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**Getting shops to voluntarily stop selling cheap, strong beers and ciders: a time-series analysis evaluating impacts on alcohol availability and purchasing**

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4 analysis evaluating impacts on alcohol availability and purchasing.  
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13 no role in the design of the study, the interpretation of the findings, the writing of the paper or  
14 the decision to submit.  
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## Abstract

### Background

'Reducing the Strength' (RtS) is a public health initiative encouraging retailers to voluntarily stop selling cheap, strong beers/ciders ( $\geq 6.5\%$  alcohol by volume). This study evaluates the impact of RtS initiatives on alcohol availability and purchasing in three English counties with a combined population of 3.62 million people.

### Methods

We used a multiple baseline time-series design to examine retail data over 29 months from a supermarket chain that experienced a two-wave, area-based roll out of RtS: initially 54 stores (W1), then another 77 stores (W2). We measured impacts on units of alcohol sold (primary outcome: beers/ciders; secondary outcome: all alcoholic products), economic impacts on alcohol sales and substitution effects.

### Results

We observed a non-significant W1 increase (+3.7%, 95% CI = -11.2, 21.0) and W2 decrease (-6.8%, 95% CI = -20.5, 9.4) in the primary outcome. We observed a significant W2 decrease in units sold across all alcohol products (-10.5%, 95% CI = -19.2, -0.9). The direction of effect between waves was inconsistent for all outcomes, including alcohol sales, with no evidence of substitution effects.

### Conclusions

In the UK, voluntary RtS initiatives appear to have little or no impact on reducing alcohol availability and purchase from the broader population of supermarket customers.

## 1 Introduction

2 Modifying the availability of commercial products (e.g. alcohol, food) is a widely advocated  
3 public health strategy.<sup>1,2</sup> The World Health Organization has proposed a number of  
4 interventions and policies to reduce availability including interventions reducing the alcoholic  
5 strength of products.<sup>3</sup> Research from North America, Australia and Europe has examined  
6 ways in which modifying local food availability impacts on health outcomes,<sup>4-7</sup> but there are  
7 relatively fewer evaluations of local alcohol availability interventions.<sup>1, 6, 8-14</sup>

8 Alcohol is a causal factor in more than 200 disease and injury conditions accounting for 5.9%  
9 of deaths worldwide.<sup>2</sup> Social costs attributable to alcohol, including crime and disorder,  
10 representing 1.3% to 3.3% of gross domestic product globally.<sup>2</sup> Interventions modifying  
11 alcohol availability have been seen to reduce both alcohol consumption and alcohol related  
12 harm.<sup>2, 15-19</sup> In many countries, including the United Kingdom (UK), attempts to modify  
13 availability through national government regulation, such as minimum unit pricing, have  
14 been met with political and legal barriers. Regulating the sale and consumption of alcohol  
15 products often takes place at sub-national levels.<sup>6, 8, 20</sup> Local government initiatives to reduce  
16 alcohol availability have been implemented, involving both statutory and voluntary  
17 approaches, the latter often targeting specific population groups.<sup>15, 21-24</sup>

18 Evaluative research of natural policy experiments is important because innovative practices  
19 can diffuse to new settings, including across national boundaries, sometimes before they have  
20 been robustly evaluated.<sup>25, 26</sup> Reducing the strength of alcoholic products or modifying high  
21 strength product availability have been proposed as 'best practices' to regulate physical  
22 availability.<sup>3, 27</sup> This, however, stems from an interpretation of availability theory rather than  
23 a synthesis of empirical evidence assessing impacts of reducing availability of high strength  
24 beers and ciders (so-called 'superstrength' products) and the evidence base around this is

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2  
3 25 under-developed. Superstrength products and their marketing have been said to encourage  
4  
5 26 alcohol misuse and harmful behaviours among vulnerable populations.<sup>28</sup> In the UK, the term  
6  
7 27 ‘Reducing the Strength’ (RtS) is now widely used to refer to area-based public health  
8  
9 28 initiatives that involve removing low price, superstrength alcoholic products from sale in  
10  
11 29 stores through voluntary agreements with local retailers and off-licenses. RtS has been  
12  
13 30 originally designed to tackle problems associated with alcohol social harms, often focused on  
14  
15 31 street drinking.<sup>22</sup> Suffolk was the first UK area to adopt the initiative in 2012 as part of a  
16  
17 32 multi-intervention approach to tackling street drinking. Since then at least 30 schemes have  
18  
19 33 been implemented in the UK.<sup>29</sup> The approach varies, but most RtS initiatives tend to target  
20  
21 34 alcohol products above 6.5% alcohol by volume (ABV), although some have focused on a  
22  
23 35 slightly lower ABV or lower cost products.<sup>22</sup> In this RtS, the products targeted were lower  
24  
25 36 cost products above 7.5% ABV. Superstrength products vary by price, brand and strength.  
26  
27 37 The least expensive products (e.g. ‘white ciders’) are amongst the lowest cost per unit alcohol  
28  
29 38 products in UK stores, purchased for as little as 11.1 pence per unit.<sup>30, 31</sup> UK local and  
30  
31 39 regional governments have complained to the alcohol industry that specific superstrength  
32  
33 40 products sold in 500ml cans encourage rapid consumption of high quantities of alcohol  
34  
35 41 causing population harms; although this is refuted by the industry.<sup>32</sup>  
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40 42 It has been argued that targeted interventions, such as RtS, offer local and regional  
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42 43 government authorities a potential means of tackling publicly visible social and health  
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44 44 problems associated with alcohol consumption.<sup>21, 22, 29</sup> Retailers and the alcohol industry have  
45  
46 45 raised concerns about RtS that have included questioning its evidence base, legal status (in  
47  
48 46 terms of competition law) and its potential financial impact.<sup>22, 33-35</sup> On the other hand, some  
49  
50 47 retailers arguably demonstrate a degree of support for RtS by voluntarily participating in  
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52 48 initiatives, although their reasons for doing so may vary. For example, some retailers saw  
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54 49 street drinking as a problem in their area and hoped that participation would reduce anti-

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3 50 social behaviour within their own shops while others saw this as an opportunity to co-operate  
4  
5 51 with the licensing authorities.<sup>35</sup> An intervention that is designed to deter anti-social customers  
6  
7 52 could potentially improve shops' image with the wider customer base in addition to licensing  
8  
9 53 authorities and other stakeholders.<sup>22, 33, 36, 37</sup>

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11  
12 54 From a public health perspective, it remains unclear to what extent local-level voluntary  
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14 55 interventions, such as RtS, can play an effective role in reducing alcohol consumption at the  
15  
16 56 population level.<sup>12</sup> Retail sales data routinely collected by shops provides one means of  
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18 57 measuring the impact of alcohol interventions. Such data can provide an objective and  
19  
20 58 accurate estimate of alcohol purchase and proxy consumption, particularly in the case of  
21  
22 59 larger supermarket and shop chains that have invested heavily in data collection.<sup>38</sup> However,  
23  
24 60 shop-level data are hard to obtain due to commercial sensitivity.<sup>39</sup> There are few published  
25  
26 61 evaluations of alcohol interventions in the UK using retail data to assess changes in physical  
27  
28 62 and economic availability of specific alcohol products for health improvement.<sup>18, 40</sup>

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33 63 The RtS studied here was originally launched as a joint initiative between Suffolk Police,  
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35 64 Ipswich Borough Council, Suffolk County Council and the National Health Service (Suffolk)  
36  
37 65 in September 2012.<sup>41</sup> Following interviews with local practitioners and policymakers who  
38  
39 66 designed and implemented the RtS in Suffolk, we hypothesised several possible mechanisms  
40  
41 67 for RtS impacts on alcohol availability and sales. These include a potential 'nudge' effect  
42  
43 68 where the impact of reducing physical availability of alcohol products by removing super-  
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45 69 strength products helped discourage and denormalise the practice of purchasing cheap  
46  
47 70 products. The RtS was also theorised as an economic availability intervention: customers  
48  
49 71 with finite resources wishing to purchase low cost per unit super-strength products may, on  
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51 72 finding those products removed, substitute for products with lower alcohol content or for  
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53 73 different alcohol products.<sup>29, 35</sup> This study aims to evaluate the impact of the introduction of a



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2  
3 74 RtS initiative on alcohol availability in the form of overall availability of alcohol units and  
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5 75 purchasing in one national retail chain across three English counties using time-series  
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7 76 analyses of retail sales data.  
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## 10 77 **Methods**

### 11 12 13 78 *Setting and intervention*

14  
15  
16 79 A major supermarket chain (East of England Co-operative Society, known commonly as ‘Co-  
17  
18 80 op’) voluntarily joined RtS in Suffolk and consequently ensured that its stores in that county  
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20 81 cleared their stock of all their low-priced brands of high-strength beers/lagers and ciders in  
21  
22 82 the month leading up to September 2012. These consisted of four superstrength products  
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24 83 (7.5% to 9.0% ABV) but did not include any more expensive ‘craft’ or ‘premium’ high-  
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26 84 strength products as the implementers did not associate such products with street drinking  
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28 85 (Table 1). The same chain required stores in Essex and Norfolk to begin a similar process of  
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30 86 withdrawing those products from sale by September 2013. Every shop from the chain  
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32 87 participated in the intervention although a minority of stores, 6% from wave 1 and 36% from  
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34 88 wave 2, took longer than one month to stop selling superstrength products (Appendix S1).  
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39 [Table 1 here]  
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### 41 90 *Data*

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43  
44 91 Monthly retail sales data were provided for the period January 2012 to May 2014 obtained  
45  
46 92 for 131 stores in one retail chain in the three English counties. We used the full range of data  
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48 93 that East of England Co-operative Society provided us with for this analysis: the researchers  
49  
50 94 did not have direct access to the company’s internal data systems but rather were sent data  
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52 95 pertaining only to the intervention period and localities so that the researchers could analyse  
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54 96 them independently. Shop-level characteristics and sales data were available including prices,  
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3 97 quantities, product brands, alcohol content, and sales for the following drink categories: beer/  
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5 98 lager and cider, wines, affordable sparkling and low alcohol wines, and spirits. Our primary  
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7 99 outcome was units of alcohol sold for beer/lager and cider. Secondary outcomes included  
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9 100 units of alcohol sold for two high strength premium products (ABV over 7.5%) not removed  
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11 101 as part of the RtS (Table 1), the remaining drink categories and for all products in order to  
12  
13 102 examine substitution effects and in line with qualitative findings on drinkers' responses to  
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15 103 RtS. We looked at sales value to assess the potential economic impact of RtS on stores.  
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17 104 Stores in Suffolk (n=54) were regarded as stores participating in wave 1 (W1) of the  
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19 105 intervention and stores in Norfolk and Essex (n=77) as stores participating in wave 2 (W2) a  
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21 106 year later.  
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### 25 107 *Statistical analysis*

26  
27 108 We used a quasi-experimental multiple baseline time-series design<sup>42</sup> to study changes in units  
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29 109 of alcohol sold and sales value for beer/lager and cider, wines, sparkling and low alcohol  
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31 110 wines, spirits and for total alcohol products after the introduction of the RtS initiative. The  
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33 111 RtS was introduced in a staggered approach, implemented at two different time points (W1  
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35 112 and W2) across three different geographical areas with a combined population of 3,62 million  
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37 113 people.<sup>43</sup> We examined the impact of implementing RtS separately for the two waves in order  
38  
39 114 to identify whether the intervention produced similar effects in the entire population of  
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41 115 interest (ie. whether the impact of the intervention was consistent in the two waves).<sup>42, 44</sup> The  
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43 116 repeated pattern of a reduction in the measured outcome following the implementation of the  
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45 117 intervention in each geographical area (i.e. wave) would suggest that the intervention is  
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47 118 having an effect.<sup>42</sup> An appropriate statistical approach to evaluate such impacts is the use of  
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49 119 segmented linear regression, which divides a time series into pre- and post-intervention  
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51 120 segments,<sup>44</sup> with panel-corrected standard errors.<sup>45, 46</sup> We took autocorrelation into account  
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53 121 by means of a common autoregressive first order (AR(1)) model and we included the  
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3 122 calendar month as a term to adjust for seasonality.<sup>44, 47</sup> Details of the assumptions and model  
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5 123 specification are available in Appendix S2.  
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8 124 The intervention effect was assumed to occur immediately after implementation, so no  
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10 125 transition period was taken into account in the analysis. We log-transformed our dependent  
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12 126 variables as these were highly skewed. For ease of interpretation, regression coefficients ( $\beta$ )  
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14 127 were converted into per cent change in sales and units of alcohol sold using the formula  
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16 128  $[\exp(\beta)-1]*100$ . This approach was used to ensure data confidentiality when using  
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18 129 commercially sensitive information, such as sales of specific alcohol products and brands.  
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20 130 We therefore examined substitution effects at a product category level and for high-strength  
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22 131 premium products that were not removed rather than at the level of specific products or  
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24 132 brands. Analysis was carried out in Stata 14.1.  
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## 28 133 **Results**

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30 134 Stores in W1 and W2 were similar in terms of size, area-level deprivation score and urban vs  
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32 135 semi-urban location. Stores in W1 were open on average for fewer hours compared to those  
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34 136 in W2 (Appendix S3). Mean units of alcohol sold per store per month were lower in W1  
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36 137 compared to W2 stores in all products. Overall, beer/lager and cider accounted for 32.4% of  
37  
38 138 total units of alcohol sold during the study period. Super-strength products removed had  
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40 139 previously accounted for 6.5% and 3.6% of total units sold for beer/lager and cider in W1 and  
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42 140 W2 stores, respectively (Table 2). In terms of sales, these four products accounted for 2.1%  
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44 141 and 1.3% of total revenue for W1 and W2 stores, respectively, before the intervention (data  
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46 142 not shown).  
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50 143 [Table 2 here]  
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53 144 Our analysis indicates that the impact of RtS on units of alcohol sold for beer/lager and cider  
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55 145 was not significant in the two waves (Fig. 1 and Appendix S4). More specifically, following  
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3 146 RtS implementation, W1 stores experienced a non significant increase (3.7%, 95%  
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5 147 Confidence Intervals (CI) = -11.2 – 21.0, P=0.647) whereas W2 stores experienced a non  
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7 148 significant decrease (-6.8%, 95% CI =-20.5 – 9.4, P =0.390) (Figure 1). In terms of all  
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9 149 alcohol products, the introduction of RtS was associated with a non significant increase in  
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11 150 W1 stores (8.0%, 95% CI = -1.3 – 18.3, P =0.094). In contrast, a significant decrease (-  
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13 151 10.5%, 95% CI =-19.2 – -0.9, P =0.034) was observed in W2 stores (Fig. 2 and Appendix  
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15 152 S4). Similar patterns for beer/cider and lager were observed for sales value (Fig. 2).

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19 153 [Figure 1 and Figure 2 here]

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21  
22 154 In order to examine substitution effects we repeated the analysis for high-strength premium  
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24 155 products, spirits, affordable sparkling and low alcohol wines and wines. We found that all  
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26 156 product categories experienced similar changes in units of alcohol sold and sales value during  
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28 157 this time period in W1 and W2 to those observed for beer/lager and cider. None of them were  
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30 158 significant except for units of alcohol sold for wines, which appeared to drive the significant  
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32 159 decrease observed in units of alcohol sold for all products. We found no evidence of  
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34 160 substitution effects for high-strength premium products (Fig. 1 and Appendix S4).

## 35 36 37 38 161 **Discussion**

### 39 40 162 *Main findings of this study*

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43 163 We used retail sales data to evaluate the introduction of RtS, a public health initiative targeted  
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45 164 at supermarkets and off-licenses to remove low cost, super-strength beers and ciders from  
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47 165 sale in three English counties. Our results show that this RtS had no significant impact on  
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49 166 total units of alcohol sold and sales value for beer/lager and cider. We also found no  
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51 167 observable substitution effects of alcohol products attributable to the RtS intervention in the  
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53 168 131 stores.

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3 169 *What is already know on the topic*  
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6 170 Only a small number of previous studies have used retail sales data in quasi-experimental  
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8 171 designs to evaluate alcohol interventions. Evaluation of the Scottish Alcohol Act 2010  
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10 172 showed that banning alcohol multi-buy promotions did not reduce alcohol purchasing at the  
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12 173 household level,<sup>18</sup> and the introduction of the Alcohol Act was not associated with any  
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14 174 changes in off-trade beer sales.<sup>40</sup> In our study, the majority of results were non significant.  
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16 175 The small significant decrease in units and value of alcohol sales of all products in W2 stores  
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18 176 appears to be driven by declining wine (rather than beer/cider) sales.<sup>48</sup> Furthermore, the  
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20 177 changes observed in the two waves were not consistent and so the overall findings showed no  
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22 178 intervention attributable impact.<sup>42</sup>  
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26 179 An Australian evaluation of local alcohol availability restrictions (cask wines and products  
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28 180 over 2.7% ABV) found that some participants travelled further to access non-participating  
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30 181 shops.<sup>13, 14</sup> In our study we theorise that overall alcohol purchases could be influenced by  
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32 182 whether or not customers changed where they purchased alcohol (i.e. shops not participating  
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34 183 in RtS), or if they substituted products within participating stores.<sup>14</sup> Our study focused on one  
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36 184 retail chain which maintained compliance with RtS<sup>22</sup> and we found no substitution effects  
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38 185 between categories of alcohol products within study stores attributable to the intervention.  
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40 186 Customers in the study areas had the ability to access other local stores that did not  
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42 187 participate in the RtS but we did not detect any sudden or sustained loss of income in  
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44 188 participating stores that might be expected if substantial numbers of customers had started  
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46 189 shopping elsewhere for alcohol. The availability of alternative stores not participating may  
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48 190 vary within and between the three counties studied.  
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3 191 *Limitations of this study*  
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6 192 The retail data we had available related to one retail supermarket chain and the data available  
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8 193 could not be used to consider overall area effects, shop-level or brand/product-level  
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10 194 substitution effects, individual or sub-group level purchasing or consumption.<sup>14, 18, 37</sup> Our  
11  
12 195 results cannot be generalized to RtS initiatives that have removed products with >6.5% or  
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14 196 lower ABV. We did not have the data to measure long term impacts on purchasing and  
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16 197 consumption, although we theorised that RtS should impact on availability as soon as shops  
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18 198 stopped selling superstrength products.<sup>13, 14</sup> The confidence intervals for our findings were  
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20 199 wide and statistical precision might have been improved with inclusion of a greater number  
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22 200 of stores, and/or time points.<sup>44, 46</sup> Stores in W1 and W2 had different rates of compliance,  
23  
24 201 which may compromise internal validity.<sup>42</sup> In addition, RtS is only one intervention targeting  
25  
26 202 alcohol consumption and harms, and we are aware that there are a range of local alcohol  
27  
28 203 policies routinely implemented in local government which we were unable to adjust for. Such  
29  
30 204 unmeasured events may introduce confounding and compromise internal validity.<sup>49</sup> Finally,  
31  
32 205 segmented regression analysis has its own limitations, allowing only linear trends to be  
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34 206 examined but changes may follow non-linear patterns.<sup>44</sup>  
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38 207 *What this study adds*  
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41 208 Our study makes an important contribution to the evidence-base for local voluntary retail  
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43 209 alcohol interventions.<sup>18, 40</sup> The use of retail data is novel for evaluating alcohol initiatives and  
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45 210 it has been advocated as an important means to monitor alcohol consumption<sup>40, 50</sup> despite the  
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47 211 limitations.<sup>38</sup> In this study, we used a retail sales time series panel data set, that contains far  
48  
49 212 more information than single cross-sectional data allowing for an increased precision in  
50  
51 213 estimation.<sup>46</sup> Panel difference-in-differences analysis has been used in a previous study,<sup>18</sup> but  
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53 214 we opted to use panel-corrected standard errors within a regression framework, because  
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3 215 ignoring possible correlation of regression disturbances over time and between panels may  
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5 216 lead to overly optimistic standard errors and lead to biased statistical inference.<sup>46</sup>  
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8 217 The RtS initiative<sup>21</sup> was originally developed as part of a strategy that also involved alcohol  
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10 218 and drug treatment services and street policing to tackle street drinking and anti-social  
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12 219 behavior due to excess alcohol consumption, and there is some evidence that this targeted,  
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14 220 multi-intervention approach led to reductions in police call outs and other indicators of social  
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16 221 problems related to street drinking.<sup>21, 41</sup> This evaluation does not test RtS's impact on wider  
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18 222 aims of tackling alcohol social harms including street drinking. The RtS was not originally  
19  
20 223 expected to have impacts on reducing overall population alcohol consumption. Potential  
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22 224 secondary effects of RtS on the broader population of alcohol consumers are of interest to the  
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24 225 public health community.  
25  
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27  
28 226 Voluntary agreements between governments and the private sector have previously been used  
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30 227 to encourage businesses to take actions.<sup>36</sup> However, there is little evidence to suggest such  
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32 228 approaches are more (cost-) effective, particularly if they are unaccompanied by monitoring,  
33  
34 229 and appropriate incentives and sanctions.<sup>36</sup> The alcohol industry and retail sector may be  
35  
36 230 more willing to participate in voluntary initiatives targeting selected population groups (i.e.  
37  
38 231 street drinkers) that have minimal impact on their profits. Our analysis suggests that RtS had  
39  
40 232 no impact on revenues. Addressing alcohol related harms and drinking behaviours in 'high-  
41  
42 233 risk' groups is important but our analysis suggests that RtS may not be effective for  
43  
44 234 addressing alcohol harms across the whole population. The evidence base recommends  
45  
46 235 regulatory or statutory enforcement interventions restricting alcohol availability are more  
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48 236 effective than local non-regulatory or voluntary approaches targeting specific groups.<sup>12, 51-54</sup>  
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3 237 **Conclusion**

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5 238 This evaluation did not specifically test impacts on target groups, such as street drinkers, but  
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7 239 examined impacts on all consumers' alcohol purchasing patterns from one retail supermarket  
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9 240 chain. Our findings suggest that voluntary RtS initiatives, have little or no impact on reducing  
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11 241 alcohol availability and purchase amongst a broader population of customers. The research  
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13 242 literature suggests that more effective regulatory public health interventions will be required  
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15 243 to achieve substantial population health benefits in reducing alcohol consumption and  
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17 244 alcohol-related harms.  
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## References

1. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013–2020. Geneva: WHO, 2013.
2. World Health Organization. Global status report on alcohol and health. Geneva: WHO, 2014.
3. World Health Organization. Global strategy to reduce the harmful use of alcohol. Geneva: WHO, 2010.
4. Morland KB. An evaluation of a neighborhood-level intervention to a local food environment. *American journal of preventive medicine* 2010; 39:e31-8.
5. Gase LN, McCarthy WJ, Robles B, Kuo T. Student receptivity to new school meal offerings: assessing fruit and vegetable waste among middle school students in the Los Angeles Unified School District. *Preventive Medicine* 2014; 67 Suppl 1:S28-33.
6. Soler RE, Whitten KL, Ottley PG. Communities putting prevention to work: Local evaluation of community-based strategies designed to make healthy living easier. *Preventive Medicine* 2014; 67, Supplement 1:S1-S3.
7. Valdivia Espino J, Guerrero N, Rhoads N, Simon N, Escaron A, Meinen A, et al. Community-Based Restaurant Interventions to Promote Healthy Eating: A Systematic Review. *Prev Chronic Dis* 2015; 12.
8. Nelson TF, Xuan Z, Babor TF, Brewer RD, Chaloupka FJ, Gruenewald PJ, et al. Efficacy and the Strength of Evidence of U.S. Alcohol Control Policies. *American journal of preventive medicine* 2013; 45:19-28.
9. Rammohan V, Hahn RA, Elder R, Brewer R, Fielding J, Naimi TS, et al. Effects of Dram Shop Liability and Enhanced Overservice Law Enforcement Initiatives on Excessive Alcohol Consumption and Related Harms: Two Community Guide Systematic Reviews. *American journal of preventive medicine* 2011; 41:334-43.
10. Campbell CA, Hahn RA, Elder R, Brewer R, Chattopadhyay S, Fielding J, et al. The Effectiveness of Limiting Alcohol Outlet Density As a Means of Reducing Excessive Alcohol Consumption and Alcohol-Related Harms. *American journal of preventive medicine* 2009; 37:556-69.
11. Stockwell T, Zhao J, Giesbrecht N, Macdonald S, Thomas G, Wettlaufer A. The Raising of Minimum Alcohol Prices in Saskatchewan, Canada: Impacts on Consumption and Implications for Public Health. *American journal of public health* 2012; 102:e103-e10.
12. Martineau F, Tyner E, Lorenc T, Petticrew M, Lock K. Population-level interventions to reduce alcohol-related harm: an overview of systematic reviews. *Preventive Medicine* 2013; 57:278-96.
13. Kinnane S, Farrington F, Henderson-Yates L, Parker H. Fitzroy Valley Alcohol Restriction Report: An evaluation of the effects of a restriction on take-away alcohol relating to measurable health and social outcomes, community perceptions and behaviours after a two year period, 2010. Available at: [http://www.dao.health.wa.gov.au/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=680&Command=Core\\_Download&PortalId=0&TabId=211](http://www.dao.health.wa.gov.au/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=680&Command=Core_Download&PortalId=0&TabId=211) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dhBDi59v> on 11 December 2015.
14. National Drug Research Institute. Restrictions on the Sale and Supply of Alcohol: Evidence and Outcomes. Perth: National Drug Research Institute, Curtin University of Technology, 2007. Available at: <http://ndri.curtin.edu.au/local/docs/pdf/publications/R207.pdf> (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dhAzukmG> on 11 December 2015.
15. Maclennan B, Kypri K, Room R, Langley J. Local government alcohol policy development: case studies in three New Zealand communities. *Addiction* 2013; 108:885-95.

16. Ahern J, Margerison-Zilko C, Hubbard A, Galea S. Alcohol outlets and binge drinking in urban neighborhoods: the implications of nonlinearity for intervention and policy. *American journal of public health* 2013; 103:e81-7.
17. Fone D, Dunstan F, White J, Webster C, Rodgers S, Lee S, et al. Change in alcohol outlet density and alcohol-related harm to population health (CHALICE). *BMC Public Health* 2012; 12:428.
18. Nakamura R, Suhrcke M, Pechey R, Morciano M, Roland M, Marteau TM. Impact on alcohol purchasing of a ban on multi-buy promotions: a quasi-experimental evaluation comparing Scotland with England and Wales. *Addiction* 2014; 109:558-67.
19. Purshouse RC, Meier PS, Brennan A, Taylor KB, Rafia R. Estimated effect of alcohol pricing policies on health and health economic outcomes in England: an epidemiological model. *Lancet* 2010; 375:1355-64.
20. Han D, Gorman DM. Evaluating the Effects of the Introduction of Off-Sale Alcohol Outlets on Violent Crime. *Alcohol and Alcoholism (Oxford, Oxfordshire)*. 2013; 48:370-4.
21. Alcohol Concern. Guide to Alcohol for Councillors. London: 2014. Available at: [http://www.alcoholconcern.org.uk/wp-content/uploads/woocommerce\\_uploads/2014/12/Guide-to-Alcohol-160813-APPROVED.pdf](http://www.alcoholconcern.org.uk/wp-content/uploads/woocommerce_uploads/2014/12/Guide-to-Alcohol-160813-APPROVED.pdf) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh8ZwRom> on 11 December 2015.
22. Local Government Association. Reducing the Strength schemes: Guidance for councils considering setting up a scheme, 2014. Available at: [http://www.local.gov.uk/regulatory-services-and-licensing-/journal\\_content/56/10180/6793034/ARTICLE](http://www.local.gov.uk/regulatory-services-and-licensing-/journal_content/56/10180/6793034/ARTICLE) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh8jYS00> on 11 December 2015.
23. Nicholls J. The Government Alcohol Strategy 2012: Alcohol policy at a turning point? *Drugs: Education, Prevention, and Policy* 2012; 19:355-9.
24. Hughes K, Bellis MA, Leckenby N, Quigg Z, Hardcastle K, Sharples O, et al. Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city. *Journal of epidemiology and community health* 2014; 68:453-6.
25. McGill E, Egan M, Petticrew M, Mountford L, Milton S, Whitehead M, et al. Trading quality for relevance: non-health decision-makers' use of evidence on the social determinants of health. *BMJ open* 2015; 5.
26. Dolowitz D, Marsh D. Learning from abroad: The role of policy transfer in contemporary policy-making. *Governance* 2000; 13:5-23.
27. Alcohol, Public Policy G. Alcohol: No Ordinary Commodity – a summary of the second edition. *Addiction* 2010; 105:769-79.
28. Goodall T. White Cider and Street Drinkers: Recommendations to Reduce Harm. London: Alcohol Concern UK, 2011. Available at: <http://www.thamesreach.org.uk/publications/research-reports/white-cider-and-street-drinkers/> (accessed 25 June 2015). Archived at: <http://www.webcitation.org/6ZYIecFEw> on 25 June 2015.
29. McGill E, Marks D, Sumpter C, Egan M. Consequences of removing cheap, super-strength beer and cider: a qualitative study of a UK local alcohol availability intervention. *BMJ open* 2016; 6:e010759.
30. Sweeting H. Alcohol units at pocket money prices [e-letter]. *BMJ* 2006; 333:825-b.
31. Gornall J. Doctors and the alcohol industry: an unhealthy mix? *BMJ* 2013; 346:f1889.
32. Portman Group. K Cider, Complaint decision details, 2017. Available at: <http://www.portmangroup.org.uk/complaints/complaint-decisions/complaint-decision->

- 1  
2  
3 details/2017/01/12/k-cider (accessed 24 January 2017). Archived at:  
4 <http://www.webcitation.org/6nkoGttF8> on 24 January 2017.
- 5 33. Association of Convenience Stores. Reducing the Strength: Retailer Guidance, 2015.  
6 Available at: <http://www.acs.org.uk/advice/reducing-the-strength/> (accessed 10 December  
7 2015). Archived at: <http://www.webcitation.org/6dh7Gcc5S> on 11 December 2015.
- 8 34. Competition and Markets Authority. High-strength alcohol schemes: competition law  
9 advice for retailers, 2015. Available at: [https://www.gov.uk/government/publications/high-  
10 strength-alcohol-schemes-competition-law-advice-for-retailers](https://www.gov.uk/government/publications/high-strength-alcohol-schemes-competition-law-advice-for-retailers) (accessed 10 December  
11 2015). Archived at: <http://www.webcitation.org/6dh7NK9Rb> on 11 December 2015.
- 12 35. Sumpter C, McGill E, Dickie E, Champo E, Romeri E, Egan M. Reducing the  
13 Strength: a mixed methods evaluation of alcohol retailers' willingness to voluntarily reduce  
14 the availability of low cost, high strength beers and ciders in two UK local authorities. *BMC*  
15 *Public Health* 2016; 16:448.
- 16 36. Bryden A, Petticrew M, Mays N, Eastmure E, Knai C. Voluntary agreements between  
17 government and business - a scoping review of the literature with specific reference to the  
18 Public Health Responsibility Deal. *Health policy* 2013; 110:186-97.
- 19 37. Community Alcohol Partnerships. About Community Alcohol Partnerships, 2015.  
20 Available at: <http://www.communityalcoholpartnerships.co.uk/> (accessed 10 December  
21 2015). Archived at: <http://www.webcitation.org/6dh622qSP> on 11 December 2015.
- 22 38. Robinson M, Thorpe R, Beeston C, McCartney G. A review of the validity and  
23 reliability of alcohol retail sales data for monitoring population levels of alcohol  
24 consumption: a Scottish perspective. *Alcohol and alcoholism* 2013; 48:231-40.
- 25 39. Egan M, Pliakas T, Grace D, McGill E, Jones A, Wong J, et al. Use of retail data in  
26 the assessment of natural experiments: the case of Reducing the Strength, an intervention to  
27 reduce alcohol availability. *Lancet* 2014; 384:S30.
- 28 40. Robinson M, Geue C, Lewsey J, Mackay D, McCartney G, Curnock E, et al.  
29 Evaluating the impact of the alcohol act on off-trade alcohol sales: a natural experiment in  
30 Scotland. *Addiction* 2014; 109:2035-43.
- 31 41. Suffolk Constabulary. Reducing the Strength Ipswich - One year on, 2012. Available  
32 at:  
33 [http://www.suffolk.police.uk/safetyadvice/personalsafety/alcoholawareness/reducingthestren-  
34 gth/oneyearon.aspx](http://www.suffolk.police.uk/safetyadvice/personalsafety/alcoholawareness/reducingthestrength/oneyearon.aspx) (accessed 10 December 2015). Archived at:  
35 <http://www.webcitation.org/6dh6n05NZ> on 11 December 2015.
- 36 42. Hawkins NG, Sanson-Fisher RW, Shakeshaft A, D'Este C, Green LW. The multiple  
37 baseline design for evaluating population-based research. *American journal of preventive*  
38 *medicine* 2007; 33:162-8.
- 39 43. Office for National Statistics. Population Estimates for UK, England and Wales,  
40 Scotland and Northern Ireland, Mid-2014, 2015. Available at:  
41 <http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-368259>  
42 (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh6SoR4s> on 11  
43 December 2015.
- 44 44. Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis  
45 of interrupted time series studies in medication use research. *Journal of clinical pharmacy and*  
46 *therapeutics* 2002; 27:299-309.
- 47 45. Beck N, Katz JN. What to do (and not to do) with Time-Series Cross-Section Data.  
48 *The American Political Science Review* 1995; 89:634-47.
- 49 46. Hoechle D. Robust standard errors for panel regressions with cross-sectional  
50 dependence. *The Stata Journal* 2007; 7:281-312.
- 51 47. Linden A. Conducting interrupted time-series analysis for single- and multiple-group  
52 comparisons. *The Stata Journal* 2015; 15:480-500.
- 53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 48. The Drinks Report. UK alcohol market returns to growth, 2015. Available at:  
4 <http://www.thedrinksreport.com/news/2015/16101-uk-alcohol-market-returns-to-growth.html>  
5 (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh702Jz8> on 11  
6 December 2015.
- 7 49. Craig P, Cooper C, Gunnell D, Haw S, Lawson K, Macintyre S, et al. Using natural  
8 experiments to evaluate population health interventions: new Medical Research Council  
9 guidance. *Journal of epidemiology and community health* 2012; 66:1182-6.
- 10 50. Robinson M, Shipton D, Walsh D, Whyte B, McCartney G. Regional alcohol  
11 consumption and alcohol-related mortality in Great Britain: novel insights using retail sales  
12 data. *BMC Public Health* 2015; 15:1.
- 13 51. de Vocht F, Heron J, Angus C, Brennan A, Mooney J, Lock K, et al. Measurable  
14 effects of local alcohol licensing policies on population health in England. *Journal of*  
15 *epidemiology and community health* 2016; 70:231-7.
- 16 52. de Vocht F, Heron J, Campbell R, Egan M, Mooney JD, Angus C, et al. Testing the  
17 impact of local alcohol licencing policies on reported crime rates in England. *Journal of*  
18 *epidemiology and community health* 2017; 71:137-45.
- 19 53. Knai C, Petticrew M, Durand MA, Scott C, James L, Mehrotra A, et al. The Public  
20 Health Responsibility deal: has a public-private partnership brought about action on alcohol  
21 reduction? *Addiction* 2015; 110:1217-25.
- 22 54. de Vocht F, Tilling K, Pliakas T, Angus C, Egan M, Brennan A, et al. The  
23 intervention effect of local alcohol licensing policies on hospital admission and crime: a  
24 natural experiment using a novel Bayesian synthetic time-series method. *Journal of*  
25 *epidemiology and community health* 2017.
- 26 55. Department of Health. Health risks from alcohol: new guidelines, 2016. Available at:  
27 <https://www.gov.uk/government/consultations/health-risks-from-alcohol-new-guidelines>  
28 (accessed 2 August 2017). Archived at: <http://www.webcitation.org/6sQ3CIIWX> on 2 August  
29 2017.  
30  
31  
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3 **List of titles for all figures**

4 **Figure 1** Percent change in units of alcohol sold after the introduction of the  
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6 *Reducing the Strength* initiative. Wave 1 stores started implementation by  
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8 September 2012. Wave 2 stores started implementation by September 2013.  
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10  
11 **Figure 2** Percent change in sales value after the introduction of the *Reducing the*  
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13 *Strength* initiative. Wave 1 stores started implementation by September 2012. Wave  
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15 2 stores started implementation by September 2013.  
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**Table 1** List of beer and cider products over 6.5% ABV sold during the 'Reducing the Strength' initiative.

EAN	ABV	Description	Size	Units	Price (£) <sup>a</sup>	Price per unit (£) <sup>a</sup>
5010079105150	7.5	White Star <sup>b</sup>	2Ltr	15.0	2.50 to 5.23	0.17 to 0.35
5010153737048	9.0	Carlsberg special brew <sup>b</sup>	4x440ml	15.8	1.52 to 9.75	0.10 to 0.62
5000128393041	7.5	Co-op superstrength lager <sup>b</sup>	4x440ml	13.2	1.39 to 7.25	0.11 to 0.55
5010017012526	9.0	Tennent's super strong lager <sup>b</sup>	4x440ml	15.8	2.08 to 9.59	0.13 to 0.61
5014201655414	8.2	Special vintage cider <sup>c</sup>	500ml	4.1	1.73 to 2.13	0.42 to 0.52
5012845198120	8.2	Imperial cider <sup>c</sup>	500ml	4.1	2.15 to 2.61	0.52 to 0.64
5016878000207	6.7	Adnams Jack brand innovation	500ml	3.4	1.42 to 2.94	0.42 to 0.88
5012845172809	7.0	Aspall dry Suffolk cider premier cru	500ml	3.5	1.31 to 2.84	0.37 to 0.81
5012845177101	7.0	Aspall premier cru Suffolk cider pack	4x330ml	9.2	1.78 to 6.17	0.19 to 0.67
5012845172830	7.0	Aspall organic Suffolk cider	500ml	3.5	1.15 to 2.79	0.33 to 0.80
8594403110159	7.4	Budweiser Budvar Czech premium lager	330ml	2.4	0.88 to 2.28	0.36 to 0.93
5014201203554	6.5	Westons - Wyld Wood Classic cider	500ml	3.3	1.88 to 2.52	0.58 to 0.78
609722874786	7.0	NSB dry cider	750ml	5.3	1.80 to 3.78	0.34 to 0.72
609722874793	7.0	NSB medium cider	750ml	5.3	1.40 to 3.78	0.27 to 0.72
609722874809	7.0	NSB 7sweet cider	750ml	5.3	0.90 to 3.78	0.17 to 0.72
5020628002809	7.4	Thatchers Katy cider	500ml	3.7	1.78 to 2.51	0.48 to 0.68
5020628006685	7.4	Thatchers vintage cider	500ml	3.4	1.82 to 2.37	0.49 to 0.64
5010327658544	6.6	Innis & Gunn original oak aged beer	330ml	2.2	1.00 to 2.11	0.46 to 0.97
5410228102762	6.6	Leffe blonde	750ml	5.0	2.94 to 4.49	0.59 to 0.91
5410228190424	6.6	Leffe blonde pack	4x330ml	8.7	1.46 to 7.83	0.16 to 0.85
609224793127	7.0	Carter's Essex cider <sup>7%</sup>	500ml	3.5	1.25 to 2.49	0.36 to 0.71
5011348010953	7.4	Banks's Barley Gold	4x330ml	9.8	4.42 to 5.70	0.48 to 0.62
5000264004184	7.3	McEwans champion ale	500ml	3.7	2.02 to 2.14	0.55 to 0.58
5010549302348	6.5	Old crafty hen	500ml	3.3	1.93 to 2.40	0.59 to 0.74

<sup>a</sup>: Range of values during the period of study.

<sup>b</sup>: Superstrength products (over 7.5% ABV) removed as part of the Reducing the Strength initiative.

<sup>c</sup>: High strength premium products (over 7.5% ABV) not removed as part of the Reducing the Strength initiative.

<sup>d</sup>: High strength premium products (over 6.5% but below 7.5% ABV) still available during the study period.

EAN: European Article Number (also called International Article Number)

ABV: Alcohol by volume (ABV) (%)

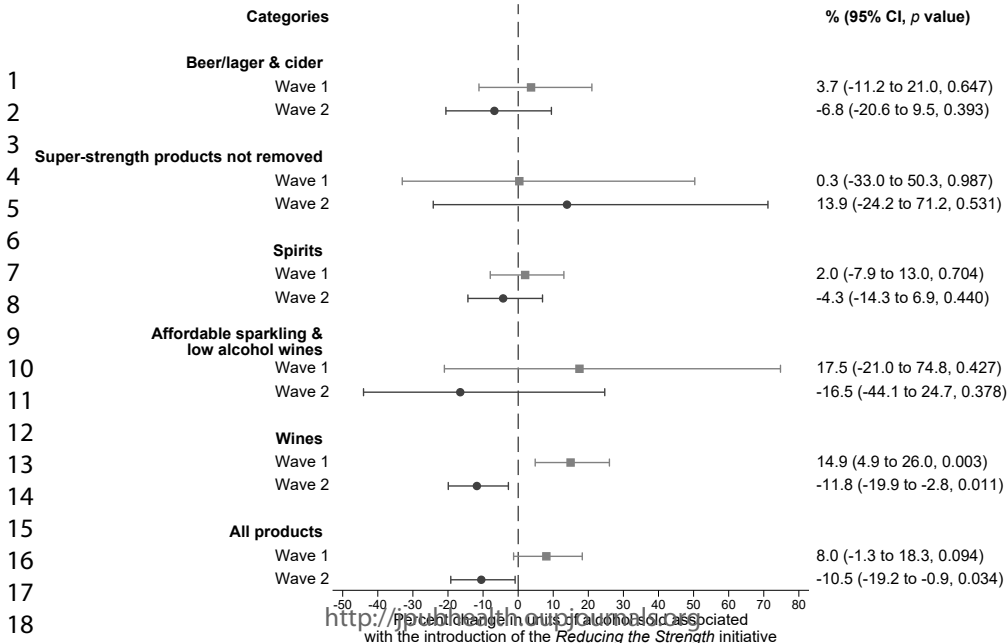
Recommended weekly limit of 14 units of alcohol for men and women<sup>55</sup>

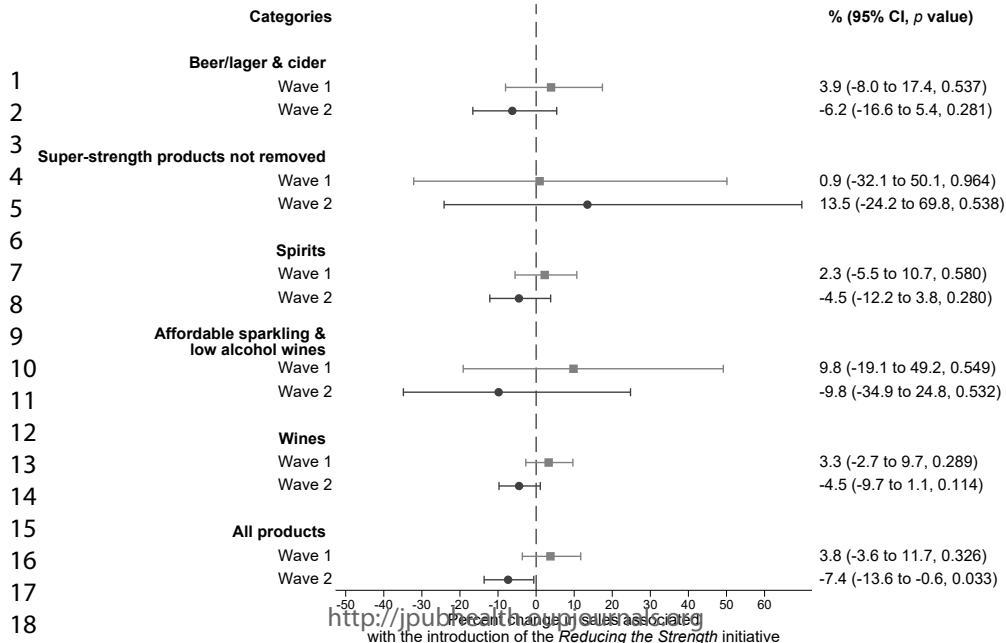
**Table 2** Summary statistics for units of alcohol sold per store per month.

Product categories	Stores in wave 1 (n=54)			Stores in wave 2 (n=77)			All stores (n=131)		
	Mean (SD)	Median	Min - Max	Mean (SD)	Median	Min - Max	Mean (SD)	Median	Min - Max
Beer/lager & cider	11,641 (8,364)	9,189	2,566 – 61,692	14,159 (9,330)	11,646	884 – 71,467	13,120 (9,029)	10,489	884 – 71,467
Of which super-strength products removed <sup>a</sup>	761 (680)	547	13 - 4782	512 (614)	305	13 - 5165			
Of which super-strength products not removed	334 (273)	246	4 – 1,816	388 (344)	279	4 – 2,325	365 (317)	258	4 – 2,325
Spirits	9,002 (8,261)	6,602	1,984 – 62,816	9,903 (8,279)	7,280	334 – 72,664	9,531 (8,282)	6,967	334 – 72,664
Affordable sparkling and low alcohol wines	951 (1,047)	643	66 – 13,151	1,080 (1,089)	711	35 – 9,819	1,026 (1,074)	680	35 – 13,151
Wines	16,280 (16,722)	11,334	2,485 – 133,557	17,147 (15,134)	12,786	668 – 102,783	16,790 (15,812)	12,087	668 – 133,557
All products	37,873 (33,311)	28,273	10,314 – 262,238	42,277 (32,390)	33,023	1,920 – 221,608	40,462 (32,840)	30,944	1,920 – 262,238

<sup>a</sup>: Only for the period up until September 2012 for wave 1 and September 2013 for wave 2.







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with the introduction of the *Reducing the Strength* initiative

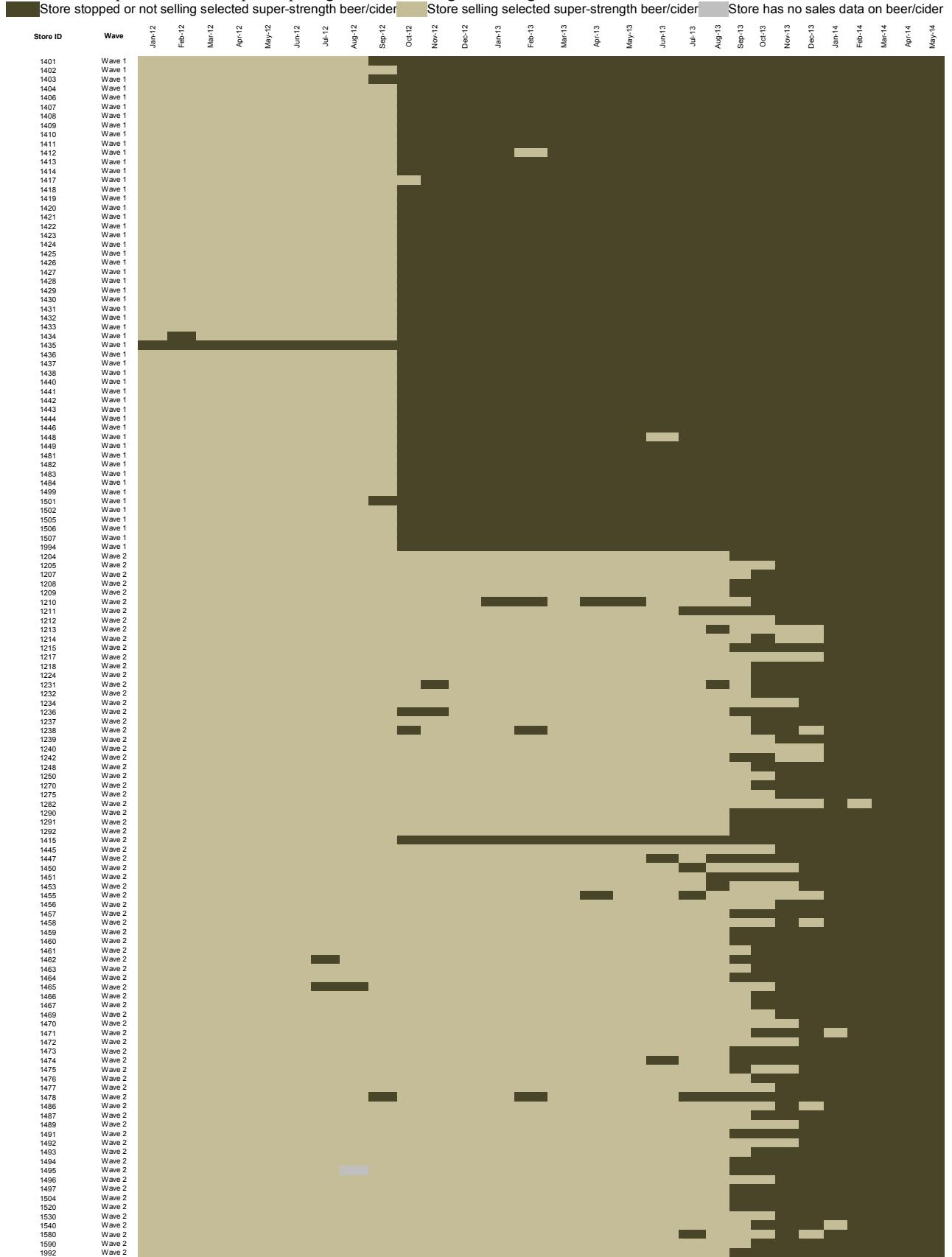
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3 **Appendix S1** Voluntary compliance in stores participating in the Reducing the Strength  
4 initiative.  
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8 Table S1 below illustrates the voluntary compliance of stores that took part in the *Reducing*  
9 *the Strength* initiative.  
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12 In wave 1 (Suffolk) all but three stores (94.4%) were compliant in removing the four  
13 superstrength products. However, it should be noted that only one item of a withdrawn  
14 product was sold in those three stores. In October 2012, in store ID 417, one item of 7.5%  
15 White Star (EAN 5010079105150) was sold. In February 2013, in store ID 412, one item of  
16 7.5% CP S/Strength lager (EAN 5000128393041) was sold. In June 2013, in store ID 448,  
17 one item of 7.5% White Star (EAN 5010079105150) was sold.  
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22 In wave 2 (Essex and Norfolk), a more mixed picture of compliance was observed. The chain  
23 required stores to withdraw the *RtS* products from sale by September 2013. In October 2013,  
24 49 of 77 stores (63.6%) had withdrawn these products. A total of 66 out of 77 (85.7%) stores  
25 had withdrawn the *RtS* products within three months. Full voluntary compliance in wave 2  
26 stores was achieved six months (February 2014) after the initiation of the *RtS* in those areas  
27 (September 2013).  
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Table S1 Compliance of stores participating in the Reducing the Strength initiative.



**Appendix S2** Assumptions and model specification of segmented linear regression and results before and after taking into account first-order autocorrelation (AR(1)) within panels.

### *Assumptions*

We used segmented linear regression to examine the impact of the introduction of a *RtS* initiative on alcohol availability and purchasing in one retail chain. Segmented linear regression requires a number of assumptions that need to be met, including the typical assumptions of linear ordinary least squares analysis, the presence of seasonal trends, autocorrelation and taking into account the panel structure of the data.<sup>1,2</sup> Details on how these assumptions were addressed are presented below.

### *Model specification*

Our analysis was carried out treating the data as two time series panel datasets for each of the two waves, with the primary outcomes analysed at individual store level. In each series we estimated the change in level (ie. step change) following the *RtS* intervention in wave 1 and 2, using the following regression model<sup>2,3</sup>:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 T_t X_t + \varepsilon_t$$

where  $Y_t$  is the outcome variable at time  $t$ ,  $T_t$  is the time (ie. months) since the start of the study and  $X$  is a dummy variable representing the intervention (coded as 0 and 1, before and after the intervention, respectively), and  $T_t X_t$  is the interaction between time and intervention. The parameter of interest is the  $\beta_2$  coefficient which represents the step change following the intervention (i.e. the introduction of *RtS*). The  $\beta_3$  coefficient and the interaction term  $T_t X_t$  represents the slope change (i.e. change over time). The error term  $\varepsilon_t$  at time  $t$  represents the random variability not explained by the model. It consists of a normally distributed random error and an error term at time  $t$  that may be correlated to errors at preceding or subsequent time points [3]. For an AR(1) process, the random error term  $\varepsilon_t$  is specified as follows:

$$\varepsilon_t = \rho \varepsilon_{t-1} + u_t$$

where  $\rho$  is the autocorrelation parameter (i.e. the correlation coefficient between adjacent error terms) and the disturbances  $u_t$  are independent.<sup>3</sup>

This analysis was separately done for stores in wave 1 and wave 2. The coefficient  $\beta_2$  in the two series can then be compared to assess the consistency of the effects of the intervention across the entire study sample.<sup>2,4</sup> Our hypothesis was that the introduction of *RtS* would lead to a statistically significant downward change (ie. a negative  $\beta_2$  coefficient) in sales and units of

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3 alcohol sold for beer/lager and cider and all products and the observed effect would be  
4 consistent across both time series. As a result we excluded the  $\beta_3$  coefficient and the interaction  
5 term  $T_t X_t$  in our models.  
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8 *Results before and after taking into account first-order autocorrelation (AR(1)) within panels*  
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10 Our analysis indicated that the estimate of the autocorrelation parameter were high, and the  
11 standard errors were found to be larger than for the model without autocorrelation, which is to  
12 be expected if there is autocorrelation (Table S2-1 and Table S2-2).  
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**Table S2-1** Coefficients of segmented linear regression on log transformed total units of beer/lager and cider sold without taking autocorrelation into account

Product category and parameter	Estimated RtS effect at wave 1				Estimated RtS effect at wave 2			
	beta	SE	95% CI	p value	beta	SE	95% CI	p value
Beer/lager and cider (units)								
Pre-intervention slope	0.0017	0.00173	-0.0016 to 0.0051	0.319	0.0051	0.00181	0.0015 to 0.0086	0.005
Intercept/step change	-0.0270	0.03460	-0.0948 to 0.0408	0.435	-0.0590	0.03448	-0.1265 to 0.0085	0.087
<u>High-strength premium products (over 7.5% ABV) not removed as part of RtS (units)</u>								
<u>Pre-intervention slope</u>	<u>0.0062</u>	<u>0.00434</u>	<u>-0.0022 to 0.0147</u>	<u>0.150</u>	<u>0.0135</u>	<u>0.00449</u>	<u>0.0047 to 0.0223</u>	<u>0.003</u>
<u>Intercept/step change</u>	<u>0.2481</u>	<u>0.08701</u>	<u>0.0775 to 0.4186</u>	<u>0.004</u>	<u>-0.1448</u>	<u>0.08602</u>	<u>-0.3134 to 0.0237</u>	<u>0.092</u>
Spirits (units)								
Pre-intervention slope	-0.0046	0.00121	-0.0069 to -0.0022	<0.001	-0.0029	0.00131	-0.0054 to -0.0003	0.027
Intercept/step change	-0.0090	0.02428	-0.0566 to 0.0385	0.710	-0.0248	0.02504	-0.0738 to 0.0243	0.323
Affordable sparkling/low alcohol wines (units)								
Pre-intervention slope	0.0081	0.00471	-0.0011 to 0.0173	0.086	0.0102	0.00468	0.0010 to 0.0193	0.030
Intercept/step change	0.0183	0.09443	-0.1667 to 0.2033	0.846	-0.0928	0.08937	-0.2679 to 0.0823	0.299
Wines (units)								
Pre-intervention slope	0.0054	0.00115	0.0031 to 0.0076	<0.001	0.0169	0.00121	0.0145 to 0.0193	<0.001
Intercept/step change	0.1202	0.02314	0.0748 to 0.1656	<0.001	-0.1327	0.02309	-0.1779 to -0.0874	<0.001
All alcohol products (units)								
Pre-intervention slope	0.0018	0.00105	-0.0002 to 0.0038	0.084	0.0079	0.00119	0.0055 to 0.0101	<0.001
Intercept/step change	0.0345	0.02098	-0.0065 to 0.0756	0.100	-0.0812	0.02265	-0.1256 to -0.0368	<0.001
Beer/lager and cider (value £)								
Pre-intervention slope	0.0005	0.00130	-0.0020 to 0.0030	0.688	-0.0003	0.00127	-0.0027 to 0.0022	0.827
Intercept/step change	-0.0650	0.02616	-0.1163 to -0.0137	0.013	0.0018	0.02415	-0.0455 to 0.0491	0.940
<u>High-strength premium products (over 7.5% ABV) not removed as part of RtS (value £)</u>								
<u>Pre-intervention slope</u>	<u>0.0089</u>	<u>0.00427</u>	<u>0.0005 to 0.0172</u>	<u>0.037</u>	<u>0.0162</u>	<u>0.00446</u>	<u>0.0075 to 0.0250</u>	<u>&lt;0.001</u>
<u>Intercept/step change</u>	<u>0.2501</u>	<u>0.08573</u>	<u>0.0821 to 0.4181</u>	<u>0.004</u>	<u>-0.1518</u>	<u>0.08542</u>	<u>-0.3192 to 0.0156</u>	<u>0.076</u>
Spirits (value £)								
Pre-intervention slope	-0.0033	0.00088	-0.0050 to -0.0015	<0.001	-0.0001	0.00100	-0.0020 to 0.0018	0.933
Intercept/step change	0.0103	0.01775	-0.0244 to 0.0450	0.562	-0.0404	0.01902	-0.0777 to -0.0031	0.033
Affordable sparkling/low alcohol wines (value £)								
Pre-intervention slope	0.0057	0.00308	-0.0003 to 0.0117	0.066	0.0072	0.00343	0.0004 to 0.0139	0.036
Intercept/step change	0.0014	0.06186	-0.1198 to 0.1226	0.982	-0.0509	0.06552	-0.1793 to 0.0775	0.437
Wines (value £)								
Pre-intervention slope	-0.0008	0.00058	-0.0019 to 0.0003	0.150	0.0039	0.00069	0.0025 to 0.0052	<0.001
Intercept/step change	0.0251	0.01165	0.0022 to 0.0479	0.031	-0.0401	0.01314	-0.0658 to -0.0143	0.002

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All alcohol products (value £)								
Pre-intervention slope	-0.0008	0.00072	-0.0022 to 0.0005	0.243	0.0017	0.00084	0.0001 to 0.0033	0.040
Intercept/step change	-0.0097	0.01437	-0.0379 to 0.0184	0.498	-0.0279	0.01597	-0.0592 to 0.0033	0.080

CI: Confidence intervals; SE: Standard errors.

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**Table S2-2** Coefficients of segmented linear regression on log transformed total units of beer/lager and cider sold taking into account first-order autocorrelation (AR(1)) within panels

Product category and parameter	Estimated RtS effect at wave 1				Estimated RtS effect at wave			
	beta	SE	95% CI	p value	beta	SE	95% CI	p value
Beer/lager and cider (units)			$\rho = 0.88$				$\rho = 0.84$	
Pre-intervention slope	-0.0011	0.00649	-0.0138 to 0.0117	0.870	0.0057	0.00617	-0.0064 to 0.0178	0.356
Intercept/step change	0.0361	0.07885	-0.1184 to 0.1907	0.647	-0.0700	0.08138	-0.2295 to 0.0895	0.390
<a href="#">High-strength premium (over 7.5% ABV) not removed as part of RtS (units)</a>			$\rho = 0.66$				$\rho = 0.72$	
<a href="#">Pre-intervention slope</a>	<a href="#">0.0159</a>	<a href="#">0.01191</a>	<a href="#">-0.0074 to 0.0393</a>	<a href="#">0.181</a>	<a href="#">0.0012</a>	<a href="#">0.01293</a>	<a href="#">-0.0242 to 0.0265</a>	<a href="#">0.927</a>
<a href="#">Intercept/step change</a>	<a href="#">0.0034</a>	<a href="#">0.20631</a>	<a href="#">-0.4010 to 0.4077</a>	<a href="#">0.987</a>	<a href="#">0.1303</a>	<a href="#">0.20781</a>	<a href="#">-0.2770 to 0.5376</a>	<a href="#">0.531</a>
Spirits (units)			$\rho = 0.81$				$\rho = 0.85$	
Pre-intervention slope	-0.0047	0.00366	-0.0118 to 0.0025	0.202	-0.0009	0.00445	-0.0097 to 0.0078	0.832
Intercept/step change	0.0199	0.05238	-0.0828 to 0.1225	0.704	-0.0436	0.05750	-0.1564 to 0.0691	0.448
Affordable sparkling/low alcohol wines (units)			$\rho = 0.72$				$\rho = 0.76$	
Pre-intervention slope	0.0059	0.01244	-0.0185 to 0.0303	0.634	0.0176	0.01352	-0.0089 to 0.0441	0.193
Intercept/step change	0.1611	0.20263	-0.2360 to 0.5583	0.427	-0.1802	0.20721	-0.5864 to 0.2259	0.384
Wines (units)			$\rho = 0.89$				$\rho = 0.91$	
Pre-intervention slope	0.0050	0.00407	-0.0030 to 0.0130	0.222	0.0170	0.00453	0.0082 to 0.0259	0.000
Intercept/step change	0.1393	0.04688	0.0474 to 0.2312	0.003	-0.1252	0.04945	-0.2221 to -0.0282	0.011
All alcohol products (units)			$\rho = 0.91$				$\rho = 0.89$	
Pre-intervention slope	0.0006	0.00421	-0.0076 to 0.0089	0.885	0.0097	0.00446	0.0010 to 0.0185	0.029
Intercept/step change	0.0774	0.04615	-0.0131 to 0.1679	0.094	-0.1109	0.05218	-0.2132 to -0.0087	0.034
Beer/lager and cider (value £)			$\rho = 0.89$				$\rho = 0.88$	
Pre-intervention slope	-0.0037	0.00536	-0.0142 to 0.0068	0.487	0.0030	0.00496	-0.0067 to 0.0127	0.545
Intercept/step change	0.0385	0.06230	-0.0836 to 0.1606	0.537	-0.0645	0.05971	-0.1815 to 0.0526	0.280
<a href="#">High-strength premium (over 7.5% ABV) not removed as part of RtS (value £)</a>			$\rho = 0.66$				$\rho = 0.72$	
<a href="#">Pre-intervention slope</a>	<a href="#">0.0182</a>	<a href="#">0.01170</a>	<a href="#">-0.0047 to 0.0411</a>	<a href="#">0.120</a>	<a href="#">0.0034</a>	<a href="#">0.01278</a>	<a href="#">-0.0216 to 0.0285</a>	<a href="#">0.787</a>
<a href="#">Intercept/step change</a>	<a href="#">0.0092</a>	<a href="#">0.20257</a>	<a href="#">-0.3878 to 0.4062</a>	<a href="#">0.964</a>	<a href="#">0.1265</a>	<a href="#">0.20558</a>	<a href="#">-0.2765 to 0.5294</a>	<a href="#">0.538</a>
Spirits (value £)			$\rho = 0.82$				$\rho = 0.86$	
Pre-intervention slope	-0.0031	0.00288	-0.0088 to 0.0025	0.276	0.0008	0.00347	-0.0060 to 0.0076	0.808
Intercept/step change	0.0223	0.04043	-0.0569 to 0.1016	0.580	-0.0460	0.04337	-0.1310 to 0.0390	0.288
Affordable sparkling/low alcohol wines (value £)			$\rho = 0.78$				$\rho = 0.78$	
Pre-intervention slope	0.0042	0.01041	-0.0162 to 0.0245	0.690	0.0107	0.01139	-0.0117 to 0.0330	0.349
Intercept/step change	0.0937	0.15624	-0.2126 to 0.3999	0.549	-0.1036	0.16870	-0.4342 to 0.2271	0.539
Wines (value £)			$\rho = 0.93$				$\rho = 0.91$	
Pre-intervention slope	-0.0009	0.00303	-0.0068 to 0.0050	0.763	0.0040	0.00269	-0.0012 to 0.0093	0.133
Intercept/step change	0.0324	0.03053	-0.0274 to 0.0922	0.289	-0.0457	0.02893	-0.1024 to 0.0110	0.114
All alcohol products (value £)			$\rho = 0.92$				$\rho = 0.89$	

Pre-intervention slope	-0.0023	0.00365	-0.0095 to 0.0049	0.527	0.0042	0.00310	-0.0019 to 0.0102	0.179
Intercept/step change	0.0370	0.03767	-0.0368 to 0.1108	0.326	-0.0764	0.03585	-0.1466 to -0.0061	0.033

CI: Confidence intervals; SE: Standard errors.

$\rho$  is the autocorrelation parameter (i.e. the correlation coefficient between adjacent error terms).

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## References

1. Hoechle D. Robust standard errors for panel regressions with cross-sectional dependence. *The Stata Journal* 2007;**7**(3):281-312
2. Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *Journal of clinical pharmacy and therapeutics* 2002;**27**(4):299-309
3. Linden A. Conducting interrupted time-series analysis for single- and multiple-group comparisons. *The Stata Journal* 2015;**15**(2):480-500
4. Hawkins NG, Sanson-Fisher RW, Shakeshaft A, D'Este C, Green LW. The multiple baseline design for evaluating population-based research. *American journal of preventive medicine* 2007;**33**(2):162-8 doi: 10.1016/j.amepre.2007.03.020[published Online First: Epub Date]].

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## Appendix S3 Description of stores.

Table S3 Descriptive statistics of stores.

	Stores in wave 1 (n=54)			Stores in wave 2 (n=77)			All stores (n=131)		
	Mean (SD) or n (%)	Median	Min - Max	Mean (SD) or n (%)	Median	Min - Max	Mean (SD) or n (%)	Median	Min - Max
Urban	37 (68.5%)			47 (61.0%)			84 (64.1%)		
IMD score	16.6 (10.01)	14.1	3.4 – 43.3	19.3 (11.96)	16.0	4.2 – 51.4	18.2 (11.24)	15.1	3.4 – 51.4
Store size (sq feet)	3908 (3504.3)	2861	1019 - 21205	3974 (3917.8)	2685	1000 - 19709	3947 (3739.1)	2777	1000 - 21205
Opening hours	95 (9.2)*	96	63 – 110.5	99 (7.4)	101	71 - 114	98 (8.4)	97	63 – 110.5

\*P&lt;0.05, \*\*P&lt;0.01, \*\*\*P&lt;0.001

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3 **Appendix S4** Impact of RtS initiative on log transformed sales and units of alcohol sold for different categories of alcohol.  
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6 **Figure S4-1** Impact of RtS initiative on log transformed units of alcohol sold for beer/lager and cider. Wave 1 stores started  
7 implementation by September 2012. Wave 2 stores started implementation by September 2013.  
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10 **Figure S4-2** Impact of RtS initiative on log transformed units of alcohol sold for high-strength premium products that were not  
11 removed as part of the RtS initiative. Wave 1 stores started implementation by September 2012. Wave 2 stores started implementation  
12 by September 2013.  
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14 **Figure S4-3** Impact of RtS initiative on log transformed units of alcohol sold for spirits. Wave 1 stores started implementation by  
15 September 2012. Wave 2 stores started implementation by September 2013.  
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18 **Figure S4-4** Impact of RtS initiative on log transformed units of alcohol sold for affordable sparkling and low alcohol wines. Wave 1  
19 stores started implementation by September 2012. Wave 2 stores started implementation by September 2013.  
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21 **Figure S4-5** Impact of RtS initiative on log transformed units of alcohol sold for wines. Wave 1 stores started implementation by  
22 September 2012. Wave 2 stores started implementation by September 2013.  
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25 **Figure S4-6** Impact of RtS initiative on log transformed units of alcohol sold for all alcohol products. Wave 1 stores started  
26 implementation by September 2012. Wave 2 stores started implementation by September 2013.  
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29 **Figure S4-7** Impact of RtS initiative on log transformed sales for beer/lager and cider. Wave 1 stores started implementation by  
30 September 2012. Wave 2 stores started implementation by September 2013.  
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32 **Figure S4-8** Impact of RtS initiative on log transformed sales for high-strength premium products that were not removed as part of the  
33 RtS initiative. Wave 1 stores started implementation by September 2012. Wave 2 stores started implementation by September 2013.  
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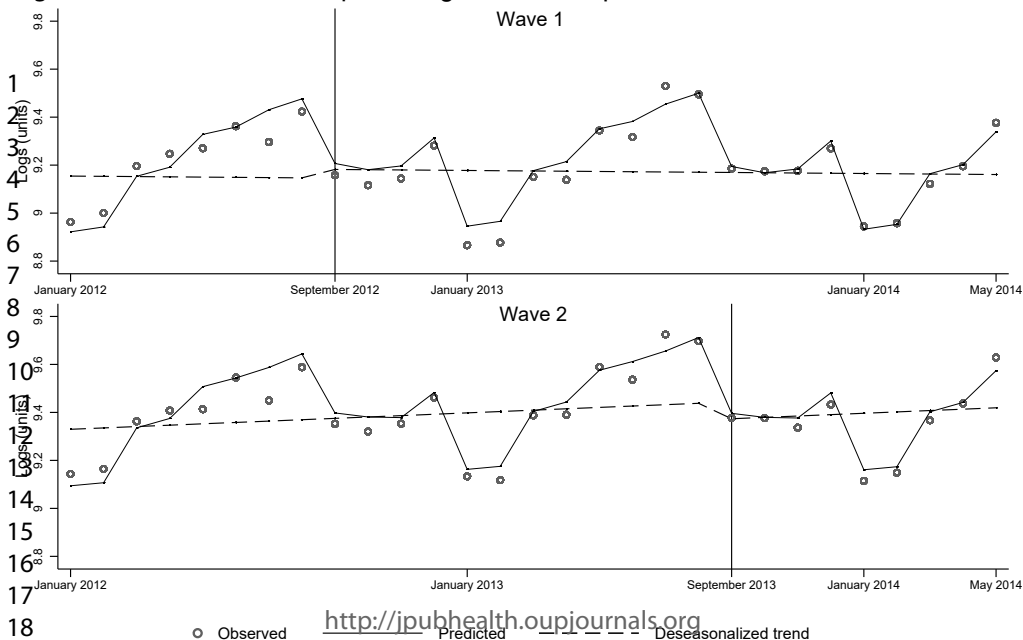
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36 **Figure S4-9** Impact of RtS initiative on log transformed sales for spirits. Wave 1 stores started implementation by September 2012.  
37 Wave 2 stores started implementation by September 2013.  
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3 **Figure S4-10** Impact of RtS initiative on log transformed sales for affordable sparkling and low alcohol wines. Wave 1 stores started  
4 implementation by September 2012. Wave 2 stores started implementation by September 2013.  
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7 **Figure S4-11** Impact of RtS initiative on log transformed sales for wines. Wave 1 stores started implementation by September 2012.  
8 Wave 2 stores started implementation by September 2013.  
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10 **Figure S4-12** Impact of RtS initiative on log transformed sales for all alcohol products. Wave 1 stores started implementation by  
11 September 2012. Wave 2 stores started implementation by September 2013.  
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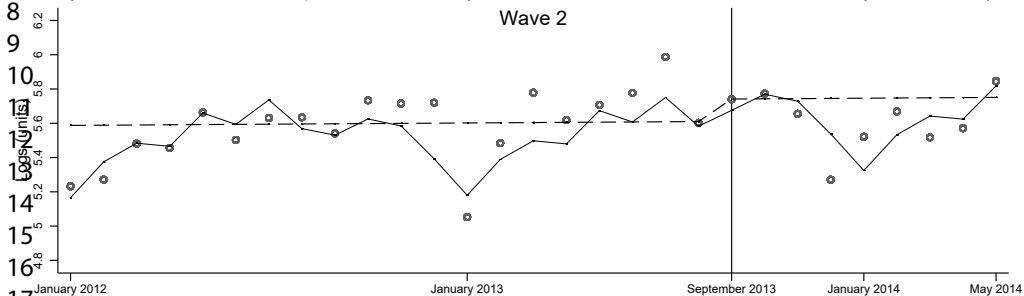
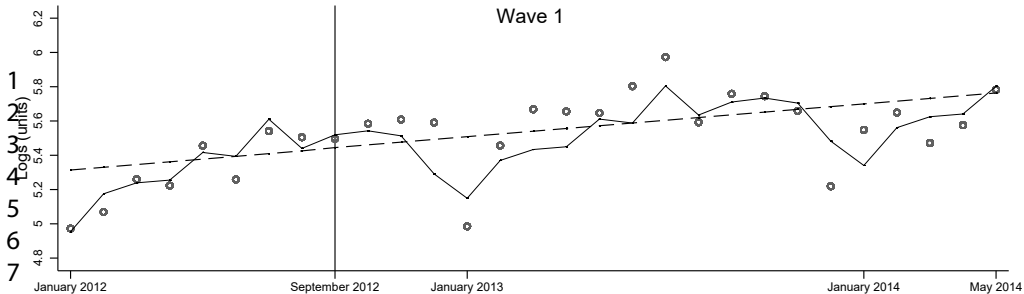


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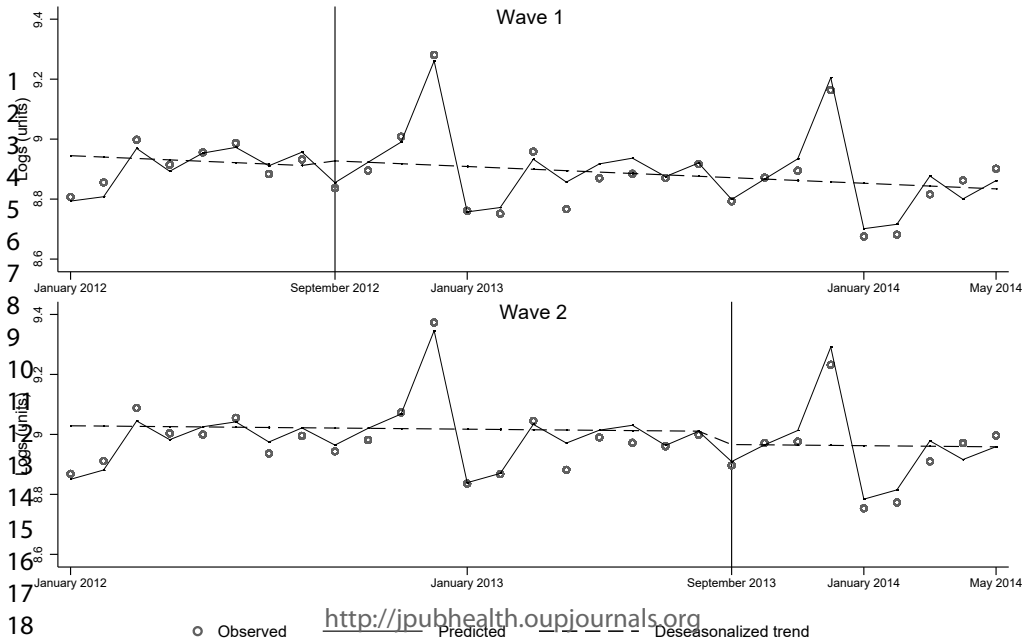
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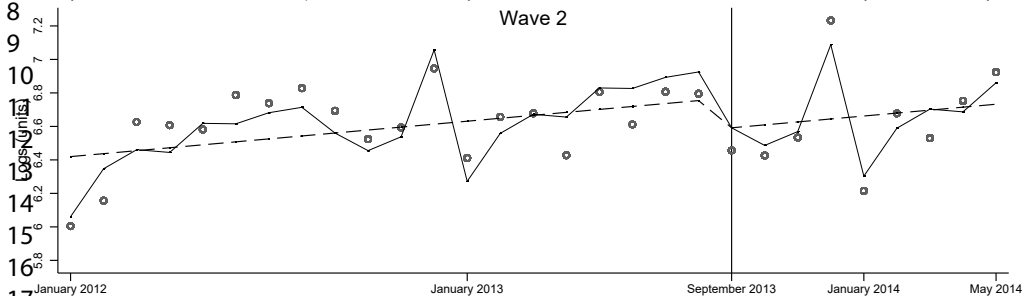
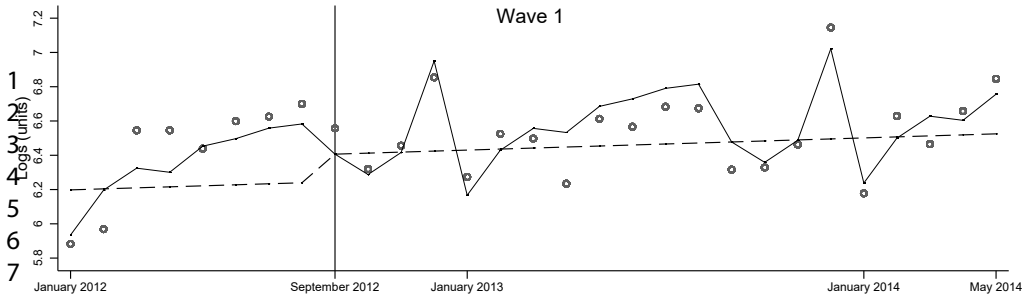


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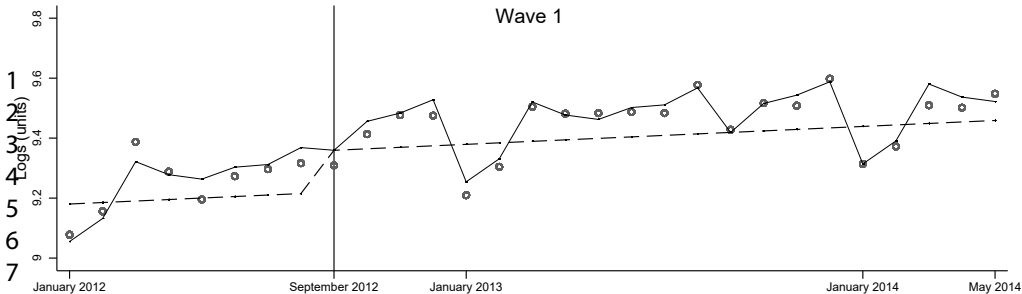
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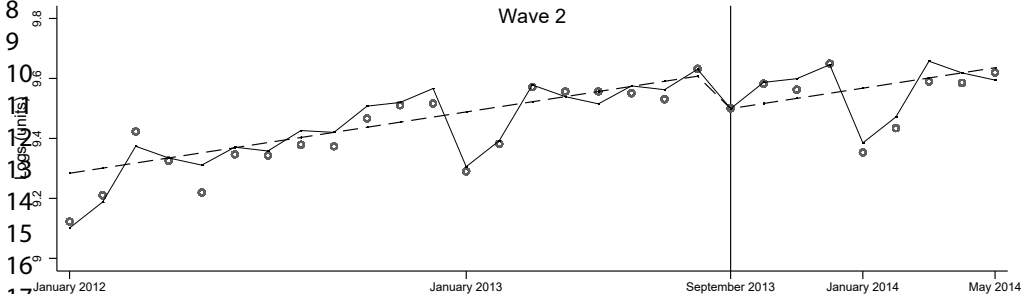


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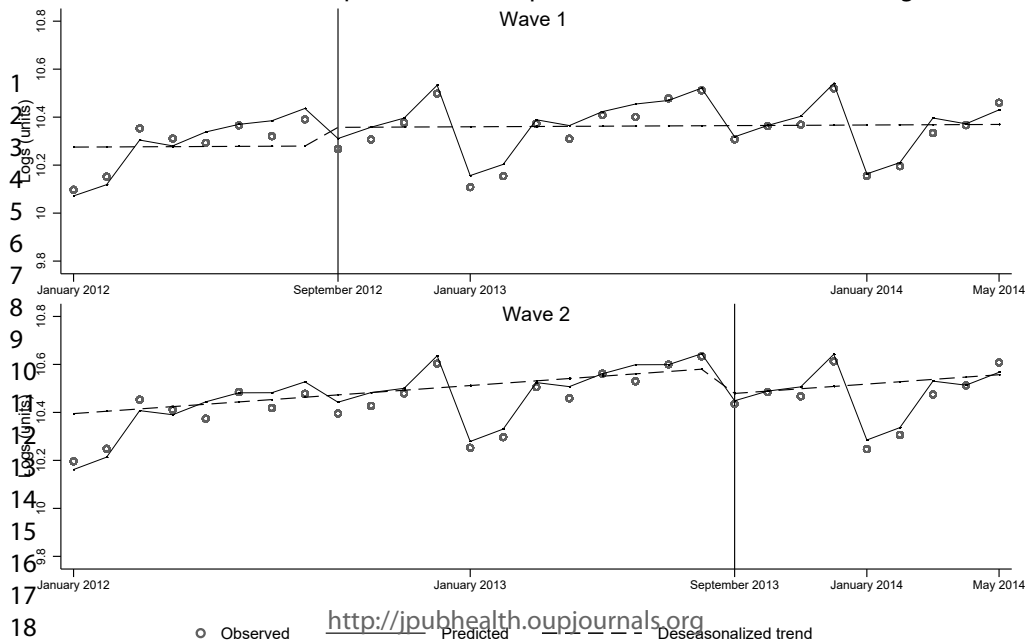
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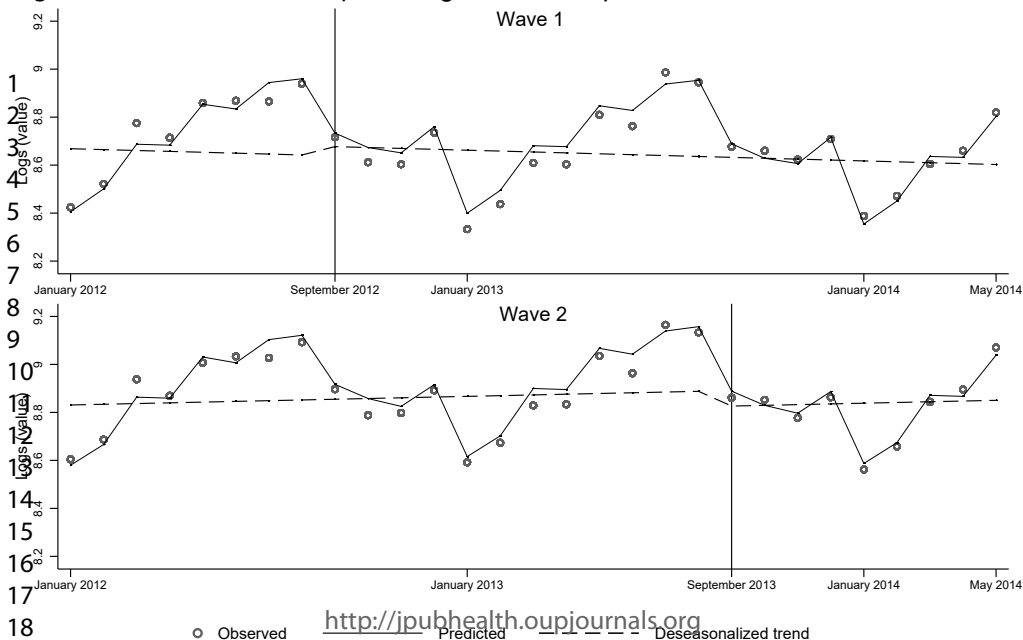


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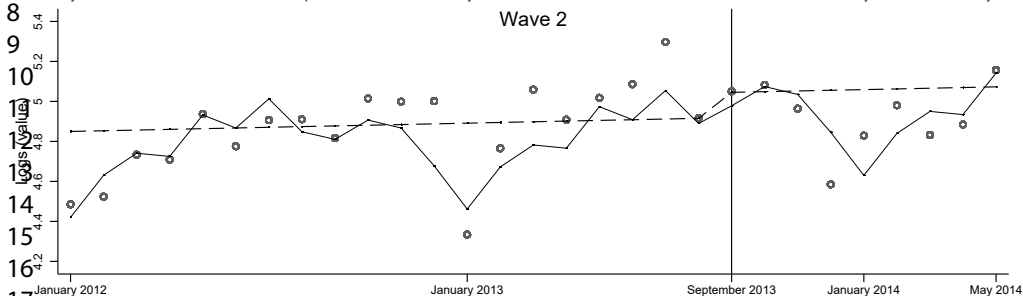
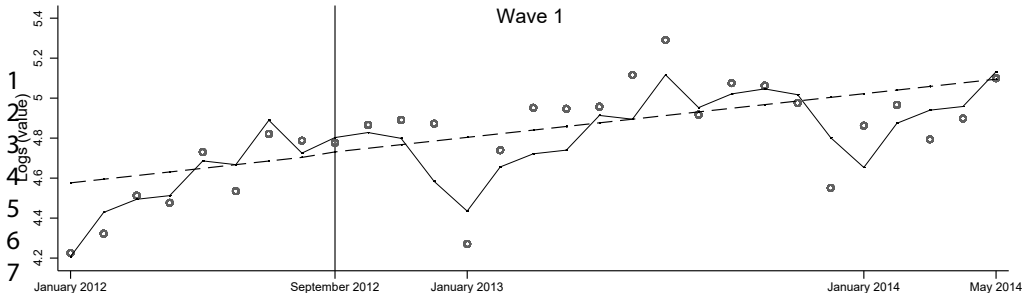


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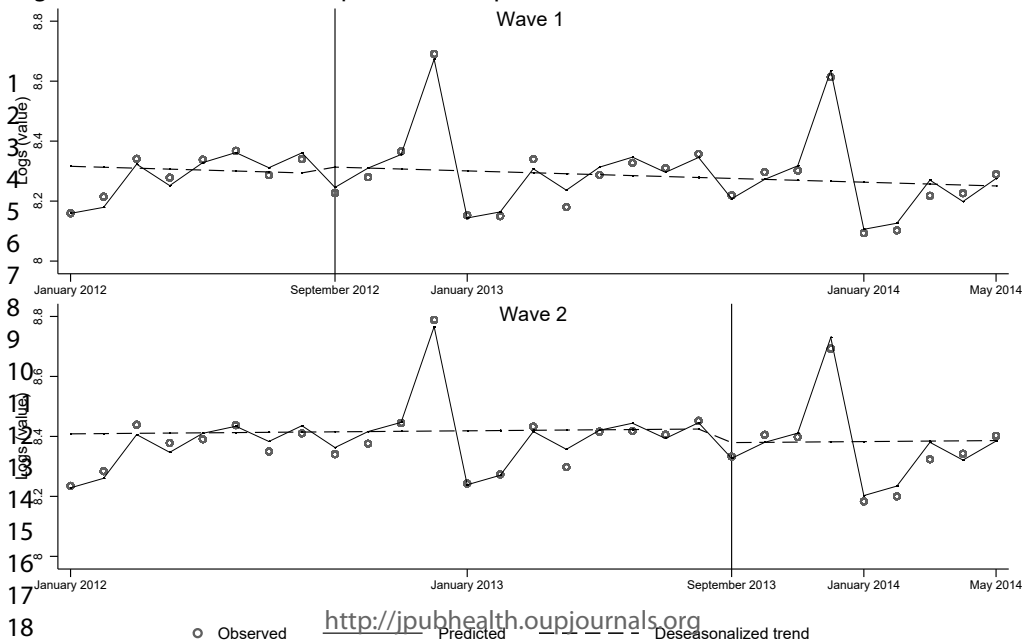
<http://jpubhealth.oupjournals.org>

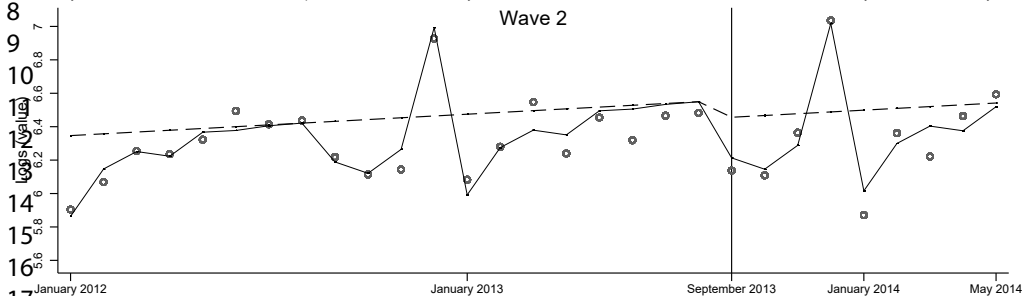
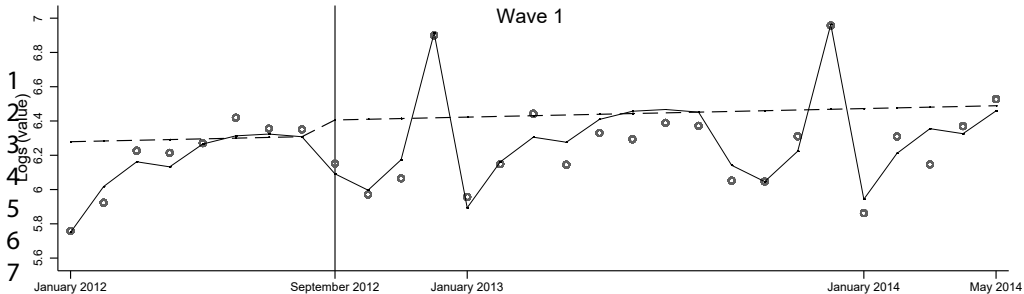
— Predicted

- - - Deseasonalized trend



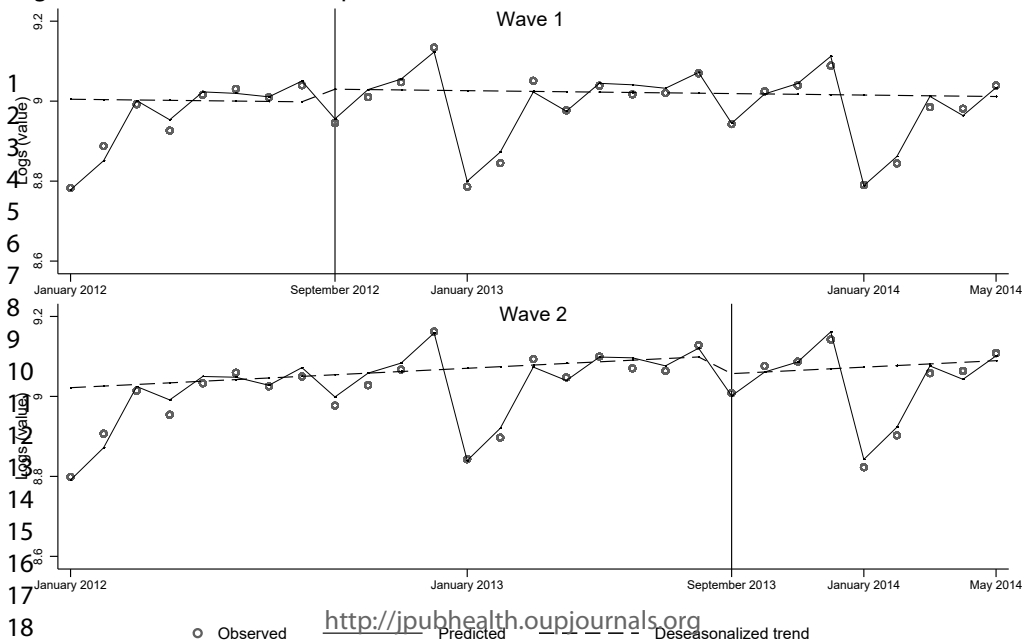
18 ○ Observed <http://jpubhealth.oupjournals.org> Predicted Deseasonalized trend

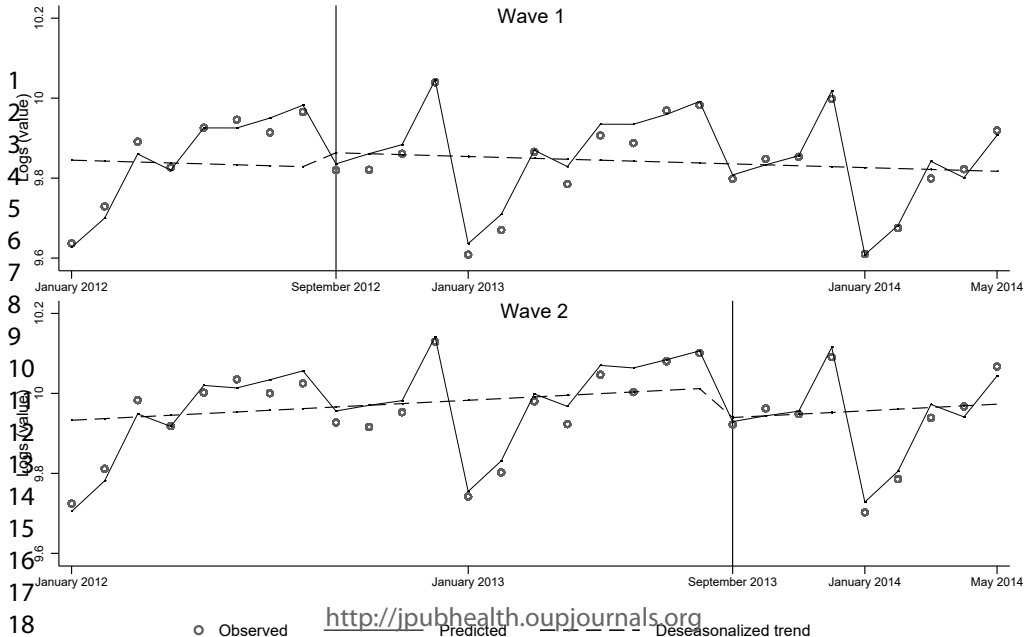




○ Observed      http://jpubhealth.oupjournals.org      — Predicted      - - - Deseasonalized trend







## Abstract

### Background

'Reducing the Strength' (RtS) is a public health initiative encouraging retailers to voluntarily stop selling cheap, strong beers/ciders ( $\geq 6.5\%$  alcohol by volume). This study evaluates the impact of RtS initiatives on alcohol availability and purchasing in three English counties with a combined population of 3.62 million people.

### Methods

We used a multiple baseline time-series design to examine retail data over 298 months from a supermarket chain that experienced a two-wave, area-based roll out of RtS: initially 54 stores (W1), then another 77 stores (W2). We measured impacts on units of alcohol sold (primary outcome: beers/~~and ciders only~~; secondary outcome: all alcoholic ~~beverages products~~). ~~We measured~~ economic impacts on alcohol sales (~~£~~)~~and substitution effects~~.

### Results

We observed a non-significant W1 increase (+3.7%, 95% CI = -11.2, 21.0) and W2 decrease (-6.8%, 95% CI = -20.5, 9.4) in the primary outcome. We observed a significant W2 decrease in units sold across all alcohol ~~beverages products~~ (-10.5%, 95% CI = -19.2, -0.9), ~~but the~~ ~~The~~ direction of effect between waves was inconsistent for all outcomes, ~~including alcohol sales, with no evidence of substitution effects~~.

### Conclusions

In the UK, voluntary RtS initiatives appear to have little or no impact on reducing alcohol availability and purchase from the broader population of supermarket customers.

## 1 Introduction

2 Modifying the availability of commercial products (e.g. alcohol, ~~food, food tobacco~~) is a  
3 widely advocated public health strategy.<sup>1,2</sup> ~~For example, the~~ The World Health Organization's  
4 ~~global strategy to reduce the harmful use of alcohol~~ has proposed ~~s~~ a number of interventions  
5 and policies to reduce availability including interventions ~~reducing that reduce~~ the alcoholic  
6 strength of ~~available beverages products~~.<sup>3</sup> ~~National policies affecting different types of~~  
7 ~~product availability have been advocated but regulating the sale and consumption of such~~  
8 ~~products in jurisdictions around the world takes place at sub-national levels. Studies Research~~  
9 from ~~the~~ North America, Australia and Europe ~~has~~ ve examined ~~different~~ ways in which  
10 modifying local food availability ~~may impact~~ impacts on health ~~related~~ outcomes,<sup>4-7</sup> but there  
11 are relatively few er evaluations of local alcohol availability ~~interventions evaluations in the~~  
12 ~~academic literature~~.<sup>1, 6, 8-14</sup>

13 Alcohol is a causal factor in more than 200 disease and injury conditions accounting for 5.9%  
14 of ~~all~~ deaths worldwide.<sup>2</sup> Social costs attributable to alcohol, including crime and disorder,  
15 representing ~~ing-between~~ 1.3% to 3.3% of gross domestic product globally.<sup>2</sup> Interventions  
16 modifying alcohol availability have been seen to reduce both alcohol consumption and  
17 alcohol related harm.<sup>2, 15-19</sup> In ~~ma~~ many countries, including the United Kingdom (UK),  
18 attempts to modify availability through national government regulation, such as minimum  
19 unit pricing, have ~~been~~ met with political and legal barriers. Regulating the sale and  
20 consumption of alcohol products often takes place at sub-national levels.<sup>6, 8, 20</sup> Concurrently,  
21 local government initiatives to reduce alcohol availability have been implemented, involving  
22 both statutory and voluntary approaches, the latter often targeting specific population  
23 groups.<sup>15, 21-24</sup>

1  
2  
3 24 Evaluative research of natural policy experiments is important because innovative practices  
4  
5 25 can diffuse to new settings, including across national boundaries, sometimes before they have  
6  
7 26 ~~been had a chance to be~~ robustly evaluated.<sup>25, 26</sup> Reducing the strength of alcoholic ~~beverages~~  
8  
9 27 ~~products~~ or modifying ~~high strength product~~ availability ~~by alcoholic strength~~ have been  
10  
11 28 proposed as ‘best practices’ ~~of policies~~ to regulate physical availability.<sup>3, 27</sup> This, however,  
12  
13 29 stems from an interpretation of availability theory rather than a synthesis of empirical  
14  
15 30 evidence assessing impacts of reducing availability of high strength beers and ciders (so-  
16  
17 31 called ‘superstrength’ products) and the evidence base around this is under-developed.  
18  
19 32 Superstrength products and their marketing have been said to encourage alcohol misuse and  
20  
21 33 harmful behaviours among vulnerable populations.<sup>28</sup> In the UK, the term ‘Reducing the  
22  
23 34 Strength’ (RtS) is now widely used to refer to area-based public health initiatives that involve  
24  
25 35 removing low price, superstrength ~~alcoholic~~ products from sale in stores through voluntary  
26  
27 36 agreements with local retailers and off-licenses. RtS has been originally designed to tackle  
28  
29 37 problems associated with alcohol social harms, often ~~with a focused~~ on street drinking.<sup>22</sup>  
30  
31 38 Suffolk was the first ~~UK area in the UK~~ to adopt the initiative in 2012 as part of a multi-  
32  
33 39 intervention approach to tackling street drinking. ~~S, and~~ since then at least 30 schemes have  
34  
35 40 been implemented in the UK.<sup>29</sup> The approach varies, but most RtS initiatives tend to target  
36  
37 41 alcohol products above 6.5% alcohol by volume (ABV), although some have focused on a  
38  
39 42 slightly lower ABV or lower cost products.<sup>22</sup> ~~In this RtS, the products targeted were lower~~  
40  
41 43 ~~cost products above 7.5% ABV.~~ Superstrength products vary by price, brand and strength.  
42  
43 44 The least expensive products (e.g. ‘white ciders’) are amongst the lowest cost per unit alcohol  
44  
45 45 products in UK stores, purchased for as little as 11.1 pence per unit.<sup>30, 31</sup> UK local and  
46  
47 46 regional governments have complained to the alcohol industry that specific superstrength  
48  
49 47 products sold in 500ml cans encourage rapid consumption of high quantities of alcohol  
50  
51 48 causing population harms; although ~~this is esse are~~ refuted by the industry.<sup>32</sup>  
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3 49 It has been argued that targeted interventions, such as RtS, offer local and regional  
4  
5 50 government authorities a potential means of tackling ~~some of the more~~ publicly visible social  
6  
7 51 and health problems associated with alcohol consumption.<sup>21, 22, 29</sup> Retailers and the alcohol  
8  
9 52 industry have raised concerns about RtS that have included questioning its evidence base,  
10  
11 53 legal status (in terms of competition law) and its potential financial impact.<sup>22, 33-35</sup> On the  
12  
13 54 other hand, some retailers arguably demonstrate a degree of support for RtS by voluntarily  
14  
15 55 participating in ~~the~~ initiatives, although their reasons for doing so may vary. For example,  
16  
17 56 some retailers saw street drinking as a problem in their area and hoped that participation  
18  
19 57 would reduce anti-social behaviour within their own shops while others saw this as an  
20  
21 58 opportunity to co-operate with the licensing authorities.<sup>35</sup> An intervention that is designed to  
22  
23 59 deter anti-social customers could potentially improve shops' image with the wider customer  
24  
25 60 base ~~as well as within addition to~~ licensing authorities and other ~~relevant~~ stakeholders.<sup>22, 33, 36,</sup>  
26  
27 61 <sup>37</sup>

31  
32 62 From a public health perspective, it remains unclear to what extent local-level voluntary  
33  
34 63 interventions, such as RtS, can play an effective role in reducing alcohol consumption ~~and~~  
35  
36 64 ~~alcohol-related health harms~~ at the population level.<sup>12</sup> Retail sales data routinely collected by  
37  
38 65 shops provides one means of measuring the impact of alcohol interventions. Such data can  
39  
40 66 provide an objective and accurate estimate of alcohol purchase and proxy consumption,  
41  
42 67 particularly in the case of larger supermarket and shop chains that have invested heavily in  
43  
44 68 data collection.<sup>38</sup> However, shop-level data are hard to obtain due to commercial sensitivity.<sup>39</sup>  
45  
46 69 ~~T~~and there are few published evaluations of alcohol interventions in the UK using retail data  
47  
48 70 ~~specifically intended~~ to assess changes in physical and economic availability of specific  
49  
50 71 alcohol products for ~~public~~ health improvement.<sup>18, 40</sup>

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2  
3 72 The RtS studied here was originally launched as a joint initiative between Suffolk Police,  
4  
5 73 Ipswich Borough Council, Suffolk County Council and the National Health Service (Suffolk)  
6  
7 74 in September 2012.<sup>41</sup> Following interviews with local practitioners and policymakers who  
8  
9 75 designed and implemented the RtS in Suffolk, we hypothesised several possible mechanisms  
10  
11 76 for RtS impacts on alcohol availability and sales. These include a potential ‘nudge’ effect  
12  
13 77 where the impact of reducing physical availability of alcohol products by removing super-  
14  
15 78 strength products ~~together with marketing of the RtS in local media and within stores~~ helped  
16  
17 79 discourage and denormalise the practice of purchasing cheap products ~~for the purpose of~~  
18  
19 80 immediate intoxication. The RtS was also theorised as an economic availability intervention:  
20  
21 81 customers with finite resources wishing to purchase low cost per unit super-strength products  
22  
23 82 may, on finding those products removed, substitute for products with lower alcohol content  
24  
25 83 or for different alcohol products.<sup>29,35</sup> This study aims to evaluate the impact of the  
26  
27 84 introduction of a RtS initiative on alcohol availability in the form of overall availability of  
28  
29 85 alcohol units and purchasing in one national retail chain across three English counties using  
30  
31 86 time-series analyses of retail sales data.  
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## 36 87 **Methods**

### 38 88 *Setting and intervention*

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41  
42 89 A major supermarket chain (East of England Co-operative Society, known commonly as ‘Co-  
43  
44 90 op’) voluntarily joined RtS in Suffolk and consequently ensured that its stores in that county  
45  
46 91 cleared their stock of all their low-priced brands of high-strength beers/lagers and ciders in  
47  
48 92 the month leading up to September 2012. These consisted of four superstrength products  
49  
50 93 (7.5% to 9.0% ABV) but did not include any ~~of the~~ more expensive ‘craft’ or ‘premium’  
51  
52 94 high-strength products as the implementers did not associate such products with street  
53  
54 95 drinking (Table 1). The same chain required stores in Essex and Norfolk to begin a similar  
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3 96 process of withdrawing those products from sale by September 2013. Every shop from the  
4  
5 97 chain participated in the intervention although a minority of stores, 6% from wave 1 and 36%  
6  
7 98 from wave 2, took longer than one month to stop selling superstrength products (~~see~~  
8  
9 99 Appendix S1).

10  
11  
12 100 [Table 1 here]

13  
14 101 *Data*

15  
16  
17 102 ~~This evaluation is based on m~~Monthly retail sales data ~~were~~ provided for the period January  
18  
19 103 2012 to May 2014 obtained for 131 stores in one retail chain in the three English counties.  
20  
21 104 We used the full range of data that East of England Co-operative Society provided us with for  
22  
23 105 this analysis: the researchers did not have direct access to the company's internal data  
24  
25 106 systems but rather were sent data pertaining only to the intervention period and localities so  
26  
27 107 that the researchers could analyse them independently. ~~The data detailed s~~Shop-level  
28  
29 108 characteristics and sales data ~~were available including such as~~ prices, quantities, product  
30  
31 109 brands, alcohol content, and sales for the following drink categories: beer/ lager and cider,  
32  
33 110 wines, affordable sparkling and low alcohol wines, and spirits. Our primary outcome was  
34  
35 111 units of alcohol sold for beer/lager and cider. Secondary outcomes included units of alcohol  
36  
37 112 sold for two high strength premium products (ABV over 7.5%) not removed as part of the  
38  
39 113 RtS (Table 1), the remaining drink categories and for all products in order to examine  
40  
41 114 substitution effects and in line with qualitative findings on drinkers' responses to RtS. We  
42  
43 115 looked at sales value to assess the potential economic impact of RtS on stores. Stores in  
44  
45 116 Suffolk (n=54) were regarded as stores participating in wave 1 (~~W1~~) of the intervention and  
46  
47 117 stores in Norfolk and Essex (n=77) as stores participating in wave 2 (~~W2~~) a year later.  
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3 118 *Statistical analysis*

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5 119 We used a quasi-experimental multiple baseline time-series design<sup>42</sup> to study changes in units  
6  
7 120 of alcohol sold and sales value for beer/lager and cider, wines, sparkling and low alcohol  
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9 121 wines, spirits and for total alcohol products after the introduction of the RtS initiative. The  
10  
11 122 RtS was introduced in a staggered approach, implemented at two different time points (~~wave~~  
12  
13 W1 and ~~wave~~ W2) across three different geographical areas with a combined population of  
14  
15 123 3,62 million people.<sup>43</sup> We examined the impact of implementing RtS separately for the two  
16  
17 124 waves in order to identify whether the intervention produced similar effects in the entire  
18  
19 125 population of interest (ie. whether the impact of the intervention was consistent in the two  
20  
21 126 waves).<sup>42, 44</sup> The repeated pattern of a reduction in the measured outcome following the  
22  
23 127 implementation of the intervention in each geographical area (i.e. wave) would suggest that  
24  
25 128 the intervention is having an effect.<sup>42</sup> An appropriate statistical approach to evaluate such  
26  
27 129 impacts is the use of segmented linear regression, which divides a time series into pre- and  
28  
29 130 post-intervention segments,<sup>44</sup> with panel-corrected standard errors.<sup>45, 46</sup> We took  
30  
31 131 autocorrelation into account by means of a common autoregressive first order (AR(1)) model  
32  
33 132 and we included the calendar month as a term to adjust for seasonality.<sup>44, 47</sup> Details of the  
34  
35 133 assumptions and model specification are available in Appendix S2.  
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37 134

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40 135 The intervention effect was assumed to occur immediately after implementation, so no  
41  
42 136 transition period was taken into account in the analysis. We log-transformed our dependent  
43  
44 137 variables as these were highly skewed. For ease of interpretation, regression coefficients ( $\beta$ )  
45  
46 138 were converted into per cent change in sales and units of alcohol sold using the formula  
47  
48 139  $[\exp(\beta)-1]*100$ . This approach was used to ensure data confidentiality when using  
49  
50 140 commercially sensitive information, such as sales of specific alcohol products and brands.  
51  
52 141 We therefore examined substitution effects at a product category level (~~e.g. beers/ciders,~~

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3 142 | ~~wines, spirits, etc)~~ and for high-strength premium products that were not removed rather than  
4  
5 143 | at the level of specific products or brands. ~~All a~~Analysis was carried out in Stata 14.1.  
6  
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## 8 144 | **Results**

9  
10 145 | Stores in ~~wave-W~~1 and ~~wave-W~~2 were similar in terms of size, area-level deprivation score  
11  
12 146 | and urban vs semi-urban location. Stores in ~~wave-W~~1 were open on average for fewer hours  
13  
14 147 | compared to those in ~~wave-W~~2 (Appendix S3). Mean units of alcohol sold per store per  
15  
16 148 | month were lower in ~~wave-W~~1 compared to ~~wave-W~~2 stores in all products. Overall,  
17  
18 149 | beer/lager and cider accounted for 32.4% of total units of alcohol sold during the study  
19  
20 150 | period. Super-strength products removed had previously accounted for 6.5% and 3.6% of  
21  
22 151 | total units sold for beer/lager and cider in ~~wave-W~~1 and ~~wave-W~~2 stores, respectively (Table  
23  
24 152 | 2). In terms of sales, these four products accounted for 2.1% and 1.3% of total revenue for  
25  
26 153 | ~~wave-W~~1 and ~~W~~2 stores, respectively, before the intervention (data not shown).  
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30 154 | [Table 2 here]  
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33 155 | Our analysis indicates that the impact of RtS on units of alcohol sold for beer/lager and cider  
34  
35 156 | was not significant in the two waves (Fig. 1 and Appendix S4). More specifically, following  
36  
37 157 | RtS implementation, ~~wave-W~~1 stores experienced a non significant increase (3.7%, 95%  
38  
39 158 | Confidence Intervals (CI) = -11.2 – 21.0, P=0.647) whereas ~~wave-W~~2 stores experienced a  
40  
41 159 | non significant decrease (-6.8%, 95% CI =-20.5 – 9.4, P =0.390) (Figure 1). In terms of all  
42  
43 160 | alcohol products, the introduction of RtS was associated with a non significant increase in  
44  
45 161 | ~~wave-W~~1 stores (8.0%, 95% CI = -1.3 – 18.3, P =0.094). In contrast, a significant decrease (-  
46  
47 162 | 10.5%, 95% CI =-19.2 – -0.9, P =0.034) was observed in ~~wave-W~~2 stores (Fig. 2 and  
48  
49 163 | Appendix S4). Similar patterns for beer/cider and lager were observed for sales value, ~~which~~  
50  
51 164 | ~~indicate that the RtS had a minimal impact on revenue generated from beer/lager and cider by~~  
52  
53 165 | ~~all stores~~ (Fig. 2).  
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3 166 [Figure 1 and Figure 2 here]  
4  
5

6 167 In order to examine substitution effects we repeated the analysis for high-strength premium  
7  
8 168 products, spirits, affordable sparkling and low alcohol wines and wines. We found that all  
9  
10 169 product categories experienced similar changes in units of alcohol sold and sales value during  
11  
12 170 this time period in ~~wave-W1~~ and ~~wave-W2~~ to those observed for beer/lager and cider. None  
13  
14 171 of them were significant except for units of alcohol sold for wines, which appeared to drive  
15  
16 172 the significant decrease observed in units of alcohol sold for all products. We found no  
17  
18 173 evidence of substitution effects for high-strength premium products (Fig. 1 and Appendix  
19  
20  
21 174 S4). ~~This suggests that there has been no observable substitution effects of alcohol products~~  
22  
23 175 ~~attributable to the RtS intervention in the 131 stores.~~  
24  
25

## 26 176 **Discussion**

### 27 28 177 *Main findings of this study*

29  
30  
31 178 We used retail sales data to evaluate the introduction of RtS, a public health initiative targeted  
32  
33 179 at supermarkets and off-licenses to remove low cost, super-strength beers and ciders from  
34  
35 180 sale in three English counties. Our results show that this RtS had no significant impact on  
36  
37 181 total units of alcohol sold and sales value for beer/lager and cider. We also found no  
38  
39 182 observable substitution effects of alcohol products attributable to the RtS intervention in the  
40  
41 183 131 stores.  
42  
43  
44

### 45 184 *What is already know on the topic*

46  
47  
48 185 Only a small number of previous studies have ~~previously~~ used retail sales data in similar  
49  
50 186 quasi-experimental designs to evaluate alcohol interventions. Evaluation of the Scottish  
51  
52 187 Alcohol Act 2010 showed that banning alcohol multi-buy promotions did not reduce alcohol  
53  
54 188 purchasing at the household level,<sup>18</sup> and the introduction of the Alcohol Act was not  
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189 associated with any changes in off-trade beer sales.<sup>40</sup> In our study, the majority of results  
190 were non significant. The small significant decrease in units and value of alcohol sales of all  
191 products in ~~wave-W2~~ stores appears to be driven by declining wine (rather than beer/cider)  
192 sales.<sup>48</sup> Furthermore, the changes observed in the two waves were not consistent and so the  
193 overall findings showed no intervention attributable impact.<sup>42</sup>

194 An Australian evaluation of local alcohol availability restrictions (~~relating to~~ cask wines and  
195 products over 2.7% ABV) found that some participants ~~were prepared to travel~~travelled  
196 further to access non-participating shops.<sup>13, 14</sup> In our study we theorise that overall alcohol  
197 purchases could be influenced by whether or not customers changed where they purchased  
198 alcohol (i.e. shops not participating in RtS), or if they substituted products within  
199 participating stores.<sup>14</sup> Our study focused on one retail chain which maintained compliance  
200 with RtS<sup>22</sup> and we found no substitution effects between categories of alcohol products  
201 within study stores attributable to the intervention. Customers in the study areas had the  
202 ability to access other local stores that did not participate in the RtS but we did not detect any  
203 sudden or sustained loss of income in participating stores that might be expected if substantial  
204 numbers of customers had started shopping elsewhere for alcohol. The availability of  
205 alternative stores not participating may vary within and between the three counties studied.

#### 206 *Limitations of this study*

207 The retail data we had available related to one retail supermarket chain and the data available  
208 could not be used to consider ~~(for example)~~ overall area effects, shop-level or brand/product-  
209 level substitution effects, individual or sub-group level purchasing or consumption.<sup>14, 18, 37</sup>  
210 Our results cannot be generalized to RtS initiatives that have removed products with >6.5%  
211 or lower ABV. We did not have the data to measure long term impacts on purchasing and  
212 consumption, although we theorised that RtS should impact on availability as soon as shops

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2  
3 213 stopped selling superstrength products.<sup>13, 14</sup> The confidence intervals for our findings were  
4  
5 214 wide and statistical precision might have been improved with inclusion of a greater number  
6  
7 215 of stores, and/or time points.<sup>44, 46</sup> Stores in ~~waves W1~~ and ~~W2~~ had different rates of  
8  
9 216 compliance, which may compromise internal validity.<sup>42</sup> In addition, RtS is only one  
10  
11 217 intervention targeting alcohol consumption and harms, and we are aware that there are a  
12  
13 218 range of local alcohol policies routinely implemented in local government which we were  
14  
15 219 unable to adjust for. Such unmeasured events may introduce confounding and compromise  
16  
17 220 internal validity.<sup>49</sup> Finally, segmented regression analysis has its own limitations, allowing  
18  
19 221 only linear trends to be examined but changes may follow non-linear patterns.<sup>44</sup>

22 *What this study adds*

23  
24  
25 223 ~~Despite these limitations, o~~Our study makes an important contribution to the [evidence-base](#)  
26  
27 224 ~~evaluation for local~~of [public health voluntary retail](#) alcohol interventions, ~~particularly~~  
28  
29 225 ~~voluntary retail initiatives, and adds to the limited evidence base.~~<sup>18, 40</sup> The use of retail data is  
30  
31 226 ~~relatively~~novel for ~~conducting evaluation~~[evaluating](#) of alcohol initiatives and it has been  
32  
33 227 advocated as ~~one of the best~~[an important](#) means to monitor alcohol consumption<sup>40, 50</sup> despite  
34  
35 228 ~~the~~their limitations.<sup>38</sup> In this study, we used a retail sales time series panel data set, that  
36  
37 229 contains far more information than single cross-sectional data allowing for an increased  
38  
39 230 precision in estimation.<sup>46</sup> Panel difference-in-differences analysis has been used in a previous  
40  
41 231 study,<sup>18</sup> but we opted to use panel-corrected standard errors within a regression framework,  
42  
43 232 because ignoring possible correlation of regression disturbances over time and between  
44  
45 233 panels may lead to overly optimistic standard errors and lead to biased statistical inference.<sup>46</sup>

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48  
49 234 ~~*What this study adds*~~

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53 235 The RtS initiative<sup>21</sup> was originally developed as part of a strategy that also involved alcohol  
54  
55 236 and drug treatment services and street policing to tackle street drinking and anti-social

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3 237 behavior due to excess alcohol consumption, and there is some evidence that this targeted,  
4  
5 238 multi-intervention approach led to reductions in police call outs and other indicators of social  
6  
7 239 problems related to street drinking.<sup>21, 41</sup> This evaluation does not test RtS's impact on  
8  
9 240 ~~wider these aims~~ of tackling alcohol social harms ~~and including~~ street drinking. ~~It should~~  
10  
11 241 ~~be noted that~~ The RtS was not originally expected to have impacts on reducing overall  
12  
13 242 population alcohol ~~purchasing and intake~~ consumption. Potential secondary effects of RtS on  
14  
15 243 the broader population of alcohol consumers are ~~however~~ of interest to the public health  
16  
17 244 community ~~which has for some time raised concerns about the rise in alcohol health harms~~  
18  
19 245 ~~across the whole population~~.

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21  
22  
23 246 Voluntary agreements between governments and the private sector have previously been used  
24  
25 247 to ~~persuade encourage~~ businesses to take actions.<sup>36</sup> However, there is little evidence to  
26  
27 248 suggest such approaches are more (cost-) effective, particularly if they are unaccompanied by  
28  
29 249 monitoring, and appropriate incentives and sanctions.<sup>36</sup> The alcohol industry and retail sector  
30  
31 250 may be more willing to participate in voluntary initiatives targeting selected population  
32  
33 251 groups (i.e. street drinkers) that have minimal impact on their profits. ~~Our and our~~ analysis  
34  
35 252 suggests that RtS ~~had~~ no impact on ~~revenues~~ businesses. Addressing alcohol related harms  
36  
37 253 and drinking behaviours in ~~'high-risk'~~ ~~these~~ groups is ~~important~~ crucial and should be  
38  
39 254 ~~encouraged~~ but our analysis suggests that RtS may not be ~~an~~ effective ~~instrument~~ for  
40  
41 255 addressing ~~those broader population level~~ alcohol harms across the whole population. The  
42  
43 256 ~~There is a pattern of support from the~~ evidence base recommends ~~for~~ regulatory or statutory  
44  
45 257 enforcement interventions restricting alcohol availability are more effective than over-local  
46  
47 258 non-regulatory ~~or~~ voluntary approaches targeting specific groups.<sup>12, 51-54</sup>

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3 259 **Conclusion**

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5 260 This evaluation did not specifically test impacts on targeted groups, such as ~~homeless and~~  
6  
7 261 street drinkers, but ~~rather examined~~ looked at impacts on all consumers' alcohol purchasing  
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9 262 patterns from one retail supermarket ~~chain-of-store~~. Our findings suggest that voluntary RtS  
10  
11 263 initiatives, have little or no impact on reducing alcohol availability and purchase amongst a  
12  
13 264 broader population of customers ~~at a participating supermarket chain~~. The research literature  
14  
15 265 suggests that more effective regulatory public health interventions will be required to achieve  
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17 266 substantial population health benefits in ~~reducing~~ relation to alcohol consumption and alcohol-  
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19 267 related harms.  
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## References

1. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013–2020. Geneva 2013.
2. World Health Organization. Global status report on alcohol and health. Geneva: World Health Organization; 2014; Available from: Available at: [http://www.who.int/substance\\_abuse/publications/global\\_alcohol\\_report/en/](http://www.who.int/substance_abuse/publications/global_alcohol_report/en/) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh7lvC4k> on 11 December 2015.
3. World Health Organization. Global strategy to reduce the harmful use of alcohol. Geneva: World Health Organization; 2010; Available from: Available at: [http://www.who.int/substance\\_abuse/activities/gsrhua/en/](http://www.who.int/substance_abuse/activities/gsrhua/en/) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh7so88i> on 11 December 2015.
4. Morland KB. An evaluation of a neighborhood-level intervention to a local food environment. *American journal of preventive medicine*. 2010; 39:e31-8.
5. Gase LN, McCarthy WJ, Robles B, Kuo T. Student receptivity to new school meal offerings: assessing fruit and vegetable waste among middle school students in the Los Angeles Unified School District. *Prev Med*. 2014; 67 Suppl 1:S28-33.
6. Soler RE, Whitten KL, Ottley PG. Communities putting prevention to work: Local evaluation of community-based strategies designed to make healthy living easier. *Preventive Medicine*. 2014; 67, Supplement 1:S1-S3.
7. Valdivia Espino J, Guerrero N, Rhoads N, Simon N, Escaron A, Meinen A, et al. Community-Based Restaurant Interventions to Promote Healthy Eating: A Systematic Review. *Prev Chronic Dis*. 2015; 12.
8. Nelson TF, Xuan Z, Babor TF, Brewer RD, Chaloupka FJ, Gruenewald PJ, et al. Efficacy and the Strength of Evidence of U.S. Alcohol Control Policies. *American journal of preventive medicine*. 2013; 45:19-28.
9. Rammohan V, Hahn RA, Elder R, Brewer R, Fielding J, Naimi TS, et al. Effects of Dram Shop Liability and Enhanced Overservice Law Enforcement Initiatives on Excessive Alcohol Consumption and Related Harms: Two Community Guide Systematic Reviews. *American journal of preventive medicine*. 2011; 41:334-43.
10. Campbell CA, Hahn RA, Elder R, Brewer R, Chattopadhyay S, Fielding J, et al. The Effectiveness of Limiting Alcohol Outlet Density As a Means of Reducing Excessive Alcohol Consumption and Alcohol-Related Harms. *American journal of preventive medicine*. 2009; 37:556-69.
11. Stockwell T, Zhao J, Giesbrecht N, Macdonald S, Thomas G, Wettlaufer A. The Raising of Minimum Alcohol Prices in Saskatchewan, Canada: Impacts on Consumption and Implications for Public Health. *American journal of public health*. 2012; 102:e103-e10.
12. Martineau F, Tyner E, Lorenc T, Petticrew M, Lock K. Population-level interventions to reduce alcohol-related harm: an overview of systematic reviews. *Preventive Medicine*. 2013; 57:278-96.
13. Kinnane S, Farrington F, Henderson-Yates L, Parker H. Fitzroy Valley Alcohol Restriction Report: An evaluation of the effects of a restriction on take-away alcohol relating to measurable health and social outcomes, community perceptions and behaviours after a two year period. 2010; Available from: Available at: [http://www.dao.health.wa.gov.au/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=680&Command=Core\\_Download&PortalId=0&TabId=211](http://www.dao.health.wa.gov.au/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=680&Command=Core_Download&PortalId=0&TabId=211) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dhBDi59v> on 11 December 2015.
14. National Drug Research Institute. Restrictions on the Sale and Supply of Alcohol: Evidence and Outcomes. Perth: National Drug Research Institute, Curtin University of Technology; 2007; Available from: Available at:

- <http://ndri.curtin.edu.au/local/docs/pdf/publications/R207.pdf> (accessed 10 December 2015).  
Archived at: <http://www.webcitation.org/6dhAzukmG> on 11 December 2015.
15. Maclennan B, Kypri K, Room R, Langley J. Local government alcohol policy development: case studies in three New Zealand communities. *Addiction*. 2013; 108:885-95.
  16. Ahern J, Margerison-Zilko C, Hubbard A, Galea S. Alcohol outlets and binge drinking in urban neighborhoods: the implications of nonlinearity for intervention and policy. *American journal of public health*. 2013; 103:e81-7.
  17. Fone D, Dunstan F, White J, Webster C, Rodgers S, Lee S, et al. Change in alcohol outlet density and alcohol-related harm to population health (CHALICE). *BMC Public Health*. 2012; 12:428.
  18. Nakamura R, Suhreke M, Pechey R, Morciano M, Roland M, Marteau TM. Impact on alcohol purchasing of a ban on multi-buy promotions: a quasi-experimental evaluation comparing Scotland with England and Wales. *Addiction*. 2014; 109:558-67.
  19. Purshouse RC, Meier PS, Brennan A, Taylor KB, Rafia R. Estimated effect of alcohol pricing policies on health and health economic outcomes in England: an epidemiological model. *Lancet*. 2010; 375:1355-64.
  20. Han D, Gorman DM. Evaluating the Effects of the Introduction of Off-Sale Alcohol Outlets on Violent Crime. *Alcohol and Alcoholism (Oxford, Oxfordshire)*. 2013; 48:370-4.
  21. Alcohol Concern. Guide to Alcohol for Councillors. London 2014; Available from: Available at: [http://www.alcoholconcern.org.uk/wp-content/uploads/woocommerce\\_uploads/2014/12/Guide-to-Alcohol-160813-APPROVED.pdf](http://www.alcoholconcern.org.uk/wp-content/uploads/woocommerce_uploads/2014/12/Guide-to-Alcohol-160813-APPROVED.pdf) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh8ZwRom> on 11 December 2015.
  22. Local Government Association. Reducing the Strength schemes: Guidance for councils considering setting up a scheme. 2014; Available from: Available at: [http://www.local.gov.uk/regulatory-services-and-licensing/-/journal\\_content/56/10180/6793034/ARTICLE](http://www.local.gov.uk/regulatory-services-and-licensing/-/journal_content/56/10180/6793034/ARTICLE) (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh8jYS00> on 11 December 2015.
  23. Nicholls J. The Government Alcohol Strategy 2012: Alcohol policy at a turning point? *Drugs: Education, Prevention, and Policy*. 2012; 19:355-9.
  24. Hughes K, Bellis MA, Leckenby N, Quigg Z, Hardcastle K, Sharples O, et al. Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city. *Journal of epidemiology and community health*. 2014; 68:453-6.
  25. McGill E, Egan M, Petticrew M, Mountford L, Milton S, Whitehead M, et al. Trading quality for relevance: non-health decision-makers' use of evidence on the social determinants of health. *BMJ open*. 2015; 5.
  26. Dolowitz D, Marsh D. Learning from abroad: The role of policy transfer in contemporary policy-making. *Governance*. 2000; 13:5-23.
  27. Alcohol, Public Policy G. Alcohol: No Ordinary Commodity – a summary of the second edition. *Addiction*. 2010; 105:769-79.
  28. Goodall T. White Cider and Street Drinkers: Recommendations to Reduce Harm. London: Alcohol Concern UK 2011 Contract No.: <http://www.webcitation.org/6ZYIecFEw>.
  29. McGill E, Marks D, Sumpter C, Egan M. Consequences of removing cheap, super-strength beer and cider: a qualitative study of a UK local alcohol availability intervention. *BMJ open*. 2016; 6:e010759.
  30. Sweeting H. Alcohol units at pocket money prices [e-letter]. *Bmj*. 2006; 333:825-b.
  31. Gornall J. Doctors and the alcohol industry: an unhealthy mix? *Bmj*. 2013; 346:f1889.
  32. Portman Group. K Cider, Complaint decision details. 2017 [cited 2017 24 January]; Available from: Available at: <http://www.portmangroup.org.uk/complaints/complaint->

- 1  
2  
3 [decisions/complaint-decision-details/2017/01/12/k-cider](#) (accessed 24 January 2017).  
4 Archived at: <http://www.webcitation.org/6nkoGttF8> on 24 January 2017. .
- 5 33. Association of Convenience Stores. Reducing the Strength: Retailer Guidance. 2015  
6 [cited 2015 5 November]; Available from: Available at:  
7 <http://www.acs.org.uk/advice/reducing-the-strength/> (accessed 10 December 2015). Archived  
8 at: <http://www.webcitation.org/6dh7Gcc5S> on 11 December 2015.
- 9 34. Competition and Markets Authority. High-strength alcohol schemes: competition law  
10 advice for retailers. 2015 [cited 2015 5 November]; Available from: Available at:  
11 [https://www.gov.uk/government/publications/high-strength-alcohol-schemes-competition-](https://www.gov.uk/government/publications/high-strength-alcohol-schemes-competition-law-advice-for-retailers)  
12 [law-advice-for-retailers](https://www.gov.uk/government/publications/high-strength-alcohol-schemes-competition-law-advice-for-retailers) (accessed 10 December 2015). Archived at:  
13 <http://www.webcitation.org/6dh7NK9Rb> on 11 December 2015.
- 14 35. Sumpter C, McGill E, Dickie E, Champo E, Romeri E, Egan M. Reducing the  
15 Strength: a mixed methods evaluation of alcohol retailers' willingness to voluntarily reduce  
16 the availability of low cost, high strength beers and ciders in two UK local authorities. BMC  
17 Public Health. 2016; 16:448.
- 18 36. Bryden A, Petticrew M, Mays N, Eastmure E, Knai C. Voluntary agreements between  
19 government and business - a scoping review of the literature with specific reference to the  
20 Public Health Responsibility Deal. Health policy. 2013; 110:186-97.
- 21 37. Community Alcohol Partnerships. About Community Alcohol Partnerships. 2015  
22 [cited 2015 5 November]; Available from: Available at:  
23 <http://www.communityalcoholpartnerships.co.uk/> (accessed 10 December 2015). Archived  
24 at: <http://www.webcitation.org/6dh622qSP> on 11 December 2015.
- 25 38. Robinson M, Thorpe R, Beeston C, McCartney G. A review of the validity and  
26 reliability of alcohol retail sales data for monitoring population levels of alcohol  
27 consumption: a Scottish perspective. Alcohol and alcoholism. 2013; 48:231-40.
- 28 39. Egan M, Pliakas T, Grace D, McGill E, Jones A, Wong J, et al. Use of retail data in  
29 the assessment of natural experiments: the case of Reducing the Strength, an intervention to  
30 reduce alcohol availability. Lancet. 2014; 384:S30.
- 31 40. Robinson M, Geue C, Lewsey J, Mackay D, McCartney G, Curnock E, et al.  
32 Evaluating the impact of the alcohol act on off-trade alcohol sales: a natural experiment in  
33 Scotland. Addiction. 2014; 109:2035-43.
- 34 41. Suffolk Constabulary. Reducing the Strength Ipswich - One year on. 2012 [cited  
35 2015 5 November]; Available from: Available at:  
36 [http://www.suffolk.police.uk/safetyadvice/personalsafety/alcoholawareness/reducingthestren-](http://www.suffolk.police.uk/safetyadvice/personalsafety/alcoholawareness/reducingthestrength/oneyearon.aspx)  
37 [gth/oneyearon.aspx](http://www.suffolk.police.uk/safetyadvice/personalsafety/alcoholawareness/reducingthestrength/oneyearon.aspx) (accessed 10 December 2015). Archived at:  
38 <http://www.webcitation.org/6dh6n05NZ> on 11 December 2015.
- 39 42. Hawkins NG, Sanson-Fisher RW, Shakeshaft A, D'Este C, Green LW. The multiple  
40 baseline design for evaluating population-based research. American journal of preventive  
41 medicine. 2007; 33:162-8.
- 42 43. Office for National Statistics. Population Estimates for UK, England and Wales,  
43 Scotland and Northern Ireland, Mid-2014. 2015 [cited 2015 5 November]; Available from:  
44 Available at: [http://www.ons.gov.uk/ons/publications/re-reference-](http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-368259)  
45 [tables.html?edition=tcm%3A77-368259](http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-368259) (accessed 10 December 2015). Archived at:  
46 <http://www.webcitation.org/6dh6SoR4s> on 11 December 2015.
- 47 44. Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis  
48 of interrupted time series studies in medication use research. Journal of clinical pharmacy and  
49 therapeutics. 2002; 27:299-309.
- 50 45. Beck N, Katz JN. What to do (and not to do) with Time-Series Cross-Section Data.  
51 The American Political Science Review. 1995; 89:634-47.
- 52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 46. Hoechle D. Robust standard errors for panel regressions with cross-sectional  
4 dependence. *The Stata Journal*. 2007; 7:281-312.
- 5 47. Linden A. Conducting interrupted time-series analysis for single- and multiple-group  
6 comparisons. *The Stata Journal*. 2015; 15:480-500.
- 7 48. The Drinks Report. UK alcohol market returns to growth. 2015 [cited 2015 5  
8 November]; Available from: Available at:  
9 <http://www.thedrinksreport.com/news/2015/16101-uk-alcohol-market-returns-to-growth.html>  
10 (accessed 10 December 2015). Archived at: <http://www.webcitation.org/6dh702Jz8> on 11  
11 December 2015.
- 12 49. Craig P, Cooper C, Gunnell D, Haw S, Lawson K, Macintyre S, et al. Using natural  
13 experiments to evaluate population health interventions: new Medical Research Council  
14 guidance. *Journal of epidemiology and community health*. 2012; 66:1182-6.
- 15 50. Robinson M, Shipton D, Walsh D, Whyte B, McCartney G. Regional alcohol  
16 consumption and alcohol-related mortality in Great Britain: novel insights using retail sales  
17 data. *BMC Public Health*. 2015; 15:1.
- 18 51. de Vocht F, Heron J, Angus C, Brennan A, Mooney J, Lock K, et al. Measurable  
19 effects of local alcohol licensing policies on population health in England. *Journal of*  
20 *epidemiology and community health*. 2016; 70:231-7.
- 21 52. de Vocht F, Heron J, Campbell R, Egan M, Mooney JD, Angus C, et al. Testing the  
22 impact of local alcohol licencing policies on reported crime rates in England. *Journal of*  
23 *epidemiology and community health*. 2017; 71:137-45.
- 24 53. Knai C, Petticrew M, Durand MA, Scott C, James L, Mehrotra A, et al. The Public  
25 Health Responsibility deal: has a public-private partnership brought about action on alcohol  
26 reduction? *Addiction*. 2015; 110:1217-25.
- 27 54. de Vocht F, Tilling K, Pliakas T, Angus C, Egan M, Brennan A, et al. The  
28 intervention effect of local alcohol licensing policies on hospital admission and crime: a  
29 natural experiment using a novel Bayesian synthetic time-series method. *Journal of*  
30 *epidemiology and community health*. 2017.
- 31 55. Department of Health. Health risks from alcohol: new guidelines. 2016; Available  
32 from: Available at: [https://www.gov.uk/government/consultations/health-risks-from-alcohol-](https://www.gov.uk/government/consultations/health-risks-from-alcohol-new-guidelines)  
33 [new-guidelines](https://www.gov.uk/government/consultations/health-risks-from-alcohol-new-guidelines) (accessed 2 August 2017). Archived at:  
34 <http://www.webcitation.org/6sQ3CIIWX> on 2 August 2017..
- 35  
36  
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3 **List of titles for all figures**

4 **Figure 1** Percent change in units of alcohol sold after the introduction of the  
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6 *Reducing the Strength* initiative. Wave 1 stores started implementation by  
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8 September 2012. Wave 2 stores started implementation by September 2013.  
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10  
11 **Figure 2** Percent change in sales value after the introduction of the *Reducing the*  
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13 *Strength* initiative. Wave 1 stores started implementation by September 2012. Wave  
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15 2 stores started implementation by September 2013.  
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For Peer Review

**Table 1** List of ~~super strength~~ beer and cider products over 6.5% ABV sold during the 'Reducing the Strength' initiative.

EAN	ABV	Description	Size	Units	Price (£) <sup>a</sup>	Price per unit (£) <sup>a</sup>
5010079105150	7.5	<del>7.5% WHITE STAR</del> White Star <sup>b</sup>	2Ltr	15.0	2.50 to 5.23	0.17 to 0.35
5010153737048	9.0	<del>9% CARLSBERG SPEC BREW</del> Carlsberg special brew <sup>b</sup>	4x440ml	15.8	1.52 to 9.75	0.10 to 0.62
5000128393041	7.5	<del>7.5% CP S/STRENGTH</del> LAGERCo-op superstrength lager <sup>b</sup>	4x440ml	13.2	1.39 to 7.25	0.11 to 0.55
5010017012526	9.0	<del>9.0% Tennent's super strong</del> lagerTENNENTS SUPER <sup>b</sup>	4x440ml	15.8	2.08 to 9.59	0.13 to 0.61
5014201655414	8.2	<del>Special vintage cider</del> 8.2% SPEC VINTAG <sup>c</sup>	500ml	4.1	1.73 to 2.13	0.42 to 0.52
5012845198120	8.2	<del>8.2% IMPERIAL CYDER</del> Imperial cider <sup>c</sup>	500ml	4.1	2.15 to 2.61	0.52 to 0.64
<a href="#">5016878000207</a>	<a href="#">6.7</a>	<a href="#">Adnams Jack brand innovation</a>	<a href="#">500ml</a>	<a href="#">3.4</a>	<a href="#">1.42 to 2.94</a>	<a href="#">0.42 to 0.88</a>
<a href="#">5012845172809</a>	<a href="#">7.0</a>	<a href="#">Aspall dry Suffolk cider premier</a>	<a href="#">500ml</a>	<a href="#">3.5</a>	<a href="#">1.31 to 2.84</a>	<a href="#">0.37 to 0.81</a>
<a href="#">5012845177101</a>	<a href="#">7.0</a>	<a href="#">Aspall premier cru Suffolk cider</a>	<a href="#">4x330ml</a>	<a href="#">9.2</a>	<a href="#">1.78 to 6.17</a>	<a href="#">0.19 to 0.67</a>
<a href="#">5012845172830</a>	<a href="#">7.0</a>	<a href="#">Aspall organic Suffolk cider</a>	<a href="#">500ml</a>	<a href="#">3.5</a>	<a href="#">1.15 to 2.79</a>	<a href="#">0.33 to 0.80</a>
<a href="#">8594403110159</a>	<a href="#">7.4</a>	<a href="#">Budweiser Budvar Czech premium</a>	<a href="#">330ml</a>	<a href="#">2.4</a>	<a href="#">0.88 to 2.28</a>	<a href="#">0.36 to 0.93</a>
<a href="#">5014201203554</a>	<a href="#">6.5</a>	<a href="#">Westons - Wyld Wood Classic</a>	<a href="#">500ml</a>	<a href="#">3.3</a>	<a href="#">1.88 to 2.52</a>	<a href="#">0.58 to 0.78</a>
<a href="#">609722874786</a>	<a href="#">7.0</a>	<a href="#">NSB dry cider</a>	<a href="#">750ml</a>	<a href="#">5.3</a>	<a href="#">1.80 to 3.78</a>	<a href="#">0.34 to 0.72</a>
<a href="#">609722874793</a>	<a href="#">7.0</a>	<a href="#">NSB medium cider</a>	<a href="#">750ml</a>	<a href="#">5.3</a>	<a href="#">1.40 to 3.78</a>	<a href="#">0.27 to 0.72</a>
<a href="#">609722874809</a>	<a href="#">7.0</a>	<a href="#">NSB 7sweet cider</a>	<a href="#">750ml</a>	<a href="#">5.3</a>	<a href="#">0.90 to 3.78</a>	<a href="#">0.17 to 0.72</a>
<a href="#">5020628002809</a>	<a href="#">7.4</a>	<a href="#">Thatchers Katy cider</a>	<a href="#">500ml</a>	<a href="#">3.7</a>	<a href="#">1.78 to 2.51</a>	<a href="#">0.48 to 0.68</a>
<a href="#">5020628006685</a>	<a href="#">7.4</a>	<a href="#">Thatchers vintage cider</a>	<a href="#">500ml</a>	<a href="#">3.4</a>	<a href="#">1.82 to 2.37</a>	<a href="#">0.49 to 0.64</a>
<a href="#">5010327658544</a>	<a href="#">6.6</a>	<a href="#">Innis &amp; Gunn original oak aged</a>	<a href="#">330ml</a>	<a href="#">2.2</a>	<a href="#">1.00 to 2.11</a>	<a href="#">0.46 to 0.97</a>
<a href="#">5410228102762</a>	<a href="#">6.6</a>	<a href="#">Leffe blonde</a>	<a href="#">750ml</a>	<a href="#">5.0</a>	<a href="#">2.94 to 4.49</a>	<a href="#">0.59 to 0.91</a>
<a href="#">5410228190424</a>	<a href="#">6.6</a>	<a href="#">Leffe blonde pack</a>	<a href="#">4x330ml</a>	<a href="#">8.7</a>	<a href="#">1.46 to 7.83</a>	<a href="#">0.16 to 0.85</a>
<a href="#">609224793127</a>	<a href="#">7.0</a>	<a href="#">Carter's Essex cider 7%</a>	<a href="#">500ml</a>	<a href="#">3.5</a>	<a href="#">1.25 to 2.49</a>	<a href="#">0.36 to 0.71</a>
<a href="#">5011348010953</a>	<a href="#">7.4</a>	<a href="#">Banks's Barley Gold</a>	<a href="#">4x330ml</a>	<a href="#">9.8</a>	<a href="#">4.42 to 5.7</a>	<a href="#">0.48 to 0.62</a>
<a href="#">5000264004184</a>	<a href="#">7.3</a>	<a href="#">McEwans champion ale</a>	<a href="#">500ml</a>	<a href="#">3.7</a>	<a href="#">2.02 to 2.14</a>	<a href="#">0.55 to 0.58</a>
<a href="#">5010549302348</a>	<a href="#">6.5</a>	<a href="#">Old crafty hen</a>	<a href="#">500ml</a>	<a href="#">3.3</a>	<a href="#">1.93 to 2.4</a>	<a href="#">0.59 to 0.74</a>

<sup>a</sup>: Range of values during the period of study.

<sup>b</sup>: Superstrength products (over 7.5% ABV) removed as part of the Reducing the Strength initiative.

<sup>b</sup>: High strength premium products (over 7.5% ABV) not removed as part of the Reducing the Strength initiative.

<sup>d</sup>: High strength premium products (over 6.5% but below 7.5% ABV) still available during the study period.

EAN: European Article Number (also called International Article Number)

ABV: Alcohol by volume (ABV) (%)

Recommended weekly limit of 14 units of alcohol for men and women<sup>55</sup>



**Table 2** Summary statistics for units of alcohol sold per store per month.

Product categories	Stores in wave 1 (n=54)			Stores in wave 2 (n=77)			All stores (n=131)		
	Mean (SD)	Median	Min - Max	Mean (SD)	Median	Min - Max	Mean (SD)	Median	Min - Max
Beer/lager & cider	11,641 (8,364)	9,189	2,566 – 61,692	14,159 (9,330)	11,646	884 – 71,467	13,120 (9,029)	10,489	884 – 71,467
Of which super-strength products removed <sup>a</sup>	761 (680)	547	13 - 4782	512 (614)	305	13 - 5165			
Of which super-strength products not removed	334 (273)	246	4 – 1,816	388 (344)	279	4 – 2,325	365 (317)	258	4 – 2,325
Spirits	9,002 (8,261)	6,602	1,984 – 62,816	9,903 (8,279)	7,280	334 – 72,664	9,531 (8,282)	6,967	334 – 72,664
Affordable sparkling and low alcohol wines	951 (1,047)	643	66 – 13,151	1,080 (1,089)	711	35 – 9,819	1,026 (1,074)	680	35 – 13,151
Wines	16,280 (16,722)	11,334	2,485 – 133,557	17,147 (15,134)	12,786	668 – 102,783	16,790 (15,812)	12,087	668 – 133,557
All products	37,873 (33,311)	28,273	10,314 – 262,238	42,277 (32,390)	33,023	1,920 – 221,608	40,462 (32,840)	30,944	1,920 – 262,238

<sup>a</sup>: Only for the period up until September 2012 for wave 1 and September 2013 for wave 2.