Association between income and education with quit attempts, use of cessation aids, and short-term success in tobacco smokers: a social gradient analysis from a population-based cross-sectional household survey in Germany (DEBRA study)

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ABSTRACT

Introduction

Smoking is more prevalent in smokers from lower compared with higher socioeconomic (SES) groups, but studies are inconsistent regarding underlying mechanisms. We aimed to assess associations between SES indicators and three distinct aspects of the smoking cessation process: attempting to quit; use of evidence-based cessation treatments; and success.

Methods

We analysed data of 12,161 last-year smokers (i.e., current smokers and recent ex-smokers who quit ≤ 12 months) from 20 waves (June/July 2016 to August/September 2019) of the German Study on Tobacco Use (DEBRA) - a representative household survey. Associations between indicators of SES (income and education) and (1) last-year quit attempts; (2) use of evidence-based cessation treatment or electronic cigarettes during the last attempt; and (3) short-term self-reported abstinence were analysed using multivariable logistic regression, adjusted for potential confounders.

Results

Of all last-years smokers, 18.6% had attempted to quit, of whom 15.2% had successfully stopped. Higher income (OR 0.82, 95%CI=0.77-0.88 per 1000€) but low vs. high education (OR 0.84, 95%CI=0.73-0.96) were associated with lower odds of quit attempts. In smokers with quit attempts, higher income but not education was associated with higher odds of using cessation medication (OR 1.31, 95%CI=1.08-1.59 per 1000€). Neither income nor education were associated with using behavioural support or success.

Conclusions

In the German healthcare system without free access to evidence-based cessation therapy, low-income smokers are more likely to make a quit attempt but less likely to use cessation medication than high-income smokers. Equitable access to such medication is crucial to reduce SES-related health disparities.

Study registration number

DRKS00011322, DRKS00017157

1. INTRODUCTION

Tobacco smoking is the largest single and avoidable risk factor for a huge number of diseases (World Health Organization (WHO), 2017). In Germany, one third of the population smokes tobacco, which leads to approximately 125,000 deaths each year (Kotz & Kastaun, 2018; Mons & Brenner, 2017). Like many countries (Cancer Research UK, 2018; Leventhal et al., 2019; Mackenbach et al., 2008; Tabuchi & Kondo, 2017; U.S. Department of Health and Human Services, 2014), prevalence remains considerably higher among smokers from more disadvantaged socioeconomic status (SES) groups with lower educational levels and/or lower income (Kotz et al., 2018; Kuntz et al., 2016), leading to substantial health disparities and differences in life expectancy (Gregoraci et al., 2017; Mackenbach et al., 2008).

Reducing socioeconomic inequalities in smoking is a key factor to reduce health inequalities. Implementation of tobacco control strategies (Feliu et al., 2019), including access to smoking cessation treatment (Hartmann‑Boyce et al., 2018; Kotz et al., 2014a), can help to decrease smoking prevalence rates. There is some concern that higher SES groups benefit more from the provision of stop smoking support (T. Brown et al., 2014; Hill et al., 2014). However, the latest evidence from the United Kingdom (UK) suggests that the provision of equity-oriented support can achieve a range of equity-positive outcomes in disadvantaged groups (Smith et al., 2020). For the further refinement and implementation of equitable tobacco control strategies and support, the causes of higher smoking prevalence in disadvantaged groups need to be understood.

It is known that people from more deprived SES groups are more likely to take up smoking, due to different living conditions with a higher availability of tobacco products, and greater exposure to stress (Hiscock et al., 2012), but these smokers are also less likely to quit (Hiscock et al., 2012; Kuntz et al., 2016; Lampert & Thamm, 2004; Leventhal et al., 2019).

Successful smoking cessation is a function of two processes: attempting to quit and succeeding in staying abstinent. Both processes might be separately influenced by socioeconomic factors

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(Hiscock et al., 2012). Hence, it is important to distinguish whether smokers from different SES groups differ regarding the incidence of quit attempts and/or the success of such attempts (Kotz & West, 2009), which is closely correlated with the use of evidence-based cessation methods (Hartmann‑Boyce et al., 2018; Kotz et al., 2014a). Evidence for the former remains inconsistent (Reid, Hammond, Boudreau, et al., 2010). Studies from the United States (US) have reported a lower rate of quit attempts among smokers with lower education (Levy et al., 2005; Reid, Hammond, Boudreau, et al., 2010). In contrast, other studies from the US, UK, and Canada, did not report a social gradient (Hackshaw et al., 2010; Hyland et al., 2006; Reid, Hammond, & Driezen, 2010).

It seems reasonable that the health system context and varying tobacco control policy environments over time contribute to this inconsistency (Reid, Hammond, Boudreau, et al., 2010). While cessation treatment was not reimbursed in the US, lower educated smokers appeared less likely than higher educated smokers to support their quit attempt with evidence-based cessation aids (Shiffman et al., 2008). Cross-sectional data from the Smoking Toolkit Study (STS) in England, where such treatment is freely available, showed in contrast that low SES-smokers were just as likely as high-SES smoker to try to quit and to use evidence-based cessation aids. However, a strong social gradient was found for cessation success, with disadvantaged groups being half as likely to succeed compared with the highest SES group (Kotz & West, 2009). Stronger dependence and lower levels of self-efficacy in low-SES smokers may explain these findings (Kotz & West, 2009). Seo et al. , recently reported prospective data from Korean smokers who participated in a cessation program and showed that lower income, higher dependence, and choice of bupropion versus varenicline were associated with lower cessation success. The association with dependence was found only in low-income smokers.

Drawing on a sample of 12,161 last-year tobacco smokers (i.e., current smokers and ex-smokers who quit during the past year) representative of the German population, the present study aims at

assessing associations between two different indicators of SES (income and education) and three distinct processes of smoking cessation: 1) self-reported attempts to quit smoking during the past year, 2) the use of evidence-based smoking cessation aids and electronic cigarettes (ECs), and 3) short-term "success" rates in quitting among those who attempted to quit, adjusted for potential confounders including the level of tobacco dependence. We planned to analyse income and education separately, since both factors may differently influence the process of smoking cessation, and no universally valid composite index of social status exist in Germany.

2. METHODS

2.1 Design, setting, and participants

The DEBRA study (www.debra-study.info) is a nationwide, cross-sectional, computer-assisted, face-to-face household survey of the German population aged 14 years and over (Kastaun et al., 2017). Every other month, a new, sample of approximately 2,000 persons is interviewed as part of a multi-topic omnibus survey, which is conducted by a commissioned market research institute. Respondents are selected through multi-stage, multi-stratified random probability sampling, and all respondents are interviewed on the use of combustible tobacco products and ECs and on general sociodemographic and socioeconomic factors. Current tobacco smokers and those who had quit during the past year (= recent ex-smokers), were interviews in further detail on their smoking and quitting behaviour. Details on the methodology can be found in the study protocol (Kastaun et al., 2017). The DEBRA study is conducted in accordance with the Declaration of Helsinki, it's methodology was reviewed by the Ethics Commission of the Heinrich-Heine-University (ID 5386/R), and it has been registered in the German Register of Clinical Trials (DRKS00011322, DRKS00017157).

This article presents the data of the first 20 waves of the DEBRA study from the period between June/July 2016 and August/September 2019) with a total of 40,817 respondents. Smoking status

was assessed by asking for the current or former use of cigarettes or other combustible tobacco products (e.g., cigars, pipe). For the present analyses, current tobacco smokers and those who stopped during the year before the survey were summarised and categorised as "last-year smokers". Of the total sample, 12,161 (29.8%) respondents were last-year smokers, and 317 (0.8%) refused to answer the question on their smoking status.

2.2 Measurements

A translated version of the original DEBRA questionnaire, including all questions relevant to the present study, has been published: https://osf.io/ndu6r/ (version No. v44).

2.2.1 Measurement of explanatory variables: socioeconomic status

For the present analyses, SES was measured by both the level of education and net monthly household income. Since the needs and expenses of a household depend on the age and number of people living in it, we used an equalisation technique of the Organisation for Economic Co-operation and Development (OECD) (2013) (OECD-modified equivalence scale) to adjust for household size and composition. According to this scale, each member of a household receive different weightings: 1.0 to the first adult of a household, 0.5 to the second and to each further person aged $\geq$ 14 years, and 0.3 to each child below 14 years; and the net total household income is then divided by the sum of weightings. Details on the calculation have been published: https://osf.io/e2nqr/.

For the descriptive analyses, both variables were categorised into three groups, respectively: educational level into low (= junior high school equivalent or no qualification), middle (= secondary school equivalent), and high (= high school equivalent or advanced technical college equivalent); and for equalised net monthly household income we aimed to obtain a categorisation into low (= approximately <20th income percentile), middle (=approx. 20th to 80th income percentiles), and high (= approx. >80th income percentile), roughly reflecting the distribution of

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income in the German population (Grabka et al., 2016; Institute of the German Economy, 2017; Rakesh, 2017). Since categorisation of continuous variables may result in loss of statistical power (Froslie et al., 2010), income was entered as a continuous variable with units of 1,000€ for all regression models.

2.2.2 Measurement of outcomes: quit attempts, use of cessation methods, short-term success

Last-year smokers were asked: "How many serious attempts to stop smoking have you made in the last 12 months? By serious attempt I mean that you decided that you would try to make sure you never smoke again. Please include any attempt that you are currently making and please include any successful attempt". The number of attempts was recoded into a dichotomous variable "Yes" (= at least one attempt) versus "No".

Respondents who reported at least one quit attempt were shown a comprehensive list of evidence-based and non-evidence-based **smoking cessation methods** and asked to select all methods they had used during their most recent attempt. Evidence-based methods were selected according to national and international clinical guidelines (Batra & Mann, 2015; Fiore et al., 2008; National Institute for Clinical Excellence (NICE), 2013): pharmacological (varenicline, bupropion, and nicotine replacement therapy (NRT) over-the-counter or on prescription) and behavioural (brief physician advice, behavioural counselling, quit line) treatment. ECs have become the most frequently used method for attempts to stop smoking in several countries, with different usage rates across SES groups (Kotz et al., 2018; Rodu & Plurphanswat, 2017; Smoking Toolkit Study, 2019), and the evidence on their effectiveness for smoking cessation has become stronger (Hajek et al.; Hartmann-Boyce et al., 2016). We therefore decided to assess the use of an EC with/without nicotine to quit smoking as well.

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Short-term "success" of quit attempts was assessed by asking respondents who had made a quit attempt during the past year: "How long did your most recent serious quit attempt last before you went back to smoking?". Those responding "I am still not smoking' were defined to have "short-term success" (independently at what time the most recent quit attempt was initiated). This answer was double-checked against the response "I have quit during the past year" to a question on their current smoking status. Respondents with conflicting answers were excluded.

2.2.3 Measurement of potential confounders: level of dependence, time since quit attempt was initiated

The level of tobacco dependence was assessed using the German version of the Strength of Urges to Smoke Scale (SUTS) (Fidler et al., 2011). The SUTS consists of two items: item 1 – time spent with urges to smoke – asks "How much of the time have you felt the urge to smoke in the past 24 hours?" (response options: "not at all", "a little of the time", "some of the time", "a lot of the time", "almost all of the time", "all of the time", and item 2 – strength of urges to smoke – asks "In general, how strong have the urges to smoke been?" (response options: "light", "moderate", "strong", "very strong", "extremely strong", and "zero/none" for those who answered "not at all" on item 1. The SUTS reflects an individual's level of tobacco dependence, and has shown to be a relatively stable measurement of the urges to smoke from pre- to post-quitting in recent (<12 months) ex-smokers in cross-sectional surveys (J. Brown et al., 2014; Kotz et al., 2014b).

Previous population studies suggest differential recall bias in respondents, with assisted quit attempts being recalled better than unassisted attempts, (J. Brown et al., 2014; Kotz et al., 2014b) and this effect might increase with time. To control for potential confounding associated with different lengths of "time since quitting" between individuals, this variable was included in the statistical analyses. Last-year smokers who attempted to quit during the past year were asked at what time their most recent quit attempt was initiated: a) "during the past week", b) "more than one week ago", c) "more than one month ago", d) "more than two months ago", e) "more than three

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months ago", f) "more than six months ago". This variable was dichotomised into "$\leq$6 months vs. >6 months" for the descriptive and regression analyses.

2.3 Statistical analyses

Prevalence data on the main outcome variables were weighted to be representative of the German population. Details on the weighting technique are described in the study protocol (Kastaun et al., 2017). The weighting procedure consists of three steps. First, weighting at household level to give a higher weight to households with a lower probability of selection. Second, weighting at person level to adjust for different selection probabilities for persons within the same household, and third, weighting to correct for differences between the demographic characteristics (e.g., age, gender) of the respondents and of the total population. Weighted prevalence rates will be reported as weighted percentages "$\%_w$" an their sample sizes ("N_w").

Among last-years smokers, multivariable logistic regression was used to examine associations of predictor variables of interest a) education level and b) income level with the three outcome variables: 1) at least one quit attempt ("Yes" vs. "No"), and, among those with a quit attempt, 2) the use of cessation aids (evidence-based: cessation medication, behavioural support; and ECs with/without nicotine), and 3) short-term success ("Yes" vs. "No"). All analyses included respectively income and education as covariates, and age, sex, level of tobacco dependence as potential confounders, and survey wave as a design factor. Analysis 2 and 3 further included "time since quit attempt started", and analysis 3 further included the "use of any evidence-based support" ("Yes" vs. "No"), and, in a second step, the use of ECs with and/or without nicotine.

Multivariable regression analyses were carried out using complete data; respondents with missing values were excluded from the analyses. In the face-to-face DEBRA survey, the rate of missing data for the main outcome variables and covariates is low ($\leq$ 5%). One exception was the rate of

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missing data on the "number of cigarettes per day", which was 17.3% (N=53) in recent ex-smokers, while current smokers only had 3.3% (N=367) missing data on this question. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA).

3. RESULTS

3.1 Sample characteristics

The unweighted total sample of last-year smokers (N=12,161) had a mean age of 46.6 years (standard deviation (SD) = 17 years) and 46.9% (N=5,698) were female. Demographic and smoking characteristics among the total sample of last-year smokers, stratified by educational level and net household income, are presented in **Table 1**. Of all last-years smokers, 18.6%$_w$ (N$_w$=2,258; 18.4%, N=2,238) had tried to quit during the last year. Of those who attempted to quit, 15.2%$_w$ (N$_w$=344; 14.6%, N=326) had successfully stopped, and 13.0%$_w$ (N$_w$=295; 12.4%, N=278) had used at least one form of an evidence-based cessation method to assist this most recent quit attempt: 8.2%$_w$ (N$_w$=185; 7.6%, N=169) had used any evidence-based medication, 6.9%$_w$ (N$_w$=156; 6.8%, N=153) had used behavioural support, and 10.4%$_w$ (N$_w$=235; 9.9%, N=221) had used an EC with and/or without nicotine.

3.2 Associations between SES and main outcome variables

When including age, sex, level of tobacco dependence, survey wave, and income and education into the model, the multivariable logistic regression analysis revealed inconsistent social gradients for attempts to quit smoking. Higher income (OR 0.82, 95%CI=0.77-0.88 per 1000€) and low

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compared to high education (OR 0.83, 95%CI=0.73-0.95) were associated with lower odds of quit attempts (see (1) in **Table 2**).

In the subgroup of last-year smokers who attempted to quit (see (2) **Table 2**), income was positively associated with higher odds of using any evidence-based treatment (OR 1.18, 95%CI=1.00-1.39 per 1000€). This association seemed mainly influenced by use of pharmacological support (OR 1.31, 95%CI=1.08-1.59 per 1000€); no association could be observed for use of evidence-based behavioural support, or for the use of ECs (with and/or without nicotine). Education was neither significantly associated with the use of medication nor with behavioural support.

Regarding short-term success of the most recent quit attempt (see (3) **Table 2**), there were no significant associations with education or income. The inclusion of EC use in this model did not influence these results significantly (income: OR 1.11, 95%CI=0.91-1.36; e.g., low vs. high education: OR 0.71, 95%CI=0.45-1.12).

4. DISCUSSION

In a large national survey of the German population, lower education but higher income were associated with a lower likelihood of attempting to quit, after adjustment for important confounders including tobacco dependence. Smokers with higher incomes had greater odds of using of evidence-based cessation methods, particularly pharmacological support, but there were no significant associations with education. Neither income nor education were significantly related to short-term success of quit attempts.

The present data conflicts with previous results (Kotz & West, 2009) of the English Smoking Toolkit Study (STS), which reported little difference in the use of cessation aids but a strong social gradient in success rates. The studies have comparable methodologies (Kastaun et al., 2017) and

relied on similar sample sizes. However, the studies included different adjustments. The STS did not adjust for tobacco dependence, which is typically higher among low-SES smokers, and may account for the gradient in success (Kotz & West, 2009; Ussher et al., 2016). One possible explanation for the difference in use of cessation methods relates to the different healthcare systems. Whereas evidence-based smoking cessation aids are reimbursed in the UK, German health insurances do not cover pharmacological cessation treatment and smokers with lower income have difficulties to afford such aids. This might also explain why the present study found that lower income in smokers in Germany is associated with a lower likelihood of using evidence-based treatment, particularly medication, whereas smokers from low-SES groups in England seem to be just as likely as those in higher groups to use such aids (Kotz & West, 2009).

In the present study there was no significant association between income and the use of behavioural treatment, possibly because costs for these treatments are at least partially (50-75%) covered in Germany.

Somewhat surprisingly, there was a contrasting association between education and income with quit attempts. Lower education but higher income were associated with lower odds of quit attempts. Smokers with the lowest household income reported the highest rates of attempts to quit, with about every fifth smoker of this group attempting to quit during the past year. Although income and education are both indicators of SES, they are distinct and appear to relate differently to quit attempts. On the one hand, it may be that financial strain pushes smokers to quit in order to saving money. The reverse association with education, on the other hand, may relate to health literacy, which is associated with lower educational attainment, less knowledge about the health risks of smoking, and lower risk perceptions (Stewart et al., 2013).

Consistent with the associations with income in the current study, a US study found that smokers with financial strain were more likely to attempt to quit but were no more successful in quitting

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than smokers without financial strain, when adjusting for SES-related factors such as the level of dependence (Kalkhoran et al., 2018).

Differences in success of quit attempts between low- and high-income smokers are very likely to be an indirect result of low usage of evidence-based cessation methods among those from low-income groups. In healthcare systems, where smoking cessation treatment is not freely available, smokers with lower income are severely and systematically put at a disadvantage, and tobacco-related health disparities between different socioeconomic groups of the society will further increase.

The present study has several strengths including a dataset of more than 12,000 last-years smokers representative for the German population, adjustment for a large number of potential confounders including the level of tobacco dependence assessed with the SUTS which produces robust results even in recent ex-smokers (J. Brown et al., 2014; Kotz et al., 2014b). Finally, to the best of our knowledge, the use of ECs was taken into account for the first time.

However, this study is also subject to limitations. First, all data were obtained by self-report with outcomes reported retrospectively for the year prior to the interview, and may thus be subject to reporting and recall bias. Second, some participants provided inconsistent answers on their quit attempts and success during the last year. These smokers had been excluded, which led to a drop-out of 106 respondents (0.3% of the total sample, 0.9% of the total sample of last-year smokers) from the analyses. Third, since this is a cross-sectional study, "short-term success" was not defined by a clear start and endpoint, meaning that someone who tried to quit during the week before the interview and was still smoke-free at the interview, was included as a "short-term" successful quitter. Fourth, the present study included important confounders but did not include other possibly important factors such as mental health symptoms, or the level of self-efficacy, which are associated with the SES (Kalkhoran et al., 2018; Siahpush et al., 2006). Finally, regarding the use of smoking cessation

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aids, we only measured whether or not such an aid was used but not how compliant respondents were when using this treatment.

4.1 Conclusions

In a healthcare system with no free access to evidence-based smoking cessation treatment – Germany – the social gradient in absolute quit rates seems to be related to the reduced affordability of such treatment in low-income smokers who are subject to higher levels of dependence. Making such therapies freely available for everyone is the most promising public health strategy to ensure that all smokers have an equal chance to use them and to become abstinent. Clinicians should be encouraged to provide targeted support, having the potential to improve smoking cessation among the more disadvantaged groups.

ABBREVIATIONS

CI = Confidence interval

DEBRA = German Study on Tobacco Use (In German: "Deutsche Befragung zum Rauchverhalten")

EC(s) = electronic cigarette(s)

OECD = Organization for Economic Co-operation and Development

OR = Odds ratio

SD = Standard deviation

SES = Socioeconomic status

STS = Smoking Toolkit Study

SUTS = Strength of Urges to Smoke Scale (In German: VRS = "Verlangen zu Rauchen Skala")

UK = United Kingdom

US = United States

WHO = World Health Organization

FOOTNOTES

Conflict of Interests

Author contributions

SK coordinates the DEBRA study, drafted the manuscript, analysed and interpreted the data. JB co-wrote the manuscript and interpreted the data. DK conceived the DEBRA study, contributed to the study design, co-wrote the manuscript, and supervised the analyses. All named authors contributed substantially to the manuscript and agreed on its final version.

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Table 1 Demographic and smoking characteristics of last-year smokers, and use of evidence-based‡ smoking cessation aids and electronic cigarettes amon...
who tried to quit during the past year, stratified by educational level and household income (**weighted data**, N_w = 12,156, unweighted N=12,161)

	Education†			Monthly net household income in €#		
	Low **30.3%** **(N_w = 3,682,** **N=4,075)**	**Middle** **42.1%** **(N_w = 5,121,** **N=4,764)**	**High** **25.4%** **(N_w = 3,082,** **N=3,080)**	**Low** **18.1%** **(N_w = 2,198,** **N=2,750))**	**Middle** **63.3%** **(N_w = 7,694,** **N=7,425)**	**High** **18.6%** **(N_w = 2,264,** **N=1,983)**
Age, years (mean ± SD)	48.6 ± 17.0	44.4 ± 14.9	43.6 ± 16.1	41.4 ± 16.6	45.4 ± 16.6	46.6 ± 14.5
Sex						
Female	45.4% (1,672)	48.1% (2,462)	42.4% (1,306)	53.5% (1,176)	44.9% (3,456)	42.3% (957)
Male	54.6% (2,010)	51.9% (2,659)	57.6% (1,776)	46.5% (1,022)	55.1% (4,238)	57.7% (1,307)
Cigarettes smoked/day (mean ± SD)	15.4 ± 8.2	13.8 ± 7.9	11.6 ± 8.1	14.5 ± 8.7	13.5 ± 7.9	13.7 ± 8.3
Nicotine dependence (SUTS§)						
Time spend with urges (mean ± SD)	3.4 ± 1.1	3.3 ± 1.1	3.0 ± 1.1	3.4 ± 1.2	3.2 ± 1.1	3.2 ± 1.2
Strength of urges (mean ± SD)	2.1 ± 1.0	2.0 ± 1.0	1.8 ± 1.1	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.1
Quit attempt during the last year, at least one	16.7% (615)	18.9% (970)	20.2% (624)	22.0% (484)	18.5% (1421)	15.6% (353)
Smokers who tried to quit last year	**Low** **N_w = 615**	**Middle** **N_w = 970**	**High** **N_w = 624**	**Low** **N_w = 484**	**Middle** **N_w = 1,421**	**High** **N_w = 353**
Use of any evidence-based cessation aid‡	11.4% (70)	13.0% (126)	15.2% (95)	9.7% (47)	14.5% (206)	11.9% (42)
Use of any evidence-based cessation medication (NRT, Vareniclin, Bupropion)‡	6.8% (42)	8.0% (78)	10.3% (64)	5.4% (26)	9.1% (129)	8.2% (29)
Use of any evidence-based behavioural cessation aid (medical advice, group therapy, quit line)‡	6.5% (40)	6.8% (66)	7.9% (49)	6.4% (31)	7.7% (110)	4.5% (16)
Use of an electronic cigarette (with and/or without nicotine)	9.3% (57)	12.3% (119)	8.7% (54)	11.4% (55)	10.0% (142)	10.8% (38)
Time since quitting >6 months#	54.6% (335)	50.9% (491)	56.5% (350)	50.3% (242)	51.6% (728)	63.7% (225)
Successful quitter	8.8% (53)	14.9% (141)	22.8% (140)	12.7% (61)	14.8% (205)	22.6% (78)

Data are presented as mean± standard deviation (SD) or weighted percentages (number, N_w). ‡evidence-based smoking cessation aids according to national and international clinical guidelin...
ECs) (Batra & Mann, 2015; Fiore et al., 2008; National Institute for Clinical Excellence (NICE), 2013); †German equivalents to education levels listed in table from highest to lowest: high =
equivalent ("Allgemeine Hochschulreife") and advanced technical college equivalent ("Fachhochschulreife"), middle = secondary school equivalent ("Realschulabschluss"), and low = junio...
equivalent ("Hauptschulabschluss") or no qualification; #OECD equivalent net monthly household income in € from lowest to highest income group: low = approx. <20th income percent...
approx. 20th to 80th income percentiles, to high = approx. >80th income percentile; §SUTS (Fidler et al., 2011)= Strength of Urges to Smoke Scale; differences when calculating the total perc...
explained by missing data on the respective variables. #Time since quit attempt started was measured in categories: 'in the last week'; 'more than a week and up to a month'; 'more than 1 r...
to 2 months'; 'more than 2 months and up to 3 months'; 'more than 3months and up to 6 months'; and 'more than 6 months and up to a year'.

Table 2 Multivariable associations between income and education and the outcomes (1) last-year quit attempts, (2) use of evidence-based cessation methods, and (3) short-term self-reported abstinence adjusted for age, sex, level of tobacco dependence (urges to smoke), income respectively education. Analyses (2) and (3) were further adjusted for time since quit attempt started, and analysis (3) additionally for the use of any evidence-based method (unweighted data).

	(1) Quit attempt (yes/no) in last-year smokers (N=12,161) OR (95%CI)	(2) Use of an evidence-based‡ cessation method or of an electronic cigarette (yes/no) in smokers who attempted to quit (N=2,238) OR (95%CI)				(3) Short term success (yes/no) in smokers who attempted to quit (N=2,238) OR (95%CI)
		Any evidence-based cessation method	Evidence-based medication	Evidence-based behavioural Support	Electronic cigarette	
Net household income#[a]	0.82 (0.77-0.88)***	1.18 (1.00-1.39)*	1.31 (1.08-1.59)**	1.04 (0.84-1.29)	1.17 (0.97-1.42)	1.11 (0.91-1.36)
Education†						
High (Reference)	1	1	1	1	1	1
Middle	0.93 (0.82-1.05)	0.83 (0.61-1.14)	0.93 (0.63-1.38)	0.82 (0.55-1.23)	1.30 (0.91-1.85)	1.09 (0.75-1.59)
Low	0.83 (0.73-0.95)**	0.82 (0.57-1.16)	0.78 (0.50-1.23)	0.83 (0.53-1.30)	0.96 (0.63-1.46)	0. 71 (0.46-1.12)
Potential confounders						
Age[a]	0.99 (0.99-1.00)***	1.01 (1.00-1.02)	1.01 (1.00-1.02)	1.01 (1.00-1.02)	0.98 (0.97-0.99)***	1.00 (0.99-1.01)
Sex						
Female (Reference)	1	1	1	1	1	1
Male	0.93 (0.85-1.03)	0.94 (0.73-1.21)	0.95 (0.69-1.31)	0.93 (0.67-1.29)	1.08 (0.81-1.44)	1.15 (0.84-1.57)
Time spend with urges§[a]	0.79 (0.74-0.84)***	1.06 (0.90-1.25)	1.16 (0.94-1.43)	0.99 (0.80-1.23)	1.32 (1.10-1.58)**	0.30 (0.23-0.40)***
Strength of urges§[a]	1.15 (1.07-1.23)***	1.25 (1.05-1.49)*	1.27 (1.02-1.58)*	1.19 (0.94-1.49)	1.01 (0.83-1.23)	0.54 (0.40-0.72)***
Time since quitting						
≤6 months	N/A	1	1	1	1	1
>6 months	N/A	0.85 (0.66-1.09)	1.00 (0.73-1.37)	0.72 (0.52-0.99)*	0.89 (0.67-1.19)	1.44 (1.05-1.97)*
Use of any evidence-based cessation method						
No (Reference)	N/A	N/A	N/A	N/A	N/A	1
Yes	N/A	N/A	N/A	N/A	N/A	1.46 (0.89-2.39)

Data are presented as adjusted Odds Ratios (OR) and 95% confidence interval (CI) around OR. *p<0.05; **p<0.01 ***p<0.001; N/A = not applicable; ‡evidence-based smoking cessation aids according to national and international clinical guidelines (excluding ECs) (Batra & Mann, 2015; Fiore et al., 2008; National Institute for Clinical Excellence (NICE), 2013); †German equivalents to education levels listed in table from highest to lowest: high = high school equivalent ("Allgemeine Hochschulreife") and advanced technical college equivalent ("Fachhochschulreife"), middle = secondary school equivalent ("Realschulabschluss"), and low = junior high school equivalent ("Hauptschulabschluss") or no qualification; #OECD equivalent net monthly household income in €; §SUTS(Fidler et al., 2011)= Strength of Urges to Smoke Scale; all analyses are adjusted for the variable "survey wave" (as a design factor).