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Personalizing mobile-health Apps using social media reinforcement learning to increase physical activity among bachelor nursing students: A feseable study

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Abstract

Background: Applying a smartphone health-App might suitable in the context of bachelor nursing students in Indonesia.
Purpose: This study was conducted an smartphone health Apps and social media for bachelor nursing students to promote physical activity.
Method: A quasy experiment with pre and post-test design included 80 bachelor nursing students with physical inactive by sample power to estimated, and recruited convinience samples from the nursing institutions. The eligible participants were randomly assigned to intervention or control group. The smartphone health-app group received electronic booklet of physical activity (PA) and health app combine with social media tool reinforcement during 12-week, and control group received usual care. Physical activity was measured using the questionaire and smartphone-health-app, and self-efficacy were assessed through extensive questionnaire. Data was analyzed within and between smartphone health-app and control groups to assess progarm using pair t-tests.
Results: The primary outcome of promoting PA, there was a significant increase after 12-week of intervention, and significant difference between the groups was observed. The secondary outcomes, there was a significant increase in self-efficacy in both groups, and significant difference between groups.
Conclusion: The intervention was successfully promoted PA of bachelor nursing students over 12-week. The intervention was designed to be simple for widespread implementation in a variety of bachelor nursing students and settings, as it requires no special equipment or previous PA knowledge.

Keywords: Smartphone Apps; Physical activity, Self-efficacy; Bachelor nursing students

INTRODUCTION

Physically inactivity in bachelor nursing students is one of the most serious public health challenges of the 21st century worldwide that is considered to be a behavioral health risk (Lee et al., 2012; WHO, 2018). The negative impacts of physically inactive includes weight gain (Deliens et al., 2015; LaCaille, Dauner, Krambeer, & Pedersen, 2011; Nelson, Story, Larson, Rauner, Mess, & Woll, 2013; Söderlund, Fischer, & Johansson, 2009), increase the risk of developing non-communicable diseases such as cardiovascular disease (Chomistek et al., 2013; Lee et al., 2012), and diabetes (Kyu et al., 2016; Wilmot et al., 2012).

Previous systematic review found that the app-based interventions migth effective to promote physical activity (PA) and multicomponent interventions appear to be more effective than stand-alone app interventions (Schoeppe et al., 2016). However, there is a lack of randomized trials, and most previous studies have included

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older populations (Muellmann, Forberger, Möllers, Bröring, Zeeb, & Pischke, 2018) or relied on self-reported measures of PA (Schoeppe et al., 2016). The discrepancy between self-reported and objectively measured PA is well established (Schuna, Johnson, & Tudor-Locke, 2013), and several app-based PA intervention studies show substantial increases in self-reported PA but not objectively (accelerometer) measured PA (Marsaux et al., 2015; Wanner, Martin-Diener, Braun-Fahrländer, Bauer, & Martin, 2009). This lack of uniformity, in combination with the inaccuracy of self-reported data as a measure of PA, makes it difficult to compare and summarize outcomes across PA interventions.

Early use of technology, such as use of mobile phones with short text message services, has been shown to have positive effects on the level of physical activity in university students (Hamari, Koivisto, & Sarsa, 2014; Hswen, Murti, Vormawor, Bhattacharjee, & Naslund, 2013). However, with the rapid technology development of today, smartphone-applications (apps) are now available for large-scale use. Smartphone technology and mobile applications have shown promising results in PA and health promotion (Ozdalga, Ozdalga, & Ahuja, 2012; Fanning, Mullen, & McAuley, 2012; Kirwan, Duncan, Vandelanotte, & Mummery, 2012; King et al., 2013). Of the 875,683 active Apps available in iTunes and the 696,527 active Apps in Google Play, 23,490 and 17,756 were categorized as health and fitness (Middelweerd, Mollee, van der Wal, Brug, & Te Velde, 2014; Jee, 2017). Apps designed based on the behavioral changes theory, in which users will receive a motivational message, predefined goal set up, daily feedback, percent of an archived goal, and can share their information to other through social media such as Facebook and MyFitnessPal (Hamari, Hassan, & Dias, 2018; Al Ayubi, Parmanto, Branch, & Ding, 2014). In Indonesia, over 100 millions people have smartphone and ownership (Kementrian Komunikasi dan Informatika Republik Indonesia, 2019). Use of new technology could be a way to reach large numbers of nursing students.

Applying a smartphone health-App might suitable in the context of bachelor nursing students in Indonesia. However, there is no culturally tailored reinforcement learning by self-efficacy program to improve physical activity, and health outcomes among bachelor nursing students. Therefore, this study is urgent need to know the impact will be having on users. Recent study was conducted a physical activity program through an smartphone health Apps and social media tool for bachelor nursing students to promoting physical activity.

RESEARCH METHODS

A quasy experiment with pre and post-test design was used to evaluate the effectiveness of smartphone health apps using social media tool reinforcement learning to increase physical activity among bachelor nursing students.

Participants

Convenience sampling was applied to obtain a sample that adequately represents the target population are bachelor nursing students in Bandung with an estimated around 6,000 Students. Recruitment started in May 2020, and the last 12 weeks measurements were finished in August 2020. The eligiblity criteria comprised the following: both gender, aged with 20 years or above, nursing students in bachelor degree, who reported having experienced any mobility-related problems affecting their everyday life before enrollment in this study. Participants who were bound to a wheelchair or whose medical condition prevented them from moderate-intensity walking, as well as people unable to speak and read Bahasa Indonesia or who did not have access to a smartphone, were excluded.

G*Power software version 3.1.9.2 was used to carry out the sample size with the confidence level of 95%, confidence interval of 9.81, the power of 0.80, the effect size of 0.25, and an alpha level of 0.05 were set for the main and interaction effects. The 80 participants was required. A number of 40 bachelor nursing students in each group was required.

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Instrumen

Physical activity (Primary Outcome)

Outcomes was measured at baseline and at 16-weeks. The primary outcome physical activity was used International Physical Activity Questionnaire short form (IPAQ-SF). Bachelor nursing students in both groups were reported frequency of physical activity performed during the last 7 days and the duration (minutes/hours usually spent on one of those days). The report activities include their vigorous-intensity physical activity, moderate-intensity physical activity, and walking. The range of physical activity needs to report at least 10 minutes.

Participants also report the total time that they spent sitting in a weekday, during at the last 7 days (Group, 2005). IPAQ was validated in 12 countries. The short version of the IPAQ was found to have acceptable test-retest reliability using pooled Spearman's (0.75). The IPAQ short questionnaire has reliability 75 % of the correlation coefficients above 0.65 and ranging from 0.88 to 0.32. Overall, the pooled was 0.76 (95% CI 0.73–0.77). Criterion validity was 0.67 (95% CI 0.64–0.70) and for comparisons of different short instruments was 0.58 (0.51–0.64) (Craig et al., 2003).

Secondary outcome

Anthropometric evaluation

In anthropometric evaluation, participants were asked to remove shoes while height was measured to the nearest 0.1 cm. Weight and height were measured using a portable stadiometer, in the standing position, without shoes and record to the nearest millimeter (Gibson, 2005). The anthropometric measurements indices was calculate: body mass index (BMI) reach by dividing the weight (kg) by the height (m) squared. The World Health Organization classification of the BMI (weight/height^2; (kg/m^2)) was used to classify underweight, normal-weight, overweight and obesity in the studied population (WHO, 2000).

Blood pressure measurement

Blood pressure was measured by a registered nurse using a validated and calibrated digital automated sphygmomanometer, after the participant had rested for at least 15 minutes (El Assaad, Topouchian, Darne, & Asmar, 2002). Two consecutive measurements were obtain 5-minutes apart and the average of the two readings were recorded (Pickering et al., 2005).

Assessment of Exercise self-efficacy

Exercise self-efficacy in Bahasa Indonesia version (ESES-I) (Hakim et al., 2020) is defined as participants' confidence in their ability to exercise regularly (most days of the week). In this study, Exercise self-efficacy in Bahasa Indonesia version was assessed with the self-administered an 18-item exercise self-efficacy (ESES) scale developed by Bandura (2005). In the first time, ESES-I was asked participants to rate perform exercise routine per week (three or more times per week), for a range of conditions. The ESES-I was require participant to rate the strength of their belief in current capabilities to do a specific activity at the time of the measurement. Scales can be from 0 to 100 with increments of 10 or from 1 to 10 depending on the age and ability of participants. The scale ranged from 0 (I cannot do this activity at all) to 10 (I am certain that I can do this activity successfully)." A 5 interval scale is weaker than using a 0- 100 scale because it does not allow responses to be distributed over a range.

The ESES-I was demonstrated robust evidence of reliability (Cronbach's alpha ranged from 0.78 to 0.92), and high internal correlation (0.91) (Hakim et al., 2020).

Data Collection Procedure

After giving informed consent from each respondent, the program was processed in 12 weeks. In the first visit, the researchers were explained purposes of this study and give an electronic booklet for providing physical activity (PA) information. Self-administrated structured questionnaires were used to collect data within 20 minutes that include social demographics, self-efficacy exercise, and the PA performances. Regarding the objective measures for level of physical activity in one week, it was collected by

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smartphone health-app. The physical anthropometrics including height and weight were measured by a stadiometer, and automated sphygmomanometer for blood pressure.

Researchers were sent all physical activity information by social media approaches. The outcomes measurements were assessed before and after the program for participants. After pretest, respondents in the smartphone health-app group were received one-30 minutes' instruction related to increase and report of steps and distances of PA in the log-book and reinforcement learning by self-efficacy program during 12 weeks using social media. Participants in the control group were received usual care.

Data analysis

Analysis was performed using SPSS 23th version. Descriptive statistic were analyzed demographics, health beliefs and the behavior. Paired T-test was compared means variables within group. Demographic characteristics and baseline measures were compared at baseline using chi-square test and independent t-test. Changes from pretest to posttest in outcome variables were calculated using pair t-test. All the tests were conducted at *p-value* of 0.05. If the *p*-value ≤ 0.05, the analyzed data were considered statistically significant.

Ethical consideration

The Ethics Committee of the Ethics Review Board of the Local Government (Ref: 423.4/0012/wasbang/2020) approved the present study. All participants were provided a consent form and given the assurance of data confidentiality and privacy.

RESULT

Study Participants and Smartphone Health-Apps Intervention Adherence

In total, 80 bachelor nursing students were participated in this study. The participants' ages ranged from 21 to 24 years, 23.3 years being the average. There were no significant differences between the intervention and control groups in any of the demographic, physical activity, and self-efficacy variables at pretest (all p > .05, see Table 1 and Table 2).

A total of 37.5% (15/40) bachelor nursing students in the smartphone health-app group used the smartphone apps daily, 27.5% (11/40) for 5 to 6 days/week, 20% (8/40) for 3 to 4 days/week, and 15% (6/40) for less than 3 times/week.

Baseline Characteristics

Baseline characteristics of the participants are shown in Table 1. A series of smartphone health-app or control between-groups were showed no significant with regard to baseline characteristics. Almost half of the bachelor nursing students were lower level of physical active (n = 37, 46.3%) (Table 2).

Table 1 Based Line Social Demographics And Family History

Variable	Group	Total	Exp. (n=40)	CN (n= 40)	*p*-value
			n, %		
Gender (n,%)	Male	36	17 (42.5)	19 (47.5)	**0.78**
	Female	44	23 (57.5)	23 (52.5)	
Age (Mean ±SD)		80	22.67(2.37)	23.16(2.46)	**0.57**
Religion (n,%)	Islam	28	16 (40)	12 (30)	**0.69**
	Others	42	24 (60)	28 (70)	
Family History of DM (n,%)	Yes	20	11 (27.5)	9 (22.5)	**0.83**
	No	60	29 (72.5)	31 (77.5)	

The final sample included a total of 80 participants (36 female, 44 male) and the mean ages in smartphone health-app

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group was 23.16 (SD= 1.71) and the control group (M = 22.46; SD= 1.46). Attrition was low (n=8), and was solely attributed to app or smartphone malfunctions. Descriptive statistics for each condition can be found in Table 1-2. Results of an independent samples t-test showed that there was no significant difference between avarege of step counts, distance walked, BMI, systolic blood pressure, and SE of the control and smartphone health-app group at baseline (P > 0.05), ensuring that both groups were not different and randomization was effective.

Table 2. Physical Activity Behavior, Self-Efficacy and Health Outcomes in Pre-test

Variable	Overall (Mean, SD)	Exp. (n=40)	CN (n= 40)	*p*-value
		Mean (SD)		
PA				
Average of steps	2976.75 (37.21)	2956.91 (73.92)	2996.59 (74.91)	0.562
Distances	19.72 (0.25)	20.15 (0.50)	19.29 (0.48)	0.638
IPAQ (PA)				
Vigorous	42.04 (40.72)	37.95 (37.32)	46.13 (43.95)	0.373
Moderate	38.63 (47.78	34.50 (46.85)	42.75 (48.94)	0.444
Walking	53.75 (54.28)	49.63 (54.40)	57.88 (54.54)	0.500
Total days of activity	4.18 (2.83)	3.98 (2.87)	4.38 (2.81)	0.530
Total activity (min/wk)	128.41 (115.34)	108.58 (95.42)	148.25 (130.52)	0.125
MET Vigrous	927.80 (1153.55)	784.60 (972.91)	1071.00 (1306.47)	0.270
MET Moderate	457.50 (638.73)	414.00 (656.68)	501.00 (625.54)	0.546
MET Walking	569.66 (693.47)	638.96 (761,61)	500.36 (619.86)	0.375
MET Total	1828.48 (1734.79)	1584.58 (1507.69)	2073.38 (1923.80)	0.211
PA Cathegory (n,%)				0.481
Low	37 (46.3%)	20 (50.0%)	17 (42.5%)	
Moderate	18 (22.5%)	10(25.0%)	8 (20.0%)	
Vigrous	25 (31.3%)	10 (25%)	15 (37.5%)	
Self-efficacy Exercise				
Self-Efficacy	75.42 (24.16)	75.72 (24.63)	75.12 (23.69)	0.832
Health Outcomes				
Systolic Blood Pressure	111.23 (1.39)	113.24 (2.83)	109.22 (2.73)	0.394
Diastolic Blood Pressure	70.13 (0.88)	70.92 (1.77)	69.34 (1.73)	0.578

Changes in Outcomes From Baseline to 12 weeks Between-Group

Between-group differences at 12 weeks in the primary and secondary outcomes were shown in Table 3. The significant differences were found between the groups for any of the outcomes at 12 weeks, except for dyastolic blood presure and BMI. A total of 90% (36/40) of participants in the smartphone health-app group, promote PA at 12 weeks.

For the primary outcome of the levels of physical activity, there was a significant increase after 12 weeks of program, and significant difference between the groups were observed. The smartphone health-app group recorded more average of steps, longer distances walked, and lower systolic blood pressure ($p < 0.05$) than the control group of bachelor nursing students. No main effects of the smartphone health-app and social media program were observed on diastolic blood pressure and BMI ($p > 0.05$). With respect to the secondary outcomes, there was a significant increase in self-efficacy in both groups, and significant difference between the groups.

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Table 3. The Smartphone Health-App and Social Media Program Effects at 12 Weeks

Factors	Variable	Group	Pre-test Mean (SD)	Posttest Mean (SD)	Diff. mean	P-value
Physical Activity IPAQ (PA)	Average of steps	Exp.	2956.91 (73.92)	3173.42 (79.34)	216.51	0.000
		CN	2996.59 (74.91)	2875.61 (71.89)	-120.98	
	Distances	Exp.	20.15 (0.50)	21.13 (0.53)	0.98	0.032
		CN	19.29 (0.48)	19.42 (0.49)	0.13	
	Vigorous	Exp.	37.95 (37.32)	44.71 (7.07)	6.76	0.052
		CN	46.13 (43.95)	40.65 (6.43)	-5.48	
	Moderate	Exp.	34.50 (46.85)	46.57(7.36)	12.07	0.191
		CN	42.75 (48.94)	42.20(6.67)	-0.55	
	Walking	Exp.	49.63 (54.40)	48.80(7.72)	-0.83	0.181
		CN	57.88 (54.54)	48.81(7.72)	-9.07	
	Total days of activity	Exp.	3.98 (2.87)	2.75(0.43)	-1.23	0.221
		CN	4.38 (2.81)	2.36(0.37)	-2.02	
	Total activity (min/wk)	Exp.	108.58 (95.42)	94.85(15.00)	-13.73	0.094
		CN	148.25 (130.52)	80.27(12.69)	-67.98	
	MET Vigrous	Exp.	784.60 (972.91)	1195.62(189.04)	411.02	0.058
		CN	1071.00 (1306.47)	786.76(124.40)	-284.24	
	MET Moderate	Exp.	414.00 (656.68)	554.54(87.68)	140.54	0.061
		CN	501.00 (625.54)	548.80(86.77)	47.8	
	MET Walking	Exp.	638.96 (761,61)	641.57(101.44)	2.61	0.287
		CN	500.36 (619.86)	596.06(94.25)	95.7	
	MET Total	Exp.	1584.58 (1507.69)	1378.47(217.96)	-206.11	0.048
		CN	2073.38 (1923.80)	1209.37(191.22)	-864.01	
Self-Efficacy	Self-efficacy	Exp.	75.72 (24.63)	77.62 (1.94)	1.9	0.037
		CN	75.12 (23.69)	75.17 (1.88)	0.05	
Health Outcomes	Systolic Blood Pressure (mmHg)	Exp.	113.24 (2.83)	110.54 (2.76)	-2.7	0.016
		CN	109.22 (2.73)	109.67 (11.36)	0.45	
	Diastolic Blood Pressure (mmHg)	Exp.	70.92 (1.77)	69.56 (1.74)	-1.36	0.051
		CN	69.34 (1.73)	69.10 (1.73)	-0.24	
	BMI (kg/m2)	Exp.	85.34(10.31)	79.98(11.63)	-5.36	0.067
		CN	88.52 (12.30)	89.07(10.26)	0.55	

DISCUSSION

This study was used smartphone health app in combination with social media tool to promote PA in bachelor nursing students. Overall, the smartphone health apps using social media tool reinforcement learning was successful increased physical activity in bachelor nursing students. The smartphone health apps using social media tool reinforcement learning had significant effects on the average of steps, and distance walked. These findings were similar with previous review studies that smartphone apps can be effective in increasing physical activity (Coughlin, Whitehead, Sheats, Mastromonico, & Smith, 2016). A more recent review suggests that app-based physical activity interventions are the most effective in the short term (Romeo et al., 2019). Bachelor nursing students in the current study could participate in their own choosing and preferences to increase duration of PA.

The increase in PA might still have influenced health outcomes. Previus studies reported that social influence was significantly affected individual's intention to exercise (Zhu, Dailey, Kreitzberg, & Bernhardt, 2017) and use of mHealth technology (Perski, Blandford, West, & Michie, 2017).The PA information sharing on social media colud lead to friendly competition that might initiate behavior changes (Higgins, 2016). The intentions to use smarphone health apps are shaped by social influence of performance and effort.

Further studies is required to determine how social influences to achieve the recommended

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level of PA in bachelor nursing students. Previous studies suggested that the smartphones apps may useful to maintain and increase physical activity level in recomended levels in long period (Fjeldsoe et al., 2011). While the study's intervention was mainly guided by the theory of planned behavior, other behavior change theories which emphasize behavior maintenance, such as the transtheoretical model (Prochaska & Velicer, 1997) or the health action process approach, and self-regulation theories (Maes & Karoly, 2005), could provide valuable insights into further strategies to maintain behavior changes in the longer period.

Recent study were neither given any information or reminder to increase PA after the 12-week program. The lack of interaction with participants during follow-up could decrease physical activity levels (Marcus et al., 2000; Carr et al., 2008; Linke et al., 2019). Future studies should examine the effect of post-intervention interaction to maintenance of PA in the recomended levels.

This study results found that exercise self-efficacy was significant increase in the smartphone health-app group. Our results was similar with prior studies (Annesi, 2012; McAuley & Blissmer, 2000). Exercise self-efficacy is therefore defined as an individual's belief in his/her ability to engage in physical activity (Bandura, 1997). The greater self-efficacy individuals have, the more motivation they have to perform exercise, thereby resulting in their greater investment in physical activity (Annesi, 2012; McAuley & Blissmer, 2000). The others issue is cultural and experiences could influence individu thinking and changes self-efficacy to promote physical activity (Markus, & Kitayama, 1991; Lim, Waters, Froelicher, & Kayser-Jones, 2008; Vandelanotte et al., 2007; Davies et al., 2012).

A major strength of this study was significant in developing the smartphone health app and social media program to increase physical activity in bachelor nursing students. Use of the apps during the program was ad libitum and not closely monitored, which reflects real-life app use, and contact with participants in the app group was minimal to reflect a real-world context and therefore increase generalizability. Furthermore, the primary and secondary outcomes were measured with subjective and objective measurements, in accordance with current recommendations for evaluating the effectiveness of PA interventions (Silfee et al., 2018).

Some limitations of current study should be recognized. The participants in this study were self-recruited from the nursing institutions; they could not be representative of all bachelor nursing students. Using free apps maigth have increased contamination and/or co-interventions. Participants were aware of the study when they performed the baseline measurements of PA, it is most likely that they were more physically active than usual, which limits the comparison of baseline and outcome for PA measures.

CONCLUSION

The smartphone health app in combination with social media tool reinforcement learning was successfully promoted PA of bachelor nursing students over 12 weeks. The program was designed to be simple for widespread implementation in a variety of bachelor nursing students and settings, as it requires no special equipment or previous physical activity knowledge. Although apps have the potential to increase the reach of health behavior change interventions, our results mirror the recent study showing that few individuals will use an offered app consistently over time. Given the high degree of smartphone use in the bachelor nursing students, the fact that an app-based intervention has the potential to increase reach at a low cost and the substantial health effects associated with an increased physical activity and self-efficacy. However, the program should be tested in a variety of population groups over a longer period before wide scale implementations.

CONFLICTS OF INTEREST

The authors declared that no conflict of interest.

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