Predictors of Cessation Outcomes Among Older Adult Smokers Enrolled in a Proactive Tobacco Quitline Intervention

Margaret C. Fahey

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PREDICTORS OF CESSATION OUTCOMES AMONG OLDER ADULT SMOKERS
ENROLLED IN A PROACTIVE TOBACCO QUITLINE INTERVENTION

By

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A Dissertation
Submitted in Partial Fulfillment of the
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Abstract

The prevalence of cigarette smoking has not declined among older adults. Further, this age group is more impacted by the negative health effects of smoking. Cessation trials rarely report quitting outcomes exclusively among older adults and fewer explore individual characteristics which impact cessation within this population. This study aimed to identify individual characteristics predicting an older adult smoker’s likelihood of successful quitting after engaging in a proactive tobacco quit line intervention. Older adult (≥60 years) TRICARE beneficiaries enrolled in a four-session proactive tobacco quit line with eight-weeks of nicotine replacement therapy reported demographics and information about cigarette use history, previous quit attempts, ever use of cessation resources, current use of other tobacco products, beliefs about cessation, confidence to quit, and reasons for quitting at baseline. Cessation (i.e., seven-day abstinence) was reported at 3 and 12-month follow-ups. In final logistic regression models, each unit increase in endorsement of quitting to take control of one’s life and one-unit increase in confidence in quitting some day were associated with a 74% and 75% increased likelihood of quitting at 3 months, respectively ($OR=1.74$, $95\% CI=1.16, 2.62$; $OR=1.75$, $95\% CI=1.21, 2.52$). At 12 months, a one-unit increase in endorsement of quitting to take control of one’s life and each decreased score in nicotine dependence were associated with a 51% and 19% increased likelihood of being quit, respectively ($OR=1.51$, $95\% CI=1.05, 2.17$; $OR=0.84$, $95\% CI=0.71, 0.99$). Older adult cessation programs might provide additional support to those with higher nicotine dependence, promote quitting self-efficacy, and encourage quitting as means to gain control of life and health.
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Predictors of Cessation Outcomes Among Older Adult Smokers Enrolled in a Tobacco Quitline Intervention

Approximately 14% of the U.S. population (i.e., 34.2 million adults) smoke cigarettes, and this use constitutes the leading cause of disease and preventable death (Cornelius et al., 2020; World Health Organization, 2019). Unlike other age groups, which have shown significant declines in cigarette prevalence since the first Surgeon’s General Report in 1964, rates among U.S. adults over age 65 years have not decreased [Cornelius et al., 2020; U.S. Department of Health and Human Services (US DHHS), 2014; US DHHS, 2020]. In fact, the prevalence of cigarette smoking among older adults, a population expected to double between 2012 and 2050, is slowly rising (Cornelius et al., 2020; Creamer et al., 2019; Ortman et al., 2019; US DHHS, 2020). Today, 8.2% of individuals over age 65 years use cigarettes compared to 6.8% in 2000 (Cornelius et al., 2020; US DHHS, 2020). Further, older age increases the risk of severe illness and hospitalization from COVID-19 [Center for Disease Control (CDC), 2021a], and this risk continues to increase if an individual is a current smoker (CDC, 2021b). Thus, it will be an important public health initiative for tobacco prevention and cessation efforts to target older adults in order to reduce cigarette rates in this population as in other age groups.

Health Effects of Cigarette Use in Older Age

The lack of declining cigarette rates among older adults is concerning, given that this age group is more likely to be impacted by tobacco related morbidity and mortality than younger smokers (Mons et al., 2015; US DHHS, 2014). In fact, more than 70% of smoking-related deaths are experienced by those over the age of 60 years (Cataldo, 2019; Jamal et al., 2018). There is extensive literature documenting the negative health effects of cigarette smoking in later life (Andrews et al., 2004; Mons et al., 2015; US DHHS, 2014). Among those over the age of 60
years, smoking independently contributes to the incidence of strokes, acute coronary events, and cardiovascular deaths (Mons et al., 2015). An older adult who uses cigarettes is almost twice as likely to have an acute coronary event or stroke (Mons et al., 2015). Further, smoking doubles an older adult’s risk of cardiovascular mortality and decreases the lifespan up to 5.5 years (Mons et al., 2015). Cigarette use also exacerbates chronic health conditions (e.g., circulatory and vascular conditions, diabetes, osteoporosis) which are more likely to occur in older age, and smoking can decrease the levels of certain prescription drugs in the bloodstream (e.g., propranolol) (Andrews et al., 2004; Rimer et al., 1990; US DHHS, 2014). Not surprisingly, this age group contributes to the highest burden of tobacco morbidity, mortality, and U.S. health care costs compared to other ages (Mons et al., 2015; US DHHS, 2014). Understanding how and why older adults use cigarettes can help cessation interventions reduce the substantial health disadvantages and financial burden of tobacco.

**Correlates of Cigarette Use in Older Age**

There is a paucity of recent literature examining individual factors associated with cigarette smoking among older adults (Cataldo, 2019; Kulak & LaValley, 2018); however, it is clear from existing studies that older adult smokers are a unique population with differing characteristics than younger smokers (Babb et al., 2017; Cataldo et al., 2015a; Kulak & LaValley, 2018; Kerr et al., 2006; Orleans et al., 1991; Yong et al., 2005). In a U.S. national sample comparing older and younger smokers, older adults smoked for a longer period of time, smoked more cigarettes per day, had higher nicotine dependence, and reported more previous quit attempts (Orleans et al., 1991). More recently, Jordan and colleagues (2017) found that older cigarette smokers (up to age 70 years) had higher nicotine dependence than those younger (Jordan et al., 2017). However, those above 70 years were actually less nicotine dependent than
other age groups (Jordan et al., 2017). Unlike previous findings (Orleans et al., 1991), recent research indicated that older smokers were less likely to have made a quit attempt in the past year (Babb et al., 2017; Jordan et al., 2017).

In samples of exclusively older adults, gender, age, race/ethnicity, socioeconomic status, mental and physical health, and social support are all factors which have differentiated the likelihood of being a smoker rather than a non-smoker (Choi & DiNitto, 2015; Sachs-Ericsson et al., 2009). Choi and DiNitto (2015) found that current smoking (compared to never smoking) was associated with male gender, younger age, non-Hispanic White race, lower education and income, more depressive symptoms and greater social isolation. These factors, along with a higher rate of chronic illnesses, were also associated with formerly smoking (compared to never smoking) (Choi & DiNitto, 2015). Other research comparing smoking and non-smoking groups found that current smokers were younger (within older age), more likely to be male, and had a lower income (Sachs-Ericsson et al., 2009). Although some research found smokers (compared to non-smokers) had fewer physical functioning problems (Sachs-Ericsson et al., 2009), other findings found no such differences in health status (Choi & DiNitto, 2015). Yet, comparisons broadly between smoking and non-smoking groups are challenging to interpret, given that non-smokers include both former and never smokers.

Inconsistencies in the literature on factors unique to older adult smoking might be due to variability in the year that these studies were conducted, as well as age group differences even within older adulthood (i.e., 60 – 70 years versus 70+ years of age) (Choi & DiNitto, 2015; Jordan et al., 2017; Orleans et al., 1991; Sachs-Ericsson et al., 2009). Notably, this previous research does suggest that the age of the smoker likely influences level of nicotine dependence, smoking duration, and number of previous quit attempts. Further, male gender, lower
socioeconomic status, poorer mental health, as well as decreased social support, are possibly factors common among smokers in older age. In conclusion, older smokers are likely to have greater nicotine dependence, more psychiatric comorbidity, and fewer social resources which are factors that can make it more difficult to quit smoking.

**Beliefs About Smoking**

Older adult cigarette smokers (compared to younger ones) have consistently been found to underestimate harms of tobacco and the benefits of cessation (Cataldo, 2019; Goldberg et al., 2018; Kerr et al., 2006; Kulak & LaValley, 2018; Yong et al., 2005). Specifically, smokers in older age have been found to be less likely to agree that cigarettes are harmful and more likely to report that there would be no benefits to quitting (Goldberg et al., 2018; Yong et al., 2005). Not surprisingly, older smokers were also less confident than younger smokers in their ability to quit cigarettes (Yong et al., 2005). Similarly, Kulak and LaValley (2018) compared smoking beliefs in those over the age of 65 years to those younger. Older adults were more likely to endorse the belief that smoking is something about a person that cannot be changed and were more likely to be misinformed about the role of nicotine in addiction (Kulak & LaValley, 2018). These findings have been replicated in a qualitative study as well, in which older adult cigarette users more frequently discussed concerns about the negative consequences of quitting than the potential benefits of cessation (Kerr et al., 2006). Overall, the literature indicates that older smokers hold false beliefs about cigarette harm and cessation benefits.

An underestimation of smoking harm in this population is likely attributable to the commonly held misbelief across all ages that the “damage is done” for older smokers— in other words, cigarette cessation is believed to have little benefit for someone in older age (Kerr et al., 2006; Yong et al., 2005). Contributing to a lack of education about older adult cessation, anti-
smoking campaigns and messages are largely youth focused (Cataldo et al., 2015a; Cataldo, 2019). In fact, a qualitative exploration found that older cigarette users were not inspired to quit by anti-smoking advertisements, and many reported these advertisements actually triggered smoking cravings (Cataldo et al., 2015a). Further, the older population has had a longer history of exposure to positive messages and false beliefs about cigarettes from tobacco companies (Cataldo et al., 2015b; Cataldo & Malone, 2008; Cataldo, 2019). For example, the tobacco industry has historically promoted the idea that cigarette use is an adult choice rather than a nicotine addiction (Cataldo, 2019; Balbach et al., 2006). For decades, tobacco companies have also advertised “low-tar” and “light” cigarettes as a “safer alternative to cigarettes,” and these products are more commonly used by older populations (Cataldo et al., 2015b; Cataldo & Malone, 2008; Cataldo, 2019; Donzé et al., 2007). Because older adults have a longer history of tobacco advertising exposure and are less likely to receive relevant anti-smoking messages, it is not surprising that this population retains more positive beliefs about smoking and might be misinformed about cessation.

**Cigarette Cessation in Older Age**

Despite the widely held perception that quitting smoking does not benefit older adults, smoking cessation does have significant short- and long-term health advantages for this age group (Doll et al., 2004; US DHHS, 2020). In fact, cessation at age 60 can increase the life span by three years (Doll et al., 2004). At any age, smoking cessation reduces the risk of developing or dying from many types of cancer (e.g., lung, pancreatic, kidney, cervical), as well as cardiovascular disease and stroke (US DHHS, 2020). In the short term, smoking cessation can enhance an individual’s quality of life by improving the quality of comorbid chronic health conditions and diminishing the financial burden of cigarettes (US DHHS, 2020).
**Cessation Resources**

There are a number of available free or cost-reduced tobacco cessation resources for older adults [CDC, 2020b; Centers for Medicare & Medicaid Services (CMS), 2016; CMS, 2019; U.S. Food and Drug Administration (FDA), 2017; Lichtenstein et al., 2010; National Cancer Institute (NCI), 2019]. For example, Medicare (i.e., federal health insurance program for those ≥ 65 years) covers up to eight individual counseling sessions annually to aid in quit attempts, and also helps cover FDA-approved cessation pharmacotherapy [i.e., nicotine replacement therapy (NRT), Chantix (varenicline tartrate), and Zyban (bupropion hydrochloride)] with cost-sharing (CMS, 2016; CMS, 2019; FDA, 2017). NRT (in the form of patches, chewing gum, and lozenges) is offered by prescription and over the counter (FDA, 2017). Although older adults are more likely to experience polypharmacy drug interactions, which can lower levels of medications in the bloodstream, NRT has been found effective for smoking cessation among older adults (Andrews et al., 2004; Cawkwell et al., 2015). The cessation medications Chantix and Zyban have been deemed safe for use in older adulthood (Cawkwell et al., 2015). However, the effectiveness of these medications in this population is understudied, with no placebo-controlled trials conducted within exclusively older adult samples (Cawkwell et al., 2015; Chen & Wu, 2015; Kleykamp & Heishman, 2011). Finally, free cessation information and guides are available online, as well as online information tailored specifically to those in older age (CDC, 2020b; NCI, 2019).

**Tobacco Quit Lines**

Tobacco quit lines, a telephone-based resource, have been widely used as a cost-effective cessation intervention in every U.S. state (Lichtenstein et al., 2010). Individuals interested in quitting can initiate services by calling a quit line number, receiving an intervention which
improves quit rates compared to minimal intervention (e.g., pharmacotherapy alone, brief advice or self-help materials) (Lichtenstein et al., 2010; Stead et al., 2013). Estimates from pooled studies suggests a modest effect of proactive telephone quit line (compared to no intervention; Stead et al., 2013). A modest effect was also found when comparing cessation rates among individuals who completed more than one quit line call to those in control groups who completed only one quit line call or received self-help materials (Stead et al., 2013). Quit rates in these control groups ranged from 1.5 to 12%, or up to 17% if free NRT was offered (Stead et al., 2013). Those randomized to quit lines had cessation rates from five to 14%, or up to 21% if NRT was offered (Stead et al., 2013). State-based tobacco quit lines are typically free and services can include mailed material, counseling at the time of the call, callback by a counselor, recorded messages from a counselor, NRT starter packs, or some combination of these services [Lichtenstein et al., 2010; North American Quitline Consortium (NAQC), 2019]. Generally, quit lines are convenient, diminish logistical barriers to care, and offer access to anonymous counseling (Lichtenstein et al., 2010).

There are some characteristics of tobacco quit lines that facilitate even better cessation outcomes (Stead et al., 2013). More frequent proactive (i.e., counselor initiated) calls compared to less frequent or reactive (i.e., tobacco user initiated) calls increase quit rates (Stead et al., 2013). In both state-based quit lines and interventions including quit lines, treatment engagement (i.e., increased number of calls with a counselor) is associated with higher self-reported and biochemical cessation success (Bernstein et al., 2016; Biazzo et al., 2010; Stead et al., 2013; Zbikowski et al., 2011). More specifically, a Cochrane review found some evidence that completing at least three calls (compared to fewer) was associated with long-term self-reported quit success among adults enrolled in tobacco quit line trials (Stead et al., 2013). Thus, tobacco
quit lines are a widely accessible and cost-effective resource in which treatment engagement increases the chances of long-term cessation.

**Underutilization of Resources**

Despite substantial health benefits across the lifespan and availability of free cessation resources, older adult cigarette users are less interested in quitting and are less likely to access cessation resources or treatment compared to younger smokers (Babb et al., 2017; CDC, 2020b; CMS, 2016; CMS, 2019; FDA, 2017; Henley et al., 2019; Lichtenstein et al., 2010; NCI, 2019; US DHHS, 2020). In a recent nationally representative sample, although more than half (54%) of older smokers were interested in quitting and 47% had attempted to quit, only 5% succeeded (Henley et al., 2019). Comparatively, in the most recent nationally representative report of U.S. adult tobacco quitting behavior, 68% of adult smokers were interested in quitting, 55% had attempted to quit in the past year, and 7% were successful (Babb et al., 2017). In the nationally representative sample observed by Henley and colleagues (2019), among older adults interested in quitting, or older adults who had successfully quit, only about one third had tried counseling (e.g., individual, group, quit line) or FDA-approved pharmacotherapy (37% and 34%, respectively). Many fewer (6%) had concurrently tried both counseling and FDA-approved pharmacotherapy, which is the gold standard cessation approach for adult smokers (Henley et al., 2019; US DHHS, 2020).

Tobacco quit lines are a resource that older smokers are less aware of compared to younger smokers (Kaufman et al., 2010; Kulak & LaValley, 2018). One study found that individuals between the ages of 18 and 34 years were more than twice as likely to know of quit lines compared to those over the age of 65 years (Kaufman et al., 2010). Although older age was associated with greater likelihood of actually calling a quit line, this association was not found
after controlling for other important factors (i.e., smoking status, psychological distress, cancer history; Kaufman et al., 2010). Further, a recent study found that older adults were less likely to access quit lines compared to those in mid-life (Kulak & LaValley, 2018). Thus, lack of awareness might be deterring older adults from initiating treatment with this widely available and free cessation resource.

Other barriers can impact older adults’ ability to get information about cessation treatment. For example, across studies, older adult medical patients were less likely than younger patients to receive advice from healthcare providers about tobacco cessation (Huddleston et al., 2015; Jordan et al., 2017; Kerr et al., 2006). In a national sample in England, conversations with a physician about cessation during primary care visits differed by patient age (Jordan et al., 2017). Older smokers were less likely to discuss smoking during their appointment, be prescribed NRT, be referred for counseling, or be offered cessation support compared to younger age groups (Jordan et al., 2017). When interviewing primary care physicians in England, Huddlestone and colleagues (2015) found that although most (90%) reported asking older adults about their smoking status, only 59% provided an older adult with cessation support (Huddleston et al., 2015). Although a national report in the U.S. found that older smokers were more likely than young adults to receive brief advice from a physician to quit smoking, older adults were less likely to actually use cessation resources (Babb et al., 2017). Overall, the literature suggests that despite typically receiving brief advice, older medical patients are less likely to receive substantial education and support when trying to quit. Perhaps, widespread false beliefs about the health benefits of cessation in older age might deter medical providers from facilitating access to cessation treatment for an older adult patient. Lack of information about
how to access cessation treatment in these settings might be negatively impacting an older adult’s likelihood of quitting.

**Electronic Cigarettes and Cigarette Cessation**

Electronic nicotine delivery systems (ENDS) (i.e., e-cigarettes, vaporizers) have increased drastically in prevalence in the U.S. (Cornelius et al., 2020; US DHHS, 2016). Although this product is more common among adolescents and young adults, rates of use among older adults are increasing as well and less is understood about how and why these products are used in older age (Cataldo et al., 2015b; Cornelius et al., 2020; Creamer et al., 2019; US DHHS, 2016).

In the general adult population, there is some evidence supporting the efficacy of nicotine-containing e-cigarettes for tobacco cessation in treatment seeking smokers (Farsalinos, 2018; El Dib et al., 2017; Malas et al., 2016; McRobbie et al., 2014; Rahman et al., 2015). However, results from randomized controlled trials and observational cohort studies are limited and of low certainty, often using convenience samples lacking generalizability across various populations (Farsalinos, 2018; El Dib et al., 2017). In addition, these products are diverse and constantly evolving, which makes it challenging to develop well-designed studies representing current patterns of use (Farsalinos, 2018). The use of ENDS for cigarette cessation remains controversial, particularly given a rise in emergency department visits beginning in August 2019 due to lung injury from vitamin E acetate found in these products (CDC, 2020a; Glasser et al., 2017; Farsalinos, 2018; Warner, 2019). Although cases of e-cigarette and vaping related lung injury have slowly been declining, and vitamin E acetate was most commonly found in tetrahydrocannabinol (THC)-containing products, the CDC still warns that there is not sufficient evidence to rule out other chemicals of concern in either THC or non-THC vaping products.
Thus, these products are not an FDA-approved cessation tool (FDA, 2017). Nonetheless, e-cigarettes are more commonly used by adults in quit attempts than all FDA-approved products combined (Benmarhnia et al., 2018; Caraballo et al., 2017).

There is limited research observing e-cigarette use patterns among older adult cigarette smokers. In a nationally representative sample of older smokers (≥ 65 years), most (60%) had tried e-cigarettes; although, it is unclear what percentage of these individuals tried e-cigarettes specifically for cigarette cessation (Goldberg et al., 2018). Among older smokers, those who were seriously considering cigarette cessation held more positive beliefs about e-cigarettes than those not interested in cigarette cessation (Goldberg et al., 2018). Specifically, these older adults more strongly agreed that e-cigarettes help individuals quit and that e-cigarette flavors can facilitate quit success (Goldberg et al., 2018). Similarly, in qualitative explorations, older individuals were commonly interested in e-cigarettes as a cigarette cessation aid and reported the convenience of using this product in locations forbidding cigarette smoking (Cataldo et al., 2015b). This literature suggests that older adult cigarette smokers hold positive beliefs about e-cigarettes and perhaps use these products to help quit cigarettes. However, information about the use of e-cigarettes among older adults trying to quit cigarettes is sparse. To our knowledge, no studies have explored how ENDS impact long-term cigarette cessation exclusively among older smokers.

In tobacco quit lines, the use of ENDS products is common among adults of all ages (Vickerman et al., 2013; Vickerman et al., 2021). Vickerman and colleagues (2013) found that about one third (31%) of adults enrolled in quit lines had ever used e-cigarettes, mostly to quit tobacco products (51.3%) or to replace with other tobacco products (15.2%) (Vickerman et al., 2013). Yet, ever-use of e-cigarettes (regardless of the duration of use) was associated with poorer
quit success seven months after completing the quit line (Vickerman et al., 2013). Perhaps individuals who used e-cigarettes for cigarette cessation were those who needed the most support and resources with their quit attempts. In a more recent study, Vickerman and colleagues (2021) found that in 2018, about 15% of adults in quit lines across 23 states and the District of Columbia were currently using ENDS products, and the majority (71.8%) were using these products to help quit cigarettes (Vickerman et al., 2021). To our knowledge, no study has examined the use of e-cigarettes for cigarette cessation in relationship to quit outcomes among older adults participating in a tobacco quit line. Further, no study has explored how the dual use of other tobacco products (i.e., smokeless tobacco, cigars, little cigarillos, hookah) with cigarettes impact long-term cessation outcomes among older adults enrolled in a tobacco quit line.

**Cessation Interventions**

Despite being less aware of cessation treatments, when older adults do enroll into cessation interventions, they experience similar rates of quit success compared to adults of other ages. Reviews of the literature consistently indicate that treatment-seeking older adult smokers are highly likely to quit smoking (Abdullah & Simon, 2006b; Chen & Wu, 2015; Doolan & Froelicher, 2008; Zbikowski et al., 2012). Specifically, the most recent meta-analytic review of randomized controlled trials reporting outcomes among those aged ≥ 50 years found significant treatment effects for pharmacological (i.e., NRT or cessation medication), non-pharmacological, and multimodal interventions (i.e., pharmacology and behavioral intervention combined; Chen & Wu, 2015). Across studies, which typically defined cessation as seven-day abstinence from smoking at follow-up, for older adults the average quit rate for multimodal interventions was highest (36.7%), followed by pharmacological (29.7%) and non-pharmacological (23.7%) compared to control conditions (15.6%; Chen & Wu, 2015). Additionally, longer time to follow-
up was associated with less likelihood of quit success (Chen & Wu, 2015). Results from this meta-analysis also suggest increasing age might actually improve quit success (Chen & Wu, 2015). Specifically, a one-year increase in the lower bound of the age range (i.e., minimum age included in older adult study sample) was associated with a 0.42 percentage point increase in abstinence rate (Chen & Wu, 2015). Further, Doolan and Froelicher (2008) found that women over the age of 62 years had significantly higher quit success compared to younger women (i.e., 52.0% vs. 38.1%, respectively). Thus, there is extensive evidence that older adults are able to successfully quit when receiving various types of cessation treatment.

**Cessation Outcomes**

Research comparing older adult former smokers to those who continue to use cigarettes can help identify what makes it easier for an older adult to quit. In cross-sectional studies of older adults, characteristics associated with formerly, rather than currently, smoking have been identified (Abdullah et al., 2006a; Pengpid & Peltzer, 2019; Weaver et al., 2018). These characteristics included older age, male gender, living alone, needing mobility assistance, having chronic health conditions, not using alcohol, smoking more cigarettes per day, and smoking for a shorter duration (Abdullah et al., 2006a; Pengpid & Peltzer, 2019). Among older women exclusively, not having a favorite type of cigarette (i.e., menthol, nonmenthol), using NRT during a previous quit attempt, and not reporting the cost of cessation medication as a barrier to quitting were factors associated with formerly smoking (Weaver et al., 2018). Interestingly, endorsing other people as a barrier to quitting was associated with increased likelihood of formerly (rather than currently) smoking among older women (Weaver et al., 2018). Yet, these previous studies (Abdullah et al., 2006a; Pengpid & Peltzer, 2019; Weaver et al., 2018) were cross-sectional; thus, longitudinal examinations are needed to identify initial characteristics that
facilitate later quit success. Longitudinal designs can better identify factors prior to the beginning of treatment that might be associated with success by the end of treatment. Identifying modifiable factors that hinder success can help programs adapt interventions to address certain needs (e.g., enhance confidence in quitting). Additionally, learning that certain demographic characteristics are associated with less likelihood of success can alert programs to provide more appropriate resources and support for certain groups.

Some longitudinal studies explored predictors of long-term quitting in community samples of older adults. Across these studies, poor health factors (e.g., chronic illness, use of medication, greater cognitive dysfunction), smoking fewer cigarettes per day, and social support predicted long-term quitting success in older adults (Choi & DiNitto, 2015; Cohen-Mansfield, 2016; Donzé et al., 2007; Sachs-Ericsson et al., 2009; Shahab et al., 2015; Whitson et al., 2006). Some demographic characteristics have also been identified as predictors of long-term quitting (Sachs-Ericsson et al., 2009; Whitson et al., 2006). Although race did not predict outcomes, women (compared to men) experienced higher cessation rates (Sachs-Ericsson et al., 2009; Whitson et al., 2006). When examining community samples of older women, greater self-efficacy for quitting predicted long-term cessation (Donzé et al., 2007). Although one study found no relationship between depressive symptoms and quit outcomes (Choi & DiNitto, 2015), other research indicates depressive symptoms can be a barrier to long-term cessation (Shahab et al., 2015). Overall, longitudinal community observations indicate that female gender, chronic illness, fewer depressive symptoms, initially smoking fewer cigarettes per day, self-efficacy to quit, and social support are factors which might predict an older adult’s likelihood of successfully quitting.
Some cessation trials have reported individual characteristics of older adults that predicted higher quit rates (Chen & Wu, 2015; Ferketich et al., 2012; Hall et al., 2009; Hsu et al., 2018; Ossip-Klein et al., 1997; Tait et al., 2008; van der Aalst, 2012). Across various treatment modalities (e.g., smoking cessation clinic, self-help materials, telephone counseling), predictors of quit success included concurrent use of NRT, lower levels of nicotine dependence and less time smoking (Chen & Wu, 2015; Hall et al., 2009; Hsu et al., 2018; Tait et al., 2008). In a stop-smoking clinic in Taiwan, older adults who had ever had a quit attempt before (compared to never) were more likely to have quit success 36-months later (Hsu et al., 2018); however, Tait and colleagues (2008) found that an increasing number of quit attempts during a multi-modal intervention for older adults was associated with lower odds of being quit 24 months later. In the general adult population, not accounting for possible engagement in cessation treatment, it takes most tobacco users up to 30 tries to successfully quit smoking (Chaiton et al., 2016).

Specifically, for older adults entering cessation treatment, who on average have had more prior quit attempts than younger smokers, more research is needed to explore the impact of quit attempts on treatment success.

In regard to demographic characteristics, in the meta-analysis by Chen & Wu (2015), across studies, a one-point increase in the percentage of women participants in the study sample was associated with a 0.14 percentage increase in abstinence rate (Chen & Wu, 2015). However, when comparing quit rates between older men and women in a Taiwanese smoking clinic, men had higher quit success than women; yet authors note that smoking among women in Taiwan is less prevalent compared to other countries and women in this sample might have had more barriers to quitting initially (Hsu et al., 2018). Other studies, when exploring interaction effects of gender and intervention effectiveness, found no gender differences among older smokers.
(Chang et al., 2019; Hall et al., 2009). However, Ossip-Klein and colleagues (1997) found that in a tailored self-help guide intervention, women had higher quit rates when receiving proactive calls from a counselor and men had higher quit rates when receiving letters in the mail from a counselor (Ossip-Klein et al., 1997). Thus, across older adult studies, women have higher quit rate success than men; however, this finding should be considered in the context of culture and intervention modality.

Consistently in the older adult literature, increasing age and higher educational background have been associated with successful quitting (Chen & Wu, 2015; van der Aalst, 2012). Although one study found younger age within older adulthood predicted quit success, this study differed in that it included treatment tailored for older adults, was self-directed with coaching, and observed a longer follow-up period for smoking abstinence (i.e., two years) (Hall et al., 2009). Although Hall and colleagues (2009) did not provide detail on how treatment was specifically tailored for age considerations, perhaps tailored components in this study were more impactful for those in the younger age range of older adulthood; or this intervention was less impactful for those in the older age range when followed over a longer period of time (Hall et al., 2009). Mental health symptoms and individual beliefs about cessation have also been found to be associated with quit outcomes (Tait et al., 2008; Ferketich et al., 2012). Specifically, fewer depressive symptoms, more anxiety symptoms, and greater reported worry about lung cancer were associated with success (Tait et al., 2008; Ferketich et al., 2012). Ferketich and colleagues (2012) also found that individuals who quit were more likely to initially report that smoking negatively impacts health, as well as to have lower scores on a decisional balance measure (i.e., indicate the pros of smoking outweighed the cons to a lesser extent) (Ferketich et al., 2012). Thus, overall, the literature indicates that concurrent use of NRT, less nicotine dependence, less
time smoking, more previous quit attempts, older age, higher educational background, female
gender, fewer depressive symptoms, more anxiety symptoms, and more concern and awareness
of the health effects of smoking, as well as identifying more cons and less pros of smoking, are
all individual characteristics and beliefs that facilitate higher quit success among older adults in
cessation programs.

**Tailored Interventions**

Personalizing messages within cessation treatment, for both web-delivered interventions
and paper-based resources, helps to improve quit rates among adults (Krebs et al., 2010; Noar et
al., 2007). Yet, rarely are cessation intervention trials tailored specifically to older adult smokers
(Chen & Wu, 2015; Doolan & Froelicher, 2008; Smith et al., 2019; Zbikowski et al., 2012). Two
previous studies found that compared to control (i.e., non-tailored) interventions, implementation
of a self-help guide, *Clear Horizons*, and a telephone-based counseling protocol, both tailored to
older smokers, more strongly improved treatment engagement and quit rates among older adults
(Rimer et al., 1994; Ossip-Klein et al., 1997). Specifically, compared to receiving a non-tailored
self-help guide, those who received the tailored *Clear Horizons* guide alone or *Clear Horizons* in
combination with two brief calls from a counselor, had significantly higher seven-day abstinence
from smoking at 3 months (7% compared to 9% and 12%, respectively; Rimer et al., 1994).
Furthermore, those who received the *Clear Horizons* guide were more likely to report reading
and re-reading their guide compared to those with the non-tailored guide (Rimer et al., 1994).
*Clear Horizons* was tailored to older smokers by using a large typeface, including a series of
photographs and vignettes of multiracial smokers in older age, and including health messages
focusing on smoking cessation benefits specifically within older age (Rimer et al., 1994). Ossip-
Klein and colleagues (1997) disseminated this *Clear Horizons* self-help to another sample of
older adult smokers and randomized participants to additionally receive either two letters or two calls from a counselor. Although there were no significant differences in quit outcomes among these two conditions, Ossip-Klein and colleagues (1997) concluded that both types of tailored intervention styles were feasible to facilitate 3-month quitting (9.5%, 14.1%), with quit rates higher than non-tailored self-help guides in the literature (Ossip-Klein et al., 1997). Hall and colleagues (2009) extended this previous work by comparing four cessation conditions among older smokers. The standard condition included the tailored Clear Horizons self-help with pharmacotherapy (i.e., bupropion and NRT) for 12 weeks and was compared to standard condition plus extended NRT (i.e., 52 weeks), to standard condition plus 52-weeks of cognitive behavioral therapy (CBT), and standard condition plus extended NRT and cognitive behavioral therapy combined (Hall et al., 2009). Across all follow-ups over time, the standard condition plus extended CBT produced higher quit rates (55% at 104-week follow-up) than the standard condition alone (36%) and standard condition plus extended NRT (40%; Hall et al., 2009). However, the other three conditions did not significantly differ in quit success. Thus, overall, these previous studies suggest a tailored self-help guide for older adult smokers is feasible, effective, and accepted by older adult smokers (Hall et al., 2009; Rimer et al., 1994; Ossip-Klein et al., 1997). However, it is unclear what specific components of these interventions helped older adults to quit smoking. Further, although Hall and colleagues (2009) reported that extended CBT was also tailored for their sample of older smokers, they did not provide information on how CBT components were modified for age considerations. For example, because this population holds unique views about cigarettes and cessation, it might be important to tailor educational components of interventions to address these beliefs. In addition, interventions promoting increased valued life activities might improve quit rates because older adults have higher rates of
chronic illness and physical disability compared to younger smokers (Busch et al., 2012). Thus, unique aspects of cessation interventions which might help an older adult quit more easily are unknown in the current literature.

Gaps in the Current Literature

Overall, cigarette cessation treatments infrequently examine age group differences in quit outcomes, and even fewer report outcomes exclusively among older adults (Chen & Wu, 2015; Doolan & Froelicher, 2008; Smith et al., 2019; Zbikowski et al., 2012). Among this limited research, older adult samples typically include a wide age range (50 years of age and older) and rarely do studies examine smokers exclusively over 60 years (Chen & Wu, 2015; Doolan & Froelicher, 2008; Smith et al., 2019; Zbikowski et al., 2012). Part of the difficulty in examining cessation outcomes in this population lies in the lack of a clear and universal definition of older age. However, the World Health Organization recognizes that most developed countries define older age to be 60 or 65 years (Kowal et al., 2001). Further, studies often fail to report individual characteristics that facilitate higher quit rates within older adulthood; and, among studies that do, mixed findings are common. And not surprisingly, components of cessation intervention which promote cessation in adult smokers are unexplored in recent studies (Chen & Wu, 2015; Doolan & Froelicher, 2008; Smith et al., 2019; Zbikowski et al., 2012). Therefore, current information about smoking cessation in older adults is limited.

Despite the changing tobacco landscape with increases in ENDS product use, no recent studies, to our knowledge, have explored how the dual or poly use of other tobacco products (e.g., e-cigarettes, smokeless tobacco, etc.) impact older adults trying to quit cigarettes in cessation interventions (Cornelius et al., 2020; US DHHS, 2016). Further, although tobacco quit lines offer a free and widely accessible resource for those interested in quitting (Lichtenstein et
al., 2010), no previous research has explored individual characteristics that facilitate or impede quit success among older adult smokers engaged in a tobacco quit line intervention.

**Study Purpose**

The first aim of the current study was to examine individual characteristics that predict an older adult smoker’s likelihood of successful quitting (versus continued smoking) at the 3-month and 12-month follow-ups of a proactive tobacco quit line intervention. Unlike previous studies that have ranged widely in their definitions of older age, or that have only compared younger and older samples on risk factors and cessation outcomes, we initially focused specifically on predictors of quitting in an older adult sample (≥ 60 years). We aimed to examine individual characteristics associated with quit outcomes found in the previous older adult cessation literature, including age, gender, cigarette use history (i.e., nicotine dependence, years of smoking), quitting history, ever use of other cessation resources, confidence to quit, and beliefs about cessation. We also explored the influence of other demographic characteristics (i.e., race, ethnicity, marital status, military status), as well as concurrent use of other tobacco products and reasons for quitting in relationship to cessation outcomes in this population. A secondary aim of the current study was to observe cessation outcomes among older (≥60 years) versus younger (<59 years) adults enrolled in the proactive tobacco quit line in order to compare our findings with the previous literature.

This study aims to provide information about how to tailor cessation interventions, particularly tobacco quit lines, to the unique needs of older adults in order to optimize cessation success in this population. Specifically, the proposed study aims to identify modifiable aspects of older adult smoking (e.g., beliefs about cessation, reasons for quitting, confidence to quit, concurrent use of other tobacco products) which might aid or hinder older adults to quit.
cigarettes. Understanding certain modifiable variables associated with cessation can help counselors know which beliefs or behaviors to address. Additionally, if aspects of an individual’s history with cigarette use or quitting make it more challenging to achieve treatment success, interventionists could provide more resources to these individuals. Finally, understanding which demographic characteristics are associated with less likelihood of quitting can help cessation treatment cater to the diverse needs of populations within older adulthood most in need of tailored interventions.

**Methods**

**Parent Study Overview**

The parent study aimed to evaluate the effectiveness of a quit line for smoking cessation (data collected between May 2015 and June 2020). Using an observational design, the parent study followed TRICARE beneficiaries who enrolled in a proactive quit line for smoking cessation. TRICARE is the Department of Defense health care system and includes U.S. military active duty and coast guard, retirees, and dependents. Participants who failed to quit after an initial 4 session combined behavioral and pharmacological quit line treatment were then offered randomization into several re-engagement programs. Thus, the parent study evaluated whether re-engagement helped promote eventual cessation and which types of re-engagement strategies were most effective. For more detailed information on the parent study rationale and design please refer elsewhere (Little et al., 2017).

**Recruitment**

TRICARE beneficiaries who reported smoking five or more cigarettes per day for one year or longer were eligible to participate. Participants were recruited through the distribution of flyers, posters, magnets, newspaper advertisements, announcements at multiple military
installments, and electronic media use. Individuals interested in participating were able to call the toll-free study number, email the study team or visit the study website to learn about study requirements. Those interested completed a screening phone call in which eligibility was assessed and verbal informed consent was received prior to enrollment. Participants did not receive compensation for the study. However, up to four small token incentives were provided in order to increase retention and follow-up completion.

Inclusion criteria for participation included TRICARE beneficiary status, reporting smoking five or more cigarettes per day for at least one year, the ability to understand consent procedures, having access to a telephone, and being 18 years of age or older. Individuals in basic military training were excluded because this period includes an enforced tobacco ban and telephone access is not easily available. Beneficiaries who were unwilling to discontinue smoking cessation products (i.e., NRT, Wellbutrin, or Chantix) were excluded, along with those who were pregnant, breastfeeding, or planning to become pregnant in the next year. Participants who reported unstable heart conditions [i.e., unstable angina (chest pain), ever had a myocardial infarction (heart attack), heart rhythm/tachycardia (cardiac dysrhythmia other than medication-controlled atrial fibrillation or paroxysmal supraventricular tachycardia), medically uncontrolled or untreated hypertension (high blood pressure defined as blood pressure higher than 180/100 and not on treatment)] or had any mailing restrictions were enrolled in behavioral treatment only and not provided NRT.

**Procedures**

All treatment was delivered over the phone. All treatment was delivered over the phone. The parent study was approved by the 59th Medical Wing Institutional Review Board of the Department of Defense.
**Baseline**

At baseline, participants completed questionnaires measuring demographic characteristics, history of cigarette use and quit attempts, past use of cessation resources, current tobacco use, confidence to quit, beliefs about cessation and reasons for quitting.

**Quit Line Intervention Components**

All participants received four telephone sessions with a counselor within an 8-week period. Participants were also mailed eight weeks of NRT patches in one of three strengths (i.e., 21 mg, 14 mg, 7 mg). Patch strength was determined by smoking rates reported at baseline (i.e., 21 mg for those smoking 20 or more cigarettes per day, 14 mg for 10 to 19 cigarettes per day, and 7 mg for five to nine cigarettes per day). Four weeks of patches were mailed at the beginning of the intervention, and four weeks of patches were mailed after the participant completed session 4. Participants were informed that if they were still smoking cigarettes at the 3-month follow-up, they would have the opportunity to re-engage with the intervention.

In four telephone sessions of 40 minutes each, counselors used motivational interviewing strategies to facilitate motivation and self-efficacy for smoking cessation (Miller et al., 2012; Moyers et al., 2010). This collaborative style of intervention focused on the participant’s personalized goals and reasons for quitting. Motivational interviewing has been found to be effective for smoking cessation interventions (Heckman et al., 2010). The first treatment session focused on the participant’s motivation and unique reasons for cessation. Participants were allowed to set a quit date, and skills that might help the participant reach their quit date were discussed (e.g., reducing cigarettes consumed per day, clarifying triggers). In session two, participants learned about handling triggers, the proper use of NRT, and making a public commitment to remain tobacco free. The third session focused on managing withdrawal
symptoms and relapse prevention. Session four included a review of progress, relapse prevention strategies, and advice for managing withdrawal.

**Counselors and training.** In order to meet the unique needs of military and veteran participants, and to facilitate better rapport, counselors in the current study (n=20) were former military members. All counselors received 100 hours of motivational interviewing training and participated in weekly supervision to maintain their skills (Moyers et al., 2010). A member of the Motivational Interviewing Network of Trainers trained and supervised quit line counselors (Fiore et al., 2008).

**Three-Month Follow-Up**

Three months following treatment enrollment, individuals completed questionnaires about their current use of tobacco, as well as quit attempts and use of cessation methods during the intervention. Those who relapsed or failed to quit (i.e., reported smoking even a puff of a cigarette in the last seven days) were asked to re-engage with the intervention. Those who re-engaged were randomized using individualized block stratification (i.e., method to assign the same number of participants to each condition while also reducing the likelihood of bias) to one of three treatment arms: recycle, reduction, or choice condition. This procedure was performed by a biostatistician who did not interact with participants or interventionists. All participants who completed measures at baseline, regardless of re-randomization into a second dose of treatment, were contacted nine months later for the 12-month follow-up.

**Recycle condition.** The recycle condition received a repetition of the proactive quit line (i.e., four telephone sessions within an 8-week period) with the same counselor. An additional eight weeks of NRT (patch) was provided with a step-down approach. Patch strength was determined by reported smoking rates at the 3-month follow-up. Those smoking 20 or more
cigarettes per day received four weeks of 21mg, followed by two weeks of 14mg and two weeks of 7 mg. Those who reported smoking 10-19 cigarettes per day received four weeks of 14mg followed by four weeks of 7 mg. Finally, those who reported smoking nine or less cigarettes per day, received eight weeks of 7 mg.

**Rate reduction condition.** Those in the rate reduction condition were enrolled in a three-session proactive quit line intervention with the same counselor. These sessions focused on helping the participant to reduce the number of cigarettes smoked by 75% across the three sessions. Additionally, NRT in the form of the gum was provided for up to 16 weeks with a step-down approach. Those smoking more than 25 cigarettes per day at the 3-month follow-up received 600 pieces of 4 mg gum to use for eight weeks followed by 210 pieces of gum for eight additional weeks. Those who reported smoking less than 25 cigarettes per day at the 3-month follow-up received 600 pieces of 2 mg gum to use for eight weeks followed by 210 pieces to use for 8 additional weeks. Participants were asked to dose every one to two hours as needed.

**Choice condition.** Those randomized to the choice condition were informed about the rationale for both the recycle and rate reduction conditions and told they could choose one of the two.

**Twelve-Month Follow-Up**

At the 12-month follow-up, all enrolled participants, regardless of smoking status or re-engagement into a second dose of treatment at 3 months, were contacted over the phone to complete study measures assessing current tobacco use.

**Participants**

The older adult sample in the current study are those who completed baseline screening of the parent study and are ≥ 60 years of age (n=186) (Table 1). This sample of older adults ranged
from 60 to 79 years of age, with a $M (SD)$ age of 66.5 (4.4) years. The sample is comprised of mostly White (i.e., 83.3% White/Caucasian, 11.3% Black/African American, 5.4% other racial background or multiracial), non-Hispanic (94.6%), military retirees (62.9%) and non-military TRICARE beneficiaries (36.6%). One participant reported active-duty military status. Approximately 59% of the sample identified as men and 41% as women. Of these participants, 18.3% had a high school education/GED, 49.5% had some college/Associates degree, 17.2% had a bachelor’s degree, and 13.4% attended graduate school. Most of the sample were married or living as married (69.9%), 15.6% were widowed, 11.8% were divorced, 2.2% were never married, and one person was separated. Demographic characteristics of younger adults enrolled in the study and who completed baseline measures ($n=428$) (age range: 19 to 59 years), as well as the total sample ($n=614$) are presented in Table 1.

Among the older adult sample ($n=186$), at 3 months, 88% ($n=163$) completed follow-up measures (Figure 1). Of those who completed 3 month measures, 72 reported having quit smoking, 44 did not quit and re-engaged with the intervention and 47 did not quit and refused re-engagement. Thus, at 3-month follow-up with penalized imputation, 72 participants out of 186 (38.7%) successfully quit and 114 participants out of 186 (61.3%) were classified as continued smokers (i.e., reported still smoking or lost to follow-up). At the 12-month follow-up, 91% ($n=169$) of 186 individuals who completed baseline measures completed 12 month procedures. Thus, with penalized imputation, at the 12-month follow-up, 36.0% ($n=67$ out of 186) reporting no use (not even a puff) of cigarettes in the past seven days and 64.0% ($n=119$ out of 186) were continued smokers (i.e., reported still smoking or lost to follow-up).
Measures

Demographic Characteristics

Demographic characteristics included gender [women (0), men (1)], race [White/Caucasian (0), individuals of non-White racial minority backgrounds (1)], ethnicity [non-Hispanic/Latino (0), Hispanic/Latino (1)], marital status [married/living as married (0) versus widowed, divorced, separated, or never married (1)], and highest level of education [high school diploma/GED (0) versus some college/vocational training/associate degree or higher (1)]. Age was included as a continuous variable, as well as categorized as older adults [aged ≥ 60 years (1)] and younger adults [age range 18 – 59 years (0)] depending on analysis. Military characteristics included military status [non-military TRICARE beneficiary (0), military TRICARE beneficiary (1)], military grade 1 [E (enlisted member), W (officer), O (commissioned officer)] and military grade 2 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10). For military grade 2 pay scale, increasing number indicates increasing pay. If retired, participants reported military grades at the time of retirement.

Cigarette Use History

Years of smoking. At baseline, participants reported how many years they had smoked cigarettes, which was coded as a continuous item.

Nicotine dependence. At baseline, participants completed the Fagerstrom Test for Nicotine Dependence, a six-item widely used validated measure for nicotine dependence (Heatherton, et al. 1991). The six items from this measure were summed with possible scores ranging from (0) to (10), so that higher numbers indicated more nicotine dependence.
**Quitting Variables**

**Previous quit attempts.** At baseline, participants reported how many times they had tried to quit smoking cigarettes (for 24 hours or more) in the last 12 months. Number of previous quit attempts were coded *none* (0), *one time* (1), *two times* (2) or *three or more* (3).

**Ever Use of Cessation Resources**

**NRT.** At baseline, participants reported ever use of NRT to help quit smoking, coded as *yes* (1) and *no* (0).

**E-cigarettes.** At baseline, participants reported if they had ever used e-cigarettes in an attempt to quit smoking. Ever use of e-cigarettes for cessation was coded as *yes* (1) and *no* (0). If yes, participants were asked if they were currently using e-cigarettes to quit smoking, coded as *yes* (1) and *no* (0).

**Alternative resources.** At baseline, participants reported if they had ever used any of the following methods in a quit attempt: Chantix, Zyban/Wellbutrin/Bupropion, group quit program, individual counseling or therapy to quit, internet quit smoking program, another tobacco quit line, or any other method (e.g., acupuncture, hypnosis). Ever use of an alternative quit resource was coded as *yes* (1) and *no* (0).

**Other Tobacco Use**

At baseline, other tobacco users were those who reported past 30-day use of at least one of the following products: smokeless tobacco, snus, e-cigarettes, cigars, cigarillos/little cigars, pipe, hookah/water pipe, roll your own cigarettes. Concurrent other tobacco use (including one or more of the products) at baseline was coded as *yes* (1) versus *no* (0).
Beliefs about Cessation

Health benefit. At baseline, participants were asked, “How beneficial do you think quitting cigarettes is to your health?” Responses ranged from not at all (1) to extremely (5). Responses were coded dichotomously as extremely (1) versus all other responses (0).

Reasons for Quitting

At baseline, all participants were given the following options as reasons for cigarette cessation: to save money, I am getting pressure from others, so that my hair and clothes won’t smell, it is difficult to find a place to smoke, to improve my overall health, to be a good role model for others, so that I can be in control of my life, to improve my overall physical fitness, because smoking may have a negative effect on my career. Participants identified if these reasons were not at all true (1) to extremely true (5) for a reason they wanted to quit cigarettes. Each reason was coded as a continuous item.

Summary score. A summary score of these reasons for quitting was calculated. Each item was dichotomized (0 = not at all true vs. 1 = all other responses). Each reason endorsed by participants was added cumulatively into a total score with a range of 0 to 9 reasons.

Confidence to Quit

All participants at baseline were asked “How confident are you that you will quit smoking someday” and “How confident are you that you will quit smoking in the next six months?” Responses ranged from: not at all (1) to extremely (5). Responses were coded continuously.

Intervention Characteristics

Second dose of treatment. At 3 months, those who failed to quit and subsequently agreed to re-engage with the study, were randomized into one of the three conditions and
completed a second dose of treatment. We compared those individuals who completed a second
dose of treatment (1) versus those who did not (0; i.e., those who had either quit smoking at 3
months, were lost to follow-up, or refused to re-engage with the study).

**Re-engagement.** In the subpopulation of only those who had not quit smoking at 3
months, individuals were offered re-engagement with the study to receive a second dose of
treatment. Among this subpopulation, we compared those who re-engaged with the study (1)
versus those who refused (0).

**Cessation Outcomes**

At the 3-month and 12-month follow-ups, participants were asked, “Have you smoked a
cigarette (even a puff) in the past 7 days?” Those who responded no were coded as those who
quit smoking (1). Those who responded yes or did not complete follow-up measures, were coded
as continued smokers (0). Using penalized imputation to classify those lost to follow-up as
continued smokers is a conservative estimate of quitting commonly used in smoking cessation
intervention trials (West et al. 2005). Further, this method was chosen in the current study to
remain consistent with methodology chosen to be used in the parent study (Little et al., 2017).

**Data Analysis**

Descriptive statistics were calculated for outcome and predictor variables (Table 2 and
Table 3). Among the entire full sample, Pearson correlations were run between age (measured
continuously) and continuous predictor variables. Outcome variables included cessation at 3-
month and 12-month follow-ups [smoking cessation (1) versus continued cigarette use (0)]. An
intent to treat analysis was used, whereby all participants enrolled in the study were included in
analyses. Participants lost to follow-up at 3 months were classified as continued smokers at 3
months. Similarly, those lost to follow-up at 12 months were classified as *continued smokers* at 12 months.

**Primary Analysis**

Our primary analysis aimed to determine which of an extensive list of baseline variables predicted successful quitting vs. continued smoking in the subgroup of older adults. Tables 1-3 present the variables used as predictors in this analysis. As seen in Table 1, demographic predictors included age, gender, race, ethnicity, marital status, educational background, military status, military grade 1 and military grade 2. Other baseline predictors included cigarette use history (i.e., years of smoking; nicotine dependence), quitting history (i.e., previous number of quit attempts in the past year), ever use of cessation resources (i.e., NRT, e-cigarettes, alternative methods), concurrent use of another tobacco product (i.e., current use of one or more other products), beliefs about cessation (i.e., quitting improves health), reasons for quitting (i.e., to save money; getting pressure from others; so that hair/clothes won’t smell; difficult to find a place to smoke; improve overall health; be a good role model; be in control of life; improve physical fitness; smoking may have a negative impact on career), and confidence in ability to quit (i.e., in the next six months; some day). Due to the small number of individuals reporting currently using e-cigarettes for cigarette cessation (*n*=10), we combined ever and current use of e-cigarettes for cessation into one predictor of cessation outcomes.

A series of models were used to select the variables for the final multivariable model predicting *smoking cessation vs. continued smoking*. Initially, each predictor variable was tested in a univariate logistic regression equation to determine whether it was predictive of outcome at 3 months (cessation vs. continued smoking). Only variables with *p*<.10 from the univariate analyses were retained. Variables that met this standard were simultaneously entered as
predictors in a multiple logistic regression predicting smoking cessation outcome. A process of backward elimination of nonsignificant variables was used to identify the best set of predictors of quit outcome in the multivariable analysis. For each step of the backward elimination, the most nonsignificant predictor \( (p > .05) \) was removed, and the multiple regression was recalculated. This process was repeated until all nonsignificant \( (p > .05) \) predictors were eliminated.

The same process was used to evaluate predictors for the 12-month outcome as well (cessation versus continued smoking); however, we also tested the relationship between receiving a second dose of treatment (i.e., individuals who were randomized to receive a second dose of treatment vs. those who had quit or refused re-randomization) and 12-month quit success. Additionally, among only older adults who were continued smokers at 3 months, we examined whether re-engaging with the intervention to receive a second dose of treatment versus refusing re-engagement was significantly related to 12-month cessation outcome. Because not receiving a second dose of treatment (compared to receiving a second dose) was significantly related to 12-month outcome at the \( p < .10 \) level, we retained this variable in multiple logistic regression modeling.

**Age group comparisons.** In secondary analyses, we determined whether older age (≥ 60 years) was associated with greater quitting than younger age in this cohort. Using the entire sample, we compared age groups (older vs. younger) to predict quitting (0) vs. continued smoking (1) at 3 months and at 12 months with a logistic regression. In an additional logistical regression, we also compared age groups (older vs. younger) to predict re-engagement (i.e., re-engagement vs. refusal) at 3 months among those who had failed to quit.
Results

Descriptive Statistics

Descriptive statistics [i.e., $M$, $SD$, range, percentage (%)] and % missingness of baseline predictor variables among the older adult sample are presented in Tables 1-3. On average, this sample of older adults smoked for 44.0 years ($SD=11.5$) and had a Fagerstrom Test of Nicotine Dependence score of 4.5 ($SD=2.2$) out of 10, indicating a moderate level of dependence (Heatherton & Kozlowski, 1992). Most participants reported that they had tried NRT (76.3%) or an alternative cessation aid (71.7%; i.e., cessation medication, psychotherapy, quit lines, or any other method) and almost half (47.3%; $n=88$) had ever tried e-cigarettes to help them quit smoking. Of these individuals ($n=88$), 10 (5.4% of the sample) were currently using these products for cigarette cessation. About 9% ($n=16$) of individuals were using an alternative tobacco or nicotine containing product concurrently with cigarettes at the time of baseline. Of these 16 individuals, 13 (7.0% of sample) were using e-cigarettes. Because a small number ($n=3$) of individuals were poly users of tobacco products (i.e., concurrently using cigarettes and at least two other tobacco or nicotine containing product in the past month), dual and poly users were combined in subsequent analyses.

In terms of beliefs about quitting, most participants (94.5%) reported that they believed quitting smoking was extremely beneficial for one’s health. Mean endorsements of reasons for quitting ranged; because it will have a negative effect on career was the lowest endorsed reason for quitting ($M=1.9$, $SD=0.5$) and to improve one’s health was the highest endorsed reason ($M=5.0$, $SD=0.3$). When reasons for quitting were added cumulatively for each individual, on average participants endorsed 7.0 reasons ($SD=1.7$) out of nine. Participants responded with a $M$ score of 4.2 ($SD=1.0$) and 4.2 ($SD=0.9$) to confidence in quitting some day and confidence in
quitting in the next six months, respectively. Missingness of baseline predictor variables ranged from 0.00% to 0.09%.

**Relationship Between Age and Predictor Variables in Full Sample**

In the full sample of adults enrolled in the proactive tobacco quitline (i.e., 18 years of age and older) Pearson correlations were examined between age (i.e., measured continuously) and continuous predictor variables. Age was positively associated with these reasons for quitting: *to improve physical fitness* \( (r(609) = .11, p = .006) \), *to control life* \( (r(612) = .11, p = .007) \), *to improve health* \( (r(612) = .15, p = .000) \), *getting pressure from others* \( (r(612) = .15, p = .000) \) and *because it is too difficult to find a place to smoke* \( (r(612) = .25, p = .000) \). Specifically, older age was associated with a higher endorsement of these reasons for quitting smoking. Age was significantly negatively associated with quitting for these reasons: *to save money* \( (r(612) = -.14, p = .001) \) and *to be a good role model* \( (r(611) = -0.09; p = .020) \); such that, older age was associated with less endorsement of these reasons for quitting. Age was not associated with quitting *so that hair and clothes won’t smell* and *because smoking has a negative effect on career* \( (p’s > .05) \).

When exploring the relationship with other continuous predictor variables in the full sample (18 years of age and older), age was not associated with the belief that quitting is beneficial to one’s health \( (p > .05) \). Yet, age was positively associated with number of years smoked \( (r(612) = .86, p = .000) \) and negatively associated with number of previous quit attempts \( (r(604) = -.09, p = .035) \). Specifically, the higher the age the more previous years smoked and fewer number of previous quit attempts in the past year. Age was not related to confidence in quitting someday or in the next six months \( (p’s > .05) \).
Predictors of 3-Month Cessation

Univariate analyses. In unadjusted logistic regression models, multiple baseline predictors were associated with 3-month cessation (compared to continuing to smoke) at the p<.10 level (Table 4). Being partnered or married (rather than not) was associated with an 89% increased likelihood of being quit (OR=0.53; 95% CI=0.27,1.04; n=186) (Table 4). Each one-year decrease in previous years spent smoking was associated with a 0.02% increased likelihood of being quit (OR=0.98; 95% CI=0.95, 1.00; n=186) and a one-unit decrease in nicotine dependence was associated with a 20% increased likelihood of being quit (OR=0.83; 95% CI=0.71, 0.97; n=171). Never use of an alternative cessation resource (versus ever use) was associated with an 85% increased likelihood of being quit (OR=0.54, 95% CI=0.28, 1.03; n=171). Those who responded “extremely” to the belief that quitting is beneficial for one’s health (compared to any other response) were more than six times as likely to be quit (OR=6.24; 95% CI=0.77, 50.35; n=181). Each increased unit of endorsement in the following reasons was associated with a higher likelihood of being quit: to save money (OR=1.28; 95% CI=1.04, 1.58, n=186), so that my hair and clothes won’t smell (OR=1.33; 95% CI=1.07, 1.64, n=186), difficult to find a place to smoke (OR=1.27; 95% CI=1.01, 1.59, n=186), to be a good role model (OR=1.37; 95% CI=1.10, 1.72, n=185) and to control one’s life (OR=1.95; 95% CI=1.29, 2.93; n=186). When examining the number of cumulative reasons endorsed, each additional reason for quitting was associated with a 34% increased likelihood of being quit (OR=1.34; 95% CI= 1.12, 1.67, n=182). Finally, an increase in score for confidence to quit some day and confidence to quit in the next six months was associated with a 94% and 66% increased likelihood of being quit, respectively (OR=1.94; 95% CI=1.34, 2.80, n=184; OR=1.66, 95% CI=1.15, 2.37; n=182). All
other baseline predictor variables were not significantly associated with cessation at 3-months at the .10 level and were not retained in the final model (Table 5).

**Final model.** In the final multivariable model predicting cessation (versus continued smoking) at the 3-month follow-up, two baseline variables were retained and significant at the $p<.05$ level (Table 5). A one unit increase in endorsing *to take control of one’s life* as a reason for quitting was associated with a 74% higher likelihood of being quit ($OR=1.74; 95\% CI=1.16, 2.62; n=184$). A one unit increase in confidence in quitting someday was associated with a 75% higher likelihood of being quit ($OR=1.75; 95\% CI=1.21, 2.52; n=184$). Thus, within this subpopulation of older adults, the primary predictors of quitting at 3 months were endorsing *to take control of one’s life* as a reason for quitting and having a higher confident in quitting.

**Predictors of 12-Month Cessation**

**Intervention characteristics.** Among older adults who had not quit smoking and were subsequently randomized to receive a second dose of treatment (i.e., re-engaged with the intervention; $n=43$), 18 participants (15.8%) were randomized to the recycle condition, 16 (14.0%) were randomized to the rate reduction condition and 9 (7.9%) were randomized to the choice condition. In a univariate logistic regression model, those who quit smoking or did not receive another round of treatment at 3 months were significantly more likely to be quit at 12 months ($OR=0.22; 95\% CI=0.09, 0.55; p=.001; n=186$). In other words, those who did not receive a second dose of treatment (i.e., those who quit smoking at 3 months, were lost to follow-up, or continued to smoke but refused re-engagement) were more than four times as likely to be quit at 12 months compared to those who got a second dose of treatment. Therefore, receiving a second dose of treatment was included as a predictor in the final multivariable modeling.
In an additional analysis, restricted to those who had failed to quit at 3 months ($n=91$), we examined the utility of re-engagement in a second dose of treatment (vs. refusal to re-engage with a second dose of treatment) as a predictor of 12-month cessation. Results indicated there was a not a significant relationship between re-engagement and 12-month cessation ($OR=1.13$, 95% CI=0.34, 3.81, $p=.842; n=91$).

Finally, in another analysis including the entire older adult sample ($n=186$), 3-month cessation was significantly associated with 12-month cessation ($OR=19.93$, 95% CI=9.26, 42.88, $p<.001; n=186$); such that those who were quit at 3 months were about 20 times more likely to be quit at 12 months compared to those who were not quit at 3 months.

**Univariate analyses.** In unadjusted logistic regression models, multiple baseline predictors were significantly associated with 12-month cessation (compared to continuing to smoke) at the $p<.10$ level (Table 4). Each one year decrease spent smoking was associated with a 3.1% increased likelihood of being quit ($OR=0.97$; 95% CI=.94, 0.99; $n=186$). Each point decrease in nicotine dependence score was associated with a 22% increased likelihood of being quit at 12-months ($OR=.82$; 95% CI=.70, 0.96; $n=171$). Each increase in unit of endorsement of to control one’s life as a reason for quitting was associated with a 53% increased likelihood of being quit at 12 months ($OR=1.53$; 95% CI=1.09, 2.15; $n=186$). Each unit increase in confidence in quitting in the next six months was associated with a 1.41 increased likelihood of being quit at 12 months ($OR=1.41$; 95% CI=0.99, 2.00; $n=182$).

**Final model.** In the final multivariable model predicting cessation (versus continued smoking) at the 12-month follow-up, three variables were retained and significant at the $p<.05$ level (Table 5). Each increased score in endorsing to take control of one’s life as a reason for quitting was associated with a 51% increased likelihood of being quit ($OR=1.51$; 95% CI=1.05,
2.17; n=171) and each point decrease in nicotine dependence scores was associated with 19% higher odds of being quit at 12-months (OR=0.84; 95% CI=0.71, 0.99; n=171). Additionally, not receiving a second dose of at 3 months (i.e., being quit, being lost to follow-up, or refusing re-engagement with treatment) compared to reengagement with treatment was associated with a 4.17 times increased likelihood of being quit at 12 months (OR=0.24; 95% CI=.09, .63, n=171).

**Age Group Comparisons of Outcomes Among Entire Sample**

In the entire adult sample, age [<59 years (0) vs. ≥ 60 years (1)] was not significantly associated with cessation at 3 months (OR=1.11; CI=0.78-1.59; p=.556; n=614) or 12 months (OR=0.89; 95% CI=.62 -1.27; p=.517; n=614). Among those who had failed to quit at 3 months, age (<59 years vs. > 60 years) was not significantly associated with re-engagement (OR=0.85, 95% CI= 0.52-1.40; p=.524; n=274).

**Discussion**

This study explored a variety of individual characteristics as predictors of quitting outcomes at 3 and 12 months among older adults enrolled in a proactive tobacco quit line study. In addition to providing information about predictors of quitting, the current study yielded information about tobacco use patterns in older adult smokers. The current sample had been smoking for an average of 44 years and reported moderate nicotine dependence (M=4.5 on Fagerstrom Test of Nicotine Dependence) (Heatherton & Kozlowski, 1992). Although these were individuals who had smoked for many years, this sample on average was highly motivated to quit. In the past year, they had tried to quit almost twice (M=1.8 times) and had high scores in confidence in quitting some day and the next six months (M=4.2, M=4.2, respectively, out of 5). The majority had used NRT (76.3%) or some type of alternative aid (71.7%) to quit cigarettes before this study. Although only about 9% of this sample were concurrently using one or more
alternative tobacco or nicotine containing product with cigarettes at baseline, notably the overwhelming majority of these individuals (13 out of 16) were using e-cigarettes specifically. In terms of ENDS product use, about half had ever used e-cigarettes to aid in a quit attempt (47.3%), which was higher than a previous study finding only 16% of adults of all ages enrolled in quit lines had ever used e-cigarettes to quit tobacco (Vickerman et al., 2013). However, the higher proportion using e-cigarettes in the current study is not surprising, given that the Vickerman and colleagues (2013) study was conducted eight years ago, and ENDS products have become more prevalent since that time (Cornelius et al., 2020; US DHHS, 2016). Among our sample, 7.0% were current users of e-cigarettes, of which 10 (5.4% of sample) were currently using these products specifically for cigarette cessation. Comparatively, Vickerman and colleagues (2021), found that about 15% of adults of all ages enrolled in tobacco quit lines in 2018 were concurrently using ENDS products, although it is unclear what percentage of these individuals were using these products specifically for cigarette cessation (Vickerman et al., 2021). Because of the small sample size of current ENDS product users in this sample (n=13), we were unable to explore how current e-cigarette use and/or current e-cigarette use specifically for cigarette cessation predicted quit outcomes. However, current findings do indicate it might be common for older adult smokers to try ENDS products for tobacco cessation at least once. However, concurrent use of e-cigarettes, motivated by any reason of use, during the time of accessing a tobacco quit line might be less common. Yet, the increasing prevalence rates of these products across the age range (Cornelius et al., 2020; US DHHS, 2016), as well as the likely common practice of experimenting with e-cigarettes for the purpose of tobacco cessation among older smokers, warrant the need for more research on this topic. Future studies should assess
how the use of ENDS products, motivated by cigarette cessation and/or alternative reasons, impacts cessation outcomes among older adults enrolled in tobacco quit lines.

When assessing beliefs about tobacco, almost the entire sample (94.5%) believed that quitting was extremely beneficial to health. In fact, the most endorsed reason for wanting to quit was to improve health. This is inconsistent with previous research in which older adults were more likely to underestimate the benefits of cessation and the harms of tobacco (Cataldo, 2019; Goldberg et al., 2018; Kerr et al., 2006; Kulak & LaValley, 2018; Yong et al., 2005). Because individuals in this study were motivated to quit and were, in fact, accessing a tobacco quit line, they were probably more likely to be educated about the benefits of cessation in older age. Interestingly, the least endorsed reason for wanting to quit was because smoking has a negative effect on career. Although occupational information for non-military TRICARE beneficiaries is unknown, most participants with a military background in this study were retired. Thus, it is less surprising that this sample was not concerned about the impact of smoking on their career. Further, on average, this sample endorsed seven out of nine possible reasons for wanting to quit.

At 3 months, 38.7% of participants had quit cigarettes and 36.0% had quit at 12 months. Both of these rates are higher compared to quit rates obtained in the general population of adults using tobacco quit lines with free NRT (21% quit success) (Stead et al., 2013) and comparable to the average rate (36.7%) obtained across multi-modal interventions (i.e., behavioral interventions and pharmacotherapy combined) in a 2015 meta-analysis specifically of older adults (Chen & Wu, 2015). Current quit success was also higher compared to the results of a self-help guide and a telephone-based counseling protocol tailored for older smokers (9.5% -14.1% quit success) (Ossip-Klein et al., 1997; Rimer et al., 1994). However, cessation rates in this study were lower than quit success in an intervention including a tailored self-help guide, pharmacotherapy, and
52-weeks of cognitive behavioral therapy for older smokers (55% quit success at 104-week follow-up) (Hall et al., 2009). Perhaps the higher quit success found in the Hall study (2009) is a reflection of the longer duration of their intervention (104 weeks vs. 8 weeks), as well as the possible benefit of tailoring self-help guides to include images and health messages inclusive of adults in older age (Ossip-Klein et al., 1997; Hall et al., 2009; Rimer et al., 1994). Yet, regardless, the current study found that this sample of older adults enrolled in an 8-week tobacco quit line experienced quit success at higher rates than adults in the general population receiving similar intervention. Thus, tobacco quit lines, an effective and logistically practical cessation treatment, could be used to specifically address the lack of declining cigarette rates among U.S. older adults.

The exploration of individual characteristics associated with quit success in this study might provide insight into aspects of quit lines that can be modified to produce even better outcomes for older adult smokers. Notably, for demographics, being married/partnered (rather than not) was associated with 3-month quit success in univariate analyses. To our knowledge, marital status has not been associated with outcomes in previous trials of older smokers. Perhaps these married or partnered participants had stronger social support, which has been linked to a higher likelihood of long-term cessation among older smokers (Cohen-Mansfield, 2016). It might be helpful for programs to enhance social support among older adults trying to quit cigarettes, particularly those who are single. Other demographics in the current study were not related to quit outcomes. This finding is inconsistent with previous trials with older adult samples, in which female gender, a higher educational background, and increasing age were related to a higher likelihood of quit success (Chen & Wu, 2015; van der Aalst, 2012). Importantly, the current sample was mostly men (59.1%), White/Caucasian (83.3%), and non-
Hispanic/Latino (94.6%); thus, future studies should examine demographic differences in outcomes among more diverse samples of older adults. Finally, although previously unexplored, military status and military grades were not characteristics associated with outcomes. Important to note, the majority of this sample included military retirees (62.9%), and non-military TRICARE beneficiary participants were likely familiar with the military lifestyle given that they had military family members. To our knowledge, no study has explored tobacco quit line success between military and civilian individuals (who might not necessarily have familiarity and exposure to the military lifestyle). Further, military grade, which could function as a proxy for socioeconomic status, might have been less relevant to individuals once retired.

Although we did not find military status to be related to quit success, quit lines might benefit from assessing military history among older adults in order to better tailor interventions to this population’s needs. For example, tobacco rates in military populations are up to twice as high as in civilians (Agaku et al., 2014; Barlas et al., 2013; Cornelius et al., 2020; Little et al., 2016), and military members have long been exposed to targeted tobacco advertisements and endorsements (Smith & Malone, 2009a; Smith & Malone, 2009b; Talcott et al., 2015). This quit line was tailored to military culture in that interventionists were former military members. Perhaps current quit success was improved because counselors were sensitive to the unique aspects of military culture. However, more research is needed to assess if counselors with a military background facilitate higher cessation rates compared to civilian counselors among military retirees in a tobacco quit line.

Univariate analyses of cigarette use and quitting history showed that more years spent smoking and higher nicotine dependence were associated with continuing to smoke at both follow-ups in this population. This finding is consistent with research showing that both are risk
factors for poorer quit outcomes (Chen & Wu, 2015; Hall et al., 2009; Hsu et al., 2018). Older smokers who have smoked for many years and are more nicotine dependent likely need additional support within cessation programs. Unlike previous studies (Hsu et al., 2018; Tait et al., 2008), we found that having more quitting attempts in the past year was not associated with 3 or 12-month quit success. Additionally, ever using e-cigarettes for cigarette cessation was also not associated with success in quitting. This finding is dissimilar from Vickerman and colleagues (2013), in which ever use of e-cigarettes for cigarette cessation was associated with poorer quit outcomes among adults in a tobacco quit line (Vickerman et al., 2013). However, ever using a cessation resource to help quit smoking in the current study was associated with a higher likelihood of continuing to smoke at 3 months. Perhaps those who used resources prior to this study had more difficulty sustaining cessation. Particularly for older adults who often have a longer history of cigarette use than younger smokers (Jordan et al., 2017; Orleans et al., 1991), it could be important to assess quitting history beforehand. Programs might consider providing education about how multiple quit attempts are common before successful cessation (Chaiton et al., 2016) and informing participants that NRT offers the best success when combined with behavioral intervention and/or counseling (Chen & Wu, 2015). Normalizing a long history of cigarette use and quit attempts, as well as exploring why previous quit attempts were unsuccessful (e.g., because counseling was not provided), might help older smokers. Finally, concurrent use of one or more other products was not associated with quit outcomes in this sample. Of our sample, 8.6% (n=16) were concurrently using another tobacco- or nicotine-containing product in addition to cigarettes at baseline. Comparatively, in a nationally representative sample, among tobacco users over the age of 55 years, 5.9% were concurrently using cigarettes and an ENDS product, 6.2% were using cigarettes and another combustible
product, 0.8% were concurrently using cigarettes and smokeless tobacco, and 1.9% were using three or more of any of these products (Hirschtick et al., 2021). Given that our population of older adults (N=186) included a subpopulation of a parent study, our sample of dual and poly tobacco users was small (n=16) and was likely underpowered to find an association between concurrent use of cigarettes and other products and long-term cessation. Future research using larger samples of older adults is needed to assess how concurrent use of other products impacts cigarette cessation. Exploring this research question in larger older adult samples can also better differentiate between the various types of products used, and motivation for use of these products in relationship to cigarette cessation.

Belief in the benefits of quitting, certain reasons for quitting, and quitting self-efficacy were also important factors related to successful quit outcomes in univariate analyses. Specifically, more strongly believing that quitting is beneficial for health, more strongly endorsing financial, esthetic, and logistic reasons for quitting, wanting to be a good role model and to control one’s life, endorsing a higher number of reasons for quitting, and having more confidence to quit were all associated with a higher likelihood of being quit at 3 months. Similarly, more strongly endorsing to take control of one’s life as a reason for quitting and having more confidence to quit someday were significantly associated with being quit one year later. Previous studies have similarly observed that awareness about the positive health effects of cessation is related to quitting in older adults (Ferketich et al., 2012). To our knowledge, other specific reasons for cessation have not been explored in relationship to quit outcomes among older smokers. However, Ferketich and colleagues (2012) found that older adults who reported fewer pros and more cons of smoking during a lung cancer screening were more likely to quit (Ferketich et al., 2012). Future qualitative and cessation intervention studies might consider
assessing individual motivations for cigarette cessation among older smokers. Given the lack of research in this area and its potential to be linked with positive outcomes, individualizing programs to promote an older adult’s motivations for quitting might be helpful.

In final multivariable models, each increased score in endorsing *take control of one’s life* as a reason for quitting and each increased score in confidence in quitting someday were associated with a 74% and 75% increased likelihood being quit at 3 months, respectively. For 12-month cessation, each increased score in endorsing *take control of one’s life* as a reason for quitting was associated with a 51% increased chance of being quit. Conversely, each decrease in nicotine dependence was associated with 19% increased likelihood of being quit at 12 months. Finally, receiving a second dose of treatment, compared to being quit at 3 months, being lost to follow-up, or not re-engaging with the intervention, was retained in the final multivariable model predicting 12-month cessation and associated with a lower likelihood of success.

Results from final models suggest the most important predictors for quit success included more strongly wanting to quit to take control of one’s life, greater quitting self-efficacy, and a lower level of nicotine dependence. Wanting to take control of one’s life as a reason for quitting was assessed through the endorsement of a single statement; thus, it would be helpful if future researchers could develop more psychometrically sound measures of this construct. Despite the limitations in the measurement of this construct, the association between wanting to quit to be in control of one’s life and subsequent cessation in this study warrants future research. Notably, the three significant predictors of successful quitting in this study (e.g., wanting to be in control of one’s life, quitting self-efficacy, and nicotine dependence) all involve the constructs of independence and control, which research has shown to decline with age (Infurna et al., 2013; Lachman et al., 2011). Older individuals are more likely to experience uncontrollable age-related
constraints on physical health and mobility, as well as to be exposed to ageist beliefs (e.g., that older adults are helpless; Lachman et al., 2011). Importantly, a stronger sense of control, or self-efficacy, in older age is associated with better health outcomes (e.g., longer survival times, improved mental health; Infurna et al., 2011; Infurna et al., 2013; Lachman et al., 2011; Nicolaisen et al., 2018; Turiano et al., 2014). Future cessation studies for older adults might consider assessing and promoting perceived control over cessation and other health goals. Perhaps acquiring agency through self-directed goals can be a strong motivator for older adults in tobacco quit lines, as well as can help improve overall health and wellbeing. For example, although it is unclear which tailored aspects of the psychotherapy (CBT) component of the intervention by Hall and colleagues (2009) facilitated high quit rate success among their older adult smokers, authors did not that their intervention utilized self-directed methods with supportive coaching by counselors. Perhaps facilitating self-directed and person-centered approaches to attaining cessation goals can help older adults feel more in control of their health. Similarly, greater quitting self-efficacy was an important predictor of quitting. This is consistent with a previous community study among older adult women in which higher self-efficacy predicted later quit success (Donzé et al., 2007). Thus, quitting self-efficacy could be an important factor to assess and promote in cessation programs, especially for older adult smokers.

The current sample of older adults (N=186) was a subpopulation of the larger parent study (N=614); and thus, was not powered to test the efficacy of the three treatment conditions in relations to quit outcomes. Receiving a second dose of treatment at 3 months was associated with a lower likelihood of quitting at 12 months in our population. However, it is not likely that a second dose of treatment was detrimental for quit success. Notably, the comparison group (i.e., those not receiving a second dose of treatment) included both individuals who successfully quit
by 3 months and those who did not quit but refused treatment re-engagement. Our results indicate that those who successfully quit at 3 months were also much more likely to be quit at 12 months. In fact, in additional analyses, we did find that those who quit at 3 months were 20 times more likely to be quit at 12 months, compared to those who continued to smoke at 3 months (OR=19.93, 95% CI=9.26,42.88). In general, long-term quit success was most likely to be achieved within the first 3 months of treatment. Further, some of the older adults in our study who were highly motivated to quit (i.e., engaged with a second dose of treatment) still had difficulty quitting. This is consistent with research among adults in the general population, in which adults often need up to 30 tries to successfully quit (Chaiton et al., 2016). Future research is needed examining barriers to cessation among older adult smokers who are highly motivated to quit but unsuccessful. Perhaps promoting perceived control in quitting and other health goals, increasing quitting self-efficacy, and normalizing a long history of cigarette use and quit attempts are ways to tailor interventions to the needs of older smokers.

In secondary analyses, the current study examined and found no significant difference in 3-month and 12-month quit success between older (≥60 years of age) and younger (<59 years) smokers. This finding is inconsistent with some prior research in which older adult smokers had higher quit rate success than those younger (Doolan & Froelicher, 2008). Further, Chen & Wu (2015) found that among older adults, increasing age was associated with increased quit success (Chen & Wu, 2015). However, to our knowledge, no studies explored age group differences in quit success among adults in tobacco quit lines with free NRT. Thus, future research is needed to assess age group differences specifically in the effectiveness of this type of intervention. Our findings indicate that older adults experience comparable quit success as those younger when engaging in a tobacco quit line intervention.
There are limitations of the current study that are important to consider. Firstly, although anxiety and depressive symptoms have been associated with quit outcomes among older adults in the previous literature (Ferketich et al., 2012; Tait et al., 2008), the current study did not assess mental health symptoms. In addition, poor health factors have been associated with a higher likelihood of cessation among older adults (Choi & DiNitto, 2015; Cohen-Mansfield, 2016; Donzé et al., 2007; Sachs-Ericsson et al., 2009; Shahab et al., 2015; Whitson et al., 2006). However, the current study did not assess specific health information regarding chronic illness. Secondly, this subsample of older adults from a parent study was not large enough to analyze quit outcome differences between treatment conditions. Further, our sample was not large enough to explore relationships between patterns of ENDS use and quit outcomes. Future studies should assess large samples of older adults in order to better capture how ENDS products might impact quit outcomes among those trying to quit cigarettes in tobacco quit lines. Because our sample included TRICARE beneficiaries, generalizability might be limited to civilian samples. However, although TRICARE beneficiaries, 36.6% of this sample were not military retirees (i.e., healthcare dependents of those in the military). Finally, future studies should explore individual characteristics associated with tobacco quit line outcomes among larger, more diverse samples of older adults.

**Conclusion**

Despite the growing prevalence of an older adult population in the U.S. (Ortman et al., 2019), the lack of declining cigarette rates in this age group (Cornelius et al., 2020), and this population’s higher risk for tobacco morbidity and mortality (Mons et al., 2015; US DHHS, 2014), older adults are underrepresented in cessation research (Chen & Wu, 2015). Aimed at addressing this gap, the current study expanded upon the literature by exploring individual
characteristics associated with long-term quit success in a tobacco quit line among a sample exclusively of older adults. Current findings provide important considerations for how to tailor cessation programs for older adults, as well as highlight possible research questions for future studies. Firstly, promoting quitting self-efficacy and perceived control in cessation and health goals might be particularly important for older adults trying to quit cigarettes, given that this age group is more likely to experience a decline in perceived control over life’s circumstances. Secondly, older smokers with higher nicotine dependence might need additional support during cessation programs. Additionally, although a subsample of these older adults was highly motivated to quit and re-enrolled for a second dose of treatment, they were not abstinent from cigarettes at the one-year follow-up. Normalizing a long history of cigarette use and quit attempts and facilitating discussions about reasons for unsuccessful quit attempts in the past could be important topics for quit line counselors to broach with older adults. Future tobacco quit line studies should assess patterns of ENDS use and the concurrent use of other tobacco products in relationship to quit success in larger gender and racially/ethnically diverse samples of exclusively older adults.
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Table 1.

Baseline Demographic Descriptives of Older Adult Sample, Younger Adult Sample, and Total Sample

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<th>Older Adults (N=186)</th>
<th>Younger Adults (N=428)</th>
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<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>155 (83.3)</td>
<td>341 (79.7)</td>
<td>496 (80.8)</td>
</tr>
<tr>
<td>Non-White racial minority</td>
<td>29 (15.6)</td>
<td>85 (19.9)</td>
<td>114 (18.6)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic/Latino</td>
<td>176 (94.6)</td>
<td>374 (87.4)</td>
<td>550 (89.7)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>7 (3.8)</td>
<td>53 (12.4)</td>
<td>60 (9.8)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school diploma/GED</td>
<td>34 (18.3)</td>
<td>92 (21.6)</td>
<td>126 (20.7)</td>
</tr>
<tr>
<td>Greater than a high school diploma/GED</td>
<td>149 (80.1)</td>
<td>333 (77.8)</td>
<td>482 (78.5)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/living as married</td>
<td>130 (69.9)</td>
<td>301 (70.3)</td>
<td>431 (70.2)</td>
</tr>
<tr>
<td>Not married or living as married</td>
<td>56 (30.1)</td>
<td>127 (29.7)</td>
<td>183 (29.8)</td>
</tr>
<tr>
<td><strong>Military Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired military</td>
<td>117 (62.9)</td>
<td>87 (20.3)</td>
<td>204 (33.2)</td>
</tr>
<tr>
<td>Non-military TRICARE beneficiary</td>
<td>68 (36.6)</td>
<td>152 (35.5)</td>
<td>220 (35.8)</td>
</tr>
<tr>
<td>Active Duty</td>
<td>1 (0.5)</td>
<td>188 (43.9)</td>
<td>189 (30.8)</td>
</tr>
</tbody>
</table>

Note: GED=General Educational Development; Older adult age range: 60 - 79 years; Younger adult age range: 19 – 59 years; N’s reflect individuals who completed baseline measures.
Table 2.

*Descriptives of Dichotomous Predictors*

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
<th>Missingness (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ever Use of Cessation Resources</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRT (yes)</td>
<td>142 (76.3)</td>
<td>(.00)</td>
</tr>
<tr>
<td>E-cigarettes (yes)</td>
<td>88 (47.3)</td>
<td>(.00)</td>
</tr>
<tr>
<td>Alternative cessation medication/resources (yes)</td>
<td>132 (71.7)</td>
<td>(.01)</td>
</tr>
<tr>
<td><strong>Other Tobacco Use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent use of one or more other products (yes)</td>
<td>16 (9.4)</td>
<td>(.09)</td>
</tr>
<tr>
<td><strong>Beliefs about Cessation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quitting improves health (response: <em>extremely</em>)</td>
<td>171 (94.5)</td>
<td>(.03)</td>
</tr>
</tbody>
</table>

*Note: Older adult sample (N=186)*
Table 3.

**Descriptives of Continuous and Ordinal Predictors**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range (lowest, highest)</th>
<th>Missing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Smoked</td>
<td>43.96</td>
<td>11.53</td>
<td>5, 67</td>
<td>(.00)</td>
</tr>
<tr>
<td>Nicotine Dependence</td>
<td>4.50</td>
<td>2.12</td>
<td>0, 10</td>
<td>(.08)</td>
</tr>
<tr>
<td>Past Year Quit Attempts</td>
<td>1.80</td>
<td>3.04</td>
<td>0, 20</td>
<td>(.01)</td>
</tr>
<tr>
<td>Reasons for Quitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To save money</td>
<td>3.62</td>
<td>1.50</td>
<td>1, 5</td>
<td>(.00)</td>
</tr>
<tr>
<td>Pressure from others</td>
<td>2.85</td>
<td>1.67</td>
<td>1, 5</td>
<td>(.00)</td>
</tr>
<tr>
<td>Hair and clothes won’t smell</td>
<td>3.41</td>
<td>1.49</td>
<td>1, 5</td>
<td>(.00)</td>
</tr>
<tr>
<td>Difficult to find a place</td>
<td>2.19</td>
<td>1.32</td>
<td>1, 5</td>
<td>(.00)</td>
</tr>
<tr>
<td>To improve health</td>
<td>4.95</td>
<td>0.29</td>
<td>3, 5</td>
<td>(.00)</td>
</tr>
<tr>
<td>To be a good role model</td>
<td>3.86</td>
<td>1.46</td>
<td>1, 5</td>
<td>(.01)</td>
</tr>
<tr>
<td>To control one’s life</td>
<td>4.41</td>
<td>1.16</td>
<td>1, 5</td>
<td>(.00)</td>
</tr>
<tr>
<td>To improve physical fitness</td>
<td>4.82</td>
<td>.51</td>
<td>3, 5</td>
<td>(.01)</td>
</tr>
<tr>
<td>Negative effect on career</td>
<td>1.89</td>
<td>1.39</td>
<td>1, 5</td>
<td>(.01)</td>
</tr>
<tr>
<td>Summary Score</td>
<td>7.04</td>
<td>1.71</td>
<td>2, 9</td>
<td>(.02)</td>
</tr>
<tr>
<td>Confidence in quitting some day</td>
<td>4.19</td>
<td>1.00</td>
<td>1, 5</td>
<td>(.01)</td>
</tr>
<tr>
<td>Confidence in quitting in next six months</td>
<td>4.24</td>
<td>.94</td>
<td>1, 5</td>
<td>(.02)</td>
</tr>
</tbody>
</table>

*Note: Older adult sample (N=186)*
Table 4. Univariate Associations with Baseline Predictors and Cessation Outcomes

<table>
<thead>
<tr>
<th>Baseline Predictor Variables</th>
<th>3 Month Cessation (continued smoking vs. quit)</th>
<th>12 Month Cessation (continued smoking vs. quit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>CI</td>
</tr>
<tr>
<td>Demographic &amp; Military</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age ‡</td>
<td>1.03</td>
<td>.96, 1.10</td>
</tr>
<tr>
<td>Race (White* vs. non-White)</td>
<td>.79</td>
<td>.34, 1.81</td>
</tr>
<tr>
<td>Gender (women* vs. men)</td>
<td>.88</td>
<td>.48, 1.60</td>
</tr>
<tr>
<td>Marital Status (married* vs.</td>
<td>.53 ‡</td>
<td>.27, 1.04</td>
</tr>
<tr>
<td>non-married)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational background</td>
<td>1.03</td>
<td>.48, 2.22</td>
</tr>
<tr>
<td>(high school/GED*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity (non-Hispanic* vs.</td>
<td>.99</td>
<td>.91, 1.08</td>
</tr>
<tr>
<td>Hispanic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Military Status (non-military* vs. military)</td>
<td>1.14</td>
<td>.62, 2.11</td>
</tr>
<tr>
<td>Military grade 1 (enlisted member *)</td>
<td>.66</td>
<td>.32, 1.37</td>
</tr>
<tr>
<td>Military grade 2 (I*)</td>
<td>1.16</td>
<td>.87, 1.56</td>
</tr>
<tr>
<td>Cigarette Use History</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years Smoked ‡</td>
<td>.98 ‡</td>
<td>.95, 1.00</td>
</tr>
<tr>
<td>Nicotine Dependence ‡</td>
<td>.83 ‡</td>
<td>.71, .97</td>
</tr>
<tr>
<td>Quitting History</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past Year Quit Attempts (none*)</td>
<td>1.05</td>
<td>.82, 1.34</td>
</tr>
<tr>
<td>Ever Use of Cessation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRT (no* vs. yes)</td>
<td>.61</td>
<td>.31, 1.22</td>
</tr>
<tr>
<td>E-cigarettes (no* vs. yes)</td>
<td>.83</td>
<td>.46, 1.50</td>
</tr>
<tr>
<td>Alternative Resources (no* vs. yes)</td>
<td>.54 ‡</td>
<td>.28, 1.03</td>
</tr>
<tr>
<td>Other Tobacco Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent use of one or more other products (no* vs. yes)</td>
<td>1.12</td>
<td>.40, 3.17</td>
</tr>
<tr>
<td>Belief about Quitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beneficial for health</td>
<td>6.24 ‡</td>
<td>.77, 50.35</td>
</tr>
<tr>
<td>(other responses* vs. extremely)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons for Quitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To save money ‡</td>
<td>1.28 ‡</td>
<td>1.04, 1.58</td>
</tr>
<tr>
<td>Pressure from other ‡</td>
<td>1.15</td>
<td>.96, 1.37</td>
</tr>
<tr>
<td>Hair and clothes won’t smell ‡</td>
<td>1.33 ‡</td>
<td>1.07, 1.64</td>
</tr>
<tr>
<td>Difficult to find a place ‡</td>
<td>1.27 ‡</td>
<td>1.01, 1.59</td>
</tr>
<tr>
<td>To improve health ‡</td>
<td>1.29</td>
<td>.43, 3.85</td>
</tr>
<tr>
<td>To be a good role model ‡</td>
<td>1.37 ‡</td>
<td>1.10, 1.72</td>
</tr>
<tr>
<td>To control one’s life ‡</td>
<td>1.95 ‡</td>
<td>1.29, 2.93</td>
</tr>
<tr>
<td>To improve physical fitness ‡</td>
<td>1.60</td>
<td>.82, 3.14</td>
</tr>
<tr>
<td>Negative effect on career ‡</td>
<td>1.12</td>
<td>.91, 1.38</td>
</tr>
<tr>
<td>Summary Score ‡</td>
<td>1.34 ‡</td>
<td>1.12, 1.67</td>
</tr>
<tr>
<td>Confidence in Quitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some day ‡</td>
<td>1.94 ‡</td>
<td>1.34, 2.80</td>
</tr>
<tr>
<td>Next six months ‡</td>
<td>1.66 ‡</td>
<td>1.15, 2.37</td>
</tr>
</tbody>
</table>

Note: * Referents for dichotomous and ordinal predictors; ‡ continuous predictor; † p<.10; Outcome coded as continued smoking=0, quit=1
Table 5.

*Final Two Multivariable Models Predicting Cessation Outcomes*

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>3 Month Cessation</th>
<th>12 Month Cessation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>CI</td>
</tr>
<tr>
<td>Quitting to take control of one’s life ‡</td>
<td>1.74</td>
<td>1.16, 2.62</td>
</tr>
<tr>
<td>Confidence in quitting some day ‡</td>
<td>1.75</td>
<td>1.21, 2.52</td>
</tr>
<tr>
<td>Nicotine dependence ‡</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Second dose of treatment (received a second dose* vs. did not)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: * referent for dichotomous predictor; ‡ continuous predictors; those who received a second dose of treatment included individuals who had not quit smoking at 3 months and agreed to re-engage with the intervention; those who did not receive a second dose of treatment included individuals who had quit smoking at 3-months, were lost to follow-up, or who did not quit at 3 months and refused re-engagement with the intervention.
Figure 1.

*Overview of Older Adult Participation in Proposed Study*