RUNNING HEAD: LONELINESS AND SMOKING

A Systematic Review of Loneliness and Smoking: Small Effects, Big Implications

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ABSTRACT

Background: Research supports an association between smoking and negative affect. Loneliness is a negative affective state experienced when a person perceives themselves as socially isolated and is associated with poor health behaviors and increased morbidity and early mortality.

Objectives: In this paper we systematically review the literature on loneliness and smoking and suggest potential theoretical and methodological implications.

Methods: PubMed and PsycINFO were systematically searched for articles that assessed the statistical association between loneliness and smoking. Articles that met study inclusion criteria were reviewed.

Results: Twenty-five studies met inclusion criteria. Ten studies were conducted with nationally representative samples. Twelve studies assessed loneliness using a version of the UCLA Loneliness Scale and nine used a one-item measure of loneliness. Seventeen studies assessed smoking with a binary smoking status variable. Fourteen of the studies were conducted with adults and 11 with adolescents. Half of the reviewed studies reported a statistically significant association between loneliness and smoking. Of the studies with significant results, all but one study found that higher loneliness scores were associated with being a smoker.

Conclusions/ Importance: Loneliness and smoking are likely associated, however half of the studies reviewed did not report significant associations. Studies conducted with larger sample sizes, such as those that used nationally representative samples, were more likely to have statistically significant findings. Future studies should focus on using large, longitudinal cohorts, using measures that capture different aspects of loneliness and smoking, and exploring mediators and moderators of the association between loneliness and smoking.

INTRODUCTION

Tobacco use is the leading cause of preventable disease and death globally (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2012; Samet, 2013). Smoking is a modifiable risk factor for cancer, cardiovascular and respiratory diseases, poor reproductive outcomes, and other diseases (Office of the Surgeon General (US) & Office on Smoking and Health (US), 2004; Samet, 2013). Efforts to reduce cigarette smoking through cessation and initiation prevention have been successful, but many people continue to smoke (Samet, 2013). Examining correlates of smoking is necessary to improve understanding of smoking etiology and refine smoking reduction efforts.

Research supports that negative affect is associated with smoking (Hall, Muñoz, Reus, & Sees, 1993; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2012). One specific kind of negative affective state is loneliness, which is experienced when a person perceives themselves as socially isolated, or has insufficient quality and/or quantity of social connection as defined by their perspective of the social environment (Hays & DiMatteo, 1987; Laursen & Hartl, 2013). It is a long-recognized human experience which has been operationalized in the form of survey questions useful for empirical research in recent decades (Peplau & Perlman, 1982). Focus on loneliness has increased in the public health field as studies have uncovered loneliness as an important, often unaddressed correlate of increased morbidity, early mortality, and poor health behaviors (Cacioppo & Cacioppo, 2014; Cacioppo & Hawkley, 2003; Hawkley & Cacioppo, 2003; Noreen E. Mahon, Yarcheski, & Yarcheski, 1998; Perissinotto, Cenzer, & Covinsky, 2012). Mixed findings have been reported regarding the association between loneliness and smoking: some researchers have found that loneliness is associated with smoking, (Christopherson & Conner, 2012; Peltzer,

2009) yet others fail to find an association (Cacioppo et al., 2002; Grunbaum, Tortolero, Weller, & Gingiss, 2000). This review intends to clarify what is currently known about the association between loneliness and smoking, identify gaps in knowledge and evidence, and suggest future research directions.

While various theories explain the experience of loneliness, most research stems from cognitive and psychodynamic perspectives (Marangoni & Ickes, 1989; Peplau & Perlman, 1982; Sønderby & Wagoner, 2013). Psychodynamic and attachment theories led to the development of social needs perspective which suggests that there is a direct association between one's actual social network and their experience of loneliness (Marangoni & Ickes, 1989). In contrast, cognitive perspectives led to development of self-discrepancy theory which suggests that when one's ideal social environment does not reflect their actual social environment, loneliness may result (Laursen & Hartl, 2013).

Loneliness may be an evolutionarily selected trait: people who did not experience loneliness may have been less likely to successfully reproduce either due to the reduced motivation to socialize and mate and/or reduced motivation to care for their young (Cacioppo et al., 2006). Therefore, loneliness may serve as a signal to increase social connection and thus increase chances of survival (Cacioppo, Cacioppo, & Boomsma, 2014). This is in agreement with research suggesting loneliness may be experienced as a transient state when a person moves to a new city where they know few people or has a close companion pass away (Marangoni & Ickes, 1989; Peplau & Perlman, 1982). However, loneliness can also act as a social deterrent by causing lonely people to feel unsafe and to perceive their environments as socially threatening, leading lonely people into a loop of distancing themselves from their threatening environment and experiencing increased loneliness due to their lack of social contact (Cacioppo et al., 2006,

2014; Hawkley & Cacioppo, 2010). This may result in loneliness manifesting as a trait, as people may continue to feel the aversive stimuli of loneliness signaling them to reconnect but they also attune to negative social cues in their environment which deter them from being able to act on their instinct to reconnect (Cacioppo et al., 2014; Marangoni & Ickes, 1989; Peplau & Perlman, 1982). Personal and behavioral traits such as poor social skills and low self-esteem may be related to the cycle of loneliness and cause people to be unsuccessful at improving their social environment and to blame themselves for their loneliness, leading to further withdrawal from their social contacts (Marangoni & Ickes, 1989). Variability in loneliness has environmental and genetic influences which affect its successfulness as a survival mechanism (Cacioppo et al., 2014), potentially also influencing its manifestation as a transient state or long-term trait.

Loneliness measures vary in both design and theoretical framework. Some scales separate loneliness into multiple sub-constructs, such as emotional loneliness (loneliness due to lack of close relationships) and social loneliness (loneliness due to lack of a larger social network), while other scales measure loneliness as a uni-dimensional construct (Marangoni & Ickes, 1989; Russell, Cutrona, Rose, & Yurko, 1984; Russell, Peplau, & Ferguson, 1978). Some loneliness scales assess loneliness in specific relationships or social networks while others do not specify which relationships are lacking (Marangoni & Ickes, 1989). Some loneliness scales contain the word lonely in survey items, while others were purposely designed to measure loneliness without the term lonely. Despite their face validity, there is some controversy regarding measures including the term lonely: some people may not recognize themselves as lonely and may not self-identify as lonely and other people may not wish to identify themselves as lonely due to the stigma associated with loneliness (Marangoni & Ickes, 1989). This is often seen in one-item measures of loneliness such as the item “I felt lonely” from the Center for Epidemiologic Studies

Depression Scale (CES-D) to assess loneliness (Radloff, 1977). Measurement and theoretical conceptualization of loneliness may alter the association between loneliness and smoking.

Rates of loneliness differ by population (Yang & Victor, 2011). Loneliness may be experienced at higher rates in both the elderly and adolescents, although some studies have found no difference in loneliness by age and others have only found age differences in certain populations (Peplau & Perlman, 1982; Victor & Yang, 2012; Yang & Victor, 2011). Higher rates of loneliness during adolescence may be of importance to smoking prevention because most adult smokers began smoking prior to the age of 18 (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2012). Nationality may affect loneliness as well: a recent paper focusing on differences in loneliness rates by age and nation in 25 European nations found nationality had a larger influence on loneliness in comparison to age (Yang & Victor, 2011). Women have been found to be lonelier than men, (Victor & Yang, 2012) although other studies report higher rates of loneliness in men (Mahon, Yarcheski, Yarcheski, Cannella, & Hanks, 2006). Gender differences are often noted when the word lonely is included in surveys as women may be more likely to identify themselves as lonely (Marangoni & Ickes, 1989; Peplau & Perlman, 1982). Loneliness rates vary by population due to methodological, cultural, and socio-demographic differences.

Various theories and hypotheses explain the potential association between loneliness and smoking. Lonely people may be drawn to the psychopharmacological properties of cigarettes in order to reduce their negative emotions or increase their positive emotions, as suggested by the self-medication hypothesis (Khantzian, 1985). DeWall and Pond suggest that motivational processes to increase social acceptance, belonging, and connection may drive lonely people to smoke (DeWall & Pond, 2011). Their theory is based on evidence that lonely people exhibit low

impulse control and irrational decision making, both which reduce lonely people's ability to abstain from unhealthy, yet potentially pleasurable activities such as smoking, and high sensitivity to cues of social affiliation, which may include the presentation of smoking as pro-social behavior (DeWall & Pond, 2011). Borges and Simoes-Barbosa suggest that smokers may anthropomorphize cigarettes and view them as their companions in response to loneliness, using them to fulfill their social needs rather than a tool to instigate actual social connection (Borges & Simões-Barbosa, 2008). Furthermore, the association between loneliness and smoking may differ by population and/or motivation for cigarette use. An association between loneliness and smoking found in adolescents experimenting with smoking or in social smokers may be due to the use of cigarettes to increase social acceptance and connection to peers. An association between smoking and loneliness in established heavy smokers may be attributed to the mood-altering effects of nicotine.

In this paper we systematically review the literature on loneliness and smoking and suggest potential theoretical and methodological implications. Questions addressed include: (1) Is loneliness associated with cigarette smoking?; (2) Does the measurement of loneliness and/or smoking affect the association between loneliness and smoking?; and (3) Is smoking and loneliness only associated in certain populations? Relevance to public health interventions is discussed.

METHODS

Search engines PubMed and PsycINFO were used to find articles assessing loneliness and smoking. PubMed was searched using the term (lonel* AND (smok* OR cig*)) on January 28th, 2014 and PsycINFO was searched using the term (lone* AND (smok* OR cig*)) on January 29th, 2014. Use of lone* as the search term for loneliness did not appear to pull any

additional relevant articles in comparison to the term lonel*. Key words could appear anywhere in the article. Both searches were conducted with filters to include only articles written in English; a filter to include only peer-reviewed articles was also included for the PsycINFO query. No limits on year of publication were included: interest in loneliness and smoking has piqued in recent decades and the majority of articles found were published recently. Reference sections of relevant publications were scanned for additional candidate articles. Articles previously obtained from prior research were also included. A new publication alert was place on PubMed to notify the authors of any newly published literature of relevance. The most recent article included was located by a PubMed alert received on July 24th, 2014.

We included studies that met the criteria of: (1) Loneliness was measured using a quantitative format; (2) Cigarette use or other smoking variable was measured quantitatively; and (3) The association between cigarette use and loneliness was assessed statistically.

RESULTS

There were 23 articles which met the inclusion criteria for the review. Detailed information concerning search results and article exclusion are included in Figure 1. Two articles contained multiple studies that used different methodology (Cacioppo et al., 2002; DeWall & Pond, 2011): these studies will be assessed separately for the remainder of the analysis. Note that only two studies from DeWall & Pond (2011) are reviewed, the third study assessed the association between retrospective childhood rejection and cigarette use and is not included here (DeWall & Pond, 2011). Three articles contained analyses from multiple countries included in the same study but not analyzed as one sample, a consistent methodology was used across the countries included in each study and therefore these studies are reported as one study each (Page et al., 2008; Page, Dennis, Lindsay, & Merrill, 2010; Stickley et al., 2013; Stickley, Koyanagi,

Koposov, Schwab-Stone, & Ruchkin, 2014). Therefore, the total study count is 25. In studies with analyses stratified by gender and/or nationality, an overall effect was determined present if at least half of the analyses had statistically significant results.

Review findings are summarized in Table 1 and descriptions of the included studies are presented in Table 2. Table 1 lists study descriptors, citations for studies within each descriptor category separately for studies with significant and non-significant results, the number of studies in each category, the percentage of studies in each category out of all reviewed studies, the number of studies in each category with significant results for the association between loneliness and smoking, and the percentage of studies with significant findings out of the number of studies in each category.

Most studies were conducted within English-speaking countries. Of the studies that indicated when data were collected, all data were collected after 1970. Eleven studies were conducted among adolescents as defined by a mean age of 18 or lower or sampling from schools. The other 14 studies were conducted in adult populations. Ten studies were conducted using nationally representative samples. All study samples were roughly half female with the exception of one composed of adults aged 50 and over living with HIV/AIDS, which was 25.6% female (Siconolfi et al., 2013). Almost all of the studies used cross-sectional survey data, even though some studies pull from longitudinal samples these studies used loneliness and smoking status data collected during only one wave. There were two exceptions: a randomized controlled trial for smoking cessation (Moadel et al., 2012) and a longitudinal study which assessed loneliness trajectories from childhood to adolescence (Qualter et al., 2013).

The most common measure of loneliness was the UCLA loneliness scale (ULS), a full or shortened version of the ULS was used in 12 studies. ULS versions included the revised ULS

(ULS-R; Russell, Peplau, & Cutrona, 1980), the four-item ULS (ULS-4; Russell et al., 1980), the eight-item ULS (ULS-8; Hays & DiMatteo, 1987), the revised ULS version 3 (Russell, 1996), the ULS Roberts Version---an eight-item version developed for adolescents (Roberts, Lewinsohn, & Seeley, 1993), and the Three-Item Loneliness Scale---a shortened version of the ULS specifically developed for studies conducted on telephone (Hughes, 2004). The other most common measure of loneliness was a one-item likert measure that included the word lonely. Current smoking status was measured in various ways in 13 studies. Four additional articles measured smoking status using the GSHS (Global School-based Health Survey) tobacco measures (Alwan, Viswanathan, Rousson, Paccaud, & Bovet, 2011; Malta et al., 2014; Page et al., 2010; Peltzer, 2009).

Of the 25 studies assessed, 13 (52%) found associations between loneliness and smoking behavior for the main sample. Of the ten nationally representative studies, seven found overall associations between smoking and loneliness. Of the nine studies that measured loneliness using a one-item measure including the word lonely, six had significant findings. Of the 12 studies which used the ULS, five had significant findings.

Some studies contained subgroup analyses and found associations between loneliness and smoking for specific subgroups of participants, including studies which did not find a significant association for the total sample. Seven studies contained analyses stratified by gender (Allen, Page, Moore, & Hewitt, 1994; Alwan et al., 2011; Christopherson & Conner, 2012; Page et al., 2008, 2010; Stickley et al., 2014; Thurston & Kubzansky, 2009) and four studies contained analyses stratified by country (Page et al., 2008, 2010; Stickley et al., 2013, 2014). One study found positive associations between smoking and loneliness for both genders, (Christopherson & Conner, 2012) two studies found a positive association among males but not females (Allen et

al., 1994; Alwan et al., 2011) while another study found a positive association for females only (Thurston & Kubzansky, 2009). In a study of four countries, all country-gender subgroups exhibited associations between loneliness and smoking with the exception of Filipino males and Chinese females (Page et al., 2010). A study comparing Russian and American adolescents found that Russian males exhibited a positive association between loneliness and smoking and American males had no significant association (Stickley et al., 2014). The same study had significant results for both Russian females and American females, although the association between loneliness and smoking did not retain significance for either subgroup after controlling for depression (Stickley et al., 2014). Another study exhibited mixed findings in country-gender subgroup analyses: this study reported a notable negative association between loneliness and smoking for Central-Eastern European females, a positive association for Southeast Asian females, and no association for males of either geographic region (Page et al., 2008). Of nine countries from the former Soviet Union, only one country, Kyrgyzstan, exhibited an association between smoking and loneliness (Stickley et al., 2013). In a study of children in Serbia and Montenegro, an association between loneliness and smoking was found only in a subsample of foster children (Backović, Marinković, Grujičić-Šipetić, & Maksimović, 2006).

Studies of smoking during adolescence may be particularly important to focus on because most adult smokers began smoking prior to the age of 18, highlighting adolescence as a prime developmental period for smoking prevention programs (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2012). The percentage of studies with significant findings did not differ much between adults (50%) and adolescents (55%). However, the methodology of the adolescent studies did differ somewhat. The adolescent studies were conducted in a greater variety of countries: only 36% of the adolescent studies were

conducted in English-speaking nations. Additionally, studies with significant findings in adolescents mostly used a one-item measure of loneliness. Of the 11 studies in adolescents, six used a one-item measure and of these six, five, or 83% had significant findings. Lastly, we highlight that one of the adolescent studies used a longitudinal sample to assess loneliness trajectories, allowing for differentiation between transient and stable loneliness (Qualter et al., 2013). This study did not find a significant association between loneliness trajectories and smoking (Qualter et al., 2013).

DISCUSSION

Overall, half of the studies reported an association between loneliness and smoking. This did not differ when considering the population in which the study was conducted. While not all of the reviewed studies reported a significant association between smoking and loneliness, those that did consistently found that lonely people were more likely to be smokers. Only one study found a negative association between loneliness and smoking, and only for one subsample (Page et al., 2008). Almost three-fourths of the studies that used large, nationally representative samples found significant associations between loneliness and smoking, while less than half of the other studies found a significant association, suggesting that studies need large sample sizes in order to be adequately powered to find an effect. This supports a statement by DeWall and Pond that the association between smoking and loneliness likely has a small effect size and that large samples are necessary to achieve statistical significance (DeWall & Pond, 2011). Due to the variety of populations, measurement instruments, and prevalence of loneliness and smoking in the reviewed studies we do not report an overall effect size for the association between loneliness and smoking. Sample sizes of future studies may be determined using effect sizes

available in Table 2 from studies with populations and methodologies similar to proposed studies to adequately power analyses assessing the association between loneliness and smoking.

Over 60% of the studies which measured loneliness using a one-item measure including the word lonely had significant findings while just over 40% of the studies which used the ULS had significant findings. This may suggest that methodological differences account for some of the variability in research findings concerning loneliness and smoking. However, seven of the nine studies which used a single item measure of loneliness also had large, nationally representative samples. It is probable that the large sample size accounts for the higher rate of statistical significance rather than the use of a single item. More research is needed to clarify this. We also note that those studies using one-item measures had higher rates of statistical significance despite concerns of underreporting on these measures due to stigma associated with the endorsement of loneliness (Marangoni & Ickes, 1989). People who self-identify as lonely could potentially be more likely to smoke in comparison to those people who experience loneliness and do not identify themselves as lonely. We also consider that one-item measures may assess a sub-dimension or variant of loneliness which is associated with smoking. Potentially people who identify as lonely are more likely to be chronically lonely or experience a variant of loneliness such as social or emotional loneliness.

Of the nine studies which assessed loneliness using a one-item measure, six were conducted in adolescents. Of these six studies, five (83%) had significant findings, suggesting that one-item measures of loneliness may be particularly useful in adolescent populations. To reconcile the suggestion that one-item measures may assess chronic loneliness with the finding that the longitudinal study conducted in adolescents did not have significant findings we note that the longitudinal study used a measure which assessed peer-related loneliness specifically

(Qualter et al., 2013). More longitudinal studies of loneliness and potential loneliness sub-dimensions are necessary to clarify these findings. Endorsement of loneliness may have a different meaning for adolescents and adults. Furthermore, the importance of different kinds of social contacts changes throughout the lifespan (Carstensen, 1992; Fredrickson & Carstensen, 1990). In order to understand the association between loneliness and smoking throughout the lifespan, longitudinal studies conducted with diverse populations and multi-dimensional measures of loneliness are needed.

A variety of smoking measures were used in the studies, however, most of the studies dichotomized their measures to indicate which participants were current smokers. Current smoking was operationalized in different ways throughout the studies. Some studies defined current smokers as those who smoked at least one cigarette in the past 30 days and other studies defined current smokers as those who smoked daily in the past 30 days. Many studies did not report how current smoking status was defined. The association between loneliness and smoking could potentially be different for established daily smokers and non-daily smokers. The one study that assessed smoking abstinence following a cessation intervention found loneliness to be a predictor of relapse (Moadel et al., 2012). Few other measures of smoking have been assessed for association with loneliness: future studies should include additional measures such as a nicotine dependence scale and describe how variables such as smoking status were assessed.

Ten of the 25 studies were conducted with nationally representative samples: the first of these was published in 2006. This represents a trend of assessing affective states and substance use in the larger population using epidemiological methodology as opposed to smaller studies of psychiatric populations or laboratory studies of healthy participants. In their 2006 study, Lauder and others argue that many studies up to that time had not found an association between smoking

and loneliness and that this was due to the use of non-representative, healthy samples in research (Lauder, Mummery, Jones, & Caperchione, 2006). Laboratory-based studies designed to assess physiological correlates of loneliness, like some included here, generally have small sample sizes and low rates of smoking. Without research in larger, representative samples, this review would uncover very different findings. Seven of the 13 studies with significant findings used nationally representative samples. Without those studies there would be little evidence for an association between smoking and loneliness.

Understanding how loneliness induces vulnerability to tobacco use may help program developers design interventions to attenuate the propensity to smoke while experiencing loneliness. Prevention programs may need to address strategies to combat feelings of loneliness other than smoking and to reframe smoking activities from their current position as a potential social bonding activity. Smoking cessation programs may be improved by adding in components to reduce loneliness experienced when quitting smoking. Interventions aimed at reducing loneliness could include a component to reduce negative health behaviors including smoking which may isolate persons and prevent social interaction with the larger population.

There are limitations of this study. Dissertations and theses were not included in the analysis. Many of the studies assessed were cross-sectional and we cannot hypothesize if loneliness is a cause of smoking or if smoking causes loneliness. The association between loneliness and cigarette smoking is likely bidirectional. One study assessed cigarette use and use of other tobacco products together, and one study assessed alcohol use and cigarette use concurrently. Findings reported for these studies may differ if smoking was examined separate from other variables. Many studies used one-item measures of loneliness which do not have preferred psychometric properties and may not have detected more subtle variations in

loneliness. While ten of the reviewed studies used nationally representative samples, some studies were conducted with small, non-representative samples such as university students which may not be generalizable to the larger population. Eight reviewed studies did not include data on the sample prevalence of loneliness and/or smoking. Researchers are encouraged to report sample descriptive statistics including prevalence in future studies because lack of variability in loneliness and/or smoking may contribute to null findings. Studies with particularly low or high smoking rates and/or loneliness prevalence may need larger sample sizes and/or stratified sampling methodologies in order to survey enough participants to satisfy statistical requirements to accurately estimate an odds ratio.

Just under half of the studies did not find an association between loneliness and smoking. While this is likely due to these studies being underpowered, there are other potential reasons for this. The association between loneliness and smoking may be population specific or moderated by the prevalence of smoking and/or loneliness, and/or the social context of smoking in a given population. Future studies that include additional measures of demographic variables, nicotine dependence or smoking heaviness, reasons for smoking, and/or coping skills may help explain why loneliness and smoking are associated in some studies, yet no association is found in other studies.

Furthermore, much of the work concerning negative affect and smoking has focused on the bidirectional association of and shared risk factors for depressive symptomatology and smoking (Boden, Fergusson, & Horwood, 2010; Munafò, Hitsman, Rende, Metcalfe, & Niaura, 2008; Steuber & Danner, 2006). Few of the reviewed studies included depression as a covariate in analyses. We note that loneliness was not a significant correlate of smoking in studies that included depression as a covariate. However, given that few studies have examined the

associations among loneliness, depression, and smoking, we cannot come to a conclusion concerning their combined associations. Past research suggests that loneliness is predictive of depression in longitudinal studies (Cacioppo, Hawkley, & Thisted, 2010; Ladd & Ettekal, 2013; Qualter, Brown, Munn, & Rotenberg, 2010). The Diagnostic and Statistical Manual of Mental Disorders includes social impairment as a functional impairment associated with depression, and loneliness is often included in measures of depression such as the CESD (American Psychiatric Association, 2013; Radloff, 1977). The association between loneliness and smoking may be mediated by depression, or may be spurious due to confounding by depression.

The studies examined do not explain why people who report higher loneliness are more likely to smoke. Various theories provide potential pathways through which loneliness and smoking may impact each other, however, to our knowledge these theories have not yet been tested in the specific association between loneliness and smoking. Loneliness may cause people to smoke either due to self-medication reasons or use of cigarettes to increase social connection (DeWall & Pond, 2011; Khantzian, 1985). Smoking may induce loneliness either through neuro-pharmacological effects of nicotine or social isolation experienced as a smoker. Studies of theoretical models linking smoking and loneliness may provide health promotion program designers with moderating and mediating variables to address during intervention design.

Little research was located examining the association among loneliness and smoking measures within a sample of smokers. Only one study was located which assessed a sample of smokers, and that study only assessed cessation outcomes. A follow-up article on that same sample found that self-efficacy to quit smoking was also significantly associated with loneliness (Shuter, Moadel, Kim, Weinberger, & Stanton, 2014). Future studies conducted within samples of smokers are warranted. Future research should focus on comparing measures of loneliness and

studying if single item measures of loneliness which contain the word lonely produce the same association with smoking as multi-item and/or multidimensional measures, given that higher rates of significant findings were found with single item measures in comparison to other measures in the articles located. None of the reviewed studies addressed the difference in the association between loneliness and smoking for loneliness experienced as a transient state or experienced as a prolonged trait. We do not have evidence to suggest if state and trait loneliness operate in different ways. There has been recent emphasis on trajectories of loneliness, (Qualter et al., 2013; van Dulmen & Goossens, 2013). However, research with other measures of loneliness, smoking measures which assess a range of smoking behaviors, and a varied population is still needed to clarify how loneliness is experienced through the lifespan in conjunction with cigarette smoking. Longitudinal studies may contribute to understanding of the directionality of the loneliness/smoking association. It is unclear how motivations to smoke due to loneliness may differ or how the association between smoking and loneliness may change through developmental stages. Our research supports that loneliness and smoking is associated in both adolescent and adult samples. However, little is known concerning the nature of and theoretical reasons for this association. Future research is needed to clarify methodological and theoretical questions and to guide program developers to address loneliness as a component of smoking prevention and cessation interventions.

GLOSSARY

Loneliness: A negative affective state which is experienced when a person perceives themselves as socially isolated.

UCLA Loneliness Scale (ULS): Measure of loneliness with 20 questions answered on a likert scale. Does not contain the word lonely in any item.

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Figure 1.

Flowchart for article inclusion

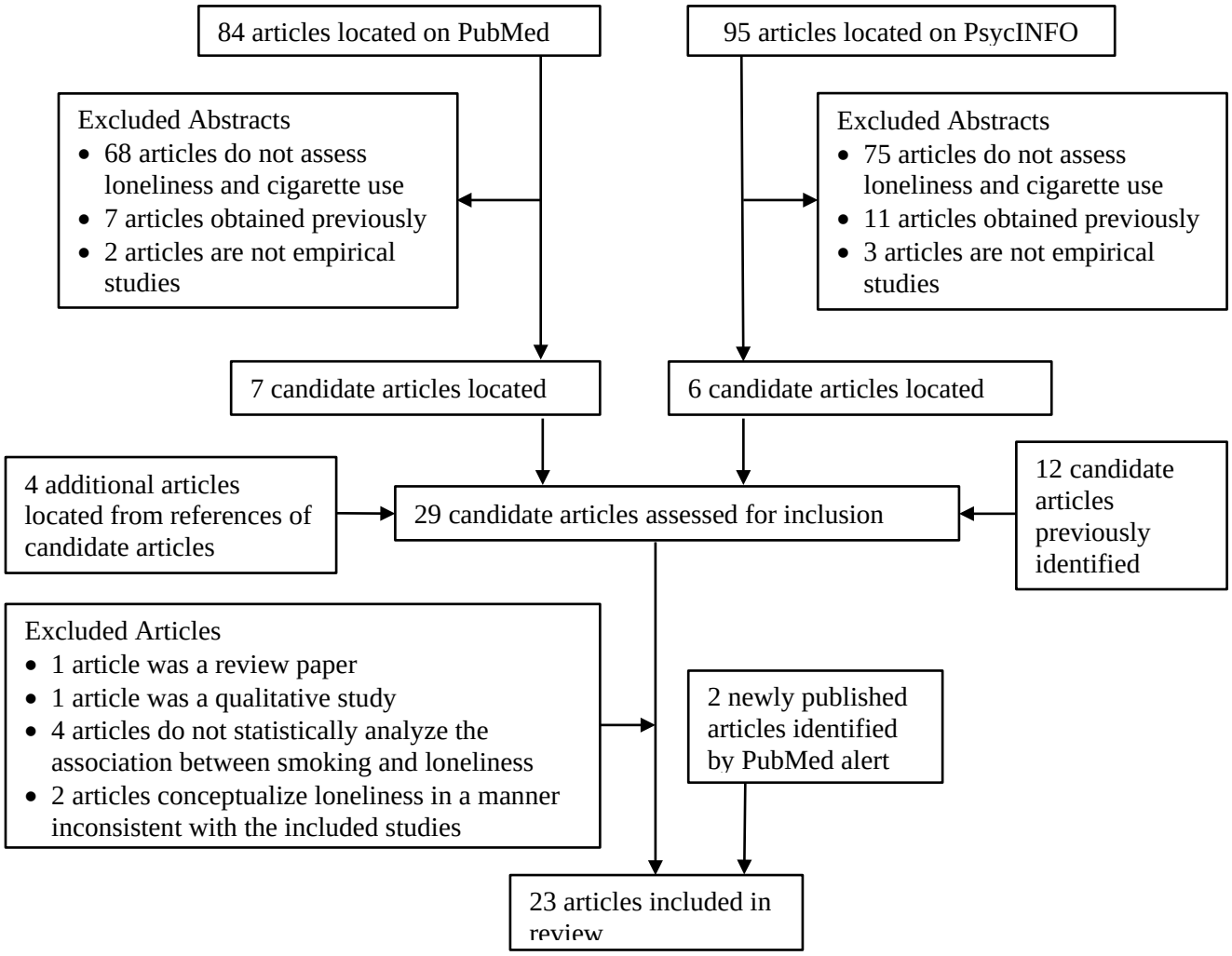

Table 1.

Summary of review findings on the association between loneliness and smoking

Variable	Category	Studies with Significant results	Studies with Nonsignificant results	*N*	%†	*N* *	%‡
Study Location	US	Allen et al., 1994; Christopherson & Conner, 2012; DeWall & Pond, 2011; Moadel et al., 2012	Cacioppo et al., 2002; Grunbaum et al., 2000; Hays & DiMatteo, 1987; Siconolfi et al., 2013; Thurston & Kubzansky, 2009	11	44	5	45
	England	Shankar et al., 2011; Whisman, 2010	Qualter et al., 2013; Steptoe, Owen, Kunz-Ebrecht, & Brydon, 2004	4	16	2	50
	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, and Ukraine		Stickley et al., 2013	1	4	0	0
	Australia	Lauder et al., 2006		1	4	1	100
	Brazil	Malta et al., 2014		1	4	1	100
	Hong Kong	Leung et al., 2008		1	4	1	100
	Kenya, Namibia, Uganda, Zimbabwe	Peltzer, 2009		1	4	1	100
	Philippines, China, Chile, and Namibia	Page et al., 2010		1	4	1	100
	Serbia and Montenegro		Backović et al., 2006	1	4	0	0
	Seychelles		Alwan et al., 2011	1	4	0	0
	Thailand, Taiwan, the Philippines, Hungary, Ukraine, Slovakia, Poland, Romania, and the Czech Republic		Page et al., 2008	1	4	0	0
	US and Russia	Stickley et al., 2014		1	4	1	100
Loneliness Measures	ULS	Allen et al., 1994; Christopherson & Conner, 2012; Moadel et al., 2012; Shankar et al., 2011; Whisman, 2010	Cacioppo et al., 2002; Grunbaum et al., 2000; Hays & DiMatteo, 1987; Page et al., 2008; Siconolfi et al., 2013;	12	48	5	42

			Steptoe et al., 2004				
	One-item likert measure including word lonely	DeWall & Pond, 2011; Malta et al., 2014; Page et al., 2010; Peltzer, 2009; Stickley et al., 2014	Thurston & Kubzansky, 2009; Stickley et al., 2013; Alwan et al., 2011;	9	36	6	67
	De Jong Gierveld Loneliness Scale	Lauder et al., 2006; Leung et al., 2008		2	8	2	100
	Peer-Related Loneliness Subscale from the Loneliness and Aloneness Scale for Children and Adolescents		Qualter et al., 2013	1	4	0	0
	unspecified		Backović et al., 2006	1	4	0	0
Smoking measures	Smoking status	Allen et al., 1994; Lauder et al., 2006; Leung et al., 2008; Shankar et al., 2011; Stickley et al., 2014; Whisman, 2010	Backović et al., 2006; Page et al., 2008; Qualter et al., 2013; Siconolfi et al., 2013; Steptoe et al., 2004; Stickley et al., 2013; Thurston & Kubzansky, 2009;	13	52	6	46
	GSHS two-item measure	Malta et al., 2014; Page et al., 2010; Peltzer, 2009	Alwan et al., 2011	4	16	3	75
	Number of cigarettes/packs consumed daily/weekly		Cacioppo et al., 2002	2	8	0	0
	YRBS measures	Christopherson & Conner, 2012	Grunbaum et al., 2000	2	8	1	50
	Ever-smoking, ever-weekly smoking, heavier past smoking in comparison to current smoking, and ever chain smoking	DeWall & Pond, 2011		1	4	1	100
	Ever-smoking and frequency of smoking in past 30 days	DeWall & Pond, 2011		1	4	1	100
	Past 7 day smoking following cessation	Moadel et al., 2012		1	4	1	100
	Quantity/frequency of smoking in past 6 months		Hays & DiMatteo, 1987	1	4	0	0
Population	Adult	Christopherson & Conner, 2012; DeWall & Pond, 2011; Lauder	Cacioppo et al., 2002; Hays & DiMatteo, 1987; Siconolfi et	14	56	7	50

		et al., 2006; Leung et al., 2008; Moadel et al., 2012; Shankar et al., 2011; Whisman, 2010	al., 2013; Steptoe et al., 2004; Stickley et al., 2013; Thurston et al., 2009				
	Adolescent	Allen et al., 1994; DeWall & Pond, 2011; Malta et al., 2014; Page et al., 2010; Peltzer, 2009; Stickley et al., 2014	Alwan et al., 2011; Backović et al., 2006; Grunbaum et al., 2000; Page et al., 2008; Qualter et al., 2013;	11	44	6	55
Sampling strategy	Nationally representative	DeWall & Pond, 2011; Lauder et al., 2006; Page et al., 2010; Peltzer, 2009; Shankar et al., 2011; Whisman, 2010	Alwan et al., 2011; Stickley et al., 2013; Thurston & Kubzansky, 2009	10	40	7	70
	High schools	Allen et al., 1994; Malta et al., 2014; Stickley et al., 2014	Grunbaum et al., 2000; Page et al., 2008; Qualter et al., 2013	6	24	3	50
	Community samples	Leung et al., 2008	Cacioppo et al., 2002; Steptoe et al., 2004	3	12	1	33
	University students	Christopherson & Conner, 2012	Cacioppo et al., 2002; Hays & DiMatteo, 1987	3	12	1	33
	Sampled on HIV/AIDS status	Moadel et al., 2012	Siconolfi et al., 2013	2	8	1	50
	Foster homes and community comparison group		Backović et al., 2006	1	4	0	0

*Note. N**=Number of studies with statistically significant findings † = Percent of studies in category out of all studies included in review. ‡ = Percent of studies in category with significant findings out of all studies included in the category. Percentages rounded to the nearest whole percent.

Table 2.

Summaries of studies included in review

Publication Information	Location and year	Sample description	Loneliness Measure	Prevalence loneliness†	Smoking Measure	Prevalence smoking†	Results
Allen et al. (1994) Gender differences in selected psychosocial characteristics of adolescent smokers and nonsmokers	Central Mississippi County, USA	1679 adolescents sampled from 9th-12th grades	ULS-R	Males: *M*=39.55, Females: *M*=36.76	"How many cigarettes do you smoke during an average day?" Smokers defined as those who report smoking 1+ cigs on an average day.	Males: 19.2%, Females: 15.8%, Overall: 17.5%	Smokers scored higher on loneliness than nonsmokers, $F(1, 1678) = 7.73$, $p = .0055$. Gender interaction found, male smokers more lonely than all other groups. No difference in loneliness for female nonsmokers and female smokers.
Alwan et al. (2011) Association between substance use and psychosocial characteristics among adolescents of the Seychelles	Seychelles, 2007	1417 nationally representative students aged 11-17 participating in GSHS	"During the past 12 months, how often have you felt lonely?"	Males: 10.4% Females: 15.2%	"During the past 30 days, on how many days did you smoke cigarettes?" Current smokers were defined as having smoked on 1 or more days.	Males: 22%, Females: 10.6%	Loneliness was positively associated with smoking for males only in age-adjusted analyses [Males; *OR*=2.4, *95%CI*=(1.3,4.5) *p*=.008, Females: *OR*=1.7, *95%CI* =(1.0,3.2) *p*=.065]. The association does not reach significance in multivariate analyses.
Backović et al. (2006) Differences in substance use patterns among youths living in foster care institutions and in birth families	Belgrade, Serbia and Montenegro 2003-2004	303 adolescents aged 14-17 living in foster homes (*n*=58) and with birth family (*n*=245)	"Feelings of loneliness", unspecified measure	Foster care: 32.8%, Birth family: 16.3%	Current Smoking, unspecified definition	Foster care: 55.2%, Birth home: 20.8%	Loneliness was positively associated with smoking for children in foster care, *OR*=4.85, *95%CI* = (1.36, 17.31), *p* =.0149. No association for children living with birth families (*p* =.4773).
Cacioppo et al. (2002) Loneliness and Health: Potential Mechanisms	Ohio, USA	89 undergraduate students aged 18-24 participating in an experimental study	ULS-R; pts included in analyses if they scored low or high on loneliness	*M* = 37.8	Average # of packs of cigarettes consumed weekly	Nonlonely= .4 packs/week Lonely= .3 packs/week	No association between smoking and loneliness ($F < 1$).
	Chicago, Illinois, USA	25 healthy adults aged 53-78 participating in experimental study	ULS-R, pts included in analyses if they scored low or high on loneliness	*M* = 35.1	Average # of cigarettes consumed daily	Nonlonely = 2.5 cigs/day, Lonely = 1.07 cigs/day	No association between smoking and loneliness ($F < 1$).
Christopherson & Conner (2012) Mediation of late	California, USA	437 students attending a junior college, mean age	Revised ULS version 3	*M* = 39.95	Composite of YRBS measures: How old were you when you smoked a	*M*=2.63 (TOB1), *M*=1.89	SEM indicates higher loneliness was significantly associated with higher scores on the smoking latent factor

adolescent health-risk behaviors and gender influences		= 19			whole cigarette for the first time?"; "During the past 30 days, on how many days did you smoke cigarettes?"; "During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?"	(TOB2), *M*=1.73 (TOB 3)	(Females: *B*=.28, Males: *B*=.21)]
Dewall & Pond (2011) Loneliness and smoking: The costs of the desire to reconnect	USA 1977-2007	89,348 nationally representative high school seniors from MTF	"Alot of times I feel lonely.''	NR	"How frequently have you smoked cigarettes in the past 30 days?", "Have you ever smoked cigarettes?'	NR	Loneliness associated with past 30 day cig use (*b*=0.04, *p*=.001), and ever having smoked cigarettes (*b*=0.05, *p*=.001). Year of administration, gender, and ethnicity included as covariates.
	USA, 2001-2003	5692 nationally representative adults aged 18-99 from NCS-R	"Over the past month, how lonely did you feel?"	NR	"Have you ever smoked a cigarette, cigar, or pipe, even a single puff?'', ''Was there ever a period in your life lasting at least two months when you smoked at least once per week?'', ''Was there ever a year in your life when you smoked more than you did in the past 12 months?'', ''Have you chain smoked for several days or more?''	NR	Loneliness was associated with having ever smoked [*OR*=1.17, *95% CI*=(1.08,1.28), *p*<.001], increased likelihood of smoking once per week for at least two months [*OR*=1.37, *95% CI*=(1.18, 1.59), *p*<.001], smoking more in a past year than in the past 12 months [*OR*=1.15, *95% CI*=(1.05,1.25), *p*<.002], and chain smoking [*OR*=1.25, *95%CI*=(1.13, 1.37), *p*<.001], Age, gender, and ethnicity included as covariates.
Grunbaum et al. (2000) Cultural, social, and intrapersonal factors associated with substance use among alternative high school students	Texas, USA, 1997	441 Alternative high school students	ULS, Roberts Version	NR	YRBS measure: Cigarette use in past month and alcohol use in past month combined.	60.7%	Loneliness was not associated with combined cigarette/alcohol use, *OR*=.98, *95% CI*=(.94, 1.04).
Hays & DiMatteo (1987) A Short-form measure of loneliness	California, USA, 1981	199 college students aged 17-48	ULS-20, ULS-8, ULS-4	ULS-20: *M*=32.6	Composite of quantity of cigarettes smoked (1 ½, 1, ½ less than ½ pack daily, or nonsmoker) and frequency (number of days smoked in past 6 months)	NR	Smoking was not correlated with any of the loneliness scales; *r* ranged from -.02 to -.03.

Lauder et al (2006) A comparison of health behaviours in lonely and non-lonely populations	Queensland, Australia 2003	1278 nationally representative adults, mean age= 46.25	De Jong Gierveld Loneliness Scale	35%	Participants were asked if they smoke.	22.3%	Loneliness was associated with smoking [*OR*=1.55, *95% CI* =(1.14, 2.09)]. Marital status, age, employment, gender, and overweight/ obese status included as covariates.
Leung et al. (2008) Validation of the Chinese translation of the 6-item De Jong Gierveld Loneliness Scale in elderly Chinese	Hong Kong 2007-2008	103 Chinese elders aged 62-89	Formal Chinese translation of 6-item De Jong Gierveld Loneliness Scale	*M*= 1.5 (range=0-6)	Current smoking status in comparison to non or ex-smoker.	NR	Loneliness was correlated positively with current smoking status (r = 0.24; p = 0.014).
Malta et al. (2014) Psychoactive substance use, family context and mental health among Brazilian adolescents, National Adolescent School-based Health Survey (PeNSE 2012)	Brazil 2012	9th grade, 109,104 students from PeNSA, sampled using stratified sampling methods	"In the past 12 months, how often have you felt lonely?" Dichotomized to never sometimes vs. most of the time, always	NR	Current smoking: "In the past 30 days, how many days did you smoke cigarettes?", dichotomized to never smoked on any day or one or more days.	5.1%	Loneliness was associated with smoking [*OR*=1.27, *95% CI* =(1.19, 1.37)], adjusted for all other significant variables in model including age, race, school type, living with parent(s), having meals with parents, family supervision, missing classes w/o permission, insomnia, and having no friends.
Moadel et al. (2012) A randomized controlled trial of a tailored group smoking cessation intervention for HIV-infected smokers	New York, USA	145 smokers living with HIV age 29-70 participating in a randomized controlled trial	Revised ULS version 3	Abstinent: *M*= 20.1, Non-abstinent: *M*= 25.4	From CDC QIT inventory: "Now, think carefully about the last 7 days. Did you smoke cigarettes, even a puff, on any of those days?"	14.5% abstinent at end of study	Loneliness was associated with lower abstinence rates at 3 months [*OR*=.92, *95% CI*=(.85,1.00), *p*=.04] (reported from intention-to-treat analyses, association retained significance in complete case analysis. Intervention condition, age, ethnicity, quit attempts in past year, positive affect, social situations score, and decisional balance pros score included as covariates.
Page et al. (2008) Cigarette Smoking and Indicators of Psychosocial Distress in Southeast Asian and Central-Eastern European Adolescents	Thailand, Taiwan, Philippines,	4518 Southeast Asian adolescent females	ULS-R	Smoker: *M*=40.26, Nonsmoker: *M*=38.59	"How often do you smoke cigarettes?" Current smoking defined as smoking cigarettes in the past 30 days.	Taiwan=7.6% Thailand=1.8% Philippines=3.2 %	Loneliness was associated with increased smoking, *F*=9.06 (6, 3753), p = .0026[a].
	Hungary, Ukraine, Slovakia,	1705 Central-Eastern European adolescent	ULS-R	Smoker: *M*=35.67, Nonsmoker:	"How often do you smoke cigarettes?" Current smoking defined	Hungary=36.9% Ukraine=21.3% Slovakia=28.8%	Loneliness was associated with decreased smoking, *F*=9.35 (4, 1602), p = .0023[a].

	Poland, Romania, Czech Republic	females		*M*=37.22	as smoking cigarettes in the past 30 days.	Romania=36.5% Poland=35.2% Czech Republic=37.6%	
	Thailand, Taiwan, Philippines,	4122 Southeast Asian adolescent males	ULS-R	Smoker: *M*=40.39, Nonsmoker: *M*=40.37	"How often do you smoke cigarettes?" Current smoking defined as smoking cigarettes in the past 30 days.	Taiwan=15.5% Thailand=5.4% Philippines=5.3 %	Loneliness was not associated with smoking, F=0.00 (6, 3149), p = .9676 [a].
	Hungary, Ukraine, Slovakia, Poland, Romania, Czech Republic	1392 Central-Eastern European adolescent males	ULS-R	Smoker: *M*=36.98, Nonsmoker: *M*=37.55	"How often do you smoke cigarettes?" Current smoking defined as smoking cigarettes in the past 30 days.	Hungary=31.4% Ukraine=32.6 % Slovakia=23.4% Romania=33.8% Poland=15.3% Czech Republic=34.8%	Loneliness was not associated with smoking, F=2.13 (3, 1061), p = .1452 [a].
Page et al. (2010) Psychosocial Distress and Substance Use Among Adolescents in Four Countries: Phillippines, China, Chile, and Namibia	Philippines, China, Chile, and Namibia 2003-2004	14370 adolescent males from GSHS. Data from Philippines and Namibia are nationally representative.	"During the past 12 months, how often have you felt lonely?"	Smoker= 11.9%, Nonsmoker= 7.6%	"During the past 30 days, on how many days did you smoke cigarettes?" Current smoking defined as smoking cigarettes in the past 30 days.	Philippines=37. 2%, China=18.2%, Chile=28.1%, Namibia=34.6%	Loneliness was associated with smoking for the overall sample [*OR*=1.46, *95% CI* =(1.26,1.70)] and all country-specific subgroups with the exception of Filipino males.
	Philippines, China, Chile, and Namibia 2003-2004	16196 adolescent females from GSHS. Data from Philippines and Namibia are nationally representative.	"During the past 12 months, how often have you felt lonely?"	Smoker= 25.4%, Nonsmoker= 11.2%	"During the past 30 days, on how many days did you smoke cigarettes?" Current smoking defined as smoking cigarettes in the past 30 days.	Philippines=19. 7%, China=10.1%, Chile=29.1%, Namibia=30.2%	Loneliness was associated with smoking for the overall sample [*OR*=2.01, *95% CI* =(1.76, 2.29)] and country-specific subgroups with the exception of Chinese females.
Peltzer (2009) Prevalence and correlates of substance use among school children in six African countries	Kenya, Namibia, Uganda, Zimbabwe* 2003-2004	12740 students in grades 6-10 from GSHS. Data are nationally representative with exception of Zimbabwe sample.	"During the past 12 months, how often have you felt lonely?"	16.1%	Participants were asked if they smoked cigarettes and/or used any other form of tobacco in the past 30 days. Current tobacco use defined as using any tobacco product in the past 30 days.	Tobacco use aggregate= 12.6% Smoking= 11.7%	Loneliness was associated with tobacco use [*OR*=1.92, *95% CI* = (1.89, 1.94), p<.001] in adjusted and unadjusted analyses.
Qualter et al. (2013) Trajectories of loneliness during childhood and adolescence:	England, UK	361 students surveyed from age 7 to 17	Peer-related loneliness subscale from the Loneliness	22% followed a high stable loneliness trajectory	"Do you smoke cigarettes everyday (1), somedays (2), or not at all (3)?"	Ranges between 1.43-1.60, reported by loneliness subgroup	Loneliness latent class not associated with smoking status. The high stable lonely group could not be differentiated from the non-lonely groups in terms of whether they

Predictors and health outcomes			and Aloneness Scale for Children and Adolescents				were currently smokers (*ORs* ≤ 2.21, *95% CI* = [.34 -14.51]). The group who increased on loneliness could also not be differentiated from the non-lonely groups (*ORs* ≤ 1.40, *95% CI* = [.70 – 3.44]) [d].
Shankar et al. (2011) Loneliness, social isolation, and behavioral and biological health indicators in older adults	England, UK 2004	8688 nationally representative older adults from ELSA	Three-Item Loneliness Scale	*M*=4.2 (range 3-9)	Participants classified as current smokers if they stated they currently smoke.	Current smoker and physically active: 15.9%, Current smoker and physically inactive: 6.0%	Loneliness was significantly associated with smoking in unadjusted analyses. When adjusted for social isolation loneliness was no longer a predictor of being a smoker [*OR*=1.04, *95% CI* =(0.98, 1.09)] but did continue to be a predictor of being both a smoker and having low physical activity [*OR*=1.08, *95% CI* =(1.02, 1.15)].
Siconolfi et al. (2013) Psychosocial and Demographic correlates of drug use in a sample of HIV-positive adults ages 50 and older	New York City, NY, USA 2005-2006	811 HIV-positive adults age 50 and older	Revised ULS version 3	*M*=43.81	Self-reported if they used cigarettes in the prior 3 months.	57.2 %	Loneliness was not associated with cigarette use *r*=.01.
Steptoe et al. (2004) Loneliness and neuroendocrine, cardiovascular, and inflammatory stress responses in middle-aged men and women	London, England, UK	240 civil servants age 47-59 from Whitehall II prospective cohort	ULS-R	*M* =36.3	Current smoking measured with yes/no question.	9.7%	Loneliness was not associated with smoking [*OR*= 0.98, *95% CI* = (0.93,1.02), *p* = 0.33][d].
Stickley et al. (2014) Loneliness and health risk behaviours among Russian and U.S. adolescents: a cross-sectional study	Russia 2003	1995 Russian adolescents age 13-15 from SAHA	Adapted CESD, "I felt lonely."	Females= 14.4%, Males= 8.9%	"During the past 30 days, on how many days did you smoke?" Current tobacco use defined as smoking cigarettes in the past 30 days.	Females= 31.1%, Males=37.1%	Loneliness was associated with smoking for males and females, the association did not retain significance in females after controlling for depression [Females: *OR*= 1.10, *95% CI*=(.79,1.52), Males: *OR*=1.87, *95% CI* =(1.08,3.24)][c].
	USA 2003	2050 U.S. adolescents age 13-15 from SAHA	Adapted CESD, "I felt lonely."	Females= 14.7%, Males= 6.7%	"During the past 30 days, on how many days did you smoke?" Current tobacco use defined as smoking cigarettes in the	Females= 11.2%, Males=7.0%	Loneliness was not associated with smoking for males; loneliness was associated with smoking for females, the association did not retain significance after controlling for

					past 30 days.		depression [Females: *OR*=1.86, *95% CI*=(.88, 3.94), Males: *OR*=.72, *95% CI*=(.17, 2.97)] [c].
Stickley et al. (2013) Loneliness: Its Correlates and associations with Health behaviours and outcomes in nine countries of the Former Soviet Union	Armenia, 2010-2011	1605 nationally representative adults from HITT	"How often do you feel lonely?"	10.7%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking, *OR*=1.02, *95% CI*=(0.60, 1.75) [b].
	Azerbaijan 2010-2011	1650 nationally representative adults from HITT	"How often do you feel lonely?"	4.4%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=1.03, *95% CI*=(0.39, 2.77)] [b].
	Belarus, 2010-2011	1677 nationally representative adults from HITT	"How often do you feel lonely?"	8.9%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=0.99, *95% CI*=(0.60, 1.66)] [b].
	Georgia, 2010-2011	1998 nationally representative adults from HITT	"How often do you feel lonely?"	12.3%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=1.34, *95% CI*=(0.81, 2.21)] [b].
	Kazakhstan 2010-2011	1694 nationally representative adults from HITT	"How often do you feel lonely?"	5.4%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=1.32, *95% CI*=(0.73, 2.39)] [b].
	Kyrgyzstan 2010-2011	1723 nationally representative adults from HITT	"How often do you feel lonely?"	7.9%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was associated with smoking [*OR*=2.29, *95% CI*=(1.36, 3.86) *p*<.01] [b].
	Moldova 2010-2011	1667 nationally representative adults from HITT	"How often do you feel lonely?"	17.9%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=0.64, *95% CI*=(0.40, 1.03)] [b].
	Russia 2010-2011	2549 nationally representative adults from HITT	"How often do you feel lonely?"	8.1%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=1.10, *95% CI*=(0.72, 1.69)] [b].
	Ukraine 2010-2011	1768 nationally representative adults from HITT	"How often do you feel lonely?"	10.8%	"Do you smoke at least one cigarette (papirossi, pipe, cigar) per day?"	NR	Loneliness was not associated with smoking [*OR*=1.13, *95% CI*=(0.68, 1.87)] [b].
Thurston et al. (2009) Women, Loneliness, and incident coronary heart disease	USA 1971-1975	2616 nationally representative adults age 25-74 from NHANES	CESD, "I felt lonely."	9.2%	Smoking status (current versus never/former)	Low loneliness: 38.8%, Medium=39.1%, High=45.6%	Loneliness was not associated with smoking (*p*=.12). Among women only, loneliness was associated with smoking (statistics not reported in paper).
Whisman (2010) Loneliness and the metabolic syndrome in a population-based sample of middle-aged and older adults	England, UK 2004-2005	3211 nationally representative adults age 50+ from ELSA	Three-Item Loneliness Scale	*M*=4.01 (range 3-9)	Current smoking status (smoker or nonsmoker)	NR	Loneliness was associated with smoking [*OR* =1.1, *95% CI* =(1.0, 1.2), *p*< .01].

Note. NR=Not reported. GSHS= Global School-Based Health Survey, HITT= Health in Times of Transition, NHANES=National Health and Nutrition Survey, ELSA=English Longitudinal Study of Ageing, MTF=Monitoring the Future, NCS-R=National Comorbidity Survey-Replication, PeNSA=Pesquisa Nacional de Saúde dos Escolares (National Adolescent School-based Health Survey), SAHA=Social and Health Assessment, YRBS= Youth risk behavior survey. Sample sizes reported are the sample sizes used in analyses for the association of loneliness and smoking when data available. *= The overall study included Swaziland and Zambia, however, no data was available on tobacco use in either country and therefore their data was not included in analyses. †= Percentages in column indicate the percent of participants who scored high on the loneliness measure/ indicated that they were lonely or the percent of participants who smoke. Prevalence may be reported only for subsamples in the reviewed article and therefore are presented by subsample here. [a]=Adjusted for country, age, grade, alcohol use in past week, marijuana or hashish use in past month, and illegal drug use other than marijuana or hashish in the past month. [b]= Adjusted for sex, age, marital status, education, location, household size, physical activity difficulty, locus of control, wealth, social support, and death of close relative. [c]=Adjusted for age, family structure, and parental education. [d]=Statistics not reported in paper. Authors were contacted for the statistical association.