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Non-pharmacological interventions for tobacco cessation: A systematic review of existing practice and their effectiveness

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Abstract

Smoking tobacco is associated with lung cancer and other life-threatening diseases which requires serious action to curb it. Tobacco cessation interventions are available as pharmacological and non-pharmacological methods or a combination of both. The present review examines the effectiveness of the existing non-pharmacological tobacco cessation interventions and synthesizes the result for the future development of drug-free treatment in the community for tobacco cessation. The literature search was conducted in August 2020, using two electronic databases (PubMed and JSTOR), with search terms: ['tobacco cessation' OR 'smoking cessation'] AND ['intervention'] which included studies published during 2010 and 2020 (till 31st July 2020). All studies were limited to English language, human participants and excluded patients with comorbidities. A total of 2,114 publications were retrieved out of which 11 articles were reviewed. On the basis of intervention used in reviewed studies, we categorized them into seven categories: i) incentive-based intervention; ii) exercise based; iii) telephone-based proactive counselling; iv) mobile phone SMS (Short Message Service) based; v) smartphone app (application) based; vi) web-based intervention, vii) self-help material. Incentives were provided in most of the studies to maintain the retention rate and motivate the participants for completing follow-up. Non-pharmacological interventions for tobacco cessation include a combination of various elements. Our findings suggest that behavioural counselling is one of the most important elements of any non-pharmacological intervention. In addition to behaviour counselling, yoga and exercises along with self-help material, video and phone counselling may have higher efficacy. Thus, practicing non-pharmacological interventions may also increase the cessation rate and reduce the tobacco use burden.

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Introduction

Smoking tobacco is the leading cause of preventable respiratory disease, cancers and related deaths around the globe [1]. It accounts for more than 8 million death per year around the world [2], out of which around 7 million are the result of direct tobacco use while around 1.2 million are non-smokers being exposed to second-hand smoke [2]. More than 80% of the 1.3 billion tobacco users worldwide live in low- and middle-income countries, where the burden of tobacco-related illness and death is heaviest [2]. India is home to nearly 12% of the world's cigarette smokers [3], even a larger section of the population uses other forms of tobacco including smokeless tobacco (SLT) such as khaini, gutkha, zarda, or local smoking tobacco like bidi, hookah, chillum, or a mixture of these. A latest survey revealed that every fifth adult use smokeless tobacco and every tenth adult smokes tobacco, whereas 3.2 crore adults resort to dual use of tobacco [4]. According to the World Health Organisation (WHO), tobacco kills more than 1 million people each year in India, accounting for 9.5% of all deaths [2]. The most common cause of death associated with tobacco is cardiovascular disease, which contributes 48% of all tobacco-related deaths [5]. In 2017, tobacco ranked fifth among the risk

factors driving the most death and disability in India, after malnutrition, dietary risks, air pollution, and high blood pressure [6]. Thus, there is an immediate need to prevent the society from the vicious cycle of tobacco use.

With increasing awareness, people are also interested in tobacco quitting. Overall, an estimated 176.8 million adults from 31 countries had attempted to quit smoking in the previous 12 months, with prevalence ranging from 16.4% in Greece to 54.7% in Botswana [7]. The latest report of India's Global Adult Tobacco Survey (GATS-2016) revealed that 91.3% current adult smokers and 94% current adult smokeless tobacco users believe that use of tobacco causes serious illness [4]. Also, 55.4% of current smokers and 49.6% of current smokeless tobacco users were planning or thinking of quitting tobacco use [4]. Whereas, 38.5% smokers and 33.2% smokeless tobacco users had already made quit attempt in the past 12 months [4]. Thus, data suggests the immediate support for those who want to quit tobacco. WHO suggest brief advice in healthcare settings, access to free or low-cost pharmacotherapy and behavioural counselling as the evidence-based cessation service [7]. Providing free pharmacotherapy may not be possible to countries like India or other LMICs (low- and middle-income countries) due to high tobacco prevalence and many of the people cannot afford medicine. Hence, a review is required to assess the non-pharmacological tobacco cessation interventions which can help to strengthen existing interventions in resource poor countries. Thus, this systematic review is intended to synthesize the existing non pharmacological interventions and understand their effectiveness.

Methods

Search strategy

The literature search was conducted in the month of August 2020, using two electronic databases JSTOR and PubMed. The keywords search terms namely 'tobacco cessation', 'smoking cessation' were combined with Boolean phrase "or" which were later combined using AND with key word 'intervention'. The search results were filtered for the studies published in English language from 2010/01/01 to 2020/07/31, and conducted with humans (Table 1). Data duplication was managed and removed manually. We excluded studies conducted with youth below 18 years, drug addicts, hospitalized patients, co-morbid diseases and pregnant women, as these group are related to special population which have different needs and face unique barriers in attempting to quit tobacco use [8,9].

Eligible studies

A total of 2,114 publications were retrieved out of which 1,971 did not meet our eligibility criteria. A total of 132 studies were further removed after review of abstract as these were protocol trials (n=42), pharmacological interventions (n=83), or full text was not available (n=4), systematic review (n=3) (Figure 1). A total of 11 studies met our eligibility criteria and included in this review.

Data was extracted manually using a self-developed data extraction form in Excel spreadsheet (Table 2). Both the reviewers together developed the structured format which included information like year of the study, objectives, methodology, analysis procedures, major findings and reviewer's remarks. Data was first extracted by the first author (SKS) which was later cross checked and refined by the second author (TB).

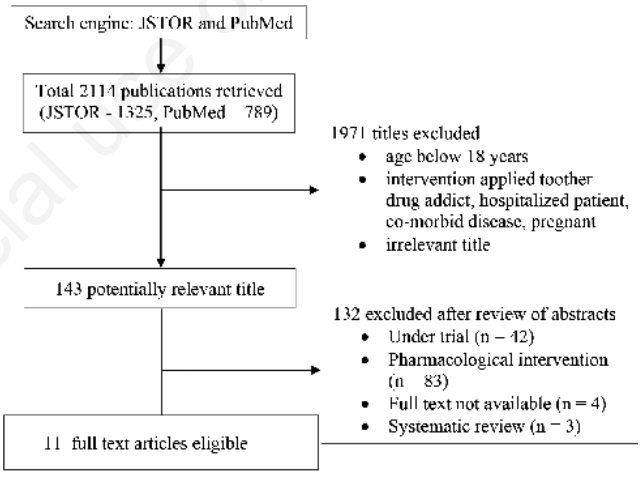

Figure 1. Flowchart of the review process.

Table 1. Keyword search and outcome.

Keyword search and outcome on 1st August 2020	
Search engine: JSTOR	
Keyword (result) 1. Smoking (21,023) 2. Tobacco (25,578) 3. Cessation (11,426) 4. Intervention (99,977) 5. Smoking cessation (2,981) 6. Tobacco cessation (2,349) 7. Smoking cessation intervention (12,224) 8. Tobacco cessation intervention (823) 9. 5 OR 6 AND 4 (1,325)	Filter applied: • Publication date: From 2010/01/01 To 2020/07/31 • Access type: Content I can access
Search engine: PubMed	
Keyword (result) 1. MeSH term: tobacco use cessation (752) 2. MeSH term: smoking cessation (1,4582) 3. MeSH term: methods (175,580) 4. MeSH term: 1 OR 2 AND 3 (789)	Filter applied: • Publication date: Start Date 2010/01/01 End Date 2020/07/31

Table 2. Summary of review studies.

First Author and Year	Objectives of the study and setting	Type of study	Sample size, dropout and LOI	Intervention	Analytic procedures*	Results and comments
Hwang [9] (2012)	To evaluate Smoking Cessation Intervention using Stepwise Exercise Incentives for male workers in the work Setting: at workplace Place: Korea	Quasi experimental	Total: 109 Drop out: 51 LOI: 3M	The program consisted of education for 1 month, 6-month exercise voucher (cash value: approximately $300) for a fitness center located near to participant's home or workplace	t test to analyse demographic factors and smoking history between the success and drop-out group. X2 test to determine differences in job category and applied t tests for age, smoking history, nicotine independence, and job stress. Multiple logistic regression analysis was applied to confirm smoking cessation.	The success rate for the smoking cessation program was 53.2%. A total of 58 participants succeeded in quitting smoking for 3 months.
Myung [16] (2011)	To examined the CAR of smoking at each follow-up of the proactive Quitline service Setting: Tobacco Quitline (Telephone counselling by the trained counsellor) Place: Korea	Observational study	Total: 3631 Drop out: 0 LOI: 12M	The intensive 30-day smoking cessation program consisted of 7 consecutives scheduled counselling sessions conducted on pre-quit day, on quit day, day 3,7,14,21 and 30. Relapse prevention program, comprising another 7 consecutive scheduled counselling sessions at 2,3,4,5,6,9 and 12 months of follow-up along with scheduled short-message services (SMSs).	Pearson's Chi-square test and R values for trend to identify the factors of successful abstinence in a univariable analysis. Multiple logistic regression analyses to assess the factors for abstinence with adjustments for main independent variables using odds (ORs) with 95% confidence intervals (CIs). Among the independent variables, those variables that showed $p < 0.3$ in univariable analyses were included in the multiple logistic regression analyses.	Self-reported CAR was 26.4%,21.5%, 15.6%,14.4%, and 12.8% at 1,3,6,9 and 12 months respectively.
Bottorff [10] (2016)	Men's use and evaluations of the interactive resources and information on the QuitNow Men website, and the potential of QuitNow Men to engage men in reducing and quitting smoking. Setting: 4 focused group gender-specific online resources for tobacco cessation. Place: British Columbia, Canada	A one-group, pretest-posttest study design	Total: 117 Drop out: 50 LOI: 6M	Men who were interested in quitting were recruited through social media and invited to use the website over a 6-month period. Data were collected via online questionnaires at baseline, 3-month, and 6-month follow-up. Participants received a maximum of CAN $50 for participating in the study ($25 gift card for completing the 3-month follow-up and $25 gift card for completing the 6-month follow-up)	Descriptive statistics were used to describe website usage and participant evaluations of QuitNow Men. One-way analysis of variance (ANOVA) was conducted to determine if those who dropped out of the study significantly differed in their demographic profile from those who completed both 3 month and 6-month follow-up. multiple logistic regression was use to investigate predictors of the number of quit attempts at 6 months.	16 (24%) out of the 67 participants had quit, 27 (40%) had reduced their smoking, and 24 (36%) had not changed their smoking habits at 6 months follow-up.
Bock [11] (2018)	To investigates the efficacy of Yoga as a complementary therapy for smoking cessation Setting: University affiliated hospital Place: New England, United States	Randomized clinical trial	Total: 227 Drop Out: 0 LOI: 8W	CBT for smoking cessation. Yoga classes included 5 minutes of pranayama, 45 minutes of dynamically linked asanas, and 5–10 minutes of resting meditation. Wellness Control Group consisted wellness classes including videos, lectures, and demonstrations on a variety of health topics. Participants were compensated $30 and $50 for completing the 3 and 6-month follow-ups, respectively	Using Latent Class Models (LCMs), to identify smoking patterns during the treatment period (exploratory analysis). Classes were compared based on baseline characteristics, randomized group, smoking rates at 3- and 6-month follow-up, and baseline motivational variables using chi-square tests and analysis of variance as appropriate.	Yoga participants had 37% greater odds of achieving abstinence than Wellness participants at the end of treatment. A significant dose effect was observed for Yoga (OR = 1.12, 95% CI = 1.09% to 1.26%), but not Wellness, such that each Yoga class attended increased quitting odds at EOT by 12%.

To be continued on next page

Table 2. Continued from previous page.

First Author and Year	Objectives of the study and setting	Type of study	Sample size, dropout and LOI	Intervention	Analytic procedures*	Results and comments
Junnual [19] (2015)	To develop a Quit-Calendar to improve the cessation counselling service as an attempt to help people quit cigarettes Setting: Psychiatric OPD, Hospital Place: Thailand	Quasi-experimental research design.	Total – 80 Drop Out: 0 LOI: 2M	2 research tools, a Quit-Calendar and a questionnaire. Calendar include facts about the dangers of smoking, Withdrawal symptoms, Fagerstrom Test for Nicotine Dependence, how to quit smoking successfully, behavioural modification, and quit date with reminder stickers.	Intention to quit smoking were evaluated with analytical t-test. The effectiveness of both Quit-Calendar and routine smoking cessation counselling were assessed at days 14 and 60 with survival analysis [Log Rank (Matel-Cox), Kaplan-Meier survival curve]. Satisfaction with the Quit-Calendar was investigated through percentages and frequencies.	Participants in the study group had longer durations of quitting smoking than those in the control group (Mean =24.63 and10.57 days, respectively). At 14and 60 day survivals, there were significant differences of a number of survival days between study and control groups
Gram [17] (2019)	To probe the efficacy of tailored smoking cessation intervention delivered by mobile text messaging versus email Setting: Internet-based smoking cessation program. Place: Norway	Nationwide 2-arm, double-blinded, fully automated RCT.	Total – 4378 Drop out: 767 LOI: 6M	Recruitment from Norwegian internet-based smoking cessation program. The baseline questionnaire consisting demographic details, tobacco use details and Fagerstrom Test for Nicotine Dependence asked. The main outcome was the 7-day self-reported PPA at 6 months post cessation.	Calculated response rates and 7-day self-reported PPA for enrolled smokers at completed 1,3,6, and 12 months post cessation. Chi-square test statistics to compare, by arm, the selected characteristics at baseline and the time point–specific response rates. Effect size of the 7-day self-reported PPA in the text message arm compared with the email arm as odds ratios (ORs) with 95% CIs for the 4 time points post cessation calculated.	11.46% (209/1823) of participants in the text message arm compared with 10.96% (196/1788) in the email arm (OR 1.05, 95% CI 0.86-1.30) reported to have achieved 7 days PPA.
Danaher [12] (2019)	To examine the efficacy and usage patterns of 2 internet interventions for smoking cessation. MobileQuit intervention for smartphones and QuitOnline intervention for use on nonmobile PCs Setting: Mobile text message and internet-based intervention. Place: US	Nationwide RCT	Total – 1271 LOI: 6M	A total of 290 text messages composed of 4 types of content were scheduled over the 6-month study period. Additional text messages were sent if required. The QuitOnline was an internet intervention that used interactive and multimedia components to deliver smoking cessation content and email reminder.	Logistic regression models were used to calculate the odds ratios for abstinence rate differences between intervention conditions. a univariate binary logistic regression was used to test the baseline participant characteristics as predictors of smoking abstinence using the repeated point abstinence at 3 and 6 months. the significant predictors were tested using multivariate binary logistic regression with backward elimination.	Abstinence rates using intention-to-treat analysis MobileQuit vs QuitOnline were 20.7% (131/633) vs 11.4% (73/638) at 3 months, 24.6% (156/633) vs 19.3% (123/638) at 6 months.
BinDhim [18] 2018)	To determine the efficacy of a smartphone smoking cessation decision-aid app with support features compared with an app that contains only smoking cessation information. Setting: Smartphone-based. Place: USA, Australia, UK and Singapore	Multi-country double-blind automated RCT	Total – 684 LOI: 6M	The intervention app included four main components that made optimal use of smartphone features: (1) mandatory information about quitting options, with their benefits and harms; (2) daily motivational messages using push notifications sent from the study server, (3) a quitting diary and (4) a quitting benefits tracker. The control app included non-mandatory information about quitting options, benefits and harms, similar to those available in the intervention app.	The participants from the USA, Australia, Singapore and the UK were randomised over a 5-month period. All analyses were undertaken on an intention-to-treat basis. To account for the non-responses at follow-up, four multiple imputation models were constructed for the non-responses at the follow-up at 10 days, 1 month, 3 months and 6 months continuous abstinence	Smokers who received the decision-aid app were more likely to be continuously abstinent at 1 month compared with the information-only app (28.5% vs 16.9%). The effect was sustained at 3 months (23.8% vs 10.2%; RR 2.08; 95% CI 1.38 to 3.18) and 6 months (10.2% vs 4.8%; RR 2.02; 95% CI 1.08 to 3.81).

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Table 2. Continued from previous page.

First Author and Year	Objectives of the study and setting	Type of study	Sample size, dropout and LOI	Intervention	Analytic procedures*	Results and comments
Bricker [13] (2014)	To address dual need: (1) innovative theory-based intervention content and (2) controlled trials to evaluate the efficacy of apps for smoking cessation. Setting: Smartphone based Place: US	Nationally-recruited pilot RCT	Total – 196 LOI: 8W	Intervention app focuses on ACT values-based motivations to quit via testimonials of former smokers and develop a personalized quit plan, identify social support for quitting, and provides information on selecting FDA-approved medications for quitting smoking,audio and text-based acceptance skills for craving and relapse management. Tracking tool for self-monitoring. Control App focuses on thinking about quitting, preparing to quit, skills for avoiding cravings and skills for coping with slips. Participants were compensated $25 for completing the survey.	The two interventions were evaluated over the 8 weeks following randomization. Logistic and linear regression was used to compare the two treatments on participant satisfaction, utilization of the app, and smoking cessation outcomes. Univariate logistic regression to test whether any of these factors predicted two-month retention. ACT theory-based acceptance outcomes were compared using linear regression models and t-tests.	Intervention group participants were more active than control group participants, opened application an average of 37.2 times, as compared to 15.2 times for control group participants. Overall, the quit rates were 13% (95% CI: 6%-22%) in intervention app vs. 8% (95% CI: 3%-16%) in control app (OR = 2.7; 95% CI = 0.8-10.3).
Bricker. [14] (2013)	To determine design feasibility, user receptivity, effect on 30-day point prevalence quit rate at 3 months post-randomization, and mediation by ACT theory-based processes of acceptance. Setting: Web based Place: US	Double-blind RCT	Total – 222 LOI: 3M	The ACT experimental arm of the study was adapted from the telephone-based and group ACT intervention protocols. The program centered on the metaphor of a car journey. Participants compensated $10 for completing study at 3-month follow-up.	ACT Theory-Based Acceptance Processes were measured at baseline and 3-month follow-up using a 27-item adaptation of the Avoidance and Inflexibility Scale. Demographic characteristics, baseline smoking habits, and baseline process measures were assessed for balance between study groups using two-sample t tests for continuous variables and Fisher exact test for categorical variables.	Intervention group remained on the site for a significantly greater number of minutes per login than the control group. Intervention group participants reported greater satisfaction with their assigned Web site. More than double the fraction of participants in the ACT intervention arm had quit smoking at the 3-month follow-up (23% vs. 10%; OR = 3.05; 95% CI = 1.01–9.32; p = .050).
Zhu. [15] (2012)	To test the effects of telephone counseling for smoking cessation in Chinese, Korean, and Vietnamese speaking smokers Setting: Telephone based Place: California, US	Single RCT	Total – 2277 LOI: 1M	Intervention group received telephone counseling plus self-help materials and the control group received self-help materials only. For each completed evaluation call, subjects received a $5 grocery store coupon.	The Pearson $\chi 2$ was used to test for equality between the counseling and self-help groups. For each analysis of 6-month prolonged abstinence and 7-day point abstinence, the difference between the counseling and self-help groups was calculated along with the 95% confidence intervals and tested using a two-sided two-sample test between independent binomial proportions.	Counseling increased the 6-month prolonged abstinence rate among all smokers compared with self-help (counseling vs self-help, 16.4% vs 8.0%, difference = 8.4%, 95% confidence interval [CI] = 5.7% to 11.1%, P < .001).

LOI, length of intervention; W, weeks; M, months; **compiled from the above mentioned studies.

Quality assessment and grading of the studies

We developed a tailor-made quality assessment form based on criteria from standard forms for appraisal of the studies [10]. The selected studies were assessed on the basis of structured objectives, sampling, sample size calculation, feasibility of methods, statistical analysis, recruitment rate, length of interventions, *etc*. (Table 3). In order to ensure rigour, we first discussed major points in each study, then SKS first assessed and inserted information in the form, TB then reviewed all the points of randomly selected 50% of the studies for cross checking. Any points of contradictions were discussed till consensus was achieved.

Results

A total of 11 studies met the inclusion criteria. All the selected papers used a combination of interventions. We categorized the selected papers into seven categories (Table 4), viz. incentive based intervention (7), exercise based (2), telephone-based proactive counselling (2), mobile phone SMS (Short Message Service) based (2), smart phone app (application) based (3), web-based intervention (4), self-help material (2).

Incentive based intervention

Seven studies used incentive in their intervention, wherein participants were provided incentives either as cash or gift vouchers for gymnasium grocery shopping [11-17]. It is very important to note that all these studies were not solely dependent on incentive but other intervention elements like CBT, exercise, self-help materials etc were also present in tobacco cessation treatment plan. Two of these studies [11,12] excluded the female participations as their participation was low [11,12]. One of these studies used gender directed web-based information specifically designed to address the needs of men tobacco users [12]. A quasi experimental research conducted at South Korea with 109 participants, provided incentives in the form of gift voucher on target achievement [11]. The participants had to clear the

Table 3. Quality grading of the reviewed studies.

S. No.	Criteria		Study 1 [9]	Study 2 [16]	Study 3 [10]	Study 4 [11]	Study 5 [19]	Study 6 [17]	Study 7 [12]	Study 8 [18]	Study 9 [13]	Study 10 [14]	Study 11 [15]
1	Structured abstract		No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
2	Objectives defined	At the outset			Yes	Yes		Yes		Yes	Yes	Yes	Yes
		Implied in the paper	Yes	Yes			Yes		Yes				
		Unclear											
3	Hypotheses framed	At the outset				Yes		Yes					Yes
		Implied in the paper	Yes							Yes	Yes	Yes	
		Unclear/Nil		Nil	Nil		Nil		Nil				
4	Pre-sample size calculation based on statistical power		No	No	No	No	Yes	Yes	No	Yes	Not Clear	Yes	Yes
5	Recruitment rate (%)		N.C	N.C	N.C	N.C	N.C	71.3	N.C	N.C	N.C	N.C	N.C
6	Retention rate (%)		N.C	N.C	57.3	94.7	N.C	N.C	N.C	85.2	84	54	N.C
7	Blinding	Subjects	Nil	Nil	Nil	Nil	Nil	Yes	Nil	Yes	Yes	Yes	Yes
		Researchers	Nil	Nil	Nil	RA	Nil	Yes	Nil	Yes	Yes	Yes	No
8	Adequate sample size		To some extent	Yes	No	Yes	To some extent	Yes	Yes	Yes	Yes	Yes	Yes
9	Well defined treatment		Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
10	Random allocation		No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	Method of random allocation		NA	NA	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	Description of drop-out		Yes	NA	Yes	NA	NA	Yes	NA	NA	NA	NA	NA
13	Length of intervention (more than 3 months)		No	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No
14	Intent to treat analysis		No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes
15	Presentation of statistical material (table, graph, numbers satisfactory)		Yes	Yes (to a large extent)	Yes (to a large extent)	No	Yes	Yes	Yes (to a large extent)	Yes (to a large extent)	Yes	Yes	Yes
16	Statistical methods appropriate for data		Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes
17	Is p value presented with confidence interval		Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18	Clear discussion on hypothesis testing		None	None	None	None	None	None	None	None	None	None	None

RA, research assistant.

urinary nicotine test to be eligible for further stages of incentives [11]. In addition, incentives were planned in the form of facilitation of the successful tobacco quitter in a special ceremony by the workplace CEO [11]. Another study based on a single group pre and post assessment design was conducted with a sample of 117 participants in Canada [12]. The study gave gift card incentives in two instalments, one at successful completion of their participation at 3 months and second continuous participation at 6 months [12]. Another randomized clinical trial compensated $30 and $50 for completing the 3 and 6-month follow-ups, hypothesized that yoga intervention may have significantly higher abstinence rates [13]. Adult smokers were given option to choose 8-week program of cognitive-behavioural smoking cessation with either twice-weekly Iyengar Yoga classes or general Wellness classes (control) [14]. A nationally-recruited pilot randomized controlled trial (RCT) where two smartphone app were compared on the basis of content also offered incentive of $25 for completing the survey [15]. In another double-blind RCT to determine feasibility of web-based smoking cessation intervention, the participants received $10 for completing study assessments at 3-month follow-up [16]. A study in California evaluated the effects of a multilingual telephone Quitline along-with incentives for Asian smokers provided ($5 grocery coupon) for each completed evaluation call [17]. In another study to examine the efficacy and usage patterns of two internet interventions for smoking cessation, participants were given a total of US $40 for completing the follow-up assessment [14].

Exercise based intervention

Physical exercise or yoga as the complementary intervention in tobacco cessation treatment plan were included in two studies [11,13]. One study [11] was quasi experimental conducted at Korea with a sample of 109 respondents while another [13] at United States a RCT with 113 subjects in each of the intervention and control arm. Both the studies provided group-based smoking cessation counselling in addition to yoga or exercises [11,13]. Interestingly 53.2% had successfully quitted smoking continuously for 3 months with exercise, social support, incentive, and competition [11]. Another research revealed that yoga participants had 37% greater odds of achieving abstinence [13]. Yoga included 5 min of pranayama, 45 min of dynamically linked asanas, and 5-10 min of resting meditation [13]. Both the studies included cotinine-verified assessment and abstinent [11,13]. In both of the studies yoga or exercise were provided at workplace or clinical settings in groups [11,13]. One study [13] tracked the home practice of yoga weekly through 6-month follow-up. The home practice yoga for smoking cessation gradually reduced after the end of the treatment (EOT) [13]. At EOT, the number of days was 2.56/week which reduced to 90.00 min/week at 3 month and at 9 month it was reported 75.36 min/week [13].

Telephone based proactive counselling

Two studies were based on telephonic proactive counselling which focused only on telephonic counselling to attain tobacco quit rate [17,18]. One of these were observational research [18] conducted with a sample of 3631 subjects while another [17] a RCT (intervention group n=1124, control group n=1153) [17,18]. The telephonic counselling was given on scheduled time from tobacco Quitline, best known for providing behavioural counselling to help callers develop and follow a plan to quit tobacco. In

Table 4. Type of intervention used in studies

S. No.	Studies/Researches	Participant M	Participant F	Incentive based	Exercise based	Telephone based proactive counselling	Mobile phone SMS based	Smart phone App based	Web-based intervention	Self-help material	Total intervention	Quit rate (m = months)	TA biochemically verified
1	Hwang [9] (2012)	109	0	✓	✓	×	×	×	×	×	3	53.2% (at 3m)	*Yes
2	Myung [16] (2011)	3232	399	×	×	✓	✓	×	×	×	3	21.5% (at 3m)	No
3	Bottorff [10] (2016)	117	0	✓	×	×	×	×	✓	×	3	24% (at 6m)	No
4	Bock [11] (2018)	46	67	✓	✓	×	×	×	×	×	3	11.2% (at 6m)	*Yes
		55	59	✓	×	×	×	×	×	×	2	No sig. differences	
5	Junnual [19] (2015)	38	2	×	×	×	×	×	×	✓	2	32.5% (at 2m)	#Yes
		40	0	×	×	×	×	×	×	×	1	10% (at 2m)	
6	Gram [17] (2019)	626	1562	×	×	×	✓	×	×	×	1	11.5% (at 6m)	No
		588	1559	×	×	×	×	×	✓	×	1	11.0% (at 6m)	
7	Danaher [125] (2019)	142	491	✓	×	×	×	✓	×	×	2	24.6% (at 6m)	No
		138	500	✓	×	×	×	×	✓	×	2	19.3% (at 6m)	
8	BinDhim [18] (2018)	161	181	×	×	×	×	✓	×	×	2	10.2% (at 6m)	No
		147	195	×	×	×	×	✓	×	×	1	4.8% (at 6m)	
9	Bricker [13] (2014)	46	52	✓	×	×	×	✓	×	×	2	13% (at 2m)	No
		48	50	✓	×	×	×	✓	×	×	2	8% (at 2m)	
10	Bricker [14] (2013)	46	55	✓	×	×	×	×	✓	×	2	23% (at 3m)	No
		39	72	✓	×	×	×	×	✓	×	2	10% (at 3m)	
11	Zhu [15] (2012)	1012	112	✓	×	✓	×	×	×	✓	4	16.4% (at 6m)	No
		1038	115	✓	×	×	×	×	×	✓	2	8% (at 6m)	

*Tobacco abstinence biochemically verified by cotinine level, sample taken from blood/urine/saliva; #tobacco abstinence verification done by breath carbon monoxide level; dotted lines, division between intervention group and control group, where the upper row represents intervention group, and lower row represent control group.

both the studies, trained counsellors set a quit date followed by brief tobacco use assessment and intensive counselling [17,18]. The intensive 30-day smoking cessation program consisted of seven consecutive scheduled counselling sessions yielded self-reported CAR 26.4%, 21.5%, 15.6%, 14.4%, and 12.8% at 1,3,6,9 and 12 months respectively [18]. Another study suggested almost similar result (16.4%) in 6-month prolonged abstinence rate among all smokers [17].

Mobile phone SMS (Short Message Service) based

Two reviewed papers found SMS as an important element in tobacco cessation treatment [18,19]. For those who did not have a smartphone, text messages were alternative to the app-based intervention. In a RCT (intervention group n=1823, control group n=1788), a maximum of 150 individually tailored text messages were developed and delivered on phone as an intervention of smoking cessation to recruited participants [19]. The mobile phone text message intervention achieved 11.46% 7-days point prevalence abstinence (PPA) at 6 months post cessation [19]. In an observational study SMSs were the part of smoking cessation maintenance program [18]. A total of 17 scheduled text messages on day 1, 2, 5, 10, 17, 25, 30, 45, 75, 105, 135, 165, 210, 240, 300, and 330 were sent to a subject's cellular phone between follow-up counselling sessions, to remind and encourage the subject to quit smoking [18].

Smart phone application based

The smartphone smoking cessation app included tobacco quit assistance, maintaining abstinence, and relapse preventions. Three studies [14,15,20] included smart phone application in their intervention. A double blind RCT (intervention group n=342, control group n=342), provided through interactive smoking cessation decision-aid app found 10.2% CAR at 6 months [20]. A RCT conducted in US (intervention group n=98, control group n=98), used acceptance and commitment therapy (ACT) through smartphone app for smoking cessation [15]. The study reported 13% CAR at two-week follow-up [15]. ACT is based on a behaviour change model which focuses on increasing willingness to experience physical cravings, emotions, and thoughts while making values-guided committed behaviour changes. In another RCT (intervention group n=633, control group n=638), a total of 290 text messages which had 4 types of content (health benefit and milestone message, program content and motivation message, prompt to use app message, smoking status message) were delivered through smartphone smoking cessation app [14]. The intervention scheduled over the 6-months period, reported 24.6% abstinence rates at 6 months using intent-to-treat analysis [14].

Web-based intervention

Four studies examined the web-based interventions [12,14,16,19]. These studies included evidence-based information, tools, and behavioural support to assist tobacco users in quitting. One study [12] hypothesed that men continue to smoke cigarettes in greater numbers than women hence they developed gender specific website (addressing men's health concerns and information needs. The study reported 24% quit rate at 6 months follow-up [12]. A RCT using email based intervention in one arm (n=1788) and, text based intervention (n=1823) in another arm reported that follow-up through email was less effective in comparison of text message (10.96% *vs* 11.46%) at 6 months [19]. One pilot RCT (intervention group n=111, control group n=111) provided web-based ACT for smokers which included three factors i.e. physical sensations, cognitions, and feelings that cue smoking, reported 23% quit rates at 3-month follow-up (16). Other web based interventional study (n=638) in control group [14] which included interactive, multimedia and CBT reported 19.3% quit rates at 6-month follow-up [14].

Self-help material

Two studies reported self-help material based intervention for tobacco cessation [17,21]. A quasi experimental study [21] (study group n=40, control group n=40) evaluated the quit-calendar effectiveness for smoking cessation reported a significantly higher intention to quit smoking compared to those in the study group (mean= 4.20 and 3.35, respectively; $p<0.001$) [21]. The study mentioned 60 days survival time (i.e., number of days a participant quit smoking after starting cessation program) at 32.5% [21]). This study was done in hospital setting where participants were required to set a quit date on quit-calendar along with routine counselling process that included 5 A's model. The 5A model involves components of ask, advise, assess, assist and arrange. The first component "Ask" meant identify and document tobacco use status for every tobacco user on every visit. The second component "Advise" – involved urging every tobacco user in a clear, strong, and personalized manner, to quit. The third component required "Assessing" - the willingness of the tobacco user to make a quit attempt. The fourth component involved "Assisting" willing patient through counselling and pharmacotherapy. The fifth component involved "Arranging" –or scheduling follow-up contact, in person or by telephone, preferably within the first week after the quit date of smoking cessation, which require assistance from trained counsellor [21]. In another RCT of 1153 subjects a colourful 28-page self-help manual in three languages (Chinese, Korean, Vietnamese) was provided to motivate participants to make a quit attempt and utilize coping strategies for relapse prevention. To ensure cultural relevance, the manual was created using both the expertise of Asian language counsellors at the California Smokers' Helpline and data from focus groups performed by the California Tobacco Control Program [17]. The 6-month prolonged abstinence rate for Chinese, Korean and Vietnamese language reported 7%, 6.3% and 15.6%, respectively [17].

Discussion

There was a plethora of researches on tobacco cessation intervention, but a large number of interventions were related to smoking exclusive. Studies related to smokeless tobacco were limited. This could be because the use of smokeless tobacco in high-income and upper middle-income countries is not as prevalent as in India [22]. Our broad searches in two search engines yielded 2114 publications, out of which 11 studies were reviewed. Five of these studies were conducted in US [13-17], 2 in Korea [11,18], 1 study each in

Thailand [21], Norway [19], and Canada [12]. Only one study was a multi-country study [20] (USA, Australia, UK and Singapore).

The efficacy of the interventions in reviewed studies was measured with quit rate alone ignoring any changes in behaviour and emotional patterns of the subjects. Two of the reviewed studies were conducted in hospital settings and used group-based cognitive-behavioural therapy which were delivered by trained counsellors or psychologists [13,21]. In addition, two more elements namely yoga [13] and quit calendar [21] were added to the intervention package in these studies. The efficacy of yoga intervention recorded with quit rates was 11.2% for prolonged abstinence at 6 months [13], whereas quit calendar mention 32.5% quit rate at 2 months [21]. Tobacco cessation interventions which had combinations of other elements may report higher rate of success, as seen in Hwang's et al. study wherein incentive, exercise, social support, and competition along-with behavioural counselling were provided to the participants at workplace under the supervision of trained nurses [11]. However providing incentives may not be ethical in tobacco cessation or in any research settings as it may lead to misleading result, response and data corruption [23-25]. Thus, research studies based on cash or gift cards incentives to quit tobacco [11-17] may evoke ethical questions from scientific community as incentives may give directionality to the results [25]. The incentive-based intervention requires huge fund which may not be cost-effective and successful in larger population. There are few circumstances where incentives may be required [25]; as seen in a study in Glasgow, Scotland on pregnant smokers, where the financial incentive found as a cost-effective measure in smoking cessation, with £482 incremental cost per quality□adjusted life years [26]. There is also a question that people are really interested to quit smoking with the monetary benefits? A study in Scotland found a significant dropout despite a weekly financial incentive of £12.50 to buy groceries over a 12-week period [27,28]. An exploratory study used in-depth interview tool to find out the reason of disengagement from incentive-based intervention explored a number of factors such as stigma, guilt (emanating from self-criticism) and shame (emanating from disapproval from others) for discontinuation from cessation support [28]. The study suggested that incentive may be an insufficient measure to overcome psychological, social and practical issues to reduce smoking [28].

There were mixed results for exercise-based intervention in our review. A randomized clinical trial found low quality evidence (11.2%) for the effectiveness of yoga for tobacco cessation at the end of the treatment [13], whereas, a quasi-experimental study on exercise showed a higher rate (53.2%) of cessation [11]. The length of intervention may also contribute difference in success rate as 8-week yoga [13] and 12-week exercise [11] did not conferred proportionate quit rate [13,16]. A meta-analysis of RCT concluded no effect of aerobic exercise and physical activity on smoking cessation [29]. In a previous systematic review of 20 studies only 4 studies found an effect in favour of the exercise-based intervention at the end of smoking cessation treatment [30]. However, among the smokers, the moderate intensity of exercise had shown rapid and measurable effect on smoking urge and tobacco withdrawal symptoms [31].

Proactive telephone counselling which is generally done by tobacco Quitline has been identified with several advantages such as decreasing logistical barriers, convenient, quick and economical [32]. There are inherent limitations to this intervention as the participants are required to have their own phones. Similarly, mobile phone intervention and web-based intervention also require a mobile phone/smartphone and computer with internet connection. The user must be literate and able to read and understand the e-content. This requirement may be challenging for less educated and poor individuals. The move to make gender specific website could be welcomed for web-based intervention as the content may be tailored according to gender related physiological and psychological needs. The pilot testing done in men-centered website where the participants were provided with a unique ID and password to access, hence female had no option to access the content [12]. This is important to consider that depriving female from information and knowledge which they may like to use for their loved ones and family is just like depriving one section of the society from a particular service.

None of the reviewed study discussed about the withdrawal symptoms associated with the interventions. Two studies reported tobacco abstinence rates which was verified biochemically by urine/blood cotinine level [11,13]. In two other studies confirmation of smoking status was obtained by carbon monoxide breath testing abstinence rates [21]. In another study, the return rate of saliva samples by treatment group for biochemical validation was not statistically significant, hence self-reported abstinence rate were measured [17]. However, in another research a biochemical verification was considered unnecessary in case of low-intensity interventions, such as those in the telephone Quitline service and web-based [18,33,34).

The literature suggests that there are two ways to quit tobacco, the first one is cold turkey method, in which tobacco users quit tobacco all at once immediately, whereas, other method requires setting a quit date in which the tobacco users set a quit date and try to reduce tobacco use slowly day by day and on the quit date stop using tobacco totally [35,36]. Nine of the studies recruiting current tobacco users set a quit date [12-14,16-21] and two of the study did not specify the method. However, WHO guidelines for smoking cessation recommends setting a quit plan which includes setting a quit date [37]. The self-help material as an intervention works on the self-efficacy theory [38]. Self-efficacy is a theoretical construct first postulated by Bandura in 1977 as a cognitive mechanism underlying behavioural change [38]. It is the self-perception of having the skills to perform a particular behaviour [38]. The studies suggest that self-efficacy play an important role in mediating cognitive behavioural change among the tobacco users who attempt to quit [15]. Individuals who successfully quit tobacco by themselves had higher self-efficacy than those who were unwilling to quit or those who relapsed [38]. In this paper we examined the quit-calendar as the self-help material where the tobacco users were required to set a quit date on the first day of the visit for tobacco cessation counselling. The study combined self-help material intervention with behavioural counselling which was extended to the participants in the hospital setting. But the study examined efficacy only on the basis of quit calendar and the contribution of behavioural counselling was ignored or not filtered from the total result [21]. Thus, this study [21] is insufficient to determine the efficacy of self-help material. In a systematic review of 11 studies, it was found that self□help materials alone with no intervention had a small effect in favour of the intervention [39]. Another study using 28-page self-help material in three languages reported 7%-15.6% six months prolonged abstinence rate representing a good success without any other intervention [17]. Few other studies suggest that the self-help material adjunct to tobacco treatment may increase cessation rates [40,41].

It is important to highlight that the recruitment rate and retention rate were not clearly mention in most of studies. Majority of studies reported self-reported abstinence which may not be accurate or misguiding. All of the studies [11-21] reported declining

smoking abstinence rate at each subsequent month or at longer duration which suggest to reduce relapse rate, regressive follow-up is required. Six studies [11,13,15-17,21] have low length of intervention (≤3 months), which is insufficient to evident the effectiveness at a longer period (Table 3). Studies [11,13] which have schedule monitoring of the participant have shown good tobacco quitting rate, suggesting that proper monitoring in the form of regular follow-up is effective to achieve higher success rate. All the reviewed studies used quantitative base and no attempt to involve qualitative methodology was involved suggesting that future studies have scope for triangulation approach to holistically study the subject matter.

Limitations

There are several limitations in this review. First the systematic search done through only two databases. Hand search and cross referencing could not be possible due to time constraints. The keyword searches and eligibility criteria yielded a very limited studies on different types of interventions for tobacco cessation. Further all the reviewed studies gave combined effect of multifaceted interventions. Hence, it is difficult to ascertain the efficacy of individual interventions. A meta-analysis is required to assess the effectiveness of each independent intervention separately and then study the combined effect of multifaceted interventions.

Conclusions

Tobacco cessation interventions were delivered as a multifaceted interventions package which combined main interventions. Therefore, it is difficult to conclude that which intervention or element has the highest efficacy in tobacco cessation and increasing the tobacco quit rate. But it is clear that non-pharmacological interventions like yoga and exercises along with self-help material, motivational video and phone counselling can increase the tobacco abstinence rate. Future studies are required to compare each categorized intervention with other modalities to isolate their individual effectiveness. Thus, we conclude that non-pharmacological interventions are a good resource for controlling tobacco related behaviour and preventing a number of cancers associated with tobacco use [1,2].

What this paper adds

1. This comprehensive review of non-pharmacological tobacco cessation intervention synthesizes the existing non pharmacological interventions and understand their effectiveness.
2. This review explores the various cessation elements which can be used adjunct to behavioural counselling in the clinical or non-clinical setup of tobacco cessation without any medication.
3. In the challenging situations imposed by COVID-19 pandemic, the face-to-face counselling or physical presence is limited, the review also summarizes the possible mode to compensate the face-to-face counselling using alternate interventions like web-based, smart phone and SMS.

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