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Master of Science Psychology

# **Anxiety, depression and smoking cessation success**

master thesis

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## **Abstract**

Tobacco use is a widespread addiction and severely threatens the public health. This study uses data of the LiveSmokeFree study (N= 344), generated by the Medisch Spectrum Twente in Enschede. The aim of the study was to establish links between anxiety, depression, and smoking cessation success. The connections between depression as well as anxiety and smoking cessation success were determined by including the moderators social support and self-efficacy. On a sample of individuals, aged 16 to 77 years old and participating in a smoking cessation treatment, the variables were measured. The results show a non-significant relationship between anxiety as well as depression and smoking cessation success. However, smoking cessation success or abstinence is related with reduction in anxiety and depression symptoms afterwards. In addition, social support, self-efficacy after smoking cessation treatment, and social modelling significantly predict smoking cessation success. Accordingly, social support and self-efficacy positively predict abstinence. Social modelling, on the other hand, negatively predicts abstinence.

*Keywords:* smoking cessation, anxiety, depression, addiction, social determinants, self-efficacy

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## 1 Introduction

According to the World Health Organization (2020), half of tobacco users die as a result of tobacco use. 7 million people die each year due to direct tobacco use and around 1.2 million people die because they were being exposed to second-hand smoke. Thus “the tobacco epidemic is one of the biggest public health threats the world has ever faced” (World Health Organization, 2020). Only 4% of attempts to quit tobacco use do succeed without cessation support. It is very important that cessation support and cessation medication is offered because they can more than double the chance to quit tobacco use (World Health Organization, 2020). Due to this, this study serves to investigate different variables. On the one hand, variables are examined that might interfere with smoking cessation, and on the other hand, variables are examined that might facilitate smoking cessation outcome. The latter could potentially complement and enhance current smoking cessation treatment.

The expression of the mental health of each individual appears to play a role in smoking behaviour and cessation (Baiardini, Sorino, DI Marco, & Facchini, 2014). In 2010, 26% of the general population in Germany experience depressive symptoms (Robert-Koch-Institut, 2010). Overall, 25% of all people suffer from an anxiety disorder once in their lifetime (Focus, 2011). Therefore, anxiety and depression are no longer rare afflictions in our society. The most common reasons to engage in substance misuse or addictive behaviour are rapid management of feelings (Kennerley, Kirk, & Westbrook, 2017). Smoking behaviour serves to regulate the own mood by either control depression or anxiety or by enhancing positive moods (Kennerley et al., 2017). Moreover, it serves to manage physiological or psychological cravings or to cope with adverse circumstances (Kennerley et al., 2017). Several research findings already exist that demonstrate the negative impact of anxiety and depression on smoking behaviour and cessation (Piper, Cook, Schlam, Jorenby, & Baker, 2011; Morrell & Cohen, 2006). The other way around also successful smoking cessation can have an positive effect on people's mood and their mental health (Stepankova et al., 2017; McClave et al., 2009).

Moreover, also social-cognitive determinants can influence smoking behaviour. Existing research findings show, that self-efficacy to quit and social support seem to be supporting factors in smoking cessation (Gwaltney, Metrik, Kahler, & Shiffman, 2009; Mermelstein, Cohen, Lichtenstein, Baer & Kamarck, 1986). Since depression is one of the barriers to stop smoking, a higher self-efficacy can facilitate coping with depressive mood to remain abstinent

(Martinez et al., 2010). And research findings suggest the higher the social support in general, the lower is the anxiety of persons (Yasin & Dzulkifli, 2010). Therefore, social support may be a supportive factor with regard to smoking cessation in smokers with increased anxiety, because social support to help quitting smoking seems to have a positive impact on smoking cessation success (Mermelstein et al., 1986). Since anxiety is also one of the main barriers to quit smoking, social support in the context of smoking cessation seems to regulate anxiety. Thus, self-efficacy to quit and social support to help quitting smoking are expected to play a positive role in the context of depression and anxiety in smoking cessation. The aim of the current study is to examine the effect of anxiety and depression on smoking cessation and moreover, to examine the influence of self-efficacy and social support in this context. Can the predicted negative effect of anxiety and depression on smoking cessation be diminished by social support and/or self-efficacy to quit?

### 1.1 Existing research findings

In general individuals with mental health conditions may have greater difficulties to cease tobacco use as a result of their psychological or psychiatric status (Baiardini et al., 2014). Among individuals with anxiety and/or depression, smoking rates are significantly higher than in the general population (Richards, Cohen, Morrell, Watson, & Low, 2013). Furthermore, the review of Morrell and Cohen (2006) found a high comorbidity among several studies regarding depression and smoking. “Anxiety diagnoses were common among treatment-seeking smokers and were related to increased motivation to smoke, elevated withdrawal, lack of response to pharmacotherapy and impaired ability to quit smoking” (Piper et al., 2011, p. 418). When individuals experience escalating levels of depression and lower levels of self-efficacy, relapse is more likely to happen among these (Morrell & Cohen, 2006). In a study of Stepankova et al. (2017) depression at the start of the smoking cessation treatment predicted reduced smoking abstinence one year later. The study of Piper et al. (2011) showed higher levels of nicotine dependence and withdrawal symptoms after quitting among smokers with anxiety disorders. Furthermore, the study reported greater quit-day negative affect for people with panic attacks or social anxiety (Piper et al., 2011). Barriers among anxious and depressed smokers for stopping smoking could be unhelpful beliefs, like not wishing to stop smoking, not being able to stop and increased emotional and functional risk whilst trying smoking cessation (Richards et al., 2013). The review of Morell and Cohen (2006) summarizes, that many smokers reported anxiety relief in a variety of contexts as their main reason for smoking. In anxiety-provoking situations they tended to smoke more. Furthermore, nicotine increases positive affect and decreases negative affect and thus

diminishes depression (Morrell & Cohen, 2006). It is possible that individuals abuse nicotine to regulate especially negative affects and emotions and thus lose their ability to cope in a healthy way (Morrell & Cohen, 2006; Joseph, Manafi, Iakovaki, & Cooper, 2003). These findings suggest a negative association between anxiety as well as depression and smoking cessation outcome of patients. Furthermore, they also suggest a self-efficacy related mechanism.

There is evidence that anxiety and depression decrease in the long term in people who quit smoking. Regarding abstinent patients, the majority with depression before the smoking cessation treatment reported lower depression levels one year later (Stepankova et al., 2017). “Quitting smoking is associated with a reduction of depression, anxiety, and stress, with an improvement of psychological quality of life, and positive affect compared with continuing to smoke” (Baiardini et al., 2014, p. 15). The study of McDermott, Marteau, Hollands, Hankins and Aveyard (2013) measured a reduction in anxiety in people who achieved abstinence in smoking. In contrast to this, people who fail to quit smoking experience long-term increase of anxiety (McDermott et al., 2013). Furthermore, McClave et al. (2009) measured current depression prevalence of 8.0% among successful quitters, 14.3% among non-quitters and 18.8% among unsuccessful quitters. Besides, successful smoking quitters experienced least lifetime depression and unsuccessful quitters experienced most lifetime depression compared with non-quitters (McClave et al., 2009). Based on the existing literature, this suggests a long-term decrease in anxiety and depression and an improvement in mental health in people who quit smoking.

### 1.1.1 Moderating mechanisms

Self-efficacy to quit in connection with the successful attempt to quit smoking is often mentioned in literature. Joseph et al. (2003) proved that low self-efficacy was associated with habitual smoking, negative affect control and social skills deficit, whereas self-efficacy to quit was associated with smoking motivation. Self-efficacy is reliably associated with future abstinence (Gwaltney et al., 2009). The study of Condiotte and Lichtenstein (1981) measured that the higher the level of self-efficacy the more likely it is that people would stay abstinent throughout the experimental period of smoking cessation. Besides, there was found an association between self-efficacy and longer periods of abstinence after the treatment (Condiotte & Lichtenstein, 1981). Participants who reported higher perceived control over abstinence symptoms, like withdrawal, irritability and depression also had higher internal and external self-efficacy scores (Martinez et al., 2010). Furthermore, participants with lower reactivity to social situation or positive affect smoking cues had higher levels of smoking-

cessation self-efficacy and external self-efficacy (Martinez et al., 2010). A study of Cinciripini, Wetter, Fouladi, Blalock, Carter, Cinciripini and Baile (2003) found out that depressed mood before the start of the smoking cessation treatment negatively predicted abstinence 6 months after the treatment. Self-efficacy towards sustaining abstinence after the cessation treatment accounted for 32% to 48% of this relationship (Cinciripini et al., 2003). Besides, based on research findings higher initial self-efficacy was associated with lower depression one year later (Holahan & Holahan, 1987). Based on these results, self-efficacy to quit appears to play a positive role in smoking cessation and may attenuate the assumed negative association between depression and smoking cessation outcome. In addition, it makes sense to include self-efficacy before and after smoking cessation treatment (at T0 and T2) in the analysis, as patients' self-efficacy may increase during treatment. This could also depend on a successful attempt to quit smoking during the three-month treatment. Furthermore, post-treatment anxiety (at T2) should be included in the analysis, as it may also change. Staff support during treatment may reduce patient anxiety and is thus more relevant for predicting long-term smoking cessation success at T4.

Social support to help quitting smoking and social modelling seem to play a significant role in trying to quit smoking. In a study of Mermelstein et al. (1986) evidence was found that social support is associated with smoking cessation. Support from a partner and general support were associated with cessation and short-term maintenance and abstinence (Mermelstein et al., 1986). The study results of May and West (2000) suggested that support from another individual may be of some benefit for people in a smokers clinic. Besides, relapsed smokers often mentioned more instability in their social connections as reason for instability in smoking status (Thomeer, Hernandez, Umberson, & Thomas, 2019). Furthermore, the qualitative study of Thomeer et al. (2019) found out that people who were able to change their smoking behaviour associated the important transitions as related to social connections.

In contrast, social modelling (= the presence of smokers in the participant's social environment) hindered maintenance in the long-term (Mermelstein et al, 1986). Successfully abstained participants 12 months after the smoking cessation treatment were less likely to have another smoker in their household than were relapsers (Mermelstein et al, 1986). Additionally, relapsers reported higher number of smokers as friends than abstainers did (Mermelstein et al, 1986). The meta-analysis of Liu, Zhao, Chen, Falk and Albarracín (2017) showed the association between having peers who smoke and adolescents beginning smoking. Furthermore, this association was even stronger when the interpersonal closeness between peers and the individual was higher (Liu et al., 2017). In the longitudinal study of Blok, de

Blas, van Empelen and van Lenthe (2017) participants with the largest amount of smokers in their social environment were less likely to quit smoking and more likely to relapse. The strongest associations were found for amount of smokers in the household and friends (Blok et al., 2017). The study of Choi and DiNitto (2015) measured that current smokers had higher depressive symptoms and were more socially isolated than people who never smoked. The study of Yasin and Dzulkifli (2010) additionally showed that social support negatively correlates with anxiety. Common social support consequences are positive health states and among other things decreased anxiety (Langford, Bowsher, Maloney, & Lillis, 1997). Based on these results, social support and presence of smokers in peoples' environment seem to have a significant impact on the success of smoking cessation. Social support may attenuate the assumed negative association between anxiety and smoking cessation outcome.

## **1.2 Derivation of the research question and hypotheses**

The aim of this study is to examine the influence of anxiety and depression on smoking cessation success and vice versa. The aim is also to find out if social support can reduce the assumed negative correlation between anxiety and smoking cessation success. Furthermore, it is to be found out if self-efficacy can reduce the assumed negative correlation between depression and smoking cessation success. The aim is to give implications for future content in smoking cessation treatments. Besides, the goal is to find out whether the involvement of the social environment or/and therapy interventions to increase self-efficacy are useful for smoking cessation success. In addition, the goal of this study is to find out if abstinence is associated with decreases in depression and anxiety symptoms.

(RQ 1) Is a higher individual's level of self-efficacy associated with being abstinent at the end of the treatment (T4)?

(RQ 2) Is a higher individual's experience of social support associated with being abstinent at the end of the treatment (T4)?

(RQ 3) Is a higher number of smokers in the individuals' social environment (social modelling) associated with being a smoker at the end of the treatment (T4)?

(RQ 4) Is the association between depression and smoking cessation success influenced by self-efficacy?

(RQ 5) Is the association between anxiety and smoking cessation success influenced by social support?

(RQ 6) How does depression develop in the long term in people who have quit smoking?

(RQ 7) How does anxiety develop in the long term in people who have quit smoking?



Derived from the research results in *1.2 Existing research findings* the following hypotheses arise;

H1: The higher the patient's level of self-efficacy (at T0 and T2), the more successful their smoking cessation treatment outcome (at T4).

H2: The higher the patients' experience of social support (at T0), the more successful their smoking cessation treatment outcome (at T4).

H3: The higher the number of smokers in the patients' social environment (social modelling at T0), the less successful their smoking cessation treatment outcome (at T4).

H4: A high depression score (T2) after smoking cessation treatment negatively predicts cessation (at T4), but his effect is attenuated by a high score on self-efficacy (at T2).

H5: A high score on patients' anxiety (T2) after smoking cessation treatment negatively predicts cessation (at T4), but this effect is attenuated by a high score on patients' social support (at T0).

H6: The patients' depression scores (T0) will decrease significantly after successful smoking cessation (T4).

H7: The patients' anxiety scores (T0) will decrease significantly after successful smoking cessation (T4).

## 2 Method

### 2.1 Participants

Data from 344 participants of the LiveSmokeFree study, generated by the Medisch Spectrum Twente in Enschede, were used. The average age of participants were 46.90 years with 16 years old being the youngest participants and 77 years old the oldest participants in the study. 49,8 % of participants were male and 50,2 % were female. Inclusion criteria to participate in the LiveSmokeFree study were; age of 16 or older, smoking of at least one cigarette per day, intention to quit smoking, internet access, use of email and ability to read and write in Dutch (Siemer et al., 2016).

### 2.2 Intervention

In the present study data from the LiveSmokeFree study was used for analysis. As part of the LiveSmokeFree study 344 participants were randomly assigned to a blended or a face-to-face smoking cessation treatment group (Siemer et al., 2016). Both treatment options consisted of ten sessions within six months. In the blended treatment option, the participants had five sessions on site at the clinic and five other sessions were delivered online (Siemer et al.,

2016). The sessions on site took place at the outpatient smoking cessation clinic at Medisch Spectrum Twente in Enschede. As primary outcome parameter biochemically validated prolonged abstinence was measured 15 months after the start of the treatment and self-report questionnaires regarding the smoking status were filled out by the participants (Siemer et al., 2016). In this study, questionnaires were used to assess inter alia depression, anxiety, self-efficacy, social support, and social modelling (= the number of smokers in the individual's social environment).

“Both treatments fulfil the requirements of the Dutch care module for smoking cessation” (Siemer et al., 2016, p. 3). The part of the Blended Smoking Cessation Treatment (BSCT), which was held online, was organized by using Tactus Addiction Treatment's website. <http://rokendebaas.nl>. The team of the smoking cessation treatment consisted of one pulmonologist and three qualified stop-smoking counsellors (Siemer et al., 2016). These counsellors offered counsellor-dependent and counsellor-independent components. Regarding the counsellor-independent components, patients had to deal with some topics on their own, for example keeping a smoking diary (Siemer et al., 2016). Counsellor-dependent components were interactive dialogues between patient and counsellor, either by mail or face-to-face (Siemer et al., 2016). Both treatments BSCT and Treatment as usual (TAU) offer various behaviour change techniques to support patients smoking cessation. Relevant behaviour change techniques were the advise on or facilitate use of social support, advise on conserving mental resources, advise on avoiding social cues for smoking, facilitate barrier identification and problem solving, advise on changing routine, facilitate relapse prevention and coping as well as providing reassurance (Siemer et al., 2016). The intensity and content of both treatments were equivalent (Siemer et al., 2016). Besides, there were different options available to stop smoking. The first option was to *stop at once*. The patients made a preparation plan and set a date to stop smoking completely (Siemer et al., 2016). The second option was to *stop gradually*. Patients had to stop step-by-step habitual smoking at selected daily activities. Then, the patient set a quit date to stop smoking completely (Siemer et al., 2016). The third option was to *stop smoking by scheduled reduced smoking*. First participants had to adjust their cigarette consumption to a fixed schedule, and later the number of cigarettes per day were continuously decreased at regular intervals according to a fixed schedule (Siemer et al., 2016).

### **2.3 Measuring instruments**

*Assessment time points.* There were five different time points where different variables were measured. A detailed overview about the time points of measurement and variables can be

found in Table 1. The first measurement was before the smoking cessation treatment started (= T0) (Siemer et al., 2016). This was followed by the second measurement, 3 months after the start of the treatment (= T1). At this point, it was expected of all patients to stop smoking. The third measurement took place at the end of the smoking cessation treatment (= T2) (Siemer et al., 2016). Three months after the end of the treatment, the fourth measurement was implemented (=T3). And the final measurement was carried out nine months after the end of the treatment and 15 months after the smoking cessation treatment start (= T4) (Siemer et al., 2016). The biochemical measurements of the cotinine level and the exhaled carbon monoxide (CO) level were done on site at the hospital (Siemer et al., 2016). These biochemical measurements were used to capture smoking cessation outcome. To measure depression, anxiety, social influence and self-efficacy, data of a questionnaire was used.

**Table 1**

*Measurement schedule of the relevant variables (Siemer et al., 2016, p. 6)*

variables	measurement at month				
	0 (=T0)	3 (=T1)	6 (=T2)	9 (=T3)	15 (=T4)
smoking cessation success	X	X			X
depression and anxiety	X		X	X	X
social influence	X				
self-efficacy	X		X		X

*Depression, anxiety and stress symptoms.* The variables depression and anxiety were measured using the Depression Anxiety Stress Scales (DASS21) (Siemer et al., 2016). The DASS21 consists of three self-report scales to measure the negative emotional states of depression, anxiety and stress (Antony, Bieling, Cox, Enns, & Swinson, 1998). Each scales consists of seven items and patients had to answer the questions by using 4-point frequency scales to specify how severe they experienced different negative, emotional states in the last week (Antony et al., 1998; Siemer et al., 2016). The DASS21 serves as a valid method to assess anxiety and depression (Antony et al., 1998). Depression and Anxiety scores were calculated by summing up the scores for the items measuring depression and for the items measuring anxiety and multiplying each of these by 2 (Siemer et al., 2016). Only the depression and anxiety subscales were used for the analyses.

*Social support and social modelling.* Social support and social modelling as number of smokers in patient's environment were measured in the context of social influence. Social

support was measured by “recording if the patient is stimulated to stop smoking by acquaintances” (Siemer et al., 2016, p. 7) and social modelling was measured by “recording if his/her partner is a smoker and how many of his/her acquaintances are smokers” (Siemer et al., 2016, p. 7).

*Self-efficacy.* Self-efficacy was collected by measuring six typical relapse situations by using “standardized questions developed by the former Dutch foundation STIVORO” (Siemer et al., 2016, pp. 7–8). The patients had to answer these questions by using 6-point likert scales to answer how likely it is that they do not smoke in the specific situations. For example, one question is: “You feel stressed or tense. Does that mean you can manage not to smoke?” 1 means “it certainly does”, 5 means “certainly not” and 6 means “I do not know”.

*Smoking cessation success.* The smoking cessation success was captured by measuring the cotinine level only by those patients who had reported in the questionnaire that they had quit smoking (Siemer et al., 2016). Thereby it was mandatory to make a biochemical verification of abstinence of patients 15 months after the start of the treatment. Patients had to “chew on a cotton swab for 1min to stimulate the salive flow rate” (Siemer et al., 2016, p. 6). Afterwards all saliva specimens were transported to the laboratory to measure the cotinine level. Salivary cotinine levels had to be  $< 20$  ng/ml to confirm the self-reported abstinence three months after the start and 15 months after the start (Jarvis, Fidler, Mindell, Feyerabend, & West, 2008) (Siemer et al., 2016). Patients who did not report abstinence in the questionnaire or who had a higher level of cotinine were taken as smokers (Siemer et al., 2016). This measure is used to capture the binary dependent variable smoking cessation success. If abstinence was proven by the cotinine levels, smoking cessation success is present and if abstinence was disproved, smoking cessation success is not present. Additionally, exhaled carbon monoxide (CO) level was measured to be used if cotinine measurements were missing (Siemer et al., 2016). Smoking status has been easily assessed by patients breathing in a piCo Smokerlyzer. With a breath CO level of 5 ppm or higher it was confirmed that patients were smokers and with a breath CO level less than 5 ppm patients were taken as non-smokers (Siemer et al., 2016).

*Reliability.* Cronbach's alpha of depression at the different measurement time points was between  $\alpha = 0.91 - 0.94$ . This high value suggests that the items measuring depression may be redundant and too similar (Streiner, 2003). Furthermore, for the items measuring anxiety at the different times, cronbach's alpha was between  $\alpha = 0.69 - 0.82$ . This means Cronbach's alpha is in the acceptable to very good range (Streiner, 2003). For self-efficacy at the multiple times, cronbach's alpha was between  $\alpha = 0.84 - 0.94$ . These values suggest a very good

internal consistency, but also indicate redundant items (Streiner, 2003). Overall, the internal consistencies indicate good reliability. However, the redundant items for the measurement of depression and self-efficacy might reduce the reliability.

#### **2.4 Data analysis**

The present study was analysed with the statistical program SPSS and partly with PROCESS. In the first step, individual variables were reversed and the variables were combined into scales. Additionally, variable names were modified. In case of a missing value of the cotinine measurement 15 months after the start of the treatment, the value was replaced by the CO measurement, if available. This formed the dependent variable smoking cessation outcome. Descriptive statistics were calculated to capture and describe the sample of the study. Since smoking cessation is a binary variable, a multiple logistic regression analyses were conducted measuring the predictive power of social support and social modelling at baseline on smoking cessation outcome. This multiple logistic regression analyses were conducted to test the second and third hypothesis. Besides, two binary logistic regressions with the predictors self-efficacy before the smoking cessation treatment and three months after the end of the treatment on smoking cessation success were conducted to test the first hypothesis. To address H4 and H5, moderation analyses were conducted using the PROCESS software (Hayes & Rockwood, 2017). The regression analysis with the predictor variables depression at T2 and self-efficacy at T2 as well as smoking cessation outcome as dependent variable was conducted to test hypothesis four. To test hypothesis five, the regression analysis with the predictor variables anxiety at T2 and social support at T0 as well as smoking cessation outcome at T4 as dependent variable was conducted. Furthermore, mean differences of the variables depression and anxiety before and after successful smoking cessation (T0 and T4) were assessed for smokers and non-smokers using the Wilcoxon test. The results of the Shapiro Wilk test showed that the data for anxiety and depression at T0 and T4 were not normally distributed. Thus, the Wilcoxon test as a non-parametric test was used to test hypothesis six and seven with no normal distribution for the variables depression and anxiety. Moreover T-test were conducted for anxiety and depression at T0 between participants who dropped out of the study and participants who did not. This was analysed to control for selective drop-outs.

#### **2.5 T-tests between participants and drop-out participants regarding baseline anxiety and depression**

T-tests were performed between patients who participated until the end of the study and those who terminated participation early. These T-tests compared the scores of each anxiety and

depression before the start of smoking cessation (at T0). The results show significant differences between the baseline values of anxiety of the two groups. Baseline depression scores also differed significantly. Accordingly, the mean score for depression and anxiety is significantly higher in patients who discontinued participation in the study during the course than in people who participated until the end of the study (see Table 2 and 3). These results suggest a selective drop-out.

**Table 2**

*group statistics for drop-out patients and patients who finished the participation in the study*

variable		<i>N</i>	mean
depression	drop-out patients	293	7.51
	finishers	33	4.24
anxiety	drop-out patients	293	6.98
	finishers	33	4.36

**Table 3**

*T-tests between drop-out patients and patients who finished the participation in the study*

variable	T	significance	mean difference
depression at T0	3.11	.003	3.27
anxiety at T0	3.32	.002	2.61

### 3 3. Results

#### 3.1 Baseline social support and social modelling as predictors of smoking cessation outcome at T4

The full model ( $p = .01$ ), as well as both predictors social support ( $B = -.35$ ;  $p = .08 < .10$ ) and social modelling ( $B = .18^1$ ;  $p = .05 < .10$ ) is significant. Thus, both predictors are contributing independently. Furthermore, the model explains 6% ( $R^2 = .06$ ) of the variance of smoking cessation outcome. According to this, the probability of being a smoker 15 months after the start of the smoking cessation treatment gets higher by .70 odds when social support gets lower by one unit. Thus, as assumed in H2, the higher the social support, the greater the smoking cessation success at T4. If social modelling gets higher by one unit, the probability of being a smoker 15 months after the start of the smoking cessation treatment gets higher by

<sup>1</sup> It should be mentioned that smoking cessation success was coded with 1 = abstinent and 2 = smoker in general. Regarding the logistic regressions, smoking cessation success was automatically coded with 0 = abstinent and 1 = smoker.

1.20 odds. This is consistent with H3; the higher social modelling the lower the smoking cessation success at T4. The odds ratio is  $OR = 1.20$  and according to Chen, Cohen and Chen (2010) indicates a small effect.

**Table 4**

*Multiple Logistic Regression model in SPSS with social support and social modelling as independent variables and smoking cessation outcome as dichotomous dependent variable (N= 326)*

variables	<i>B</i>	<i>p</i>	OR [95%-CI]
social support	-.35	.08	.70 [.48; 1.04]
social modelling	.18	.05	1.20 [.1.00; .1.43]

### **3.2 Self-efficacy before and after cessation treatment as prediction of smoking cessation outcome at T4**

Two binary logistic regression models with self-efficacy before the cessation treatment and after the cessation treatment were conducted with regard to prediction of smoking cessation outcome. The logistic regression model with self-efficacy at baseline has a  $p$ -value of  $p = .54$  and is therefore not suitable to explain the dependent variable. The  $R^2 = .003$  of Nagelkerke also indicates no explanatory power. The regression coefficient is  $B = -.02$  with a significance of  $p = .55$ . Thus, self-efficacy at baseline does not have a significant, predictive power on smoking cessation outcome. In contrary, the logistic regression model of self-efficacy at T2 is significant with  $p = .00$  and therefore suitable to explain the dependent variable. The  $R^2 = .12$  indicates average explanatory power. Self-efficacy after the cessation treatment has a regression coefficient of  $B = -.21$  with a significance of  $p = .02$ . As assumed, self-efficacy after the end of the treatment significantly predicts smoking cessation outcome. Since smoking cessation success was coded with 0 = abstinent and 1 = smoker, the probability of being a smoker 15 months after the start of the smoking cessation treatment gets lower by .81 odds when self-efficacy after cessation treatment gets higher by one unit. The odds ratio is  $OR = .81$  and according to Chen, Cohen and Chen (2010) indicates a small effect.

**Table 5**

*Binary Logistic Regression Models in SPSS with dependent variable smoking cessation outcome*

variable	<i>B</i>	<i>p</i>	OR [95%-CI]
self-efficacy at T0 ( <i>N</i> = 326)	-.02	.55	.98 [.91; 1.05]
self-efficacy at T2 ( <i>N</i> = 123)	-.21	.02	.81 [.68; .96]

### **3.3 Self-efficacy as moderator in predicting depression on smoking cessation treatment**

The regression model is significant ( $p = .04$ ) and the  $R^2 = .14$  indicates medium explanatory power. The interaction of depression and self-efficacy after cessation treatment is  $B = -.01$  with a significance of  $p = .73$ . Accordingly, the interaction is not significant in contrary with the hypothesis. Furthermore, the variable depression after the cessation treatment has no predictive power on smoking cessation outcome ( $B = .10$ ;  $p = .33$ ). In addition, self-efficacy after the treatment has predictive power on smoking cessation outcome ( $B = -.21$ ;  $p = .06$ ). This confirms the effect found for T2 self-efficacy in a bivariate model.

**Table 6**

*moderator analysis depression\*self-efficacy ~ smoking cessation outcome in a regression model in PROCESS (N= 110)*

	<i>B</i>	<i>p</i>
depression T2	.10	.33
self-efficacy T2	-.21	.06
depression*self-efficacy	-.01	.73

The regression model is not significant ( $p = .53$ ) and the  $R^2 = .04$  indicates no explanatory power.



**Table 7**

*moderator analysis anxiety\*social support ~ smoking cessation outcome in a regression model in PROCESS (N= 117)*

	<i>B</i>	<i>p</i>
anxiety T2	.09	.31
social support T2	.31	.34
anxiety*social support	.03	.71

### 3.4 Anxiety and depression after successful and unsuccessful smoking cessation

The results of the Shapiro Wilk test were almost exclusively significant and, accordingly, except for fear at T0 in the non-smokers, not normally distributed (see Table 6).

**Table 8**

*Shapiro Wilk test for non-smokers (N=16) and smokers (N= 54)*

variable	<i>p</i> -value for non-smokers	<i>p</i> -value for smokers
depression at T0	.00	.00
depression at T4	.00	.00
anxiety at T0	.16	.00
anxiety at T4	.00	.00

Since the variables depression and anxiety were not normally distributed, the Wilcoxon test was used to compare the mean scores of depression and anxiety before smoking cessation treatment and after successful smoking cessation treatment, more specifically abstinence. Therefore, only participants who were no longer smokers 15 months after starting smoking cessation treatment ( $N = 16$ ) were included in the analysis. Depression at T0 differs significantly from depression at T4 ( $p = 0.011 < p = 0.05$ ). As suspected, the depression score among non-smokers significantly decreased 15 months after the start of successful smoking cessation treatment ( $Z = 2.530 > Z = 1.645$ ). Besides, anxiety at T0 differs significantly from anxiety at T4 ( $p = 0.003 < p = 0.05$ ). In accordance with the hypothesis, the anxiety score among non-smokers significantly decreased 15 months after the start of successful smoking cessation treatment ( $Z = 2.530 > Z = 1.645$ ).

**Table 9***statistic for Wilcoxon test of non-smokers (N= 16)*

	depression T4 – depression T0	anxiety T4 – anxiety T0
Z	-2.530	-2.991
asymptotic significant (2-sided)	0.011	0.003
effect size (r)	0.45	0.53

The same analysis was performed with people who continued to be smokers 15 months after the start of smoking cessation treatment (N= 54). As expected, depression at T0 does not differ significantly from depression at T4 ( $p= 0.77 > p= 0.05$ ). As assumed, the depression score among smokers did not significantly decrease 15 months after the start of the cessation treatment ( $Z= 0.294 < Z= 1.645$ ). However, anxiety at T0 differs significantly from anxiety at T4 ( $p= 0.01 < p= 0.05$ ). In contrast to our assumptions, the anxiety score among smokers did significantly decrease 15 months after the start of the cessation treatment ( $Z= 2.571 > Z= 1.645$ ).

**Table 10***statistic for Wilcoxon test of smokers (N= 54)*

	depression T4 – depression T0	anxiety T4 – anxiety T0
Z	-.294	-2.571
asymptotic significant (2-sided)	.769	.010
effect size (r)	0.03	0.25

However, when comparing the effect sizes of the analyses between smokers and non-smokers, it is noticeable that the effect sizes for the outcomes regarding non-smokers are significantly stronger. The effect size for the comparison of depression scores is clearly stronger for non-smokers than for smokers and is thus medium for non-smokers and very weak for smokers ( $r= 0.45 > r= 0.03$ ). Also, the effect size for the comparison of anxiety is clearly stronger for non-smokers than for smokers and is thus strong for non-smokers and weak for smokers ( $r= 0.53 > r= 0.25$ ).

## 4 Discussion

The purpose of this study was to predict abstinence in individuals who were smokers before starting smoking cessation treatment. The aim was to find out whether social cognitive determinants such as social support, social modelling, as well as self-efficacy can predict

abstinence. Furthermore, to determine whether and to what extent these social cognitive determinants have an influence on the relationship between abstinence and depression and/or anxiety symptoms. Finally, to find out whether successful smoking cessation is associated with altered, possibly lower, anxiety and depression symptoms. Overall, the goal of this study is to provide food for thought in making smoking cessation treatment more promising, especially for people with depression and/or anxiety symptoms. For this purpose, data from 344 participants in a smoking cessation treatment, generated by the Medisch Spectrum Twente in Enschede were used and analyzed. The participants were 16 to 77 years old, smoked at least one cigarette per day before the treatment and had the intention to quit smoking. In this quantitative study with repeated measurements design the data were analyzed doing a secondary analysis and the research questions were answered and theoretically classified.

#### **4.1 Impact of self-efficacy, social support and social modelling on smoking cessation success**

Given the results of this study, self-efficacy is an important factor in the success of smoking cessation treatment. The higher a person's self-efficacy directly at end of smoking cessation treatment, the higher the smoking cessation success. This study confirms that high self-efficacy is an important component for the path to abstinence (Gwaltney et al., 2009; Conditte & Lichtenstein, 1981). Unlike existing studies, self-efficacy was recorded before and after smoking cessation treatment. The present study found that self-efficacy prior to smoking cessation treatment was not relevant to future abstinence. Regarding this, in Gwaltney et al.'s (2009) study, the relationship between self-efficacy and abstinence was stronger when self-efficacy was measured after rather than before a quit attempt. From this it can be concluded that methods for increasing self-efficacy should still be the content in a smoking cessation treatment and should be intensively involved shortly before people stop smoking. Pre-treatment self-efficacy is not relevant for smoking cessation success. It might be possible that self-efficacy is improved through treatment and treatment itself reduces such baseline differences of self-efficacy.

It has been found out, that social support has a positive impact on smoking cessation success 15 months after the start of the treatment accompanied by the findings of Mermelstein et al. (1986). This can be explained by increasing social support during months following start of treatment. In this important period of time, when smoking is still tempting and habitual for patients, social support may provide great support. Furthermore, it was determined that the higher social modelling (the number of smokers in the person's social environment), the

higher the probability that the smoking cessation treatment will be unsuccessful, and the person will start smoking again. These findings confirm results of Mermelstein et al. (1986) and Blok et al. (2017). These findings suggest that a high number of smokers in the social environment is a hindering factor, which should be addressed in the addiction treatment. These findings can be explained by the findings of Bresnahan, Zhuang and Sun (2013). In their study participants were more persuaded to refrain from smoking by the friend-gainframed message rather than self-targeted messages. Social contacts seem to have a massive influence on a person's smoking behaviour. Another reason could be the adoption of the attitude towards smoking and the will to belong. If close relatives smoke and one otherwise shares similar values with them, it could be that one can be changed more easily about smoking behaviour. Another reason especially explaining relapse could be the higher number of external triggers through smokers in the social environment. A study of Siahpush, Borland and Scollo (2003) also confirmed the difficulty of quitting if the proximal social environment is filled with smokers.

#### **4.2 impact of depression on smoking cessation success moderated by self-efficacy**

Based on the results of this study, it can be derived, that severity of depressive symptoms does not interfere with smoking cessation treatment. Self-efficacy also did not influence the non-existent association between severity of depressive symptoms and smoking cessation success. This contradicts previous research findings by Morell & Cohen (2006), Stepankova et al. (2017) and Richards et al. (2013), which found that depression negatively affects smoking cessation success and abstinence. Also contrary to the results, a study by Mee (2014) found that, on the one hand, depression and smoking are positively related. On the other hand, self-efficacy was identified as a mediator for the relationship between depression and smoking. One reason for the present findings could be using scores of depressive symptoms at T2, with then 9 months until smoking cessation outcome was assessed. Due to the long-time lag, the effect of predictors tends to become smaller. In a comparable study by Stepankova et al. (2017), there were also 12 months between measurements of baseline depression and smoking status. Another reason could be that the present study included participants with depressive symptoms but not with diagnosed clinical depression. In contrast, comparable literature partly included people with clinical depression.

#### **4.3 impact of anxiety on smoking cessation success moderated by social support**

The results show anxiety measured at the end of treatment does not predict smoking cessation success and thus has no impact, neither positive nor negative. Besides, this non-existent

association is not affected by social support. The non-prediction of anxiety on smoking cessation success is contrary to the findings from Piper et al. (2011), Morrell & Cohen (2006) and Richards et al. (2013), which found negative prediction of anxiety on smoking cessation success and abstinence. One reason for the present findings could be the large time lag between measuring anxiety and smoking cessation success 12 months later. In contrast, other studies measured smoking status at 6 months (Piper et al., 2011). In addition, other studies used only participants who had clinically diagnosed anxiety disorders (Richards et al., 2013; Piper et al., 2011). Overall, it is notable that participants who dropped out of the study early had significantly higher depression and anxiety scores before smoking cessation began than participants who did not drop out (see Table 2 and 3 in *Method*). It seems likely that participants who quit early started smoking again. These were also counted as such in the analyses. The significant mean differences suggest a negative predictive effect of anxiety and depression on smoking cessation success.

#### **4.4 Development of anxiety and depression in abstinent ex-smokers and smokers**

The findings indicate a strong reduction of depression and a moderate reduction of anxiety in the long-term after people successfully stopped smoking. This means a moderate to strong improvement in people's mental health after successful smoking cessation. These results are consistent with the findings of previous studies from Stepankova et al. (2017), Baiardini et al. (2014), McDermott et al. (2013) and McClave et al. (2009). At this point, it is important to note that the time at which participants actually quit smoking was not recorded. This means, that the mental state (lower depression and anxiety symptoms) may have changed first, which could then have had a positive effect on the smoking status. In future studies, this analysis could include only participants who quit smoking immediately after smoking cessation treatment. The present study compared the depression and anxiety scores over a relatively long period of 15 months. Thus, a long-term improvement in mental health through stopping smoking or the smoking cessation treatment can be assumed. These findings could serve as an additional motivation for addictive people to start a smoking cessation treatment. Contrary to the assumption, the present study was not able to uncover a reciprocal relationship between depression as well as anxiety and smoking cessation success, but only a bidirectional one between smoking cessation and the reduction of depression and anxiety symptoms. This could also be since a part of the participants quit smoking only shortly before recording the smoking cessation success (T4) and the previous improvement in mental health contributed to this.

Another portion may have quit smoking earlier, at which point depression and anxiety symptoms may have been reduced.

## **4.5 Strengths and limitations of the study**

### **4.5.1 Strengths**

The external validity is supported by the “heterogeneous population of regular patients of an outpatient smoking cessation clinic” (Siemer et al., 2016, p. 9). Otherwise, the external validity may be diminished due to the flexible quit approach, which is not common in other smoking cessation treatments (Siemer et al., 2016). Regarding internal validity, all three quit strategies were distributed equally and therefore did not affect the internal validity (Siemer et al., 2016). Furthermore, standardized questionnaires and questions were used to assess depression, anxiety, social support, social modelling as well as self-efficacy.

### **4.5.2 Limitations**

The internal validity is limited by the fact that the variables social support and social modelling were only measured before and not after smoking cessation treatment. Measurements after the cessation treatment eventually would cause different results. Self-efficacy at T0 was collected from 326 participants, while self-efficacy at T2 was collected from only 123 participants. In general, there was a highly variable number of participants for different variables or measurement time points. Often questions were omitted from the questionnaire or participants stopped taking part in the questionnaires over time. This shrinks the number of participants enormously and the results are less valid. Many people dropped out of the study and one reason could be that they started smoking again. The T-tests in the method section regarding baseline depression and anxiety between people who dropped out of the study and those who did not, suggest a selective drop-out. It can be derived those participants may started smoking again due to negative affect, anxiety, or depression. Therefore, participants who dropped out were recorded as smokers at the end of the study. It can be assumed that the conclusions derived from the results are valid.

## **4.6 Implications**

Despite the limitations of this study, valuable implications can be derived. In future smoking cessation treatments and addiction treatments self-efficacy should be trained and improved to reach more successful outcomes. To be more specific, self-efficacy should already be improved when people make a quit attempt, to enhance the ability to master the first phase of abstinence more easily. Furthermore, patients' self-efficacy should be assessed prior to treatment and a decision should be made based on this assessment for whom self-efficacy training makes sense and for whom it does not. Accordingly, self-efficacy training would tend

to have a positive effect on the smoking behaviour of patients who had low self-efficacy at the beginning. Furthermore, it makes sense to measure and strengthen self-efficacy even after treatment. Especially in the period after the three-month treatment, when regular counselling sessions are omitted, this can threaten abstinence and increased self-efficacy is necessary. If persons have very low levels of self-efficacy or difficulties to improve it, it should be identified why. The problems behind the addiction should be addressed, because a lack of self-efficacy can make people more vulnerable to mental illnesses (Holahan & Holahan, 1987). Besides, many people use substance abuse to cope with adverse circumstances or to contain severe psychiatric symptoms (Kennerley et al., 2017). It might also make sense to conduct interviews with patients and psychotherapists before starting smoking cessation treatment in order to uncover possible psychological problems and work on them during the course of treatment. The study review of Woody (2003) shows that psychosocial treatments for patients with an addictive disorder are helpful related to abstinence and well-being of patients.

In the treatment of addiction disorders, it should be focused on the dealing with smokers or consumers in the social environment of the person and develop helpful behaviours preventing or dealing with resulting trigger situations. Successful smoking cessation treatments should consider the social contexts in which smoking behaviour takes place. In addition, the development of social support is a reinforcing factor to become and remain abstinent. Seminars and information events could be offered specifically for relatives of (ex)smokers. In these seminars, relatives could learn how to behave in a supportive manner. Although the results of this study could not fully confirm it, including anxiety and depression among other things in treatment often makes sense anyway, since the most common reason for addictive behaviour is rapid emotion regulation (Kennerley et al., 2017). In future studies other aspects of mental health, like emotional instability should be identified and examined, which may also be relevant for smoking cessation success and overcoming addictions in general. Looked at the other way around, it makes sense to address smoking cessation in depression and anxiety treatments or therapies, since successful quitting smoking would have a positive impact on people's mental health. However, this needs to be considered carefully because unsuccessful smoking cessation can also lead to increased depression and/or anxiety symptoms (McDermott et al., 2013; McClave et al., 2009). Another reason why it must be handled with care is the short-term regulation of mood by smoking (Kennerley et al., 2017). If this is omitted, especially in the first time, therapy could be negatively affected, or the person could experience an increase of anxiety and/or depression symptoms. In further studies it could be

examined if the reduction of depression and anxiety also occurs when people stop consuming in case of alcohol or drugs addiction. The long-term reduction of anxiety and depression could serve as additional motivation before a smoking cessation treatment. It should be implemented before or in the beginning of the smoking cessation treatment in the context of psychoeducational sessions.



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