Original Article

Effectiveness of Nicotine Withdrawal Symptoms Management Program Using LINE Application to Increase Self-Efficacy for Industrial Workers

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Background: Smoking is a risk factor for chronic diseases. A combination of tobacco use with occupational hazards among industrial workers could increase the risk of occupational disease and injury. Nicotine is known to be highly addictive. It is difficult not only to maintain the decrease in smoking but also to continue quitting tobacco use. Moreover, nicotine withdrawal can be challenging and lead to failure in the smoking cessation process. Self-efficacy theory has been used recently for the development of effective smoking cessation programs.

Objective: To develop an online nicotine withdrawal symptoms management program based on self-efficacy theory and examine its effectiveness.

Materials and Methods: A quasi-experimental design with a control group pretest-posttest design was used. The sample consisted of male employees working in a consumer product manufacturing industry in Bangkok. An intervention group (n=28) received an online nicotine withdrawal symptoms management program via LINE application based on self-efficacy theory for one month. In comparison, participants in the control group (n=29) received a conventional smoking cessation program. The effectiveness of the intervention on nicotine withdrawal symptoms, cigarette craving, self-efficacy perception of nicotine withdrawal management, cigarette rolls per day, nicotine dependence level, exhaled carbon monoxide level, and smoking cessation behavior the first and fourth week were examined using a repeated-measures analysis of variance.

Results: At one-month follow-up, there were significant differences between the two groups on nicotine withdrawal symptoms score, cigarette craving level, self-efficacy perception of nicotine withdrawal management, cigarette rolls per day, nicotine addiction level, exhaled carbon monoxide level, and smoking cessation behaviors ($p<0.001$). In addition, there was a significant difference in the self-reported nicotine withdrawal symptoms score in terms of irritability, anger, anxiety, concentration deficit, depression, and insomnia ($p<0.001$) between groups, between times, and between times and groups ($p<0.001$).

Conclusion: Nicotine withdrawal symptoms management program using LINE application is effective in encouraging smoking cessation.

Keywords: Smoking cessation; Nicotine withdrawal symptoms; LINE application; Industrial workers

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Smoking is the most significant public health threat as eight million deaths result from tobacco annually[1]. Smoking is a risk factor for chronic diseases. The risk and severity of most adverse health outcomes caused by smoking are directly related to the duration and intensity of tobacco smoking[2]. Combining tobacco use with occupational hazards among industrial workers could increase the risk of occupational disease and injury[3]. The National Institute for Occupational Safety and Health recommends that all workplaces become tobacco-free environments, and employers should make smoking cessation available for workers[2]. Therefore, a workplace smoking cessation program should be implemented to improve the health and wellness of workers. Effective smoking cessation therapy consists of behavioral modification, encouragement, and tobacco cessation medication[4]. Nevertheless, the successful tobacco cessation rate is only 30 percent.

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Nicotine withdrawal symptoms are the prohibiting factors to successful smoking cessation[5]. Smokers suffer from nicotine withdrawal symptoms that lead to failure in the smoking cessation process[6]. Both symptoms occurred immediately within four hours after the last cigarette smoking. The symptoms were severely increased during the first three to five days and relieved after two weeks[6]. Therefore, the first two weeks are the most important period to support the quitters to help them manage the nicotine withdrawal symptoms and quit smoking successfully. In addition, methods to relieve nicotine withdrawal symptoms are most needed in the first week of the smoking cessation process[7]. Several methods to ease nicotine withdrawal symptoms in Thailand were implemented, such as reflexology[8,9], deep breathing relaxation[10], and exercise[11-13].

Moreover, increasing self-awareness and self-efficacy to manage nicotine withdrawal symptoms before the cessation is essential[14]. Increased self-efficacy in smoking cessation and nicotine withdrawal management would lead to successful management of the symptoms[14-19]. This is consistent with the self-efficacy theory that the relationship of self-efficacy level and a successful behavioral modification, low self-efficacy would lead to the perception of difficulty and termination of behavioral modification process[20].

The current study used the LINE application to facilitate the nicotine withdrawal symptoms management program among the industrial workers. A previous study that used the LINE application as a smoking cessation tool in industrial workers revealed cost-saving achievement in the process and could follow-up and notify the participants effectively[21]. Therefore, the present study could serve as a guideline for smoking cessation in a manufacturing setting. This program will enhance the smoking cessation behavioral modification process. As well as help workers to manage nicotine withdrawal symptoms and cigarette cravings by themselves and prevent smoking relapse in the future. Moreover, the present study could be a model for nicotine withdrawal management in manufacturing settings for occupational health nurses.

Materials and Methods

Study design

A two-group quasi-experimental study used a pretest-posttest design to examine the effectiveness of nicotine withdrawal symptoms management program using LINE application for industrial workers based on self-efficacy theory.

Participants and setting

The population in the present study was male workers in the consumer product factories in Bangkok, Thailand. The eligibility criteria of participants were 1) male worker who smoked at least one time during the past 30 days according to the National Survey on Drug Use and Health[22], 2) full-time factory worker for at least three months and aged between 18 to 59 years, 3) the smoker was willing to quit smoking or in the process of smoking cessation but unable to quit smoking during the past six months, 4) the smoker had a smartphone with internet to receive text messages and other media, 5) the smoker should not have diabetes mellitus and chewing problems, 6) the smoker had a moderate or high level of nicotine addiction, and 7) the smoker was willing to participate in a smoking cessation program. The sample size was calculated from the power analysis formula by alpha=0.5 and power=0.8[23]. Therefore, the authors needed 50 participants as 25 people per group. Allowing participants to drop out, the authors recruited 60 participants, with 30 in the intervention group and 30 in the control group for the study.

Ethical considerations

The present study was approved by the Ethics Committee of the Faculty of Public Health, Mahidol University, approval number MUPH 2019-108. First, all participants were informed about the study purpose and procedures, voluntary participation, and confidentiality of the study, and then written consent was obtained from each participant.

Measurements

The participants' general characteristics of age, marital status, educational level, and religion, occupation, average monthly income, underlying disease, smoking, and alcohol consumption history were assessed. The smoking-related characteristics such as initial smoking age, cigarettes per day, previous attempts in smoking cessation, smoking cessation method, reasons of smoking cessation, and reasons of smoking relapse were collected.

Nicotine withdrawal

Nicotine withdrawal questionnaire Thai-translated version of the Wisconsin Smoking Withdrawal Scale (WSWS)[10] was utilized. The scale consisted of 22 questions related to nicotine withdrawal symptoms such as depression, insomnia, irritability and anger, anxiety, concentration deficit, and increased appetite. Responses were made on a

5-point scale ranging from 1 as strongly disagree to 5 as strongly agree. The Cronbach's alpha coefficient was 0.76 for the nicotine withdrawal symptoms questionnaire.

Cigarette craving

Cigarette craving questionnaire was adopted from Thai-translated version of the Brief Questionnaire of Smoking Urges (QUS-brief)[10]. The questionnaire consisted of nine questions, with a 7-point scale ranging from 1 as strongly disagree to 7 as strongly agree. The Cronbach's alpha coefficient was 0.82 for the cigarette craving questionnaire.

Self-efficacy perception

Self-efficacy perception in managing nicotine withdrawal symptoms questionnaire consisted of 12 questions. Responses were made on a 5-point scale ranging from 5 as strongly agree to 1 as strongly disagree. The Cronbach's alpha coefficient was 0.94 for the self-efficacy perception questionnaire.

Nicotine dependence level

Nicotine dependence level was applied to evaluate dependency level by the Fagerstrom Test for Nicotine Dependence (FTND)[24]. The FTND consisted of six questions, with one or 3-point given for each item. Thus, the total scores range from 0 to 10 points, and higher scores indicate higher nicotine dependence.

Smoking cessation behavior

Smoking cessation behavior was applied from the smoking cessation behavior evaluation questionnaire[13]. The scale consisted of 14 questions with a 3-point scale of performing frequency from 3 for usually to 1 for never. The Cronbach's alpha coefficient was 0.89 for smoking cessation behavior.

Exhaled carbon monoxide level

Exhaled carbon monoxide level was measured by Pico Smokerlyzer at the pre-post intervention and the follow-up period at one month.

Daily self-record smoking cessation

A daily self-record smoking cessation form was applied[21]. The record form included the date, smoking (yes/no), number of cigarette rolls, time of smoking, the reason for smoking, and self-management method.

Intervention

The nicotine withdrawal symptoms management program has been developed in a systematic way and was validated by three faculty experts on tobacco. A reliability test of the research tools was conducted with 30 industrial workers. Clyde et al[14] stated that increasing self-awareness and self-efficacy to manage nicotine withdrawal prior to the cessation process was essential. Low self-efficacy would lead to the perception of difficulty and termination of the behavioral modification process[20]. In addition, a previous study revealed the effectiveness of the LINE application as a smoking cessation tool in factory workers in terms of notification and cost-saving[21]. Thus, in the present study, the researcher applied self-efficacy theory to the nicotine withdrawal symptoms management program. The program was delivered via LINE application throughout the four weeks period. Contents of the nicotine withdrawal symptoms management program based on self-efficacy theory using LINE application are shown in Table 1.

In the case of the control group, participants received a smoking cessation leaflet as well as knowledge about nicotine addiction symptoms, nicotine withdrawal symptoms, and nicotine withdrawal symptoms management. Group consultation and goal setting were performed in the first week. After four weeks, the researcher examined nicotine withdrawal symptoms, cigarette craving, exhaled carbon monoxide level, and smoking cessation behavior among participants in the control group.

Data analysis

Data were analyzed using the PASW Statistics software, version 18.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics summarized demographic and smoking-related characteristics of participant samples. A homogeneity test was performed using an independent t-test or chi-square with Fisher's exact test. The effectiveness of the intervention on nicotine withdrawal symptoms, cigarette craving, self-efficacy perception of nicotine withdrawal management, cigarette rolls per day, nicotine dependence level, exhaled carbon monoxide level, and smoking cessation behavior at week one and week four was examined using a repeated-measures analysis of variance. Between groups comparison was analyzed by independent t-test to examine the effectiveness of the intervention on nicotine withdrawal symptoms, cigarette craving, self-efficacy perception of nicotine withdrawal management, cigarette rolls per day, nicotine dependence level, exhaled carbon monoxide

Table 1. Contents of a nicotine withdrawal symptoms management program based on self-efficacy theory using LINE application

Week	Objective	Content
1	To enhance literacy in nicotine addiction symptoms, nicotine withdrawal symptoms, and nicotine withdrawal symptoms management	- Overview of a nicotine withdrawal symptoms management program based on self-efficacy - Video presentation on the experience of successful quitter to encourage participants to quit the cigarette and enhance individual self-efficacy in managing nicotine withdrawal symptoms - Provide knowledge about nicotine addiction symptoms, nicotine withdrawal symptoms, and nicotine withdrawal symptoms management, as well as how to use nicotine gum through a video presentation - Individual and group consultations are provided to support smoking cessation and provide knowledge about how to manage nicotine withdrawal symptoms - A consensus of a start date for quitting smoking - Set a time to receive LINE notification related to smoking cessation - Learning how to record smoking dairy
2 to 3	To increase self-perception in the ability to manage nicotine withdrawal symptoms	- Encouragement messages are sent out via the LINE application once a day - Providing nicotine gums for participants who can set a date for quitting smoking - Providing effective options for nicotine withdrawal symptoms management (e.g., exercise, deep breathing exercise, distraction method, and extending of smoking period technique) - Building skills for handling withdrawal symptoms by learning from a successful group member who successfully quit or reduced daily cigarette consumption - Monitoring smoking dairy and nicotine withdrawal symptoms - Providing practical & relevant feedback - Encouragement for success in quitting smoking - Developing empathy and encouragement for difficulties of quitting smoking
4	To evaluate the effectiveness of smoking cessation program	- Encouragement messages are sent out via the LINE application once a day - Experience sharing about a method to alleviate the nicotine withdrawal symptoms within the group - Monitoring the daily smoking record - Examine nicotine withdrawal symptoms, cigarette craving, exhaled carbon monoxide level, and smoking cessation behavior - Encourage participants to maintain successful smoking cessation

level, and smoking cessation behavior. The p-values of less than 0.01 were considered statistically significant.

Results

Demographic data and smoking history

Male participants in the present study worked in the consumer product factories in Bangkok. Twenty-nine participants were in the intervention group, and twenty-eight participants were in the control group. No difference in the demographic data and smoking-related characteristics was identified between the control and the intervention groups ($p>0.01$) except for age. Table 2 demonstrates demographic and smoking-related characteristics between the intervention and the control groups.

Effectiveness of a nicotine withdrawal symptoms management program

The effectiveness of the Nicotine Withdrawal Symptoms Management Program on nicotine withdrawal symptoms, cigarette rolls per day, nicotine dependence level, as well as exhaled carbon monoxide level was shown.

Nicotine withdrawal symptoms

There were statistically significant differences in nicotine withdrawal symptoms. Specifically, domains anger, anxiety, concentration deficit, depression, and insomnia were statistically significant differences, with interactions between groups, between times, and between times and groups ($p<0.001$) (Table 3). Even though, the irritability score was statistically

Table 2. Demographic and smoking-related characteristics between intervention and control groups

Characteristics	Intervention group (n=28); n (%)	Control group (n=29); n (%)	χ^2	p-value
Age (years); mean±SD	32.36±6.76	39.86±5.86	7.73	0.005[a]
Marital status			1.04	0.308[a]
Single/divorced/separated	8 (28.57)	5 (17.24)		
Married	20 (71.43)	24 (82.76)		
Religion				
Buddhism	28 (100)	29(100)		
Education level			-	0.237[b]
< Bachelor's degree	28 (100)	26 (89.66)		
≥ Bachelor's degree		3 (10.34)		
Income per month (THB); mean±SD	19,910.71±6,536.30	34,206.90±9,510.81	-	0.052[b]
Working department			5.96	0.015[a]
Production line	16 (57.14)	25 (86.21)		
Others	12 (42.86)	4 (13.79)		
Alcohol consumption			-	1.00[b]
No	1 (3.57)	1 (3.45)		
Yes	27(96.43)	28 (96.55)		
Cigarettes per day; mean±SD	12.71±3.56	12.28±3.14	0.01	0.910[a]
Total years of smoking; mean±SD	13.00±5.86	20.14±4.44	5.22	0.02
Experience of smoking cessation			0.04	0.851[a]
No	19 (67.86)	19 (65.52)		
Yes	9 (32.14)	10 (34.48)		

SD=standard deviation

[a] Chi-square test, [b] Fisher's exact test

significant between groups at pre-intervention period, there was a significant decrease of the irritability scores within intervention group at post-intervention period ($p<0.001$). There was no significant difference in increased appetite score at the post-intervention period ($p=0.025$) but significantly increased at the follow-up period ($p=0.003$) between the comparison groups. In comparison, there was a significant difference in increased appetite score within groups comparison (Table 3).

Cigarette craving

There was a significant difference in cigarette craving levels between the intervention and control groups ($p<0.01$) at pre-post intervention and follow-up (Table 4). Even though the cigarette craving level at the pre-intervention period was significantly different between groups at pre-intervention periods, the cigarette craving score of the intervention group was statistically significantly lower at the post-intervention and follow-up period ($p<0.01$), while, the cigarette craving score of the control group was statistically significantly higher at the post-intervention and follow-up period.

Self-efficacy perception of nicotine withdrawal management

There was a significant difference in nicotine withdrawal management self-efficacy perception between groups, between time, and between groups and time ($p<0.01$). In addition, the intervention group had a significantly higher self-efficacy perception of nicotine withdrawal management than the control group at the post-intervention and follow-up period ($p<0.01$) (Table 4).

Cigarette rolls per day

There was a significant difference in cigarette rolls per day in the intervention and control groups ($p<0.01$) at pre-post intervention and follow-up. There was no significant difference in cigarette rolls per day between the intervention and the control group at the pre-intervention period ($p=0.245$). However, the intervention group consumed significantly lower cigarette rolls per day when compared to the control

Table 3. Comparison of average nicotine withdrawal symptoms score in terms of irritability and anger, anxiety, concentration deficit, increased appetite, depression, and insomnia at the pre-post intervention and follow-up period between the intervention and control group

Variables	Intervention group (n=28)		Control group (n=29)		t	df	p-value
	Mean	SD	Mean	SD			
Nicotine withdrawal symptoms irritability							
Pre-intervention	6.43	2.03	4.83	1.77	3.18	55	0.002*
Post-intervention	3.82	1.28	6.66	1.90	–6.60	55	0.001*
Follow-up	3.54	1.07	7.00	1.63	–9.47	55	0.001*
Anxiety							
Pre-intervention	8.61	1.97	7.59	1.72	2.09	55	0.042
Post-intervention	5.25	1.74	7.83	1.17	–6.60	55	0.001*
Follow-up	4.93	1.76	7.90	1.29	–7.27	55	0.001*
Concentration deficit							
Pre-intervention	6.89	1.40	6.45	1.84	1.02	55	0.311
Post-intervention	4.43	0.84	7.55	1.90	–8.08	38.72	0.001*
Follow-up	3.93	0.77	7.59	1.70	–10.53	39.21	0.001*
Increase appetite							
Pre-intervention	6.79	2.38	6.28	2.28	0.83	55	0.412
Post-intervention	11.86	1.72	10.62	2.27	2.31	55	0.025
Follow-up	11.79	1.75	10.00	2.49	3.12	55	0.003*
Depression							
Pre-intervention	6.96	2.08	7.14	1.51	–0.36	55	0.719
Post-intervention	3.57	1.43	7.72	1.96	–9.11	55	0.001*
Follow-up	2.89	1.47	7.79	1.78	–11.30	55	0.001*
Insomnia							
Pre-intervention	7.46	2.59	6.72	2.22	1.16	55	0.251
Post-intervention	4.68	2.07	7.21	2.68	–3.98	55	0.001*
Follow-up	3.86	1.84	7.48	2.67	–5.99	49.86	0.001*

SD=standard deviation

* p<0.01, statistical significance

group at the post-intervention and follow-up period with (p<0.01) (Table 4).

Nicotine dependence level

There were significant differences in nicotine dependence levels in the intervention and control groups (p<0.01) at pre-post intervention and follow-up period. There was no significant difference in nicotine dependence between the intervention and control groups at pre-intervention (p=0.903). However, the intervention group had a significantly lower nicotine dependence level compared to the control group at the post-intervention and follow-up period (p<0.01) (Table 4).

Exhaled carbon monoxide level

There was a significant difference in exhaled carbon monoxide level in the intervention and control groups (p<0.01) at pre-post intervention and follow-up. There was no difference in nicotine addiction level (p=0.730) at the pre-intervention period. The intervention group had a significantly lower average exhaled carbon monoxide level compared to the control group at the post-intervention and follow-up period with statistical significance (p<0.01) (Table 4).

Smoking cessation behavior

There was a significant difference in smoking cessation behavior in the intervention group (p<0.01) at pre-post intervention and follow-up. In contrast, there were no significant differences in smoking cessation behavior in the control group (p=0.747) at pre-post intervention and follow-up. In addition, there was no difference in smoking cessation behavior

Table 4. Comparison of average cigarette craving score, self-efficacy perception of nicotine withdrawal management, cigarette rolls per day, nicotine addiction level, exhaled carbon monoxide level, and smoking cessation behavior at the pre-post intervention and follow-up period between the intervention and control group

Variables	Intervention group (n=28)		Control group (n=29)		t	df	p-value
	Mean	SD	Mean	SD			
Cigarette craving score							
Pre-intervention	29.25	10.00	22.93	7.55	2.70	55	0.009*
Post-intervention	21.57	6.30	29.45	7.90	–4.15	55	0.001*
Follow-up	19.54	6.59	29.38	8.52	–4.87	55	0.001*
Self-efficacy perception of nicotine withdrawal management							
Pre-intervention	39.36	7.58	48.93	10.21	–4.01	55	0.001*
Post-intervention	50.96	6.87	38.38	10.08	5.49	55	0.001*
Follow-up	54.25	5.81	35.38	9.42	9.06	55	0.001*
Cigarette rolls per day							
Pre-intervention	11.36	2.87	10.66	1.42	1.18	55	0.245
Post-intervention	3.32	1.66	6.34	1.26	–7.77	55	0.001*
Follow-up	3.21	1.62	6.86	1.73	–8.22	55	0.001*
Nicotine dependence level							
Pre-intervention	6.32	0.67	6.34	0.77	–0.12	55	0.903
Post-intervention	2.18	1.09	5.00	1.28	–8.94	55	0.001*
Follow-up	1.32	0.61	5.41	1.09	–17.44	55	0.001*
Exhaled carbon monoxide level							
Pre-intervention	7.86	0.53	7.90	0.31	–0.35	55	0.730
Post-intervention	3.46	2.20	7.00	1.00	–7.76	37.39	0.001*
Follow-up	3.32	2.31	7.07	0.96	–7.95	35.81	0.001*
Smoking cessation behavior							
Pre-intervention	19.79	3.49	20.59	6.39	–0.58	55	0.562
Post-intervention	20.59	6.39	20.00	3.79	14.54	55	0.001*
Follow-up	36.64	2.82	20.21	3.62	19.08	55	0.001*

SD=standard deviation

* p<0.01, statistical significance

Table 5. Comparison of the proportion of succeed behavioral modification participants at the pre-post intervention and follow-up period

Smoking cessation	Intervention group (n=28)		Control group (n=29)		p-value
	Number	Percent	Number	Percent	
Failure in behavioral modification	0	0.00	9	31.04	0.002[f]*
Success in behavioral modification	28	100	20	68.96	

[f] Fisher's exact test, * p<0.01, statistical significance

between the intervention and control group at the pre-intervention period (p=0.562). The intervention group had a statistically significant higher average smoking cessation behavior score compared to the control group at the post-intervention and follow-up period (p<0.01) (Table 4).

The proportion of successful behavioral modification participants

The intervention group reported a statistically significantly higher number of participants who could decrease the number of cigarette consumption per day compared to the control group (p<0.01) (Table 5).

Discussion

The present study supported the smoking cessation program using the LINE application to increase self-efficacy for industrial workers is effective. This smoking cessation program led to decreased nicotine withdrawal symptoms, cigarette rolls per day, nicotine dependence level, and exhaled carbon monoxide level and increased self-efficacy perception of nicotine withdrawal management and smoking cessation behavior.

The present study finding indicated that the intervention group has decreased nicotine withdrawal symptoms, particularly in irritability, anger, anxiety, depression, concentration deficit, insomnia, and cigarette craving. The reason for a significant decrease in nicotine withdrawal symptoms in the present study was the program that included a variety of strategies for managing nicotine withdrawal symptoms. For example, text messages and video presentations were sent out via the LINE application to learn how to manage nicotine withdrawal symptoms. In addition, individual and group consultations were provided to support workers to choose effective strategies to cope with nicotine withdrawal symptoms. However, the increased appetite may result from a lack of nicotine in controlling insulin and leptin levels through neuropeptide in the hypothalamic nucleus[25], which causes hunger and food appetite[26]. Therefore, future research should include weight and appetite management in the program, as most quitter reported they had gained weight and increased appetite after successful smoking cessation.

In addition, the results of the present study revealed that the applied self-efficacy theory of managing nicotine withdrawal symptoms by industrial workers via the LINE application program could enhance nicotine withdrawal symptom management ability, lead to the success in cigarette craving elimination, and eventually lower nicotine withdrawal symptoms level. Several activities embedded in the applied self-efficacy theory encourage participants to set their individualized goal and group target of the quitting date, such as video presentation, peer support, group discussion, and positive reinforcement. The present study found the intervention group reported higher self-efficacy perception in nicotine withdrawal management score. Consistent with the previous studies that applied for self-efficacy support and role modeling supported the management of the nicotine withdrawal symptoms[27-29]. In addition, the previous studies also found that a higher level of self-efficacy in nicotine withdrawal symptoms management significantly increased the smoking cessation and nicotine withdrawal symptoms management performance[17,19].

Nicotine dependence level, cigarette rolls consumption per day, and exhaled carbon monoxide level were measured to evaluate whether the participants succeeded in quitting smoking. The present study has demonstrated that nicotine dependence level, cigarette rolls consumption per day, and exhaled carbon monoxide level of the intervention group were significantly lower at post-intervention and follow-up period when compared to the control group. Several techniques were implemented to manage the nicotine withdrawal symptoms among the intervention group such as extended the smoking period, decreased cigarette rolls consumption per day, and offered notification by LINE message. These actions resulted in the time extension of the first cigarette after awakening and reducing cigarette consumption per day, leading to lower nicotine addiction levels. Similar to the previous studies, a significantly lower nicotine addiction level was found in the intervention group at post-intervention and follow-up period[14,16].

It is noticeable that lower cigarette rolls consumption per day is related to higher self-efficacy in nicotine withdrawal symptoms management at the post-intervention and the follow-up period. Self-efficacy would enhance nicotine withdrawal symptoms and cigarette craving management and eventually reduce daily cigarette consumption. Several studies also identified a significantly lower cigarette consumption per day in the intervention group, who received brief intervention before the smoking cessation process such as motivational interview and self-efficacy enhancement[27,28]. In addition, the evidence from the previous study revealed that nicotine dependency level and exhaled carbon monoxide level in the intervention group significantly decreased at the post-intervention period compared to the control group[14,21].

In the present study, three participants in the intervention group successfully quit smoking, while the other twenty-five participants could reduce their daily consumption. On the other hand, none of the participants in the control group was able to quit smoking, twenty participants could reduce their daily consumption, and nine participants reported no behavioral change. The behavioral modification of individuals depends on their stage of change[29]. Therefore, delivering activity during the determination stage, such as follow-up via LINE

application or instant notification, could lead to more sustained cessation of smoking. Consistent with the previous study, the participants in the determination stage, according to the stage of change, received telephone follow-up after nicotine withdrawal were able to quit smoking more than the participants who did not receive any telephone follow-up[21].

Conclusion

Nicotine withdrawal management program delivered by Line application enhances industrial worker's self-efficacy in nicotine withdrawal management and leads to decrease nicotine withdrawal symptoms, cigarette rolls per day, nicotine addiction level, and exhaled carbon monoxide level. In addition, the intervention group was able to modify their behaviors to quit smoking better than the control group.

What is already known on this topic?

Increased self-efficacy in smoking cessation and nicotine withdrawal management would lead to successful smoking cessation. Several methods to relieve nicotine withdrawal symptoms in Thailand were implemented, such as reflexology, deep breathing relaxation, and exercise.

What this study adds?

Occupational health nurses are in a significant role to assist smokers in the workplace setting to quit smoking successfully by applying a smoking cessation program based on self-efficacy theory using LINE application. This smoking cessation program led to decreased nicotine withdrawal symptoms, cigarette rolls per day, nicotine dependence level, and exhaled carbon monoxide level and increased self-efficacy perception of nicotine withdrawal management that lead to successful smoking cessation.

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Conflicts of interest

The authors declare no conflict of interest.

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