Has the introduction of point-of-sale legislation led to a reduction in exposure to tobacco retailing? A longitudinal study

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Summary

Greater availability of tobacco retailers in neighbourhoods has been linked with increased odds of adolescent smoking. We examined change in neighbourhood tobacco retailer density surrounding the introduction of the Point Of Sale legislation (POS: 2013 and 2015) using data from the Scottish Tobacco Retailers Register (STRR) (2012-2017). We then linked STRR data to surveys of secondary school pupils and marketing audits of retailers to further understand variability in exposure by activity space and visibility of tobacco products. Growing socioeconomic disparity in the availability and visibility of tobacco in urban communities, undermine national declines in tobacco retailing following the introduction of the POS legislation.

KEYWORDS: Tobacco outlets, deprivation, adolescent health, activity space, longitudinal

1. Background

Greater availability, reduced price, and higher visibility are all known to encourage initiation, particularly amongst children (Shortt, Tisch et al. 2016), and undermine cessation efforts (Pearce, Rind et al. 2016). In Scotland, point of sale tobacco displays by tobacco retailers were prohibited in large supermarkets in April 2013 and smaller retailers from April 2015. The legislation required the covering of all tobacco and smoking-related products.

The first stage of the analyses considers the change in retail provision at the national level. This is followed by a more detailed consideration in four communities in Scotland that differ in terms of their deprivation and urban/rural profile. Our objectives are to: (i) examine whether there has been a change in geographical availability at national-level between 2012 and 2017; (ii) consider whether these changes vary by geography (local authorities) and area level measures (deprivation and urban/rural group); and (iii) for a sample of areas consider change in exposure to tobacco products at a school catchment level and for our sample of individuals over this period.

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2. Methods

DISPLAY is a multimodal, longitudinal study assessing the effect of the tobacco point of sale display ban in Scotland (Haw, Amos et al. 2014).

2.1. DISPLAY Mapping Data

Addresses of premises registered on the Scottish Tobacco Retailers Register were obtained for 2012, 2013, 2014, 2015, 2016 and 2017 (www.tobaccoregisterscotland.org). For each year from 2013 onwards fieldwork was undertaken in four confidential school catchment areas. Briefly, schools were selected to represent large urban – medium/low deprivation (C6), large urban – high deprivation (C3), small town – medium/low deprivation (C7) and small town – high deprivation (C2) communities.

2.2. DISPLAY Audit Data

The DISPLAY visibility tool was developed to measure tobacco display visibility before and after the POS legislation (Eadie 2018). Briefly, product and storage visibility measures were collected for verified outlets within the school catchment each year. We generated four visibility variables: external storage visibility, internal storage visibility, total storage visibility, total product visibility.

2.3. DISPLAY School Survey data

Participants who supplied their postcode unit (6 characters) of their residence for each wave they took part in, were eligible for the current analysis (n=1,710). Additional information was gathered via questionnaire on their mode of transport to school and the duration of their commute. Individual level data on material affluence, as a proxy for socioeconomic status, was derived from questions that make up the family affluence scale (FAS) (Boyce, Torsheim et al. 2006). We used the Google Maps Directions API to determine the optimal route to school for each participant, based on their starting location (residential postcode), end location (school) and mode of transport.

2.4. Linking Mapping, Audit and School Survey Data

We used the retailer locations to create a Kernel Density Estimation (KDE) surface. The study area is divided into 50 m by 50 m^2 grid cells, and the number and proximity of outlets within 800 m radius (a 10 minute walk for an average person) from the grid cell is calculated. A density measure is calculated (i.e. number of outlets divided by area) with the weight of each outlet determined by the quartic kernel function (Silverman 1986).

We estimated a KDE surface using outlets from the Tobacco Register for each year (2012-2017). We undertook a Geographic Information System (GIS) overlay analysis to estimate Scottish Datazone

(2011) availability (n=6,976). Area level data included Scottish Index of Multiple Deprivation (SIMD) income domain rank, 6-fold urban rural classification and population estimates. The mean of the KDE surface grid cells within each 2011 Datazone polygon was calculated. We estimated a KDE surface for the residential extent of the participants for each school for each year (2013-2017). We extracted KDE estimates for residence points and route to school polylines. We also derived residence and route to school estimates weighted by the four outlet visibility measures.

2.5 Data analysis

To examine the geographic variability between 2012 and 2017 we calculated the number of outlets per 10,000 people at the national and local authority level (n=32). The mean density and 95% CI were calculated and then stratified by SIMD income domain quintile and 6-fold urban rural classification group to examine how change in availability varied by area level measures. To group local authorities that displayed similar trajectories we created a linear latent class mixed model (LCMM) using the 'lcmm' package in R (ver 3.3.2). We excluded Eilean Siar, the Shetland Islands and Orkney due to very low tobacco retailer densities. To investigate changing geographic distribution within selected local authorities, we calculated local moran statistics to identify positive local spatial autocorrelation for each year (high-high and low-low clusters of datazones).

A detailed descriptive analysis of the four school catchment areas (2013-2017) was undertaken. We used both unweighted and weighted (by audit visibility measures) estimates for both neighbourhood (N) and route to school activity space (AS). The mean density and 95% CI were calculated and presented by school and results described in relation to school catchment deprivation and urban/rural status. Density was then stratified by FAS tertile group to examine how change in availability varied by socioeconomic factors.

3. Results

3.1. National level change in tobacco retailers

Table 1 shows the change in tobacco retailers in Scotland from 2012 to 2017. The number of tobacco retailers per 10,000 people increased slightly from 2012 (19.12) to 2013 (19.16) before going through a significant drop between 2013 and 2014 (16.85). The lowest number was recorded in 2015 (16.47), and has increased steadily from 16.73 in 2016 to 16.87 in 2017. At the local authority level there was significant variation in the number of retailers per 10,000 people.

Table 1 The Number of Tobacco Retailers per 10,000 people in Scottish Local Authorities (2012-2017)

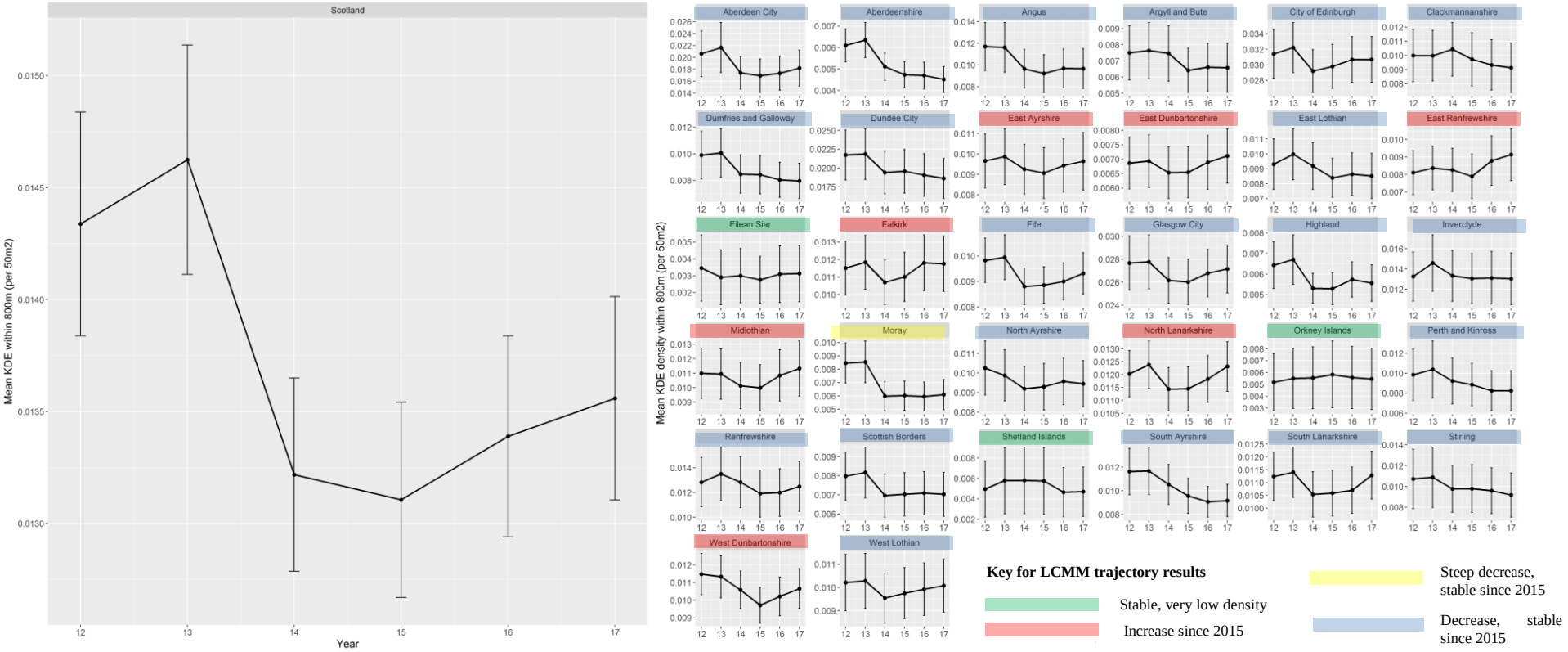
Local Authority	2012	2013	2014	2015	2016	2017
Aberdeen City	18.01	18.36	14.46	13.81	14.40	15.23
Aberdeenshire	16.63	16.37	12.90	11.83	11.37	11.10
Angus	18.50	18.57	14.82	14.11	14.93	14.93
Argyll and Bute	30.95	30.89	30.01	26.12	27.55	26.97
City of Edinburgh	20.43	20.45	17.97	18.16	18.28	18.16
Clackmannanshire	16.38	16.58	17.39	16.36	15.77	15.58
Dumfries and Galloway	28.57	28.35	23.01	22.65	21.94	21.74
Dundee City	20.77	21.07	18.29	18.15	17.87	17.33
East Ayrshire	18.74	18.95	16.87	16.63	17.35	17.68
East Dunbartonshire	10.29	10.49	9.75	9.63	10.04	10.32
East Lothian	16.16	16.47	14.59	13.68	13.83	13.45
East Renfrewshire	11.09	11.03	10.60	10.11	11.09	11.41
Eilean Siar	3.83	3.75	4.00	3.72	4.14	4.20
Falkirk	7.59	7.63	6.86	7.04	7.40	7.43
Fife	10.86	10.83	9.27	9.22	9.32	9.61
Glasgow City	52.08	52.12	48.87	48.01	49.41	50.13
Highland	74.61	74.18	58.71	59.12	64.17	63.04
Inverclyde	17.33	17.35	15.19	14.65	14.45	14.33
Midlothian	14.74	14.52	12.77	12.56	13.64	14.05
Moray	73.66	73.36	50.28	50.98	51.67	52.04
North Ayrshire	16.94	16.80	15.61	15.87	16.63	16.41
North Lanarkshire	16.84	17.08	15.71	15.76	16.29	16.85
Orkney Islands	30.19	30.15	31.05	31.84	30.66	30.21
Perth and Kinross	20.31	20.10	17.46	16.74	15.46	15.40
Renfrewshire	16.75	17.37	16.36	14.95	15.29	15.86
Scottish Borders	17.85	17.83	14.82	15.00	15.19	14.93
Shetland Islands	38.35	38.36	37.90	36.64	34.91	34.91
South Ayrshire	21.87	22.15	19.46	17.88	16.63	16.63
South Lanarkshire	15.91	15.95	14.59	14.58	14.73	15.42
Stirling	21.65	21.70	20.00	18.96	18.99	18.24
West Dunbartonshire	18.26	18.26	16.72	15.18	16.02	16.92
West Lothian	16.48	16.46	15.07	15.18	15.10	15.38
Scotland	19.12	19.16	16.85	16.47	16.73	16.87

3.2. Local authority level change in tobacco retailers

Tobacco retailer density in Scotland and the 32 Scottish local authorities is presented in Figure 1. Three

groups were selected using the model fit statistics from the LCMM model. The first group consisted of 22 local authorities that had decreased moderately in density and stabilised at these lower levels. However an inflection after 2015 was identified at the Scottish level, was shown to be caused by 6 local authorities that saw increases in retailer density after 2015. The final group consisted of Moray due to the very steep fall in density between 2013 and 2014.

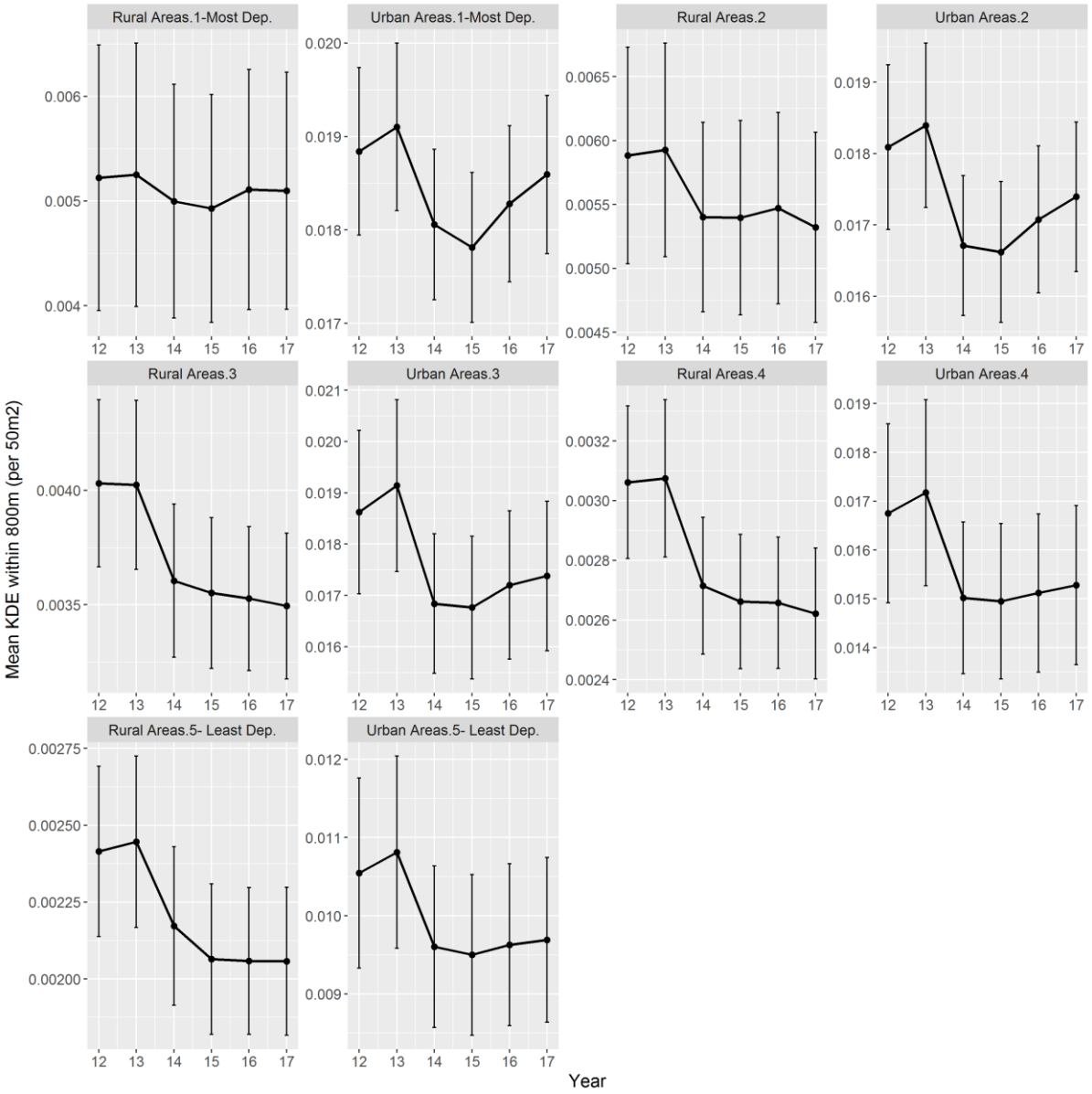
Figure 1 Tobacco retailer density estimates for Scottish datazones, by local authority (2012-2017)



3.3. National level change in tobacco retailer density by neighbourhood deprivation and urban/rural status

To illustrate how changes in tobacco retailer density were influenced by deprivation and urban/rural group we have displayed the results stratified by both area variables (Figure 2). This highlights that the post 2015 inflection was greatest in the most urban and deprived communities in Scotland.

Figure 2 Tobacco Retailer Density Estimates for Scottish datazones, by SIMD income deprivation quintile and urban/rural status (2012-2017))

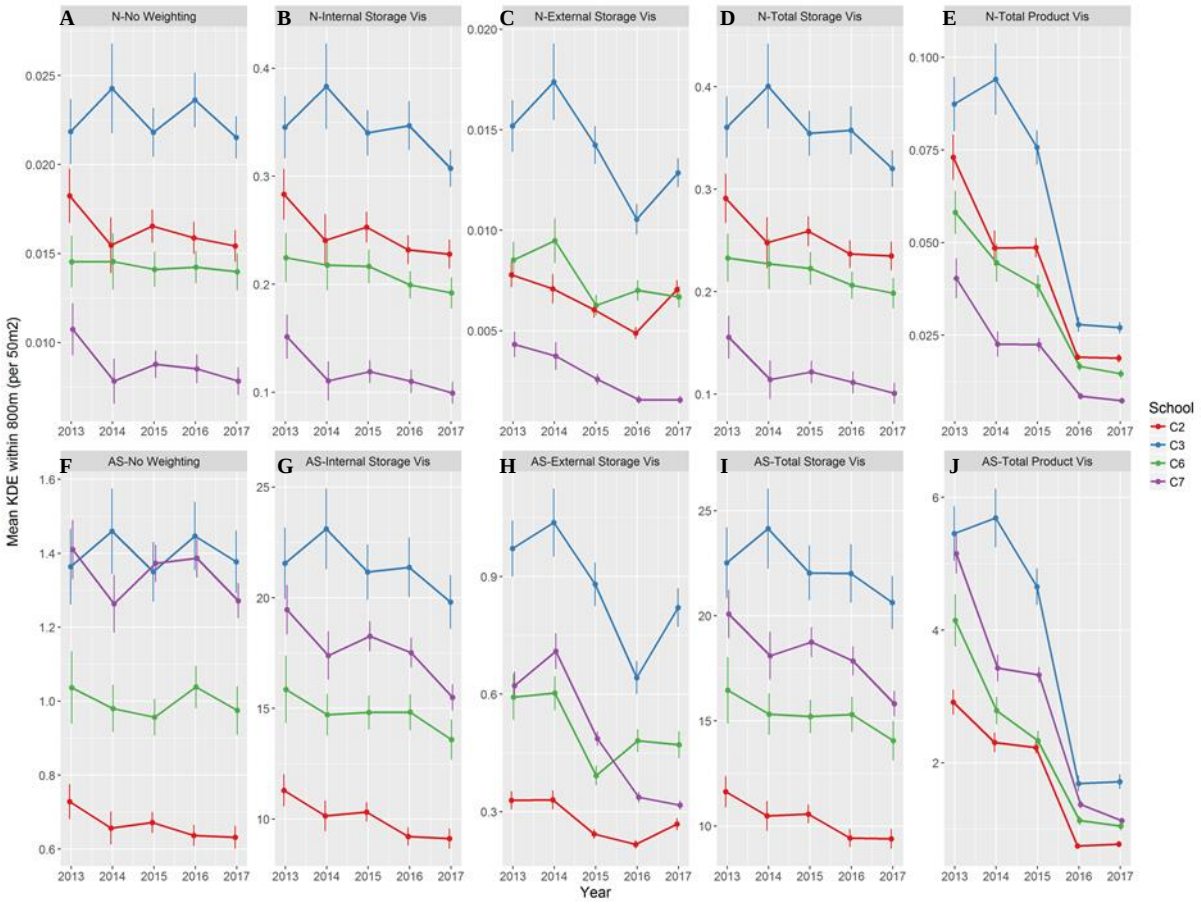


3.4. School catchment level change in tobacco retailer density

There were only minor changes (≤ 2 outlets) from 2013-2017 in the number of tobacco retailers within the four school catchments, predominantly openings and closures of small retailers (under 280 m^2). The

two rural catchments (C2 and C7) had less yearly changes compared to the urban catchments (C3 and C6). Declines in the unweighted neighbourhood exposure to tobacco density were more consistent in the rural catchments (C2 and C7) than in the urban catchments (C3 and C6) (Figure 3A). Neighbourhood exposure to tobacco density weighted by the internal storage measure declined in all the catchments (Figure 3B). Neighbourhood exposure to tobacco density weighted by the external storage measure declined in all of the catchments but there was a spike in C2 and C3 after 2016 (Figure 3C). The most consistent declines in neighbourhood exposure were shown in the tobacco density weighted by total product visibility (Figure 3E). Activity space measures were similar to neighbourhood estimates but with greater variability. There was a substantial difference in neighbourhood and activity space estimates for C2 and C7. These two catchments switch rank so that C7 was 2nd highest in terms of participant tobacco retailer exposure for activity space estimates but 4th highest when using the participant's neighbourhood only (Figure 3F-I).

Figure 3 Tobacco Retailer Density Estimates for participant's neighbourhood and activity space, for the Four DISPLAY communities, by visibility weighting (2013-2017)

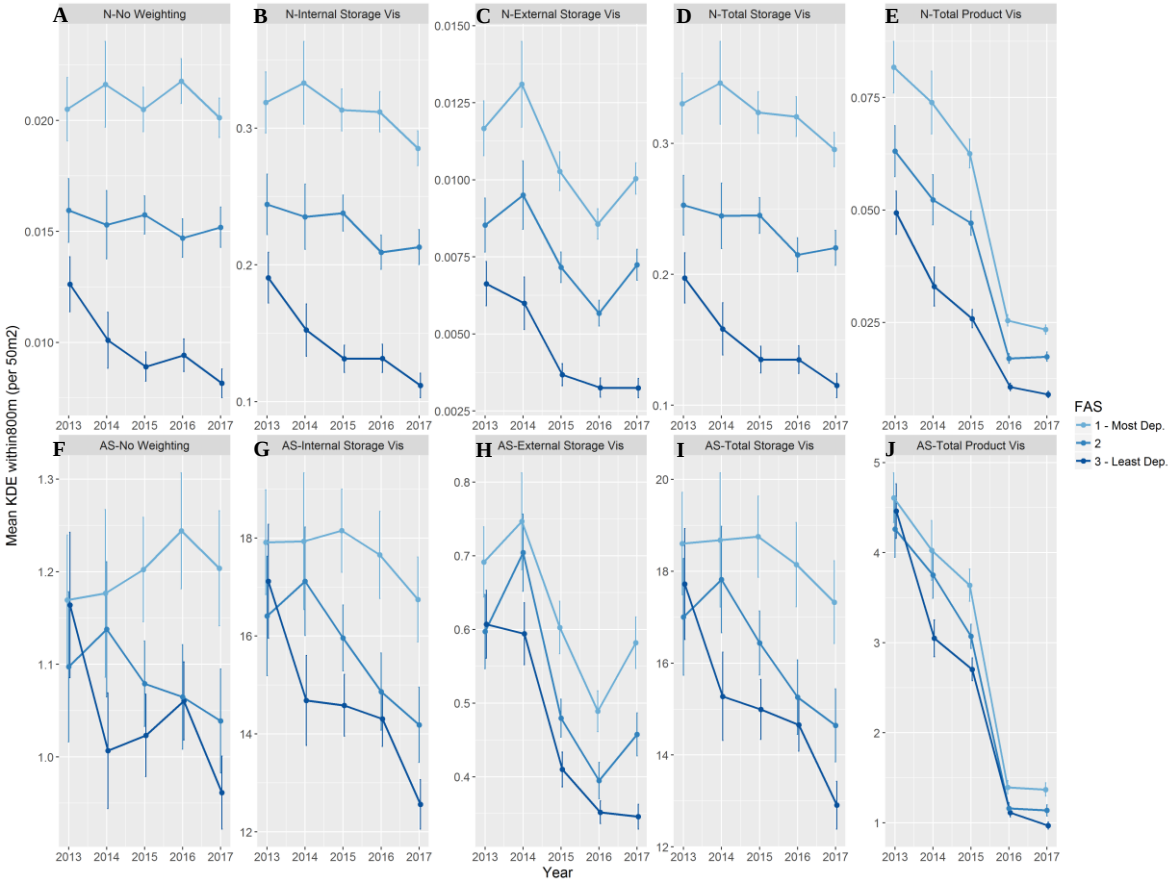


3.5. School catchment level change in tobacco retailer density by individual socioeconomic status

We observed differences in tobacco density change by FAS tertile. The difference between the most

deprived and least deprived FAS tertiles increased over the time period (Figure 4A-D). This was slightly more pronounced in the activity space measures (Figure 4F-I). We observed that this widening was most evident in the C3 catchment especially when considering activity space exposure.

Figure 4 Tobacco Retailer Density Estimates for participant's neighbourhood and activity space, for the Four DISPLAY communities, by visibility weighting (2013-2017)



4. Discussion

Retail provision of tobacco has declined following the introduction of the POS legislation. However, this has not been equally distributed among the 32 Scottish local authorities, with approximately a fifth exhibiting year-on-year increased provision since 2015. Urban and deprived neighbourhoods have also shown an increasing trend in provision since 2015. Although product visibility of tobacco product has reduced in the four DISPLAY communities due to compliance with the POS display legislation (Eadie, Stead et al. 2016), there is growing socioeconomic disparity in the availability of tobacco retailers and the visibility of tobacco storage for Scottish adolescents. Future work should build on recent computational modelling of a variety of policy options to reduce tobacco retailer density (Luke, Hammond et al. 2017), and importantly, determine the effectiveness for reducing socioeconomic disparity in exposure at the national level.

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7. Biography

Dr. Mark Cherrie – Postdoctoral Researcher (Environment and Health)

Mark is an early career researcher whose research is focused on human interactions with the built and natural environment and how this affects behaviour and health both on the short and long term (e.g. adolescent smoking behaviour, adult asthma hospitalisations, lifetime cognitive ageing).

Prof. Jamie Pearce - Professor of Health Geography

Jamie's work considers social, political and environmental processes affecting social and spatial inequalities in health. His work has focused on the role of place in understanding health outcomes and health-related behaviours, including smoking status, physical activity and obesity.

Dr. Catherine Best - Statistician/ Health Researcher

Catherine’s research interests are mainly methodological, focusing on data management and statistical

methods in population and public health research. She has also published a number of systematic literature reviews.

Prof. Sally Haw - Professor of Public & Population Health

Sally's work focuses on the evaluation of public health policy (in particular tobacco control) and the development and the evaluation of complex interventions. She is also interested in the development and application of ecological models of public health to tackle problems associated with vulnerable young adults and homelessness and child neglect.

Dr. Farhanna Haseen - Research Fellow

Since joining the Child and Adolescent Research Unit (CAHRU) at the University of St Andrews in July 2014, Farhanna has been involved in a multi-university National Institute of Health Research funded study called DISPLAY (Determining the Impact of Smoking Point-of-sale Legislation among Youth).

Dorothy Currie - Senior Statistician / Deputy HBSC International Coordinator

Dorothy has been involved in a multi-university National Institute of Health Research funded study called DISPLAY (Determining the Impact of Smoking Point-of-sale Legislation among Youth).

Dr. Godze Ozakinci - Senior Lecturer

Godze conducts applied research to help inform psychological support programmes for behaviour change and emotional support. She works with multidisciplinary groups to directly inform on public health programmes and clinical practice.

Dr. Michael Wilson - Statistician/Health Researcher

Michael has been involved in a multi-university National Institute of Health Research funded study called DISPLAY (Determining the Impact of Smoking Point-of-sale Legislation among Youth).