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INTERNET AND CELL PHONE BASED SMOKING CESSATION PROGRAMS AMONG ADOLESCENTS

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Abstract: Smoking cessation among adolescents is a salient public health issue, as it can prevent the adoption of risky health behaviors and reduce negative impacts on health. Self-efficacy, household and social support systems, and perceived benefits are some important cessation determinants. With the popular use of the Internet and cell phone usage among adolescents, smoking cessation programs are beginning to adopt these new delivery methods. The purpose of the study is to review interventions between 2005 and 2009 that used the Internet or cell phones for smoking cessation among 11 to 19 year olds. A systematic search of the CINAHL, ERIC, Google Scholar, and Medline databases was done. A total of 10 articles met the inclusion criteria. Interventions mainly used the Internet as a form of assistance to enhance the effectiveness of the program. One intervention used text messaging through cell phones. Self-efficacy, household and social support systems and perceived benefits were found to be significant predictors. Programs with multiple approaches, using the Internet as an adjunct were more effective than programs that solely relied on the Internet. Future research is needed to verify its success in cessation practices. Recommendations for future research are provided.

Keywords: smoking cessation, adolescents, internet, cell phone, intervention

Introduction

Smoking in adolescents is a public health concern due to its impact of adopting risky health behaviors as they become adults [1]. In 2008, one in every five deaths was attributed to smoking cigarettes, which resulted in 5.1 million years of potential life that was lost [1]. Reports from 2007 revealed that 20% of high school students were smoking cigarettes. On a daily basis, an estimate of 4,000 adolescents smoked a cigarette for the first time. While the number of adolescents who smoke remain high, it is important to note that smoking in adolescents has reduced since 1997. Prevalence of adolescents smoking in 1997 was about 70.4% and this reduced to 50.3% by 2007 [2]. It is important to note that this reduction was also seen due to a lower number of adolescents reporting use of cigarettes, which still puts cigarette use as a public health concern.

Adult smokers typically had their first cigarette as an adolescent [3]. Of all adult smokers, approximately 89% of them had their first cigarette before the age of 18. Experimenting with cigarettes is a common behavior in high school students, which can lead them to become regular smokers and also exposes them to greater health risks. These risks consist of lung cancer, emphysema, chronic lung diseases, and cardiovascular diseases. In addition, 84% of those that began smoking felt they could not quit and were noted to be more vulnerable to nicotine dependence. Interestingly, of the adolescents that had smoked at least once a day for a month, 79.2% had tried to quit but failed due to dependence. Adolescents exhibit similar addictive behaviors to cigarettes as adults do. As smoking increases in adolescents, nicotine dependence enhances proportionally, which causes them to continue smoking as adults. Thus, determinants of smoking cessation in adults apply to adolescents as well.

Determinants of Smoking Cessation

Household and social support systems are a couple of variables that determine whether adolescents will try smoking or not [4]. Those that smoked reported at least one parent that smoked in the household. This allowed for a lack of disapproval of smoking from parents. Smoking was viewed as a

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normal behavior. In regards to their social networks, school connectedness is an integral determinant. School connectedness is a broad spectrum which consists of social support, belonging and engagement. Not only do these occur with the teacher but are seen with peers as well. Focus groups conducted by Vuckovic, Polen and Hollis [5] found that students wanted programs that accounted for social support in their efforts to quit. McNealy and Falci [4] found that connectedness with teachers inhibited adolescents from smoking initiation.

Those variables listed above, along with self efficacy and perceived benefits aid in smoking cessation practices. Lower levels of self efficacy would inhibit smokers from quitting. Individuals that showed readiness to quit held higher levels of self efficacy, than those in a pre-contemplation stage, as found by Badr and Moody [6]. Although once individuals are in a maintenance phase, self efficacy is no longer a significant predictor. Thus, it is imperative that self efficacy levels remain high until maintenance is reached to prevent any relapse from occurring [7].

If adolescents viewed the benefits of not smoking, cessation would occur. These benefits would have to include being accepted by their social networks [8]. Outside of that, the construct of "perceived benefits of smoking cessation" was found to be associated with the motivation to do so [9]. In turn, motivation would increase self efficacy, which all lead towards individuals adopting smoking cessation habits. Rothman [10] found that perceived benefits led individuals towards adopting a smoke free life but was only significant until a maintenance phase was reached. This finding was similar to the role of self efficacy revealed by Shifmann and colleagues [7].

While these methods have been utilized for years, new developments in technology have progressed smoking cessation methods/interventions. Data from 2004 indicated that 87% of 12-17 year olds used the Internet in the United States [11]. Cell phone use and text messaging have also become quite popular in recent years. In 2009, it was found that there were approximately four billion cell phone users and a trillion text messages were sent in the United States [12]. With the surge of technology use, health care services have begun to serve patient support services through voicemails, text messages, e-mails. The new trend has allowed for medication adherence, monitoring and management of illnesses and addictions.

With regards to smoking cessation programs, new interventions are combining the use of new technology with other behavioral methods to increase efficacy levels of the intervention. Smoking cessation programs are now developing individualized interventions using the Internet [13]. The participant has access to the information from anywhere, and is able to share and learn from others. More important, a flexible learning environment is at hand for the participant, which enhances the likelihood of smoking cessation [13]. In addition, chat rooms are available for real time counseling and individualized stages are formed based on information collected on the participant [13]. Overall the 24 hour accessibility for support gives Internet usage an upper hand.

Aim

It is in this backdrop that the aim of this study was to systematically review articles that utilize the Internet or cell phones as part of a smoking cessation intervention that have been published between 2005 and 2009 and recommend ways to improve them. The focus of interventions was with adolescents in the ages 11-19 years.

Methods

Article searches were conducted on CINAHL, Google Scholar, ERIC and Medline for the time period 2005 to 2009. Keywords use to search for articles were: smoking cessation in adolescents, nicotine reduction, tobacco reduction, web-based, cell phone based, text messaging smoking cessation, nicotine reduction, tobacco reduction, teenagers, high school. Approximately 50 articles were located and narrowed down to 10 based on the inclusion and exclusion criteria. Two researchers conducted the search independently in arriving at the chosen studies. Some review articles regarding smoking cessation were located but could not be used for this study, as studies were primarily conducted in adults. Most reviews still focus on group based programs or include young adults in their interventions. Articles were fully read to determine eligibility. There are a lack of reviews with adolescents between the ages of 11 and 19 using the Internet or cell phones. In addition, Internet and

cell phone use popularity among adolescents has increased in the past five years. Thus the search had to be dated back to 2005.

Criteria for inclusion were: (i) studies published between 2005 -2009 (ii) studies in the English language, (iii) focus on adolescents, (iv) age group had to be between 11-19 years (v) Internet/cell phone use in the intervention (vi) randomized controlled design or quasi-experimental design or pre-test/post-test design or qualitative design. The exclusion criteria were: (i) articles published before 2005, (ii) non- English articles (iii) inclusion of adults along with adolescents (iv) studies using individuals beyond 19 years of age (v) cross-sectional studies (vi) studies that did not use the Internet or cell phone in the intervention.

Results

With advances in technology and its consistent use, it is vital for updates in smoking cessation interventions. The assistance of Internet/phone use or programs solely based on either or can be become a vital channel for cessation. Future health problems can be alleviated by helping adolescents cease smoking habits. There is a lack of reviews on computer based or phone based interventions among adolescents but some exist for adults.

The interventions located in the searches involve some use of the computer or phone. A majority of the articles are randomized controlled studies or quasi-experimental studies. Only one study included some qualitative methods. Figure 1 lists a summary of the ten interventions used in the study.

Figure 1. *Summary of Internet and cell phone based smoking cessation interventions between 2005-09 among adolescents (n=10)*

Study	Year	Theory/model used for development	Age/group	Intervention	Duration	Major Findings
Hollis, J.F.,. et al.	2005	None	14-17	Teen REACH (Research Approaches to Cancer in a Health Maintenance Organization)- brief counseling and Internet website called pathways to change (PTC)	1 visit with optional boosters up to 11 months	Abstinence higher at a 2 year follow up among the intervention group. Significant impacts of the intervention were seen with smokers then non-smokers.
Chen, H.H., Yeh, M., & Chao, Y.	2006	Self-efficacy- social cognitive theory	14-19	Auricular accupressure with Internet assistance	4 weeks	Intervention was effective, as it held a higher quit rate, lowered nicotine dependence ($p<.01$) and had significantly higher self-efficacy levels ($p<.05$).
Chen, H.H. & Yeh, M.	2006	Social Cognitive Theory: self-efficacy	high school seniors	Internet assisted instruction (IAI) along with the smoking cessation program	6 weeks	High positive correlation between self-efficacy and attitude toward smoking ($p=0.00$) but a negative correlation between self-efficacy and cigarette consumption ($p=0.00$).
Mermelstein, R. & Turner, L.	2006	Cognitive behavioral principles	14-19	Not on Tobacco (NOT) PLUS - NOT and a web based adjunct	10 sessions	Significant cessation at post intervention was found among NOT PLUS users but not at the 3 month follow up.
Patten, C.A. et al.	2006	Comprehensive Health Enhancement and Support System- SOS/ AMA focus group and advisory panel for BOI	11 to 18	Stomp out smokes (SOS), an Internet based intervention	24 weeks	Individuals in the SOS group showed a reduction in the number of days smoked but had low abstinence rates at follow up. The SOS site was also barely viewed and was not found to be effective.
Woodruff, S.I., Conway, T.L., Edwards, C.C., Elliott, S.P., Crittenden, J.	2007		14-19	Breathing Room- chat room	7 weeks: 45 min chat room sessions per week	Breathing Room group reported cessation for one week, reduction in smoking, days and reduction in number of cigarettes at post-intervention. At one year follow up, number of times

Study	Year	Theory/model used for development	Age/group	Intervention	Duration	Major Findings
						quit was only significant.
Fritz, D.J., Hardin, S.B., Gore, P.A., & Bram, D.	2008	NOT based on but looks at TTM	14-19	Computerized adolescent smoking cessation program (CASCP)	4- 30 min sessions	CASCP had an increase in quit attempts (p=.05), lower use of cigarettes (p=0.049) and reduced nicotine dependence (p<.05). Self-efficacy (p<.01) and negative perceptions (p = .035) were significant as well. The program was effective and inexpensive to put in place.
Norman, C.D., Li,X., & Skinner, H.A.	2008	Likelihood of Action Index: a mix of health belief model, social cognitive theory, TTM, stages of change, TRA	14-17	Smoking Zine, tailored web assistance for tobacco cessation program	6 months	Likelihood of high intention to smoke was reduced (p<.05), and increased likelihood of high resistance of cigarette use (p<.05) was found at the 6month follow up in the intervention group. Prevention of non-smokers becoming heavy smokers was also found in the intervention groups (p<.05).
Ossip-Klein & Webb	2008	Social cognitive theory	16-17	Multimedia cell phone based intervention	4 weeks	There was a general approval of convenient access of information through text messages. Focus group results found the intervention to serve as a form of social support, quick advice, and encouragement. Pilot study results indicated a 60% cessation rate and a 40% reduction in smoking.
Prokhorov, A.V., Kelder, S.H., Shegog, R., Murray, N., Peters, R., Agurcia-Parker, C. et al.	2008	Social cognitive theory and the Transtheoretical model of change	14-19	Computer based multimedia curriculum- Impact of a Smoking Prevention Interactive Experience (ASPIRE)	5 weekly 30 minute sessions	Those in ASPIRE had a higher decisonal balance (p<.05), decreased temptation to smoke (p<.05). ASPIRE showed potential for multimedia programs use in smoking cessation interventions.

The first intervention by Hollis, and colleagues [14] looked at the efficacy of a brief counseling plus computer based tobacco intervention in teenagers regular seen for medical care. The program was called teen research approaches to cancer in a health maintenance organization (Teen REACH) and the computer portion was referred to as the pathways to change (PTC). Stages of change- Transtheoretical model was the theory used in the development of the PTC. Motivational interviewing was conducted after going through the PTC and two booster sessions throughout 11 months following post intervention. These booster sessions were not computer based but carried out by the counselors instead. Follow up assessments were made after one and two years post intervention.

There were 1254 participants in the PTC intervention and 1272 in the control (dietary) group [14]. Results indicated a significant number of participants smoke free at the one year follow up but was not seen at the second year follow up. For those that smoked more than one cigarette in the past 30 days at baseline were reduced at both follow ups. A significant number of smokers at baseline in PTC had considered themselves former smokers at follow up. It was also found at a 95% confidence interval, participants who received at least one booster had higher quit rates than those who had no boosters. The control group also showed high quit rates, which were maintained at the two years follow up. Overall the PTC can be of assistance in smoking cessation among adolescents.

The second intervention looked at a Internet assistance in an auricular acupressure smoking cessation program by [15]. Auricular acupressure is a non-invasive process, stemming from Chinese medicine, which stimulates auricular points. This causes endorphin levels to increase, maintenance of the sympathetic nervous system, and curbs nicotine addiction. A website including information on smoking cessation, discussion forums, online professional counseling and access to other cessation websites, was added to the acupressure for the intervention group (group one). The aim of the intervention was to reduce cigarette addiction and increase self-efficacy for quitting.

There were 77 participants who smoked and were non-randomly assigned to either group; group one had 38 and group two had 34 [15]. Results indicated a significant increase in self-efficacy for both groups ($p < .05$). With regard to quitting, 6 of the 38 (57%) participants quit, while only one out of 34 (2.56%) in group two quit. Nicotine dependence among group one was found to be statistically significant ($p < .01$). Participants in group one scored the website a mean of five out of seven possible points. Internet assistance allowed participants to obtain quick answers, convenient access to information and additional counseling, which was not available to the control group. It served as a form of social support as well. Overall, the intervention was found to be more efficacious.

The third intervention by Chen and Yeh [13] used the Internet as additional instruction in a smoking cessation program. The study not only developed a program but also conducted its evaluation. Seventy seven high school seniors were randomly assigned to the intervention or a control group. Self efficacy from the social cognitive theory was utilized in the development of the intervention, as it was found to be a predictor for smoking cessation. Lecture, online discussion forums, online questionnaires, group interactions, role plays and other webs sources were part of the intervention. Thus, offering a curriculum not solely reliant on the Internet.

Instruction was given to participants once a week for two hours and lasted for six weeks [13]. No instruction was provided to the control group. The average age of participants was 17 years and they had an average smoking duration of 2.5 years. A reduction in cigarette consumption at ($p <.01$) and increased smoking cessation attempts ($p < .01$) were seen with the intervention group. After scores were adjusted, increased smoking cessation attempts were found for both groups ($p <.05$).

Self-efficacy in the intervention group was also statistically significant ($p < .01$), which was not seen with the control group [13]. Correlations ran for this construct showed a positive significant relationship with smoking attitude ($r = 0.55$, $p = 0.00$), and a negative significant relationship with daily consumption ($r = -0.48$, $p = 0.00$) and addiction to smoking ($r = -0.37$, $p = 0.00$). Self-efficacy and cessation attempts had no relationship ($r =.021$, $p = 0.21$).

The Internet assisted instruction had a positive impact on participants [13]. Participants were able to use this tool to communicate with each other, pace themselves throughout the intervention, and served as a social support mechanism as found in the discussion forum. Internet in the role of assistance was effective.

The fourth intervention by Mermelstein and Turner [11] looked at the web support in a group based smoking cessation program. Not on tobacco (NOT) was the ten session group based program used, which stems from cognitive behavioral principles. The control group received the NOT program, while the experimental was given the NOT Plus. There were three aspects of the NOT Plus: (i) facilitator phone call to student at quit week and four booster calls between the end of treatment and the three month follow up, (ii) Not Hooked website, (iii) American Lung Association quitline access. The website consisted of facts and motivational messages, along with incentive gear for smoking cessation. A total of 351 participants that were smokers from 29 high schools in Illinois were involved; 181 were in NOT Plus and 170 in NOT.

Participants in the NOT Plus program had a 12.2% overall quit rate, while NOT had an 8.5% rate [11]. The NOT Plus program participants were found to be twice as likely to be abstinent than those in NOT. Also more women were more likely to quit than men and light smokers were more likely to quit than heavy smokers. Out of 181 in NOT Plus, 66 reported using the website and only 29 had confirmed use through password tracking. Minimal use of the quitline and calls were processed through. Overall, the NOT Plus had better abstinence rates, even at follow up. The website aided initial cessation but was not found at three month follow up. Phone calls had no relationship with abstinence, nor were there any evidence indicating a significant role in quitting cigarettes.

The fifth intervention by Patten et al. [16] compared an Internet based intervention with a brief office intervention with 139 adolescents. Stomp out smokes (SOS) was the name of the Internet based intervention, which was based on the Comprehensive Health Enhancement and Support System module used with breast cancer patients. The brief office intervention (BOI) was based off of a national advisory of panel of experts from the American Medical Association and focus groups with teenagers. A health care model was being used by the BOI group.

Recruitment was done through three cities: Rochester, MN; Madison, WI; Hartford, CT [16]. Regular and intermittent smokers were recruited to enhance generalizability, along with randomization. The average age of participants was 15.7, with a majority of them being Caucasian (88%), 4% American Indian, and 3% Hispanic. Conditions for both groups were the same but differed in duration, number of sessions, and interactions with others. The SOS group had constant access to Internet and SOS material, while the BOI had four counseling sessions that met consecutively. Follow ups were made at week 4, 8, 12, 24, and 36 for both groups. Researchers hypothesized a higher abstinence rate at week 24 with the SOS group.

At baseline, no differences were seen between both groups [16]. Smoking abstinence rates among the SOS group was lower than the BOI at weeks 8, 12, 24 and 36; 12% and 6% respectively. Differences between groups were not seen at 24 weeks for percentage reduction from baseline measurements. There were a total of 127 smokers at this time. Within this group, the SOS participants were found to smoke fewer days in the week than those in BOI. Results for smoking abstinence rates at week 24 and 36 were lower among the SOS group than BOI.

Participants in the SOS group showed a decrease in the use of the website throughout the progression of the intervention [16]. The average days of use was found to be 6.8 +/- 7.1 days. The Internet based intervention was found to be ineffective in this study as well. Although, for those who did not cease their smoking habits, the SOS intervention was helpful in reducing the number of days they smoked. This was attributed to the self-management aspects of the SOS program. Overall, the SOS was not found to be as effective as the BOI intervention.

The sixth intervention was conducted by Woodruff, Conway, Edwards, Elliot, and Crittenden [8], which utilized an Internet chat room based intervention, called Breathing Room. Fourteen high schools from San Diego County were randomly assigned, with 77 individuals in the intervention group and 59 in the control. Age of participants ranged from 14 to 19 years, with the average being 16. A majority of the participants were Hispanics (51%), 28% were White non-Hispanics, 5% African Americans and 7% were Asian/Pacific Islanders.

The intervention took place over a seven week period which involved seven 45 minute chat room sessions and four online surveys [8]. The surveys were completed by both groups. Follow ups were conducted at three months and at 12 months. At baseline, there were no significant differences between the two groups. Significant changes from the intervention were seen with number of days smoked, and amount smoked per day in the past week. With regards to follow up, the intervention group had lower participation than the control.

Participants in the control group were found to gradually reduce smoking cigarettes [8] . Although, this could be attributed to readiness to quit within that group, as oppose to those assigned to the intervention. In the short term, the Internet chat room was useful for reducing cigarette consumption or helping adolescents stay off of them. Appearance and usefulness of the chat room was positively viewed but did not have high involvement. Results from the post-intervention follow up for the intervention indicated those individuals considered themselves to be former smokers. Follow up at three and 12 months did not yield similar results, indicating a need for booster sessions. Speculations of Internet as a sole delivery method were made.

The seventh intervention by Fritz, Hardin, Gore and Bram [17] looked at a computer based smoking cessation program to help move smokers along the stages of change. Development of the computerized adolescent smoking cessation program (CASCP) intervention modeled the American Lung Association's Not on Tobacco (NOT) program and attempted to follow the stages of change theory. Although, a stage matched intervention did not occur, enhancing self-efficacy was focused on. The intervention consisted of four half hour sessions and assessments were made at baseline, post intervention and a month after.

Two schools were randomly chosen to be in the intervention and control and a third school was involved due to shortage of participants; participants from the third school were randomly assigned [17]. A total of 121 participants were involved, with 61 in the intervention and 60 in the control. Results indicated no significant differences between groups with regard to demographics and exposure to smoking. The intervention group was found to have more quit attempts than the control ($p = .05$), and a reduction in the number of cigarettes smoked per day ($p = .049$). At the one month follow up, 23% from the intervention group had quit smoking. Nicotine dependence was also found to be reduced among the intervention group. Self-efficacy ($p < .01$) and negative perceptions ($p = .035$) of smoking were also higher in this group post intervention. In regards to stages of change, those in the intervention group showed a significant positive movement ($p = .036$) while the control did not. Overall, these findings are similar to the NOT program, indicating the CASCP to be as effective.

The eighth intervention used the Internet as assistance in a prevention and cessation program, which was conducted by Norman, Maley, Li and Skinner [18]. A mixture of the Internet, paper journals, a single group based motivational interviewing comprise the program, and follow up e-mails for six months. Paper journals were used to record assessment scores, which would be further discussed at a small group 10 minute motivational interview. Monthly e-mails tailored to the individual based on assessment scores were sent for six months post intervention. The Internet program was called Smoking Zine, which consists of five stages and emphasizes self- efficacy.

The Likelihood of Action Index (LAI) was used for its basis [18]. According to this framework, change in individual is determined by the number of behavior change conditions available. More behavior change conditions that are available, the more likely the individual's behavior will change. Researchers

hypothesized that the intervention group would have a higher resistance towards smoking and cigarette behavior, decreased intentions to smoke in the future and a decrease in overall cigarette use.

There were 1,402 diverse participants from 81 classes (nine -12th) in the Toronto area; 85% were nonsmokers and 15% were smokers at baseline [18]. Follow ups were done at three and six months. Results from modeling indicate that significant impact on the behavioral intention to continue smoking ($p < .05$) and further tobacco use ($p < .05$) but not cigarette use ($p < .05$). Greater Smoking Zine influence was seen in smokers with high intentions to quit. In comparison with classes, participants in the 10th grade showed the highest response to the intervention.

Results were generalizable, due to the diverse sample used in the study [18]. Overall, the intervention was effective in its attempts to maintain motivation to decrease cigarette use and future intentions of it. The multi-faceted component of the intervention allowed for its appeal among users and its effectiveness.

The ninth intervention developed and pilot tested a multimedia cell phone-based smoking cessation program in Maori, New Zealand by Ossip-Klein and Webb [19]. This study had a focus group and a pilot study. Social cognitive theory was used as the theoretical foundation for the intervention. Text messages included smoking cessation videos and participants would also have the option to receive additional support messages referred to as CRAVE. Duration of the intervention was four weeks.

In the focus group, 27 students participated. Results indicated an interest in text messages a form of cessation support [19]. They also found these messages gave off positive reinforcement and viewed the videos as a relaxation tool towards cessation. The pilot study had a total of 15 participants, with only 13 reporting at follow up. Those results indicated nine individuals ceased smoking habits and four reduced their amount of smoking. Participants found the text messages to be useful in their cessation attempts. It offered social support, encouragement and advice that was conveniently available on their cell phones. This allowed for participants to access these messages at any time or day of the week.

The tenth intervention used a computer based curriculum for prevention and cessation in high school students by Prokhorov, and colleagues [20]. A smoking prevention interactive experience (ASPIRE) involved 1160 students from 16 minority inner-city high schools in Houston. The curriculum is based off the social cognitive theory and the transtheoretical model of change. Duration of the intervention was for five weekly sessions that were 30 minutes each and follow-up occurred 18 months afterwards.

Results indicated that former smokers and experimenters had higher smoking initiation rates [20]. Significant differences for smoking cessation were not found for either groups ($p > .05$). Participants in the intervention had a higher decisional balance, and reduced temptation to smoke ($p < .05$). At the same time, those findings were not consistent with Hispanic students. It was also found that Hispanic students who had not gone through an acculturation process were more likely to initiate smoking than their counterparts. Hispanic students were more likely to smoke due to environmental influences. Other cultural groups showed positive impacts of the ASPIRE program. Students listed as higher risk due to peer or parents smoking, had reduced initiation levels at that follow up. While a computer based multimedia program had positive impacts, it did not account for cultural differences.

Discussion

The purpose of the study was to review smoking cessation interventions in adolescents in the ages 11-19 that used the Internet or cell phones published between 2005 and 2009. Since there were only ten such interventions it can be said that more studies using cell phones and the Internet are needed. Of the ten interventions, only one utilized the cell phone.

In terms of theory based interventions, four of the ten interventions (40%) used the social cognitive theory. Two interventions followed the transtheoretical model but did not base the program solely on the theory. Another study used a mixture of social cognitive theory, transtheoretical model, theory of planned action, and health belief model when developing the Smoking Zine website. The eclectic use of theories

was referred to as Likelihood of Action Index (LAI), showed significant results with Smoking Zine, indicating the possibility of usefulness of the theory for other technologically advanced interventions. Self-efficacy is known to be a predictor in smoking cessation behaviors. Interventions that measured self-efficacy, confirmed this notion. Higher self-efficacy was shown to help in the reduction of days smoking, alleviating nicotine dependence and quit rates. Interventions not using a theory were based off of the American Lung Association's guidelines, Comprehensive Health Enhancement and Support System or cognitive behavioral principles.

Another set of categories with the interventions were, Internet based programs and Internet assistance based programs. Three interventions were solely Internet based while six used the Internet as an adjunct. Those that only used the Internet were not as effective, while Internet assistance programs were found to have a higher effectiveness level. Thus, it is more effective to introduce the Internet or text messages for additional assistance. In the role of assistance, usage of discussion forums and online counseling were found to be more effective, as results were maintained throughout follow ups. Smoking Zine, CASCP, ASPIRE, auricular acupuncture with Internet, and IAI held these effects due to convenient access of social support and professional advice. It also allows for cessation programs to have an individualized component and lets the participant progress at their own pace.

Internet assistance programs were often accompanied with some form of counseling. In these counseling sessions, motivational interviewing was primarily used. This method allows the individual to come to the main point, as opposed to the counselor providing that information. Counseling was provided by professional counselors, or physicians, ensuring a professional degree of assistance. This allows for participants to progress in their stages of change while gaining the confidence to quit smoking or at least reduce the number of days.

At the same time, booster sessions after interventions were found to be useful for this age group. This would allow for cessation maintenance to occur over the long term, as oppose to short term. The brief intervention in the Teen REACH program, indicated a longer duration than one time, is needed. In addition, a problem faced with Internet programs was a lack of use [14]. This was primarily seen with programs that were solely based on the Internet. In order for full use of the websites, awareness of materials available needs to occur. These issues were also faced due to a variety of number of participants. Some intervention had large numbers as high as 2,526 participants, while other had as few as 13 participants.

Another point of interest with these interventions was cultural sensitivity. The ASPIRE intervention found the program did not work for Hispanic students due to their overpowering environmental influences [20]. Other interventions did not address this issue, as it was not a finding in their programs. Environmental influences play a vital role in smoking behaviors among adolescents. This is an area requiring more attention.

Limitations of the interventions

There were several limitations to these studies. While a majority of the interventions utilized a theoretical framework, not all did. Household and social support was not explored in depth, which made it hard to determine its impact on cessation. A few studies found this determinant to be an influential role but failed to assess it. At the same time, all of the programs did not assess socio-cultural factors. Effectiveness of a cessation program was undeterminable for other cultures.

Limitations of this review

There are some limitations in this review. First, interventions published in English language were included and many interventions especially in international settings are published in other languages which were excluded from this analysis. Second, only interventions published in four databases were included. While these databases are quite extensive yet these do not tap into all the health literature from all the countries. Further, many of the interventions often do not meet the rigors of being published in

peer-reviewed journals and were thus excluded. Finally, differing evaluation methodologies and outcome indices were used in different studies. In the selection criteria attempts were not made to filter studies based on methodology or outcome indicators but effort was made to be more inclusive of various interventions. As a result conclusive meta-analysis type of work cannot be done with these studies and comments cannot be made regarding the effect size of the interventions.

Recommendations for Future Studies

There are a limited number of programs tested in adolescents. Based on the review, recommendations for the future studies are made. Overall more interventions in adolescents between the ages of 11-19 need to occur. Internet based interventions need to be used in adjunct to an existing program or some form of counseling. More studies looking at different ethnic groups also need to occur, due to issues of cultural sensitivity. Programs assessing socio-cultural issues need to happen to determine if Internet or cell phased based interventions would be effective. At the same time, involving peers or family members in these interventions can counter act the role of environmental factors. The possibility of making family based interventions through Internet and counseling might alleviate these factors.

Another recommendation for the future, would be to conduct more cell phone based programs for the target population. This would allow for some generalization to be made for this delivery method. Currently a majority of cell phones have Internet accessibility as well, making the possibility of more digital multimedia programs to develop. With new waves of technology, future programs that utilize social networking websites along with some form of counseling, may help students cease smoking habits.

In addition, more studies using booster sessions post interventions also need to be conducted. A comparison between boosters and non-boosters, would provide cessation information in the long term. Another possibility would be to address differences between having access to websites post-intervention and no access. This would allow us to determine whether maintenance can occur over time.

A study looked at auricular acupressure along with Internet assistance. In the future, it would be worthwhile to see how different medicines along with an Internet or cell phone component can be as effective as the intervention reviewed. It would also be of interest to view the role of pharmaceutical medicines as well. Bupriopion has been known to be used in adult smoking cessation programs. Currently no interventions have been conducted with the target population. The role of Bupropion and Internet/cell phone use may open up different avenues for smoking cessation programs in adolescents.

Conclusions

Preventing and ceasing smoking habits among adolescents, can minimize and almost eliminate future health concerns. Minimal studies among adolescents between the ages of 11-19 years old exist. Of the few available, interventions using the Internet have been found to be effective. In addition, self-efficacy was found to be a predictor in reducing and ceasing smoking. Internet should not be the sole method of delivering a smoking cessation program. Programs that use multiple methods were found have a better impact for maintenance of behavior post intervention. More interventions need to be conducted using these methods, to gain a better understanding of their role in smoking cessation.

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