

A Review of Web Based Interventions for Managing Tobacco Use

Yatan Pal Singh Balhara, Rohit Verma¹

ABSTRACT

Web based interventions (WBIs) have been developed for various health conditions. These include interventions for various psychoactive substance use disorders including tobacco and alcohol. Tobacco use has remained the single largest preventable cause of global mortality and morbidity for many years. It is responsible for around 6 million deaths annually world-wide. Ironically, most of the tobacco users reside in resource poor low and middle-income countries. The article reviews the existing literature on WBIs for management of tobacco use. The literature search was performed using MedLine, PubMed, PsycINFO, Embase and Cochrane Review for relevant English language articles published from 1998 up to 2013. There is limited support for effectiveness of WBIs for managing tobacco use among adolescents. Although most of the trials among adults found WBIs to be more effective at short term follow-up (a few days to weeks), the benefits failed to extend beyond 3 months in most of the studies. All but one interventions studied in a randomized controlled trial is for smoking forms.

Key words: *Internet based interventions, tobacco, treatment, web based interventions*

INTRODUCTION

Since its commercialization in early 1990s internet usage has been on a constant rise.^[1] Use of internet has impacted various aspects of human life. This includes use of internet in health care service delivery. Web based interventions (WBIs) have been developed for various health conditions. These include interventions for various psychoactive substance use disorders including tobacco and alcohol. Whereas a variety of online eHealth tools emerged to help people manage

their health, relatively little was known about their effectiveness until the middle of the last decade.^[2] However, there has been an increase in interest in assessing the effectiveness of these interventions over the past few years.

The public health impact of an intervention is a product of the program's efficacy and reach.^[3] Thus, the impact is highest when an intervention is effective and has a wide reach. Web based health interventions have a potential to reach a large section of the population. This mode of delivery ensures that large numbers of individuals can be reached at lower costs than with face-to-face interventions.^[4] Furthermore WBIs enables the end users to access large amounts of information at a pace and time of their own convenience.^[5] Recent findings also support use of online support groups by individuals with lower income as well.^[6] This finding is contrary to earlier evidence^[7] and supports the public health utility of WBIs.

Access this article online	
Website: www.ijpm.info	Quick Response Code 
DOI: 10.4103/0253-7176.135367	

Departments of Psychiatry, National Drug Dependence Treatment Centre, All India Institute of Medical Sciences, ¹Lady Hardinge Medical College and SSK Hospital, New Delhi, India

Address for correspondence: Dr. Yatan Pal Singh Balhara

Department of Psychiatry, National Drug Dependence Treatment Centre, All India Institute of Medical Sciences, New Delhi - 110 029, India.

E-mail: ypsbalhara@gmail.com

Tobacco use has remained the single largest preventable cause of global mortality and morbidity for many years.^[8] It is responsible for around 6 million deaths annually world-wide. Ironically, most of the tobacco users reside in resource poor low and middle income countries (LMIC). There are limited health care facilities and a dearth of human resources to deliver the services in these countries. In spite of a high proportion of tobacco users' willingness to quit (approximately 70%) only a minority are able to quit and maintain abstinence.^[9] Moreover, the increasing demand of today's busy life leave little time, if any, for even those with resources to access the traditional models of health care service delivery. Hence, WBIs for tobacco use management are likely to be of potential use in various settings including high income and LMICs.

The article reviews the existing literature on WBIs for management of tobacco use.

METHODOLOGY

Literature search

The literature search was performed using MedLine, PubMed, PsycINFO, Embase and Cochrane Review for relevant English language articles published from 1998 up to 2013. Key search terms used in the search were: (["Online Systems" OR "Internet" OR "Web" OR "Computer"] AND ["Smoking Cessation" OR "Tobacco cessation" OR "Nicotine"] AND ["Randomized Controlled Trial"]). Only publications focused on managing smoking cessation through WBIs were included.

Selection of studies

The studies utilizing solely WBIs that were fully automated and excluded those that required additional elements, such as having face-to-face components or being delivered through intranet or mobile phone.

Titles and abstracts of all potentially relevant articles were reviewed for possible inclusion. Articles were included if (1) the primary intervention was delivered and accessed via the Internet, (2) the intervention focused on curtailing tobacco consumption and (3) the study was a randomized controlled trial (RCT) of an tobacco-related screen, assessment, or intervention with at least a no-treatment control.

Trials using internet only for recruitment or to remind participants of appointments for treatment but not for delivering tobacco cessation intervention were excluded.

Data extraction and analysis

Both authors independently carried out data extraction. The main outcome measure of interest was smoking cessation (e.g., motivation to quit, point prevalence

[PP] abstinence and/or prolonged abstinence). Where data was insufficient or not available in the published paper or by contacting authors, studies were excluded from the relevant analysis. Articles describing the study protocols and dissertations were also excluded from analysis.

RESULTS

A total of 281 potentially relevant records were identified. Out of these seven were reviews or meta-analysis. A total of 28 studies evaluating internet sites with/without co-interventions were included in this review. The characteristics of the studies and participants, results of quality assessment and key findings are described below [Figure 1].

CHARACTERISTICS OF INCLUDED STUDIES

Recruitment

Fifteen studies were solely from USA.^[10-24] One study each from Denmark^[25] and Republic of Ireland,^[26] two each from Norway^[27,28] and Switzerland;^[29,30] and four from Netherlands^[31-34] were found. The studies by Muñoz *et al.* recruited from 74^[35] to 68^[36] countries, whereas one study was based in both USA and Canada.^[37]

Overall the studies revealed data from more than 40,000 participants with sample sizes ranging from 61^[25] to nearly 12,000.^[29] The participants were mostly smokers motivated to quit smoking, who chose the Internet as a tool for smoking cessation support. Only one study focused on intervention directed toward smokeless tobacco (ST) users.^[37] Thirteen studies recruited adults and four studies recruited adolescents or college students.^[10,14,15,22] There were more female than male participants overall.

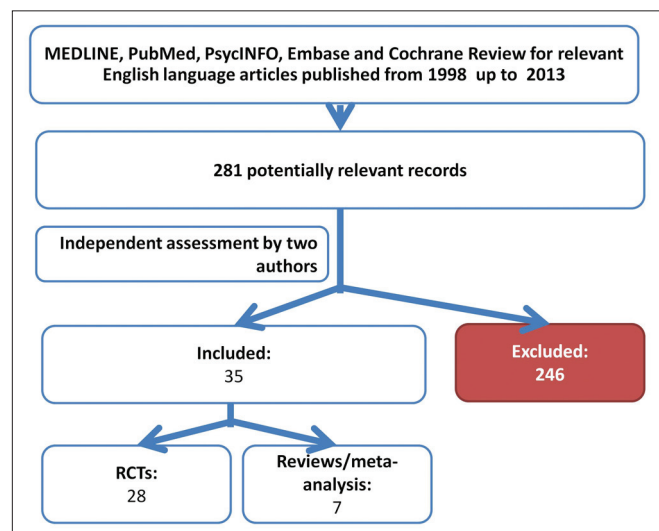


Figure 1: Flow chart depicting the data extraction procedure

The subjects were recruited mainly from the web with the participants finding the WBI through online browsing or through search engines.^[2-10,13-18,24-32,34-38] Other recruitment strategies included recruitment through the non-internet based advertising (such as television commercials, radio and newspaper announcements and flyers displayed in the schools and clinics at each respective site),^[12,15,22] a combination of non-internet based advertising and personal referrals from teachers or coaches,^[14] a combination of web based and non-web based advertisements,^[21,32-34] from attendees of lung cancer screening set up,^[11] members of cancer research institute network,^[19,26] members of health care organization.^[20]

Some studies reported use of monetary incentives to encourage adherence.^[10,14,22,24,32-35]

Selection bias

Risk of selection bias also varied across studies. Design of most of the studies resulted in low selection bias.^[10,13,17-21,27-29,32,33,35,36] However, some studies failed to provide details of the randomization process.^[11,12,14,15,22,24,26,34]

Nature of interventions

The nature of WBIs studied across these studies varied. These varied from included low intensity interventions such as list of web sites on smoking cessation with brief description of each site^[11] to extensive tailored cumulative variants of an WBI.^[36]

The intensity and rigorousness of interventions also varied. Some interventions used weekly visits to study web site.^[10]

Some interventions included only E-mail reminders to the participants.^[10] Other interventions used even more intense reminders in form of E-mail, web pages, interactive voice response, and short message service technology.^[27,28]

Although majority of the interventions used a fixed intervention module, some used a tailored approach.^[20,24,29,32-34,36]

Four studies used pharmacotherapy along with WBI.^[12,28] In a study by Japuntich *et al.*^[12] used Buprenorphine-SR (only for active arm). Three studies allowed use of NRT along with WBI.^[19,26,28] Studies by Strecher *et al.*^[19,26] assessed efficacy of WBI to support NRT assisted quit attempts. Brendryen and Kraft^[28] offered NRT free of charge to both active and control arms of the trial. A study done by Swan *et al.*^[20] offered 12 week free supply of varenicline to all participants.

Characteristics of study participants

The characteristics of participants also varied across the studies. Some studies included only active smokers.^[10-13,15,17,19-22,24,26-28,33-36] Others included both current as well as past smokers.^[29,30] Stoddard *et al.*^[18] included active smokers and recent quitters.

Some studies included willingness to quit in near future (5 days to 30 days) as one of the inclusion criteria.^[13,18,19,21,26-28,33,35,36] Smit *et al.*^[34] in their study included subjects who were willing to quit within next 6 months and Te Poel *et al.*^[32] included smokers who were willing to quit in next 1 year.

Overall more than 50% of the study participants were females across all studies. Almost all studies had preponderance of female participants. The highest proportion of female subjects was 75.4% in control group and 70.4% in intervention group in study by An *et al.*^[10] The lowest proportion of female subjects was 41.3% in the study by Muñoz *et al.*^[35]

Type of tobacco products

Almost all studies focused on cigarette smokers. However, study by Te Poel *et al.*^[32] specifically mentioned inclusion of smokers of cigarettes and/or loose-cut tobacco. Only one study included users of ST forms.^[37]

Outcomes studied

Twenty-one studies assessed smoking status at follow-up lasting at least 6 months after the start of the intervention.^[10-14,16,17,19,20,22-25,27,28,32-36] The longest follow-up was of 18 months.^[24] Most studies reported intermittent assessments also. Six studies followed participants for <6 months.^[18,21,26,29-31] Only one study assessed cessation for ST and made assessments at end of 3 and 6 months.^[37]

Multiple definitions of abstinence were employed for attributing outcome. Mostly 7-day abstinence was the main or secondary outcome measure while 30-day and 28-day continuous abstinence rates were also used in some studies. The longest abstinence duration assessed was that of continued abstinence for 12 months^[33] and the shortest duration assessed was 24-h PP of abstinence.^[34] Biochemical markers (CO levels) to confirm abstinence were also used by some studies.^[10,12,15] One study used cotinine assessments to validate reports of abstinence in a subsample.^[33]

Nearly all the studies had used intent-to-treat (ITT) analysis.

Drop out rates

Proportion of the subjects completing the trial varied across the studies. It ranged from a high of 100%^[11]

to a low of <50%.^[13,17,18,29,32-36] Five studies had a retention rate of more than 80%.^[10,12,19,27,28] and six studies had a retention rate ranging from 50% to 80% respectively.^[14,15,20-22,24,26] the study with longest follow-up of 18 months had a follow-up rate of 68.2%.^[24]

WBI TRIALS AMONG ADOLESCENTS AND COLLEGE STUDENTS

A total of four studies recruited adolescents or college students [Table 1].^[10,14,15,22]

One cessation induction study^[10] in college students compared the WBI (named RealU) with one-off untailed e-mail. It found significantly higher PP abstinence at 7 months for the WBI (RealU 59.1% vs. one-off untailed e-mail 38.5% [relative risk (RR) = 1.54, 95% of confidence interval (CI): 1.28-1.85]). However, there was no difference between groups (overall 6%) for prolonged abstinence at 7 months.

Patten *et al.*^[15] studied adolescent smoking cessation and did not detect any difference in abstinence among the study groups. The 30-day, point-prevalence smoking abstinence rates for brief office intervention (BOI) and stomp out smokes (SOS) intervention were comparable (12% vs. 6% at week 24 and 13% vs. 6% at week 36 for BOI and SOS, respectively). Although the SOS group had a significantly greater reduction in average number of days smoked than BOI ($P = 0.006$).

Another study among adolescents compared American Lung Association's Not on Tobacco program (NOT) with a Web-based adjunct (NOT Plus). The study utilized hierarchical linear modeling and detected a significant effect of NOT Plus to the comparator group for smoking cessation.^[14] Among the Web-based adjunct users, there was a significant association of use of the web site with smoking cessation at end-of-program ($P < 0.05$). However, it was not observed at 3 months.

Another study among high school students utilized an Internet-based, virtual reality world intervention comparing it with motivational interviewing (MI) by a counselor.^[22] Intervention participants had significantly higher 7-day abstinence rates than controls (35% vs. 22%). There was no difference among the groups in smoking abstinence at 12 month follow-up (RR 0.93, 95% CI: 0.60-1.44), although the number of quit attempts were significantly different between the groups ($P < 0.05$).

WBI TRIALS AMONG ADULTS

There were a total of 24 trials among adult populations.^[11,12,16,20,21,23-25,27,28,31,33-36]

Comparison of WBI to non-WBIs or no interventions at all

A study among 171 smokers during lung cancer screening test found effect of self-help materials similar to a recommended written list of Internet resources. The 7-day PP quit rates were comparable between the two groups (5% vs. 10%; RR 0.45, 95% CI: 0.14-1.40) at 1-year follow-up.^[11]

Another study using Comprehensive Health Enhancement Support System for Smoking Cessation and Relapse Prevention as an adjunct to counseling and bupropion ($N = 284$, 140 WBI, 144 control) failed to find a significant improvement in abstinence rates at 6 months (RR 1.27, 95% CI: 0.70-2.31).^[12]

One short-term follow-up (90 days) study in 351 participants detected a significant effect of WBI compared with no intervention at all (24.1% vs. 8.2%; RR 2.46, 95% CI: 1.16-5.21).^[21]

The Happy Endings trials recruited 290 participants (144 intervention, 146 control) via Internet advertisements.^[27,28] In the first of two studies, the intervention was delivered as 1-year smoking cessation program through the Internet and cell phone while controls received a self-help booklet.^[27] The second study offered nicotine replacement therapy (NRT) to both groups.^[28] WBI group was significantly more effective on sustained abstinence at 12 months compared with self-help controls without adjunct NRT (20% vs. 7%, 7%; RR 2.94, 95% CI: 1.49-5.81) as well as with adjunct NRT (22.3% vs. 13.1%, RR 1.71, 95% CI: 1.10-2.66).

The study by Oenema *et al.*^[31] showed that the WBI was not more effective than providing no intervention at all for self-reported smoking status at 1 month (RR = 1.28, 95% CI: 0.52-3.13).

Another cessation induction study evaluated the effectiveness of Online Transtheoretical Model tailored communications and MI with the adjunct of Health Risk Intervention.^[16] This study reported statistically insignificant difference in PP abstinence at 6 months between the two groups (21% vs. 35%).

In a study among general practitioners, no significant additional effect of referral to group-based (Odds ratio [OR]: 1.05; 95% CI: 0.6-1.8) or internet-based smoking cessation programs (OR: 0.91; 95% CI: 0.6-1.4) was noted among smokers ($n = 760$) at 1-year follow-up.^[25]

Swan *et al.*^[20] compared WBI ($n = 401$) to proactive telephone counseling (PTC) ($n = 402$), or as an adjunct ($n = 399$) with varenicline in all groups. The study

Table 1: Trials of WBIs for management of tobacco use (arranged alphabetically by author name)

Study	Recruitment method	Intervention and comparison (sample size)	Outcome measure
An <i>et al.</i> , 2008 ^[10]	College students at one university; internet health screening e-mail invitations; \$10 weekly incentives	RealU interactive website + peer e-mail support (257) versus e-mail with links to QuitNet.com and other online health resources (260)	30-day abstinence and 6-month prolonged abstinence at 8, 20 and 30 weeks; intervention favored significantly only at 30 week for 30 day abstinence (41% vs. 23%, $P<0.001$) (RR=1.95, 95% CI=1.42-2.69)
Brendryen <i>et al.</i> 2008 ^[27]	Internet advertisements	Happy ending utilizing internet + cell phone (144) versus booklet only (146)	Repeated point abstinence at 1, 3, 6 and 12 month; WBI more effective than control (20% vs. 7%, OR=3.43, 95%CI=1.60-7.34, $P=0.002$)
Brendryen and Kraft 2008 ^[28]	Internet advertisements	Happy ending + NRT (197) versus booklet only + NRT (199)	Repeated point abstinence at 1, 3, 6, 12 month; higher in WBI at repeated PP using ITT analysis (OR=1.91, 95% CI=1.12-3.26, $P=0.02$)
Clark <i>et al.</i> 2004 ^[11]	Current smokers undergoing lung cancer screening	Written list of internet resources (85) versus written self-help materials (86)	7-day PP abstinence at 1 and 12 month; no statistically significant difference in abstinence rates, more subjects receiving WBI reported making a stop attempt at 1 year (68% vs. 48%, $P=0.011$)
Elfeddali <i>et al.</i> 2012 ^[33]	Ads and flyers on web and newspapers, no face-to-face recruitment, €250 incentive as prize	AP (190) versus AP plus (174) versus no intervention (202)	Self-reported continued abstinence at 12 months; AP and AP plus program were more effective than controls (33%, 31%, and 22% respectively) but not amongst each other
Etter, 2005 ^[29]	Visitors of a French-language website	Tailored, interactive smoking cessation program based on psychological and addiction theory (5966) versus modified tailored program (6003)	Self-reported 7-day PP abstinence at 11 weeks post randomization Significant differences in quit rates in smokers in the contemplation stage favoring the original program (OR=1.54, CI=1.18-2.02, $P=0.002$) No between-group differences in quit rates were observed in smokers in the precontemplation (OR=1.07, CI=0.36-3.14, $P=0.91$) and preparation (OR=1.15, CI=0.97-1.37, $P=0.10$) stages of change
Etter 2009 ^[30]			Lapse/relapse rates at follow-up were similar in both groups (tailored: 25.1%, untailored: 23.5%, $P=0.64$)
Graham <i>et al.</i> 2011 ^[24]	US adults clicking specific terms over internet or using QuitNet website; \$15 to \$25 incentive	BI (679) versus EI (651) versus EI + PTC (675)	24 h quit attempts or 30 day PP abstinence at 3, 6, 12, and 18 months; EI + PTC better than other two modalities only at 3,6 and 12 moths ($P<0.01$), No difference between EI and BI
Japuntich <i>et al.</i> 2006 ^[12]	Billboards, bus interior posters, flyers, television advertisements, and press releases	CHESS SCRP + counseling + bupropion (140) versus counseling + bupropion (144)	7-day PP at 3 and 6 m after quit date; no significant association with abstinence (OR=1.48, 95% CI=0.66-2.62), usage/week of WBI was related to abstinence at 6-month (OR=1.59, 95% CI=1.06-2.38)
McDonnell <i>et al.</i> 2011 ^[23]	Community-based participatory research in Korean Americans	Online Quitting is Winning program (562) versus booklet program (550)	30-day abstinence at 50 week; no significant difference, <i>post-hoc</i> analysis revealed higher quit rates in WBI completers ($n=562$) compared to non-completers (26% vs. 10%, ITT difference=16%, 95% CI=3-29%)
McKay <i>et al.</i> 2008 ^[13]	Internet-based recruitment campaign	Tailored web pages (tunnel design) followed by own path to access a broad array (using a matrix design) based on social cognitive theory (1159) versus web-based program designed to encourage to engage in a personalized fitness program (1159)	Self-reported 7-day PP abstinence at 3 and 6 m post-enrolment PP non-smoking at both the 3- and 6-m Participants exposure, physical activity, pharmacotherapy use, program Usability No difference at three or 6 m follow-up between two cessation interventions
Mermelstein and Turner 2006 ^[14]	29 high schools; flyers, school announcements assemblies, and/personal referrals from teachers or coaches; \$500 incentive	Not on Tobacco Plus Program (171) versus standard NOT program (180)	30 day abstinence at 7 day and 3 months NOT plus significantly more effective ($P=0.06$) at end-of-treatment and 3-month ($P<0.05$) (RR=1.96, 95% CI=1.02-3.77)
Muñoz <i>et al.</i> , 2006 ^[35]	Press releases and standard links from online search engines	Web-based brochure with ITEMS and MM (281) versus web-based brochure and ITEMS (287)	Self-reported 7-day PP at 12 months after entry Self-reported 7-day PP at 3 months Abstinence assessed at 1 and 6 m Abstinence rates by history of major depression No benefit of adding MM intervention even after pooling comparable arms (RR=0.90, 95% CI=0.70-1.15) at 12 months More complex intervention (Guia + ITEMS + MM) yielded significantly lower quit rates at 12 months

(continued)

Table 1: (Continued)

Study	Recruitment method	Intervention and comparison (sample size)	Outcome measure
Muñoz <i>et al.</i> , 2009 ^[36]	Through internet	Compared four cumulative variants of an internet based intervention: Condition 1: a cigarette counter, and an online journal to record experiences while quitting (247) versus Condition 2: Plus ITEMS; automated e-mails (251) versus Condition 3: Plus eight-lesson cognitive-behavioral MM course (251) versus Condition 4: 3. plus “virtual group” asynchronous bulletin board for mutual support and suggestions (251)	Self-reported 7-day PP at 12 months after entry Short term abstinence: self-reported 7-day PP at 3 months Abstinence at 1 and 6 m Satisfaction with web site Site utilization All four arms had similar long-and short-term quit rates, ranging from 19.1% to 22.7% at 12 m No evidence that the more tailored conditions had any incremental benefit over the static website control
Oenema <i>et al.</i> , 2008 ^[31]	Pool of an online research panel, recruited by e-mail invitation	Tailored website (1080) versus delayed intervention (1079)	Self-reported smoking cessation at 1 month No difference in static website to controls (21.4% vs. 15.9%)
Patten <i>et al.</i> , 2006 ^[15]	3 ethnically diverse sites; television commercials, radio and newspaper announcements and flyers	Home-based internet delivered intervention-stomp out smokes (70) versus clinic-based, brief office intervention (69)	30-day abstinence at 2, 3, 6, 9 month No significant difference (RR=0.44, 95% CI=0.14-1.36 at 36 weeks)
Pisinger <i>et al.</i> , 2010 ^[25]	24 general practitioners in 4 municipalities	Referral to group-based SC counseling (600) versus referral to internet-based SC program (476) versus no referral (442)	Self-reported point abstinence at 1-year Abstinence rates were comparable (6.7%, 5.9% and 5.7%)
Prochaska <i>et al.</i> , 2008 ^[16]	Medical university employees; letter, phone and e-mail, some given incentives	HRI (464) versus online: TTM + HRI (504) versus MI + HRI (433)	Stage of change, PP abstinence at 6 month; PP abstinence comparable at 6 months was 21% and 35% for online TTM and MI
Rabius <i>et al.</i> , 2008 ^[17]	Through Internet-link placed on ACS website	Access to one of five tailored interactive sites provided by co-operating research partners (SmokeClinic, CAMH, V-CC, ORCAS, QuitNet, and ProChange) (5404) versus access to a targeted, minimally interactive ACS site with text, photographs, and graphics providing stage based quitting advice and peer modeling (1047)	Self-reported 30-day PP, 13 m after randomization Self-reported 7-day PP abstinence at 3 m No difference between the interactive site group and control group (8-12% vs. 12%; RR=1.12, 95% CI=0.92-1.36)
Smit <i>et al.</i> , 2012 ^[34]	Ads on web, newspapers, television, radio, local social forums, €10 voucher incentive	Tailored WBI (552) versus no intervention (571)	24-hour, 7-day and prolonged abstinence at 6 weeks and 6 months; significantly increased 24-h PP abstinence (OR=1.85, 95%CI=1.30-2.65), 7-day PP abstinence (OR=2.17, 95% CI=1.44-3.27), and prolonged abstinence (OR=1.99, 95% CI=1.28-3.09) rates after 6 weeks No difference after 6 m
Stoddard <i>et al.</i> , 2008 ^[18]	Federal employees and contractors were invited by e-mails	Website that included asynchronous bulletin board (BB condition) (691) versus publicly available smokefree.gov, designated as usual care (UC condition) (684)	Self-reported 7 day PP abstinence at 3 m Time spent on the website, utilization of pages, cessation aids used in the past and during the study period Similar quit rates after three months (RR=0.95, 95% CI=0.64-1.40) Satisfaction with the website was high and did not differ significantly between conditions (UC=90.2%, BB=84.9%, P=0.08)
Strecher <i>et al.</i> , 2005 ^[26]	Smokers who purchased nicotine patch and connected to a website to enroll for free behavioral support materials	Web-based tailored behavioral smoking cessation materials (CQ PLAN) (1991) versus web-based non-tailored materials (1980)	Self-reported continuous abstinence for 28 days (6-week follow-up) or 10 weeks (12-week follow-up) Participant satisfaction Higher continuous abstinence rates in tailored intervention group (22.8% vs. 18.1%; (RR=1.26, 95% CI=1.10-1.44). Satisfaction with the program was also significantly higher in tailored intervention group
Strecher <i>et al.</i> , 2008 ^[19]	Memberships of two HMOs participating in the National Cancer Institute’s Research Network: Group health	Web-based smoking cessation program plus nicotine patch versus low depth tailored success story, outcome expectation, and efficacy expectation messages; low personalized source; and single exposure to the intervention components	Self-reported 7 day PP abstinence at the 6 month post quit date follow-up Program and NRT utilization Quit rate similar after three months (RR=0.95, 95% CI=0.64-1.40) ITT analysis revealed adjusted 6-month cessation rates among participants receiving all the three high-depth tailored components to be 27.7%
Swan <i>et al.</i> , 2010 ^[20]	Healthcare employees taking varenicline; recruited via magazine advertisements, mailings, physician referrals and free and clear quit for life program	Web-based counseling (401) versus PTC (402) versus web-based counseling + PTC (399)	7 & 30 day PP abstinence at 3 and 6 months; ITT analysis revealed PTC group having higher abstinence than web group at 3 months (OR=1.48, 95% CI=1.12, 1.96) but none at 6 months

Table 1: (Continued)

Study	Recruitment method	Intervention and comparison (sample size)	Outcome measure
Swartz <i>et al.</i> , 2006 ^[21]	Promotional materials at worksites	Tailored video based internet site 1-2-3 smoke free (171) versus no intervention (180)	Self-reported 7 day PP abstinence at 90 day assessment; ITT analysis revealed significant effect of WBI compared to controls (12.3% vs. 5%, $P=0.015$)
Te Poel <i>et al.</i> , 2009 ^[32]	Advertisements in local newspapers, banners on websites, flyers and posters and via a random selection of smokers e-mail addresses purchased from a customer information management company	Computer-tailored e-mail letter generated from responses to an online questionnaire (224) versus generic, non-tailored e-mail letter, after completing same questionnaire (234)	7 day PP abstinence at 6 months 24 h PP abstinence at 6 months program evaluation Tailored approach more effective (RR=2.48, 95% CI=1.11-5.55)
Woodruff <i>et al.</i> , 2007 ^[22]	14 high school; classroom presentations, lunch-hour sign-up tables, flyers, posters, school newspaper ads and articles, announcement and liaison referrals; \$50 incentive	Internet-based, virtual reality world (77) versus real time MI (59)	Self-reported 7 day abstinence at 3 and 12 m; higher abstinence rates in intervention group only at immediate post-assessment, than controls (35% vs. 22%: $P<0.01$)

AP – Action planning; BI – Basic internet; CHESS SCRP – Comprehensive health enhancement support system for smoking cessation and relapse prevention; CI – Confidence interval; EI – Enhanced internet; HRI – Health risk intervention; MI – Motivational interviewing; NRT – Nicotine replacement therapy; OR – Odds ratio; PP – Point prevalence; PTC – Proactive telephone counseling; RR – Relative risk; TTM – Transtheoretical model; WBI – Web based intervention; ITT – Internet and telephone treatment; ITEM – Individually timed educational messages; MM – Mood management; ACS – American Cancer Society; HMOs – Health Maintenance Organizations

failed to find any significant difference in 7-day point prevalent abstinence at 6 month (30.7% vs. 34.3% vs. 33.8%; RR 0.94, 95% CI: 0.79-1.13). Although the PTC group was found to be significantly more effective with regards to PP abstinence than the WBI group at 3 months follow-up (OR = 1.48, 95% CI: = 1.12, 1.96).

A similar design employed in Quit Using Internet and Telephone Treatment study comparing static WBI either to tailored WBI or as adjunct to PTC also failed to find any significant difference in 30-day single PP abstinence rates at 18 months.^[24]

Quitting is Winning, a cognitive-behavioral program evaluated among Korean Americans ($n = 1112$), found no significant difference in 30-day smoking cessation rates between the Internet (11%) and booklet (13%) groups (ITT difference = -2%, 95% CI: = -6% to 2%).^[23]

The stay quit for you study ($n = 2031$) reported two differently tailored web-based smoking relapse prevention programs (action planning [AP] and AP plus program) to be significantly more effective than the control group (participants with no intervention at all) for self-reported continued abstinence at 12 months follow-up (AP program [OR: 1.95, $P = 0.005$], AP + program [OR: 1.61, $P = 0.049$]).^[33] The study also suggested that the number of completed program elements had a dose-response relationship to abstinence rates.

Another recent study reported tailored WBI ($n = 552$) to be more effective than no intervention at all ($n = 571$) at 6 weeks (24-h PP abstinence [OR: 1.85, 95%

CI: 1.30-2.65], 7-day PP abstinence [OR: 2.17, 95% CI: 1.44-3.27] and prolonged abstinence [OR: 1.99, 95% CI: 1.28-3.09]). However, the difference failed to extend until end of 6 months.^[34]

Comparison of different WBIs

Studies comparing tailored to untailored WBIs report ambiguous findings. While few studies have found that tailored WBI is equally efficacious to untailored ones^[13,17,18,30,35,36] others have reported tailored intervention to be better.^[19,26,32] Two studies reporting significantly effective results for tailored WBIs assessed outcomes as 24-h or 7-day PP at 6 months.^[19,32] One short term (12 weeks) study also reported better continuous abstinence rates for tailored WBIs.^[26] A study by Muñoz *et al.*^[35] found more complex intervention to be having significantly lower quit rates at 12 months.

WBIs for ST

The Chew Free trial is the only study conducted for ST cessation.^[37] Participants were recruited online through MyLastDip program and provided two fully automated WBI as tailored ($n = 857$) or static ($n = 859$) text. The tailored WBI had significantly higher quit rates than static condition at 6 months assessed using complete case analysis (40.6% vs. 21.2%; $P < 0.001$) and ITT analysis (12.6% vs. 7.9%; $P < 0.001$).

Reviews and meta-analysis

We included 7 reviews and meta-analysis in the current review.^[39-45]

The review by Strecher *et al.*^[43] included 10 RCTs comparing tailored versus the general or targeted

modalities. They reported of very few characteristic patterns amongst the studies, strong impact on smoking cessation by trials combining tailored materials with nicotine replacement therapy and a significant positive impact of tailored materials among pre-contemplators.

Another review identified 19 studies of computer and Internet-based interventions for smoking cessation published between 1995 and August 2004.^[45] The authors reported of few patterns in terms of subject, design or intervention characteristics leading to positive outcomes. The mailed computer-generated feedback report intervention format was observed to be most consistently associated with improved outcomes.

Shahab & McEvan^[42] conducted systematic review and meta-analysis of the literature (1990–2008) and included 11 RCTs. They concluded that although there was no overall effect of interactive compared with static WBIs, web-based-tailored-interactive smoking cessation interventions were effective compared with untailored booklet or e-mail interventions [rate ratio (RR) 1.8; 95% confidence interval (CI) 1.4–2.3] increasing 6-month abstinence by 17% (95% CI 12–21%) without any publication bias. Effective Interventions were those that were only aimed at smokers motivated to quit (RR 1.3, 95% CI 1.0–1.7) or were fully automated (RR 1.4, 95% CI 1.0–2.0).

One meta-analysis of 22 RCTs found that Web- or computer-based smoking cessation programs yielded an abstinence rate about 1.5 times higher than controls (RR, 1.44; 95% CI, 1.27%–1.64%).^[44] Pooled analysis revealed significantly higher abstinence rate at 12-month follow-up in the intervention group (9.9%; 95% CI, 8.9%–10.9%) than the control group (5.7%; 95% CI, 5.1%–6.3%). Both stand alone or supplemental interventions were effective in adults but none was significantly effective in adolescents.

There have been multiple Cochrane reviews concerning with smoking cessation but only 2 focused on web based interventions.^[39,40] One review included 20 RCTs including trials with WBIs only.^[40] It concluded that though the trials did not show consistent effects, few WBIs having tailored information or frequent automated contacts with the users can effectively assist smoking cessation. There was no benefit detected of including a mood management component or an asynchronous bulletin board. Another recent Cochrane effectiveness review concluded that computer and other electronic aids increase the likelihood of cessation (aid to cessation as well as cessation induction studies) compared with no intervention or generic self-help materials, but the effect is small (prolonged abstinence: relative risk = 1.32, 95% confidence interval 1.21

to 1.45).^[39] It was also observed that the chances of sustaining abstinence increases noticeably after successfully negotiating the first month.

The review by Hutton *et al.*^[41] included 21 RCTs with 31,481 smokers. The studies in adults were observed to be of moderate quality with retention rates ranging from 27% to 86%, ninety percent in college students and losses to follow-up in 13% to 47% among the adolescents. The authors concluded that the evidence supporting the use of WBIs for smoking cessation is insufficient to moderate in adults and insufficient in college students and adolescents.

Cost effectiveness of WBIs

Some of the RCTs assessing effectiveness of WBIs for managing tobacco use have also commented on the cost-effectiveness of the intervention.

Etter^[29] reported that the cost of implementing WBI for management of tobacco use for a reach of 8000 participants in computer tailored programs (with 600,000 visitors per year to the website) is comparable to the cost of running a small smoking cessation clinic which would treat about 50 smokers a month.

Rabius *et al.*^[17] in their study have reported WBI for management of tobacco use to be cost effective. In this study, 4 days of programming at a cost of less than US \$2000 allowed approximately 5000 additional users for services from the five tailored interactive service providers. The cost was much less than the cost of serving 1000 new clients with telephone counseling amounting to approximately US \$100,000.

CONCLUSIONS

Recent years have seen a significant growth in number of WBIs in field of health care service delivery. The same is true for psychoactive substance use disorders. The WBIs for some substances of abuse (alcohol and tobacco) is more researched than others.

Limited number of specialized health care professional, busy schedules due to demands of profession and increasing penetration of internet to cities as well as villages make the WBIs an option worth exploring in LMIC settings. These interventions are expected to be cost effective due to limited recurring and maintenance cost, especially keeping in mind the large consumer base. Although a limited number of studies have commented on the cost-effectiveness of WBIs for management of tobacco use, the findings are suggestive of substantial lower cost of offering such services.^[17,29]

Accessibility of internet through the hand held devices has offered even cheaper alternatives to computers and laptops. The freedom to access the service at one's own convenient time and pace also makes these a lucrative area to invest and investigate.

Previous estimates of potential reach of WBIs for smoking cessation were criticized for being based on either national figures for Internet access or reported interest among non-representative samples.^[39] However, even the newer studies, assessing a representative sample of smokers, have estimated that 40-46% was interested in using a WBI for smoking cessation.^[40,41] Thus in this era of internet usage the applicability of WBIs for managing tobacco use is encouraging.

However, the existing evidence on WBIs for management of tobacco use is limited. These are restricted mainly to the developed world. Most of the interventions are in English. None have been developed in other languages spoken in LMICs. In addition, all but one intervention studied in a RCT is for smoking forms. ST use constitutes a major fraction of the tobacco used in LMICs including India.

In addition, the quality of trials is also heterogeneous. Some of the studies are likely to have high/uncertain risk of selection bias. Some of the studies have relatively small follow-up duration. Only a few studies have included biochemical markers as objective measure for ongoing tobacco use. Only a handful of studies have assessed the WBIs in combination with pharmacotherapy (including NRT, bupropion-SR and varenicline).^[12,19,20,26,28]

There is limited support for effectiveness of WBIs for managing tobacco use among adolescents. Although most of the trials among adults found WBIs to be more effective at short term follow-up (a few days to weeks), the benefits failed to extend beyond 3 months in most of the studies. The notable exception to this were studies by Brendryen *et al.*^[27,28] and Prochaska *et al.*^[16] Even among the studies that have reported superiority of WBIs, the effect size is small.^[42]

Randomized trials of WBIs are also limited by weakness due to generalized factors applicable to internet use itself. People who choose to participate in the WBIs based trials may be unrepresentative of the people who use websites in real life thereby raising concern about whether the same type of result would be obtained by all users of the website. The qualitative value of WBI may also be hindered by the fact that having WBI at health care setting may make participant compelled to fill out rather than when used the same service at home.

The findings from the existing RCTs can help develop more refined WBIs for managing tobacco use. Use of tailored materials among pre-contemplators; combining tailored materials with NRT, mailed computer-generated feedback report intervention format; and successful negotiation of the 1st month have been found to be effective strategies and approaches across the existing studies.

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How to cite this article: Balhara YP, Verma R. A review of web based interventions for managing tobacco use. *Indian J Psychol Med* 2014;36:226-35.

Source of Support: Nil, **Conflict of Interest:** None.