

Factors associated with verified smoking cessation among low-socioeconomic status smokers

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ABSTRACT (276 words)

Introduction: Smoking rates among low-socioeconomic status adults remain high and little is known about the modifiable factors associated with cessation for this group. This study aimed to assess factors associated with self-reported seven-day point prevalence abstinence at 2-months and 6-months prolonged abstinence biochemically verified.

Method: Secondary analysis of a two-group parallel block randomised open-label smoking cessation trial with allocation concealment. Telephone-based quit support was delivered to 1,047 Australian low-SES smokers motivated to quit and randomised to either a Financial Education and Support Program plus nicotine replacement therapy (NRT) or usual care plus NRT. Data was collected for the *Financial Intervention for Smoking Cessation Among Low-income Smokers* (FISCALs) trial between April 2013 and September 2014. Measurements included: sociodemographic, smoker characteristics, mental health, substance use, and recruitment source were measured at baseline. Outcomes were self-reported seven-day point-prevalence abstinence at 2-months and 6-months prolonged abstinence biochemically verified using urine or saliva cotinine.

Results: Twenty nine percent (95% CI 26.8, 32.3) of the sample reported seven-day point prevalence abstinence and 3% (95% CI 2.4, 4.6) reported verified 6-month prolonged abstinence. Reduced odds of seven-day point prevalence abstinence were associated with female? gender (OR: 0.63; 95% CI: 0.46, 0.85 $p<.01$); nicotine dependence (OR: 0.82; 95% CI: 0.73, 0.92 $p<.01$); and poor mental health (OR: 0.58; 95% CI: 0.42, 0.80 $p<.01$). Odds of verified 6-month prolonged abstinence were negatively associated with prior treatment utilisation (OR: 0.39; 95% CI: 0.18, 0.83 $p<.05$) and poor mental health (OR: 0.20; 95% CI: 0.08, 0.50 $p<.01$).

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Conclusions: In a large sample of low-SES smokers participating in a clinical trial, prior use of treatment and current mental health problems were associated with lower odds of achieving verified 6-month prolonged abstinence.

Keywords: smoking cessation, treatment effect, socioeconomic factors

INTRODUCTION

In many countries, there is an overrepresentation of smoking and its associated harms among low-socioeconomic status (low-SES) populations^{1, 2}. Low-SES groups comprise the long-term unemployed, homeless, mentally ill, ethnic minorities, prisoners, at-risk-youth, and single parents, and can be collectively defined as “disadvantaged”³. Factors contributing to disadvantage that are linked to differences in smoking rates include: housing and economic instability; parental and peer exposure; environments where smoking is normalised; heavier nicotine dependence; financial stress; lack of social support for quitting; and low adherence to treatment⁴⁻⁶.

While effective smoking cessation interventions for the general population include a combination of behavioural and pharmacological treatment⁷ disadvantaged groups do not quit at the same rate using these approaches⁸⁻¹⁰. Furthermore, intervention research aimed at disadvantaged groups largely target specific subgroups¹¹ captured within the broad definition of ‘low-SES or ‘disadvantage’ e.g. social or community service sector or homeless persons. Since disadvantage captures socioeconomically and marginalised groups, targeting a wider construct of welfare dependency may provide access to broader subgroups captured within the definition of low-SES. Although differences may exist between subgroups, similarities may also be present, but neither is well understood among treatment seeking low-SES smokers.

Various factors are known to be associated with smoking cessation at a wider population level. These include nicotine dependence, marital status, educational attainment, social support, and number of smokers in the household, health literacy, recent quit attempts and self-efficacy^{9, 11-15} while having a mental health condition is predictive of relapse¹⁶⁻¹⁹. Since low-SES smokers represent a distinct group from the general population, further research is needed to assess the factors that promote or inhibit smoking abstinence among this group. Understanding these factors will assist in developing targeted cessation programs with the aim to reduce the SES disparity in overall cessation rates.

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Data from a recent smoking cessation randomised controlled trial (RCT)²⁰ provides a unique opportunity to investigate factors associated with abstinence among treatment seeking low-SES smokers. This study uses data from the largest Australian community-based clinical trial evaluation (n=1047) that achieved the highest retention rate recorded for a cessation intervention targeted at a low-SES population group²⁰. The objective of this study was to determine factors associated with self-reported seven-day point prevalence abstinence at 2-months post-randomisation and 6-month prolonged abstinence biochemically verified at 8-months post-randomisation.

METHODS

Design

Secondary analyses were conducted on the *Financial Intervention for Smoking Cessation Among Low-income Smokers* (FISCALs) study. FISCALs was a two-group, single-blind, RCT testing the efficacy of a Financial Education and Support Program (FESP) with free combination nicotine replacement therapy (NRT – nicotine patch [21mg] and oral NRT: gum or lozenge [2mg]) and Quitline support versus a standard care control (NRT and Quitline support). The study protocol²¹ is available elsewhere. The study was approved by the University of New South Wales Human Research Ethics Committee, registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12612000725864) and conducted in accordance with the Consolidated Standards or Reporting Trials (CONSORT) statement (see Supplementary material: Figure 1).

Participants

A total of 1,047 Australian low-SES smokers were recruited between April 2013 and September 2014 via: 1) Quitline services; 2) study posters in Government welfare agency offices (Centrelink); and 3) newspaper advertisements. Interested smokers were eligible to participate if they were: in receipt of a government pension or allowance (proxy for low-SES); aged 18 years or over;

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able to read and speak English; contactable by telephone; smoked at least 10 cigarettes per day; willing to make a quit attempt in the next month; willing to receive telephone-based support; not taking any smoking cessation medications; and able to provide informed consent and comply with study procedures. All eligible participants were mailed an 8-week supply of combination NRT (patches plus gum or lozenge). Participants were randomised to one of two conditions: either usual care (NRT with support from a “Quitline” telephone cessation service) or intervention (FESP via telephone in addition to the NRT and Quitline support). University research staff conducted FESP sessions and control check-in calls, further detail on the FESP and check-in calls is reported elsewhere²¹. Randomisation and all study interviews were conducted by an independent contracted research organisation (CRO) with a ratio of 1:1 using a permuted block approach, with unequal block sizes of 12 and 18. Participants were allocated to treatment condition following completion of the baseline interview with CRO staff blind to allocation. Participants were reimbursed \$40 for completing each study interview and NRT was free and mailed to participants.

Measures

Outcome variables

The primary outcome was biochemically verified prolonged abstinence measured at 8-months follow-up CATI post-randomisation. Six months prolonged abstinence was assessed using Russell Standard (RS6) criteria²² i.e. continuous abstinence for a period of 6-months post-treatment; taking into account a grace period of 8-week NRT treatment. To meet the RS6 criteria, participants must not have smoked more than five cigarettes since the start of the 6-month prolonged abstinence period and produced a negative urine or saliva cotinine test (15ng/ml cotinine cut-point). We also measured use of NRT prior to test completion and those who were not smoking but using NRT were classified as quitters. Secondary outcome was self-reported 7-day point prevalence abstinence at 2-month CATI

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(post-randomisation). Participants who did not complete interviews or cotinine tests were deemed treatment failures and coded as a 'smoker'.

Predictor variables

Variables included were based on prior research²³⁻²⁵ and consensus among the research team. The following variables were included: *sociodemographic* - sex, age, Indigenous status, education, employment status, marital status, children and other smokers in the household, smokers in social network, Socio-Economic Indexes for Areas (SEIFA), and remoteness classification; *smoking-related* - heaviness of smoking index (HSI), smoking induced deprivation (SID), number of cigarettes smoked per day, and self-efficacy to quit; *psychological wellbeing* – mental health condition (diagnosed or treated for in the last 12-months), financial stress; *substance use or addiction* – alcohol consumption, cannabis use in last 12-month, recent (last 12-month) drug treatment, and problem gambling; and *recruitment source* - Quitline, Centrelink, newspaper advertisement, and word of mouth. Refer to supplementary material for details of all included variables.

Statistical analysis

Simple and multiple logistic regression models were used to identify factors associated with biochemically verified prolonged abstinence and self-reported 7-day point prevalence abstinence. Variables with p -values <0.25 in the simple models were included in the multiple logistic regression models to assess their independent association with the respective outcomes. As Quitline was both a treatment and recruitment source, recruitment source was included as a covariate in all models. P -values <0.05 were considered statistically significant. If data is not missing completely at random, the presence of missing data may introduce bias into the results, therefore, missing data for covariates was imputed using multiple imputation²⁶. The total number of missing values was 185 and data was missing primarily due to failure to answer individual questions at baseline. Imputation was conducted using the

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“mi” commands of Stata 14.1. Allowing less than 1% tolerance for power falloff, 40 imputations were used²⁷. Imputation was conducted using chained logit, mlogit and linear regression equations to impute missing data for binary, categorical variables and continuous variables respectively. All variables included as predictors in the final model were included in the imputation. A small number of participants did not identify as male or female (n=2), and they were omitted from the regression models. All analyses were conducted in Stata 14.1²⁸.

RESULTS

Sample characteristics

Participant (n=1047) sociodemographic characteristics are provided in Table 1. Participants had a mean age of 46 years (SD=14.3), 53% were female, and 63% had an educational attainment of high school or less. Over half (54%) of participants were diagnosed or treated for a mental health condition in the last 12-months, smoked an average of 24 (SD=11) cigarettes per day, had an average HSI score of 4 (SD=1.3) and the average length of time since their last quit attempt was 3 (SD=5) years.

Secondary outcome

At 2-months post-randomisation, 29.5% (95% CI 26.8, 32.3) of the sample self-reported 7-day point prevalence abstinence. The factors associated with self-reported 7-day point prevalence abstinence identified in simple models are shown in Supplementary material - Table 5. In the multiple model, mental health, gender and nicotine dependence were independently associated with reduced odds of reporting self-reported 7-day point prevalence abstinence, whereas being recruited from Centrelink increased the odds of abstinence. The ORs for short-term abstinence for the multiple model analysis are shown in Table 3.

Primary outcome

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At 8-month post-randomisation, 3.3% (95% CI 2.4, 4.6) of participants were RS6 verified abstinent. Supplementary material – Table 4 for the factors identified in simple models for RS verified abstinence. In the multiple model mental health condition and prior treatment utilisation were independent factors associated with RS6 verified abstinence and were associated with reduced odds of RS6 verified abstinence. The odds ratios (OR) for RS6 verified abstinence for the multiple model analysis are shown in Table 2.

DISCUSSION

The current study aimed to identify factors associated with self-reported 7-day point prevalence abstinence at 2-months and biochemically verified 6-months prolonged (RS6 verified) abstinence among treatment-seeking low-SES smokers. Those with current mental health conditions had lower odds of achieving self-reported 7-day point prevalence and RS6 verified abstinence and this finding is consistent with prior evidence. In addition to this finding, low-SES smokers who reported past use of smoking cessation treatments had reduced odds of achieving RS6 verified abstinence and this is a novel finding. Other factors associated with self-reported 7-day point prevalence abstinence at 2-months included being female, heavier nicotine dependence and being recruited from Centrelink.

Despite the large sample of treatment-seeking low-SES smokers, overall RS6 verified abstinence was extremely low with only 3% achieving abstinence. Smokers with multiple disadvantage are less likely to successfully quit^{6, 29} and this was reflected in the findings of this study. Over half of the sample reported being diagnosed or treated for a mental health condition within the last 12 months, this was associated with lower success rates overall for both short and RS6 verified abstinence. Despite supply of free combination NRT shown to be effective in smokers with and without mental illness³⁰, low-SES smokers with mental health problems in our study had reduced short and long-term (RS6 verified) quit success. A broad definition of ‘disadvantage’ was used in this study, and this finding may be an indicator of the presence of multiple disadvantage. Consequently, those that are low-SES with a

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comorbid mental health condition may be representative of a more disadvantaged group within the broader low-SES sample. Since persons with a mental health condition are more likely to be smokers³¹ and more nicotine dependent³² than smokers without a mental health condition, strategies that address both mental health and smoking are needed to reduce social inequalities in quitting.

Smokers who had previously used smoking cessation treatment prior to entering the study, such as NRT or Quitline support, had a lower likelihood of achieving RS6 verified abstinence. This may indicate that those who had previously used Quitline or pharmacotherapies had tried and failed using these approaches prior to study enrolment and were therefore less likely to adhere to treatment during the trial. Alternatively, this is a potential self-selection bias due to eligibility criteria. Exploratory findings in a previous study assessing treatment efficacy and smoking abstinence³⁰ in simple models also found prior treatment utilisation was associated with a lower likelihood of treatment success. It is not clear why prior treatment is associated with reduced quit success and how this affects number of quit attempts. However, our study findings suggest prior treatment may not necessarily reduce quit attempts but may reduce quit success and further research investigating this relationship is warranted.

Contrary to previous findings^{15,30} nicotine dependence was not predictive of RS6 verified abstinence in this sample, however it was associated with lower likelihood of 7-day point prevalence quit success. Higher levels of nicotine dependence are associated with reduced quit success³⁰ and while this is supported in our study for 7-day point prevalence abstinence it was not independently associated with RS6 verified abstinence. This low-SES sample of smokers was heavily nicotine dependent due to eligibility requirements (i.e. eligibility included smoking at a minimum 10 cigarettes per day) and further examination of treatment adherence to trial medication may provide an alternative measure of nicotine dependence.

Consistent with prior research, female smokers in this study were less likely than men to report short-term abstinence³³. Gender differences have been observed in other clinical trials due to

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differences between treatment seekers compared to non-treatment seekers³⁴. Whereas in a study analysing adult smokers from the International Tobacco Control Four Country Survey (ITC-4), gender differences were observed with women not using pharmacotherapies less likely to quit³⁵. Since all participants in our study were treatment-seeking and willing to make a quit attempt using NRT, the gender differences in short-term abstinence may be related to medication use but further research investigating treatment adherence by gender is required.

Recruitment source was predictive of self-reported 7-day point prevalence abstinence with participants recruited from Centrelink positively associated with short-term abstinence. Centrelink is a Government agency within the Department of Human Services and provides income support for low-income households. Government agencies such as Centrelink have the potential to access disadvantaged and hard-to-reach groups that do not otherwise present to other healthcare settings. Centrelink has been an effective setting for opportunistic health interventions³⁶ and our findings further support Centrelink as an effective strategy for health behaviour interventions. Since Centrelink is engaged with a broad group of low-SES persons, participants recruited via Centrelink may be distinct from those recruited via Quitline, newspaper advertisements, and word of mouth and therefore research investigating these potential differences is required to better target disadvantaged subgroups.

Improving cessation rates for low-SES smokers is a public health priority. Since past use of treatment was associated with reduced odds of RS6 verified abstinence, implementing novel approaches that low-SES smokers are receptive to requires further attention. A recent study investigating financial incentives and contingency management for smoking cessation demonstrated efficacy³⁷ and future research may wish to add free pharmacotherapies to contingency management as a way to overcome barriers to treatment access. Another approach low-SES smokers are receptive to is mHealth³⁸ but limited studies using technology-based interventions for smoking cessation among low-SES populations have been conducted³⁹. Stop smoking services may increase treatment utilisation

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among low-SES smokers by adopting mHealth strategies but more needs to be done to address the impact past treatment use has on quit success.

While increasing treatment utilisation may result in more quit attempts, it does not necessarily increase quit rates. Treatment engagement may be a better construct to assess the mechanism driving the negative effects of past use of treatment on quit success. Further research exploring treatment use, engagement, and adherence on number of quit attempts, quit success, and relapse prevention is needed to overcome smoking disparities.

Limitations

Since our study did not include smokers from high-SES backgrounds, we cannot directly compare factors between SES and abstinence outcomes. A further limitation of this study is the sample was heavily nicotine dependent, motivated to quit using NRT, and actively seeking quit support and thus are not representative of the general population of disadvantaged smokers or those that may prefer unassisted quitting methods. Overall, 7-day point prevalence abstinence was extremely low and the inferences made regarding factors associated with verified prolonged abstinence should be interpreted with caution. Finally, as low-SES was defined by being in receipt of a government income benefit e.g. pension, a representative sample of low-SES smokers may not have been captured.

Conclusions

The findings of this study indicate that low-SES smokers struggle to quit despite being motivated to quit and being provided with free NRT and Quitline support during a quit attempt. Mental health was independently associated with lower success in 7-day point prevalence and RS6 verified abstinence. Importantly, past use of treatment was independently associated with lower likelihood of RS6 verified quit success. The findings raise important issues for future research, and for health and service providers. While smokers with a mental health condition are motivated to try and willing to use NRT, they are less likely to succeed. This suggests additional support from frontline health

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professionals are needed with refinements to smoking cessation care delivery potentially warranted for this group. Mental health workers should recommend and continue to provide quit support, as well as promote the use of alternative treatment modalities including online support and mHealth.

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Table 1. Sample characteristics (n=1047)

Sex	Female	53%
	Male	47%
	Other	0.20%
Age	Mean (SD)	46 (14.3)
Indigenous status	No	93%
	Yes	7%
Level of education	High school or lower	63%
	More than high school	37%
Employment status	Employed	15%
	Unemployed - in workforce	26%
	Unemployed - not in workforce	59%
Marital status	Married/partnered/de facto	31%
	Separated/divorced/widowed	35%
	Single/never married	34%
Proportion of smokers in social network	None	14%
	A few	29%
	Half	17%
	Most	25%
	All	16%
Number of cigarettes smoked per day	Mean (SD)	24 (11)
Nicotine dependence (HSI)	Mean (SD)	4 (1)
Last quit attempt (years)	Mean (SD)	3 (5)
Diagnosed or treated for a mental health condition	No	46%
	Yes	54%
Heavy alcohol consumption	No	48%
	Yes	52%
Cannabis use	No	82%
	Yes	18%
Received drug treatment in last 12 months	No	87%
	Yes	13%
Problem gambling	No	85%
	Yes	15%
SEIFA	Bottom half of SEIFA	37%
	Top half of SEIFA	63%
Recruitment source	Quitline	32%
	Centrelink	24%
	Newspaper advertisement	31%
	Word of mouth	13%

Low-SES cessation predictors - tables and figures

Table 2. Factors associated with RS biochemically verified prolonged abstinence

		OR (95% CI)	<i>p</i>-value
Socio-demographics			
Sex	Male	1.00	
	Female	0.54 (0.25, 1.16)	<i>p</i> =0.113
Age		1.01 (0.98, 1.04)	<i>p</i> =0.608
Level of education	High school or lower	1.00	
	More than high school	0.51 (0.22, 1.17)	<i>p</i> =0.112
Employment status	Employed	1.00	
	Unemployed - in workforce	3.61 (0.41, 31.62)	<i>p</i> =0.246
	Unemployed - not in workforce	5.42 (0.68, 42.97)	<i>p</i> =0.110
Proportion of smokers in social network		0.87 (0.64, 1.18)	<i>p</i> =0.367
SEIFA	Bottom half of SEIFA	1.00	
	Top half of SEIFA	1.75 (0.75, 4.09)	<i>p</i> =0.193
Smoking-related			
Heaviness of smoking index		0.75 (0.57, 1.00)	<i>p</i> =0.048
Prior treatment utilisation	Never used	1.00	
	Have used	0.39 (0.18, 0.83)	<i>p</i> =0.015
Last tried to quit (prior to study enrolment)		1.00 (1.00, 1.00)	<i>p</i> =0.040
Psychological constructs			
Mental health condition	No	1.00	
	Yes	0.20 (0.08, 0.50)	<i>p</i> =0.001
Financial stress		1.10 (0.86, 1.40)	<i>p</i> =0.458
Substance use or addiction			
AUDIT-C Score		0.73 (0.34, 1.58)	<i>p</i> =0.427
Cannabis use (last X month)	No	1.00	
	Yes	0.21 (0.03, 1.55)	<i>p</i> =0.124
Recruitment source			
	Quitline	1.00	
	Centrelink	0.85 (0.30, 2.38)	<i>p</i> =0.754
	Newspaper ads	0.69 (0.29, 1.66)	<i>p</i> =0.405
	Word of mouth/other	0.28 (0.06, 1.35)	<i>p</i> =0.113

Low-SES cessation predictors - tables and figures

Table 3. Factors associated with self-reported short-term abstinence

		OR (95% CI)	<i>p</i>-value
Socio-demographics			
Sex	Male	1.00	
	Female	0.63 (0.46, 0.85)	<i>p</i> =0.003
	Other		
Age		1.00 (0.99, 1.01)	<i>p</i> =0.759
One or more smokers in the household		0.83 (0.60, 1.14)	<i>p</i> =0.248
Proportion of smokers in social network		0.94 (0.84, 1.05)	<i>p</i> =0.269
SEIFA	Bottom half of SEIFA	1.00	
	Top half of SEIFA	1.20 (0.89, 1.63)	<i>p</i> =0.236
Smoking related			
Heaviness of smoking index		0.82 (0.73, 0.92)	<i>p</i> =0.001
Smoking induced deprivation		1.10 (0.78, 1.56)	<i>p</i> =0.575
Last tried to quit		1.00 (1.00, 1.00)	<i>p</i> =0.187
Psychological			
Mental health condition	No	1.00	
	Yes	0.58 (0.42, 0.80)	<i>p</i> =0.001
Financial stress		0.97 (0.87, 1.07)	<i>p</i> =0.548
Substance use or addiction			
AUDIT-C Score			
Use of cannabis	No	1.00	
	Yes	0.66 (0.43, 1.00)	<i>p</i> =0.051
Recent drug treatment	No	1.00	
	Yes	0.64 (0.39, 1.06)	<i>p</i> =0.081
Problem gambling	No	1.00	
	Yes	0.69 (0.44, 1.07)	<i>p</i> =0.099
Recruitment source			
	Quitline	1.00	
	Centrelink	1.60 (1.08, 2.37)	<i>p</i> =0.020
	Newspaper ads	0.90 (0.62, 1.30)	<i>p</i> =0.579
	Word of mouth/other	1.04 (0.65, 1.67)	<i>p</i> =0.858