

## ORIGINAL ARTICLE

# MOBILE APPS DEVELOPMENT AND VALIDATION: TAILORED INTERVENTION ON DEPRESSION AMONG PARAMEDIC STUDENTS OF MALAYSIAN MINISTRY OF HEALTH TRAINING INSTITUTE AT KUCHING, SARAWAK

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## ABSTRACT

Depression is rather common among students in any educational institution, with no exception for local students in Malaysia. Early depression intervention, such as boosting awareness of depression, has been documented in the literature as a helpful strategy to prevent this type of mental disease. Therefore, knowledge of depression was introduced through a mobile app to enhance the knowledge level of depression among paramedic students at Institut Latihan Kementerian Kesihatan Malaysia (ILKMM) Kuching, in Sarawak. An interventional study with convenience sampling was conducted among final-year paramedic students aged 22 to 27 years old. Knowledge of Depression for Students Questionnaire (KDSQ) and clinical vignette were used to assess the knowledge on depression before and after the intervention. The Knowledge of Depression for Student Mobile Application (KDS-App) consists of 12 sections and was used in intervention to enhance the knowledge of depression among the students. Assessment for knowledge of depression of the students via KDSQ reveals higher post-intervention knowledge score than the pre-intervention performance ( $P < 0.05$ ). The KDS-App as an intervention tool in this study contributes to greater improvement in students' ability to recognize depression (93.0%), knowledge of appropriate first-aid for depression (98.3%), and ability to determine medical intervention for depression (99.1%). The control group presented no improvement in their knowledge of depression based on the clinical vignette and KDSQ assessments. Besides educating students about depression, this mobile app can also be used as a first-aid tool for depression; an alternative resource for anyone looking to learn more about depression, self-monitor for depression, or raise awareness of depression.

**Keywords:** Knowledge, Depression, Students, Higher Educational Institution, Mobile application

## INTRODUCTION

Major depressive disorder (MDD) was classified as the third leading cause of disease burden globally by WHO in 2008, with the disease anticipated to rank first by 2030<sup>1</sup>. Before 2020, mental disorders were the leading causes of the global health-related burden, with depressive and anxiety disorders being the leading contributors to this burden, and the emergence of the COVID-19 pandemic has created an environment in which many determinants of poor mental health have been exacerbated<sup>2</sup>. Globally, South Asian nations report having the highest rates of common mental disorders (CMDs)<sup>3</sup>. According to the findings from the National Health and Morbidity Survey (NHMS) Malaysia in 2018, East Malaysia's rural region had the highest frequency of mental disorders (43%), followed by Kuala Lumpur's capital, where 40% of the population met the criteria for mental diseases<sup>4</sup>.

Depression is a prevalent health issue among university students<sup>5</sup>. According to local studies, studying and independent living stress contribute to depression among young people, especially university students in Malaysia<sup>6</sup>. The prevalence

of depression and stress among students, particularly among female students may have

long-term effects on students' future career earning potential and overall health<sup>7</sup>. Mental health issues can harm many aspects of a student's life, including their quality of life, academic accomplishment, physical health, contentment with their college experience, and connections with friends and family members<sup>8</sup>.

Previous studies have found that a lack of mental health literacy is associated with higher rates of stress, depression, anxiety, internalized stigma, and carer burden<sup>9</sup>. In the study done by Cheng et al. (2021), an examination of the relationship between mental health knowledge level and depression symptoms among Chinese college students, they found that the more knowledgeable students were about mental health, the fewer depressive symptoms they reported<sup>10</sup>.

According to Dogan-Sander et al. (2021), there has been a rise in the severity of depressive symptoms among students, including suicidal ideation and drug and alcohol use. During ongoing times of crisis, universities and healthcare policies should recognize and treat the mental health difficulties

of young adults, as well as invest in easily accessible interventions<sup>11</sup>.

The use of mobile apps in the healthcare industry to deliver interventions targeted at influencing people to promote health and manage diseases is expanding tremendously<sup>12</sup>. According to the current systematic review findings, college students accept and adhere to Mobile app-based psychological interventions, and preliminary evidence of efficacy has been demonstrated in various disorders such as stress, anxiety, depression, and risky behaviors such as alcohol and tobacco abuse and sexual knowledge<sup>13</sup>. To increase knowledge and attitude about depression, it is beneficial to introduce depression education through mobile applications. An earlier version of the Happy Mother mobile app was created to help women manage postpartum depression on their own. It has now been shown to be successful in alleviating depressive moods and encouraging moms to adopt healthy behaviors<sup>14</sup>. According to a study done on secondary school students in Malaysia, mental health awareness was influenced by knowledge of mental health and attitude toward mental health<sup>15</sup>.

Mobile applications could be used to improve attitudes and knowledge about depression among people, especially among students; therefore, this intervention approach, particularly in the current post-pandemic era, may give college students a basic knowledge of depression and information about it while simultaneously opening their minds to have positive attitude towards mental health issues. To increase knowledge and attitude about depression, it is beneficial to introduce depression education through mobile applications. Users can comprehend and identify the clinical signs of depression by browsing on their mobile phones. As a result, spreading awareness of depression through mobile applications has improved individuals' attitude and knowledge about the condition, especially among students.

## METHODS

### Materials

#### *Research design*

This was an intervention study. This study was conducted in ILKMM Kuching, Sarawak, in the east region of Malaysia. Purposive sampling was used, where the paramedic students from the diploma program registered for their final year during the January 2022 academic session were included in the study.

### Subjects

The sample size was calculated using the online sample size calculator<sup>16</sup>; the formula yielded a minimum sample size of 194 from a total population of 389 students. Final year paramedic

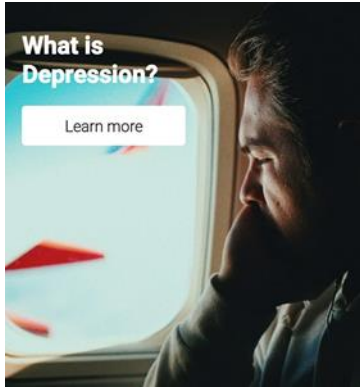
students who conveniently attended the briefing before the intervention study were welcomed to participate in this study. Paramedic students from two programs, diploma in Nursing programs and diploma in Medical Assistant who were currently in the final year; first and second semester of year 3 of their academic session at ILKMM Kuching were the inclusion criteria for the study requirements. An individual who did not meet the inclusion criteria was not permitted to participate. After applying the inclusion and exclusion criteria, a final sample of 221 paramedic students was selected, with 115 assigned for the intervention study and 106 for the control group. All the participants must be able to give written consent before the intervention study.

### Development of KDS-App

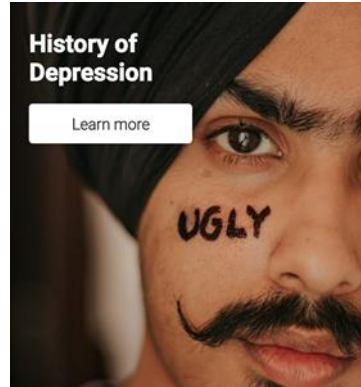
This mobile application was created over the course of around six months, from January 2022 to June 2022. Data from numerous reliable studies were used to inspire creativity, innovation, and information about depression, with an emphasis on its history, clinical manifestations, diagnosis, therapy, and prevention. Content development followed by mobile app development for a depression intervention program. There were 12 sections of subtopic on knowledge of depression developed with contains; Section 1 What is depression? Section 2 History of Depression, Section 3 Theory of Depression, Section 4 Causes of Depression, Section 5 Symptoms of Depression, Section 6 Types of Depression, Section 7 Effects of Depression; Section 8 Diagnostic Criteria of Depression, Section 9 Treatment of Depression; Section 10 Risk factors, Section 11 Prevention of depression and Section 12 Self-test of depression base on Beck's Depression Inventory (BDI) (Figure 1). This mobile app was named Knowledge on Depression for Students (KDS-App).

The mobile app includes visuals and subtopics for each area to help users visualize each piece and find what they're looking for more quickly. Beginning with a draft, modification, and expert content validation were required for acceptance and viability. There is a short clip that demonstrates how users can search for specific material in the KDS-App. The KDS-App has 12 sections and is estimated to take 15 to 20 minutes to complete. The contents were validated by professionals and specialists in mental health, particularly depression. Feasibility and acceptability followed next. At this stage, the mobile app's face validity, user feedback, and ideas all being gathered. The comments from the participants and the experts led to a small alteration. All comments from participants in the KDS-App intervention group, as well as descriptive evaluations from panel experts, were used to validate and analyze the success of the mobile app. The following table shows the finished components of the mobile app (Table 1

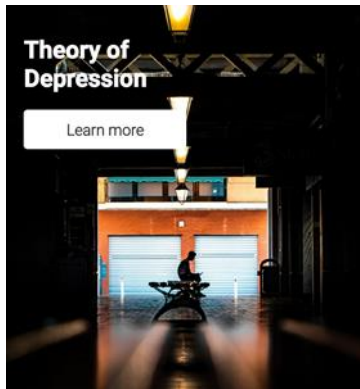
**Section 1 - What is depression?**



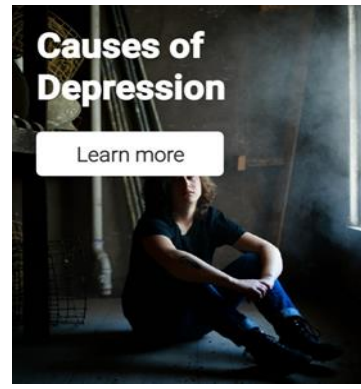
**Section 2 - History of depression**



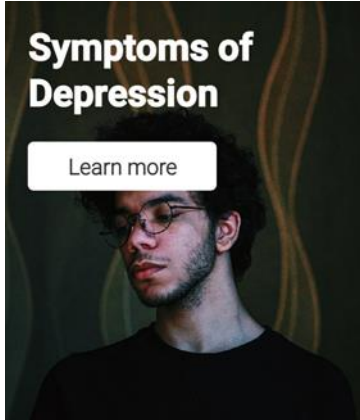
**Section 3 - Theory of depression**



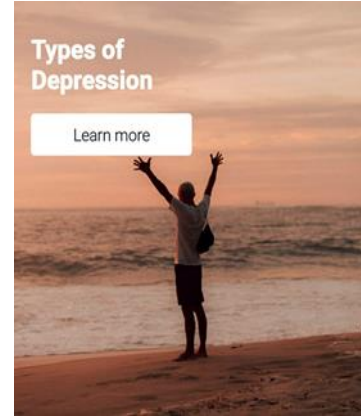
**Section 4 - Causes of depression**



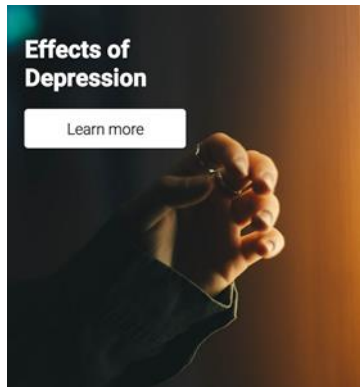
**Section 5 - Symptoms of depression**



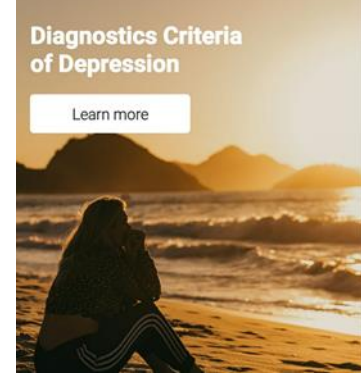
**Section 6 - Types of depression**



**Section 7 - Effects of depression**



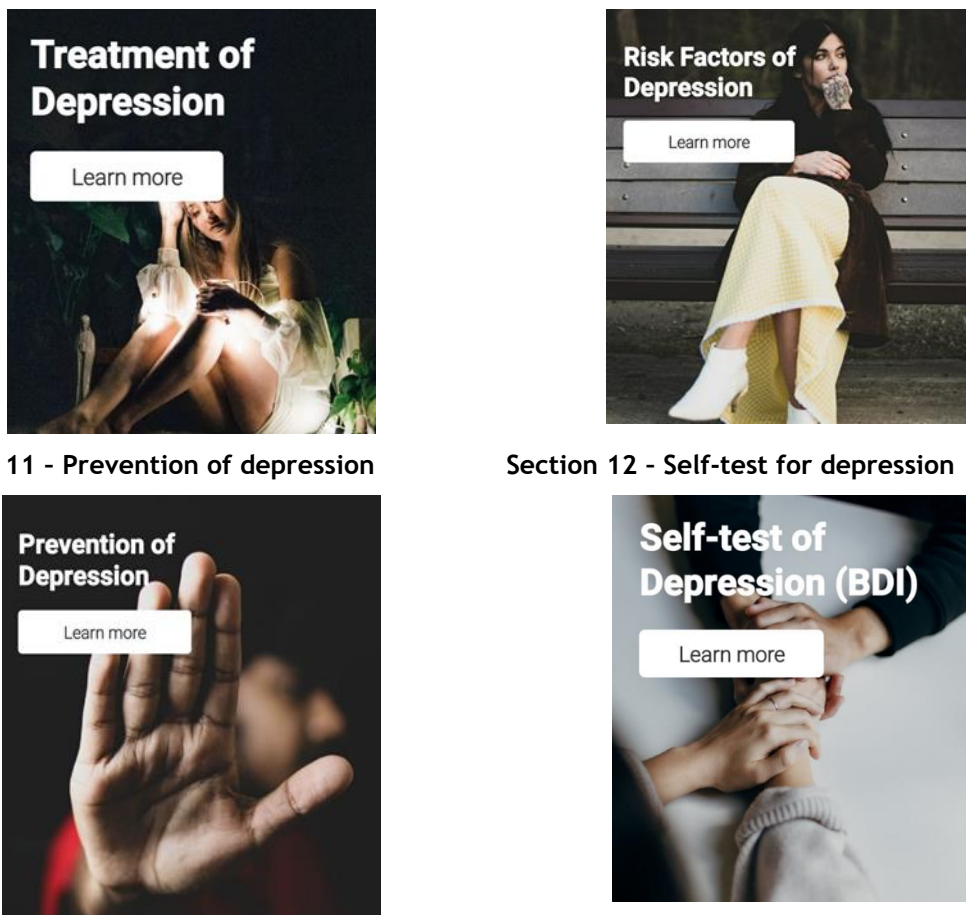
**Section 8 - Diagnostic Criteria of depression**



**Section 9 - Treatment of depression**

**Section 10 - Risk factors of depression**

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Section 11 - Prevention of depression

Section 12 - Self-test for depression

Figure 1. The sections in KDS-App

Table 1. Content of KDS-App

Section 1	<p><b>What is depression?</b></p> <p><b>World Health Organization (WHO):</b>                  Depression is characterized by persistent sadness and lack of interest or pleasure in previously rewarding or enjoyable activities which can also disturb sleep and appetite; tiredness and poor concentration are common.</p> <p><b>American Psychological Association (APA):</b>                  Depression is more than sadness. People with depression may experience a lack of interest and pleasure in daily activities; significant weight loss or gain; insomnia or excessive sleeping; lack of energy; inability to concentrate; feelings of worthlessness or excessive guilt; and recurrent thoughts of death or suicide</p> <p><b>National Institute of Mental Health (NIMH):</b>                  Depression is a common but serious mood disorder that causes severe symptoms that affect how a person feels, thinks, and handles daily activities such as sleeping, eating, or working. To be diagnosed with depression, the symptoms must be present for at least two weeks.</p>
Section 2	<p><b>History of depression</b></p> <p><b>Demonic possession:</b>                  According to historical accounts, all mental diseases were attributed to demonic possession at the time, and it was once understood as a spiritual affliction rather than a medical one.</p> <p><b>The Philosophers Theory:</b>                  Hippocrates, a Greek physician, proposed that too much black bile in the spleen produces depression, originally named "melancholia" ("black bile" in Greek).</p> <p><b>Beliefs About Depression:</b>                  The prevalent belief among educated Romans was that mental diseases like depression were caused by demons and God's wrath.</p> <p><b>Reasons for Depression:</b></p>



In 1621, Robert Burton wrote 'The Anatomy of Melancholy', in which he emphasized poverty, anxiety, and isolation as psychological and social causes of sadness.

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### Section 3 Theory of Depression

#### **Behaviorist Theory:**

Environmental factors, according to behaviorists, influence individual actions.

#### **Psychodynamic Theory:**

Depression, according to Freud and the psychodynamic theory, is produced by unresolved conflicts between the conscious and unconscious mind.

#### **Cognitive Theory:**

According to cognitive theories of depression, people's thoughts, judgments, attitudes, and interpretations, as well as how they attend to and recall experiences, can raise their risk of developing recurring depressive episodes.

#### **Humanist Theory:**

According to Maslow, people suffering from depression struggle to meet their lower hierarchical needs of love, belonging, and esteem.

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### Section 4: Causes of Depression

#### **Family history:**

According to family studies, the first-degree offspring of depressed people have a two- to threefold increased incidence of depression.

#### **Illness and health issues:**

Depression can be caused by chronic health problems, long-term health problems, or physical health problems that radically alter one's lifestyle. Chronic pain issues, according to research, can trigger metabolic alterations that lead to depression symptoms.

#### **Medications, drugs, alcohol, and nicotine:**

People with substance use problems (alcohol and drugs) have high levels of depressive symptoms, especially individuals who lack social support. Alcoholism and nicotine addiction were found to be substantially related to depressed mood, particularly in men.

#### **Personality:**

Certain personality qualities, such as poor self-esteem, pessimism, neuroticism, and being self-critical or "a perfectionist," have been associated with a higher risk of depression.

#### **Life events:**

Stressful life events are associated with a rise in depressive symptoms and the onset of severe depression.

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### Section 5 Symptoms of Depression

#### **Early symptoms of depression:**

For more than two weeks, they have been sad, down, or unhappy, or they have lost interest or enjoyment in most of their daily activities.

#### **Symptoms of Depression: Physical**

Sickness, difficulty sleeping, poor appetite, weight loss, tiredness, frequent headaches, shaking, muscle pain, nausea or vomiting, constipation, dizziness, and back pain.

#### **Symptoms of depression: Behaviour**

Withdraws from friends and family, fails to complete tasks, loses interest in activities, hobbies, and sexual life, struggles to concentrate, unhealthy lifestyle (smoking, low physical activity, heavy drinking patterns), and poor eating habits.

#### **Symptoms of depression: Thoughts**

Previous research found that depressed people had much more negative views about themselves and their future than non-depressed people.

#### **Symptoms of depression: Feelings**

The cognitive theory of depression proposes significant relationships between negative thoughts and depression; depressed people indicated significantly more negative thoughts towards themselves and the future compared with the non-depressed.

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### Section 6 Types of Depression

#### **Disruptive Mood Dysregulation Disorder (DMDD):**

The diagnostic criteria for DMDD, which is limited to children under the age of 12, comprise four symptoms, each of which refers to a distinctive aspect of "temper

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outbursts" either as severe, inconsistent with developmental level, occurring 3 or more times per week, or with the most of the day irritability or anger inter episode mood.

**Major Depressive Disorder (MDD):**

An individual is diagnosed with MDD if they have a persistently low or depressed mood, anhedonia or a decreased interest in pleasurable activities, feelings of guilt or worthlessness, a lack of energy, poor concentration, appetite changes, psychomotor retardation or agitation, sleep disturbances, or suicidal thoughts, where symptoms have been present every day for at least two weeks.

**Persistent Depressive Disorder (PDD):**

Persistent depressive disorder, formerly known as dysthymic disorder, is a chronic form of depression characterized by at least two of the following symptoms: poor or increased appetite; sleeplessness or excessive sleep; low energy or tiredness; poor self-esteem; poor concentration; difficulty making decisions; or feelings of hopelessness.

**Premenstrual Dysphoric Disorder (PMDD):**

Premenstrual symptoms are a group of mood, behavioral, and physical symptoms that occur in a cyclical pattern prior to menstruation and then fade after the menstrual period in women of reproductive age, with some women experiencing moderate-to-severe symptoms of depression that cause significant distress and impaired functioning.

**Substance / Medication-induced Depressive Disorder:**

Substance- or medication-induced depressive disorder is identified when a substance (alcohol, illegal substances, or prescribed medication) produces symptoms of depression when the substance is consumed or during a withdrawal phase associated with the substance.

**Depressive Disorder Due to Another Medical Condition:**

Most chronic illnesses, such as diabetes, rheumatoid arthritis, or osteoarthritis, were related to a higher risk of MDD depending on age, and some may have a bigger influence than others on the risk of depression.

**Other Specified Depressive Disorders:**

A category of DSM-5 diagnoses applies to individuals who have symptoms characteristic of a depressive disorder (e.g., MDD) but do not meet the full criteria for any of them.

**Unspecified Depressive Disorder:**

Any depressive disorder that does not meet the criteria for a specific disorder. In the DSM-5, it is called unspecified depressive disorder. Examples of disorders in this category include those sometimes described as minor depressive disorders and recurrent brief depression.

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Section 7      Effects of Depression

**The effects of depression on individuals:**

Major depressive disorder is a major mental illness that has a significant impact on an individual's quality of life.

**The effects of depression on family:**

Family members of those suffering from severe depression faced profound consequences. Infants with depressed mothers cry more frequently and intensively. Children who have depressive parents or guardians are more likely to have behavioral issues and are more prone to display indications of anxiety disorders or depression.

**The effects of depression on organization:**

Depression symptoms are related to work absences and impaired work performance. Depressed employees are regarded as a liability rather than an asset.

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Section 8      Diagnostic Criteria of Depression

**Diagnostic and Statistical Manual of Mental Disorders 5<sup>th</sup> Edition (DSM-5):**

The depressed individual must be experiencing five or more symptoms during the same two-week period and at least one of the symptoms should be either (1) depressed mood or (2) loss of interest or pleasure where depressed mood most of the day for nearly every day.

Other symptoms of depression that people encounter on a daily basis

1. Depressed most of the day.
  2. Markedly diminished interest or pleasure in all, or almost all, activities most of the day.
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3. Significant weight loss when not dieting or weight gain, or a decrease in appetite.
4. Insomnia or hypersomnia.
5. Psychomotor agitation or retardation is nearly (observable by others).
6. Fatigue or loss of energy.
7. Feelings of worthlessness or excessive or inappropriate guilt may be delusional.
8. Reduced ability to think or concentrate, or indecision.
9. Recurrent thoughts of death, recurrent suicidal ideation without a specific plan, a suicide attempt, or a specific plan for committing suicide.

**The International Classification of Diseases (ICD) - 11:**

A depressive episode is defined in the ICD-11 as the concurrent presence of at least five of ten symptoms that must occur most of the day, virtually every day, for at least two weeks. One of these symptoms must be a sad mood or a significant decrease in interest or enjoyment of activities.

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Section 9 Treatment of Depression

**Psychotherapy:**

Psychotherapy has the potential to be beneficial in the treatment of depression. The re-analysis demonstrates that psychotherapy for adult depression individuals is effective.

**Pharmacotherapy:**

Major depression usually necessitates the use of one or more antidepressant pharmacotherapy.

Selective serotonin reuptake inhibitors (SSRIs) and serotonin-norepinephrine reuptake inhibitors (SNRIs) are first-line treatments for depression.

**Healthy lifestyle:**

Exercise boosts the body's production of natural antidepressants, and according to one study, exercising for 30 minutes three to five days a week may boost resilience to stressful stimuli without the use of medication.

An increased intake of magnesium, folic acid, B6, and B12 in the diet is essential in preventing depression and several micronutrients have been demonstrated to increase mood in various groups.

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Section 10 Risk factors of Depression

**Family history and genetics:**

The most important risk factor for developing a depressive disorder is a positive family history. Family and twin studies have offered compelling evidence that genetic factors contribute to the risk of depression.

**Chronic stress:**

Life stress has been demonstrated to affect depression; the more stressful life events a person endures, the more likely he or she is to develop depression.

**History of trauma:**

Psychological abuse is strongly associated with depression. Victims of childhood trauma have low self-esteem and are depressed and anxious.

**Gender:**

Girls and women are twice as likely as males to suffer from depression.

Biological variables, such as changes in ovarian hormone levels, especially estrogen declines, may contribute to the increasing occurrence of depression and anxiety in women. Estradiol variation during the menopause transition is associated with a higher risk of depression in women.

**Poor nutrition:**

A 10% increase in the proportion of ultra-processed foods in the diet was associated with a 1.21-fold greater risk of depressive symptoms. Sweetened beverages, such as soft drinks, increase the risk of depression. In humans, omega-3 fatty acid deficiency is linked to an increased risk of developing a variety of psychiatric diseases, including depression.

**Unresolved grief or loss:**

Sustained death, a strained relationship with the departed, witnessing the death of a loved one, and having social assistance have all been associated to grieving depression.

**Personality traits:**

Neuroticism was positively associated with depression, whereas extraversion, openness, agreeableness, and conscientiousness were inversely associated with depressive symptoms.

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**Medication and substance use:**

Antiviral medicines, cardiovascular agents, retinoic acid derivatives, antidepressants, anticonvulsants, anti-migraine agents, antipsychotics, hormonal agents, smoking cessation agents, and immunological agents have all been associated with medication-induced depression.

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Section 11 **Prevention of depression**

**Exercise regularly:**

Frequent recreational exercise of any intensity protects against future depression. Joining group-based physical activity helps prevent depression.

**Cut back on social media:**

People's well-being, depression, and anxiety increase significantly when they are asked to refrain from using social media for one week.

**Build strong relationships:**

Research has shown that having even "adequate" social support can protect against depression.

**Practice self-care:**

Self-care activities that are well-practiced should be an instant part of a person's life to lessen depression symptoms. Dietary supplements, herbal medicines, mind-body treatments, and various forms of exercise were among the self-care options employed by the general people for depression and anxiety.

**Reduce stress:**

Mindfulness, whether natural or cultivated through meditation, can promote well-being by alleviating depressive symptoms.

**High-quality sleep:**

Improved sleep was associated with improved mental health regardless of the severity of the mental health challenge or the presence of coexisting health conditions.

Not to look at any screens for two hours before bed (including phone), meditate before bed, have a comfortable mattress, and avoid caffeine after noon.

**Eat well:**

To promote and prevent depression, people should be advised on health-promoting diets such as increasing their intake of vegetables, fruits, fish, nuts, legumes, and olive oil, and avoiding or severely restricting their intake of processed foods such as sausages, juices, soft drinks, and sweets.

**Manage chronic conditions:**

Individuals with more chronic conditions experienced more severe pain and were more likely to develop depression pain management treatments should be considered.

**Prevention of alcohol, nicotine, and drugs:**

An online global school-based preventative intervention addressing drug use, depression, and anxiety in adolescence is successful in lowering the odds of any drinking and excessive episodic drinking as well as reducing depressive symptoms.

**Minimize daily choices:**

Learn to be more decisive quickly because, when faced with too many options, those who strive to make the best choice possible suffer from higher rates of depression.

**Build strong social support:**

Social support and a sense of belonging can help people reduce their depression symptoms. Social connectedness can operate as a "social cure" for psychological illnesses such as depression, encouraging and preserving mental wellness.

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Section 12 **Self-test of depression**

**Beck's Depression Inventory (BDI):**

A self-report rating assessment of 21 items, the Beck Depression Inventory (BDI) gauges depressive symptoms and typical attitudes.

**Validity of KDS-App**

The mobile app has graphics and subtopics for each section to help users visualize each element and find what they're looking for more easily. After the data collection, participants gave this educational mobile app overwhelmingly favorable feedback. The comments from the participants and the experts led to a small alteration. The

content validity was done by two experts from local and international institutions, who specialize in mental health issues. The contents of the questionnaires were accepted and appropriate, whereby the content was able to measure the intended parameters. The questionnaire also presented an excellent response based on the items constructed, hence the instrument was validated (Table 2).



Table 2. Validity of KDS-App

Validity	Respondents	Comments
Face validity	59 respondents	<ul style="list-style-type: none"> <li>• Lively and appealing.</li> <li>• The information in the image is clear and simple to understand.</li> <li>• The sections for each subtopic were well organized and had catchy headings. The colorful pictures add to the overall appeal.</li> <li>• The content was properly explained. The topic was valuable to those who did not understand medical terminology because it was delivered in plain terms.</li> <li>• The mobile application proved quite useful in helping developing students or users better understand depression. This app raises awareness about depression.</li> <li>• Students can use this mobile application to educate themselves and those around them about depression.</li> <li>• This mobile app will be recommended to other students.</li> </ul>
Content validity	2 experts	<ul style="list-style-type: none"> <li>• Experts in this subject had validated the content.</li> <li>• According to the experts, the mobile app is really valuable for students because it allows them to study depression in-depth and become more conscious of the problem.</li> <li>• The content was understandable, reasonable, and acceptable.</li> <li>• The value calculated <math>r=.86</math>.</li> </ul>

### Feasibility and acceptability KDS-App

Based on face validity, the respondent had responded positively to the KDS-App. This finding showed the urge to know the usage of the KDS-App. KDS-App can be obtained at a low cost and can be brought along anywhere without depending on the social network. This mobile app is known as a time saver as well because it's handy and can be assessed easily. Doctors strongly advised students to use mobile apps as an alternative way to check themselves for signs and symptoms of depression so that further treatment and prevention measures can be implemented.

### Development of KDSQ

To assess the students' knowledge of depression, newly developed questionnaires were used. This instrument was named as Knowledge of Depression Questionnaire (KDSQ) and specifically was developed to measure knowledge of depression for students. The items were carefully chosen from the literature to assess students' knowledge and attitudes concerning depression. The final KDSQ consists of 25 dichotomous questions followed by three open-ended questions based on the clinical vignette, comprising the depression recognition and attitudes towards depression portion. The clinical vignettes included with this study tool aid in testing students' recognition of clinical signs of depression as well as their attitude towards depression. All items have been constructed in

bilingual English and Malay, the national language of Malaysia.

### Validity and reliability of KDSQ

During the pilot study, a test-retest technique was used to establish the reliability of the questionnaire (KDSQ), and the correlation coefficient between the two groups of participants of the first and second semester of final-year students, was 88.0 and 92.0, respectively with a good internal consistency (Cronbach's alpha = 0.76). The validation part of the questionnaire consisted of construct validity. In this study, face validity and content validity were employed to analyze the construct validity of KDSQ. This was accomplished during the pilot phase, and KDSQ was tested and evaluated. The questionnaire's face and content validity were performed by a psychologist and a psychiatrist expert in mental health.

The study has received approval from the university ethics committee; Management and Science University of Research Management Center (Code Ethics: MSU-RMC-02/FR01/02/L1/027). A pilot study was conducted on 10% of the sample size to assess the tools' clarity and usability. The students were selected according to the inclusion criteria: The inclusion criteria were paramedic students from the diploma program who currently attending their final year of the 2023 academic session at ILKMM

Kuching, Sarawak. Students who did not meet the criteria were excluded from the study. Data collection was done within three months from August to October 2022.

**Data collection**

Consent forms were obtained from the participants before administering the questionnaire (KDSQ) to both the control and intervention groups. The information on sociodemographic characteristics and medical history of depression was collected after the participants handed in their consent forms. The data for pre-intervention was collected based on the KDSQ assessment before interventions were introduced. The intervention study was initiated by distributing the tools (KDS-App) to the participants of the intervention group, and KDSQ was again administered to the participants to gather the results of the post-intervention.

**Statistical analysis**

The data were analyzed using SPSS version 27. Descriptive analyses were conducted for the sociodemographic, knowledge and awareness of

depression, and KDS-app effectiveness outcomes. The difference between the pre-and post-intervention performance of the KDSQ was measured using a paired-sample t-test. A p-value of <0.05 is considered statistically significant.

**RESULTS**

This interventional study involved 221 final-year students, year 3, Semesters 1 and 2, from the Diploma in Nursing and Medical Assistant program, who are now in their fifth and sixth semesters and represent ILKMM Kuching students. More than half of the participants were female (54.3%), with the majority coming from the second semester of year 3 students (55.2%). The participants’ ages ranged from 22 to 27 years old and came from multiple ethnic backgrounds. The mean age of the students was 23.2 years old (S.D.= ±1.38). Five students self-reported have been diagnosed with Major Depressive Disorder (MDD) and twenty-eight students with a family history of MDD (12.7%). The sociodemographic characteristics of the students are reported in Table 3.

**Table 3. Sociodemographic data of the participants**

Variable		n	%
Gender	Male	101	45.7
	Female	120	54.3
Age	22	89	40.3
	23	61	27.6
	24	32	14.5
	25	18	8.1
	26	14	6.3
	27	7	3.2
Ethnicity	Malay	62	28.0
	Sea Dayak	51	23.1
	Land Dayak	49	22.2
	Chinese	26	11.8
	Others	33	14.9
Academic session	Year 3 Semester 1	99	44.8
	Year 3 Semester 2	122	55.2
Diagnosed with MDD	Yes	5	2.3
	No	216	97.7
Family history of MDD	Yes	28	12.7
	No	193	87.3

**Effectiveness of KDS- App**

To confirm the distribution of the data, a normality test was performed. Following the normality test, the Kolmogorov-Smirnov test revealed a normal distribution for the parameters (P > 0.05). In the post-intervention study, knowledge on the recognition of depression, help-

seeking, and attitude towards depression based on the clinical vignette assessment was improved compared to before the invention of the KDS-App (refer to Table 5). The total score of KDSQ in the pre-intervention study was found to be lower than the post-intervention study given the full score is 25 point.

**Table 4. Knowledge of depression based on a clinical vignette of the control group**

	Pre-test Correct answer(%)	Post-test Correct answer(%)
Knowledge of the recognition of depression	13(12.3)	14(13.2)
Knowledge about first aid for depression	65(61.3)	66(62.3)
Knowledge about interventions for depression	55(51.9)	57(53.8)

As it was indicated in Table 4, the correct answers in post-test performance on knowledge of depression based on clinical vignette assessment increased compared to the pre-test assessment. The majority of the students failed to recognize depression based on the clinical manifestations presented in the clinical vignette (12.3%). Most of the students label the situation as other mental issues such as stress, anxiety, and just being sad (Pre- =87.7%; Post- =86.8%). More than half of the students had knowledge of first aid for

depression; approached the person, talked to the person, listened to his problems in an understanding way, suggested he seek professional help, and encouraged him to become more physically active (Pre-=61.3%; Post-=62.3%). Approximately half of the students knew the appropriate intervention for depression by suggesting seeking medical professionals such as doctors, psychologists, or psychiatrists (Pre-=51.9%; Post- =53.8%).

**Table 5. Knowledge of depression based on a clinical vignette of the experimental group**

	Pre-test Correct answer(%)	Post-test Correct answer(%)
Knowledge of the recognition of depression	21(18.3)	107(93.0)
Knowledge about first aid for depression	77(67.0)	113(98.3)
Knowledge about interventions for depression	61(53.0)	114(99.1)

According to the findings in Table 5, the post-test performance shows a tremendous increase in correct answers in the knowledge assessment of depression based on the clinical vignette after the intervention. The majority of the students managed to recognize depression (93.0%) and

correct first-aid approach for depression (98.3%) after the intervention. Almost all the students were able to suggest the most appropriate intervention for depression after the intervention with KDS-App (99.1%).

**Table 6. Mean and standard deviation of KDSQ for the control group**

	Mean	SD	n
Pre-test	16.12	3.42	106
Post-test	16.08	3.44	106

As it was indicated in Table 6, the post-test mean score (M =16.08, SD =3.44) of students in the control group was lower than their pre-test mean score (M =16.12, SD =3.42). The mean differences

between the pre-test and post-test of the control group are shown in Table 7.

**Table 7. Mean differences between the pre-test and post-test of KDSQ for the control group**

	Mean	SD	SE	t	df	P-value
Pre-test	0.05	0.29	0.03	1.681	105	0.096
Post-test						

As it was revealed in Table 5, students' post-test scores were not significantly higher than their pre-test scores, t (105) =1.68, p >0.05. Overall results indicated that there was no improvement in the control group between the pre-test and

post-test scores. The pre-test and post-test mean scores and the standard deviation of students in the experimental group is presented in Table 6.

**Table 8. Mean and standard deviation of KDSQ for the experimental group**

	Mean	SD	n
Pre-test	20.18	0.31	115
Post-test	22.77	0.23	115

As can be seen from Table 8, the post-test mean score (M = 22.77, SD =0.23) of students in the experimental group was higher than their pre-test

mean score (M =20.18, SD =0.31). The mean differences between the pre-test and post-test of the control group are shown in Table 9.

**Table 9. Mean differences between the pre-test and post-test of KDSQ for the experimental group**

	M	SD	SE	t	df	P-value
Pre-test	-2.58	1.97	0.18	-14.07	114	0.00
Post-test						

Data Table 9 indicated that the post-test mean score of students in the experimental group was significantly higher than their pre-test mean score, t (114) = -14.07, p<0.05.

To investigate whether there was a significant difference between the post-test scores of

students who were in experimental and control groups, an independent samples t-test was conducted and the results were indicated in Table 10.

**Table 10. Post-test scores of KDSQ for the control and experimental group**

	M	SD	t	df	P-value
Control group	16.08	3.44	-16.91	105	0.00
Experiment group	22.83	2.53			

As revealed in Table 10, the post-test mean score of KDSQ for the experimental group was higher than that of the control group; this result showed a statistically significant difference between the two groups (t = -16.91, p <0.05). Hence, it can be stated that the knowledge of depression of students differs significantly after the intervention.

**DISCUSSION**

**Approach to mental health promotion**

The goal of public mental health (PMH) is to increase well-being and mitigate poor mental health in the general population<sup>16</sup>. The focus of public mental health in recent decades has been on preventing and treating mental illnesses<sup>17, 18</sup>. According to the World Health Organization (2021), the promotion of healthy mental health must begin with young individuals. Many universal or selective interventions can be useful in promoting young people's mental health<sup>19</sup>. The use of innovative therapies, including mobile and internet-based interventions, as well as blended and stepped-care models of care, can address the population's large mental health needs<sup>20</sup>. Mobile apps have the potential to deliver highly effective mental health interventions<sup>21</sup>. The findings in the study by Goldberg et al. (2022) support the promise of mobile phone-based therapies and highlight crucial directions for providers, policymakers, clinical trialists, and meta-analysts working in this area<sup>22</sup>. According to Oliveira et al. (2021), college counseling services, in particular,

may benefit from the mobile app or health interventions, not just to address college students' mental health but also to alleviate some of the issues associated with a shortage of human resources<sup>23</sup>. The use of mobile apps to enhance mental health education and awareness is the best strategy since young people, particularly students, are a generation that is attached to the convenience of technology and modern media.

**KDS-App as first aid for depression**

Since the mental health status of university students, particularly those who are reluctant to seek treatment, is sometimes disregarded, teaching mental health information as a universal prevention method may be a useful alternative for mental ill health stigma reduction<sup>24</sup>. The information of the mobile app on depression knowledge was created based on numerous studies and discoveries<sup>25, 26, 27, 28, 29, 30, 31</sup>. Earlier on, Noori et al. (2016) findings demonstrated that the mobile medical application has the potential to improve and increase awareness of depression among patients and their family members<sup>32</sup>. This study has provided the medical information relevant to patients with depression and their families in a new and easy way, to enhance the application, the researchers suggested the development of a version both in Malay and English which would bring the benefits of this application to a much wider audience of users<sup>32</sup>. Martinengo et al. (2022) discovered that material in mental health and depression apps was frequently brief and insufficient, with 1 in 5 apps

giving non-evidence-based information in a systematic examination of the educational content about depression in the apps accessible<sup>33</sup>. Van et al. (2020) discovered group effects over time in depression and bipolar recognition, social anxiety labeling, stigma, and parent help-seeking intention in a research of college students that examined the feasibility of a mobile-based mental health literacy intervention called "Shining Mind"<sup>34</sup>. This current research on a mobile application to educate students about depression named the KDS application, has improved their overall understanding of depression, which focuses on depression as an important and addressable mental health issue. Students also showed a better ability to recognize clinical signs of depression and a positive attitude toward approaches to depression prevention. Those who self-reported mild, moderate, or severe depression using the Beck's Depression Inventory (BDI) via the KDS app demonstrated insufficient knowledge of depression and later showed significant improvement following the intervention. According to Wu et al. (2021), meta-analyses have shown that digital mental health apps can help reduce depression and anxiety symptoms<sup>35</sup>. Self-learning components and information that can be easily understood by reading simple English to describe depression details were among the benefits of this KDS-App.

### **Acceptance and practicality of KDS-App**

Participants replied positively to the KDS-App based on face validity findings. This discovery demonstrated their interest in learning about KDS-App. Mobile apps offer the ability to deliver handy and high-quality mental health interventions<sup>21</sup>. Because the KDS-App is still in the prototype stage, it will be registered in the Google Play Store and on iOS, allowing it to be downloaded for free and used by students as well as the general public. This mobile app also was called "user-friendly" because the information is kept simple and easy to understand. Feedback indicates that the KDA-App was regarded to be appealing, the wording was easily comprehended, and the contents were addressed appropriately. Even without translation into the national language, the language was straightforward to understand. KDS-App was discovered to be effective for students since it increased their knowledge of depression, which aided them. Respondents also stated that the KDS-App taught them a lot about depression. As an example, consider the various varieties of depression, their origins, manifestations, and effects. They also learned about different types of therapies and treatments that were previously unknown to them. When asked if they wanted to own the KDS-App and recommend it to other students, friends, and family, the students responded positively.

According to expert panels, the KDS-App is extremely beneficial to students since it allows

them to learn more about depression and improve their mindset. As a result of this input, it was concluded that the newly built KDS-App, which took the shape of an instructional mobile app, greatly improved students' knowledge and thinking regarding depression. Apps have developed as a feasible tool to bridge the mental health treatment and awareness gap, given the global shortage of mental health care personnel such as psychiatrists or therapists and the lack of mental health care access especially in rural areas<sup>21</sup>. There has never been a mobile app-based intervention program for knowledge of depression in Malaysia, particularly for students. This KDS-App was useful, and the content was simple to understand; with self-assessment depression inventory within the mobile app, students could check their depression level at any moment.

### **CONCLUSION**

As an outcome of the study, the KDS-App received favorable feedback, indicating that the newly built KDS-App was viable and appealing among students. Because of its low cost and simplicity of use, this intervention has a bright future as an efficient educational resource for teaching about depression. Although the current study shows that our mobile application provides basic medical information about depression in a novel and user-friendly manner, there are plans to improve the application by adding more sections; a chatting section to allow students to contact the psychotherapist or counselor in person; a section for students to discuss their experience with others. In the future, we hope to produce a version in both Malay and English, bringing the benefits of this program to a much larger local user base.

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### **REFERENCES**

1. Malhi, G. S., & Mann, J. J. (2018). Depression. *The Lancet*, 392(10161), 2299-2312. [https://doi.org/10.1016/s0140-6736\(18\)31948-2](https://doi.org/10.1016/s0140-6736(18)31948-2)
2. Santomauro, D. F., Herrera, A. M. M., Shadid, J., Zheng, P., Ashbaugh, C., Pigott, D. M., Abbafati, C., Adolph, C., Amlag, J. O., Aravkin, A. Y., Bang-Jensen, B. L., Bertolacci, G.



- J., Bloom, S. S., Castellano, R., Castro, E., Chakrabarti, S., Chattopadhyay, J., Cogen, R. M., Collins, J. K., & Dai, X. (2021). Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *The Lancet*, 398(10312), 1700-1712. [https://doi.org/10.1016/S0140-6736\(21\)02143-7](https://doi.org/10.1016/S0140-6736(21)02143-7)
3. Naveed, S., Waqas, A., Chaudhary, A. M. D., Kumar, S., Abbas, N., Amin, R., Jamil, N., & Saleem, S. (2020). Prevalence of Common Mental Disorders in South Asia: A Systematic Review and Meta-Regression Analysis. *Frontiers in Psychiatry*, 11. <https://doi.org/10.3389/fpsy.2020.573150>
  4. Vikram Singh, J., Mohamad Anuar, M. F., Baharudin, A., Abdul Ghaffar, S., Siew Man, C., Palineveloo, L., Mohd Sallehuddin, S., Abd Aziz, N. S., Che Abdul Rahim, N., Pardi, M., Nasaruddin, N. H., & Zainuddin, A. A. (2021). Nutritional and Non-Communicable Disease (NCD) Status Association with Fall among Older Persons in Malaysia: Findings from National Health and Morbidity Survey (NHMS) Malaysia 2018. *International Journal of Public Health Research*, 11(02), 1448-1454. <https://doi.org/10.17576/ijphr.1102.2021.07>
  5. Ahmed, G., Negash, A., Kerebih, H., Alemu, D., & Tesfaye, Y. (2020). Prevalence and associated factors of depression among Jimma University students. A cross-sectional study. *International Journal of Mental Health Systems*, 14(1). <https://doi.org/10.1186/s13033-020-00384-5>
  6. Ashraful Islam, M., Yun Low, W., Ting Tong, W., Wan Yuen, C. C., & Abdullah, A. (2018). Factors Associated with Depression among University Students in Malaysia: A Cross-sectional Study. *KnE Life Sciences*, 4(4), 415. <https://doi.org/10.18502/cls.v4i4.2302>
  7. Chowdhury, U., Suvro, Md. A. H., Farhan, S. M. D., & Uddin, M. J. (2022). Depression and stress regarding future career among university students during COVID-19 pandemic. *PLOS ONE*, 17(4), e0266686.
  8. <https://doi.org/10.1371/journal.pone.0266686>
  9. Mofatteh, M. (2020). Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health*, 8(1), 36-65. <https://doi.org/10.3934/publichealth.2021004>
  10. Tambling, R. R., D'Aniello, C., & Russell, B. S. (2021). Mental Health Literacy: a Critical Target for Narrowing Racial Disparities in Behavioral Health. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-021-00694-w>
  11. Cheng, S., An, D., Yao, Z., Liu, J. J.-W., Ning, X., Wong, J. P.-H., Fung, K. P.-L., Vahabi, M., Poon, M. K.-L., Yamada, J., Cheng, S., Gao, J., Cong, X., Sun, G., Li, A. T.-W., Wang, X., & Jia, C. (2021). Association between Mental Health Knowledge Level and Depressive Symptoms among Chinese College Students. *International Journal of Environmental Research and Public Health*, 18(4), 1850. <https://doi.org/10.3390/ijerph18041850>
  12. Dogan-Sander, E., Kohls, E., Baldofski, S., & Rummel-Kluge, C. (2021). More Depressive Symptoms, Alcohol and Drug Consumption: Increase in Mental Health Symptoms Among University Students After One Year of the COVID-19 Pandemic. *Frontiers in Psychiatry*, 12. <https://doi.org/10.3389/fpsy.2021.790974>
  13. Iribarren, S.J., Akande, T.O., Kamp, K.J., Barry, D., Kader, Y.G. and Suelzer, E. (2021). Effectiveness of Mobile Apps to Promote Health and Manage Disease: Systematic Review and Meta-analysis of Randomized Controlled Trials. *JMIR mHealth and uHealth*, 9(1), p.e21563. <https://doi.org/10.2196/21563>
  14. Oliveira, C., Pereira, A., Vagos, P., Nóbrega, C., Gonçalves, J., & Afonso, B. (2021). Effectiveness of Mobile App-Based Psychological Interventions for College Students: A

- Systematic Review of the Literature. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.647606>
15. Seo, J.-M., Kim, S.-J., Na, H., Kim, J.-H., & Lee, H. (2022). Effectiveness of a Mobile Application for Postpartum Depression Self-Management: Evidence from a Randomised Controlled Trial in South Korea. *Healthcare (Basel, Switzerland)*, 10(11), 2185. <https://doi.org/10.3390/healthcare10112185>
  16. Lee, J. E., Goh, M. L., & Yeo, S. F. (2023). Mental health awareness of secondary schools students: Mediating roles of knowledge on mental health, knowledge on professional help, and attitude towards mental health. *Heliyon*, 9(3), e14512. <https://doi.org/10.1016/j.heliyon.2023.e14512>
  17. Raosoft. (2004). Sample Size Calculator by Raosoft, Inc. Raosoft.com. <http://www.raosoft.com/samplesize.html>
  18. Duncan, F., Baskin, C., McGrath, M., Coker, J. F., Lee, C., Dykxhoorn, J., Adams, E. A., Gnani, S., Lafortune, L., Kirkbride, J. B., Kaner, E., Jones, O., Samuel, G., Walters, K., Osborn, D., & Oliver, E. J. (2021). Community interventions for improving adult mental health: mapping local policy and practice in England. *BMC Public Health*, 21(1). <https://doi.org/10.1186/s12889-021-11741-0>
  19. Champion, J. (2018). Public mental health: key challenges and opportunities. *BJPsych International*, 15(3), 51-54. <https://doi.org/10.1192/bji.2017.11>
  20. Colizzi, M., Lasalvia, A. & Ruggeri, M. Prevention and early intervention in youth mental health: is it time for a multidisciplinary and transdiagnostic model for care?. *Int J Ment Health Syst* 14, 23 (2020). <https://doi.org/10.1186/s13033-020-00356-9>
  21. Salazar de Pablo, G., De Micheli, A., Nieman, D. H., Correll, C. U., Kessing, L. V., Pfennig, A., Bechdolf, A., Borgwardt, S., Arango, C., van Amelsvoort, T., Vieta, E., Solmi, M., Oliver, D., Catalan, A., Verdino, V., Di Maggio, L., Bonoldi, I., Vaquerizo-Serrano, J., Baccaredda Boy, O., & Provenzani, U. (2020). Universal and selective interventions to promote good mental health in young people: Systematic review and meta-analysis. *European Neuropsychopharmacology*, 103592. <https://doi.org/10.1016/j.euroneuro.2020.10.007>
  22. Singh, V., Kumar, A., & Gupta, S. (2022). Mental Health Prevention and Promotion—A Narrative Review. *Frontiers in Psychiatry*, 13. <https://doi.org/10.3389/fpsy.2022.898009>
  23. Chandrashekar, P. (2018). Do mental health mobile apps work: evidence and recommendations for designing high-efficacy mental health mobile apps. *MHealth*, 4(6), 6-6. <https://doi.org/10.21037/mhealth.2018.03.02>
  24. Goldberg, S. B., Lam, S. U., Simonsson, O., Torous, J., & Sun, S. (2022). Mobile phone-based interventions for mental health: A systematic meta-review of 14 meta-analyses of randomized controlled trials. *PLoS Digital Health*, 1(1), e0000002. <https://doi.org/10.1371/journal.pdig.0000002>
  25. Oliveira, C., Pereira, A., Vagos, P., Nóbrega, C., Gonçalves, J., & Afonso, B. (2021). Effectiveness of Mobile App-Based Psychological Interventions for College Students: A Systematic Review of the Literature. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.647606>
  26. Wong, P. W. C., Arat, G., Ambrose, M. R., Qiuyuan, K. X., & Borschel, M. (2019). Evaluation of a mental health course for stigma reduction: A pilot study. *Cogent Psychology*, 6(1), 1595877. <https://doi.org/10.1080/23311908.2019.1595877>
  27. Arean, P. A., Hallgren, K. A., Jordan, J. T., Gazzaley, A., Atkins, D. C., Heagerty, P. J., & Anguera, J. A. (2016). The Use and Effectiveness of Mobile Apps for Depression: Results From a Fully Remote Clinical Trial. *Journal of Medical Internet*

- Research, 18(12), e330.  
<https://doi.org/10.2196/jmir.6482>
28. Graham, A. K., Greene, C. J., Kwasny, M. J., Kaiser, S. M., Lieponis, P., Powell, T., & Mohr, D. C. (2020). Coached Mobile App Platform for the Treatment of Depression and Anxiety Among Primary Care Patients: A Randomized Clinical Trial. *JAMA Psychiatry*, 77(9), 906-914.  
<https://doi.org/10.1001/jamapsychiatry.2020.1011>
  29. Kotera, Y., Ting, S.-H., & Neary, S. (2020). Mental health of Malaysian university students: UK comparison, and relationship between negative mental health attitudes, self-compassion, and resilience. *Higher Education*, 81.  
<https://doi.org/10.1007/s10734-020-00547-w>
  30. Marshall, J. M., Dunstan, D. A., & Bartik, W. (2019). Clinical or gimmickal: The use and effectiveness of mobile mental health apps for treating anxiety and depression. *Australian & New Zealand Journal of Psychiatry*, 54(1), 20-28.  
<https://doi.org/10.1177/0004867419876700>
  31. Polhemus, A., Simblett, S., Dawe-Lane, E., Gilpin, G., Elliott, B., Jilka, S., Novak, J., Nica, R., Temesi, G., & Wykes, T. (2022). Health tracking via mobile apps for depression self-management: a qualitative content analysis of user reviews (Preprint). *JMIR Human Factors*.  
<https://doi.org/10.2196/40133>
  32. Stiles-Shields, C., Montague, E., Lattie, E. G., Kwasny, M. J., & Mohr, D. C. (2017). What might get in the way: Barriers to the use of apps for depression. *DIGITAL HEALTH*, 3, 205520761771382.  
<https://doi.org/10.1177/2055207617713827>
  33. Wasil, A. R., Venturo-Conerly, K. E., Shingleton, R. M., & Weisz, J. R. (2019). A review of popular smartphone apps for depression and anxiety: Assessing the inclusion of evidence-based content. *Behaviour Research and Therapy*, 123, 103498.  
<https://doi.org/10.1016/j.brat.2019.103498>
  34. Noori, S., Mansor, E. I., Ibrahim, N., & Hinds, J. (2016). Promoting awareness of depression with a mobile application: A usability study and evaluation. 2016 4th International Conference on User Science and Engineering (I-USer).  
<https://doi.org/10.1109/iuser.2016.7857934>
  35. Martinengo, L., Stona, A.-C., Tudor Car, L., Lee, J., Griva, K., & Car, J. (2022). Education on Depression in Mental Health Apps: Systematic Assessment of Characteristics and Adherence to Evidence-Based Guidelines. *Journal of Medical Internet Research*, 24(3), e28942.  
<https://doi.org/10.2196/28942>
  36. Van, V. H., Dao, K. T. A., & Minh, D. H. (2020). Effectiveness of Shining Mind- A Smartphone App to Increase Mental Health Literacy Among College Students. *VNU Journal of Science: Education Research*.  
<https://doi.org/10.25073/2588-1159/vnuer.4480>
  37. Wu, A., Scult, M. A., Barnes, E. D., Betancourt, J. A., Falk, A., & Gunning, F. M. (2021). Smartphone apps for depression and anxiety: a systematic review and meta-analysis of techniques to increase engagement. *Npj Digital Medicine*, 4(1).  
<https://doi.org/10.1038/s41746-021-00386-8>