Older Adults Who Smoke: Do They Engage with and Benefit from Web-based Smoking Cessation Interventions?

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Abstract

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Introduction: Older adults (OA) comprise +12% of US adult smokers; this fraction may increase as OA are projected to double over 40 years. OA quit rates are comparable to those of younger smokers; yet OA face barriers to receiving cessation services. Self-help web-based cessation interventions may address access barriers but a commonly held view is that OA lack the skills to use e-health technologies. The purpose of this study was to explore OAs' level of engagement with web-based cessation interventions and cessation rates, compared to middle and younger adults. Methods: Secondary data analyses of an RCT (N=2637) of two web-based interventions for smoking cessation was conducted. The study was conducted online via two web-based interventions for smoking cessation in the United States. Participants were divided into age cohorts consistent with previous literature: young adults (YA; n=890/2637; age=18-39), middle-aged adults (MA; n=1308/2637; age=40-59), and OA (n=439/2637; age=60+). Baseline characteristics, login data, and self-reported 30-day-PPA at 12M post-randomization were collected. Results: OA had a greater mean number of logins than YA (7.7 vs. 4.9; IRR: 1.20; 95% CI: 1.02, 1.41; p=0.027) and a smaller number than MA (7.7 vs. 8.5; IRR: 0.79; 95% CI: 0.69, 0.91; p=0.001). OA quit smoking at the same rate as MA and YA (p=0.905). Conclusions:

Results contradicted prior misconceptions as OA utilized web-delivered cessation interventions more than YA and quit smoking at the same rate as YA and MA.

Introduction

Adults age 60 and older comprise over 12% of all US adult smokers (1). This percentage will likely increase to a higher fraction of all smokers as the population of older adults is projected to double over the next 40 years. Indeed, the U.S. Census Bureau estimates that the 52 million adults aged 60 and older as of 2018 will increase to 95 million by 2060 (2,3). This stark increase in the proportion of older adults who smoke means there is a growing need to develop smoking cessation interventions suited for this high-risk population.

Older adults who smoke have a great need for public health and clinical interventions both in the United States and globally. Cigarette smoking poses significant health risks at any age, but older adults who smoke are especially vulnerable because of their heightened risk for various illnesses, such as cardiovascular diseases, respiratory conditions, and cancer (4-6). Along with increasing risk or causing various illnesses, continued smoking also increases an older adult's likelihood of developing physical or cognitive impairment (i.e., difficulty concentrating, inability to focus on completing daily life tasks, and blindness) (6,7). In contrast, quitting smoking lowers the complications and risks associated with continued smoking. Long-term, even within older populations, cardiovascular disease risk significantly lowers within the first 5 years of quitting smoking (5,8,9). Smoking cessation at the age of 60 translates into an increase in life expectancy of 1.4 to 2.4 years for men and 2.7 to 3.7 years for women (10).

Recent research shows that older adults are motivated to quit and even quit at rates that are comparable to those of (or better than) younger smokers (11,12). Older adults generally have higher resilience as compared to younger adults, which allows them to have more success at quitting (13-15). However, older adults face major barriers to receiving cessation services, including these provider biases: older adults do not want to quit smoking, cannot change their

smoking habits later in life, and quitting smoking now would be too late (10). Thus, access to effective smoking cessation interventions is a critical barrier for older adult smokers.

A possible alternative method for older adults to access cessation intervention is eHealth for smoking cessation (e.g. websites). Websites reach 11 million adult smokers each year at low cost (16,17). Indeed, cessation websites have at least 21 times higher overall national reach as compared to telephone quitline interventions (17,18), and quitlines are at a 145% higher cost-per-quit as compared to website interventions (19). Regarding older adults, more than 73% of adults aged 60+ in the U.S. use the internet, and thus have great potential to access website-delivered cessation interventions (20).

However, a commonly held belief is that older adults lack the skills, confidence, and desire to use e-health technologies. Widespread "myths" about older adults' use of technology include: 1) they are not interested in utilizing computers, 2) they believe computers to be useless and unnecessary, and 3) they will be unable to learn how to use new technology (21). Contrary to these myths, research comparing older adults (55+) to younger adults (30 years of age and under) reported that older adults were less anxious using computers and had more positive attitudes towards learning how to use computers than their younger adult counterparts (22). Content analysis of 2,493 statements of 20 young adults (mean age=25) and 19 older adults (mean age=71) regarding the usability of technology found that older and younger adults had similar views, which centered on both older and younger adults appreciating computing technologies as useful (21,23). Finally, several studies have found that older adults do have the capability to adapt to innovations in technology (24,25).

While there is great potential value in web-delivered smoking cessation interventions for adults age 60 and older, to date no studies have examined their engagement and cessation rates

with these interventions, and as compared to younger adult and middle-aged adult smokers (4). Therefore, we conducted a secondary data analysis of a randomized controlled trial (N = 2637, 88% 12-month follow-up rate) of two web-based interventions for smoking cessation (26), to explore differences in: 1) older adult smokers' engagement with the intervention as compared to middle-aged and younger adult smokers and 2) cessation outcomes as compared to middle-aged and younger adult smokers. The results of this study can provide information on the potential utility and effectiveness of web-delivered cessation interventions for older adults.

Methods

Participants

Participants (n = 2637) were enrolled in a randomized controlled trial assessing the effectiveness of two web-delivered smoking cessation interventions (26). For this secondary analysis and consistent with other studies (27-29), participants were grouped into the following age cohorts: young adults (YA; age = 18-39; n = 890/2637), middle-aged adults (MA; age = 40-59; n = 1308/2637), and older adults (OA; age = 60+; n = 439/2637). Eligibility criteria: 1) age 18 or older; 2) smoke at least 5 cigarettes per day for the last 12-months; 3) motivated to quit in the next 30 days; 4) reside in the United States; 5) able to read in English; 6) have Internet and email access; 7) have never used Smokefree.gov, the control condition, or the experimental web intervention via participation in a previous study by the research group; 8) not currently be enrolled in any cessation interventions; 9) not have another household member participating; and 10) willing to be randomized into either intervention arm and complete all study procedures.

Procedures

A full description of all study methods can be found in the main outcomes paper (26). Participants were recruited for the randomized controlled trial through offline (i.e., family and

friend referrals; earned traditional media) and online (i.e., Google, Craigslist, and Facebook advertisements; online survey panel; organic search engine results) methods. The recruitment period was from March 2014 through August 2015. Individuals who were interested in participating in the study were directed to a recruitment website that included further information about the study. Those who were interested in participating were then directed to complete an online screening survey to establish eligibility. Individuals who screened eligible were sent a link via email to enter the study website to provide informed consent, complete a baseline survey, and fill out a contact form. Once completed, participants were enrolled in the study and randomized into one of two web-based cessation interventions: (a) a program based on Acceptance and Commitment Therapy (ACT) (30) or (b) a standard of care program (the National Cancer Institute's Smokefree.gov website (31,32). Once randomized, participants had access to their respective intervention program for 12-months. Furthermore, all participants received up to 4 text messages per day for 28-days; while the content of each message differed by treatment arm, all messages supported quitting and prompted participants to utilize their respective treatment intervention.

The follow up survey for this study was completed at 12-months post-randomization by utilizing a multimodal survey protocol system in order to maximize response rates. First, participants were offered to complete their surveys via a web-based survey platform. If a participant did not respond to the web-based survey, the study team sequentially offered survey completion via telephone, mail, and postcard-only options as needed until a response was received or the protocol was completed. Participants were compensated for completing each survey with $25 and received an additional $10 incentive for responding within 24 hours of receiving the emailed survey link. The Fred Hutchinson Cancer Research Center Institutional

Review Board reviewed and approved all study procedures. The trial was registered on ClincialTrials.gov (National Clinical Trial number 1166334).

Measures

Baseline Characteristics

The baseline survey that participants completed prior to randomization collected the following information: age, gender, race (American Indian or Alaska Native, Asian, Black/African American, Native Hawaiian or Other Pacific Islander, White, or Other), Hispanic ethnicity, marital status, highest level of education achieved, income, sexual minority status, and internet use. Internet use was assessed by asking participants, "How often have you used the internet in the last 30 days?" with the option of responding with (a) at least several times per day, (b) at least once per day but less than several times per day, (c) at least once per week but less than once per day, or (d) at least once in the past month but less than once per week.

Smoking

Smoking history and current smoking-related characteristics were assessed via the Fagerström Test for Nicotine Dependence (33), which gave a measure of nicotine dependence severity. Participants completed the Commitment to Quitting Smoking Scale (34) (CQSS) to assess commitment to achieving abstinence.

Engagement

Measures of participant website engagement for this study were measured through two variables: 1) number of times a participant logged into their assigned website and 2) number of unique days that a participant logged into their assigned website. These measures of engagement were collected for 12 months post-randomization and were calculated from data logged

automatically by the secured server. Any user activity occurring more than 15 minutes after the previous activity was considered a new login.

Cessation Outcomes

Cessation was assessed using the guidelines consistent with the parent trial via participant self-report of time since last cigarette (even a puff). The primary cessation outcome for the trial was analyzed using complete-case analysis of 30-day point prevalence abstinence (PPA) at 12-months post-randomization. The secondary cessation outcome was analyzed via 30-day PPA at 12-months post-randomization with missing data imputed as smoking. Based on recommendations for assessing smoking status in large, population-based cessation trials where no face-to-face contact occur, biochemical confirmation is not feasible due to the large sample size, and demand characteristics for false reporting being low, biochemical confirmation was not obtained (35).

Statistical Analyses

Baseline characteristics of each age cohort (YA, MA, and OA) were analyzed and compared against each other using chi-square tests for categorical variables and likelihood ratio tests for continuous variables. Adjusted logistic regression models were used to evaluate differences in treatment satisfaction and cessation outcomes between each age cohort. Adjusted negative binomial models were used to evaluate differences in website engagement outcomes, which were right-skewed. All outcome models were adjusted for treatment group assignment and baseline factors used in stratified randomization (i.e., education, gender, and smoking more than 20 cigarettes per day), and treatment by age cohort interactions were considered. To reduce the potential for confounding, baseline demographic and smoking variables were included in the models as covariates if they differed by age group and were associated with the cessation

outcome. All analyses were completed using R version 3.6.1. (36) and R package "MASS" (37). Furthermore, all statistical tests were two-sided with $\alpha = 0.05$.

Results

Baseline Characteristics

Baseline demographic and smoking characteristics for all groups can be found in Table 1. Notably, OAs had the lowest employment rate. OAs also had the lowest rates of screening positive for depression. Among baseline smoking characteristics, OAs' quit attempts in the past 12 months were higher than that of MAs.

Participant Engagement and Smoking Outcomes

As seen in Table 2, OA participants had a greater mean number of logins to their assigned website than YA participants (7.7 vs. 4.9; IRR: 1.20; 95% CI: 1.02, 1.80; p = 0.027) and a somewhat lower number of logins than MA participants (7.7 vs. 8.5; IRR: 0.79; 95% CI: 0.69, 0.91; p = 0.001). Similarly, OA participants had a great number of unique days using their assigned website than YA participants (6.4 vs. 4.1; IRR: 1.25; 95% CI: 1.07, 1.46; p = 0.004) and a somewhat lower number of days used than MA participants (6.4 vs. 6.6; IRR: 0.85; 95% CI: 0.75, 0.97; p = 0.014).

Table 2 also shows that OAs quit smoking at the same rate as MA participants (24% vs. 24%; OR: 1.05, 95% CI: 0.78, 1.40, p=0.758) and YA participants (24% vs. 27%; OR: 1.00; 95% CI: 0.72, 1.37; p=0.993). Results were similar for the secondary outcome of missing=smoking. There was no interaction with treatment arm.

Discussion

In a large randomized controlled trial (N = 2637, 88% 12-month follow-up rate) of two web-based interventions for smoking cessation (26), this was the first study to explore

differences in older adult smokers' 1) engagement with and 2) cessation outcomes of a digital smoking cessation intervention as compared to middle-aged and younger adults. The results showed that older adults utilized their assigned website substantially more than younger adults who smoke, but somewhat less than middle-aged adults who smoke. Furthermore, older adults quit smoking at the same rates as both middle aged and younger adults who smoke.

The solid engagement rate of older adults suggests they have a strong desire to quit smoking. However, the fact that older adults engaged with the intervention at somewhat lower rates than middle-age adults suggests that user-centered design research tailored to the specific needs and preferences of older adults could be incorporated into the design of the digital smoking cessation interventions. Potential factors to explore through user-centered design research include readability of the website, ease and clarity of instructions on how to use the website, and quick access to support teams.

The similar smoking cessation rates of older adults as compared to younger and middle-aged adults are consistent with previous literature (11,12) and suggest that age is not a deterrent or a barrier for quitting smoking. These results may indicate further support that older adults' higher level of resilience can help them face the challenges of quitting smoking, including coping with withdrawal (13-15). Finally, the similar quit rates imply that eHealth is a viable cessation treatment option for older adults, as they did utilize the study web-delivered interventions for smoking cessation.

This study has key limitations. First, as a secondary analysis of the parent trial, the study did not randomize study participants by age group and the web-delivered interventions were not tailored to specific age groups. Building on the current study's findings, future research designs should address these limitations. Second, we relied exclusively on self-reported abstinence in our

estimate of 30-day point prevalence abstinence. However, expert consensus (38) suggests that biochemical verification of abstinence is impractical and unnecessary in population-based studies that do not involve in-person contact. Moreover, there is no reason to believe that the validity of self-reported abstinence would differ by treatment group.

The study also has important strengths. First, the 88% follow-up data retention rate minimized potential non-response bias. Second, the follow-up period was 12 months, thereby accounting for significant levels of relapse that occur during the first year of quitting smoking (39, 40). Third, the large sample size (N = 2637) provided high power to detect differences between age groups. Fourth, the geographic diversity of the sample, recruited from all 50 states, along with the high fraction of minority participants, provided for more broad generalization of the study findings.

Using data from a large randomized controlled trial with high 12-month follow-up data retention, this study was the first to evaluate older adults' engagement and quit smoking rates from a digital intervention for smoking cessation. The results suggest that 1) older adults who smoke utilize web-delivered smoking cessation interventions more than younger adults who smoke and 2) older adults who smoke quit at the same rate as middle aged and younger adults who smoke when using web-delivered smoking cessation interventions. eHealth interventions may be a viable modality to provide cessation intervention to older adults who smoke.

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Table 1. Baseline Characteristics of Study Participants

Variable	***Overall, n (%)***	***Younger Adults, n (%)***	***Middle-Aged Adults, n (%)***	***Older Adults, n (%)***	***p***
	n=2637	n=890	n=1308	n=439	
Age, M (SD)	46.2 (13.4)	30.5 (5.4)[a]	50.6 (5.6)[a]	64.6 (4.4)	<0.001
Female	2091 (79%)	668 (75%)[a]	1067 (82%)	356 (81%)	<0.001
White	1914 (73%)	495 (56%)[a]	1030 (79%)[a]	389 (89%)	<0.001
Hispanic	222 (8%)	148 (17%) [a]	66 (5%)[a]	8 (2%)	<0.001
LGB	253 (10%)	147 (17%)[a]	88 (7%)[a]	18 (4%)	<0.001
High school or less education	735 (28%)	248 (28%)	379 (29%)	108 (25%)	0.209
Married	987 (37%)	297 (33%)	540 (41%)[a]	150 (34%)	<0.001
Employed	1381 (52%)	557 (63%)[a]	675 (52%)[a]	149 (34%)	<0.001
Depression screen positive	1470 (56%), n=2622	555 (63%)[a], n=883	711 (55%)[a], n=1301	204 (47%), n=438	<0.001
Daily internet use	2606 (99%)	881 (99%)	1290 (99%)	435 (99%)	0.63
Baseline Smoking-Related Variables	***Overall, n (%)***	***Younger Adults, n (%)***	***Middle-Aged Adults, n (%)***	***Older Adults, n (%)***	***p***
FTND score, M (SD)	1440 (55%)	410 (46%)[b]	791 (60%) [b]	239 (54%)	<0.001
Any e-cig use in past month	909 (34%)	291 (33%) [b]	443 (34%) [b]	175 (40%)	0.029
Quit attempts in past 12 months, M (SD)	1.7 (5.0), n=2511	1.6 (5.7), n=828	1.5 (3.4)[a], n=1261	2.1 (7.0), n=422	0.004
Commitment to quitting, CQSS[c], M (SD)	4.0 (0.8), n=2528	4.1 (0.8)[a], n=886	4.0 (0.8), n=1304	3.9 (0.7), n=438	0.010

[a]Statistically different from the older adult group, p<0.05
[b]Statistically different from the older adult group p<0.05
[c]CQSS scores range from 0-4

Table 2. User Engagement (Website Logins) and Quit Rates at 12 Months

Engagement Variables	***Older Adults***	***Younger Adults***	***Middle-Aged Adults***	***Older Adults vs. Younger Adults***		***Older Adults vs. Middle-Aged Adults***	
	n=439	n=890	n=1308	***IRR (95% CI)***	***p-value[a]***	***IRR (95% CI)***	***p-value[a]***
Number of times logged in, M (SD)	7.7 (15.7)	4.9 (14.2)	8.5 (28.7)	1.20 (1.02, 1.41)	0.027	0.79 (0.69, 0.91)	0.001
Number of unique days used website, M (SD)	6.4 (12.5)	4.1 (12.6)	6.6 (19.1)	1.25 (1.07, 1.46)	0.004	0.85 (0.75, 0.97)	0.014
Quit Rate Variables[c]	***Older Adults***	***Younger Adults***	***Middle-Aged Adults***	***Older Adults vs. Younger Adults***		***Older Adults vs. Middle-Aged Adults***	
	n=439	n=890	n=1308	***OR (95% CI)***	***p-value[b]***	***OR (95% CI)***	***p-value[b]***
30-day PPA at 12 months, complete-case, n (%)	94 (24%), n=384	211 (27%), n=775	278 (24%), n=1150	1.00 (0.72, 1.37)	0.993	1.05 (0.78, 1.40)	0.758
30-day PPA at 12 months, missing=smoking, n (%)	94 (21%)	211 (24%)	278 (21%)	1.02 (0.74, 1.38)	0.921	1.04 (0.78, 1.39)	0.773

[a] Two-sided *p* values were calculated from regression models adjusted for treatment arm, plus three factors used in stratified randomization: gender, heaviness of smoking index >4, and education.

[b]Cessation outcome analyses were controlled for 11 total baseline variables that both differed by age group and predicted cessation outcome: treatment arm; three stratification factors including gender, education, and heavy smoking (>20 cigs/day); and seven stratification factors including, White race, Hispanic, screen positive for panic disorder, high nicotine dependence, CQSS, EQ-ED anxiety, and EQ-ED health today.

[c]Self-reported 30-day PPA