# **Original Research Article**

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20213009

# Health messaging with Viber application on risk factors of non-communicable diseases among the rural population: community-based quasi-experimental study

Swe Mar Myint Lwin<sup>1\*</sup>, Khaing Lay Mon<sup>1</sup>, Aung Soe Htet<sup>2</sup>

Received: 30 May 2021 Accepted: 29 June 2021

# \*Correspondence:

Dr. Swe Mar Myint Lwin,

E-mail: swemarmyintlwin@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### **ABSTRACT**

**Background:** Mobile health and mobile phone technology have become increasingly noticed as favorable communication channels for the prevention of non-communicable diseases (NCDs) by reducing the unhealthy behaviors of NCDs. The study was carried out to assess the effect of the health messaging with the Viber application on modifiable risk factors of NCDs.

**Methods:** A community-based quasi-experimental study was conducted among a total of 240 community members who were 30 to 60 years old selected from two villages in Twantay township with a one year intervention. Face-to-face interviews with all participants using the WHO STEP survey questionnaire and measurements of behavioral and metabolic risk factors of NCDs were carried out at baseline and after 12 months follow up. Changes in behavior and metabolic risk factors between the intervention and control group were analyzed using mixed-effects random-intercept linear regression modeling with propensity score adjustment. Because of the small sample in smoking, smokeless tobacco and alcohol users, the Wilcoxon rank-sum (Mann-Whitney) test was used to compare the changes between the two groups.

**Results:** The amount of smoking and smokeless tobacco use among current users in the intervention group was reduced after the intervention (p<0.05). Of metabolic risk factors, participants in the intervention group had a significant net reduction in fasting blood sugar with a mean change relative to controls of -18.7 mg/dl 95% CI (-32.83, -4.56, p=0.010). No significant mean reduction was seen in other behavioral or metabolic risk factors.

**Conclusions:** The study results showed that intervention affected a reduction in some behavioral and metabolic risk factors of NCDs.

Keywords: Health messaging, Viber application, Risk factors of NCDs

### INTRODUCTION

NCDs are having an increasingly negative impact on health status in populations, with disproportionately higher rates in developing countries in recent years. The burden of NCD is projected to increase by 2030, especially in all low and middle-income countries. More than 80% of major NCDs can be prevented via eradicating the common risk factors mainly tobacco use,

unhealthy diets, physical inactivity and the harmful use of alcohol.<sup>3</sup> Rapid and substantial reduction in mortality can be achieved from the improvement of NCD risk factors in a population.<sup>4</sup> Moreover, improving health literacy amongst the community is important in the prevention of NCD risk factors as it focuses on inclusive and equitable access to health information and encouraging health literacy helps in improving knowledge and understanding of health determinants and can motivate people to adopt

<sup>&</sup>lt;sup>1</sup>Department of Health Behavior and Communication, University of Public Health, Myanmar

<sup>&</sup>lt;sup>2</sup>International Relations Division, MOHS, Nay Pyi Taw, Myanmar

healthy behaviors.<sup>5,6</sup> In Myanmar, the health literacy status was low and 31.5% of Myanmar adult people attained a satisfactory health literacy status.<sup>7</sup> Besides, Myanmar was high in rank among South-East Asia countries in terms of the prevalence of many NCD risk factors.<sup>8</sup> Almost every adult in Myanmar had at least one NCD risk factor and most of the risk factors were high, especially smoking, smokeless tobacco use and current alcohol drinking. Moreover, the prevalence of low consumption of fruit and vegetables, overweight and obesity, hypertension, diabetes and raised total cholesterol was high.<sup>8</sup>

Nowadays, mobile technology is increasingly used to promote health and prevent disease. 9 Mobile smartphone technology is also considered as a promising communication channel that presents the achievable to improve healthcare delivery and promote behavior change amongst vulnerable populations. 10 Thus, mHealth has been used effectively to promote the adoption of healthy behaviors and the reduction of unhealthy behaviors.<sup>11</sup> The rising burden of chronic diseases calls for innovative and cost-effective chronic disease prevention and management approaches.<sup>12</sup> Providing health messages on risk factors for NCDs plays an important role in preventing diseases.<sup>13</sup> A predominant advantage of mHealth interventions is the fact that they can be delivered to many people in a low-cost manner and in a quite brief time. 13 The majority, 90% of people living in developing countries owned a mobile phone and two-thirds of the global internet users were lived in developing countries. 10 Myanmar had fortunately, 22 million internet users as of January 2020 and the number of internet users in Myanmar increased by 1.0 million (4.8%) between 2019 and 2020.<sup>14</sup> As Viber application is one of the commonly used and user-friendly applications among Myanmar people. The present study was conducted to assess the effect of regular mobile phone health messaging on risk factors of NCDs using Viber application among the rural community in Twantay township, Yangon region. Changes in participants' behavioral and metabolic risk factors of NCDs after intervention were evaluated by comparing with a nonintervention control group.

### **METHODS**

# Study setting and participants

A community-based quasi-experimental study was conducted among 240 participants within the ages of 30 to 60 years in two selected villages of Twantay township (one situated in the north part of township and the other one situated 25.2 km distance at south part of township) within the duration of one year (July 2019 to July 2020). The two villages were purposively selected to avoid the contamination effect of the intervention. Participants were recruited by a systematic random sampling method from the sampling frame of household, which was obtained from authorities of Twantay township before data

collection. From a chosen household, one eligible person (male or female) was selected using a random sampling among household members to include in the study. The inclusive criteria were those who owned a mobile smartphone (Android, iPhone, tablet, iPad) and no plan to change residential address within one year. If a participant had poor or no skill in using a mobile phone, he/she must have at least one caregiver who knew how to use a mobile phone. We excluded participants who were mentally ill, bed-ridden, pregnant, living only temporarily in the local area and owning only a mobile keypad phone. The intervention comprised sending health messages via the Viber application corresponding to each participant's risk factor grouping.

### Data collection and intervention

Firstly, socio-demographic data and information about behavioral risk factors of NCDs were collected among the participants using the WHO STEP survey questionnaire (version 3.0) with the face-to-face interview method. Physical examination (height, weight, BMI and blood pressure) and biochemical measurement (fasting blood sugar, total cholesterol, triglyceride, LDL and HDL cholesterol) were followed. All measurement equipment was standardized just before taking measurements and the blood samples were collected with standard procedures.<sup>15</sup> Basic health education concerning major risk factors of NCDs was given to both the intervention group and the control group before intervention. During the intervention period, however, health messages on the reduction of their risk factors, promotion of healthy lifestyle, the benefits of physical activity and balanced diet and hazard of alcohol drinking and smoking were given only to the intervention group using the Viber application. All health text messages were developed by the standardized message book and IEC material from NCD units and the health literacy promotion unit of the ministry of health and sports, Myanmar. All the messages sent were in the most commonly used Myanmar languages. Each week, a different message was sent to the intervention participants on Friday and each message was presented two times in the year. For prevention of loss to follow up, the participants who missed reading three messages in a month were traced with a phone call. However, participants who could not be contacted and those who missed reading the health messages for two consecutive months were dropped from the study. At the end of the 12 months, information of behavioral risk factors of NCDs, physical and biochemical measurements was recollected using the same procedures as at baseline.

### Statistical analysis

Data analysis was conducted using STATA version 14.2. For descriptive analysis, categorical variables were presented as frequency and percentage and continuous variables presented as and mean and standard deviation. Differences in baseline characteristics between intervention and control groups were tested using the Chi

square test, Fisher's exact test, and independent sample t test. A two sample Wilcoxon rank-sum (Mann-Whitney) test was used to evaluate the difference between groups in the change over the 12 months for non-normally distributed variables. Changes in continuous variables were computed by subtraction of final follow up values from the baseline values. To minimize the selection bias arising from the study design, a propensity score, a statistical method for adjusting for baseline differences between study groups was constructed to adjust for potential confounding variables. Mixed-effects randomintercept linear regression modeling was used, after checking the assumptions, to analyze the changes in continuous behavioral, anthropometric and metabolic variables over the 12 months and to compare between the intervention and control groups by including an interaction term between pre/post intervention and group. The interaction term constituted the fixed effect in the model while the individual was considered to be the random element, thereby adjusting the standard errors and confidence intervals for repeated measures on the same subject. The propensity score was used as a covariate in the linear mixed-effects models to control for the potential confounding variables which could affect the estimated relationship between risk factors and outcomes. Because of the small sample size for the outcome variables of smoking, smokeless tobacco and alcohol drinking, the Wilcoxon rank-sum (Mann-Whitney) test was used for comparing mean changes between the intervention and control group. All statistical tests were evaluated using two-tailed 95% confidence intervals (CI). All analyses were carried out at a 0.05 significant level.

### **RESULTS**

The process of the study including the number of participants at baseline and follow up is shown in Figure 1. A total of 120 participants who met the inclusion criteria were selected from each of the two selected villages. The intervention of sending health messages to each group was conducted weekly and each message was repeated two times in the year. At the end of the 12 month intervention, 32 participants from the intervention side dropped out due to limitation of their free time, loss of their phone, change of their phone number or inability to be contacted due to switched off mobile phones, while 19

participants from the control side dropped out due to inability to be contacted. Hence, of 240 participants, 189 participants completed the study and were reassessed at 12 months. No significant difference in sociodemographic characteristics between those completed and those who were lost to follow up was observed. The baseline socio-demographic status of participants in the intervention group and control group did not differ significantly by age group, marital status or ethnic group. However, differences were evident in the distributions of sex, level of education, occupation and level of income. More female participants were included in the control group (80.8%) than the intervention group (65.8%). Participants in the intervention group were more educated than the control group and nearly half of the participants in the intervention group had received more than primary school level of education (43.3%) compared with only one-fifth (21.7%) in the control group. A higher percentage of working individuals were included in the intervention group (85.8%) than in the control group (56.7%). One-third of participants (31.7%) in the intervention group but only one-fifth (18.3%) in the control group reported a monthly per capita income within the first quartile of less than 45 thousand (MMK) (Table 1). Among current smokers after the 12 months intervention period, the number of smokes per day and the number of uses of smokeless tobacco per day were both reduced significantly in the intervention group compared to the changes in the control group (p=0.012 and p<0.001, respectively). However, no significant differences were observed in the change in the number of drinking occasions in the past 30 days or in the number of standard drinks per drinking occasion between intervention and control groups (p>0.05) (Table 2). For the factors of the number of servings of fruits and vegetables per day and physical activity (MET minute per week), no significant differences were found between the groups after adjustment for the propensity score (p>0.05) (Table 3). Regarding metabolic risk factors, no significant differences between two groups were found in the changes in systolic and diastolic blood pressure, BMI or fasting lipid profile (total cholesterol, triglyceride, LDL, and HDL) (p>0.05). However, at the end of the study, participants in the intervention group had a significant net reduction in fasting blood sugar with a mean change of 18.7 mg/dl (95% CI -32.83, -4.56, p=0.010) relative to the control group (Table 4).

Table 1: Characteristics of participants in intervention and control groups (N=240).

Characteristics	Intervention (N=120) Frequency (%)	Control (N=120) Frequency (%)	P value*	
Age (in years)	•	•		
30-40	38 (31.7)	33 (27.5)	0.165	
41-50	46 (38.3)	37 (30.8)	0.165	
51-60	36 (30.0)	50 (41.7)		
Sex				
Male	41 (34.2)	23 (19.2)	0.009	
Female	79 (65.8)	97 (80.8)	_	
Marital status		. ,		
Currently married	100 (83.3)	88 (73.3)	0.060	
Not currently married	20 (16.7)	32 (26.7)	0.060	

Continued.

Characteristics	Intervention (N=120) Frequency (%)	Control (N=120) Frequency (%)	P value*				
Ethnic	·		·				
Bamar	118 (98.3)	117 (97.5)	1.000 <sup>†</sup>				
Others	2 (1.7)	3 (2.5)	1.000				
Education							
Primary school level and below	68 (56.7)	94 (78.3)	<0.001				
Above primary school level	52 (43.3)	26 (21.7)	<0.001				
Occupation							
Dependent	17 (14.2)	52 (43.3)	< 0.001				
Working	103 (85.8)	68 (56.7)	<0.001				
Per capita income per month (MMK) (in quartiles)							
1st	38 (31.7)	22 (18.3)					
2nd	31 (25.8)	23 (19.2)	<0.001				
3rd	32 (26.7)	26 (21.7)	<0.001				
4th	19 (15.8)	49 (40.8)					

<sup>\*</sup>Chi squared test; †Fisher's exact test.

Table 2: Mean changes in smoking, smokeless tobacco and alcohol in both intervention and control group after the intervention.

Variables	Mean change (SD) (pos	P value*	
variables	Intervention	Control	P value*
Smoking			
Number of smoked per day	-3.3 (3.4)	0.1(2.9)	0.012
Smokeless tobacco			
Number of smokeless tobacco used per day	-4.8 (5.4)	-0.01(4.9)	< 0.001
Alcohol drinking			
Dinking occasions in the past 30 days	-0.1 (0.4)	-0.2 (0.4)	0.503
Standard drinks per drinking occasions	-0.3 (0.5)	-0.1 (0.3)	0.279

<sup>\*</sup>Wilcoxon rank-sum (Mann-Whitney) test.

Table 3: Linear mixed-effects modeling on change in fruits and vegetable serving and physical activity before and after intervention with propensity score adjustment.

Variables	Intervention  Before After		Control Before After		Difference in mean	P value*
v arrabics	mean (SD)	mean (SD)	mean (SD)	mean (SD)	change (95% CI)	1 value
Fruit and vegetable serving per week	1.6 (0.9)	1.6 (1.0)	1.1 (0.6)	1.2 (0.7)	-0.2 (-0.44, 0.11)	0.245
Physical activity (MET min per week)	2590.0 (2541.9)	2196.1 (2168.5)	2276.3 (2727.8)	1744.5 (2093.3)	249.3 (-477.67, 976.24)	0.514

<sup>\*</sup>The p value is for the null hypothesis of no difference in the change from before to after between the 2 groups.

Table 4: Linear mixed-effects modeling of anthropometric measurement and fasting lipid profile before and after intervention in intervention and control groups, with propensity score adjustment.

	Intervention		Control		Difference in mean	
Variables	Before mean (SD)	After mean (SD)	Before mean (SD)	After mean (SD)	change (95% CI)	P value*
SBP (mmHg)	120.8 (16.2)	121.6 (17.1)	120.1 (16.1)	120.5 (17.1)	-0.3 (-3.93, 3.23)	0.849
DBP (mmHg)	80.4 (11.2)	82.1 (12.9)	76.6 (10.4)	78.5 (10.4)	-0.6 (-3.42, 2.20)	0.669
FBS (mg/dl)	130.1 (65.9)	121.7 (46.6)	120.9 (45.1)	129.4 (52.4)	-18.7 (-32.83, -4.56)	0.010
BMI	25.9 (4.8)	26.5 (4.8)	25.2 (4.6)	25.6 (4.4)	-0.1 (-0.71,0.55)	0.800
Total cholesterol (mg/dl)	191.4 (42.9)	192.5 (38.1)	185.3 (39.2)	191.3 (36.6)	-6.6 (-16.32, 3.15)	0.185
Triglyceride (mg/dl)	167.5 (92.9)	156.8 (84.0)	161.8 (89.5)	146.8 (71.4)	1.8 (-22.27, 25.94)	0.881
LDL (mg/dl)	118.4 (41.8)	117.7 (33.4)	108.5 (37.6)	116.4 (35.6)	-8.7 (-18.19, 0.86)	0.075
HDL (mg/dl)	43.4 (11.6)	46.3 (12.0)	46.2 (10.2)	47.9 (18.9)	1.2 (-3.28, 5.67)	0.600

<sup>\*</sup>The p value is for the null hypothesis of no difference in the change from before to after between the 2 groups.

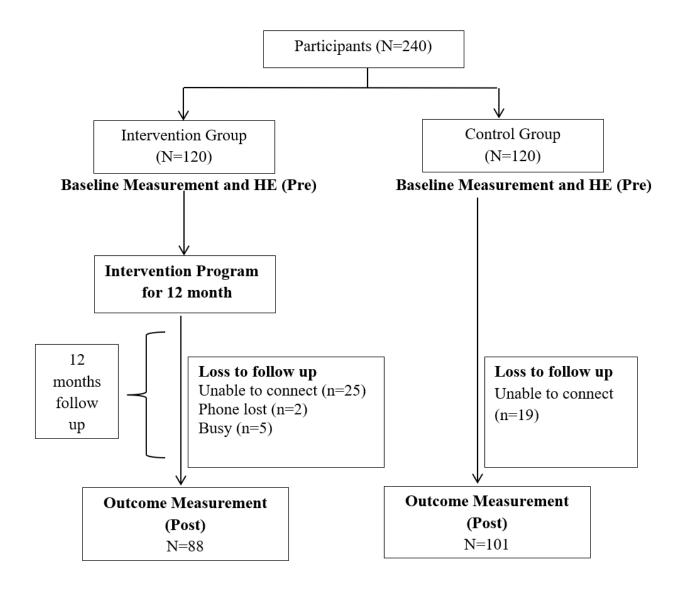


Figure 1: Flow chart of the study.

### **DISCUSSION**

Using mobile health technologies for improving population-level health outcomes around the world has emerged in the last decade. 16 The results of the present study show that mobile health messaging intervention can be effective in reducing the number of smoking and smokeless tobacco among current users and a reduction in fasting blood sugar levels among the study population. This concurs with the findings of a previous study from Myanmar, which reported that sending health messages via Viber application resulted in a reduction in smoking frequency among current users.<sup>17</sup> In contrast, findings from Lebanon showed that health messaging intervention did not affect smoking. 18 Besides, no significant changes were observed in reducing the frequency of alcohol drinking among the current users after the intervention in the present study, although another study in Myanmar has reported that health message intervention reduced alcohol drinking frequency.<sup>17</sup> It has been stated that alcohol intake was regarded as a difficult issue to be tackled by text messaging or phone conversation only, without face-to-face encounters.<sup>19</sup>

Although some studies stated positive effects of the mHealth intervention on diet behavior and physical activity in developing countries, no significant changes were observed in the present study population. <sup>10</sup> Several other studies have also pointed out that sending health messages did not affect physical activity and this is in agreement with a study that showed that lifestyle behavior such as physical activity cannot be modified through self-care education intervention, whether via SMS or pamphlets or by face-to-face meetings. <sup>19-22</sup> However, different findings were reported in the study from Delhi, India, where a significant reduction in behavioral risk factors (unhealthy diet and insufficient physical activity) was seen in the intervention group

compared with the control group.<sup>13</sup> The possible obstacle for improvement in physical activity between the intervention and the control group in the present study might be related to the reduction in the frequency of going outside because of the concurrent outbreak of COVID-19 at the time of the second data collection. However, such an explanation requires confirmation by conducting further studies.

The study finding of a considerable reduction in fasting blood sugar level in the intervention group is in agreement with other studies. 13,20 However, the intervention did not result in reducing the blood pressure among the study population. The findings were consistent with a study in Latin America, which showed that the intervention did not reduce the blood pressure but reduced systolic blood pressure in a study of Myanmar. 17,19 In contrast, a study in Lebanon mentioned that sending weekly short health messages resulted in reducing systolic blood pressure. 18

In the present study, the intervention did not affect body mass index (BMI). Consistent findings were reported in one study from India, whereas another study in India reported a contrasting finding of a significant reduction of BMI between the intervention group and the control group after the intervention. <sup>13,20</sup> In addition, the intervention in the present study showed no effect on reducing total cholesterol, triglyceride or LDL levels. The reason is not clear and further studies need to be conducted for a detailed explanation.

In conclusion, the study has provided evidence that the intervention can reduce the amount of smoking and using smokeless tobacco among current users and reduce fasting blood sugar. These facts favor considering giving health messages via Viber application to the community who have risk factors of NCDs as a national policy because the incidence of risk factors of NCDs is rising around the world and particularly in developing countries including Myanmar. From the feasibility point of view, mobile phone usage and the number of internet users in Myanmar have increased in recent years. The ministry of health and sports is strongly promoting e-health development among the community and mobile phone tablets have already been distributed to basic health staff in most areas of Myanmar. Sending readymade health messages at regular intervals, in addition to in-person contact via the Viber group to many members of the community having at least one NCD risk factor, by basic health staff in their respective local areas can be an effective way to reduce the burden on providing health education in person especially during the pandemic period. The findings of the study may apply to other similar contexts to the study area.

The strengths of the present study include the geographic separation between the control and intervention group (two villages were 25.2 km apart) which would have prevented contamination of health messages. Moreover,

propensity score adjustment was used to reduce confounding by covariates that were not equally distributed at baseline. Utilization of WHO standard questionnaire and standardization of instruments minimized potential information bias. Another point to mention is that the participants in the present study can be considered to represent most of the rural population of the country because the most rural settings in Myanmar are more or less similar. As the limitations, participant's response to behavioral risk factors was self-reported based on recall, which was prone to recall and selfdesirability bias. Another limitation was the occurrence of the COVID-19 pandemic, which started between the first and second time of data collection. However, the impact would have been more or less similar in the intervention and control groups. The pandemic induced people from both groups to adopt a more sedentary lifestyle.

### **CONCLUSION**

The study results showed that intervention affected a reduction in some behavioral and metabolic risk factors of NCDs.

## **ACKNOWLEDGEMENTS**

We gratefully acknowledge all my supervisors and senior colleagues from the university of public health, Yangon, and Ajarn Alan Geater, lecturer, epidemiology unit, Prince Songkla university, Thailand for his constructive suggestions on this work.

Funding: This work was supported by an implementation research grant by the ministry of health and sports, Myanmar

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

### REFERENCES

- 1. Islam SMS, Purnat TD, Phuong NTA, Mwingira U, Schacht K, Fröschl G. Non-communicable diseases (NCDs) in developing countries: a symposium report. Global Health. 2014;10:81.
- 2. Robinson HM, Hort K. Non-communicable diseases and health systems reform in low and-middle-income countries. Pac Health Dialog. 2012;18(1):179-90.
- 3. Kassa M, Grace J. The global burden and perspectives on non-communicable diseases (ncds) and the prevention, data availability and systems approach of NCDs in low-resource countries. Pub Health Develop Count Challeng Opport. 2019.
- 4. Htet AS, Bjertness MB, Sherpa LY, Kjøllesdal MK, Oo WM, Meyer HE. The prevalence of selected risk factor for non-communicable diseases among 25-74 year old urban citizens of Yangon Region, Myanmar. BMC Public Health. 2016;16(1):1225.

- Park VS, Molesworth K, Karimova G, Matthys B, Obris B. Health Promotion and Health Literacy: Toward transformative action for noncommunicable diseases. Medicus Mundi Schweiz. 2018.
- Shrestha A, Singh SB, Khanal VK, Bhattarai S, Maskey R, Pokharel PK. Health Literacy and Knowledge of Chronic Diseases in Nepal. Health Liter Res Pract. 2018;2(4):221-30.
- 7. Oo WM, Khaing W, Mya KS, Moh MM. Health literacy-is it useful in prevention of behavioral risk factors of NCDs? Int J R Med Sci. 2015;3(9):2331-6.
- 8. Ministry of Health. Fact sheet: Report on national survey of diabetes mellitus and risk factors for non-communicable diseases in Myanmar, 2014. Available at: https://www.who.int/ncds/surveillance/steps/Myanmar\_2014\_STEPS\_Report.p df. Accessed on 14 May 2021.
- 9. Cole-Lewis H, Kershaw T. Text messaging as a tool for behavior change in disease prevention and management. Epidemiol Rev. 2010;32(1):56-69.
- Müller AM, Alley S, Schoeppe S, Vandelanotte C.
   The effectiveness of e- and mHealth interventions to promote physical activity and healthy diets in developing countries: A systematic review. International J Behav Nutr Phys Activ. 2016;13(1):109.
- 11. Gary LK. The relevance of health literacy to mHealth. IOS Press. 2017;37(2):123-30.
- 12. Amdie FZ, Woo K. The use of mHealth technology for chronic disease management: the challenges and opportunities for practical application. Wounds Int. 2020;11(2).
- 13. Sharma M, Banerjee B, Ingle GK, Garg S. Effect of mHealth on modifying behavioural risk-factors of non-communicable diseases in an adult, rural population in Delhi, India. Mhealth. 2017;3:42.
- Data Reportal. Fact sheet: Digital 2020: Myanmar, 2020. Available at: https://datareportal.com/ reports/digital-2020-myanmar. Accessed on 14 May 2021.
- WHO. Fact sheet: WHO STEP surveillane manual, 2017. Available at: https://www.who.int/ncds/ surveillance/steps/STEPS\_Manual.pdf. Accessed on 14 May 2021.

- Kruse C, Betancourt J, Ortiz S, Luna SMV, Bamrah IK, Segovia N. Barriers to the use of mobile health in improving health outcomes in developing countries: systematic review. J Med Internet Res. 2019;21(10):13263.
- 17. Kyaw OO. Effectiveness of e-Health promotion programme for major non-communicable diseases among sailors of Ayeyarwady Naval Regional Command, Myanmar Navy in 2017. Def Serv Med Acad. 2018.
- 18. Saleh S, Farah A, Dimassi H, ElArnaout N, Constantin J, Osman M, et al. Using mobile health to enhance outcomes of noncommunicable diseases care in rural settings and refugee camps: Randomized controlled trial. JMIR Mhealth Uhealth. 2018;6(7):137.
- 19. Rubinstein A, Miranda JJ, Beratarrechea A, Diez-Canseco F, Kanter R, Gutierrez L, et al. Effectiveness of an mHealth intervention to improve the cardiometabolic profile of people with prehypertension in low-resource urban settings in Latin America: a randomised controlled trial. Lancet Diabetes Endocrinol. 2016;4(1):52-63.
- 20. Ramachandran A, Snehalatha C, Ram J, Selvam S, Simon M, Nanditha A, et al. Effectiveness of mobile phone messaging in prevention of type 2 diabetes by lifestyle modification in men in India: a prospective, parallel-group, randomised controlled trial. Lancet Diabetes Endocrinol. 2013;1(3):191-8.
- 21. Pfammatter A, Spring B, Saligram N, Davé R, Gowda A, Blais L, et al. mHealth intervention to improve diabetes risk behaviors in India: a prospective, parallel group cohort study. J Med Internet Res. 2016;18(8):207.
- 22. Golshahi J, Ahmadzadeh H, Sadeghi M, Mohammadifd N, Pourmoghaddas A. Effect of self-care education on lifestyle modification, medication adherence and blood pressure in hypertensive adults: randomized controlled clinical trial. Adv Biomed Res. 2015;4:204.

Cite this article as: Lwin SMM, Mon KL, Htet AS. Health messaging with Viber application on risk factors of non-communicable diseases among the rural population: community-based quasi-experimental study. Int J Community Med Public Health 2021;8:3823-9.