

The Usability and Feasibility of *DailyCalm* Application in Reducing Stress among Adolescents During COVID-19 Pandemic

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ABSTRAK

Tekanan atau stres adalah perkara biasa dalam kalangan remaja yang merosakkan kesejahteraan mereka. Kajian ini bertujuan untuk menentukan kebolehgunaan dan kebolehlaksanaan aplikasi mudah alih yang baru dibangunkan, *DailyCalm* dalam mengurangkan stres dalam kalangan pelajar sekolah menengah di Kedah. Pelajar direkrut melalui pensampelan mudah menggunakan media sosial pada bulan Ogos 2020 semasa pandemik COVID-19. Pautan akses disediakan untuk memuat turun aplikasi *DailyCalm* yang mengandungi video pengajaran teknik pernafasan dan relaksasi. Pelajar digalakkan untuk menggunakan aplikasi tiga kali seminggu. Pelajar menjawab borang dalam talian yang mengukur tahap tekanan menggunakan Skala Persepsi Stres (PSS) pada awal kajian dan empat minggu kemudian serta persepsi mengenai kebolehgunaan dan kelayakan aplikasi setelah empat minggu penggunaan. Seramai 83.8% daripada 80 pelajar berusia 13 hingga 17 tahun yang menamatkan kajian ini, mengalami stres pada tahap sederhana hingga tinggi. Pelajar menilai kebolehgunaan aplikasi sebagai sederhana dengan min 39.91 ($SD = 6.12$) dan kebolehlaksanaan dengan min 41.74 ($SD = 6.99$). Namun, tiada penurunan yang signifikan dalam skor PSS selepas 4 minggu penggunaan [min 18.10 ($SD = 5.15$) pada awal dan min 17.44 ($SD = 5.06$) selepas intervensi; nilai $p = 0.19$]. Kesimpulannya, *DailyCalm* dilihat mudah digunakan dan sangat boleh dilaksanakan, namun penggunaannya selama 4 minggu tidak

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menunjukkan pengurangan tahap stres pelajar yang signifikan. Aplikasi DailyCalm berpotensi untuk digunakan sebagai aplikasi pengurusan stres tetapi memerlukan penambahbaikan untuk penggunaan yang berkesan.

Kata kunci: aplikasi mudah alih, kebolegunaan, kebolehlaksanaan, remaja, stres

ABSTRACT

Stress is common among adolescents that impairs their well-being. This study aimed at determining the usability and feasibility of a newly developed mobile apps, *DailyCalm* in reducing stress among secondary school students in Kedah. They were recruited via convenience sampling using social media in August 2020 during COVID-19 pandemic. An access link was provided to download the *DailyCalm* apps that contained videos teaching on breathing and relaxation techniques. Students were encouraged to use the apps thrice a week. Students responded to an online form that measured stress level using Perceived Stress Scale (PSS) at baseline and four weeks later and perception on the usability and feasibility of the apps after four weeks of use. Among the 80 students aged 13 to 17 years who completed the study, 83.8% of them were having moderate to high level of stress. The students rated the apps as moderately usable with mean of 39.91 (SD = 6.12) and highly feasible with mean of 41.74 (SD = 6.99). However, there was no significant reduction in PSS score after 4 weeks of use [mean of 18.10 (SD =5.15) at baseline and mean of 17.44 (SD =5.06) at post-intervention; p-value = 0.19]. In conclusion, *DailyCalm* was viewed as moderately usable and highly feasible, yet its use over 4 weeks did not show a significant reduction in the stress level experienced by the students. The *DailyCalm* app has the potential to be used as a stress management application but needs further improvement for an effective use.

Keywords: adolescent, feasibility, mobile applications, stress, usability

INTRODUCTION

Stress is the health epidemic of the 21st century and about 20% of adolescents worldwide are having mental health problems related to stress (WHO 2019). In Malaysia, the prevalence of stress among schooling adolescent was 9.6% (IPH 2017). Apart from hormonal and physical changes that occur during the adolescence stage, life demands

such as academic pressure, parental expectations and relationship issue with parents, peers and teachers are also causing them stress. Furthermore, the school environment itself can be a source of stress to adolescents. Students were reported having stress related to school activities and demands such as inappropriate workloads or assignments, examinations and ranking among their classmates (et al.

2020; Saqib & Rehman 2018; Wahab et al. 2013). Unfortunately, not all adolescents are equipped with stress management skills, thus they tend to use negative coping strategies such as self-distraction, self-blame, smoking cigarette and misusing drugs (Yusoff et al. 2011; Tohid et al. 2016). The national data showed that 20-30% of stressed adolescents are substance users like cigarette, marijuana and alcohol (IPH 2017) and these negative sequelae of stress is alarmingly worrying. If stress is poorly managed, these adolescents are at risk of having physical and mental health problems, low self-esteem and poor academic achievement (Toussaint et al. 2016; Yusoff et al. 2011). Therefore, it is important to detect and manage the affected adolescents early and effectively.

However, not many people including adolescents are well equipped with skills to manage their stress. Relaxation technique is a scientific based psychotherapeutic approach in stress management. It increases the physical and mental resistance to stress and helps in decreasing the negative effects (Mandreş & Crăciun 2015). The use of relaxation technique as part of stress management has been shown to be effective in a study conducted among high school students in Boston and Romania (Foret et al. 2012; Mandreş & Crăciun 2015). Another technique that is commonly being used is deep breathing exercise that improves heart rate and induce relaxation in adolescents (Burkhart et al. 2018; Mason et al. 2019). Teaching the adolescents on stress including empowering them with

skills to control their emotions during stressful situations and basic self-help techniques for short-term stress has been shown to be useful in reducing stress among schooling adolescents (Admiraal 2020; Mason et al. 2019).

Over the recent years, the nature of medical therapy has evolved and digital application or known as mHealth has been used as part of patient's overall management. Mobile- and internet-based interventions were found to be effective in reducing stress (Griffiths et al. 2010; Harrer et al. 2018). Majority of users rated the mobile-based intervention as excellent in reducing their stress level (Harrer et al. 2018). Safety, engagement and functionality were among the important features that encourage adolescent to use the mobile apps. They would use the mobile apps if it is considered as safe, fun, interactive, useful and relevant (Kenny et al. 2016).

National data has shown 6 in 7 of our secondary school students are active internet users and quite a number of them own handheld devices including smartphones (MCMC 2018). Based on this, a mobile application has the potential to be used as an educational tool to assist our adolescents to cope with their stress. Thus far, there are limited local studies on the use of mobile applications in the management of adolescents with stress. Therefore, the aim of this study was to assess adolescents' perception on the usability and feasibility of a newly developed mobile application named *DailyCalm* to aid them in managing their stress. This study also aimed to get the user's satisfaction feedback on

the application and its content as well as technical support that they received during the trial period.

MATERIALS AND METHODS

This single arm pre- and post-prospective interventional pilot study was conducted at a public secondary school in Jitra, a semiurban area in Kedah from August until September 2020 during the first wave of the COVID-19 pandemic. Students aged between 13 and 18 years old, who were able to speak and understand the Malay language and had access to an Android smartphone or tablet with an internet connection, were invited to participate in this study. Those without parental consent were excluded from this study. In determining the sample size, 75 was decided as a minimum sample size based on the recommendation made for a pilot study and the number should be sufficient to cater for a study power of 90%, two-sided significance of 5% and a small effect size of 0.1 (Whitehead et al. 2016). Considering a 10% drop-out rate, 86 students were recruited with the help from the school counsellor using the snowballing technique.

Data Collection and Intervention

Those who agreed to participate were given a Google Form link that contained participant information sheet and consent forms to be filled by them and either parent. Subsequently, they were requested to answer the pre-intervention questionnaire that assessed their sociodemographic data and the

degree of perceived stress in different situations using the locally validated Malay version of the Perceived Stress Scale (PSS-10) (Al-Dubai et al. 2012). The PSS-10 is a 10 item with 5-points Likert type of responses with a higher score indicating higher stress level (Sandhu et al. 2015). The PSS-10 score can be further divided into a low level of stress (total score of <13), a moderate level of stress (total score of between 14 and 26) and a high level of stress (total score of between 27 and 40).

Upon completion of the baseline questionnaire, the students were given a digital link to allow them to download the intervention tool, the *DailyCalm* app into their Android mobile phone. This newly developed mHealth app was a collaborative work of Family Medicine Physicians, Clinical Psychologist and Software Technologist to educate adolescents on breathing and relaxation techniques using 2 minutes videos. The breathing technique video taught the users step-by-step on deep breathing technique, in which the users had the chance to practice the demonstrated technique simultaneously. Also, they could replay the videos to repeat the technique at any step. The narration was done by a Clinical Psychologist and simulated the real face-to-face session. The relaxation technique video was adopted with permission from the Ministry of Health which trained the adolescents to perform relaxation using music. The users were encouraged to use the app daily at least 30 minutes/day, minimally thrice a week and whenever they were in distress. In this pilot study, all participants were automatically

enrolled into a WhatsApp messenger group moderated by five researchers. The main purpose of this group was mainly to provide technical support, answer any questions from the participants and give a daily reminder to use the *DailyCalm* app.

After 4 weeks, the participants were required to complete the post-intervention questionnaire comprising the PSS-10 and the usability and feasibility questionnaire to assess their feedback regarding the app, which was developed based on literature reviews (Broderick et al. 2014; Nouri et al. 2018). Usability was defined as the ability of the technology to meet the users' needs and tasks, while feasibility was defined as the ability of users to adopt a technology or intervention in daily routines which is often assessed through the use of the tool (Steele Gray et al. 2016). Both usability and feasibility are important to improve the overall user experience and to ensure that users can benefit from the use of mobile applications in managing their stress. There were 11 items for each usability and feasibility constructs that used 5-points Likert Scale responses of strongly disagree (1) to strongly agree (5). The total score of each construct ranged between 11 and 55; the higher the score the higher they perceived usability or feasibility of the mobile app. The total scores were also classified according to tertiles into low (scores: 11.0-26.0), moderate (scores: 26.1-40.0) and high (scores: 40.1 to 55.0). This set of items had been reviewed for content validity by the Information Technology expert and Family Medicine specialist. The

reliability of the usability and feasibility constructs using Cronbach alpha were 0.95 and 0.92, respectively. Besides, there were seven items examining the participants' satisfaction towards the app and its content (five items) and the technical support (two items).

Data Analysis

The online data was generated in the Microsoft Excel Spreadsheet software that was later imported to the IBM SPSS version 22.0 (Armonk, NY, USA) for analysis. Descriptive statistics were computed for the participants' sociodemographic data and all variables. Categorical data were presented using numbers (n) and percentages (%), whereas continuous data were presented as either means and standard deviation (SD) or median and interquartile (IQR). Since the pre- and post-intervention PSS scores were normally distributed, a paired t-test was used to assess the differences between the two scores. The result was deemed significant when the p-value was <0.05.

Ethical Consideration

This research protocol was reviewed and approved by the Research and Ethics Committee of the researchers' institution. Permission was also obtained from the Ministry of Education and the school administrator. All participants and their parents provided electronic consent before participating in this study. Participants were informed that their participation was voluntary and that they could withdraw at any

Table 1: Sociodemographic characteristics of the study participants (N=78)

Variables	n (%)	Median (IQR)
Age (years)		16 (0)
Gender		
Male	19 (24.40)	
Female	59 (75.60)	
Race		
Malays	74 (94.90)	
Chinese	2 (2.55)	
Indian	2 (2.55)	
Others	-	
Father's highest education level		
Primary	-	
Secondary	32 (41.00)	
Tertiary	45 (57.70)	
None	1 (1.30)	
Mother's highest education level		
Primary	1 (1.30)	
Secondary	24 (30.76)	
Tertiary	53 (67.94)	
None	-	
Parent's marital status		
Married	73 (93.60)	
Divorced	3 (3.80)	
Single parents	2 (2.60)	
Family income (RM)	21 (26.90)	
<3000	30 (38.50)	
3000-7000	27 (34.60)	
>7000		

time.

RESULTS

From the initial 86 students enrolled on this study, 6 students dropped out and did not complete the post-intervention questionnaire, making the response rate 93.0%. In addition, 2 students aged 13 and 14 years old were excluded in order to reduce age bias. Hence, the total participants included in the final statistical analysis was 78 who aged between 15 and 17 years old. The participants' characteristics are presented in Table 1. Majority were female (n=59, 75.60%) and Malay (n=74, 94.90%) students. Most of their

parents attained tertiary education level (father: n=45, 57.70%; mother: n=53, 67.90%) and from middle to high-income families (n=57, 73.10%).

Perceived Stress Level Assessed using the PSS-10

At baseline, only 16.7% (n=13) of the students were classified as having a low level of stress, whereas a majority (n=63, 80.8%) had a moderate level of stress and 2 (2.6%) students were having a high level of stress. After 4 weeks of intervention using the *DailyCalm* apps, the same proportion of students were classified into having a low, moderate and high level of stress. Table 2 shows

Table 2: Mean (SD) score, Kolmogorov-Smirnov test and Paired t-test of PSS-10 at pre- and post-intervention

	Perceived Stress Scale score		Tests of normality: Kolmogorov-Smirnov test	Paired t-test	
	Mean	Standard deviation	p-value	t value	p-value
Pre-intervention	18.08	5.20	0.069	-	-
Post-intervention	17.46	5.07	0.002	-	-
Difference between pre- & post-intervention	0.62	4.53	0.200	1.200	0.234

the difference in the stress level at two-time intervals. There was a reduction in the mean (SD) PSS-10 score by 0.62 (4.53) but the difference was not significant (p-value = 0.234).

Perceived Usability and Feasibility of the *DailyCalm*

The mean (SD) score for the usability was 39.95 (6.15) and based on the scoring classification mentioned earlier, *DailyCalm* was perceived as moderately usable in reducing the stress of the adolescents. The mean score (SD) for the feasibility was 41.77 (7.08) and based on the scoring classification, the *DailyCalm* was

perceived as highly feasible to be used in their daily life.

Participants' Satisfaction on the *DailyCalm* and its Content

Figure 1 shows the percentages of the participants who were satisfied with the application and the technical support from the researchers. The majority of the students would recommend the *DailyCalm* application to their friends (70.5%), agreed the application was easily accessible (64.1%) and liked both videos embedded in the app (the relaxation technique video: 93.6%, the breathing technique video: 92.3%). More than three-fifths were satisfied

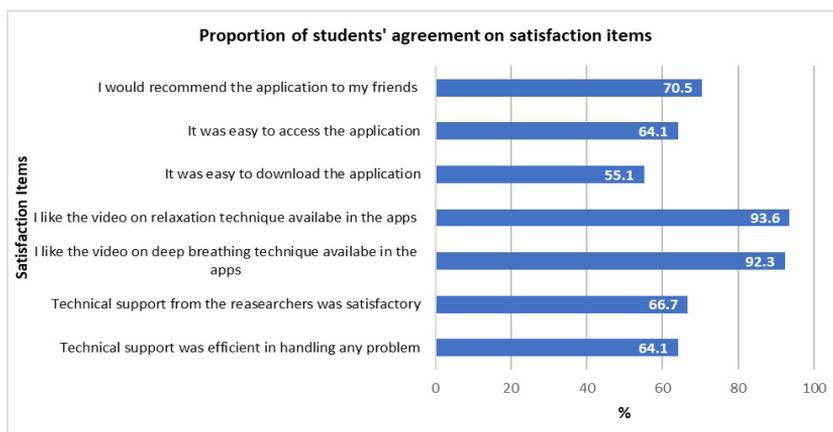


Figure 1: Analysis of the *DailyCalm* satisfaction Items

with the technical support given to them.

DISCUSSION

This study aimed to pilot test a newly developed mobile application named *DailyCalm*, specifically in terms of its usability and feasibility in reducing stress among secondary school students in Malaysia. This study also gathered participants' satisfaction towards the app, its content and technical support that they received during the trial period. Based on the PSS, it is alarming to note that a high proportion (83.4%) of the students in this study had symptoms indicating a moderate to a high level of stress. This proportion was more than what was reported in the National Health Morbidity Survey in 2017 of only 9.6% (IPH 2017) and earlier studies conducted in Johor and Kuala Lumpur of between 20% and 40% (Latiff et al. 2017; Ibrahim et al. 2014). The high proportion of stress among the students in this study could be related to the COVID-19 pandemic that occurred during the data collection period in which the whole country was in the restriction movement order, schools were closed and students had to embrace the new norms of online schooling and not being able to meet their friends or teachers physically. Online connection with friends was shown to be related to mental distress in adolescents (Ellis et al. 2020) and may even lead to unhealthy eating habit (Hatta & Srijit, 2021) during this COVID-19 pandemic.

In terms of the usability of the

DailyCalm in reducing the stress level among the adolescents, although there was a reduction in the stress level after 4 weeks of using the application, it was not statistically significant. This could have been attributed to the short duration of usage; similar studies that showed effectiveness of application in reducing stress utilizing a longer usage period of up to 7 weeks (Harrer et al. 2018; Huberty et al. 2019; Mccloud et al. 2020). It could also be due to the non-interactive features and absence of reminders in the *DailyCalm* app. The main content of the *DailyCalm* was the two-minute videos to teach on breathing and relaxation techniques using real people that may not be attractive to adolescents, hence leading to its low usage and ineffectiveness. In addition, adolescents may need beyond the skills in managing their stress, having correct knowledge on COVID-19 may lessen their mental distress (Puwaneswary et al. 2020). Under-usage of mHealth apps by adolescents (Sousa et al. 2020) is a known barrier to be examined and having their input on ways to improve the *DailyCalm* would be the step forward. Although a high proportion of them liked both videos, their score on the usability construct indicated the *DailyCalm* was perceived as only moderately usable to them. There is a need to further improve the application such as by adding notification and reminders as well as enhancing the design of the interface and navigation, yet preserving its simplicity and easy use (Vaghefi & Tulu 2019; Peng et al. 2016).

As for the feasibility, the *DailyCalm*

was perceived as highly feasible. More than half of the students reported it was easy for them to get access and download the application through the link for free. As adolescents nowadays are avid users of smartphone and internet, an easily accessible mobile application that is installed to their devices were well accepted by them. These findings are in line with previous studies that showed easy accessibility and free application could encourage people to use an application (Vaghefi & Tulu 2019; Peng et al. 2016). The availability of technical support might have also contributed to their willingness to install the application into their smartphone. As many of them would like to recommend the application to their friends, it indicates the trustworthiness and credibility of an application (Peng et al. 2016).

This study is novel as it is amongst the first few studies conducted in Malaysia that examined the use of mHealth in adolescents. The findings of this pilot study are quite promising, contributing to the existing knowledge on the management of stress among adolescents and providing a foundation for the development of the improved versions of the *DailyCalm*. In addition, the usability of the *DailyCalm* was assessed using a questionnaire as well as changes on the Perceived Stress scale score providing a more rigorous assessment of the usability of the application.

We acknowledge the limitations in the *DailyCalm* application such as the absence of notification and reminders features that can increase its usage. Besides, the application did not have

a tracking feature that is necessary to objectively measure the frequency of its use and the engagement of the users with the application. This had limited our understanding of the students' real usage of the application. The usability score and feasibility score presented in this paper were merely self-reported claims in which social desirability bias responses could not be completely excluded. Time was also a limiting factor as this study was an undergraduate research project that only allowed the development of the prototype, a four-week usage and testing of its usability and feasibility. The short duration of usage may not be enough to show any significant result in the reduction of the level of stress among the students. In addition, this study was conducted during the COVID-19 pandemic during its first wave and the uncertainties, as well as worries related to the pandemic, which may explain the persistently high level of stress among the students during the study. This study may also be limited by the study population and locality. As the students were from a small town in Kedah, their lifestyle, stressors and motivation to use the *DailyCalm* might not truly reflect the entire Malaysian adolescent population.

CONCLUSION

The *DailyCalm* was highly viewed as a feasible mobile application that was practical to be used in their daily life. The app was desirable and worth recommended to others. However, a lack of engaging features might limit their usage, resulting in lower usability

and a non-significant reduction in the stress level over 4 weeks period. There is a need to further improve the application in order to increase the users' engagement and use. In terms of assessing the effectiveness, future study, preferably a randomised control trial, may need to be carried out over a longer period.

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REFERENCES

- Admiraal, W. 2020. A Typology of Student-Teachers' Coping with Stressful Classroom Events. *Eur J Educ* 3(1): 6-17.
- Al-Dubai, S.A., Alshagga, M.A., Rampal, K.G., Sulaiman, N.A. 2012. Factor structure and reliability of the Malay version of the perceived stress scale among Malaysian medical students. *Malays J Med Sci* 19(3): 43-9.
- Broderick, J., Devine, T., Langhans, E., Lemerise, A.J., Lier, S., Harris, L. 2014. Designing Health Literate Mobile Apps. *NAM Perspect*. Discussion Paper, National Academy of Medicine, Washington, DC. <https://doi.org/10.31478/201401a> [16 September 2019].
- Burkhardt, K., Mason, E., Lazebnik, R. 2018. Stress management intervention: A pilot evaluation in an urban adolescent medicine clinic. *Clin Pediatr (Phila)* 57(6): 700-5.
- Ellis, W.E., Dumas, T.M., Forbes, L.M. 2020. Physically isolated but socially connected: Psychological adjustment and stress among adolescents during the initial COVID-19 crisis. *Can J Behav Sci* 52(3): 177-87.
- Foret, M.M., Scult, M., Wilcher, M., Chudnofsky, R., Malloy, L., Hasheminejad, N., Park, E. R. 2012. Integrating a Relaxation Response-Based Curriculum into a Public High School in Massachusetts. *J Adolesc* 35(2): 325-32.
- Griffiths, K.M., Farrer, L., Christensen, H. 2010. The Efficacy of internet interventions for depression and anxiety disorders: a review of randomised controlled trials. *Med J Aust* 192: S4-S11.
- Harrer, M., Adam, S.H., Fleischmann, R.J., Baumeister, H., Auerbach, R., Bruffaerts, R., Cuijpers, P., Kessler, R.C., Berking, M., Lehr, D., Ebert, D.D. 2018. Effectiveness of an internet- and app-based intervention for college students with elevated stress: randomized controlled trial. *J Med Internet Res* 20(4): e136.
- Hatta, S., Srijit, D. 2021. Obesity during COVID-19 lockdown: interesting facts. *Med & Health* 16(1): 1-3.
- Huberty, J., Green, J., Glissmann, C., Larkey, L., Puzia, M., Lee, C. 2019. Efficacy of the mindfulness meditation mobile app "Calm" to reduce stress among college students: randomized controlled trial. *JMIR Mhealth Uhealth* 7(6): e14273.
- Ibrahim, N., Amit, N., Suen, M.W. 2014. Psychological factors as predictors of suicidal ideation among adolescents in Malaysia. *PLoS One* 9(10): e110670.
- Institute for Public Health (IPH) 2017. National Health and Morbidity Survey 2017 (NHMS 2017): Adolescent Mental Health (DASS-21). <https://iku.gov.my/images/IKU/Document/REPORT/NHMS2017/MHSReportNHMS2017.pdf> [6 August 2021]
- Kenny, R., Dooley, B., Fitzgerald, A. 2016. Developing mental health mobile apps: exploring adolescents' perspectives. *Health Informatics J* 22(2): 265-75.
- Latiff, L.A., Tajik, E., Ibrahim, N., Bakar, A.S.A., Ali, S.S.A. 2017. Psychosocial problem and its associated factors among adolescents in the secondary schools in Pasir Gudang, Johor. *Mal J Med Health Sci* 13(1): 35-44.
- Malaysian Communication and Multimedia Commission (MCMC). 2018. *Hand Phone Users Survey 2018*. Statistical brief Cyberjaya: Malaysian Communication and Multimedia Commission. <https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/HPUS2018.pdf> [6 August 2019].
- Mandreş, C.-M., Crăciun, A. 2015. The effectiveness of the relaxation techniques, in stress reduction and optimization strategies for coping in teenagers. *Rom J Cogn Behav Ther Hypn* 2(4): 31-41.
- Mason, E.B., Burkhardt, K., Lazebnik, R. 2019. Adolescent stress management in a primary care clinic. *J Pediatr Health Care* 33(2): 178-85.
- McCloud, T., Jones, R., Lewis, G., Bell, V.,

- Tsakanikos, E. 2020. Effectiveness of a mobile app intervention for anxiety and depression symptoms in university students: randomized controlled trial. *JMIR Mhealth Uhealth* 8(7): e15418.
- Nouri, R., Niakan Kalhori, S., Ghazisaeedi, M., Marchand, G., Yasini, M. 2018. Criteria for assessing the quality of mhealth apps: a systematic review. *J Am Med Inform Assoc* 25(8): 1089-98.
- Pascoe, M.C., Hetrick, S.E., Parker, A.G. 2020. The Impact of Stress on Students in Secondary School and Higher Education. *Int J Adolesc Youth* 25(1): 104-12.
- Peng, W., Kanthawala, S., Yuan, S., Hussain, S.A. 2016. A qualitative study of user perceptions of mobile health apps. *BMC Public Health* 16(1): 1158
- Puwaneswary, M., Ayeshah, Z., Gaaitheri, K., Lim, K., Wong, Y., Tang, S., Ng, C. 2020. Development of Knowledge, Attitudes, and Practices (KAP) Towards COVID-19 Pandemic in Malaysia. *Med & Health* 15(2): 262-75.
- Sandhu, S.S., Ismail, N.H., Rampal, K.G. 2015. The Malay Version of the Perceived Stress Scale (Pss)-10 Is a Reliable and Valid Measure for Stress among Nurses in Malaysia. *Malays J Med Sci* 22(6): 26.
- Saqib, M., Rehman, K.U. 2018. Impact of Stress on Students Academic Performance at Secondary School Level at District Vehari. *Int J Learn Dev* 8(1): 84-93.
- Sousa, P., Martinho, R., Reis, C.I., Dias, S.S., Gaspar, P.J.S., Dixe, M.D.A., Luis, L.S., Ferreira, R. 2020. Controlled trial of an mHealth intervention to promote healthy behaviours in adolescence (TeenPower): Effectiveness analysis. *J Adv Nurs* 76(4): 1057-68.
- Steele Gray, C., Gill, A., Khan, A.I., Hans, P.K., Kuluski, K., Cott, C. 2016. The electronic patient reported outcome tool: testing usability and feasibility of a mobile app and portal to support care for patients with complex chronic disease and disability in primary care settings. *JMIR Mhealth Uhealth* 4(2): e58.
- Tohid, H., Omar, K., Muhammad, N.A., Jaffar, A., Md Monoto, E.M., Mohd Ishak, N. 2016. Smoking is worth the risk: Understanding adolescents' rationalisation of their smoking behaviour. *Pertanika J Soc Sci Hum* 24(2): 573-86.
- Toussaint, L., Shields, G.S., Dorn, G., Slavich, G.M. 2016. Effects of lifetime stress exposure on mental and physical health in young adulthood: how stress degrades and forgiveness protects health. *J Health Psychol* 21(6): 1004-14.
- Vaghefi, I., Tulu, B. 2019. The continued use of mobile health apps: insights from a longitudinal study. *JMIR Mhealth Uhealth* 7(8): e12983.
- Wahab, S., Rahman, F.N.A., Wan Hasan, W.M.H., Zamani, I.Z., Arbaie, N.C., Khor, S.L., Nawi, A.M. 2013. Stressors in secondary boarding school students: association with stress, anxiety and depressive symptoms. *Asia Pac Psychiatry* 5(suppl 1): 82-9.
- Whitehead, A.L., Julious, S.A., Cooper, C.L., Campbell, M.J. 2016. Estimating the sample size for a pilot randomised trial to minimise the overall trial sample size for the external pilot and main trial for a continuous outcome variable. *Stat Methods Med Res* 25(3): 1057-73.
- World Health Organization (WHO). 2019. Adolescent Mental Health. <https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health> [11 May 2021].
- Yusoff, M.S.B., Hamid, A.H.A., Rosli, N.R., Zakaria, N.A., Rameli, N., Rahman, N.S.A., Rahman, A. 2011. Prevalence of stress, stressors and coping strategies among secondary school students in Kota Bharu, Kelantan, Malaysia. *Int J Stud Res* 1(1): 23-8.

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