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The effect of alcohol use on smoking cessation: A systematic review

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ABSTRACT

Only a small minority of all attempts to stop smoking are successful, especially among smokers who are heavy drinkers and those with an alcohol use disorder. The current systematic review focuses on the negative effects of alcohol use, either before or during attempts to quit smoking, on the success rate of these attempt(s) in alcohol-drinking tobacco smokers. We conducted a systematic review of naturalistic and experimental studies, which included at least 40 tobacco smokers with a recorded drinking status (non-drinking, heavy drinking, alcohol use disorder) and a clearly documented change in alcohol consumption. We could not conduct a meta-analysis and, thus, used consistency across studies to draw conclusions. The evidence presented here shows that alcohol use is associated with lower rates of success in quitting smoking in 20 out of 27 studies. This includes both lapses and relapses. Similarly, in 19 out of 20 long-term follow-up studies, the duration of smoking abstinence was shorter among persons with higher alcohol consumption. Finally, 12 out of 13 experimental studies showed that exposure of smokers to alcohol cues or to drinking of alcohol induce a strong propensity to smoke. It is, therefore, recommended for smokers who drink alcohol and who intend to quit smoking to use an integrated approach, i.e., to stop or substantially reduce their alcohol consumption before and/or during their attempt to quit smoking.

Introduction

Predictors of failure or success in smoking cessation

About two-thirds of current smokers want to quit smoking and more than half of them make a quit attempt each year (Babb, Malarcher, Schauer, Asman, & Jamal, 2017). Still, only about 6% are successful (Centers for Disease Control and Prevention (CDC), 2011; World Health Organization (WHO), 2022), and less than 10% remain abstinent for at least 6–12 months (Babb et al., 2017). Most smokers need several attempts before achieving long-term abstinence (Borland, Partos, Yong, Cummings, & Hyland, 2012). On average, a smoker makes 30 or more quit attempts before being successful on the long term (Chaiton et al., 2016), frequently due to isolated incidents of smoking, known as lapses, often resulting in full relapse to smoking (United States Department of Health and Human Services, 2020). These findings indicate that most smoking cessation attempts end in failure.

A wide variety of factors, like severity of nicotine dependence, history of smoking, and awareness of smoking-related health risks, predicts success or failure in attempts to quit smoking (Burling & Burling, 2003; Kalman et al., 2004; Patten, Martin, Calfas, Lento, & Wolter, 2001).

Concurrent use of tobacco and alcohol

Alcohol use and tobacco smoking are highly prevalent and are often co-used. Globally, adult smoking prevalence in 2020 was 32.6% and 6.5% among men and women, respectively; 1.18 billion people regularly smoke tobacco (Dai, Gakidou, & Lopez, 2022; World Health Organization (WHO), 2018), and an estimated 2.3 billion people (around 30%) were current drinkers (World Health Organization (WHO), 2018). According to the 2012–2013 NESARC data, the year's prevalence of alcohol use disorder (AUD) and tobacco use disorder (TUD) in the United States was 13.9% (Grant et al., 2015) and 20.0% (Chou et al., 2016), respectively.

The concurrent use of tobacco and alcohol has been well documented (Dawson, 2000; Falk, Yi, & Hiller-Sturmhöfel, 2006;

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Friedman, Tekawa, Klatsky, Sidney, & Armstrong, 1991; Hasin, Stinson, Ogburn, & Grant, 2007; Mintz, Boyd, Rose, Charuvastra, & Jarvik, 1985; Piasecki, McCarthy, Fiore, & Baker, 2008; Piasecki, Wood, Shiffman, Sher, & Heath, 2012). Compared to non-smokers, smokers drink alcohol more frequently (Harrison, Hinson, & McKee, 2009; Krukowski, Solomon, & Naud, 2005; Reed, Wang, Shillington, Clapp, & Lange, 2007) and more heavily (Anthony & Echeagaray-Wagner, 2000; Chiolero, Wietlisbach, Ruffieux, Paccaud, & Cornuz, 2006; Dawson, 2000; Falk, Yi, & Hiller-Sturmhöfel, 2008; Jiang, Lee, & Ling, 2014; Kahler, Strong, et al., 2008; Ockene et al., 2000; Toll et al., 2012). Similarly, the prevalence of nicotine dependence among alcohol-dependent persons was alarmingly high (~80%) (Dierker & Donny, 2008).

Rationale of this study

The well-documented co-use of tobacco and alcohol implies a considerable health risk because this combination severely hampers the ability of people dependent on these substances to stop their use. In their review from 2006, Hughes and Kalman (2006) compared smoking cessation success among smokers with current, past, or lifetime alcohol problems versus smokers with no alcohol problems. To their own surprise, they found that smokers with past, but no current alcohol problems were just as able to quit on a given attempt as smokers who never had an alcohol problem. Meanwhile, it seems that alcohol consumption before or during the attempts is one of the most important predictors of failed attempts (Derefinko, Salgado García, & Sumrok, 2018). However, no systematic review is available about the effect of drinking on the success or failure of smoking cessation. Therefore, the current review provides data on the interference of alcohol use with smoking cessation attempts and includes findings observed in daily smokers and moderate to heavy drinkers from the general population up to 2022. The purpose of the present systematic review is to outline and propose a simple approach to increase success in smoking cessation that can be of help in routine clinical consultation.

Methods

The systematic review concerning the effect of alcohol use on tobacco smoking status and/or smoking cessation used the PRISMA protocol and was performed on August 19th, 2022, without backward date limitation. Tobacco smoking comprises all variants of tobacco daily smoked: cigarettes, cigars, cigarillos, and pipes. Eligible studies were retrieved from PsycInfo and PubMed and most recent publications, i.e., those 'in process' were retrieved by adding the term "NOT medline" to the search string. The following search string was used: (recurrence OR relapse[tiab] OR quit*[tiab]) AND ("Smoking Cessation"[MeSH Terms] OR "smoking"[MeSH Terms] OR smoker*[tiab]) AND ("Alcohol Drinking"[MeSH Terms] OR "alcohol"[Title/Abstract] OR drink*[tiab]) NOT review[pt]. See Supplement for the PRISMA checklist.

Inclusion and exclusion criteria

The review included randomized controlled trials (RCTs) to obtain optimal internal validity, naturalistic studies to obtain optimal external validity, and experimental laboratory studies to obtain a better insight into possible mechanisms of action, thus supporting internal validity. Other inclusion criteria: studies were eligible if they recorded both drinking status (non-drinking, heavy drinking, AUD) and changes in alcohol consumption by tobacco smokers, irrespective of whether smoking cessation was the aim of the study. Exclusion criteria were: a) studies performed in smokers with comorbid other substance use disorders (except AUD) and/or other mental disorders, because people with mental disorders are significantly less successful in smoking cessation (Ziedonis et al., 2008), or other specific groups like pregnant women, homeless people, prisoners, and patients with cancer or pulmonary disease due to the high risk of bias on the overall effect of alcohol use on smoking quit rates, b) studies with a sample size <40 patients due to the risk of false negative findings (type II errors), and c) reviews or case reports.

Evaluation of the data

The following outcome variables were used to assess the effects at follow-up: smoking quit rate, smoking lapse and relapse rates, proportion of relapsers vs. sustained quitters, and self-reported temptation and rates of slip-ups to smoke. The selection of eligible studies was performed by the authors in two rounds, first round by JvA and WvdB, and disagreements discussed in a second round: 1) screening of the abstracts using the inclusion and exclusion criteria, followed by 2) evaluation of the full text of articles, selected in round one, for eligibility to be included in the current review.

Results

A total of 1549 publications were identified from the initial search after removal of duplicates, and 48 of these studies were finally included in this review. Using the reference lists of these studies, 12 additional eligible studies were identified and included. The final sample, therefore, consisted of 60 studies, including 405,361 subjects. Fig. 1 shows the PRISMA flow chart for the identification, screening, and inclusion of the studies.

Three different types of eligible studies could be identified: a) 20 studies about the effects of alcohol use on smoking cessation in naturalistic follow-up (FU) studies (Table 1), b) 27 studies about the effects of alcohol use during attempts to quit smoking on relapse and lapse to smoking (Table 2), and c) 13 studies about the effect of exposure to alcohol on smoking urges/craving, and about the effects of prior alcohol use during attempts to quit smoking on expectancy (before stopping) to successfully stop smoking (Table S1).

Effects of alcohol use on smoking cessation in naturalistic follow-up studies

Table 1 depicts the results of 20 studies about the effects of alcohol use on smoking cessation in naturalistic follow-up studies (N = 396,809 subjects in total), of which 19 studies consistently showed that prior alcohol consumption was related to higher rates of lapse and relapse in both dependent and non-daily smokers, with the level of prior alcohol consumption being inversely associated with the smoking abstinence rate at follow-up. The only exception was the study of Toll and co-workers (Toll et al., 2012), who failed to demonstrate a relationship between level of alcohol consumption and smoking quit rate. Furthermore, smokers with AUD or a substance use disorder (SUD) showed lower smoking quit rates when alcohol use was continued (Weinberger, Gbedemah, & Goodwin, 2017), and they were less likely to have stopped smoking than those without a diagnosis of AUD or drug use disorder (DUD) (Weinberger, Pilver, Hoff, Mazure, & McKee, 2013). However, in two of the 19 studies the effect was not shown in females. In the study of Sorlie and Kannel (Sorlie & Kannel, 1990), consumption of alcohol (>1 drink/day) did not decrease smoking abstinence rates in women, and in the study of Agudo and co-workers (Agudo et al., 2004), increased drinking was not significantly related ($p = .26$) to lower smoking cessation among women.

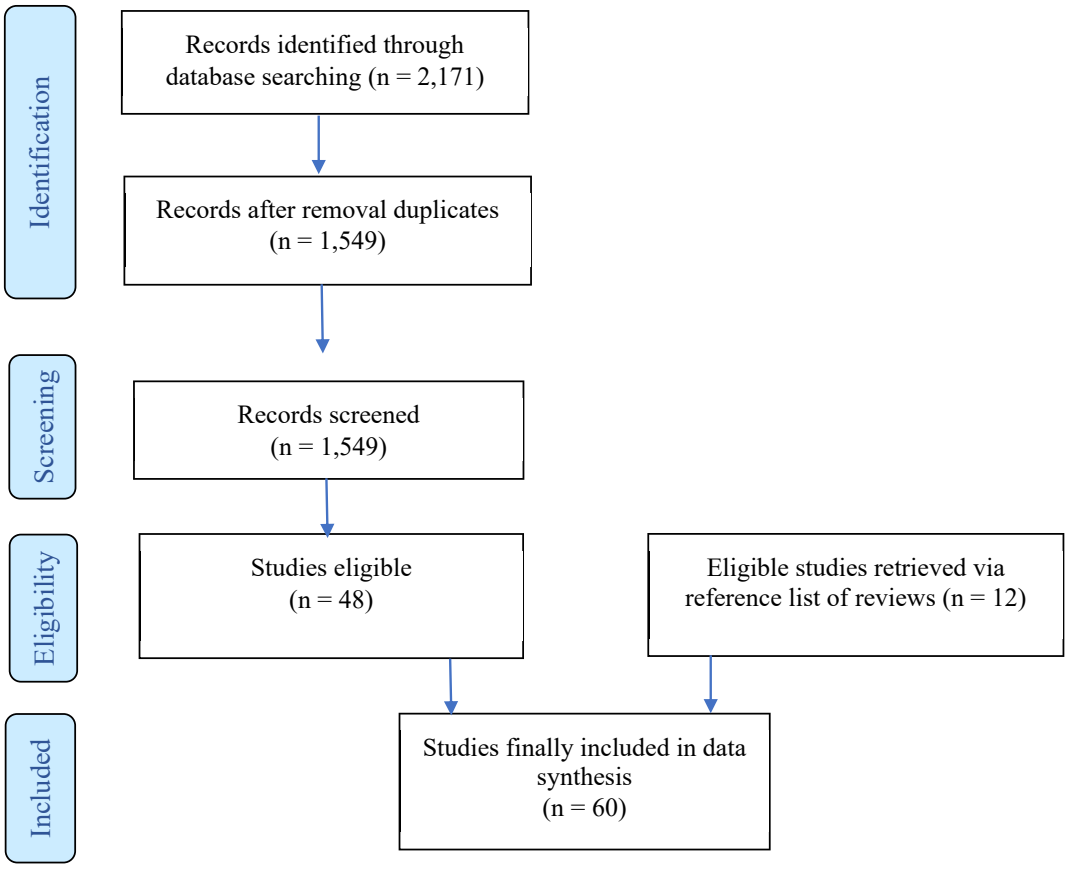

Fig. 1. PRISMA flow diagram

Effect of alcohol use on relapse and lapse to smoking

Drinking during quit attempts was an important reason for smoking lapse and relapse. Table 2 (27 studies; two studies reported on the same sample; 7171 subjects in total) summarizes the effects of alcohol use during a smoking cessation attempt on the outcome of smoking cessation. Table 2A summarizes the results of 14 studies with 'smoking relapse' as endpoint. Eleven of the 14 studies show that prior alcohol use was associated with a smoking relapse during follow-up. In addition, the amount of alcohol consumption was associated with smoking relapse, e.g., heavy alcohol consumption (5 drinks/day) was associated with the doubling of the risk for smoking relapse (Krall, Garvey, & Garcia, 2002). The remaining three studies showed no or only a weak effect of alcohol use on smoking relapse (Gnys et al., 1996; Lisha, Carmody, Humfleet, & Delucchi, 2014; Shiffman et al., 1996; Stahre et al., 2013), which may be due to specific differences in study design, such as defining quitting as ceasing smoking for >1 day (Lisha et al., 20 199614), use of African American light smokers (Stahre et al., 2013), and a short follow-up (at least one day) (Shiffman et al., 1996).

Table 2B depicts the results of 13 studies with endpoint 'lapse to smoking', and shows that compared to light or no drinking, heavy drinking was associated with a greater risk of a lapse to smoking in eight of the 13 studies. Two of the 13 studies showed borderline, but insignificant effects (Dermody & Shiffman, 2020; Kahler et al., 2017). The first study, an RCT on naltrexone for smoking cessation in heavy-drinking smokers, showed that 34% of all smoking lapses occurred when participants were drinking, and that alcohol-involved lapse to smoking was reduced by a factor of 2 in the naltrexone condition, but this effect was not significant (Kahler et al., 2017). In the second study, recent drinking was initially associated with smoking lapse, but not at the long term (Day 25) (Dermody & Shiffman, 2020). In the remaining three studies, no effect of alcohol consumption on smoking lapse was observed.

Association between alcohol use and smoking urges/craving and expectancy to successfully stop smoking

Table S1 (see Supplement) summarizes a) the association between alcohol use and smoking urges and smoking under laboratory conditions and b) studies about the effects of alcohol exposure on expectancies to successfully stop smoking (13 studies: 2142 subjects). The results consistently show that, in both men and women, alcohol consumption was associated with increased smoking urges/craving and smoking under laboratory conditions, though the level of statistical significance of the study of Kahler and co-workers (Kahler et al., 2014) is not known. For instance, smokers who drink even at moderate levels were less able to resist smoking after consuming alcohol, relative to a placebo beverage (McKee, Krishnan-Sarin, Shi, Mase, & O'Malley, 2006). Interestingly, both in daily and non-daily smokers, alcohol use increased self-administration of cigarettes (Barrett, Campbell, Roach, Stewart, & Darredeau, 2013). Similarly, craving/urges and temptations to smoke were induced by alcohol use during quit attempts (Kahler et al., 2017; Lam et al., 2014; Shiffman et al., 2020).

With respect to expectancies for a successful quit attempt, baseline alcohol use was significantly associated with various barriers to cessation, like stressors and feelings less in control of moods (Britton et al., 2021). Interestingly, higher baseline alcohol

Table 1
Studies about the effects of alcohol use on smoking cessation in naturalistic follow-up (FU) studies.

N	Study type	Subjects	Main outcome at follow-up (FU)[a]	Impairment[b]	Reference
2833	Quitline callers	Hazardous drinkers, moderate drinkers, or non-drinkers (n = 2833)	At 3 month FU: no difference in smoking quit rate of hazardous drinkers vs. moderate drinkers (aOR = 1.23; 95% CI: 0.98–1.55, $p = 0.07$) and hazardous drinkers vs. non-drinkers (aOR = 1.10; 95% CI: 0.88–1.38, $p = .41$). No effect.	No	Toll et al. (2012)
374	Prospective observational study	148 male and 226 female ex-smokers	Pre-quit status of hazardous alcohol drinking predicted smoking relapse in women at 3 months, (OR = 1.15, $p < 0.05$), and in men at 6 and 12 months after smoking cessation (OR = 1.17, $p < 0.05$ and OR = 1.16, $p < 0.05$), respectively.	Yes	Rodríguez-Cano, López-Durán, Martínez-Vispom, Martínez, and Becoña (2016)
38,271	Population-based, observational study	14,288 smoking men and 23,983 smoking women	Compared with not drinking, alcohol use ≥60 g/day in the past 3 years predicted relapse (OR = 1.35; 95% CI: 0.90–2.01) or lower quit rate (OR = 0.75; 95% CI: 0.57–0.97). Linear trends ($p = 0.05$) for men, not for women.	Yes (males)	Agudo et al. (2004)
13,415	Household survey (1988–1993)	All daily smokers	At 5 year FU, compared to daily drinking, drinking less than once per month, or never increased smoking abstinence rate (OR = 1.35; 95% CI: 1.16–1.57); for drinking 1–3 times per month (OR = 1.24; 95% CI: 1.04–1.47).	Yes	Hymowitz et al. (1997)
9085	Longitudinal observational study	Daily smokers: 9085 (5-year FU), 6053 (10–16-year FU)	At 5 year FU: drinking >1–2 drinks/day resulted in less abstinence from smoking than those drinking 1–2 drinks/day (aOR = 0.8; 95% CI: 0.6–1.0); for 10–16-year FU: aOR = 0.7 (95% CI: 0.6–0.8).	Yes	Osler, Prescott, Godtfredsen, Hein, and Schnohr (1999)
5209	Longitudinal observational study	All daily smokers	At 20 year FU: compared with non-drinking, alcohol use (>1 drink/day) decreased smoking abstinence (aOR = 0.72, $p < 0.05$) in man, but not in woman.	Yes (males)	Sorlie and Kannel (1990)
11,973	Household Survey (2001–2005)	All daily smokers using either alcohol or drugs or both	At 3 year FU, daily smokers with current AUD (OR = 0.70; 95% CI: 0.55–0.89), past AUD (OR = 0.73; 95% CI: 0.60–0.89), current DUD (OR = 0.48; 95% CI: 0.31–0.76), and past DUD (OR = 0.62; 95% CI: 0.49–0.79) were less likely to have quit smoking than those with no AUD or DUD diagnosis.	Yes	Weinberger et al. (2013)
2115	Population-based, cross-sectional study	All daily smokers. 44% quit; 34% tried to quit and 21% never tried to quit smoking	Heavy drinkers were less likely to succeed in quitting smoking (OR = 0.78). Having quit drinking was strongly related to success at smoking cessation with an aOR of 1.43.	Yes	Zimmerman, Warheit, Ulbrich, and Auth (1990)
6603	Household survey (1988–2001)	All daily smokers	At 3 year FU, compared with daily drinking, less drinking resulted in later quitting smoking with ORs (95% CI): 1.52 (1.26–1.83), 1.40 (1.14–1.72) and 1.31 (1.08–1.59) for <1 time per month or never, 1–3 times/month, 1–2 times/week, respectively.	Yes	Hyland et al. (2004)
4509	Longitudinal observational study	Daily smoking or ex-smoking adolescents (group number not further specified)	Quit smoking success was inversely associated with at least once a month alcohol use (aOR = 0.65; 95% CI: 0.56–0.76).	Yes	Mertens et al. (2021)
2767	Nested case–control study	1379 sustained quitters and 1388 relapsers	At 5–8 years FU, relapsers reported more drinking than sustained quitters (OR = 1.58; 95% CI: 1.17–2.13, $p < 0.001$).	Yes	Augustson et al. (2008)
12,586	Population-based, observational study	All past-year smokers	Heavy drinking in the past year was associated with less smoking cessation compared to never heavy drinking (aOR = 0.58; $p < 0.001$).	Yes	Dawson (2000)
7334	Retrospective case review study (NRT + CBT)	All daily smokers who received quit smoking service	Smoking abstinence rates at 52 weeks FU: drinkers: 36.1% (95% CI: 0.35–0.38), non-drinkers: 37.2% (95% CI: 0.35–0.39), and heavy drinkers (AUDIT score >15): 21.6% (95% CI: 0.18–0.26).	Yes	Ho, Fok, and Chan (2021)
2121	Population-based, cross-sectional survey	Daily smokers; 1181 quitted; 940 failed quitting	At 1 year FU, compared to <1 time per month or never use of alcohol, ORs (95% CI) were 0.66 (0.50–0.88; $p < 0.05$) and 0.55 (0.39–0.77; $p < 0.05$) for 1–4 times per month and 2–3 times per week use of alcohol, respectively.	Yes	Kim (2014)
3360	Quit liners offered behavioral counseling	All daily smoking women	At 1 year FU: compared with non-drinkers, pre-quit drinking over 5 times/month reduced smoking abstinence rate (41.8% vs. 22.0%; $p = 0.027$).	Yes	Jeong et al. (2021)
222,967	Household Survey (2002–2014)	All daily smokers	At 3 year FU, smoking relapse was lower when alcohol use was discontinued. Smoking quit rate was 26% (AUD), 49% (no AUD), 22% (heavy alcohol use; HAU) and 48% (no HAU).	Yes	Weinberger et al. (2017)
884	Longitudinal observational study	All daily smokers	At 10–11 years FU: heavy alcohol use was associated with a lower likelihood of quitting smoking (OR = 0.50; 95% CI: 0.29 to 0.85, $p < 0.05$).	Yes	Ruokolainen et al. (2021)
13,180	Household survey (2004–2008). Health Examinees (HEXA) Study in Korea	Current drinkers: quit (n = 4420); ongoing (n = 6614) and non-drinkers: quit (n = 960); ongoing (n = 1196)	Alcohol drinking status negatively predicted achieving smoking cessation (ex-drinkers as reference): OR = 0.82 (β = −0.1947, SE = 0.0166). Compared to current drinkers, non-drinkers and ex-drinkers were more likely	Yes	Yang et al. (2015)

Table 1 (*continued*)

N	Study type	Subjects	Main outcome at follow-up (FU)[a]	Impairment[b]	Reference
			to be > 2 years abstinent (OR = 1.10; 95% CI: 1.00–1.22, and OR = 2.53; 95% CI: 2.21–2.90, respectively.		
36,698	Population-based, cross-sectional study	All users of tobacco, alcohol, or both	Stop drinking resulted in more quit smoking than continued drinking (OR = 8.83; 95% CI: 6.91–11.28) or non-drinkers (OR = 7.51; 95% CI: 5.93–9.52).	Yes	Wang et al. (2019)
525	Longitudinal observational study	Gay, bisexual, and other men who have sex with men (GBMSM)	At 2.5 years FU: compared with non-drinking, social drinking (aRR = 0.45, 95% CI: 0.22–0.92), binge drinking (aRR = 0.39, 95% CI: 0.20–0.77), or heavy binge drinking (aRR = 0.17, 95% CI: 0.05–0.67) were less likely to quit and more likely to resume daily smoking	Yes	Shariati et al., 2017

[a] OR: Odds Ratio; aOR: adjusted OR; aRR: adjusted relative risk; 95% CI: 95% confidence interval; SE: standard error; AUD: alcohol use disorder; DUD: drug use disorder; AUDIT: Alcohol Use Disorder Identification Test.
[b] Impairment of smoking cessation rate by alcohol consumption. See previous column for effect size and statistical significance, if Yes. No: no effect observed.

consumption was associated with greater confidence in the success of quit attempts (Britton et al., 2021). Another study among married couples about their expectancies for success in future attempts to quit smoking, showed that the highest risks of failure perceived were associated with having a spouse who smokes and who is a heavy drinker (>1 time/week) (Dollar, Homish, Kozlowski, & Leonard, 2009).

Discussion

Current data obtained in naturalistic follow-up studies on smoking cessation (Table 1) show that alcohol consumption during a quit smoking attempt negatively impacts the success rate. The results of the studies about the effects of alcohol use on relapse and lapse to smoking (Table 2) provide the rationale for the lower quit smoking rate due to alcohol consumption during smoking cessation attempts. In addition, this lower quit smoking rate due to alcohol consumption is explained by the studies showing that exposure of smokers to alcohol or alcohol cues induced a strong propensity to smoke (cf. Table S1).

The higher smoking relapse risk of heavy drinkers has been claimed to result from engaging in a pervasive pattern of drinking behavior (King, de Wit, McNamara, & Cao, 2011) and a heightened stimulatory response to alcohol that may be predictive of increased cigarette craving (Epstein, Sher, Young, & King, 2007). Even smokers who drink at moderate levels were less able to resist smoking after consuming alcohol, relative to a placebo beverage (McKee et al., 2006). Alcohol consumption also increased the subjective rewarding effects of nicotine, including self-reported pleasure and satisfaction from smoking and relief of craving for cigarettes (Harrison et al., 2009; Rose et al., 2004), and hence negatively affects smoking relapse (Lisha et al., 2014). In contrast, the tendency to start drinking, e.g., after having lit a cigarette early in the morning, is known to be much weaker, indicating that the interaction between the two behaviors is not reciprocal. Though alcohol use clearly has a negative impact on the success of smoking cessation attempts, this does not imply that individuals with AUD are not able to quit smoking, considering the successful quit smoking reports in this group (Carmody et al., 2012; Hughes & Kalman, 2006; Hurt et al., 2018; Kalman et al., 2011; Zawertailo, Ivanova, Ng, Le Foll, & Selby, 2020). In addition, Hughes and Kalman (2006) showed that smokers with past alcohol problems were just as able to quit on a given attempt as smokers with no alcohol problems. On the other hand, they observed that smokers with current or past alcohol problems appeared to be less likely to quit smoking in their lifetime, which confirms our finding that a higher level of alcohol use is associated with a lower rate of smoking cessation.

Alcohol abstainers and light drinkers tried more often to quit smoking than heavy drinkers (Jiang, Gonzalez, Ling, & Glantz, 2015), and alcohol consumption level at baseline had a dose-dependent inverse association with the duration of smoking abstinence (McClure, Wetter, de Moor, Cinciripini, & Gritz, 2002). Indeed, moderate drinkers, and less so abstainers from alcohol, showed lower relapse rates than drinkers at 12 weeks' follow-up (Leeman et al., 2008).

It is generally known that quitting smoking goes along with considerable psychological stress, arousal, and negative feelings due to craving. According to the Tension Reduction Theory (Cappell & Greeley, 1987), alcohol may reduce arousal/tension, which at least partly explains why smokers drink more alcohol during smoking cessation attempts. In addition, women are in general more sensitive to stress and negative stimuli, which might at least partly explain why women have more difficulty achieving long-term abstinence than men (Smith, Bessette, Weinberger, Sheffer, & McKee, 2016). A variety of behavioral and psychological traits have been suggested to account for this difference, like fear of post-cessation weight gain, negative affect from not smoking, need for social support, and the presence of depression and anxiety (Gritz, Nielsen, & Brooks, 1996; Reynoso, Susabda, & Cepeda-Benito, 2005). As such, women may be at increased risk to use alcohol during smoking cessation attempts. To circumvent this reflex, but also to neutralize the adverse effect of drinking on smoking cessation, one may consider the feasibility of an integrated smoking and alcohol intervention to simultaneously reduce alcohol and tobacco use. Several studies have shown that individuals who received such an integrated intervention showed better outcomes compared to treatments addressing either tobacco or alcohol use alone (Ames, Pokorny, Schroeder, Tan, & Werch, 2014; Kahler, Metrik, et al., 2008; Toll et al., 2015). For instance, smoking cessation treatment, which included a brief alcohol intervention to increase the motivation to reduce alcohol consumption, resulted in a significant increase over 26 weeks in smoking abstinence compared with standard cessation treatment (aOR = 1.56; 95% CI: 1.01–2.43) (Kahler, Metrick, et al., 2008). Similarly, an integrated smoking and alcohol intervention in drinking smokers that included calling a quitline for counseling resulted in significantly higher smoking abstinence rates at 7 months (13.5%) compared to standard quitline counseling (10.3%; OR = 1.37; 95% CI: 1.04–1.80, $p = 0.03$) (Toll et al., 2015). Others also found that an integrated smoking and alcohol intervention resulted in greater cigarette smoking abstinence at 24 weeks follow-up compared to nicotine patch therapy alone (23% vs. 11%) (Ames et al., 2014), though another study (Correa-Fernández et al., 2017) could not confirm this observation. Some alcohol-dependent individuals may still prefer sequential treatment because simultaneous treatment can negatively impact alcohol use outcomes. However, the literature is not conclusive (Kodl, Fu, & Joseph, 2006), and outcome appeared to depend on ethnic background, i.e., alcohol abstinence rate was consistently lower in the concurrent group than the delayed group

Table 2
Studies about the effects of alcohol use on relapse and lapse to smoking.

N	Study type[b]	Subjects	Main outcome at follow-up (FU)	Impairment[a]	Reference
A. Relapse to smoking					
302	RCT (NRT + CBT vs. TAU)	AUD (n = 139); HIV (n = 163)	At 12 month FU, those who stopped smoking (even for one day) and those who never stopped consumed the same level of alcohol. No effect.	No	Lisha et al. (2014)
151	Prospective observational study (CBT) with EMA-data	All daily smokers	Over 1–23 days FU, alcohol use tempted to smoke in 75% of subjects who wanted to quit smoking, but it did not affect relapse rate. No effect.	No	Shiffman et al. (1996)
755	RCT (Motivational interviewing [MI] or health education [HE] plus NRT or placebo (PLC)]	African American, light smokers. NRT/MI, NRT/HE, PLC/MI, PLC/HE (approximately 189 in each group)	Regardless of counseling type, at 8 week FU: lower past 30-day binge drinking in quitters of smoking than those who did not quit ($p = 0.035$), but the effect was not sustained at the end of the study (week 26). Average daily alcohol use in the past 30 days was not associated with quitting smoking. No effect.	No	Stahre et al. (2013)
739	Three RCTs (NRT, bupropion, nortriptyline, placebo, and various psychological interventions)	Daily smokers: n = 219, 160, and 360, respectively	Drinking quantity consumed in the previous 7 days predicted smoking relapse (aOR = 0.97; 95% CI: 0.95–0.99; $p < 0.01$).	Yes	Hendricks, Delucchi, Humfleet, and Hall (2012)
255	Prospective observational study in callers of quitline	All daily smokers	At 3 month FU, 216 respondents (85%) reported slip-ups resulting in 172 cases of relapse. 12% of slip-ups in relapsers involved drinking alcohol; 88% involved other contextual factors.	Yes	Borland (1990)
235	Prospective observational study	All daily smokers performing self-initiated quit attempt	At 1 year FU, greater alcohol use (drinks per week; DPW) increased the risk to smoking relapse with 4.7, 6.6, and 6.3 DPW for those relapsing within 7, 30, 31–364 days, respectively vs. 3.3 DPW for 1-year abstainers ($p = 0.023$). OR for DPW subjects abstinent 8–30 days vs. those abstinent for 365 days: 2.06 ($p = 0.04$).	Yes	Garvey, Bliss, Hitchcock, Heinold, and Rosner (1992)
423	Cross-sectional survey	291 smokers relapsed and 132 quit	At 1 year FU, alcohol use increased relapse (OR = 2.11; 95% CI: 1.13–3.93, $p = 0.02$).	Yes	Koçak et al. (2015)
483	Prospective observational study	All elderly male daily smokers (73 ± 7 years)	Over 2–6 years FU after smoking cessation, alcohol consumption (5 drinks/day) doubled the risk of smoking relapse (OR = 2.08; 95% CI: 1.06–4.05).	Yes	Krall et al. (2002)
923	Population-based, retrospective survey (NRT)	All adults recruited through a smoking cessation website	At 7 month FU, current alcohol use on smoking relapse (no alcohol use is reference): moderate alcohol use: OR = 1.32; (95% CI: 0.92–1.91), heavy alcohol use: OR = 2.32 (95% CI: 1.35–3.96%).	Yes	Lynch, Twesten, Stern, and Augustson (2019)
236	RCT: NRT + TAU vs. TAU + brief intervention (BI)	Heavy drinkers (all NRT). TAU (n = 119) or TAU + BI (n = 117)	At 26 weeks FU, those having an alcohol-involved smoking lapse during treatment were significantly less likely to be abstinent (aOR = 0.42; 95% CI: 0.24–0.76, $p = 0.004$), i.e., had relapsed.	Yes	Kahler, Metrik, et al. (2008)
148	RCT (NRT vs. aerobic exercise)	All daily smoking women	At 12 month FU: compared to none-drinking, hazard ratio of drinking >7 drinks/week to relapse was 1.62 (95% CI: 1.06–2.48; $p = 0.025$).	Yes	Korhonen et al. (2005)
199	RCT: nortriptyline (N) vs. counseling (C), CBT or placebo (P)	Daily smokers with MDD. N/CBT (51); N/C (48); P/CBT (52) and P/C (48)	At 65 weeks FU, alcohol use during treatment predicted smoking relapse vs. non-drinking (57.1% and 23.3%, respectively; $\chi 2 = 14.917$, $p < 0.001$).	Yes	Humfleet et al. (1999)
109	Prospective observational study (NRT) with EMA-data	All daily smokers	Drinking in the past 2 h predicted smoking relapse (OR = 3.71, 95% CI = 1.40–9.89, $p = 0.009$).	Yes	Bold et al. (2016)
134	Prospective observational study with EMA-data	All daily smoking adolescents with quit attempt in their own natural environments	Alcohol consumption was associated with a five times greater relapse to smoking (after having lapsed already) (OR = 5.02; 95% CI: 2.90–8.67, p = 0.000).	Yes	Van Zundert, Kuntsche, & Engels, 2012
B. Lapse to smoking					
159	Prospective observational study with EMA-data	All daily smokers	Recent drinking initially predicted smoking lapse ($p < 0.05$), but the effect diminished in time and was insignificant at Day 25. No effect.	No	Dermody and Shiffman (2020)
150	RCT (NRT + NTX vs. NRT + placebo)	All NRT. NTX (n = 75); placebo (n = 75)	At 26 weeks FU, alcohol induced lapse to smoking in heavy drinkers (OR = 0.51), but not significantly ($p = .10$). No effect.	No	Kahler et al. (2017)
150	Prospective observational study on smoking cessation	All smoking young adults who drink heavily episodically	Facebook-based counseling. At 1 year FU, the average reduction in past-month days of heavy episodic drinking versus the reduction in smoking rate (the number of cigarettes per day) did not differ significantly. No effect.	No	Yonek, Meacham, Shumway, Tolou-Shams, and Satre (2021)
183	Retrospective survey	All former smokers contacting relapse-counseling hotline	18.6% of former smokers calling the hotline were drinking alcohol prior to the relapse. Proportion of non-relapsers drinking alcohol was not reported.	+/−	Shiffman, 1982
129	Prospective observational study (behavioral counseling)	All smokers who quit smoking; 129 reached complete abstinence at end of treatment	At 2 years FU, 92 responders relapsed while 37 did not. 47.2% of relapsers reported consumption of alcohol immediately preceding lapse to smoking. Proportion of non-relapsers drinking alcohol was not reported.	+/−	Brandon, Tiffany, Obremski, and Baker (1990)
108	Prospective observational study plus EMA data	All ex-smokers (>24 h abstinent) recording a lapse	Over 4 weeks FU, 15% of participants reported recent alcohol use during ($p < 0.05$) and just before lapse to smoking ($p < 0.001$), compared to random assessments.	Yes	Shiffman, Paty, Gnys, Kassel, & Hickcox (1996)
74	Prospective observational study (NRT) with EMA data	All daily smokers	During the first 3 weeks of the quit attempt, after adjustment for situational variables, alcohol consumption	Yes	Piasecki et al. (2008)

Table 2 (*continued*)

N	Study type[b]	Subjects	Main outcome at follow-up (FU)	Impairment[a]	Reference
			was related to lapse to smoking (aOR = 1.81, 95% CI: 1.53 −2.14, $p < 0.001$).		
300	Prospective observational study (NRT + counseling) with EMA data	All daily smoking women	Alcohol use during 7 days post-quit increased lapse to smoking (OR = 1.98; 95% CI: 1.01−3.89).	Yes	Lam et al. (2014)
249	RCT (psychosocial intervention on weight loss plus open label bupropion)	Alcohol at baseline: abstainer (29.3%), moderate (38.2%), and hazardous (32.5%)	In the 12-week post-quit period, the probability of a smoking lapse was higher on a heavy drinking day (38.5%) than on a moderate drinking day (24.5%) versus abstinent days (19.1%); $p < 0.001$.	Yes	Leeman et al. (2008)
119	RCT (web-intervention). Smoking cessation (SC) vs. SC plus alcohol cessation with EMA-data	Heavy drinkers (HD). SC (n = 61); SC + alcohol cessation (n = 58)	Drinking-induced lapse to smoking was lower in SC + alcohol cessation compared to SC (7/58 = 16% vs. 18/61 = 41%; Cohen *h*: −0.56. Relative risk = 0.41/0.16 = 2.56 ($\chi 2_1 = 6.2$; p = 0.01).	Yes	Kahler et al. (2020)
236[c]	RCT (NRT + TAU vs. TAU + brief intervention)	Heavy drinkers (all NRT). TAU (n = 119) or TAU + brief intervention (n = 117)	74 out of 178 participants reported a smoking lapse within 26 weeks post-quit. Adjusted for drinking status at baseline, the risk (HR) of lapsing on a drinking day was 5.08 times greater than on a no drinking day (B = 1.62, SE = 0.17, $p < 0.0001$).	Yes	Kahler, Spillane, and Metrik (2010)
92	Uncontrolled clinical trial with standard smoking cessation + anti-smoking smartphone app	All daily smokers	Alcohol use in smoking abstainers was 3.4% compared to 19.1% in those who lapsed to smoking within 4 h of alcohol use ($p < 0.001$).	Yes	Businelle et al. (2016)
130	Prospective observational study (NRT) with EMA data	All abstinent intermittent smokers	Over 6 weeks FU, drinking was associated with lapse to smoking (OR = 6.99; 95% CI: 3.12−15.66).	Yes	Shiffman et al. (2020)

[a] NRT: nicotine replacement therapy; EMA: ecological momentary assessments; NTX: naltrexone; CBT: cognitive behavioral treatment; TAU: treatment as usual; OR: Odds Ratio; aOR: adjusted OR; 95% CI: 95% confidence interval; N.S.: not statistically significant; aRR: adjusted relative risk; SE; standard error; AUD: alcohol use disorder; MDD: major depressive disorder.

[b] Impairment of smoking cessation rate by alcohol consumption. See previous column for effect size and statistical significance, if Yes. +/−: effect observed, but statistical level is unknown; No: no effect observed.

[c] Same sample as Kahler, Metrik, et al., 2008.

among Caucasians, but not among African Americans (Fu et al., 2008). A meta-analysis of 11 randomized controlled trials of concurrent treatment for tobacco and other substances provided no evidence for lower long-term smoking abstinence rates compared to single substance interventions (Prochaska, Delucchi, & Hall, 2004).

With respect to clinical consultation, cognitive behavior therapy (Lancaster & Stead, 2000) and/or nicotine replacement therapy (NRT), bupropion, and varenicline (Cahill, Stevens, Perera, & Lancaster, 2013) are proven effective as quitting aids, with NRTs, for instance, increasing the rate of quitting by 50%–60% (Hartmann-Boyce, Chepkin, Ye, Bullen, & Lancaster, 2018). However, high drinking rate at baseline or drinking during smoking cessation may impair the success rate of the stop smoking attempt. Therefore, if a history of current AUD is present, a referral to a specialist center may be recommended, because this category of smokers performs poorly in non-specialist smoking cessation programs (Breslau, Peterson, Schultz, Andreski, & Chilcoat, 1996; Humfleet, Muñoz, Sees, Reus, & Hall, 1999; Hurt et al., 1994). As an alternative, an integrated treatment (aimed at the reduction of both alcohol and tobacco) could be offered to heavy drinking smokers.

Based on the current findings, it is recommended for smokers who drink alcohol and who intend to quit smoking to use an integrated approach, i.e., to stop or substantially reduce their alcohol consumption before and/or during their attempt to quit smoking.

Strengths and limitations

A major methodological limitation of the current review is that we presented data from studies with very different designs and sample sizes and with different ways to estimate the influence of alcohol use on smoking cessation outcomes. For a proper evaluation of the association between alcohol use and success of smoking cessation, RCTs with a pre-stratification for drinking status are needed. Unfortunately, no such studies were available for this review. Moreover, the studies on the effect of drinking status on smoking cessation outcome were all based on group means, while monitoring the effect at an individual level would be more valuable and appropriate, considering the inter-individual variation within the samples. In addition, gender-related barriers to smoking cessation are not clear and should be further studied in future research.

On the other hand, despite the large differences in terms of design, sample composition and selection, and outcome measures, all studies came to the same conclusion: alcohol use during smoking cessation has in general a negative impact on quit attempts and drinking prior to smoking cessation is a negative predictor of successful cessation attempts. Still, due to the large methodological differences across the studies, no meta-analysis and quality ratings of the studies could be performed. For instance, a large variety of factors, including age, gender, level of education, smoking rate, and motivation, may have an impact on the success rate. However, many of these predictors cannot be changed, whereas drinking levels can potentially be changed, and the success of smoking cessation attempts can thus be improved.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.alcohol.2022.12.003.

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