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Short Report

Impact of tobacco outlet density and proximity on smoking cessation: A longitudinal observational study in two English cities

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ABSTRACT

A previous study conducted in the USA reported an association between residential proximity to a tobacco outlet and reduced likelihood of a quit attempt enduring beyond six months. We replicated this study in an English urban setting using data on 611 smokers motivated to quit, of whom 66 were biochemically validated as being quit at six months. Sustained quitting at six months was unrelated to residential proximity of a tobacco outlet. Future studies would be improved by the use of validated mappings of retail outlets, mapped in relation to multiple activity spaces, not just residence.

1. Background

Smoking is the main cause of preventable premature death, accounting for an estimated 6 million deaths worldwide each year (Tobacco Fact Sheet). It is also the single largest contributor to health inequalities in high income countries, explaining an estimated 20 to 50% of the variation in difference in life expectancy between the least and the most deprived groups (Marmot and Wilkinson, 2006). Rates of smoking have declined markedly over the past 40 years in most high-income countries but this decline has been less marked in those who are most socially and materially deprived. There is increasing interest in the contribution of neighbourhood characteristics to smoking rates, a focus with the potential for intervention. A similar focus is evident for alcohol control policies in which reduction of retail outlet densities have reduced alcohol-related harms (Campbell et al., 2009; Reynolds et al., 1997). By contrast, interventions to change neighbourhood environments to reduce smoking remain rare (Shareck and Frohlich, 2013). Our focus in this paper is upon one aspect of environments that hinders quitting and sustains smoking, namely the presence of tobacco retail outlets.

Young people living in neighbourhoods with a high density of tobacco retailers are more likely to have smoked in the previous month than those living in areas with lower density outlets, leading to suggestions that initiation of smoking in children and young adults may be reduced by limiting retail tobacco outlet density (Novak et al., 2006; Ogneva-Himmelberger et al., 2010; Lipperman-Kreda et al., 2012). Reducing the number of tobacco retail outlets may also increase the success of quit attempts. The majority of smokers in the UK and the USA want to stop, but while many attempt to quit each year, fewer than 7% will succeed even with pharmacotherapy (Moore et al., 2009). In a study conducted in the USA, quitters residing less than 250 m from the closest tobacco outlet were less likely than those living further away to sustain their quit attempt beyond six months (Reitzel et al., 2011). The aim of the current study is to replicate this study in an English urban setting using a well characterised data set of a cohort of smokers attempting to quit.

2. Methods

We used data from a cohort of 633 smokers who participated in a randomised controlled trial (RCT) in primary care assessing the impact of tailoring nicotine replacement therapy (NRT) by

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genotype (Trial registration ISRCTN14352545) (Marteau et al., 2010; 2012) (Appendix 1). Participants who wanted to quit smoking were recruited from 29 general practices in two English cities, Birmingham and Bristol.

2.1. Geocoding (digital coding of location using geographical information system software)

Residential postcodes were linked to the Easting and Northing coordinates from the "National Administrative Codes Service—Technology Reference Data Update Distribution (NACS-TRUD)" postcode lookup table (TRUD Service). We used ArcEditor software version 10.0 (ESRI, Redlands CA) to geocode them. We retrieved and analysed data on tobacco outlets using UK Ordnance Survey InterestMap dataset of 2009. Since there is no licence required to sell tobacco in England, newsagents, tobacconists, convenience stores, supermarkets, off-licences, shopping centres, nightclubs, pubs, bars and inns were assumed to be tobacco outlets.

To measure the proximity of each participant's home to the closest tobacco outlet, we used the Closest Facility tool in ArcGIS Network Analyst, which calculates the shortest travel distance in metres along the road network from the home to the closest outlet. We classified the proximity into: under 250 m, and from 250 m to under 500 m.

To measure density of tobacco retail outlets, we mapped four road network buffers around the residence of each participant using the New Service Area tool in the ArcGIS Network Analyst. This was based on travel distances of 250, 500, 1000 and 3000 m. Next, the geocoded tobacco outlets were overlaid with the road network buffers, and the numbers of outlets within each were identified using the Spatial Join tool. Outlet density for each buffer was then calculated by dividing the number of outlets by the area of each buffer.

3. Analysis

Following the analysis used by Reitzel et al., we modelled continuous abstinence by continuation ratio (CR) logit models using the STATA module OCRATIO and examined the influence of tobacco outlets on abstinence six months after quitting. Abstinence was used in the model as an ordered outcome. We had three levels of abstinence: 0 "not abstinent at 4 weeks", 1 "abstinent at 4 weeks but not at 6 months" and 2 "abstinent at 4 weeks and at 6 months". First, we ran respective CR logit models to assess the associations between tobacco outlet density within (1) 250 m, (2) 500 m, (3) 1 km and (4) 3 km of the participant's residence, and continuous abstinence at six months. Second, we ran respective CR logit models to assess the associations between tobacco outlet proximity within: (1) 250 m, and (2) 500 m of the participant's residence, and continuous abstinence at six months. To minimize confounding variables we progressively adjusted analyses for trial arm, city of residence, age, gender, education, ethnicity, and nicotine dependence (Appendix 2).

4. Results

We included 611 participants (417 from Birmingham and 194 individuals from Bristol) from the original RCT cohort, 22 being excluded because of missing data. At six months, 66 were recorded as quit, following biochemical validation. Participant characteristics are shown in Table 1. A summary of the density and distance to tobacco outlets in the two cities is presented in Table 2. The density of tobacco outlets and participants in each city are shown in Appendix 3.

Table 1
Participant demographic and smoking characteristics (N=611).

Characteristics	
Age (years), mean (95% CI[a], SE[b])	45.5 (41.95 to 48.99, 1.79)
Race/ethnicity, % (n)	
White	91 % (558)
Non-white	9 % (53)
Gender, % male (n)	46 %(282)
Education, % (n)	
No qualifications	28 %(173)
GCSE or GCE A-level	38 %(233)
Higher education	28 %(174)
Other	5 %(31)
Own or have use of a car % (n)	74 %(450)
abstinent at 4 weeks % (n)	47 %(287)
abstinent at 6 months (biochem validated) % (n)	11 %(66)
Pre-quit smoking rate[c]: median (IQR[d])	20 (16–26)
FTND[e] score: median (IQR), mean (95% CI, SE)	6 (4–7), 5.56 (5.39 to 5.73, 0.09)

[a] CI: Confidence interval.
[b] SE: Standard error.
[c] Pre-quit smoking rate is expressed in number of cigarettes per day.
[d] IQR: Interquartile range.
[e] FTND: Fagerström Test for Nicotine Dependence.

4.1. Tobacco outlet proximity

Smoking abstinence at six months was not predicted by the proximity of residences to the closest tobacco outlet in any analyses, adjusted for trial arm, city of residence, age, gender, education and ethnicity, or additional adjustment with pre-quit smoking rate or nicotine dependence score (Table 3).

4.2. Tobacco outlet density

Smoking abstinence at six months was not predicted by the density of tobacco outlets around participants' residences in any analyses, adjusted for trial arm, city of residence, age, gender, education and ethnicity (Table 3). Progressive adjustment for pre-quit smoking rate or nicotine dependence did not affect this result.

4.3. Sensitivity analysis

Sensitivity analyses were conducted using questionnaire-based abstinence records at weeks 1, 2, and 3, and biochemically validated abstinence at weeks 4 and at 6 months. Neither the proximity of residence to a tobacco outlet nor the density of tobacco outlets predicted abstinence in these analyses.

5. Discussion

Although there is some evidence that initiation of smoking is associated with ease of access to retail tobacco outlets (Novak et al., 2006; Ogneva-Himmelberger et al., 2010; Lipperman-Kreda et al., 2012), little is known about the relationship between ease of access and quitting. One study reported that distance from home to the nearest tobacco outlet but not the density of the outlets reduced the chances of a quit attempt extending beyond six months (Reitzel et al., 2011). Our analyses in two English cities failed to replicate this finding. There are several possible explanations for this including differences between the two studies in participants, places of residence and measures.

Regarding participants, there is a remarkable similarity in the ages, gender and pre-quit smoking rates between those in the