The Association between Smoking Cessation Method and Sustained Smoking Cessation in

the Women's Interagency HIV Study, 2008-2016

Submitted by

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In partial fulfillment of the requirements

For the degree of Master of Science

Johns Hopkins University Bloomberg School of Public Health

Baltimore, Maryland

Spring 2017

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Abstract

Background: People living with HIV are living longer and are more likely to die from chronic conditions than other causes, many of which are associated with cigarette smoking. People living with HIV also have a higher prevalence of cigarette smoking. Smoking cessation strategies are therefore an important area of research to focus on, but female smokers with HIV are an under-studied population.

Objectives: To compare the prevalence and effectiveness of smoking cessation methods and determine characteristics associated with sustained (6-12-month) smoking cessation among women with and at risk for HIV.

Methods: We used data from the Women's Interagency HIV Study (WIHS), the largest ongoing prospective cohort study of HIV among women in the United States, to study smoking cessation methods among female smokers with HIV.

Analysis: We compared incidence of sustained smoking cessation among women who tried to quit smoking in the WIHS, and used a generalized linear model using Poisson regression to determine characteristics associated with sustained smoking cessation.

Results: The proportion of women achieving 6-12 month sustained smoking cessation was highest among those using self-help interventions (36%), other pharmacological aids such as Chantix, Wellbutrin, and Bupropion (35%), quitting "on her own" (35%), and quitting "cold turkey" (32%). The most prevalent method cited was nicotine replacement therapy. Characteristics associated with achieving 6-12-month sustained smoking cessation included fewer number of cigarettes smoked prior to quitting, fewer years smoked prior to quitting, having

her own place of residence, and higher self-rated health, regardless of which smoking cessation method used.

Conclusions: Smoking history, residence, and higher self-rated health are associated with achieving sustained smoking cessation among women in the WIHS. Self-directed smoking cessation therapies, like self-help interventions and quitting "cold turkey", and nicotine replacement therapy are methods with the highest proportion of 6-12-month sustained smoking cessation among women who reported using them.

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Introduction

Despite the decrease in the prevalence of cigarette smoking in the United States over the last fifty years, smoking prevalence remains high among people living with HIV (Mdodo, 2015). Now that people diagnosed with HIV are living longer, thanks to the widespread availability and use of antiretroviral therapies, the causes of death for people living with HIV are now more likely to be chronic conditions (Deeks, 2013). Many of these conditions, such as cardiovascular disease, pulmonary conditions, and lung cancer, are associated with cigarette smoking. As more people with HIV live longer and develop more of these conditions, research is needed on the impact of smoking in HIV-infected populations.

Globally, there are 1 billion smokers, 80% of whom live in low- and middle-income countries (WHO, 2016). These are also the countries in which the burden of the HIV epidemic is most intense (UNAIDS, 2016). It is estimated that 40-70% of people living with HIV in the United States are cigarette smokers (Mdodo, 2015), which is higher than the general US population's smoking prevalence of 15.1% (CDC, 2016). People living with HIV are therefore an important group on which to focus smoking cessation efforts.

The trends and predictors of cigarette smoking have been described in various sub-populations of people living with HIV. Globally, men are more likely to be current smokers than women, among people living with HIV, although in the United States, men and women have similar prevalence of cigarette smoking (Weinberger, 2017). A survey of adults with HIV found that non-Hispanic white and non-Hispanic black race was independently associated with greater smoking prevalence (Mdodo, 2015), and Gritz et al. (2004) found that white participants were more likely to be current smokers than Hispanic participants. Among men who have sex with men in the Multicenter AIDS Cohort Study in 2012, 11.8% of men who enrolled before 2001 and

36.9% of men who enrolled during or after 2001 were current smokers (Akhtar-Khaleel, 2016).

Being black or non-Hispanic, lower education, and alcohol and marijuana use were positively

associated with current cigarette smoking in MACS (Akhtar-Khaleel, 2016). HIV serostatus was

not associated with cigarette smoking, but detectable viral load was (Akhtar-Khaleel, 2016). As

of March 2016, 39% of HIV+ and 47% of HIV-uninfected women were current smokers, and

28% of each group were former smokers (unpublished data).

Smoking has a serious effect on the health of people living with HIV. HIV-infected

smokers now lose more years of their lives to cigarette smoking than to HIV infection

(Helleberg, 2013). A study of veterans in the United States living with HIV found that the

mortality rate for smokers was twice that of non-smokers, even after adjusting for age, CD4

count, and viral load (Crothers, 2007). Smoking is associated with increased morbidity and

mortality, especially related to cardiovascular disease, respiratory conditions, and cancer.

Worldwide, smoking and tobacco use causes more than 5 million deaths per year (WHO, 2016).

People living with HIV have a disproportionately high risk for cardiovascular disease (Barbaro,

2003). People living with HIV also have elevated risks of respiratory-related conditions, such as

chronic obstructive pulmonary disease and bacterial pneumonia (Crothers, 2005). In the HIV

Epidemiologic Research Study (HERS), the most significant clinical risk factor for the

development of bacterial pneumonia was current cigarette smoking (Kohli, 2006). Lung cancer is

also a concern, given the clear causal association between smoking and lung cancer. Lung cancer

is now the third most commonly diagnosed cancer among people living with HIV, behind

Kaposi's sarcoma and non-Hodgkins lymphoma (Kirk, 2007). The risk of developing lung

cancer among people living with HIV remains elevated, even after controlling for smoking status

(Kirk, 2007).

Smoking also has an adverse effect on HIV-related outcomes. Findings from the WIHS suggest that smokers are more likely than non-smokers to have poorer viral and immunologic responses, more frequent immunologic failure, a higher risk of developing AIDS, and a higher risk of pregnancy loss (Feldman, 2006, Westreich, 2017). This could be due to the relationship of cigarette smoking and HAART adherence. One study found that smokers were significantly more likely to report non-compliance with HAART regimens in the last 6 months than non-smokers (Feldman, 2006). Another study found that cigarette smoking can decrease the response to HAART by 40% (Miguez-Burbano, 2005).

Other psychiatric and social-level characteristics are associated with smoking in people living with HIV. Among HIV-infected individuals, those who were depressed were more likely to smoke (Stewart, 2011). Heavy drinking (Gritz, 2004) and illegal drug use (Burkhalter, 2005) have also been found to be associated with cigarette smoking in people living with HIV. In a study of people living with HIV, both who inject drugs and who do not, current injectors had a higher smoking prevalence and greater daily cigarette consumption compared to former injectors (Marshall, 2011).

Given the adverse effects of cigarette smoking among people living with HIV, smoking cessation is a major health goal for care of people living with HIV (PLWH). However, it is important to recognize that different sub-populations of smokers living with HIV have different cessation and recidivism rates. For example, in the WIHS, factors associated with taking a longer time to cessation among smokers included less education, alcohol use, having health insurance, >10-year smoking history, self-reported poor health rating, and having hypertension (Hessol, 2014). Pregnancy in the last six months was associated with a shorter time to smoking cessation (Hessol, 2014). Hessol et al. (2014) also investigated the factors associated with time to smoking

relapse after cessation, and found that marijuana use and not living in one's own place were associated with shorter time to recidivism. Among HIV-infected women, older age and HAART use were associated with longer time to recidivism (Hessol, 2014).

Perceived barriers to smoking cessation, among both smokers and health care providers, are also crucial to understand. At the individual smoker level, some research has shown that some people living with HIV do not think they will live long enough to suffer the health consequences of cigarette smoking (Burkhalter, 2005). Burkhalter et al. (2005) also found that greater levels of emotional stress were associated with less readiness and interest in smoking cessation. There are also barriers among health care providers. A survey of HIV provider attitudes and practices found that 55% of HIV care providers said they were not confident in their ability to provide smoking cessation advice to their patients (Horvath, 2012). Furthermore, 60% of these providers said that they believe that their patients know that smoking is a health problem, but do not want to quit (Horvath, 2012).

Despite the prevalence of cigarette smoking in people living with HIV, and the health impacts resulting from smoking, little research has been done on the effectiveness of smoking cessation interventions. A review of the literature by Pacek and Crum (2015a) found few studies that had been conducted to evaluate interventions, and speculated that this lack of focus could be due to a few reasons: the desire of practitioners to focus on acute treatment to a life threatening disease, a belief that other substance use issues should be addressed first, or, a lack of specific interventions tailored to the HIV-infected population. Focus on smoking cessation interventions is important, because a significant portion of smokers in the general population attempts to quit each year (more than half of adult smokers in 2010 [CDC, 2011]), and cessation interventions can increase the success of quit attempts. One study found that smokers who seek out cessation

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interventions are twice as likely to be abstinent from smoking at 12 months than smokers who do not seek out cessation interventions (Zhu, 2000). However, cessation rates in HIV-positive populations are different than the general population. One study of HIV-infected and at risk women from the WIHS found that both groups of women have lower smoking cessation rates than the general population (Goldberg, 2010).

Smoking cessation interventions can be broadly grouped into two categories: behavioral and counseling interventions, and pharmacological interventions, including nicotine replacement therapy (NRT). Counseling interventions are fairly common – one study found that 81% of current smokers living with HIV reported receiving medical advice to quit smoking in the past year (Burkhalter, 2005). Some of the behavioral and counseling interventions tested among people living with HIV have been shown to be effective. Huber et al. (2012), using data from the Swiss HIV Cohort Study, found that training physicians in a cessation counseling intervention increased the likelihood of smoking cessation among their patients. Moadel et al. (2012) found in a randomized controlled trial that group therapy was effective in increasing rates of smoking cessation, and that self-rated loneliness and self-efficacy were influential factors in cessation. Some studies have also investigated the use of technology in smoking cessation counseling interventions. Vidrine et al. (2011) found that in a randomized trial of HIV-positive smokers, individuals who received a cell phone-delivered smoking cessation intervention were significantly more likely to quit smoking at 3 months compared to individuals who received the usual care (brief physician advice to quit, written materials, nicotine replacement therapy).

However, these studies on the effectiveness of smoking cessation method are few in number. A review of the literature by Pacek and Cioe (2015b) found that in the previous five years, only 10 studies had been conducted to evaluate the effectiveness of smoking cessation

interventions among smokers living with HIV. None of these studies looked specifically at female smokers living with HIV, even though this group has different smoking cessation rates than the general population (Goldberg, 2010).

One gap in the literature is the prevalence of e-cigarette smoking among people living with HIV. Little is known about e-cigarette smoking among the general population to begin with, but current estimates are that in 2014, 3.7% of adults currently used e-cigarettes, and 12.6% of adults had ever tried one (Schoenborn, 2015). In addition, little is known about e-cigarette's safety or efficacy in quitting smoking. As far as this literature review conducted in March, 2017, could tell, there are no studies investigating e-cigarette use specifically among people living with HIV. Given the higher prevalence of cigarette smoking in this population, studying this new nicotine delivery system is an important gap to fill in the literature.

This study explored the effectiveness of smoking cessation methods in achieving 6-12-month sustained smoking cessation among women in the WIHS cohort, April 1 2008 to March 31 2016. Other factors associated with sustained smoking success were also investigated. This study builds on previous research relating to smoking cessation among people living with HIV, and adds to it the under-studied population of women living with HIV. The findings from this study might allow more tailored and effective recommendations for smoking cessation among women living with HIV.

Methods

Participants were enrolled in the Women's Interagency HIV Study (WIHS), the largest ongoing prospective cohort study of HIV among women in the US (Barkan, 1998 & Bacon, 2005). The WIHS began enrolling in 1994 at six clinical sites: Bronx, NY; Brooklyn, NY; Chicago, Il; Los Angeles, CA; San Francisco, CA; and Washington, DC. In 2013, sites in Atlanta, GA, Birmingham, AL/Jackson, MS, Chapel Hill, NC, and Miami, FL were added to reflect the growing HIV epidemic among women in the southern US. To date, 3,678 HIV-infected women and 1,304 HIV-uninfected women have been enrolled in the WIHS.

Women enrolled in the WIHS attend semiannual study visits, at which a trained interviewer using standardized methods assesses data on demographics, medical history, obstetric/gynecological history, contraceptive use, alcohol, tobacco, and other drug use, and sexual behavior. Each visit also includes a physical and gynecological examination. To be eligible for enrollment in the 1994-95 cohort, women had to be 13 years or older, give informed consent, be tested for HIV, complete the interview in Spanish or English, travel to and from the clinic site to complete the baseline visit, and give blood for laboratory testing (Barkan, 1998). To recruit a comparable control group of women without HIV, women were recruited from similar sources and frequency matched on demographic variables and risk factors (including injection drug use since 1978 and total number of sexual partners since 1980) (Barkan, 1998). Highly active therapy did not yet exist and many already had an AIDS-defining illness (Bacon, 2005).

This study incorporates data from 2,511 women who were enrolled prior to 2013 and attended at least one study visit on or after visit 28 (April 1, 2008 to September 30, 2008); the WIHS began collecting data on smoking cessation method at visit 29 (October 1, 2008 to March

31, 2009). Data for these analyses were collected between April 1, 2008 and March 31, 2016. Among these 2,511 women, 725 were HIV-uninfected and 1,786 were HIV-infected.

The main outcome of interest was 6 to 12 months of sustained smoking cessation. A participant was considered to have the outcome if she reported that she had quit smoking at one visit, and that she was not currently smoking at her next consecutive semiannual visit. The main exposure of interest was method of smoking cessation. Starting at visit 29, participants who reported that they had quit smoking since their last study visit were asked which methods of cessation they had used to help them quit. Participants could report multiple options, so categories of methods are not mutually exclusive. Response options included individual counseling (support groups, cessation clinics), self-help interventions (like manuals, books, tapes), specialist smoking cessation clinics, toll-free telephone help-lines, nicotine replacement therapy (including nicotine gum, spray, patch, and inhaler), other pharmacological aids (such as medications like Chantix, Wellbutrin, or Buproprion), acupuncture, homeopathy, hypnotherapy, exercise, or an otherwise-specified "other" option. Another response option, electronic cigarettes, was introduced at visit 35, in October 2011.

For these analyses, cessation method was collapsed into three categories: behavioral (including individual counseling, self-help interventions, telephone help-lines, and specialist clinics), pharmacological (including nicotine replacement therapy, other pharmacological aids, and electronic cigarettes), and other (including acupuncture, homeopathy, hypnotherapy, exercise, and other). Frequency of each method was calculated. A measure of proportional success by method was calculated, comparing women who reported trying a method and also achieved 6-12-month sustained smoking cessation over all women who reported trying the method at their quit visit.

Other fixed exposure variables measured at enrollment included age (categorized as 18-29, 30-39, 40-49, and ≥50), WIHS enrollment wave (categorized as 1994/1995, 2001/2002, 2011/2012, and 2013-15), race/ethnicity (categorized as African-American, Hispanic, white, and other), and education (categorized as some high school, high school, and some college or education beyond college).

Time-varying covariates included number of cigarettes currently smoked per day, number of years the participant smoked cigarettes (categorized as fewer than ten years, ten to twenty years, and greater than twenty years), place of residence (dichotomized as living in her own place or not), having health insurance (yes or no), average household income per year (dichotomized as less than or equal to $12,000 per year or greater than $12,000 per year), number of alcoholic drinks per week since the last visit, injection drug use since the last visit (yes or no), non-injection recreational drug use since the last visit (yes or no), prescription drug use in a way not prescribed (yes or no), depressive symptoms (CES-D, depression threshold score of 16), currently pregnant (yes or no), parity, HIV status, participant's rating of her own health (dichotomized as fair/poor or good/excellent), and participant's rating of her overall quality of life (scale of 1 to 10).

A generalized linear model using Poisson regression and robust standard errors, and adjusting for the clustering within WIHS participants, was used to estimate the relative risk of sustained (6-12-month) smoking cessation among women who tried to quit smoking. Multiple models were fitted to adjust for smoking history variables, other alcohol and drug use, demographic variables, and quality of life, self-rated health, and depression variables. Analyses were conducted in Stata version 14 (College Station, TX).

This study was approved by the Institutional Review Boards at all participating institutions, including the Johns Hopkins Bloomberg School of Public Health.

Results

This study included data from 2,511 women who were enrolled in the WIHS prior to 2013 and attended at least one study visit on or after visit 28 (April 1–Sept 30, 2008). At baseline (i.e., the first study visit on or after visit 28), 1,065 women were currently smoking, and 1,446 women were not currently smoking. At baseline, 342 women had a history of smoking for fewer than 10 years, 461 women had a history of smoking for between 10 and 19 years, and 955 women had a history of smoking for at least 20 years. Analysis included women who had smoked and reported that they had attempted to quit since their last visit (N=685). Of the study population, 64% were African American, 19% were Hispanic, 13% were White, and 4% were another race/ethnicity. Among methods, the counseling category had the highest prevalence of HIV-infected women (77% versus 67% of pharmacological methods and 65% of other methods, Table 1). During the study period, 685 women reported that they had quit smoking since their last visit; this includes some women who attempted multiple times. We looked at the first quit attempts for each woman, bringing our study population to 595 women (Figure 1). There were 203 women who had the outcome, 6-12-month sustained smoking cessation, and 392 women who had <6-month smoking cessation (i.e., they reported quitting but did not have sustained smoking cessation at their next study visit) (Table 2). 16 of the 203 women who achieved 6-12-month sustained smoking cessation did not report that any of the smoking cessation methods were helpful to her in quitting.

Of the three categories of smoking cessation method, counseling, pharmacological, and other, the other category was the most common among women with 6-12-month smoking cessation (Table 2). This category included methods such as acupuncture (n=2), homeopathy (n=3), hypnosis (n=2), and exercise (n=6), which were not frequently used among sustained 6-

12-month smoking cessations, but also included a self-reported open field response (Table 2). An analysis of these responses revealed that the most common method among women with 6-12-month smoking cessation in the other category was "cold turkey" or "just stopped" (n=29), and the second-most common method was "on her own" or "by herself" (n=28). Other open field responses included incarceration, health problems (most commonly, asthma), and family concerns (pregnancy or citing family members such as granddaughters).

The most common method mentioned among all women who made a quit attempt was nicotine replacement therapy (n=193), followed by "cold turkey" (n=98) and "on her own" (n=80). Among women who achieved 6-12-month sustained smoking cessation, self-help interventions were the most commonly used of the counseling interventions (n=28). Of the pharmacological interventions, nicotine replacement therapy was the most common method (n=52). Also of interest were 12 participants who achieved 6-12-month sustained smoking cessation using e-cigarettes, compared to the 34 participants who reported using e-cigarettes but did not achieve 6-12-month sustained smoking cessation.

The methods with the highest proportion of women who achieved 6-12-month sustained smoking cessation among all women who tried the method were the self-help interventions (36.4% of those who reported using this method at their quit visit went on to have 6-12-month sustained smoking success), quitting "on her own" (35.0%), other pharmacological aids (32.0%), and quitting "cold turkey" (29.6%) (Table 2). Among women who reported using homeopathy, 75% achieved 6-12-month sustained smoking cessation, although only 4 women reported using it.

In univariate analysis, method of smoking cessation (counseling, pharmacological, or other) was significantly associated with sustained 6-12-month smoking cessation, whereby

women who used counseling methods were more likely to have quit for 6-12 months (IRR

compared to pharmacological method = 0.55, 95% CI: 0.38, 0.80 and IRR compared to other

methods = 0.61, 95% CI: 0.43, 0.86, Table 3).

Model 2 was adjusted for two variables relating to smoking history: number of cigarettes

smoked per day and number of years smoked, both measured at the visit immediately prior to

visit at which the woman reported quitting. In this model, an increase of one cigarette smoked

per day was associated with a 15% lower rate of achieving smoking cessation success

(IRR=0.85, 95% CI: 0.80, 0.90, Table 4). Smoking for 10 to 20 years, as compared to less than

10 years, was associated with a 29% lower rate of achieving smoking cessation (IRR=0.71, 95%

CI: 0.50, 1.01) and smoking for greater than 20 years, as compared to less than 10 years, was

associated with a 41% lower rate of achieving smoking cessation (IRR=0.59, 95% CI: 0.44,

0.80). Controlling for smoking history variables, pharmacological methods were no longer

significantly associated with a reduced risk of achieving smoking cessation as compared to

counseling methods (IRR=0.71, 95% CI: 0.50, 1.02), but other methods were still significant,

and had a 37% lower incidence of cessation success, compared to counseling methods

(IRR=0.63, 95% CI: 0.45, 0.88).

Model 3 included additional substance use variables: number of alcoholic drinks per

week, injection drug use since the last visit, non-injection recreational drug use since the last

visit, and recreational prescription drug use, all measured at the visit before the quit attempt

(Table 5). None had statistically significant reductions in the rate of cessation success (p>0.05).

After adjusting for substance use, use of other method as compared to counseling still had a

significant reduction in the rate of cessation success (IRR=0.62, 95% CI:0.44, 0.86), and number

of cigarettes (IRR=0.85, 95% CI: 0.80, 0.90) and greater than twenty years of smoking history,

as compared to less than ten years (IRR=0.59, 95% CI: 0.44, 0.80), were both still significantly associated with reduction in the rate of cessation success.

Model 4 also included demographic characteristics: education (categorized as less than high school, high school, and more than high school), race (categorized as African American, Hispanic, white, and other), WIHS enrollment wave, age, health insurance, residence, household income (dichotomized as less than or equal to $12,000 per year and greater than $12,000 per year), being currently pregnant, parity, and HIV status. These covariates were all measured at the visit before the quit attempt (Table 6). Not having her own place of residence was significantly associated with having a 47% reduction in the rate of smoking cessation success (IRR=0.53, 95% CI: 0.33, 0.85). Being Hispanic, as compared to being African American, had a 40% increased incidence of smoking cessation success (IRR=1.40, 95% CI: 1.05, 1.87). Smoking history variables remained significant: an increase of one cigarette in the number of cigarettes smoked per day was associated with a 14% lower incidence of smoking cessation success (IRR=0.86, 95% CI: 0.81, 0.91), and smoking for twenty years, as compared to less than ten years, had a 51% lower incidence of smoking cessation success (IRR=0.49, 0.33, 0.71). After adjusting for demographic variables, neither smoking cessation method, as compared to counseling, was significant (pharmacological IRR=0.83, 95% CI: 0.56, 1.23; other IRR=0.74, 95% CI: 0.51, 1.08). Other covariates were no longer significant.

Model 5 included all previous covariates, as well as depressive symptoms (CES-D score of greater than 16), self-rated health perception (dichotomized as poor/fair or good/excellent), and self-rated overall quality of life (scale from 1 to 10). Having a good or excellent self-rated health perception, as compared to having a poor or fair health perception, was associated with a 59% increase in the rate of sustained smoking cessation success (IRR=1.59, 95% CI: 0.98, 2.58,

Table 7). With all covariates included, a higher number of cigarettes smoked per day was still associated with a reduction in the incidence of smoking cessation success (IRR=0.89, 95% CI: 0.83, 0.95), as was having smoked for greater than twenty years as compared to fewer than ten (IRR=0.46, 95% CI: 0.25, 0.85) and having smoked for ten to twenty years as compared to less than ten years (IRR=0.59, 95% CI: 0.34, 1.02). Not having a place of one's own to reside in, as compared to women who did have their own place of residence, was also still associated with a reduction in the incidence of smoking cessation success (IRR=0.50, 95% CI: 0.25, 0.99).

Discussion

  This study found that, after adjusting for covariates, method of smoking cessation was not significantly associated with a reduction in the incidence of achieving 6-12-month sustained smoking cessation, but other factors, like number of cigarettes smoked per day before quitting, number of years having been a smoker before quitting, having her own residence, and good to excellent self-rated health were all significantly associated with 6-12-month sustained smoking cessation among women in the WIHS. The methods with the highest proportion of women who achieved 6-12-month sustained smoking cessation were self-help interventions, quitting "on her own", quitting "cold turkey", and nicotine replacement therapy. This study also found that nicotine replacement therapy was the most commonly reported method of smoking cessation.

  The findings here are similar to the previous literature, which found that individual and counseling interventions have been effective in achieving smoking cessation among HIV-infected populations (Huber, 2012). Other covariates associated with 6-12-month sustained smoking cessation, such as self-rated health, number of cigarettes, and smoking history, were also similar to previous research on smoking cessation in the WIHS (Hessol, 2014).

  One strength of this study is that the Women's Interagency HIV Study's longitudinal design allows us to establish temporality. We know what women's smoking habits and other covariates were at the visit before they reported having quit smoking. The representativeness of the cohort, meant to represent women with HIV and at risk for HIV in the United States, also allows us to generalize our findings to the portion of this population in the United States that smokes and attempts to quit. Finally, a strength of this study is that it fills a gap in the literature by exploring the effectiveness of cessation methods among women smokers living with HIV.

The main limitation of this study is that women were only asked about cessation method as a follow-up question, if they first responded that they had quit smoking since their last visit. In other words, method of cessation was not assessed for women who may have tried to quit, but failed, between visits. Some more resource-intensive methods, such as specialist smoking cessation clinics, were not commonly reported (n=9), but it is not clear how accessible these methods were to the women in the study population. It is also unknown whether the women had tried to quit smoking before, and what methods she had used previously. Previous research estimates that smokers attempt to quit 30 or more times before quitting successfully (Chaiton, 2016). An understanding of a woman's quit attempt history would have been helpful in predicting her sustained smoking cessation success. Finally, another limitation is that the option for choosing e-cigarettes as a helpful cessation method was not introduced until October 2011. The study could therefore have missed women who used this method prior to its introduction on the questionnaire. These limitations should be taken into account when interpreting our conclusions.

This study has implications for interventions designed to assist HIV-infected and at-risk women in achieving smoking cessation. It provides information on the methods with the highest proportion of women who achieved 6-12-month smoking cessation and the most commonly reported methods in this population, which could be used to more effectively target interventions. Future interventions should recognize other factors that influence successful smoking cessation, like self-rated health and residence, and incorporate these concerns into their counseling. Some current research has taken this into account. A study by Balfour, et al (2017) found success in a randomized controlled trial by addressing depressive symptoms among HIV-infected smokers in combination with standard nicotine replacement therapy and counseling.

Future interventions should also expand access to methods that have been found in previous studies to be effective, such as group workshops, but were not commonly used in this population.

In conclusion, this analysis of smoking cessation methods among women smokers who tried to quit in the Women's Interagency HIV Study found that, in the unadjusted model, the most effective methods of achieving 6-12-month sustained smoking cessation were self-help interventions, quitting "on her own," other pharmacological aids, and quitting "cold turkey." Accounting for other factors, characteristics associated with the likelihood of achieving 6-12-month sustained cessation include number of cigarettes smoked per day at the visit before the quit attempt, smoking history, place of residence, and self-rated health. This study fills a gap in the literature on smoking cessation strategies for women smokers living with HIV. These findings could help clinicians and researchers more effectively tailor interventions for smoking cessation in this population in the future.

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Tables

Table 1: Baseline characteristics of current smokers by smoking cessation method category in the WIHS (April 1, 2008 - March 31, 2016), N=595

	Counseling	Pharmacological	Other
	N (%)	N (%)	N (%)
Age group			
18-29	3 (2)	5 (2)	14 (4)
30-39	25 (17)	39 (15)	77 (23)
40-49	61 (40)	101 (39)	106 (32)
$\geq$50	68 (45)	125 (49)	154 (46)
Enrollment wave			
1994-1995	87 (58)	137 (53)	168 (50)
2001-2002	37 (25)	73 (28)	120 (36)
2011-2012	27 (18)	47 (18)	45 (14)
Race/ethnicity			
African-American	97 (64)	164 (64)	219 (66)
Hispanic	21 (14)	39 (15)	68 (20)
White	27 (18)	48 (19)	36 (11)
Other	6 (4)	6 (2)	10 (3)
Number of years smoked			
0-10	11 (7)	9 (4)	48 (14)
10-19	36 (24)	51 (20)	68 (20)
$\geq$20	106 (70)	201 (78)	224 (67)
HIV Status			
Uninfected	35 (23)	86 (33)	116 (35)
Infected	116 (77)	171 (67)	217 (65)

Counseling methods: smoking cessation advice, individual counseling, self-help interventions, group sessions/workshops, telephone helplines, and specialist smoking cessation clinics. Pharmacological methods: nicotine replacement therapy, other pharmacologic aids, electronic cigarettes. Other methods: acupuncture, homeopathy, hypnotherapy, exercise, other. Method categories are not mutually exclusive.

Table 2: Smoking cessation by cessation method* among women who reported having quit in the WIHS (April 1 2008 to March 31 2016)

	6-12-month sustained smoking cessation (N=203)	<6-month smoking cessation (N=392)	Women who achieved 6-12-month cessation/all women who tried the method
	N (%)	N (%)	
Counseling			
Advice	9 (4)	34 (9)	0.21
Individual counseling	5 (2)	16 (4)	0.24
Self-help interventions	28 (14)	49 (13)	0.36
Group sessions/workshops	2 (1)	14 (4)	0.13
Telephone help-lines	7 (3)	20 (5)	0.26
Specialist smoking cessation clinics	1 (0.5)	8 (2)	0.11
Total	40 (20)	82 (21)	0.33
Pharmacological			
Nicotine replacement therapy	52 (26)	141 (36)	0.27
Other pharmacological aid	16 (8)	34 (9)	0.32
E-cigarettes	12 (6)	34 (9)	0.26
Total	67 (33)	173 (44)	0.28
Other			
Acupuncture	2 (1)	10 (3)	0.17
Homeopathy	3 (1)	1 (0.3)	0.75
Hypnosis	2 (1)	8 (2)	0.20
Exercise	6 (3)	20 (5)	0.23
"Cold turkey"	29 (14)	69 (18)	0.30
"On her own"	28 (14)	52 (13)	0.35
Other	13 (6)	64 (16)	0.17
Total	80 (39)	189 (48)	0.30

*Categories not mutually exclusive.

Table 3: Model 1, univariate incidence rate ratio of 6-12-month sustained smoking cessation among women who reported having quit in the WIHS (April 1, 2008 to March 31, 2016)

	IRR (95% CI)	Robust Standard Error
Cessation method		
Counseling	1.00 (reference)	
Pharmacological	0.55 (0.38, 0.80)	0.10
Other	0.61 (0.43, 0.86)	0.11
Constant	0.42 (0.31, 0.56)	0.06

Table 4: Model 2, incidence rate ratio of 6-12-month sustained smoking cessation among women who reported having quit in the WIHS (April 1 2008 to March 31 2016), adjusted for smoking history characteristics

	IRR (95% CI)	Robust Standard Error
Cessation method		
Counseling	1.00 (reference)	
Pharmacological	0.71 (0.50, 1.02)	0.13
Other	0.63 (0.45, 0.88)	0.11
Number of cigarettes smoked daily (+1)	0.85 (0.80, 0.90)	0.02
Smoking history		
<10 years	1.00 (reference)	
10-20 years	0.71 (0.50, 1.01)	0.13
>20 years	0.59 (0.44, 0.80)	0.09
Constant	0.73 (0.51, 1.04)	0.13

*Smoking history characteristics adjusted for were number of cigarettes smoked per day and number of years smoked.

Table 5: Model 3, incidence rate ratio of 6-12-month sustained smoking cessation among women who reported having quit in the WIHS (April 1 2008 to March 31 2016), adjusted for smoking history and substance use characteristics

	IRR (95% CI)	Robust Standard Error
Cessation method		
Counseling	1.00 (reference)	
Pharmacological	0.70 (0.50, 1.00)	0.13
Other	0.62 (0.44, 0.86)	0.10
Number of cigarettes smoked daily (+1)	0.85 (0.80, 0.90)	0.03
Smoking history		
<10 years	1.00 (reference)	
10-20 years	0.72 (0.50, 1.04)	0.13
>20 years	0.59 (0.44, 0.80)	0.09
Number of drinks per week	1.00 (0.99, 1.01)	0.00
Injected drugs since last visit		
No	1.00 (reference)	
Yes	1.40 (0.39, 4.92)	0.90
Non-injected recreational since last visit		
No	1.00 (reference)	
Yes	0.88 (0.67, 1.16)	0.12
Use of rx drugs in way not prescribed		
No	1.00 (reference)	
Yes	1.02 (0.26, 4.01)	0.71
Constant	0.77 (0.53, 1.13)	0.15

Table 6: Model 4, incidence rate ratio of 6-12-month sustained smoking cessation among women who reported having quit in the WIHS (April 1 2008 to March 31 2016), adjusted for smoking history, substance use, and demographic characteristics

	IRR (95% CI)	Robust Standard Error
Cessation method		
Counseling	1.00 (reference)	
Pharmacological	0.83 (0.56, 1.23)	0.17
Other	0.74 (0.51, 1.08)	0.14
Number of cigarettes smoked	0.85 (0.81, 0.91)	0.03
Smoking history		
<10 years	1.00 (reference)	
10-20 years	0.69 (0.47, 1.01)	0.13
>20 years	0.49 (0.33, 0.71)	0.10
Number of drinks per week	1.00 (0.99, 1.01)	0.00
Injected drugs since last visit		
No	1.00 (reference)	
Yes	1.65 (0.45, 6.05)	1.10
Non-injected recreational since last visit		
No	1.00 (reference)	
Yes	0.96 (0.71, 1.28)	0.14
Use of rx drugs in way not prescribed		
No	1.00 (reference)	
Yes	1.28 (0.39, 4.23)	0.78
Education		
Less than high school	1.00 (reference)	
High school	1.13 (0.81, 1.58)	0.19
More than high school	1.19 (0.87, 1.62)	0.19
Race/ethnicity		
African American	1.00 (reference)	
Hispanic	1.40 (1.05, 1.87)	0.21
White	1.25 (0.87, 1.77)	0.22
Other	0.65 (0.19, 2.24)	0.41
WIHS wave		
1994/95 recruit	1.00 (reference)	
2001/02 recruit	0.84 (0.61, 1.17)	0.14
2011/12 recruit	0.72 (0.47, 1.10)	0.16
Age	1.01 (0.99, 1.03)	0.01
Has health insurance		
No	1.00 (reference)	
Yes	1.11 (0.70, 1.77)	0.26

Lives in her own place			
	No	1.00 (reference)	
	Yes	0.53 (0.33, 0.85)	0.13
Income greater than $12,000/year			
	No	1.00 (reference)	
	Yes	0.96 (0.75, 1.23)	0.12
Currently pregnant			
	No	1.00 (reference)	
	Yes	1.08 (0.58, 2.02)	0.34
Parity		0.99 (0.93, 1.05)	0.03
HIV-infected			
	No	1.00 (reference)	
	Yes	0.91 (0.69, 1.21)	0.13
Constant		1.16 (0.31, 4.34)	0.78

Table 7: Incidence rate ratio of 6-12-month sustained smoking cessation among women who reported having quit in the WIHS (April 1 2008 to March 31 2016), adjusted for smoking history, substance use, demographic characteristics, and depression, self-rated health, and quality of life

	IRR (95% CI)	Robust Standard Error
Cessation method		
Counseling	1.00 (reference)	
Pharmacological	1.10 (0.60, 2.02)	0.34
Other	1.09 (0.59, 2.01)	0.34
Number of cigarettes smoked	0.89 (0.83, 0.95)	0.03
Smoking history		
<10 years	1.00 (reference)	
10-20 years	0.59 (0.34, 1.02)	0.16
>20 years	0.46 (0.25, 0.85)	0.14
Number of drinks per week	1.00 (0.99, 1.02)	0.01
Injected drugs since last visit		
No	1.00 (reference)	
Yes	0.00 (0.00, 0.00)	0.00
Non-injected recreational since last visit		
No	1.00 (reference)	
Yes	0.95 (0.62, 1.44)	0.20
Use of rx drugs in way not prescribed		
No	1.00 (reference)	
Yes	0.70 (0.12, 4.01)	0.62
Education		
Less than high school	1.00 (reference)	
High school	1.33 (0.85, 2.08)	0.30
More than high school	1.21 (0.81, 1.82)	0.25
Race/ethnicity		
African American	1.00 (reference)	
Hispanic	1.11 (0.73, 1.69)	0.24
White	1.25 (0.82, 1.91)	0.27
Other	0.00 (0.00, 0.00)	0.00
WIHS wave		
1994/94 recruit	1.00 (reference)	
2001/02 recruit	0.63 (0.40, 1.00)	0.15
2011/12 recruit	0.58 (0.31, 1.10)	0.19
Age	1.00 (0.91, 1.03)	0.01
Has health insurance		
No	1.00 (reference)	
Yes	0.80 (0.43, 1.50)	0.26
Lives in her own place		

No	1.00 (reference)	
Yes	0.50 (0.25, 0.99)	0.18
Income greater than $12,000/year		
No	1.00 (reference)	
Yes	0.81 (0.56, 1.17)	0.15
Currently pregnant		
No	1.00 (reference)	
Yes	1.10 (0.56, 2.16)	0.38
Parity	0.98 (0.90, 1.06)	0.04
HIV-infected		
No	1.00 (reference)	
Yes	1.03 (0.68, 1.56)	0.22
CES-D score >16 (depressed)		
No	1.00 (reference)	
Yes	0.72 (0.45, 1.17)	0.18
Good to excellent self-rated health		
No	1.00 (reference)	
Yes	1.59 (0.98, 2.58)	0.39
Quality of life scale	0.97 (0.88, 1.07)	0.05
Constant	2.29 (0.31, 4.34)	0.78

Figure 1: Study Population Flowchart

2,511 women in the WIHS → 1065 current smokers at baseline (visit 28 or first visit after V28) → 685 quit attempts (some women have multiple quit attempts) → 595 women included in analysis (using each woman's first quit attempt, not including 90 later repeat attempts for some women)
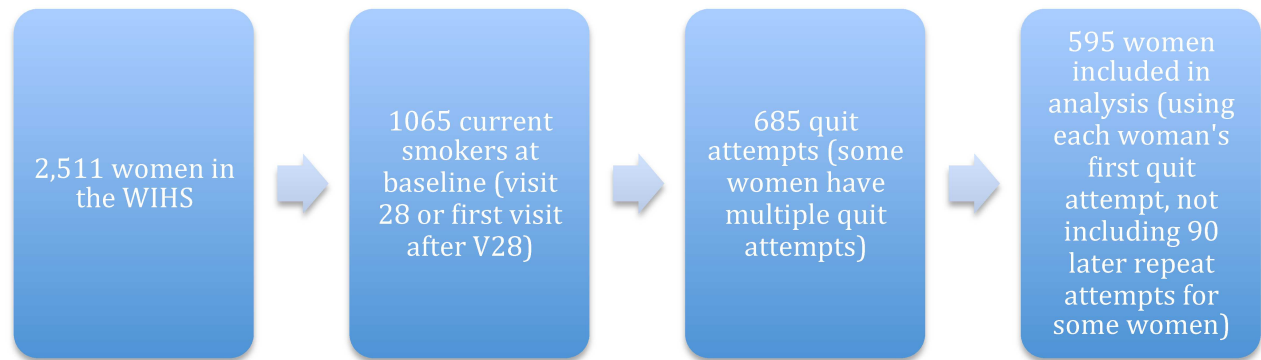
Curriculum Vitae

Education
Johns Hopkins Bloomberg School of Public Health **Expected Graduation August 2017**
Master of Science in Epidemiology, General Epidemiology and Methods track
Masters Thesis: Investigating the effectiveness of methods of smoking cessation among women in the Women's Interagency HIV Study. Advised by Dr. Elizabeth Golub.

The Ohio State University **Graduated May 2015**
Bachelor of Science in Public Health, Minor in Statistics, Cum Laude with Research Distinction

Experience
Section Instructor, Fundamentals of Epidemiology Course at Johns Hopkins University
September 2016 – Present
- Independently lead weekly review section of undergraduate epidemiology course for 25 students
- Assist in creating exam questions, grading assignments, and proctoring exams

Research Assistant, Baltimore Syringe Exchange Program **September 2016 – Present**
- Recruit, consent, and interview non-clients of the Baltimore Syringe Exchange Program in West Baltimore to evaluate barriers to SEP use and characteristics of non-client drug use
- Attend study meetings, perform data entry, and coordinate with a team of fellow interviewers

Qualitative Coding Research Assistant, Department of Epidemiology
June 2016 – Present
- Qualitatively code 40 interviews with female sex workers in Port Elizabeth, South Africa
- Work collaboratively with a fellow research assistant to create codebook of 30 variables and resolve discrepancies in coding

Research Assistant, Department of Health Behavior and Society
June 2016 – August 2016
- Conducted analyses linking Maryland's Prescription Drug Monitoring Program with the Maryland Department of Health and Mental Hygiene Opioid Overdose Database, investigating the relationship between number and type of prescription to overdose death
- Cleaned, recoded, and analyzed data in SAS

Study Coordinator and Research Assistant, Department of Epidemiology
June 2016 – August 2016
- Recruited, consented, and interviewed more than 50 HIV positive patients to the OHIP Study, a multi-site case-control investigation of the relationship of HIV and HPV, supervised by Professor Amber D'Souza
- Ensured accurate and timely collection, shipping, and coordination of survey results and specimen samples for testing

Office and Research Assistant, Division of Epidemiology **October 2012 – July 2015**
- Assisted Professor Sarah E. Anderson with research by assembling literature reviews, maintaining EndNote libraries, performing statistical analyses in SAS, and proofing manuscripts
- Performed office duties, including faculty recruitment and editing online faculty CVs

Publications

Newman SL, Tumin R, Andridge A, Anderson SE. (2015) Family meal frequency and association with household food availability in United States multi-person households: National Health and Nutrition Examination Survey 2007-2010. PLoS ONE 10(12): e0144330. doi: 10.1371/journal.pone.0144330

Activities

Co-Social Chair, Epidemiology Student Organization **August 2016 – Present**
- Plan, secure event space, and procure catering for social events for a diverse group of students and faculty, including a 120-person mixer to celebrate the new academic year, and an 80-person picnic to welcome back students
- Coordinate student happy hours once per term to facilitate discussion and networking

Co-Coordinator, General Epidemiology and Methodology Journal Club **August 2016 – Present**
- Coordinate monthly journal club meetings of 30 students and faculty to discuss important papers in the field of epidemiology
- Lead discussions and assist new students in presenting in journal club on their own

Honors
- Master's Tuition Scholarship, Johns Hopkins Bloomberg School of Public Health
- University Honors Program, The Ohio State University
- Medalist and Lewis Heldt Scholarships, The Ohio State University