable	Time	Time	Mean difference	SE	p-value
Comparison	Time 1	Time 2	-6.727	3.601	0.227
		Time 3	-11.818	7.110	0.334
	Time 2	Time 3	-5.091	5.448	1.000
Perceived stress					
Experimental	Time 1	Time 2	8.318	3.687	0.105
		Time 3	21.227	3.426	0.001
	Time 2	Time 3	12.909	2.044	0.001
Comparison	Time 1	Time 2	-2.545	1.805	0.519
		Time 3	-7.864	1.467	0.001
	Time 2	Time 3	-5.318	0.990	0.001

Note. Time 1 = Baseline (before using application), Time 2 = Week 4 (during use at 4 weeks), Time 3 = Week 8 (after using for 8 weeks)

Satisfaction with the Usability of BeWS-SPA Program

After finishing 8-weeks of trial, the experimental group indicated that the overall satisfaction with the app's usability had a high satisfaction level with an average score of 4.12 (SD = 0.43). The satisfaction level in the app components was categorized from highest to lowest order, and the results were as follows: system usability was 4.08 (SD = 0.48), effectiveness was 4.09 (SD = 0.59), efficiency was 4.11 (SD = 0.52), and users' satisfaction was 4.18 (SD = 0.47).

Discussion

This study showed that the BeWS-SPA program developed from the concept of ACT can promote positive thinking and reduce perceived stress in at-risk adolescents. When adolescents used this app continuously every day for 4-8 weeks, there was a shift in positive thinking and perception of stress over time. These findings demonstrate the efficacy of the core principles of the ACT therapy approach,[9] and consistent with previous research.[31] For example, a systematic literature review and meta-analysis that analyzed ACT-based intervention programs for stress reduction in children and adolescents found that these effectively reduced perceived stress among adolescents.[12] The six core components of ACT work together to help adolescents accept their distressed thoughts and emotions without escaping and turn to individual conscious consideration by positively changing perspectives until they adhere to their chosen values.[31] Thus, over the trial of 8weeks, participants in our study could experience realistic levels of stress that occurred in their daily lives without escaping it. The app helped them learn to adjust their thoughts by examining and considering various aspects of unsatisfactory situations more thoroughly and positively. Finally, the BeWS-SPA's processes have great potential to help lead these adolescents to live in the present and move forward with their goals.

In addition, the BeWS-SPA contains various stress management strategies. It gives adolescents options for managing stressful emotions that are appropriate for their contexts to prevent the accumulation of stress that causes chronic physical and mental disorders.[32] This is consistent with another study that found that stress management strategies, such as practicing mindfulness, imagination therapy, and changing perspectives and thinking could reduce perceived stress in adolescents.[17] In addition, creating

a social support network through online assistance can be an essential help for adolescents with high stress levels who want to vent their feelings or consult someone who can help them.[32] However, most Thai adolescents share their problems with others instead of telling their family members and teachers.[5] Therefore, help from health professionals through online systems is one of the options to help these adolescents get access to counseling services that are convenient, safe, and effective.

The strength of this research is the use of smartphones as an alternative tool for mental health services for adolescents. This option aligns with the behavior patterns of using smartphones in adolescents' daily lives, such as for communication, information searching, and creating entertainment from various online media. It is also easily accessible anywhere and anytime.[3] Furthermore, the study of smartphone usage among adolescents is associated with achieving practical problem-solving skills.[33] Hence, mental health technology through smartphones could be used as support media to promote self-learning in stress management.

Another strength of this study is that the researchers developed a health platform through a mobile app. Some advantages of using apps include quick responses to users and the ability to contain systems for gathering data and interpreting its results. These would help the users know their health status, namely health awareness.[34] The BeWS-SPA program uses a notification system to encourage users to assess their daily stress levels. In addition, the researchers developed this app by considering the limitations or related problems in the app functions in a previous study and adjusting for better functions.[35] The researchers also developed a system to collect data on the number of times and durations using this app. This data can be employed to analyze the durability of health behaviors of the app users and the frequency and continuity of the app access, which will help indicate changes in health status (dose-response effects).

This study also recruited adolescents in different school grades, but their education levels may not entirely affect such stress levels. Piekarska found that education levels affect not only perceived stress but also self-esteem and the perception of an individual's ability to manage stress. These two factors are significant contributors to adolescents' perception of stress.[36] To address this concern, besides recruiting adolescents with different levels of education, screening for stress levels was conducted in both groups and comparing them at a pretest (baseline) with no discernible differences provided some assurance of internal validity of the study findings.

Limitations

This study had some limitations. It was conducted in one opportunity expansion school, which may limit generalizability, and the outcome measures were collected during the school examination period, in which the primary support for students regarding their stress was concurrently given by classroom teachers. This may confound the findings, especially the primary outcomes, limiting internal validity. Secondly, the app was developed for adolescents with mild to moderate stress levels and is not intended at this stage of development for adolescents with other mental illnesses. Adolescents with severe stress need to use the app with combined other face-to-face nursing interventions, such as psychoeducation and counseling.

Thirdly, the app platform was developed for adolescent users. The app functions were suitable for this age group, such as having a user interface for playing games. For future studies, researchers should consider the users' contexts, including their behaviors, needs, and preferences. These factors can significantly impact the app's usability, influencing user retention rate and feasibility.

Finally, this current app can be operated only on the Android operating system, and to increase

accessibility, it should be redeveloped for other systems, such as Apple iOS.

Conclusions, Implications for Nursing Practice, and Recommendations

The BeWS-SPA is an innovative nursing approach that promotes positive thinking and reduces the perception of stress among at-risk adolescents. The program shows promising results for mental health nurses, school nurses, and classroom teachers to consider its implementation for stressed adolescents. Recommendations for nursing research, education, and administration are made as follows:

For nursing research, the results show that mobile health (mHealth) technology innovation effectively promotes individuals' mental health status. Therefore, those interested in using this program can apply this innovative app and adapt it to suit the users' context by using BeWS-SPA in conjunction with other forms of therapy or developing functionality to be more suitable for user groups. Moreover, future studies should include more schools considering controlling potential confounders and employing more rigorous research designs, such as randomized controlled trials, to ensure unbiased results. Outcome evaluation studies are recommended for further refinement of the app.

There is increasing attention to the development of nursing innovations in nursing education. The BeWS-SPA serves as an example of a theoretical-based and evidence-based innovation. This app can be used as educational material for teaching nursing students and as an alternative option for providing mental health services.

For nursing administration, the results support the transformation of the health service system according to the digital technology strategy of the Department of Mental Health, Thailand. This strategy focuses on comprehensive, equitable, and fair services for individuals of all age groups. Therefore, nurse administrators, particularly those in the field of mental health nursing, may facilitate launching the BeWS-SPA as an alternative mental health service channel in their settings.

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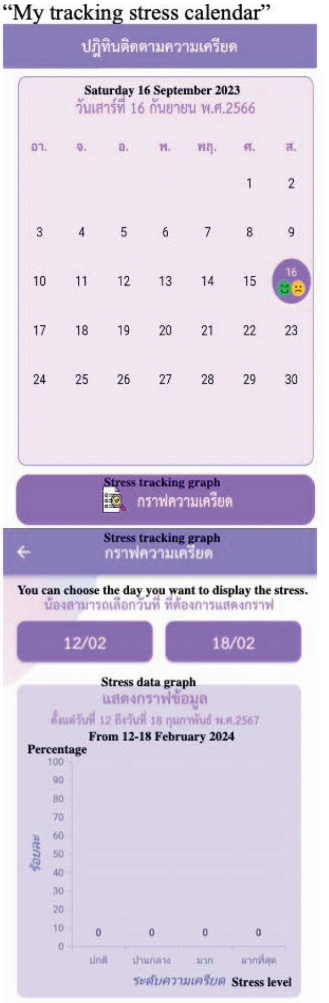
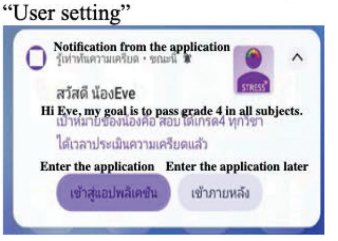
Appendix

Table A. The components of Be Aware of Stress app and implementations

ACT principle and objective	Application function (User interface)	Working system	User implementation
Each user performed all functions every day for 15-20 minutes for 8 weeks.			
Part 1: Mindfulness and acceptance process			
1. Acceptance: To enable adolescents to recognize and accept their own stress realistically	"My tracking stress calendar" 	Comparison of self-perceived stress assessment results with standard tools and presentation of assessment results with recommendations	Each user assesses stress by evaluating their perception and answering online questionnaires. The stress evaluation was divided into four levels: normal, moderate, high, and severe.
2. Cognitive defusion: To allow adolescents consider the reality of language defined as stress and the meaning that arises from the fusion of ideas with reality	"My stress management" with develop positive thinking approach 	Adjusting the adolescents' perspective of positive thinking with thought-checking games, by asking questions that contrast with previous views or weighing positive and negative thoughts with a thought-weighing game	The users who reported high stress were asked to practice stress management techniques aimed at modifying their negative thoughts.
3. Being present: To promote adolescents' learning to be mindful of the current situation as much as possible, without involving the past or predicting the future	"My stress management" with emotional focused coping approach 	Practicing mindfulness and diverting emotions using distraction strategies, such as imagination therapy, music therapy, and garden therapy	The users who reported moderate stress were asked to practice stress management techniques using various forms of emotion-focused coping strategies.

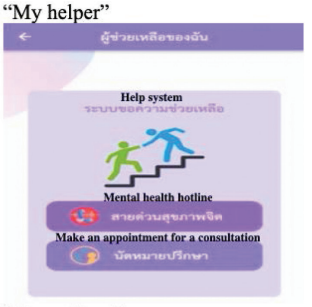
Appendix

Table A. The components of Be Aware of Stress app and implementations (Cont.)

ACT principle and objective	Application function (User interface)	Working system	User implementation
Part 2: Commitment and behavior-change processes			
4. Self as context: To keep adolescents up to date with the changes in adolescent thinking that causes stress in daily living	"My tracking stress calendar"  "User setting" 	Stress assessment according to the time set in the stress monitor, time reminder and summarizing the frequency and percentage of stress level from the database for users	Each user sets up a stress notification alert and accesses the application at the notification time. Then, each week, each user monitors his or her own stress level.

Appendix

Table A. The components of Be Aware of Stress app and implementations (Cont.)

ACT principle and objective	Application function (User interface)	Working system	User implementation
5. Defining valued directions: Values are used to create goals, plan actions step by step, and remind adolescents of their determination to follow their aspirations.	"My personal data" 	The personal motto, goals, and methods for reaching adolescents' goals will appear when users register for use every time.	To ensure data security and privacy, each user is asked to enter the login code and specify their personal identity information.
6. Commit to action: To develop potential and gain self-confidence	"My helper"  "Stress Guru" 	Create personal and information support resources to maintain the ability to manage their obstacles	Users with severe stress will receive an internal or external support system and self-study about stress, such as its meaning, signs and symptoms, and basic methods of dealing with it.

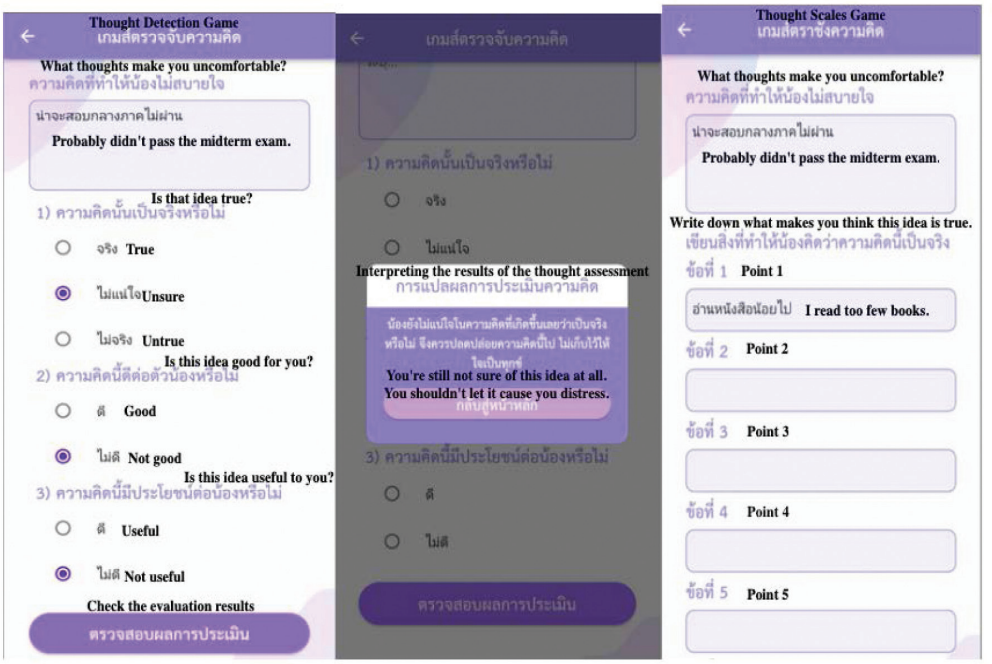


Figure A. The Be Aware of Stress app (Positive thinking approach)

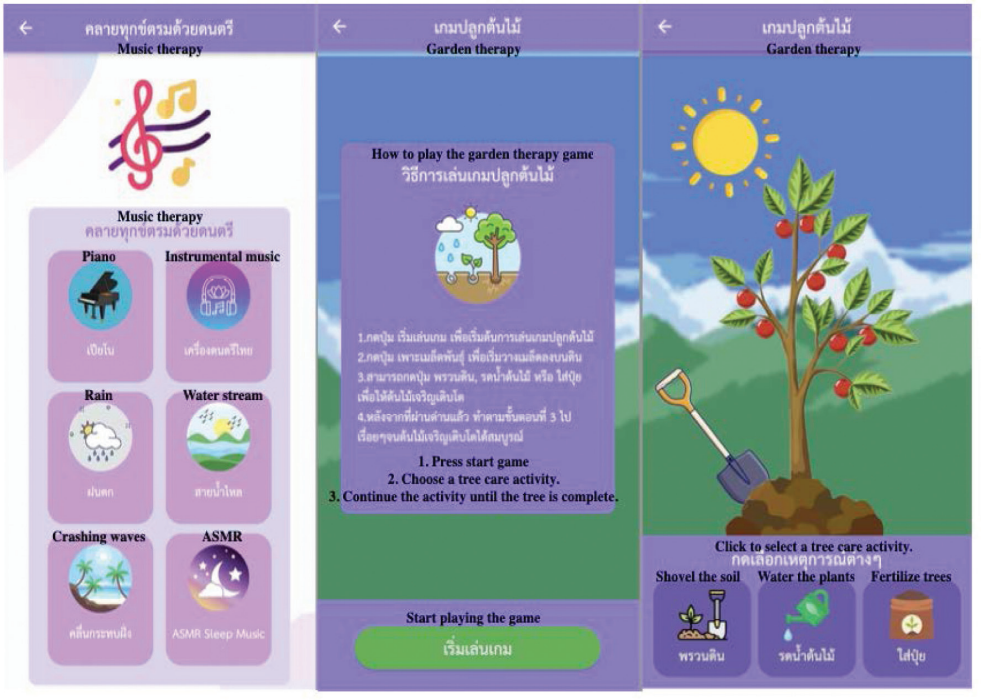


Figure B. The Be Aware of Stress app (Emotional focused coping approach)

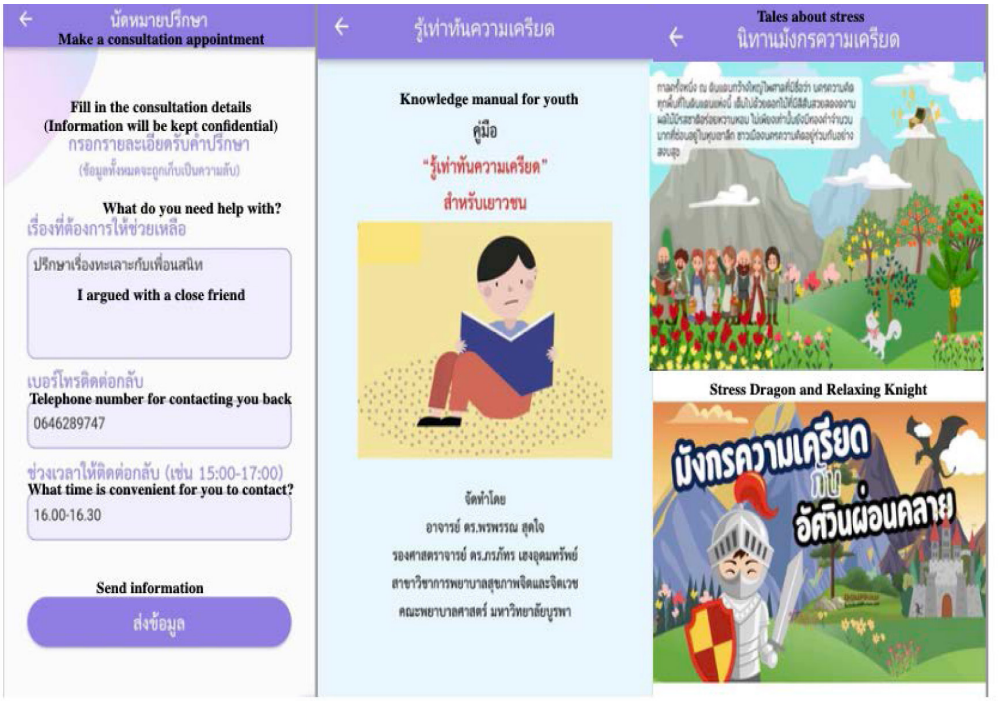


Figure C. The Be Aware of Stress app (Personal and information support resources)

การส่งเสริมการคิดเชิงบวกและลดการรับรู้ความเครียดด้วยสมาร์ทโฟนแอปพลิเคชัน “รู้เท่าทันความเครียด” สำหรับวัยรุ่นกลุ่มเสี่ยง : การศึกษากึ่งทดลอง

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บทคัดย่อ: ประมาณการว่าวัยรุ่นหลายล้านคนทั่วโลกประสบกับปัญหาสุขภาพจิต โดยเฉพาะความวิตกกังวลและภาวะซึมเศร้า วัยรุ่นที่มีการรับรู้ความเครียดสูงมักประสบปัญหาทางจิต มีความคิดเชิงลบ หรือไม่พึงพอใจกับเหตุการณ์ในชีวิตประจำวัน การศึกษานี้ใช้การออกแบบกึ่งทดลองที่มี 2 กลุ่มและวัดผลซ้ำ เพื่อทดสอบโปรแกรมทางการพยาบาลที่เป็นนวัตกรรมใหม่ คือ แอปพลิเคชัน “รู้เท่าทันความเครียด” บนสมาร์ทโฟน แอปพลิเคชันนี้มีจุดมุ่งหมายเพื่อเพิ่มการคิดเชิงบวกและลดการรับรู้ความเครียดของวัยรุ่นที่มีความเสี่ยงอายุ 13 ถึง 16 ปี และอธิบายความพึงพอใจของวัยรุ่นต่อการใช้งาน การศึกษานี้ดำเนินการกับนักเรียนมัธยมศึกษาตอนต้น 44 คน จากโรงเรียนขยายโอกาสในภาคตะวันออกของประเทศไทย ซึ่งได้รับการสุ่มให้อยู่ในกลุ่มทดลองและกลุ่มเปรียบเทียบ (กลุ่มละ 22 คน) รวบรวมข้อมูลระหว่างเดือนธันวาคม 2566 ถึงกุมภาพันธ์ 2567 โดยใช้แบบสอบถามข้อมูลทั่วไป แบบสอบถามการคิดเชิงบวก แบบสอบถามการรับรู้ความเครียด และแบบวัดความพึงพอใจของระดับความสามารถในการใช้งานแอปพลิเคชัน วัดผลลัพธ์พื้นฐานก่อนการทดลอง หลังจากเสร็จสิ้นโปรแกรมในสัปดาห์ที่ 4 และสัปดาห์ที่ 8 หลังจากใช้แอปพลิเคชัน วิเคราะห์ข้อมูลด้วยการทดสอบไคสแควร์และการวิเคราะห์ความแปรปรวนแบบวัดซ้ำ

ผลการศึกษานี้มีนัยสำคัญต่อการวิจัยในอนาคต สิ่งเหล่านี้บ่งชี้การปรับปรุงอย่างมีนัยสำคัญในการคิดเชิงบวกและการลดการรับรู้ความเครียดภายในกลุ่มทดลอง เมื่อเปรียบเทียบกับกลุ่มเปรียบเทียบในสัปดาห์ที่ 4 และ 8 นอกจากนี้ กลุ่มทดลองยังรายงานความพึงพอใจสูงต่อการใช้งานของแอปพลิเคชัน ผลการวิจัยเหล่านี้ชี้ให้เห็นว่าแอปพลิเคชัน “รู้เท่าทันความเครียด” เป็นประโยชน์สำหรับพยาบาลชุมชนและผู้เกี่ยวข้องในการป้องกันความเครียดของวัยรุ่น การศึกษายังเน้นย้ำถึงความจำเป็นในการวิจัยในอนาคต เพื่อปรับปรุงความสามารถในการปฏิบัติการของแอปพลิเคชันและความเข้ากันได้กับระบบปฏิบัติการโทรศัพท์ต่างๆ เพื่อให้มั่นใจว่ามีการใช้งานอย่างแพร่หลายและมีประสิทธิภาพ

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คำสำคัญ: วัยรุ่น การบำบัดด้วยการยอมรับและพันธสัญญา ซอฟต์แวร์โปรแกรมประยุกต์ นักเรียนมัธยมศึกษาตอนต้น การรับรู้ความเครียด การคิดเชิงบวก การศึกษากึ่งทดลอง

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