



## Four Weeks Intervention of Mobile Phone Text Messaging (Let's Quit!) on Smoking Cessation among University Students: A Non-Randomized Controlled Trial

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### ABSTRACT

**Background:** Mobile phone text messaging intervention is one of the newest methods to help people to stop smoking. **Objective:** The aim of the study was to determine the effectiveness between mobile phone text messaging intervention and motivational intervention in increasing quit rate which was biochemically verified at 4 weeks. **Methods:** A non-randomized control trial (n=60) was conducted among smokers aged between 18-24 years old from 1 April until 12 May 2014. The intervention group received a mobile phone text message comprising motivational message and tips to quit smoking, whereas the control group received informational pamphlet. An evaluation was done by using an assisted administered questionnaire to measure the pre- and post-outcome of quit rate, timeline follow-back (TLFB) method, Fagerstrom test for nicotine dependence (FTND), and carbon monoxide (CO) level. The baseline differences between the groups were controlled using ANCOVA and Logistic Regression to test the effectiveness of the intervention. **Results:** There were significant decrease in the mean of average cigarette smoked for the past one week (TLFB) in the intervention group compared to the control group ( $p=0.027$ ) from pre- to post intervention assessment. However, there were no significant differences were observed between the 2 groups in terms of quit rate ( $p=0.204$ ), FTND ( $p=0.880$ ) and CO level ( $p=0.981$ ) outcomes. **Conclusion:** For short term mobile phone text messaging smoking cessation intervention, only reduced TLFB result was significant. Even though this study does not achieve its aim in helping smokers to quit, this intervention still gives a positive outcome.

**Keywords:** Text message, Smoking cessation, University students, Mobile phone

**Abbreviations:** TLFB: Timeline Follow Back Method; FTND: Fagerstrom Nicotine Dependence Score; NRCT: Non-Randomised Control Trial; CO: Carbon Monoxide

### INTRODUCTION

Cigarette smoking is one of the main causes of death worldwide. Globally, around 6 million of mortalities each year are due to smoking related diseases. It is estimated that, by the year 2030, the smoking related mortalities will increase tremendously to more than 8 million [1]. A 2010 study documented overall decreasing trends in the prevalence of smoking among men in Asian communities served by the Racial and Ethnic Approaches to Community Health (REACH) project [2]. Southeast Asia, like most other delineated regions of the world, is made up of culturally, economically, socially, and politically diverse countries: Malaysia, Laos, Philippines, Cambodia, Singapore, Myanmar, Brunei, Vietnam, Indonesia, and Thailand. There are nearly 600 million tobacco users within the Southeast Asian countries, with the region contributing to about 50% of the global burden of tobacco users [3]. In Malaysia, Thailand, and Vietnam, tobacco use appears to be on a gradual decline, whereas in Indonesia there is a rising trend. Youth's use of tobacco, which mirrors the future burden, also shows remarkable variations. In terms of age-group young adults deserve special attention because initiation of smoking and establishment of regular smoking typically occurs in young adulthood as they have more autonomy yet higher instability and less parental control than during adolescence [4]. Young adulthood marks an important developmental period for exploring identity and developing health behaviours that may persist through later adulthood [5]. Therefore, young adulthood is the period during which aggressive intervention efforts should be made to thwart smoking initiation or prevent light smokers from becoming heavy smokers [4-6].

In Malaysia, smoking-related diseases have been the primary cause of mortality for the past three decades. Burden of disease in 2003 estimated that one-fifth of disability adjusted life years (DALYs) and one-third of years of life lost for Malaysians were due to smoking-related diseases [7]. In developing countries such as Malaysia, curiosity, peer pressure, and feeling more matured have been shown to be the key factors responsible for initiation of smoking among young adults [8,9].

Smoking cessation is a priority for preventing smoking-attributable disease and reducing its burden. Among the interventions done, a study with single-blind, randomised trial, undertaken in the UK, mobile phone text messaging smoking cessation programme (txt2stop), comprising motivational messages and behavioural-change support, or to a control group that received text messages unrelated to quitting which has significantly improved smoking cessation rates at 6 months and should be considered for inclusion in smoking cessation services [10]. There is another research done on the internet and mobile phone texting messaging intervention for college smokers which carried out for 6 weeks' time reported significantly reduced smoking rates and dependence [11]. Quitting smoking at any age confers substantial and immediate health benefits, including reduced risks of stroke, cardiovascular disease and smoking-related cancers, and quitting smoking by the age of 30 reduces the risk of dying from tobacco-related diseases by almost 90%. The World Bank suggests that if adult cigarette consumption were to decrease by half in the year 2020, approximately 180 million tobacco-attributable deaths could be avoided. Therefore, promotion of smoking cessation has been proposed as a primary focus of tobacco control efforts, especially in developing countries where smoking prevalence and cigarette consumption are both still relatively high [12].

To justify the study, most risk factors are associated with more than one disease, and targeting those factors can reduce multiple causes of disease. Since smoking has 9% contribution on the leading global risk towards mortality in the world and this risk factor has resulted in multiple causes of disease, for example, lung cancer, heart disease, stroke, chronic respiratory disease, and other conditions, therefore by quantifying the impact of this risk factor on diseases, may help to decrease the number of burden disease that is caused by smoking. University students age of 18-24 are among the group of age that has the highest prevalence of smoking, thus it is necessary to target the high-risk people, who are most likely to benefit from the intervention. Population-based strategies seek to change the social norm by encouraging an increase in healthy behaviour and a reduction in health risk. University students are in transition between the adolescence and early adulthood and developed unhealthy behaviours like cigarette smoking. During this critical period, there is a tendency to express maturity and thus started to smoke cigarettes as an adult behaviour. Many studies have indicated that university student between 18-24 years were not fully aware of the health consequences of cigarette smoking and reported they have different level of risk awareness.

The main objective is to determine the effectiveness of mobile phone intervention as compared with motivational intervention towards university students into a better outcome of quit rate, reduced TLFB, and low FTND score, and low carbon monoxide level.

## METHODS

A single blinded, non-randomized controlled trial (NRCT) was undertaken in Malaysia for 4 weeks starting from 1 April until 12 May 2014. This study was conducted at two local universities.

### Participants

University students were recruited to participate in this study. The inclusion criteria for this study participation include (1) smokers aged 18-24 years old (2) owned a mobile phone with text messaging capabilities (3) intention to quit (4) no current use of nicotine replacement treatment or bupropion in the past month, and (5) not in treatment for any substance abuse disorder within the past year.

Participants were considered to be excluded as (1) not a smoker (2) no desire to quit smoking, and (3) who unwilling to participate in this study.

### Sample size

Sample size calculated manually using formula from Fleiss [13]. In previous studies in China, there were significant differences in the smoking reduction rate between intervention and control groups [14]. Thus, based on this study, the minimum sample size should be 56 and 57 participants in each group. However, we only managed to get 30 subjects for both intervention and control group.

### Intervention design (Let's quit)

The text messaging components were designed to accommodate participants who are in different stages of quitting and to offer for different routes to quit. The protocol of intervention of this study was closely followed previous research conducted [15]. The content of the text messages was developed by our researchers (Table 1).

**Table 1 Examples of intervention group text messages**

<p><b>“Not ready” track</b></p> <p>“Ever tried to quit but failed? Let's change! we are NOT FAIL but NOT SUCCEED yet on keep trying let's quit smoking. Great future awaits you and your family. Did you know that 60-75% cigarette smoke is inhaled by non-smokers? You have an adverse impact on other people because of your habits!”</p>
<p><b>“Beginner” track</b></p> <p>“Appreciate your efforts to quit smoking. Buy a gift for yourself. Remember it is not a gift CIGARETTE!” “Do not have doubt or shame. Ask for help and suggestions from professional to stop. Do not be a stupid arrogant!” How many times have you promised yourself that you will quit smoking from tomorrow? Think about it.”</p>
<p><b>“Advance” track</b></p> <p>“Congratulations! You have successfully quit smoking today.” Two hours without a cigarette can cause symptoms such as nervousness, drowsiness, increased appetite, and cravings following the removal of the effects of nicotine. Brace yourself!”</p> <p>“Heart attack rates are 70% more among smokers than among non-smokers. Within 24 hours without smoking your risk of heart attack is now starting to decline. Keep it up!”</p>
<p><b>“Relapse” track</b></p> <p>“Tip 1: Are you smoking again? Throw the cigarettes away! You do not need it! Remember! We are helping you to quit smoking!” Tip 3: At this time, focus on your intention to quit smoking! You do not need to have another intention for example to lose weight at the same time. Tip 19: You are definitely capable to quit smoking! You have been successful before! Now strengthen your determination to quit. Let us help you! Let's change!”</p>
<p><b>“Distraction” track</b></p> <p>“Did you know that World Cup 2014 will take place from June 12 to July 13 in Brazil.” For your fuel gauge tells you which side your gas tank is on. Look on your cars fuel indicator this small arrow beside the gas pump icon. Did you know the blood vessels in the human body is 62000 miles is equal to 2.5 times the circumference of the earth? You can spell T-O-Y-O-T-A out of TOYOTA logo. Try it!”</p>

Five tracks were created, including “Not Ready”, “Beginner”, “Advance”, “Relapse”, and “Distraction”. The “Distraction” track was combined with all of the other remaining 4 tracks. It was aimed as a distraction (as the name indicated) method to lighten the participants' mood. It consisted of general information such as sports, fashion, dining, movies, and travelling.

At pre-intervention, participants were assigned either to the “Beginner” or “Not Ready” tracks depending on whether they set a target quit date or not. The “Not Ready” track was aimed to motivate the participant to quit. This track was designed for individuals who were not yet ready to set a quit date. Messages in the “Not Ready” track consisted of twice daily messages that were delivered up to 7 days from the set of the quit day. Those who stayed in “Not Ready” track until the post intervention period was labelled as a smoker.

The “Beginner” track was basically a preparation period. This track was designed for individuals who have set a target quit day. Within the 7 days before the quit day, participants will have received trice daily messages. The messages contained tips and advice aided to quit smoking, how to prepare self to quit, and motivational messages.

At the quit day, the participants will be moved to the “Advance” track. Initially, the participants will receive up to 5 messages on the designated quit day. On the subsequent day, the number of messages will be reduced to 4 messages on the 1st day of quit, 3 messages on the 2nd day of quit, and 2 messages on the 3rd day of quit smoking. This track then continued to delivered messages once daily for a week, then trice per week until the end of the intervention (if the participants remained quit). Messages addressed the same general topics noted above, but tailored to be appropriate for individuals who were currently engaged in quitting smoking. This track was mainly acting as a reminder of the participant's achievement in quit smoking.

Those who did not quit on their quit date will be asked whether they wish to set a new date. Those who set a new quit date (only within 7 days from the previous quit date) will be moved into the “Beginner” track, the remaining participant moved into the “Not Ready” track.

Participants who relapse after their quit date will be assigned to the “Relapse” track. Instead of required a new date to quit, this track continued the “Advance” track. Participants will be received five times daily messages in a short 3 days course. At the end of this track, participants will be asked as to either they were ready to continue being quit or not.

Those who were ready will be moved into “Advance” track, and the remaining participants moved into the “Not Ready” track. Those who in the “Not Ready” track will be moved to “Beginner” track if a new quit date were set (Figure 1).

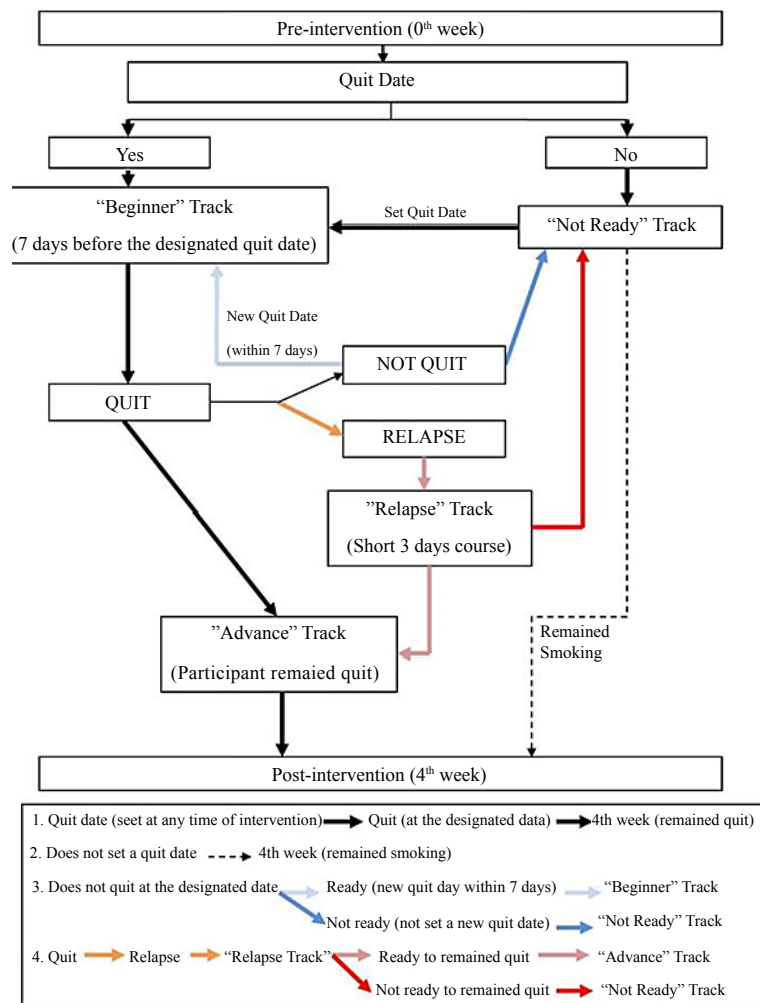


Figure 1 Intervention group flow of text messages

**Control design**

The control group received an informational pamphlet regarding smoking. The content of the pamphlet was similar to the content of the text messages for the intervention group.

**Study tools**

Self-administered questionnaire was given to both intervention and control group at the first week where by it was consist of socio demographic data, smoking behaviour, smoking knowledge and FTND. For the socio demographic data, age, gender, and race were being asked. Smoking behaviour was measured using TLFB method where the participants had to write down the amount of cigarette smoked per day for the past 1 week. TLFB has been shown to have good reliability and validity with adult [16] and adolescent smokers [17]. Besides this, the sources of cigarette and the location of smoking were also asked. General knowledge such as effect of smoking, content in the cigarette smoke, areas of smoking, and statement regarding smoking being asked. The higher number of questions being answered correctly, the higher the score. The Fagerstrom Test for Nicotine Dependence is a standard instrument for

assessing the intensity of this physical nicotine addiction. FTND was tested by having 6 questions: (1) How soon after waking do you smoke your first cigarette (2) Do you find it difficult to retain from smoking in places where it is forbidden? (3) Which cigarettes a day do you smoke (4) How many cigarettes a day do you smoke? (5) Do you smoke frequently in the morning (6) Do you smoke even if you are sick in bed most of the day? Each answer had their scoring. For the biochemical analysis assessment, CO analyser (Carefusion USA) was used to measure the carbon monoxide level in the lungs and blood for past 24 hours only.

### Data collection

Participants were recruited as Figure 2 and were informed regarding the purpose of study, time of study taken place, twice evaluation on smoking status that was done during pre-intervention and post-intervention and the methods of intervention that they received according to the respective universities. The duration of pre- and post-intervention was lasted for 4 weeks.

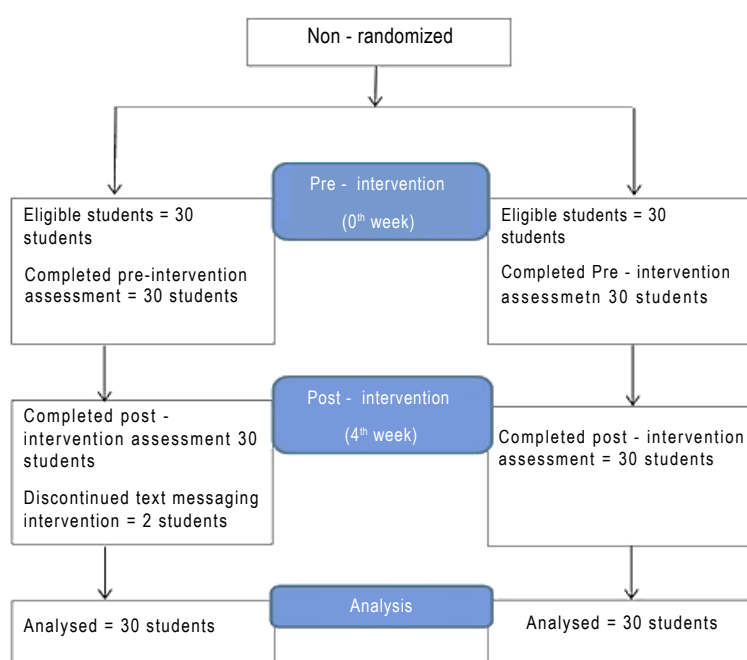


Figure 2 Flow chart of study participants

### Study outcome

Quit rates were measured during evaluation on pre- and post-intervention assessment whereby a question “are you smoking past seven days”, by providing the answer of yes or no.

Time-line follow-back (TLFB) method provides information on the average number of cigarette smoking for the past one week.

An assessment of FTND, the higher the Fagerstrom score, the more intense is the patient’s physical dependence on nicotine.

For the biochemical analysis, CO level was used by using CO analyser. The interpretation of CO level was made according to the ppm level which the higher level of CO ppm, the higher the tendency of one being a heavy smoker. The breath test served to provide feedback with positive reinforcement in participants with reduced CO levels [18].

### Ethics and informed consent

The ethical committee of Universiti Kebangsaan Malaysia (UKM) has approved this study with project code, FF-201-065. The ethical issue involved in this study includes the consent form given where in conducting surveys, researchers obtain informed consent by declaring the purpose of the study; disclosing which institutions are behind the study; explaining how privacy will be assured; and detailing with whom data will be shared and how it will be reported, before participants complete the questionnaire.

The total anonymity of study participants was maintained throughout the study [19].

### Statistical analysis

The data were analysed using SPSS software, version 20.0. The level of significance is based on p-value of less than 0.05. To test for baseline characteristic equivalence of intervention and control individuals, chi-square tests for categorical variables and t tests for continuous variables were used. With these, three factors which include age, knowledge on smoking, and frequency of smoking was found to be possible confounders for the research outcomes. For comparison of outcomes which includes quit rate, TLFB, FTND score and CO ppm level in between groups, t tests were used. Because of significant baseline differences between the study groups, particularly in the age, knowledge of smoking and frequency of smoking, ANCOVA and regression models used to control for the baseline differences for a better outcome. ANCOVA test were applied for the outcomes of TLFB, FTND and CO ppm level. Logistic regression models were applied for the binary outcome variables (quit rate).

## RESULTS

### Baseline characteristics of participants

Table 2 presents the baseline differences between intervention and control group participants were found for the following variables: age ( $\bar{X}=22.7 \pm 0.88$ ,  $20.73 \pm 1.63$ ;  $p=0.001$ ), knowledge score ( $\bar{X}=17.40 \pm 1.99$ ,  $13.53 \pm 3.7$ ;  $p=0.000$ ) and frequency of smoking ( $\bar{X}=21$ ,  $29$ ;  $p=0.015$ ).

Table 2 Baseline characteristics

Variables	Intervention (n=30)	Control (n=30)	X <sup>2</sup> (df)	p value
	N (%)	N (%)		
<b>Gender</b>				
Male	30 (100%)	27 (90%)	1.40 (1)	0.236
Female	0 (0%)	3 (10%)		
<b>Race</b>				
Malay	29 (96.7%)	29 (96.7%)	0.00 (1)	1
Non-Malay	1 (3.3%)	1 (3.3%)		
<b>Frequency of smoking</b>				
Frequent	21 (70%)	29 (96.7%)	7.68	0.006
Less Frequent	9 (30%)	1 (3.3%)		
<b>No. of attempt to quit</b>				
None	8 (26.7%)	6 (20%)	0.53	0.86
1 - 2 times	20 (66.7%)	20 (66.7%)		
> 2 times	2 (6.7%)	4 (13.3%)		
Variables	(mean $\pm$ SD)		t value	
Age (years)	22.70 $\pm$ 0.88	20.37 $\pm$ 1.63	6.91	<0.001
Knowledge Score	17.40 $\pm$ 1.99	13.53 $\pm$ 3.70	5.04	<0.001
<b>Pre-Outcomes</b>				
TLFB	33.50 $\pm$ 26.69	44.93 $\pm$ 22.33	-1.8	0.077
FTND	3.17 $\pm$ 2.00	3.90 $\pm$ 2.22	-1.34	0.184
CO Level	13.73 $\pm$ 8.29	14.03 $\pm$ 7.13	-1.15	0.881

In the intervention and control group, 21-23 (25, 83.4%) and 18-20 (17, 56.6%) age groups had a higher percentage in participation respectively. For the knowledge score, the following baseline difference between intervention and control group participants were found where the intervention group had a higher mean (17.40  $\pm$  1.99) compared to control group (13.53  $\pm$  3.7). Both participants in intervention and control group showed that they are frequent in smoking (21, 70%, 29, 96.7%).

### Study outcome

There were no significant differences between the group of intervention and control in Fagerstrom Test for Nicotine Dependence (FTND) and Carbon Monoxide Analyzer (CO ppm). There were 3 main outcomes that were controlled by using ANCOVA. The potential confounders between the 2 groups were controlled such as age, knowledge and

frequency of smoking. Timeline Follow Back Method (TLFB) between the control and intervention group was found to be significant with ( $p=0.049$ ). Furthermore, analysis made on TLFB within intervention group has shown a significant value of ( $p=0.010$ ) thus we can say that the average no of cigarette smoking for the past 7 days using TLFB method was reducing effectively more on the intervention group (Table 3).

**Table 3 Result of outcomes before and after controlling the confounding variables**

Variables	Intervention (n=30)	Control (n=30)	t value	p value <sup>a</sup>
	Mean ± SD	Mean ± SD		
TLFB	25.27 ± 21.42	41.87 ± 28.35	-2.56	0.013
FTND	3.47 ± 2.01	2.90 ± 2.48	0.97	0.335
CO Level	13.40 ± 8.07	13.6 ± 9.34	-0.09	0.93
	Adj. mean (95% CI)		F stat. (df)	p value <sup>b</sup>
TLFB	20.65 (10.17,31.14)	38.76 (26.70,50.82)	4.06 (1,54)	0.049
FTND	3.38 (2.34,4.42)	3.25 (2.05,4.44)	0.02 (1,54)	0.88
CO Level	13.79 (9.78,17.80)	13.88 (9.26,18.49)	0 (1,54)	0.981

<sup>a</sup> Independent T-Test; <sup>b</sup> Adjusted mean using ANCOVA controlling for age, knowledge score, and frequency of smoking; <sup>c</sup> TLFB within the intervention group was found to be significant ( $p=0.010$ )

In Table 4 is the result of quit rate before and after controlling the confounding variables. Quit rate outcome in which it was controlled by using multiple logistic regression. It was noted that there was no difference in the result before and after controlling the potential confounders.

**Table 4 Result of quit rate before and after controlling the confounding variables**

Variables	Quit (n=30)	X <sup>2</sup>	df	p value <sup>a</sup>
<b>Quit Rate</b>				
Intervention	3 (10%)	0	1	1
Control	2 (6.7%)			
Variables	Crude OR	(95% CI OR)	X <sup>2</sup> stat. (df)	p value <sup>b</sup>
Intervention	1	-	-	-
Control	0.78	(0.07; 8.66)	8.12 (5)	0.839

<sup>a</sup> Chi-Square Test for Association; <sup>b</sup> Logistic Regression controlling for age, knowledge score, and frequency of smoking

### Program feedback

Majority of the participants read and understood the messages well (26, 86.7%) and they felt motivated to quit smoking (22, 73.3%). However, many of the participants (13, 43.3%) were unsatisfied with the overall performance of message content (Table 5).

**Table 5 Feedback from the intervention program**

Variables	Frequency, n (%)	
	Yes	No
Read and understand message	26 (86.7%)	4 (13.3%)
Feel motivated to quit smoking	22 (73.3%)	8 (26.7%)
Confident to remain quit smoking	20 (66.7%)	10 (33.3%)
Variables	Satisfied	Unsatisfied
Overall performance of message content	17 (56.7%)	13 (43.3%)
Message content among smoker	17 (56.7%)	10 (43.3%)
Total Message Received	17 (56.7%)	10 (43.3%)
Total Message (Smoker)	15 (25%)	12 (75%)

## DISCUSSION

The mean of average smoking in the past one week that has been measured by using the time line follow – back method (TLFB) was shown to be given a short-term effect in this study. The intervention group benefits more compared to



the control group. This is in line with the study conducted at Washington D.C for 6 weeks, which shows there was a significantly reduced on the consumption to an average of cigarette per week with a pre-test of 76 cigarettes per week and post-test 32 cigarettes per week ( $p < 0.001$ ) [15]. This effectiveness in reducing the average of smoking for the past one week can be explained as Let's Quit Programme was able to provide a continuous motivational support to participants whereby the message was sent to the smokers daily. Besides that, the participants were selected among those who had intention to quit smoking and thus gave a higher probability in reducing the number of smoking throughout the intervention programme.

The quit rate, Fargerstrom nicotine dependence (FTND) and carbon monoxide level (CO ppm) was found to have no significant effect after controlling the potential confounders on both intervention and control group. The quit rate in our study only shows 10% of the smokers successfully able to quit smoking in the intervention group and 6.7% among the control group. This is similar with the result of another study done within 6 weeks follow-up whereby the number of quit rate in the active group compared to the control group: 239 (28%) v 109 (13%) ( $p < 0.0001$ ) [20]. However, another study done in 6 months' time shows better outcome in quit rate as compared to our results where the 7 days point prevalence are significant for the treatment group ( $p = 0.02$ ) [21]. From here, we can see that a longer time of study perhaps may help in a better outcome of quit rate.

Although this study was shown to have a better outcome in reducing the average smoking for the past 1 week, the participants felt that they were not satisfied with the message content given (43.3%). This was probably due to the text messages were limited to 160 characters therefore the content was short and basic. Most of the smokers (86.7%) are able to read and understand the message and only (17%) replied to give the exact date to quit.

#### Limitations

There are several limitations that must be noted in this study. These limitations include (1) smaller number of participants in the study (2) limited biochemical verified assessment. All of these limitations affect the outcomes of the study. First, we only managed to get 30 participants from each group from the real number of sample size ( $n = 57$ ). In our study, the participants were selected among the intention to treat criteria. As a result, this gives the impact to a smaller number of participants in our study as most of the university students had no intention to quit. Besides that, the smaller number of participants in the study can be explained as there was lack of cooperation gained from the students. However, since the study was only lasted for 4 weeks, there was reduced possibility of participants being dropped out.

The second limitation is that we only used carbon monoxide level as biochemical verified assessment. The disadvantages of using carbon monoxide level using carbon monoxide analyser (CO ppm) only managed to detect the carbon monoxide gas within 24 hours after tobacco use and it can be affected by physical activity (exercise). This is in comparison of using cotinine saliva and urine cotinine which is shown to be more valid in providing a longer half-life of 48 hours.

#### CONCLUSION

Our finding showed that Let's Quit Program achieved in reducing the number of average smoking for the past 7 days (TLFB). This intervention program is very potential in managing a short-term period of smoking reduction with several improvements on the message content. Thus, it can be recommended to the several existing quit smoking programs. In future, potential modification to the program is to provide revised message content, longer time period and additional biochemical verified assessment to avoid biased and achieving better outcome.

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