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# Neighbourhood inequities in the availability of retailers selling tobacco products: a systematic review

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## ABSTRACT

Objective To examine inequities in tobacco retailer availability by neighbourhood-level socioeconomic, racial/ ethnic and same-sex couple composition. Data sources We conducted a 10 November 2022

search of PubMed, PsycINFO, Global Health, LILACS, Embase, ABI/Inform, CINAHL, Business Source Complete, Web of Science and Scopus.

Study selection We included records from Organisation for Economic Co-operation and Development member countries that tested associations of area-level measures of tobacco retailer availability and neighbourhood-level sociodemographic characteristics. Two coders reviewed the full text of eligible records (n=58), including 41 records and 205 effect sizes for synthesis.

Data extraction We used dual independent screening of titles, abstracts and full texts. One author abstracted and a second author confirmed the study design, location, unit of analysis, sample size, retailer data source, availability measure, statistical approach, sociodemographic characteristic and unadjusted effect sizes.

Data synthesis Of the 124 effect sizes related to socioeconomic inequities (60.5% of all effect sizes). 101 (81.5%) indicated evidence of inequities. Of 205 effect sizes, 69 (33.7%) tested associations between retailer availability and neighbourhood composition of racially and ethnically minoritised people, and 57/69 (82.6%) documented inequities. Tobacco availability was areater in neighbourhoods with more Black. Hispanic/ Latine and Asian residents (82.8%, 90.3% and 40.0% of effect sizes, respectively). Two effect sizes found greater availability with more same-sex households.

**Conclusions** There are stark inequities in tobacco retailer availability. Moving beyond documenting inequities to partnering with communities to design, implement, and evaluate interventions that reduce and eliminate inequities in retail availability is needed to promote an equitable retail environment.

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#### INTRODUCTION

Globally, evidence on tobacco use prevention and cessation has shown reducing the retail availability of commercial tobacco products reduces supply and demand.<sup>1-3</sup> Several studies report positive associations between the neighbourhood number or concentration of brick-and-mortar stores selling tobacco products (ie, tobacco retailer availability [TRA], supply or density) and tobacco use and tobacco-related health outcomes.<sup>4-14</sup> Living

in neighbourhoods with higher TRA reduces travel costs to obtain tobacco products<sup>15</sup> <sup>16</sup> and increases the likelihood of observing tobaccorelated marketing, cueing tobacco use and relapse behaviours.<sup>17-19</sup> Several reviews document associacopyright, tions between TRA and tobacco use among youth or young adults<sup>4–7</sup> and adults.<sup>8 9</sup> A meta-analysis of 11 studies from six countries documented a significant positive association between past-month adolescent smoking behaviours and greater TRA near homes, but not near schools.<sup>4</sup> Furthermore, a meta-analysis of 27 studies from six countries found that lower availability was associated with a 2.5% reduction (95% CI 1.95 to 3.02) in the relative risk of tobacco use among adults.<sup>5</sup>

The burden of tobacco-related morbidity and mortality is not equally shared by socioeconomic status (SES),  $^{20-22}$  ethnicity or race,  $^{20}$   $^{23}$  or sexual orientation  $^{24}$   $^{25}$  which may reflect environmental injustices in TRA. In 2002, Laws et al assessed neighbourhood inequities in TRA in 10 predominately Latine business districts in Boston, Massachusetts.<sup>24</sup> Hyland et al subsequently examined availability in Erie County, New York.<sup>27</sup> Numerous studies have subsequently documented neighbourhood inequi-ties in TRA in the USA,<sup>28-34</sup> Australia,<sup>35</sup> Canada,<sup>36</sup> Germany,<sup>37</sup> New Zealand<sup>38</sup> and Scotland.<sup>39</sup>

While a systematic review of 43 studies across eight countries documented greater point-of-sale tobacco marketing in neighbourhoods with lower SES and a greater percentage of Black residents,<sup>40</sup> to our knowledge, no systematic review has examined neighbourhood inequities in TRA. This gap hinders efforts to reduce health inequities related to tobacco use and the retail environment. With a focus on health equity, we conducted a systematic review examining place-based differences in TRA by SES, ethnicity and race of neighbourhood residents and same-sex household composition. With concern for methodological gaps, we also assessed how TRA was operationalised and the number/type of data sources used to identify tobacco retailers.

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### **METHODS**

#### Search and eligibility

A professional health sciences librarian (KBS) iteratively developed the search strategy (online supplemental file A). Our search was limited to records published in 2000 and last updated on 10 November 2022. We aimed to include peer-reviewed or grey literature with the following characteristics: records that (a) were from an Organisation for Economic Co-operation and Development (OECD) member





Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of study coding and inclusion. OECD, Organisation for Economic Co-operation and Development.

country; (b) included an area-level measure of TRA; (c) included an area-level sociodemographic characteristic of interest (ie, area unit characteristics or composition by SES, ethnicity, race or sexual orientation); and (d) used statistics to test associations (eg, correlations, regression). We limited our records to OECD countries to reduce heterogeneity in country-level socioeconomic resources.

As our systematic review is focused on answering questions about area-level or neighbourhood-level inequities, we excluded records that only measured person-level or individual-level proximity measures (eg, the distance a person lived to a tobacco retailer) or individual-level sociodemographic characteristics. We further excluded school-based studies (eg, those that measured school-level inequities in TRA), as this study focused on neighbourhood inequities, and school and neighbourhood boundaries and sociodemographic characteristics do not always align. Our study is included as research question 2 in a registered protocol (PROSPERO CRD42019124984).41 We defined tobacco retailers as physical or brick-and-mortar locations that sell any tobacco products and excluded records that sell nicotine vape products exclusively from the synthesis (n=5), 42-46 given evidence these retailers may be patterned differently (online supplemental file B).

### Inclusion coding

All screening was performed in Covidence. First, two independent coders reviewed each record's title and abstract for inclusion. For each eligible record identified, two coders (AYK, JGLL) independently reviewed the full text. Disagreements were resolved by consensus. Figure 1 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020<sup>47</sup> flow diagram. In January 2024, one author (SMH-F) used Google Scholar to search for full manuscript publications by lead and

senior authors of eligible dissertations and conference abstracts to help ensure full articles were examined for data extraction.

### Data extraction and abstraction

One author (AYK) conducted data extraction in Microsoft Word, which was confirmed by a second author (SMH-F). Data extraction items included study design; study location; unit of analysis (ie, neighbourhood operationalisation) and sample size; statistical approach; data source and sociodemographic composition variables; data source, operationalisation and sample size of tobacco retailers: TRA operationalisation: and unadjusted effect sizes (online supplemental file C). We extracted and synthesised unadjusted effect sizes, or those associations that examined a relationship between a *single* sociodemographic characteristic and TRA (eg, the relationship between neighbourhood-level median household income and TRA). Adjusted results (eg, the relationship between neighbourhood percentage of Black residents and TRA controlling for neighbourhood median household income) were not synthesised because they represent what inequities would be observed in a counterfactual scenario and thus do not directly answer our research question about inequities. We included studies that report adjusted results in the evidence table, but for synthesis and analysis purposes, we focused on unadjusted results.

To aid in synthesis and analysis, we recoded extracted neighbourhood sociodemographic characteristics. The combined categories were SES composition; racially and ethnically minoritised (REM) population composition; White population composition; and same-sex household composition. We additionally recoded SES composition into subcategories (eg, income, education, employment, health insurance status) and REM population (eg, Black population composition). We present results by these larger combined categories as well as the subcategories that

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make up each. As Hispanic/Latine ethnicity was not consistently described in studies, we report racialised associations including any ethnicity (eg, White composition inclusive of non-Hispanic and Hispanic White composition).

We additionally coded extracted record characteristics for study location type (ie, country, county/city or equivalent, state/ province); neighbourhood unit of analysis (ie, census tracts, meshblocks, data zones, dissemination area); data source of tobacco retailers (ie, ground truthing [calling or visiting retailers to confirm location and tobacco product sales]; licensing list or government registry; secondary business establishment database or phone book; combination of strategies); and the operationalisation of TRA (ie, total count of tobacco retailers; tobacco retailers per land area; tobacco retailers per population; tobacco retailers per roadway; presence vs absence of tobacco retailer[s]; other measure). Some studies investigated inequities in multiple places, and we retained all effect sizes for synthesis and analysis. Additionally, some records investigated inequities by measuring TRA multiple ways (eg, tobacco retailers per 1000 population vs tobacco retailers per square mile). As there is no consensus on which measure of TRA may be most appropriate or valid and some measures may capture different geographic constructs,<sup>8 9 31</sup> we include all effect sizes reported.

# Study risk of bias assessment

One author (AYK) used a modified Downs and Black checklist to assess the risk of bias<sup>48</sup> (see online repository protocol and online supplemental file C), and when uncertain, confirmed with a second author (IGLL). We created a risk of bias index (0-7, with higher numbers indicating a higher risk of bias) and a priori planned to exclude studies with a score of 4 or higher. All studies had a risk of bias assessment under 4 (no studies excluded).

# Analysis of inequities

Due to social and systemic processes of discrimination and racism used to create and sustain group-based hierarchies to advantage and minoritise specific populations, we define an inequity as having greater TRA in neighbourhoods with lower (vs higher) SES, a greater (vs lesser) concentration of REM residents and more (vs fewer) same-sex households. We coded the indication of inequity for each eligible effect size (ie, presence of inequity; no inequity [effect size was zero or the same for all groups]; or opposite [counterhypothesised] direction, such as having greater TRA in neighbourhoods with a higher proportion of White residents).

Online supplemental file C shows the full evidence extracted, and we present and visualise results with modified harvest plots.<sup>49 50</sup> Harvest plots, as we have operationalised them, show the weight of the evidence by the directionality of the result. We additionally coded the statistical significance of each eligible effect size (ie, statistically significant at the traditional p<0.05 threshold; not statistically significant; statistical significance not specified). Records sometimes used multiple statistics to test the same associations: in these instances, two authors (AYK, JGLL) unanimously decided which primary statistical test best answered the research question and included this test for analysis. For example, we prioritised regression coefficients over analysis of variance; spatial regression coefficients over ordinary least squares regressions; and continuous operationalisation of variables over categorical/dichotomous. Following a standard distribution of significance at the p < 0.05 level when there is no association, we would expect just 2.5% of results to show a significant negative association, 95% of results to show no

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# Systematic review



**Figure 2** Count and percentage of effect sizes by direction of association and neighbourhood sociodemographic composition (n=205). Opposite Direction indicates that the effect size was in the opposite direction expected for an inequity (eg, greater tobacco retailer availability in higher income neighbourhoods). No Inequity indicates that the effect size was zero. Presence of Inequity indicates greater tobacco retailer availability in neighbourhoods with a greater concentration of marginalised residents.

sizes examined inequities by some indicator of housing or neighbourhood structure (eg, vacant housing units, owner-occupied housing),  $^{31\,32\,69\,75}$  with half of these suggesting inequities in the hypothesised direction  $^{31\,32\,75}$  and half in the opposite direction.  $^{31\,69}$ 

# Neighbourhood racial and ethnic composition

Of the 205 effect sizes, 69 (33.7%) tested associations between TRA and neighbourhood composition of residents from REM categories (figure 2), and all records were from the USA.<sup>27</sup> <sup>31</sup> <sup>32</sup> <sup>61-63</sup> <sup>65-68</sup> <sup>70</sup> <sup>72-83</sup> Of these, 41  $(59.4\%)^{27}$  <sup>31</sup> <sup>32</sup> <sup>62</sup> <sup>66</sup> <sup>68</sup> <sup>70</sup> <sup>73</sup> <sup>75-83</sup> documented an inequity of greater TRA in neighbourhoods with a higher proportion of REM while 8  $(11.6\%)^{31}$  <sup>32</sup> <sup>62</sup> <sup>75</sup> <sup>78</sup> documented an association in the opposite (counterhypothesised) direction. Specifically, neighbourhoods with a greater composition of Black and Hispanic/Latine residents had greater TRA for 19/29  $(65.5\%)^{27}$  <sup>31</sup> <sup>32</sup> <sup>37</sup> <sup>66</sup> <sup>68</sup> <sup>70</sup> <sup>73</sup> <sup>77</sup> <sup>78</sup> <sup>80</sup> <sup>81</sup> <sup>83</sup> and 19/31  $(61.3\%)^{31}$  <sup>62</sup> <sup>66</sup> <sup>68</sup> <sup>73</sup> <sup>77</sup> <sup>78</sup> <sup>81</sup> <sup>83</sup> effect sizes, respectively (figure 4). Additionally, inequities were documented for



Figure 3 Count and percentage of effect sizes by direction of association and neighbourhood socioeconomic composition (n=124). Opposite Direction indicates that the effect size was in the opposite direction expected for an inequity (eq, greater tobacco retailer availability in higher income neighbourhoods). No Inequity indicates that the effect size was zero. Presence of Inequity indicates greater tobacco retailer availability in neighbourhoods with a greater concentration of marginalised residents.

Asian population composition (n=2/5, 40.0%), but statistical significance was not specified.<sup>63</sup> Inequities were also observed for effect sizes in studies assessing immigrant status composition  $(n=1/1, 100\%)^{75}$  and that combined REM populations (n=2/3, 66.7%).<sup>76 82</sup> As seen in figure 4, there were significant effect sizes in the counterhypothesised direction for Asian (n=2/5, 40.0%),<sup>32</sup> <sup>78</sup> Black  $(n=4/29, 13.8\%)^{31} = 62 = 75$  and Hispanic/Latine  $(n=2/31, 1)^{31} = 10^{-10}$ 6.5%)<sup>31</sup> composition (ie, lower TRA in neighbourhoods with a greater composition of these population groups). A total of 10 effect sizes examined the association between White population composition and TRA, <sup>32 63 66 69 71 72 75</sup> and 5 (50.0%) found that TRA decreased as the neighbourhood composition of White people increased<sup>32 66 69 71 75</sup> while 3 (30.0%) effect sizes documented the opposite<sup>71</sup> (figure 2).

#### Neighbourhood same-sex household composition

Two effect sizes tested associations with same-sex couple household composition, and both found greater TRA with greater rates of male and female same-sex households (figure 2).<sup>2</sup>

#### Measures of TRA and tobacco retailer data sources

We also examined whether there were differences in the documentation of neighbourhood inequities in tobacco availability by different measures of the construct and data sources used to locate tobacco retailers (figure 5). Per population measures of TRA (eg, number of tobacco retailers per 1000 people) were most common (n=102), 14 28 31 32 35 39 53 61 62 65 66 70. followed by per roadway (n=40),  $^{27\,31\,63\,68\,69\,74\,77\,79\,80\,83}$  count (n=18),  $^{31\,37\,38\,52\,54\,58\,84\,85}$  land area (n=16),  $^{31\,57\,59\,64\,67\,73\,81}$ 

presence versus absence of retailers(s) (n=13),<sup>3178</sup> and other measures (eg, percentage of stores selling tobacco products;<sup>26</sup> count of block faces with at least one retail outlet divided by the total number of observed block faces per census tract)<sup>75</sup> (n=16).<sup>26 75 81</sup> For per population measures, regardless of count of block faces with at least one retail outlet divided by statistical significance, 79 (77.5%) effect sizes documented an inequity in TRA,<sup>14 28 31 32 35 39 53 61 62 65 66 70-73 76 82</sup> 19 (18.6%) documented associations in the opposite direction 313253627172 and 4 (3.9%) found no inequity.<sup>62 71</sup> Most effect sizes for all other measures of TRA (ie, count,<sup>31 37 38 52 54 58 84 85</sup> per land area, <sup>31 57 59 64 67 73 81</sup> per roadway,<sup>27 31 63 68 69 74 77 79 80 83</sup> other<sup>26</sup><sup>75</sup><sup>81</sup>) documented inequities except for measures indicating the presence versus absence of a tobacco retailer, where 8 (61.5%)<sup>31 78</sup> of 13 total effect sizes documented an association in the opposite hypothesised direction, regardless of statistical significance (eg, greater likelihood of a tobacco retailer [vs absence] in neighbourhoods with higher SES).

Effect sizes from studies that used a tobacco retailer licensing list  $(n=120)^{27}$  35 39 53 54 59 65-72 74 76-83 to locate tobacco retailers were most common, and 76  $(63.3\%)^{27\,35\,39\,53\,59\,66\,68-71\,76-83}$  of these documented the presence of an inequity while 13 (10.8%) documented an association in the opposite direction hypothesised.<sup>54</sup> <sup>69</sup> <sup>71</sup> <sup>72</sup> <sup>78</sup> Most effect sizes for other tobacco retailer data sources (ie, secondary business establishment database<sup>28 31 32 61 62 73 84</sup>/ phone book<sup>64</sup> [n=45], ground truthing [n=19<sup>26 37 52 75 85</sup>]; combination of data sources  $[n=6^{14} 38 57 58]$ ) documented inequities, regardless of statistical significance.

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# Systematic review



**Figure 4** Count and percentage of effect sizes by direction of association and specific neighbourhood racial, ethnic and immigrant status sociodemographic composition (n=69). Opposite Direction indicates that the effect size was in the opposite direction expected for an inequity (eg, greater tobacco retailer availability in higher income neighbourhoods). No Inequity indicates that the effect size was zero. Presence of Inequity indicates greater tobacco retailer availability in neighbourhoods with a greater concentration of marginalised residents.

# DISCUSSION

### **Principal findings**

This review provides strong evidence of inequities in TRA. The evidence is consistent across measures, methods and six countries. In this review, analyses focused on socioeconomic inequities were most common (n=124 total effect sizes),  $^{14262731323537-3952-5457-5961-6466-7880-85}$  and greater TRA was documented in over 80% of effect sizes, regardless of statistical significance.  $^{14262731323537-3952-5457-5961-6466-7880-85}$  Contrary to expectation, 12.1% of effect sizes documented significantly greater TRA in neighbourhoods with higher SES.  $^{31}54$   $^{62}71$   $^{72}$  One study in New York City posits that this observation may be due to wealthier residents living in business districts that are more likely to have retailers in general,  $^{72}$  while another in Australia visually explored this pattern and found more retail and entertainment businesses in areas with greater SES.  $^{54}$  It is possible that some neighbourhoods may be so disadvantaged that they have very few or no retailers, thus creating a counterhypothesised effect.

In this systematic review, all records were from crosssectional studies, and two records were repeated or pooled cross-sectional.<sup>26 64</sup> Future work that examines change over time in the associations of TRA and neighbourhood sociodemographic composition may provide new insights.<sup>30</sup> For example, there may be shifts in inequities over time due to gentrification that may partially explain why some effect sizes were in the counterhypothesised direction (eg, the few effect sizes that indicated neighbourhoods with higher SES and White population composition had greater TRA). Specific measures of SES (ie, employment,<sup>37 62 71 75</sup> educational attainment<sup>63</sup> <sup>66</sup> <sup>69–72</sup> <sup>75</sup> <sup>83</sup> and health insurance<sup>72</sup> rather than deprivation/disadvantage or poverty measures/ indices) were uncommon and may warrant future attention.

indices) were uncommon and may warrant future attention. An overwhelming majority (82.6%)<sup>27</sup> <sup>31</sup> <sup>32</sup> <sup>61-63</sup> <sup>65-68</sup> <sup>70</sup> <sup>72-83</sup> of effect sizes pointed to greater TRA in neighbourhoods with a greater composition of REM residents. Lower TRA with an increasing composition of White residents was present in almost two-thirds of effect sizes.<sup>32</sup> <sup>63</sup> <sup>66</sup> <sup>69</sup> <sup>71</sup> <sup>75</sup> These findings also held when looking only at results that are statistically significant under historical thresholds of significance. Thus, this review and synthesis provide compelling evidence that TRA remains an important issue for racial/ethnic health equity and complements prior syntheses showing similarly pervasive inequities in tobacco product marketing.<sup>40</sup> <sup>95</sup>

Of all racial and ethnic groups, associations of TRA with neighbourhood composition of Black (n=29 effect sizes)<sup>27 31 32 61 62 65-68 70 72-75 77 78 80 81 83</sup> and Hispanic/Latine residents (n=31 effect sizes)<sup>31 32 61-63 65-68 70 72-75 77-81 83</sup> were examined most frequently. Results from this review indicate that neighbourhoods with a greater composition of these population groups overwhelmingly face greater TRA, with very few effect sizes indicating null or counterhypothetical results.

Only four studies examined relationships between TRA and Asian population composition (n=5 total effect sizes),<sup>32</sup> <sup>63</sup> <sup>72</sup> <sup>78</sup> and while 2 (40.0%) effect sizes indicated greater TRA in neighbourhoods with a greater Asian population composition (though statistical significance was not specified),<sup>63</sup> 2 (40.0%) indicated significantly lower TRA in these neighbourhoods.<sup>32</sup> <sup>78</sup> One study also documented greater TRA in neighbourhoods with a higher percentage of

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Figure 5 Count and percentage of effect sizes by direction of association and tobacco retailer data source and availability measure (n=205). Opposite Direction indicates that the effect size was in the opposite direction expected for an inequity (eg, greater tobacco retailer availability in higher income neighbourhoods). No Inequity indicates that the effect size was zero. Presence of Inequity indicates greater tobacco retailer availability in neighbourhoods with a greater concentration of marginalised residents.

immigrants.<sup>75</sup> No studies examined associations by neighbourhood composition of Indigenous people. Future work examining racialised inequities with TRA may be warranted, especially within ethnic enclaves and by disaggregated ethnic categories of Asian and Hispanic/Latine populations, and by Indigenous people composition, though this work may be difficult due to small population sizes and data suppression.

On review of records, we recommend specificity in how racial and ethnic categories are defined, given evidence of substantial variation (online supplemental file C); for example, often ethnicity (eg, Hispanic/Latine) was not specified with race (eg, per cent Black vs per cent non-Hispanic/Latine Black). Additionally, language sometimes did not parallel the data source measures and further did not state how race/ethnicity was measured. Several studies report 'Caucasian' race as a synonym for White; authors should avoid the term as a synonym given its origins as part of a system of racial classification and hierarchy used to perpetuate white supremacy.96 97 All studies focused on REM were from the USA, and investigation of racialised inequities in other countries may be warranted.

Although not included in this synthesis, few studies examined other neighbourhood measures of sociodemographic composition, such as racialised (and economic) segregation<sup>98</sup> and historical redlining,<sup>92</sup> a process that delineated geograph-ical areas as 'hazardous' for investment based on sociodemographic population composition. These measures may provide

Protected by copyright, including for uses related to text and data mining sociopolitical and historical context for how population groups have been segregated into neighbourhoods relative to one another, thereby creating tobacco-related environmental inequities.9

Only one study assessed inequities by same-sex households,<sup>28</sup> documenting greater TRA in neighbourhoods with a higher proportion of male and female same-sex households. This evidence does not include single lesbian, gay and bisexual individuals, who may live in more urban areas; however, other research suggests same-sex couples may be a reasonable proxy for assessing inequities for the broader lesbian, gay and bisexual population.<sup>100</sup>

# Secondary findings

While the harvest plots excluded effect sizes that focused exclusively on the retail availability of nicotine vape products (n=6),  $\frac{42-46}{60}$  we briefly examined the findings from these records (online supplemental file B). Overall, there are inconsistent findings concerning differences in vape shop availability by neighbourhood racial, ethnic and socioeconomic composition, and these studies have been limited to the USA. Continued surveillance and monitoring of vape shop availability are needed to determine whether their locations will parallel inequities observed for more retailers selling more traditional tobacco products.

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others compared differences in TRA by counties that were matched on racial or socioeconomic composition.<sup>69–71</sup>

# CONCLUSION

This review of 58 publications and synthesis of 41 studies (2002-2022) from six high-income countries found consistent evidence of widespread neighbourhood inequities in TRA by SES, ethnicity and race. These place-based inequities may contribute to persistent inequities in exposure to tobacco marketing, tobacco use, as well as tobacco-related morbidity and mortality. Interventions to reduce TRA<sup>108-110</sup> include restricting retailer location (eg, distance from schools as has been done in Philadelphia<sup>111</sup>), limiting types of retailers that can sell tobacco (eg, banning pharmacy of retailers that can sell tobacco (eg, banning pharmacy sales as has been done in Massachusetts<sup>112</sup>) and limiting the number of licensed retailers in a given area as has been done in San Francisco.<sup>113</sup> However, analyses indicate that some of these interventions may widen inequities in TRA (eg, prohibiting the sales of tobacco products in retailer types that are more common in certain neighbourhoods, such as pharmacies).<sup>31 72 90 110</sup> Local health equity assessments to determine the impact of different interventions are needed to promote an equitable reduction in TRA and environmental justice.

Overall, we document widespread and persistent racialised and socioeconomic inequities in TRA. We challenge public health and tobacco control researchers, practitioners and policymakers to move beyond merely documenting inequities to partnering with communities to design, implement and evaluate policies and interventions to reduce and eliminate inequities in TRA.

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**Contributors** AYK conceptualised the study, developed the protocol, coded the data, abstracted the data, conducted the analyses, created the figures and led the drafting of the manuscript. JGLL conceptualised the study, developed the protocol, coded the data, assisted with data abstraction and assisted with drafting of the manuscript. SMH-F confirmed the data extraction. KBS developed and implemented the literature search. SDG, L Henriksen and KMR conceptualised the study and developed the protocol. L Herbert created the figures. All authors provided critical feedback, edited the manuscript and approved its final submission. AYK accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

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**Competing interests** AYK and KMR serve as paid expert consultants in litigation against the tobacco industry. JGLL and KMR hold a royalty interest in tobacco retailer mapping system owned and licensed by the University of North Carolina at Chapel Hill. The software was not used in this research.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

**Data availability statement** All data relevant to the study are included in the article or uploaded as supplementary information.

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To complement the primary research question, this review abstracted data sources used to measure TRA, as well as how TRA was operationalised. Effect sizes from studies that used a 'gold standard' of licensing or government registry lists or ground truthing were more common than studies of secondary business establishment databases/phone books. Regardless of the data source used, most effect sizes indicated inequities. Licensing is needed to track enforcement and compliance of tobacco retailers, and jurisdictions with tobacco retailer licensing should leverage such data to prioritise equitable tobacco retail reduction to help eliminate place-based inequities in tobacco availability. Additionally, separate licences to sell e-cigarettes and vapour products may better allow the surveillance of the vape shop industry.<sup>101</sup> 102

Regardless of how or for whom TRA was measured, most effect sizes indicated the presence of inequities. However, there was variation in the count and percentage of statistically significant inequities (eg, 58.8% of effect sizes for retailers per population<sup>14</sup> <sup>28</sup> <sup>31</sup> <sup>32</sup> <sup>35</sup> <sup>39</sup> <sup>53</sup> <sup>62</sup> <sup>66</sup> <sup>70</sup> <sup>71</sup> <sup>73</sup> <sup>76</sup> <sup>82</sup> vs 75.0% of effect sizes for retailers per land area<sup>31 57 59 64 73 81</sup> vs 38.5% for dichotomous measures [eg, any vs no tobacco retailers<sup>31 78</sup>]). Other reviews have discussed the use of different measures of TRA that may capture different aspects of the retail environment,<sup>89</sup> which was evident in effect sizes that compared and noted differences in both the presence and statistical significance of inequities when using varying measures of TRA.<sup>31</sup> Though we cannot conclude which measure of TRA may be most valid, considerations for measure selection should be taken when evaluating inequities in TRA. For example, land area or roadway measures may better capture the space where tobacco retailers are located or clustered; presence versus absence of retailers may not fully capture the concentration of tobacco retailers in a geographical area.<sup>31 74</sup> Additionally, some measures of TRA tried to account for the weighted distance of tobacco retailers to some point<sup>39 59 61 62</sup> (eg, kernel density estimation),<sup>103</sup> as indicated in online supplemental file C. Finally, while this review was focused on TRA, we note that some literature has examined inequities in the *proximity* (or distance) of population groups to tobacco retailers.<sup>37 104</sup>

# **Strengths and limitations**

There are several limitations of this systematic review. First, our review is limited to OECD countries, and the literature search ended in 2022. Notably, there are non-OECD country analyses of inequities in TRA,<sup>105-107</sup> and continued evaluation of inequities in these countries is needed. We also focused our review on place-based inequities defined by neighbourhood SES, ethnicity and race of neighbourhood residents and same-sex household composition; however, there may be other neighbourhood factors to consider, such as rurality.<sup>30 31 33</sup> Finally, there was great heterogeneity across records, including time, policy environment, history, land use planning, country and differences in measurement for both the predictor and outcome variables. Thus, we did not statistically combine records in a meta-analysis. This analysis compellingly documents inequities: however, it does not identify their origins nor are we able to provide an intersectional approach to look at combinations of neighbourhood characteristics manifesting from overlapping systems of oppression that might exacerbate inequities in TRA. Some studies did document inequities by stratification or interactions of neighbourhood racial and SES composition<sup>79</sup> while

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### REFERENCES

- Malone RE. Tobacco Endgames: what they are and are not, issues for tobacco control strategic planning and a possible US scenario. *Tob Control* 2013;22 Suppl 1:i42–4.
- 2 Malone RE, McDaniel PA, Smith EA. Tobacco control endgames: global initiatives and implications for the UK. 2014. Available: https://www.cancerresearchuk.org/ sites/default/files/policy\_july2014\_fullendgame\_report.pdf
- 3 Warner KE. An endgame for tobacco Tob Control 2013;22 Suppl 1:i3-5.
- 4 Finan LJ, Lipperman-Kreda S, Abadi M, et al. Tobacco outlet density and adolescents' cigarette smoking: a meta-analysis. *Tob Control* 2019;28:27–33.
- 5 Marsh L, Vaneckova P, Robertson L, et al. Association between density and proximity of tobacco retail outlets with smoking: a systematic review of youth studies. *Health Place* 2021;67:102275.
- 6 Nuyts PAW, Davies LEM, Kunst AE, et al. The association between tobacco outlet density and smoking among young people: a systematic methodological review. *Nicotine Tob Res* 2021;23:239–48.
- 7 Gwon SH, DeGuzman PB, Kulbok PA, *et al*. Density and proximity of licensed tobacco retailers and adolescent smoking: a narrative review. *J Sch Nurs* 2017;33:18–29.
- 8 Valiente R, Escobar F, Urtasun M, et al. Tobacco retail environment and smoking: a systematic review of geographic exposure measures and implications for future studies. *Nicotine Tob Res* 2021;23:1263–73.
- 9 Lee JGL, Kong AY, Sewell KB, et al. Associations of tobacco retailer density and proximity with adult tobacco use behaviours and health outcomes: a meta-analysis. *Tob Control* 2022;31:e189–200.
- 10 Kong AY, Baggett CD, Gottfredson NC, *et al*. Associations of tobacco retailer availability with chronic obstructive pulmonary disease related hospital outcomes, United States, 2014. *Health Place* 2021;67.
- 11 Lipton R, Banerjee A. The geography of chronic obstructive pulmonary disease across time: California in 1993 and 1999. Int J Med Sci 2007;4:179–89.
- 12 Lipton R, Banerjee A, Dowling KC, *et al*. The geography of COPD hospitalization in California. COPD 2005;2:435–44.
- 13 Barnes R, Foster SA, Pereira G, et al. Is neighbourhood access to tobacco outlets related to smoking behaviour and tobacco-related health outcomes and hospital admissions. Prev Med 2016;88:218–23.
- 14 Galiatsatos P, Kineza C, Hwang S, et al. Neighbourhood characteristics and health outcomes: evaluating the association between socioeconomic status, tobacco store density and health outcomes in Baltimore city. *Tob Control* 2018;27:e19–24.
- 15 Luke DA, Hammond RA, Combs T, et al. Tobacco town: computational modeling of policy options to reduce tobacco retailer density. Am J Public Health 2017;107:740–6.
- 16 Combs TB, Ornstein JT, Chaitan VL, *et al*. Draining the tobacco swamps: shaping the built environment to reduce tobacco retailer proximity to residents in 30 big US cities. *Health Place* 2022;75.
- 17 Robertson L, McGee R, Marsh L, et al. A systematic review on the impact of point-ofsale tobacco promotion on smoking. Nicotine Tob Res 2015;17:2–17.
- 18 Robertson L, Cameron C, McGee R, et al. Point-of-sale tobacco promotion and youth smoking: a meta-analysis. *Tob Control* 2016;25:e83–9.
- Paynter J, Edwards R. The impact of tobacco promotion at the point of sale: a systematic review. *Nicotine Tob Res* 2009;11:25–35.
- 20 Agaku IT, Odani S, Okuyemi KS, et al. Disparities in current cigarette smoking among US adults, 2002–2016. *Tob Control* 2020;29:269–76.
- 21 Reid JL, Hammond D, Boudreau C, et al. Socioeconomic disparities in quit intentions, quit attempts, and smoking abstinence among Smokers in four Western countries: findings from the International tobacco control four country survey. Nicotine Tob Res 2010;12:S20–33.
- 22 Hiscock R, Bauld L, Amos A, et al. Socioeconomic status and smoking: a review. Ann NY Acad Sci 2012;1248:107–23.

- 23 Coughlin SS, Matthews-Juarez P, Juarez PD, et al. Opportunities to address lung cancer disparities among African Americans. Cancer Med 2014;3:1467–76.
- 24 Li J, Berg CJ, Weber AA, et al. Tobacco use at the intersection of sex and sexual identity in the U.S., 2007-2020: a meta-analysis. Am J Prev Med 2021;60:415–24.
- 25 Max W, Stark B, Sung HY, et al. Smoking-attributable doctor visits and emergency room utilization and costs by California's lesbian, gay, and bisexual community. J Homosex 2022;69:1760–76.
- 26 Laws MB, Whitman J, Bowser DM, et al. Tobacco availability and point of sale marketing in demographically contrasting districts of Massachusetts. *Tob Control* 2002;11 Suppl 2:ii71–3.
- 27 Hyland A, Travers MJ, Cummings KM, et al. Tobacco outlet density and demographics in Erie County, New York. Am J Public Health 2003;93:1075–6.
- 28 Lee JGL, Pan WK, Henriksen L, *et al.* Is there a relationship between the concentration of same-sex couples and tobacco retailer density Nicotine Tob Res 2016;18:147–55.
- 29 Kong AY, Delamater PL, Gottfredson NC, et al. Sociodemographic inequities in tobacco retailer density: do neighboring places matter *Health Place* 2021;71:102653.
- 30 Mills SD, Kong AY, Reimold AE, et al. Sociodemographic disparities in tobacco retailer density in the United States, 2000–2017. Nicotine Tob Res 2022;24:1291–9.
- 31 Kong ÅY, Delamater PL, Gottfredson NC, et al. Neighborhood inequities in tobacco retailer density and the presence of tobacco-selling pharmacies and tobacco shops. *Health Educ Behav* 2022;49:478–87.
- 32 Lee JGL, Sun DL, Schleicher NM, et al. Inequalities in tobacco outlet density by race, ethnicity and socioeconomic status. J Epidemiol Community Health 2017;71:487–92.
- 33 Rodriguez D, Carlos HA, Adachi-Mejia AM, et al. Retail tobacco exposure: using geographic analysis to identify areas with excessively high retail density. Nicotine Tob Res 2014;16:155–65.
- 34 Rodriguez D, Carlos HA, Adachi-Mejia AM, et al. Predictors of tobacco outlet density nationwide: a geographic analysis. *Tob Control* 2013;22:349–55.
- 35 Wood LJ, Pereira G, Middleton N, et al. Socioeconomic area disparities in tobacco retail outlet density: a Western Australian analysis. *Med J Aust* 2013;198:489–91.
- 36 Chaiton MO, Mecredy GC, Cohen JE, et al. Tobacco retail outlets and vulnerable populations in Ontario, Canada. Int J Environ Res Public Health 2013;10:7299–309.
- 37 Schneider S, Gruber J. Neighbourhood deprivation and outlet density for tobacco, alcohol and fast food: first hints of obesogenic and addictive environments in Germany. *Public Health Nutr* 2013;16:1168–77.
- 38 Marsh L, Doscher C, Cameron C, et al. How would the tobacco retail landscape change if tobacco was only sold through liquor stores, petrol stations or pharmacies Aust N Z J Public Health 2020;44:34–9.
- 39 Shortt NK, Tisch C, Pearce J, et al. A cross-sectional analysis of the relationship between tobacco and alcohol outlet density and neighbourhood deprivation. BMC Public Health 2015;15:1014.
- 40 Lee JGL, Henriksen L, Rose SW, et al. A systematic review of neighborhood disparities in point-of-sale tobacco marketing. Am J Public Health 2015;105:e8–18.
- 41 Lee JGL, Kong AY, Sewell KB, et al. Data from: associations of tobacco retailer density and proximity with adult tobacco use and health outcomes: a meta-analysis. Tob Control 2022;31:e189–200.
- 42 Bostean G, Sanchez L, Lippert AM. Sociodemographic disparities in E-cigarette retail environment: vape stores and census tract characteristics in Orange County, CA. *Health Place* 2018;50:65–72.
- 43 Chido-Amajuoyi OG, Ozigbu CE, Zhang K. School proximity and census tract correlates of E-cigarette specialty retail outlets (Vape shops) in central Texas. *Prev Med Rep* 2020;18:101079.
- 44 Dai H, Hao J, Catley D. Vape shop density and socio-demographic disparities: a US census tract analysis. Nicotine Tob Res 2017;19:1338–44.
- 45 Giovenco DP, Duncan DT, Coups EJ, *et al*. Census tract correlates of vape shop locations in New Jersey. *Health Place* 2016;40:123–8.
- 46 Sawdey MD. Socioecological aspects of tobacco use in college populations. Virginia Commonwealth University; 2017. Available: https://scholarscompass.vcu.edu/etd/ 4805/
- 47 Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71:71:.
- 48 Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health* 1998;52:377:377–84:.
- 49 Ogilvie D, Fayter D, Petticrew M, et al. The harvest plot: a method for synthesising evidence about the differential effects of interventions. BMC Med Res Methodol 2008;8.
- 50 Thomas S, Fayter D, Misso K, et al. Population tobacco control interventions and their effects on social inequalities in smoking: systematic review. *Tob Control* 2008;17:230–7.
- 51 Gartlehner G, Persad E, Ledinger D, et al. Beyond statistical significance: nuanced interpretations of statistically nonsignificant results were rare in cochrane reviews - a metaepidemiological study. J Clin Epidemiol 2023;160:46–53.
- 52 Dalglish E, McLaughlin D, Dobson A, *et al*. Cigarette availability and price in low and high socioeconomic areas. *Aust N Z J Public Health* 2013;37:371–6.

- in New Jersey: does income and Ethnicity matter? J Ethn Subst Abuse 2013;12:197-209 80 Schneider JE, Reid RJ, Peterson NA, et al. Tobacco outlet density and demographics at the tract level of analysis in Iowa: implications for environmentally based prevention initiatives. Prev Sci 2005;6:319-25. 81 Siahpush M, Jones PR, Singh GK, et al. Association of availability of tobacco products with socio-economic and racial/ethnic characteristics of neighbourhoods. Public Health 2010;124:525-9. Siegel SD, Brooks MM, Gbadebo BM, et al. Using Geospatial analyses of linked 82 electronic health records and tobacco outlet data to address the social determinants of smoking. Prev Chronic Dis 2019;16:E152. Tucker-Seeley RD, Bezold CP, James P, et al. Retail Pharmacy policy to end the sale 83 of tobacco products: what is the impact on disparity in neighborhood density of tobacco outlets Cancer Epidemiol Biomarkers Prev 2016;25:1305-10. 84 Wheeler DC, Boyle J, Barsell DJ, et al. Associations of alcohol and tobacco retail outlet rates with neighborhood disadvantage. Int J Environ Res Public Health
  - 2022;19:1134.
    Wheeler DC, Do EK, Hayes RB, *et al.* Neighborhood disadvantage and tobacco retail outlet and vape shop outlet rates. *Int J Environ Res Public Health* 2020;17:2864.

Reid RJ, Morton CM, Garcia-Reid P, et al. Examining tobacco outlet concentration

- 86 Yu D, Peterson NA, Sheffer MA, et al. Tobacco outlet density and demographics: analysing the relationships with a spatial regression approach. Public Health 2010;124:412–6.
- 87 Yu D, Peterson NA, Reid RJ. Exploring the impact of non-normality on spatial nonstationarity in geographically weighted regression analyses: tobacco outlet density in New Jersey. GISci Remote Sens 2009;46:329–46.
- 88 Loomis BR, Kim AE, Goetz JL, et al. Density of tobacco retailers and its association with sociodemographic characteristics of communities across New York. Public Health 2013;127:333–8.
- 89 King JL, Wagoner KG, Suerken CK, et al. Are waterpipe café, vape shop, and traditional tobacco retailer locations associated with community composition and young adult tobacco use in North Carolina and Virginia? Subst Use Misuse 2020;55:2395–402.
- 90 Jenkins C, Schwartz E, Onnen N, *et al.* Variations in tobacco retailer type across community characteristics: place matters. *Prev Chronic Dis* 2022;19:E49.
- 91 Purushothaman V, Cuomo R, Leas E, et al. Longitudinal analysis of tobacco and vape retail density in California. Tob Induc Dis 2022;20:1–12.
- 92 Schwartz E, Onnen N, Craigmile PF, *et al.* The legacy of redlining: associations between historical neighborhood mapping and contemporary tobacco retailer density in Ohio. *Health Place* 2021;68.
- 93 Adibe C, Craigmile PF, Onnen N, *et al*. The relationship between tobacco retailer density and neighborhood demographics in Ohio. Ohio J Public Health 2019;2:12–8.
- 94 Wheeler DC, Boyle J, Barsell DJ, et al. Spatially varying associations of neighborhood disadvantage with alcohol and tobacco retail outlet rates. Int J Environ Res Public Health 2022;19:5244.
- 95 Yerger VB, Przewoznik J, Malone RE. Racialized geography, corporate activity, and health disparities: tobacco industry targeting of inner cities. J Health Care Poor Underserved 2007;18:10–38.
- 96 Ford CL, Griffith DM, Bruce MA, et al. Racism: science & tools for the public health professional. American Public Health Association, 2019.
- 97 Mukhopadhyay CC. "Getting rid of the word "Caucasian"" In: Privilege. Routledge, 2018: 231–6. Available: https://www.taylorfrancis.com/books/9780429963353
- 98 Kong AY, Herbert L, Feldman JM, et al. Tobacco and alcohol retailer availability and neighborhood Racialized, economic, and Racialized economic segregation in North Carolina. J Racial Ethn Health Disparities 2023;10:2861–71.
- 99 Kong AY, Golden SD, Berger MT. An intersectional approach to the menthol cigarette problem: what's race(ism) got to do with it? *Crit Public Health* 2019;29:616–23.
- 100 Lee JGL, Boynton MH, Shook-Sa BE, et al. Is where same-sex couples live a valid measure for where single lesbian, gay, and bisexual people live in population health research? Results from a national probability phone survey, 2017, United States. Ann LGBTQ Public Popul Health 2020;1:96–114.
- 101 Lee JGL, Orlan EN, Sewell KB, et al. A new form of nicotine retailers: a systematic review of the sales and marketing practices of vape shops. *Tob Control* 2018;27:e70–5.
- 102 Kong AY, Eaddy JL, Morrison SL, et al. Using the vape shop standardized tobacco assessment for retail settings (V-STARS) to assess product availability, price promotions, and messaging in New Hampshire vape shop retailers. *Tob Regul Sci* 2017;3:174–82.
- 103 Carlos HA, Shi X, Sargent J, et al. Density estimation and adaptive bandwidths: a primer for public health practitioners. Int J Health Geogr 2010;9:39:1–8:.
- 104 Kong AY, Myers AE, Isgett LF, et al. Neighborhood racial, ethnic, and income disparities in accessibility to multiple tobacco retailers: Mecklenburg County. Prev Med Rep2020;17:101031.
- 105 Morrison CN, Lee JP, Giovenco DP, et al. The geographic distribution of retail tobacco outlets in Yogyakarta, Indonesia. Drug Alcohol Rev 2021;40:1315–24.
- 106 Zheng C, Feng Z, Pearce J. A cross-sectional analysis of socio-spatial patterning of tobacco retail in Shanghai, China. *Nicotine Tob Res* 2022;24:2018–25.

- 53 Melody SM, Martin-Gall V, Harding B, et al. The retail availability of tobacco in Tasmania: evidence for a socio-economic and geographical gradient. *Med J Aust* 2018;208:205–8.
- 54 Paul CL, Mee KJ, Judd TM, et al. Anywhere, anytime: retail access to tobacco in New South Wales and its potential impact on consumption and quitting. Soc Sci Med 2010;71:799–806.
- 55 Kite J, Rissel C, Greenaway M, et al. Tobacco outlet density and social disadvantage in New South Wales, Australia. *Tob Control* 2014;23:181–2.
- 56 Marashi-Pour S, Cretikos M, Lyons C, et al. The association between the density of retail tobacco outlets, individual smoking status, neighbourhood socioeconomic status and school locations in New South Wales, Australia. Spat Spatiotemporal Epidemiol 2015;12:1–7.
- 57 Kirst M, Chaiton M, O'Campo P. Tobacco outlet density, neighbourhood stressors and smoking prevalence in Toronto, Canada. *Health Place* 2019;58:102171.
- 58 Marsh L, Doscher C, Robertson LA. Characteristics of tobacco retailers in New Zealand. *Health Place* 2013;23:165–70.
- 59 Caryl FM, Pearce J, Reid G, *et al.* Simulating the density reduction and equity impact of potential tobacco retail control policies. *Tob Control* 2021;30:e138–43.
- 60 Berg CJ, Schleicher NC, Johnson TO, et al. Vape shop identification, density and place characteristics in six metropolitan areas across the US. Prev Med Rep 2020;19:101137.
- 61 Adachi-Mejia AM, Carlos HA, Berke EM, et al. A comparison of individual versus community influences on youth smoking Behaviours: a cross-sectional observational study. BMJ Open 2012;2:e000767.
- 62 Anesetti-Rothermel A, Herman P, Bennett M, *et al.* Sociodemographic disparities in the tobacco retail environment in Washington, DC: a spatial perspective. *Ethn Dis* 2020;30:479–88.
- 63 Bostean G, Sánchez LA, Douglas JA. Spatial disparities: the role of nativity in neighborhood exposure to alcohol and tobacco retailers. *J Immigr Minor Health* 2022;24:945–55.
- 64 Chuang Y-C, Cubbin C, Ahn D, et al. Effects of neighbourhood socioeconomic status and convenience store concentration on individual level smoking. J Epidemiol Community Health 2005;59:568–73.
- 65 Craigmile PF, Onnen N, Schwartz E, *et al*. Evaluating how licensing-law strategies will impact disparities in tobacco retailer density: a simulation in Ohio. *Tob Control* 2021;30:e96–103.
- 66 D'Alessandro J. University of Washington; Tobacco retail outlet density in King County: implications for health equity and youth access to tobacco, 2016. Available: http://hdl.handle.net/1773/36450
- 67 Duncan DT, Kawachi I, Melly SJ, *et al*. Demographic disparities in the tobacco retail environment in Boston: a citywide spatial analysis. *Public Health Rep* 2014;129:209–15.
- 68 Fakunle D, Morton CM, Peterson NA. The importance of income in the link between tobacco outlet density and demographics at the tract level of analysis in New Jersey. J Ethn Subst Abuse 2010;9:249–59.
- 69 Fakunle DO, Curriero FC, Leaf PJ, et al. Black, White, or Green? The effects of racial composition and socioeconomic status on neighborhood-level tobacco outlet density. Ethn Health 2021;26:1012–27.
- 70 Fakunie DO, Milam AJ, Furr-Holden CD, et al. The inequitable distribution of tobacco outlet density: the role of income in two black mid-Atlantic geopolitical areas. *Public Health* 2016;136:35–40.
- 71 Fakunle DO, Thorpe RJ, Furr-Holden CDM, et al. Does tobacco outlet inequality extend to high-white mid-Atlantic jurisdictions? A study of socioeconomic status and density. J Racial Ethn Health Disparities 2019;6:409–18.
- 72 Giovenco DP, Spillane TE, Mauro CM, et al. Evaluating the impact and equity of a tobacco-free pharmacy law on retailer density in New York City neighbourhoods. Tob Control 2019;28:548–54.
- 73 Kong AY. The University of North Carolina at Chapel Hill; Associations of tobacco retailer density with neighborhood sociodemographics, individual smoking behaviors, & COPD hospital discharge rates: a spatial health approach, 2020. Available: https:// www.proquest.com/openview/c035de33ee5805f0457385dfc6ca9e44/1?pqorigsite=gscholar&cbl=18750&diss=y
- 74 Mayers RS, Wiggins LL, Fulghum FH, et al. Tobacco outlet density and demographics: a geographically weighted regression analysis. Prev Sci 2012;13:462–71.
- 75 Novak SP, Reardon SF, Raudenbush SW, et al. Retail tobacco outlet density and youth cigarette smoking: a propensity-modeling approach. *Am J Public Health* 2006;96:670–6.
- 76 Ogneva-Himmelberger Y, Ross L, Burdick W, et al. Using geographic information systems to compare the density of stores selling tobacco and alcohol: youth making an argument for increased regulation of the tobacco permitting process in Worcester. *Tob Control* 2010;19:475–80.
- 77 Peterson NA, Yu D, Morton CM, et al. Tobacco outlet density and demographics at the tract level of analysis in New Jersey: a statewide analysis. Drugs: Educ Prev Policy 2011;18:47–52.
- 78 Raskind IG, Vishwakarma M, Schleicher NC, et al. The changing retail landscape for tobacco: dollar stores and the availability of cheap cigarettes among tobacco-related priority populations. *Tob Control* 2022;31:e140–7.

# Systematic review

- 107 Mistry R, Kleinsasser MJ, Puntambekar N, *et al.* Neighbourhood tobacco retail access and tobacco use susceptibility in young adolescents in urban India. *Tob Control* 2022;31:e162–8.
- 108 Ackerman A, Etow A, Bartel S, *et al*. Reducing the density and number of tobacco retailers: policy solutions and legal issues. *Nicotine Tob Res* 2017;19:133–40.
- 109 Tobacco retailer density: place-based strategies to advance health and equity. 2019. Available: https://www.changelabsolutions.org/sites/default/files/CLS-BG214-Tobacco\_Retail\_Density-Factsheet\_FINAL\_20190131.pdf [Accessed 28 Jan 2020].
- Glasser AM, Roberts ME. Retailer density reduction approaches to tobacco control: a review. *Health Place* 2021;67.
- 111 Lawman HG, Henry KA, Scheeres A, et al. Tobacco retail licensing and density 3 years after license regulations in Philadelphia, Pennsylvania (2012–2019). Am J Public Health 2020;110:547–53.
- 112 Municipalities with tobacco-free pharmacy laws. 2024. Available: https://no-smoke. org/wp-content/uploads/pdf/pharmacies.pdf [Accessed 13 May 2023].
- 113 Tobacco density. 2016. Available: https://sanfranciscotobaccofreeprojectsanfrancis cotobaccofreeprojectsanfranciscotobaccofreeprojectsanfranciscotobaccofreeproject. org/density/ [Accessed 24 May 2022].