How would the tobacco retail landscape change if tobacco was only sold through liquor stores, petrol stations or pharmacies?

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Substantially reducing tobacco availability has been identified as a crucial tobacco control strategy both internationally and in New Zealand (NZ),[1-4] and has public support in New Zealand as a strategy that could help achieve a Smokefree NZ by 2025.[5] There is strong evidence of a positive association between access to tobacco retail outlets and smoking prevalence,[6] although causality has rarely been determined. A range of retail policy options can address availability, including: a cap on the number of retailers in a geographic region or relative to population size; prohibiting or only allowing particular types of retailers to sell tobacco; prohibiting retailers from being located near schools; or distance proximity limit between retailers.[4] No measures have yet been introduced in New Zealand to reduce the widespread retail availability of tobacco, and which policy to implement is even less clear.

In New Zealand, Robertson et al. assessed smokers' perceptions of five potential policies designed to reduce the retail supply of tobacco, relative to a policy of annual tobacco tax increases, a measure known to reduce smoking prevalence.[7] Two policy scenarios in which tobacco was only sold at half the existing liquor stores or only at pharmacies were rated more likely to prevent youth smoking initiation, and at least as likely to help smokers to quit, relative to annual tax

Abstract

Objective: To examine the potential impact of tobacco being available only from pharmacies, only from liquor stores or only from petrol stations on the New Zealand tobacco retail landscape.

Methods: Tobacco retailers and pharmacies were mapped using GIS. Comparisons were made between tobacco retailers and pharmacies. Simple linear regression was used to assess the relationship between outlet types and deprivation.

Results: A total of 5,243 tobacco outlets, including liquor stores and petrol stations, and 1,035 pharmacies were identified. The density of all outlets was greater in areas of higher deprivation. The majority of tobacco retailers and pharmacies were located in urban areas. Outlets were mapped in relation to walking distances from secondary schools; significant differences between outlet types are presented.

Conclusions: The policy options examined in this study would considerably reduce the overall availability of tobacco, decrease cues to smoke and reduce the density of tobacco sales around schools. However, inequities in availability would exist with access to tobacco in rural areas disproportionately reduced, and a positive sociodemographic gradient remaining.

Implications for public health: Substantially reducing tobacco availability has been identified as a crucial tobacco control strategy. This study provides information on the impact of different policy options to support Smokefree 2025.

Key words: tobacco retail, public policy, denormalisation, socioeconomic status, GIS

increases. In addition, New Zealand studies that modelled the impact of a range of interventions to reduce availability of tobacco retail outlets found that the intervention that permitted tobacco sales at pharmacies only, in combination with cessation advice, resulted in the lowest smoking prevalence.[8,9] Without the cessation advice component; however, the liquor outlet scenario resulted in the largest reduction in future smoking

prevalence. Consistent with these findings, the various tobacco retail outlet reduction strategies were projected to also result in large population health gains and health system cost savings, with the pharmacy option resulting in the largest benefits.[9,10] These benefits are attributed to the models' assumptions about reduced availability, and not proven tobacco control advantages of selling tobacco through pharmacies. In fact,

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some pharmacies in the US have made the decision to cease the sale of tobacco because of "the paradox inherent in promoting health while contributing to tobacco-related deaths".[11]

These studies have identified tobacco retail reduction policies that are likely to have the most impact on retail reduction in New Zealand in terms of health gains, health systems savings, and policies that smokers believe will be most effective. However, no geospatial examination has been undertaken to assess the impact of these policies on equitable access for smokers. For example, research has shown that since 1965 the number of pharmacies in New Zealand has been in decline and they are now primarily urban services, leaving many people with poor access to pharmacy services.[23] This lack of rural access would affect rural support for a restricted policy supporting solely pharmacy sales, and it may have practical implications for those living in rural areas. In addition, Māori are over-represented in rural communities compared with non-Māori.[10]

If higher spending on travel to purchase tobacco would result in smoking cessation for most, this may not necessarily be an issue. However, if people do not manage to quit successfully, such a policy would be regressive for Māori and rural smokers as increased spending on travel to purchase tobacco would result in less household money available for healthy products. This could potentially increase ethnic and geographic health inequities; therefore, such a measure would need extra cessation support for Māori and rural communities. To overcome this lack of availability in rural areas, a further option, which has not yet been explored in New Zealand or overseas as far as the authors are aware, is the sale of tobacco only through petrol stations. In contrast to pharmacies, this additional policy option may provide better access for rural communities, as petrol stations are located in most small towns in New Zealand.

This study uses a geospatial approach to examine the potential changes in retail availability of tobacco if policies were implemented to restrict availability based on outlet type. This includes tobacco being available only from pharmacies, only from liquor stores, or only from petrol stations on three features of the tobacco retail landscape in New Zealand; namely, the clustering of tobacco retailers in deprived communities,

density of retailers around secondary schools, and urban and rural access to tobacco.

Methods

Measures

Identification of known tobacco retailers: We developed a national database of tobacco retailers in 2012.[12] This was updated in 2017 using the same methods. The tobacco retailer database includes convenience stores, petrol stations, supermarkets, and liquor stores; pharmacies do not currently sell tobacco in New Zealand. Data on petrol stations were audited for accuracy using online lists from each fuel company. Truck stops were excluded. Ten petrol stations where the selling of tobacco was stopped voluntarily were excluded.[13] A list of off-licence liquor stores where alcohol cannot be consumed on the premises was obtained from the New Zealand Liquor Licensing Authority.[14] These were audited with a phone call to identify if they sold tobacco. One hundred stores that reported they did not sell tobacco were excluded, the majority of these were wine shops, wineries or craft breweries. This database excludes retailers that have an on-license such as bars or clubs that allow alcohol consumption only on their premises, as the quality of these data differed by region. Duplicate listings were removed and missing or incomplete physical addresses were resolved through online searches and Google Street View. Each retailer was then matched to its meshblock area; the smallest geographic unit for which statistical data are collected and processed by Statistics New Zealand.

Once the retailer addresses were confirmed, geocoding allowed the addresses in the database to be translated to spatial locations and mapped using ArcGIS 10.6 software.[15] Accuracy of the geocoding results was first checked by confirming that each retailer had been correctly located at the city or region level. Those that were in the wrong city or region were relocated to their correct street address by hand. More than 90% of the mapped points were reviewed manually to ensure proper placement. Where possible, points were relocated as close to a premise's entrance as possible.

Identification of community pharmacies: Data on the location of community pharmacies throughout New Zealand were publicly available from the Ministry of Health.[16] A community pharmacy is defined as a place

where pharmacy services are provided in a shop or community health centre. Hospital and prescribing pharmacies were excluded as these are located within hospitals and technicians interact with medical staff rather than the public. Included pharmacies were geocoded and reviewed following the same procedures as outlined above.

Population and smoking data: Tobacco retailer density per residential population and per number of smokers was measured. Data from the 2013 Census (the latest available census data)[17] were used for residents aged 15 years and above. This age range was chosen because approximately one-third of current smokers aged 14 to 15 years are known to purchase cigarettes from retail stores.[18] The 2016/2017 New Zealand Health Survey reported 602,000 current smokers, defined as people aged 15 years and older who have smoked more than 100 cigarettes in their lifetime and at the time of the survey were smoking at least once a month.[19]

Secondary school data: A spatial layer of school locations was downloaded from the online data portal Koordinates.com. The GPS position of each school (n=522) was confirmed by visual inspection and was relocated if necessary. Nine schools were removed, as they were not proposed to open until 2019. A spatial layer of the national road network was obtained from Land Information New Zealand for use in network modelling. In order to identify the areas that were accessible on foot within 500 m and 1 km via the road network, this layer was converted to a network dataset and then used to create 500 m and 1 km walking zone polygons around each secondary school. These polygons delineate the areas that are accessible within 500 m and 1 km via the road network around each school. By spatially intersecting the retailer locations and the walking zones, the density of retailers within any of the zones could then be easily quantified.

Socioeconomic deprivation: The NZDep2013 index was used to measure socioeconomic deprivation at the meshblock level for each tobacco retailer.[20] This index combines nine variables from the 2013 census that reflect eight dimensions of deprivation. The NZDep2013 scale provides an ordinal score from 1 to 10, where 1 represents the areas with the least deprived score and 10 the areas with the most deprived score. In addition, the decile values of the NZDep2013 were joined to a GIS layer of 2013 census meshblocks.[17]

By attaching the NZDep2013 index to both retailers and schools, this value could be mapped and quantified for each. For 256 tobacco retailers and 82 pharmacies, NZDep at the meshblock level was not available; instead, NZDep for the larger census area unit was used.

Rural/urban classification: Each tobacco retailer was categorised as being located in an urban area (population greater than 30,000), semi-urban area (population between 1,000 and 29,999) or rural area (population of less than 1,000) at the meshblock level based on classifications obtained from the 2013 census as published by Statistics New Zealand.

Analysis

Initially, descriptive analyses were undertaken to determine the number and type of retailers, density by population and current smokers, and their location in terms of community deprivation, rural access, and proximity to secondary schools. Tobacco retailers and pharmacies were mapped in relation to walking distances (500 m and 1 km) from all secondary schools, and comparisons were made between tobacco retailers and pharmacies as to their proximity to secondary schools. Comparisons were also made between tobacco retailers, including liquor stores and petrol stations, and pharmacies within urban and rural locations. Simple (unadjusted) linear regression was used to assess the relationships between the level of deprivation and: i) the number of tobacco retailers (including liquor stores and petrol stations); and ii) the number of pharmacies. Analyses were performed using Stata v15 software.[21]

Results

A total of 5,243 tobacco retail outlets were identified, with 46% of retailers being classified as convenience stores, these were followed by petrol stations (20%), liquor stores (17%), and supermarkets (13%). The population of residents aged 15 years and above in New Zealand at the 2013 Census was 4,242,048, giving a density of one tobacco outlet per 809 adults (Table 1). Based on 602,000 current adult smokers among the adult population (15 years and older) in 2016/2017,[19] this equates to approximately one tobacco outlet per 115 smokers (Table 1). This compares with 870 liquor stores, which equates to one liquor store per 4,876 adults and one per 692 current smokers. There were

1,045 petrol stations identified, which equates to one petrol station per 4,059 adults and one per 576 current smokers. There were 1,035 pharmacies identified, which equates to one pharmacy per 4,099 adults and one per 582 current smokers.

The density of tobacco retail outlets, including liquor stores and petrol stations, and pharmacies tended to be greater in areas of higher socioeconomic deprivation (Figure 1). There was evidence of a positive association between number of retailers in a meshblock and meshblock deprivation, which suggests a higher retail outlet density in areas of higher deprivation. For every one-unit increase in the meshblock NZDep score, the number of tobacco retailers in the meshblock (on average) increased by 87.81 (95%CI: 66.56-109.07). The number of liquor stores (on average) increased by 14.17 (95%CI: 10.48-17.86), the number of petrol stations (on average) increased by 15.17 (95%CI:

8.82-21.51), and number of pharmacies (on average) increased by approximately 16.49 (95%CI: 9.93-23.05), see Table 2.

The majority of tobacco retailers, liquor stores and pharmacies were located in urban areas, with about one-quarter in semi-urban areas (Table 1). In contrast, fewer petrol stations were located in urban areas (55%), and nearly 30% of petrol stations were in semi-urban areas. There were fewer pharmacies in rural areas compared with tobacco retailers (*p*<0.001).

Tobacco retailers and pharmacies were mapped in relation to walking distances (500 m and 1 km) from all 522 secondary schools. Fifty-four per cent of secondary schools had at least one tobacco retail outlet within a 500 m walk, and 83% of secondary schools had at least one outlet within a 1 km walk (Table 1). Significantly fewer secondary schools had at least one pharmacy located within 500 m (22%) and 1 km (55%) compared

Table 1: Characteristics of tobacco retailers and pharmacies in New Zealand.		Tobacco retailers	Liquor stores	Petrol stations	Pharmacies
		n	n	n	n
Number of retailers		5,243	870	1,045	1,035
Retailer density by population		809	4,876	4,059	4,099
Retailer density by current smokers		115	692	576	582
		n (%)	n (%)	n (%)	n (%)
Type of retailer	Convenience store	2,388 (45.5)			
	Petrol station	1,045 (19.9)			
	Liquor store	870 (16.7)			
	Supermarket	684 (13.0)			
	Other	223 (4.3)			
Deprivation	1 Least deprived	136 (2.6)	22 (2.5)	29 (2.8)	36 (3.5)
	2	219 (4.2)	33 (3.8)	49 (4.7)	46 (4.4)
	3	256 (4.9)	47 (5.4)	53 (5.1)	60 (5.8)
	4	355 (6.8)	62 (7.1)	71 (6.8)	65 (6.3)
	5	469 (8.9)	85 (9.8)	103 (9.9)	88 (8.5)
	6	600 (11.4)	89 (10.2)	138 (13.2)	107 (10.3)
	7	682 (13.0)	125 (14.3)	144 (13.8)	118 (11.4)
	8	890 (17.0)	141 (16.2)	163 (15.6)	192 (18.5)
	9	880 (16.8)	145 (16.7)	176 (16.8)	189 (18.3)
	10 Most deprived	756 (14.4)	121 (13.9)	119 (11.4)	134 (13.0)
Rurality (n=5,092)	Urban	3,433 (65.5)	598 (68.7)	571 (54.6)	749 (72.4)
	Semi-urban	1,235 (23.6)	210 (24.1)	307 (29.4)	260 (25.1)
	Rural	575 (11.0)	62 (7.1)	167 (16.0)	26 (2.5)
Location of tobacco retailers to secondary schools (n=522)					
Count (%) of schools with at least one retailer located within 500m	n (%)	281 (53.8)	91 (17.4)	98 (18.8)	116 (22.2)
Count (%) of schools with at least one retailer located within 1km of a school	n (%)	432 (82.8)	235 (45.0)	274 (52.5)	285 (54.6)
Mean number of tobacco retailers within 500m of a school	Mean (SD)	1.61 (3.62)	0.24 (0.63)	0.24 (0.55)	0.34 (0.82)
	Range	0–44	0–4	0–3	0–8
Mean number of tobacco retailers within 1km of a school	Mean (SD)	5.32 (9.25)	0.89 (1.64)	0.86 (1.03)	1.22 (1.91)
	Range	0–118	0–19	0–7	0–16

with tobacco retailers overall ($p<0.001$). Significantly fewer secondary schools had at least one liquor store located within 500 m (17%) and 1 km (45%) compared to pharmacies ($p<0.05$). One-fifth (19%) of secondary schools had a petrol station located within 500 m.

Discussion

This study examined changes in the tobacco retail landscape under four tobacco retail policy options. There would be an important reduction in overall availability of tobacco if it were only sold through liquor stores or petrol stations, which are subsets of current retailers who sell tobacco, or through pharmacies, compared with the status quo. Although there would be an overall reduction in the availability of tobacco, the positive sociodemographic gradient remained for each retail option, potentially continuing to contribute to smoking inequities. This is consistent with findings from the US that

found no change in sociodemographic disparities after the removal of tobacco from CVS-branded pharmacies, as well as all other pharmacies.[22] Smoking tobacco is a key cause of health inequities in New Zealand: Māori are more than twice as likely to smoke as non-Māori, and Pacific people and those living in socioeconomically deprived communities have higher smoking rates as compared to the New Zealand average.[19]

With the tobacco retailer scenarios examined in this study, there would be a reduction from 54% of schools having at least one tobacco retailer located within 500 m under the status quo to 22% of schools having at least one pharmacy located within 500 m, 19% having a petrol station located within 500 m, or 17% of schools having a liquor store located within 500 m. Evidence shows that the more tobacco retailers there are around a school, the more likely are students to have ever smoked, engaged in experimental smoking and be susceptible to future smoking.[24-27] Reduced density of the sale of tobacco around schools

would reduce curiosity and temptation concerning tobacco, diminish the normalising of smoking in the community, and provide fewer opportunities and cues for adolescents to attempt to purchase tobacco.[27] However, recent research has highlighted that the association between tobacco retailer density and youth smoking may be stronger in residential areas compared to schools.[28,29]

In the US, the sale of tobacco is gradually being removed from pharmacies either voluntarily[30] or through legislative change and has shown a reduction in tobacco retail density in two states.[31] New Zealand modelling research has suggested only selling tobacco from pharmacies, and banning sales from other retail outlets.[7-10] In addition to the overall reduction in the availability of tobacco, the positive aspects of tobacco being only available through pharmacies are the potential for reduced opportunity for the sale of tobacco to minors,[32] reduced operating hours, and that pharmacists are already trained to provide brief smoking cessation interventions.[9,33] In addition, there may also be increased footfall into stores, which may result in sales of additional products. However, a recent New Zealand study found that tobacco is not typically purchased simultaneously with non-tobacco items in convenience stores.[34]

The potential disadvantages for pharmacies include increased theft – although they do currently have existing security systems for medications – and increased workload, as well as damage to their reputation from the contradiction of distributing medications and promoting health while selling tobacco, and also contributing to the normalisation of smoking. In addition, this policy is only feasible if there is support from pharmacists for selling tobacco. A small New Zealand study to gauge support among pharmacists for selling tobacco, if it was not available elsewhere, found that 26% of pharmacists interviewed thought it was 'very likely' to 'extremely likely' that their pharmacy would sell tobacco.[35] This increased to 37% if it was shown that this strategy was successful elsewhere. There are significantly fewer pharmacies, compared with tobacco retailers, located in rural areas than in urban and semi-urban areas, which may result in an increase in purchase costs for rural smokers.

The sale of tobacco through liquor stores could be implemented through the existing liquor licensing scheme, eliminating the need to develop a new licensing system

Figure 1: Tobacco retail outlets, liquor stores, petrol stations and pharmacies by meshblock deprivation.

Retailer meshblock NZDep2013 Index
(1=least deprived; 10=most deprived)

☐ Tobacco outlets ☐ Liquor stores ▨ Petrol stations ▨ Pharmacies
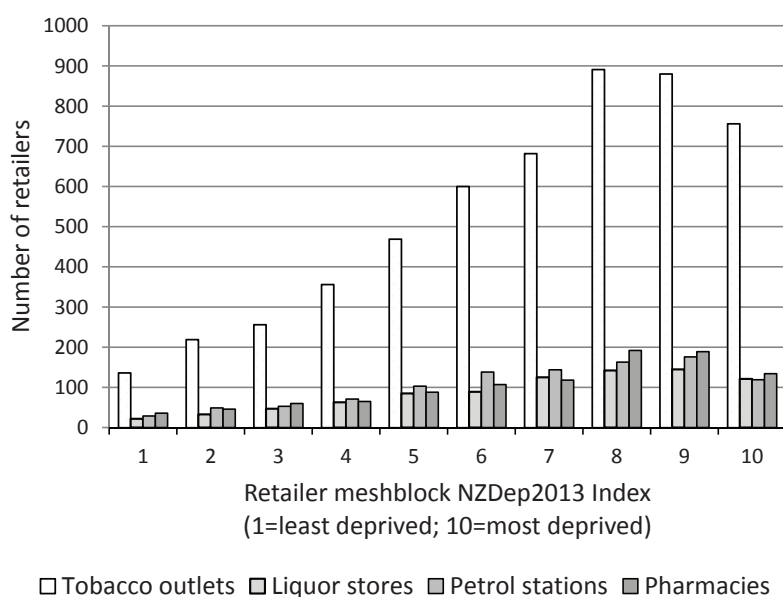
Table 2: Results of a collection of simple linear regressions assessing the relationship between the level of deprivation and i. the number of tobacco retailers (including liquor stores and petrol stations) and ii. the number of pharmacies.

Dependent variable for linear regression	Independent variable	Coefficient	Standard error	Confidence interval
Tobacco retail outlets	NZDep2013	87.81	9.22	66.56 - 109.07*
Liquor stores	NZDep2013	14.17	1.60	10.48 – 17.86*
Petrol stations	NZDep2013	15.17	2.75	8.82 – 21.52*
Pharmacies	NZDep2013	16.49	2.84	9.93 – 23.05*

Note:
$p<0.05$

that would be required for most retail reduction measures. It would also enable a more efficient enforcement of the *Smokefree Environments Act*, as Smokefree Enforcement Officers would have an accurate list of retailers and fewer retailers to engage with, and local regulatory bodies would have established relationships with liquor store retailers. In addition, local alcohol policies can be developed that are able to restrict the number and location of liquor stores, giving the opportunity to also restrict where tobacco would be sold. In addition, an R18 restriction (purchasers must be aged 18 years or older) was supported as a long-term strategy by New Zealand tobacco control experts who were interviewed about their views on policies to reduce tobacco retail availability.[36]

In contrast to the positive benefits of the sale of tobacco through liquor stores, there are also a number of consequences to be considered. The association between drinking alcohol and smoking tobacco is well established:[37,38] alcohol use fosters both smoking uptake and relapse,[37] social smoking tends to occur predominantly in the context of alcohol consumption,[38,39] and established smokers smoke more at licensed premises when cigarettes are available for purchase.[40] The health risks associated with smoking and drinking alcohol together are significant.[41] A key objective within the Achieving Smokefree Aotearoa Action Plan (ASAP),[42] developed by the New Zealand tobacco control sector in 2018, is to make tobacco products less available by disallowing sales of tobacco products in all on-licensed premises. While this current study relates to the sale of tobacco in off-license bottle stores where consumption of alcohol does not take place, this policy option is inconsistent with the ASAP plan in terms of allowing tobacco and alcohol to be available for sale concurrently, effectively undermining the de-coupling of tobacco and alcohol.

Petrol stations also offer another option as a sole retailer of tobacco. There are a smaller number of petrol stations compared with current tobacco retailers, and of all the options examined in this paper, petrol stations provided rural communities with the best access. Although petrol stations are not R18 stores, they are not the usual source of tobacco supply for young people.[43] The potential drawbacks include that petrol stations also sell a range of unhealthy foods and beverages, and in many cases resemble a convenience store.

This is the first study to examine the spatial characteristics of different tobacco retail reduction policy options for New Zealand. A particular strength of this study is that in determining the proximity of tobacco outlets to secondary schools we used polygons of 500 m and 1 km walking distances. This study included a national database of tobacco retailers, excluding retailers with an on-license. Australian research found approximately 60% of hotels and clubs sold tobacco,[44] so our study is likely to have underestimated the impact of these policies. It was beyond the scope of this study to physically verify the sale of tobacco in each store; however, online and phone auditing was undertaken. The study was limited by the lack of recent comprehensive population census data.

Myers et al. compared similar policy options for reducing retail availability of tobacco in North Carolina.[45] The findings showed that a pharmacy ban would reduce density by 14%, and a 1,000-foot near-schools' ban would reduce density by 18%. The policy that would have the greatest impact was a 500-foot proximity ban between tobacco retailers, which reduced density by 22%. An agent-based simulation model also examined limiting proximity of retailers to each other, which reduced tobacco retailer density across all towns; however, the impact varied by the type of town. The reduction in density was greater in urban vs. suburban areas, and in poor vs. rich areas.[46] This policy option has not been examined in this current study, and future research should explore the impact of this policy option in the New Zealand context. Further research is also needed to identify policy options that may reduce social inequities. This study did not assess the policy option of the sale of tobacco only through supermarkets, and future research could examine this policy option and its impact on inequity.

The conclusions reached in this research assume that prevalence of smoking, and the numbers of tobacco retailers – including liquor stores and petrol stations – and pharmacies remain the same after policy change. It is possible that, over time, implementation of such policies may have an impact on the location or number of stores that will be allowed to sell tobacco, as well as a change in the number of retailers who voluntarily stop selling tobacco. Therefore, it may be important to consider controlling the number of tobacco outlets more generally.

Conclusion

The sale of tobacco only through liquor stores, petrol stations or pharmacies would considerably reduce the overall availability of tobacco, change community norms around tobacco use, decrease cues to smoke (particularly among those trying to quit), and reduce the density of tobacco sales around schools. However, inequities in availability would exist with access to tobacco in rural areas disproportionately reduced, potentially resulting in increased travel costs for Māori and rural smokers to purchase tobacco, and a positive sociodemographic gradient remaining. The policy option of selling through pharmacies may be the least attractive of the options explored in this study, due to ethnic and geographic inequities in access restrictions to smokers, and it should be combined with increased cessation support in areas with particularly low access. The petrol station scenario, while not previously considered as a policy option to reduce tobacco availability, has the lowest density of all the policy options examined, would provide rural smokers with equitable access, and would potentially limit access to teenagers. This study presents the geospatial impact of selling tobacco through a range of different tobacco retail outlet options and, combined with the results of previous New Zealand studies,[7,8,10] adds to the currently available literature on alternative commercial sales of tobacco.

Ethical consent

The University of Otago Human Ethics Committee approved this project (D17/249).

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