Density and hotspots of outdoor tobacco advertising around schools in Semarang, Indonesia: Geospatial analysis

Nurjanah[1,2], Yusthin Merianti Manglapy[1], Sri Handayani[1], Abdillah Ahsan[3], Retno Sutomo[2], Fatwa Sari Tetra Dewi[2], Peter Wushou Chang[4], Dian Kusuma*[5]

1 Public Health Program, Faculty of Health Sciences, Universitas Dian Nuswantoro, Semarang, Indonesia
2 Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
3 Faculty of Economics, University of Indonesia, Depok, Indonesia
4 Tufts University School of Medicine, Boston, USA
5 Centre for Health Economics and Policy Innovation, Imperial College Business School, London, UK

Corresponding author: Dr. Kusuma (d.kusuma@imperial.ac.uk)

Suggested citation: Nurjanah N, Manglapy YM, Handayani S. et al. Density and hotspots of outdoor tobacco advertising around schools in Semarang, Indonesia: Geospatial analysis. Int J Tuberc Lung 2019 (in press).

ABSTRACT

Background: Indonesia has the second-highest smoking prevalence among adult males in the world, with over 61.4 million current smokers. However, there is no national regulation on outdoor tobacco advertising. **Objective**: The study aims to assess the density and hotspots of outdoor tobacco advertisements around schools in Indonesia with Semarang city as an example. **Methods**: We conducted geospatial analyses using buffer and hotspot analyses using advertisement and school data in ArcMap 10.6. We statistically test the significance of different densities, including between area 100 meter and 100-300-meter buffers from schools using Stata 15.1. **Results**: We found a total of 3,453 advertisements, of which 3,026 (87%) were at least medium in size (1.3×l.9 meters), and 2,556 (74%) were within 300 meters from schools. We also found a 45% higher density of advertisements within 100-meter around schools (compared to within 100-300 meters). There were 378 schools (39%) were in the advertisement hotspots. **Conclusion**: There were high density and significant hotspots of outdoor tobacco advertising around schools in Semarang city. Policy implications were discussed.

Keywords: density, hotspots, outdoor tobacco advertising, school, geospatial analysis, Indonesia

Word count: 2268 (main text), 170 (abstract)

INTRODUCTION

Indonesia has the second-highest smoking prevalence among adult males in the world and is among the main contributors of global smokers with more than 61.4 million current smokers in 2018.[1] The latest national survey showed that although the overall smoking prevalence among those aged above 15 years old had decreased slightly from 36% to 34%, that among those 10-18 years increased by almost 30%, from 7% to 9% during 2013-2018, respectively.[2] Furthermore, the Global School Health Survey showed that 22% of Indonesian students were smokers in 2015, and 33% of male students initiated smoking before age 13.[3]

There is, however, a lack of national tobacco control efforts. The country is not among the 181 signatories of the Framework Convention on Tobacco Control, which provides a legal framework and support for comprehensive efforts.[4] While there is a national regulation that encourages districts to implement the smoke-free policy that bans smoking, advertising, promotion and sale inside selected areas including schools, only 345 districts (67%) adopted the policy during 2012-2018, with large variation in compliance rates from 17% in Jayapura city to 78% in Bogor city.[5,6] To date, there is no national regulation to ban outdoor tobacco advertising. A study in 2015 examined the surrounding of 360 high schools in five Indonesian cities. It found that tobacco billboards were visible from the gate in 32% of schools and that retailers with tobacco advertisements surrounded 85% of the schools.[7] Also, a study in 2017 took samples of tobacco advertisements and promotions around schools in ten cities (including Semarang). It found aggressive marketing strategies showing the brand and a very low price.[8]

There is extensive evidence that youth are highly receptive to tobacco advertising and that young people exposed to tobacco advertising and promotion are more likely to smoke.[9–16] A Surgeon General's Report in 1994 concluded that nearly all first use of tobacco occurs before high school graduation, which suggests that if they can be kept tobacco-free, most will never start using tobacco.[10] A Cochrane review in 2011 concluded that longitudinal studies consistently suggest that exposure to tobacco advertising is associated with the likelihood that adolescents will start to smoke.[11] Further evidence suggests that very young children understand that tobacco promotion is promoting smoking rather than a particular brand.[17]

Given the well-established link between advertising and youth smoking, many countries such as the United States, the United Kingdom, and Sri Lanka have banned outdoor tobacco advertising since 1998, 2003, and 2006, respectively. While there is no national regulation in Indonesia, a few district governments (about 15 of 514) have started the ban; albeit with enforcement and compliance issues. Banyuwangi district enacted the ban along the main roads and sports arenas in 2016. Still, a study found a very high visibility of small to large size outdoor tobacco advertising (around 1,300 materials) around schools a year later.[18] Such evidence is lacking in districts without the ban.

Previous studies are limited in at least two ways. First, many studies are mainly older (1990s) and from high-income countries such as the United States.[19–21] Second, since many countries have national bans even before the FCTC, those studies have not employed the latest geospatial techniques such as hotspot analysis that uses Getis-Ord Gi* statistics to identify significant clustering. This approach has been regularly used in infectious disease but not in non-communicable disease research, especially tobacco control.[22,23] Thus, our study aims to assess the density and hotspots of outdoor tobacco advertisements around schools in Indonesia, a lower-middle-income country, using Semarang city where there is no outdoor advertising ban as an example.

Semarang is the capital city of Central Java province and among the largest city with over 1.7 million population in 2016. The city started to implement the smoke-free policy in 2013 but lacks more comprehensive tobacco control efforts, including an outdoor advertisement ban. Data from the Ministry of Industry showed there are currently 110 tobacco manufacturers in Central Java, including PT. Djarum that supplies about 40% of national cigarette sales, together with its subsidiary PT. Gudang Garam.

METHODS

We conducted geospatial analyses on the density of outdoor tobacco cigarette advertisements around primary and high schools in Indonesia, using Semarang city as an example. There were two primary data: advertisement and school. First, the advertisement data was collected by 16 enumerators during November-December 2018 through survey of outdoor advertisements using Open Data Kit smartphone application for data collection (https://opendatakit.org) and KoboToolbox for data server (https://www.kobotoolbox.org). Variables included geocodes (latitude and longitude), types of advertisements (billboard, videoboard, banner, store sign, neon box, poster, and sticker), brand/product name, content, and pictures. The advertisement sizes categorized into small (between 21×30 centimeters [approximately A4 size] and 1.3×1.9 meters), medium (1.3×l.9 meters [approximately the size of a bus shelter poster] and 2.0×2.5 meters), and large (>2.0×2.5 m [the size of a typical billboard]).[24] The inclusion criteria were outdoor advertisements in front of the stores/retailers with the size of A4 paper or bigger. There were 3,484 advertisement materials collected, but 31 were dropped during analysis due to locations were out of city boundary, leaving 3,453 advertisements in our analysis. Second, the school data was obtained from the city education office (http://disdik.semarangkota.go.id) and included 978 governmental and private schools in Semarang city. Variables included school name, level (primary, junior high, and senior high), and address. Google Sheets and geocoding add-ons were used to convert the addresses into geocodes.

The geospatial analyses, conducted in ArcMap 10.6 using World Topographic Map, included buffer and hotspot analysis. In buffer analysis, we used the geoprocessing tool to generate buffers of 100 and 300 meters around schools.[25,26] Using the spatial join tool, we then calculated the number of schools that had at least one advertisement inside the buffer. We used the spatial join and dissolve tools to produce the number of advertisements within the dissolved school buffer. The dissolve tool removed all the overlapping buffers and created one area (layer) around 100 or 300 meters from any schools (Appendix 1). In hotspot analysis, we used the optimized hotspot analysis tool using Getis-Ord Gi* statistics to produce the hotspots, areas with a significantly higher density of advertisements (at a 95% significance level). We used the default fish net method that divided the study area into square grids. We then used the spatial join tool to calculate the number of schools within hotspots and the geometry tool to calculate the area inside the school buffer.

Also, we identified the areas (subdistricts) inside and outside of hotspots and examined the variations. Inside was defined as subdistricts with hotspot areas covering more than half of subdistrict (Appendices 2-3). In our analyses, each advertisement and school were represented as a point on the map. Unlike in infectious disease epidemiology, hotspot analysis that identifies spatial clusters using Getis-Ord Gi* statistics has not commonly utilized in tobacco control research.[23,27] In addition, we conducted t-test and chi-square in Stata 15.1 to test the significance of different proportions of schools with at least one advertisement inside buffer between government/private and primary/junior high/senior high schools, respectively. We also conducted a t-test for different densities between area 100-meter and 100-300-meter buffers from schools.

RESULTS

Table 1 shows the sample characteristics of outdoor tobacco advertisements and schools in Semarang city, which has 1.7 million population and a total area of 374 square kilometers. There were 3,453 advertisements found, of which 3,026 (87%) were medium-sized or larger (i.e., at least 1.3×l.9 meters). While the majority of type were banners (2,489 advertisements or 72%), other types included posters, store signs, video board, and neon box. The video board and neon box were not many (86 advertisements or 2%), but potentially have more exposure because of visibility day and night because of the lights. Figure 1 shows the sampled pictures. Moreover, the top three companies were Djarum with 1,205 advertisements (35%), Gudang Garam with 636 (18%), and Norojono with 452 (13%). For educational facilities, there were 978 schools included in our analysis, of which 579 (59%) were private, and 563 (57%) were primary schools.

Figure 2 shows the visibility of outdoor tobacco advertisements around schools in Semarang city. In the buffer analysis (panel a), the red dots show advertisements and grey lines show 100 and 300 meters of dissolved buffers around schools. Results show high visibility of advertisements throughout the city, particularly around the school buffers. In the hotspot analysis (panel b), blue dots show schools and red cells show hotspots, areas with a significantly higher density of advertisements. Results show relatively large hotspot areas (i.e., areas covered in red squares) around the city center. When comparing between the areas (subdistricts) inside and outside hotspots, we found relatively similar in population size. However, subdistricts inside hotspots had on average smaller area size, more population density, proximity to the city center, and higher poverty rates (Appendices 2-3).

Table 2 shows the number and proportion of outdoor tobacco advertisements inside and outside of a 300-meter dissolved school buffer. Out of 3,453 advertisements in our analysis, 2,556 (74%) were within 300 meters from schools with almost an equal split around government and private schools. By level, 64%, 16%, and 28% of advertisements were within 300 meters from primary, junior high, and senior high schools, respectively. Furthermore, Table 3 shows the number of schools that had at least one advertisement within buffers and the number of schools within hotspots. Out of 978 schools in our analysis, 324 (33% of total 978) and 791 (81%) had at least one advertisement within their 100 and 300-meter radius, respectively. By ownership, the proportion of government schools that had at least one advertisement within 300-meter was higher than that of private schools (85% v. 78%; p-value=0.007). By level, all schools had a high proportion of having at least one advertisement within 300-meter buffer, ranging from 75% to 83%. Results also show 378 schools (39%) were inside advertisement hotspots, with similar findings by ownership and level.

Table 4 compares the density of advertisements between areas within 100 meters and within 100 to 300 meters from schools. Overall, the densities were 29.6 and 20.4 advertisements per square kilometer within 100 meters and 100-300 meters, respectively, indicating a significant nine absolute difference or 1.45 relative difference (i.e., 45%). The density was higher around private schools relative to government schools. The densities were 28.1 v. 22.0 (i.e., 28% higher) and 30.6 v. 19.3 (i.e., 58% higher) within 100 meters and 100-300 meters from government and private schools, respectively. The densities were also highest around senior high and higher around primary relative to junior high schools. The densities were 39.0 v. 23.0 (i.e., 70% higher), 30.7 v. 20.3 (i.e., 51% higher), 18.3 v. 18.4 within 100 meters and 100-300 meters from senior high, primary, and junior high schools, respectively.

DISCUSSION AND CONCLUSION

Our study showed a significant 45% higher density of outdoor tobacco advertising in the area of 100 meters from schools, compared to that of 100-300 meters in Semarang city. This result is similar to studies from high-income countries such as the United States, which showed that outdoor tobacco advertising was intense in areas close to schools.[19,21] Moreover, our findings showed even higher densities of 70% and 51% in the area of 100 meters from primary schools (usually 6-12 years old) and senior high schools (16-18 years old), respectively. Also, 2215 advertisements (64% of total) and 964 advertisements (28%) were within 300 meters (about 10-minute walk) from primary schools and senior high schools, respectively.

These findings are important for two reasons. First, primary schools are dominant in number (e.g., 562 schools or 57% of total), indicating higher potential exposure to tobacco advertising to many very young children. Data show that smokers in Indonesia are getting younger, including the infamous 2-year-old smoker.[28] A study on cigarette retailers in Scotland analyzed data from almost 1,500 students and found 80% of them recalled seeing advertising through tobacco displays.[29] Second, students at senior high schools are more likely to experimentally smoke [30], which would make them more vulnerable to exposure from tobacco advertising.

Moreover, 3,028 advertisements (87% of total) were at least medium to large-sized banners and billboards, which young people are more likely to remember (compared to smaller ones).[31] Also, most advertisements were from the most prominent national tobacco companies with aggressive and attractive marketing strategies, especially towards young people.[32–34] Results also show considerably large hotspot areas, where 378 schools (39% of total) were located. These hotspots are shown to be more densely populated and have higher poverty rates. This could contribute to the increasing tobacco use among the poor, including young people.[20]

For global health, our findings provide support for an effective national ban on outdoor tobacco advertising to reduce potential exposure to tobacco advertising among youth.[35,36] For Indonesia, these findings should be used as policy evidence for the government to ban outdoor tobacco advertising, or at least around schools and other youth populated areas. Indonesia is the only country in Southeast Asia without an outdoor tobacco advertising ban[37], which is most likely due to having the highest tobacco company interference.[38] While only 3% of district governments currently have the ban, having a national regulation is more likely to increase the adoption at the local level. All this is to halt the increasing trend of smoking prevalence among youth.[2,25,26]

Our study has at least two limitations. First, our study only assessed the density and hotspots around schools. Further studies should also examine those around other youth populated areas such as math and English tuitions, places of worship, and playgrounds. Second, our research is not representative of the entire country. Further studies should also assess the density and hotspots of advertisements in rural areas and other regions.

Funding: Support was provided by the Center for Islamic Economics and Business, the University of Indonesia, with funding awarded by Bloomberg Philanthropies to Johns Hopkins University. Its content is solely the responsibility of the authors and do not necessarily represent the official views of Bloomberg Philanthropies or Johns Hopkins University.
Conflicts of interest: None declared
Ethical approval: Health ethics committee at State University of Semarang

Statements on the authors' contributions: N, AA and DK conceived the study. N, YMM, and SH conducted data collection. N, YMM, and DK analyzed the data. N and DK drafted and YMM, SH, AA, RS, FSTD, and PWC provided inputs to the manuscript. All authors approved the final version of the manuscript.

Reference

1. World Health Organization. Factsheet 2018 Indonesia: Heart disease and stroke are the commonest ways by which tobacco kills people. 2018. Online: https://apps.who.int/iris/bitstream/handle/10665/272673/wntd_2018_indonesia_fs.pdf?sequence=1 (accessed Nov 17, 2019)
2. Ministry of Health. [Report of Riskesdas 2018]. National Institute of Health and Research Development. Jakarta: 2018. URL: http://labmandat.litbang.depkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf (accessed Nov 17, 2019)
3. Kusumawardani N, et al. (2015) [Global School Health Survey 2015 Indonesia Report: Risky behavior among high school students in Indonesia]. World Health Organization
4. Kusuma D, Kusumawardani N, Ahsan A, K Sebayang S, Amir V, Ng N. On the verge of a chronic disease epidemic: comprehensive policies and actions are needed in Indonesia. International Health. 2019.
5. Wahidin, M, Hidayat, MS, Arasy, RA, Amir, V, Kusuma D. Geographic, socioeconomic disparity and policy determinant of the adoption of smoke-free policy by districts in Indonesia 2004-2018. Int J Tuberc Lung (In Press). 2019.
6. Wahyuti W, Hasairin SK, Mamoribo SN, Ahsan A, Kusuma D. Monitoring compliance and examining challenges with a smoke-free policy in Jayapura City, Indonesia. Journal of Preventive Medicine and Public Health (In Press). 2019.
7. Childrens' Media Monitoring Foundation. (2015) Beyond the School Gate: Bombarded by Cigarette Advertising. https://www.takeapart.org/tiny-targets/reports/Indonesia-Report.pdf (accessed Nov 17, 2019).
8. Yayasan Lentera Anak. (2017) [Dark picture of 10 cities surrounded by 2,868 tobacco advertisements]. Jakarta
9. Saffer H, Chaloupka F. The effect of tobacco advertising bans on tobacco consumption. J Health Econ 2000;19:1117–37. doi:10.1016/S0167-6296(00)00054-0
10. Satcher D, et al. Preventing Tobacco Use Among Young People: A Report of the Surgeon General (Executive Summary). Morbidity and Mortality Weekly Report. 1994
11. Lovato C, Watts A, Stead LF. Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours. Cochrane Database Syst Rev Published Online First: 5 October 2011. doi:10.1002/14651858.cd003439.pub2
12. Hammond R. Tobacco Advertising and Promotion: The need for a coordinated global response. WHO Conference on Global Tobacco Control Law: Towards a WHO Framework Convention on Tobacco Control. 7 to 9 January 2000, New Delhi, India. Available at: http://www.who.int/tobacco/media/ROSS2000X.pdf (accessed Nov 17, 2019]
13. Pierce JP, Choi WS, Gilpin EA, et al. Tobacco industry promotion of cigarettes and adolescent smoking. J Am Med Assoc 1998;279:511–5. doi:10.1001/jama.279.7.511
14. Gilpin EA, White MM, Messer K, et al. Receptivity to tobacco advertising and promotions among young adolescents as a predictor of established smoking in young adulthood. Am J Public Health 2007;97:1489–95. doi:10.2105/AJPH.2005.070359

15. Action on Smoking and Health (ASH). UK Tobacco Advertising and Promotion. 2019. Online: http://ash.org.uk/wp-content/uploads/2019/02/Tobacco-Advertising-and-Promotion-download.pdf (accessed Nov 17, 2019)
16. Pierce JP, Sargent JD, Portnoy DB, et al. Association Between Receptivity to Tobacco Advertising and Progression to Tobacco Use in Youth and Young Adults in the PATH Study. JAMA Pediatr 2018;172:444. doi:10.1001/jamapediatrics.2017.5756
17. Freeman D, Brucks M, Wallendorf M, et al. Youths' understandings of cigarette advertisements. Addict Behav 2009;34:36–42. doi:10.1016/j.addbeh.2008.08.007
18. Sebayang SK, Dewi DMSK, Lailiyah S, et al. Mixed-methods evaluation of a ban on tobacco advertising and promotion in Banyuwangi District, Indonesia. Tob Control 2018. doi:10.1136/tobaccocontrol-2018-054443
19. Pucci LG, Joseph HM, Siegel M. Outdoor tobacco advertising in six Boston neighborhoods: Evaluating youth exposure. Am J Prev Med 1998;15:155–9. doi:10.1016/S0749-3797(98)00034-8
20. Stoddard JL, Johnson CA, Sussman S, Dent C, Boley-Cruz T. Tailoring Outdoor Tobacco Advertising to Minorities in Los Angeles County. J Health Commun 1998;3:137–46. doi:10.1080/108107398127427
21. Luke D, Esmundo E, Bloom Y. Smoke signs: patterns of tobacco billboard advertising in a metropolitan region. Tob Control 2000;9:16–23. doi:10.1136/tc.9.1.16
22. McKay HS, Lessler J, Moore SM, et al. What is a Hotspot Anyway? Am J Trop Med Hyg 2017;96:1270–3. doi:10.4269/ajtmh.16-0427
23. Chowell G, Rothenberg R. Spatial infectious disease epidemiology: on the cusp. BMC Med 2018;16:192. doi:10.1186/s12916-018-1184-6
24. Kelly B, Cretikos M, Rogers K, et al. The commercial food landscape: outdoor food advertising around primary schools in Australia. Aust N Z J Public Health 2008;32:522–8. doi:10.1111/j.1753-6405.2008.00303.x
25. Mistry R, Pednekar M, Pimple S, et al. Banning tobacco sales and advertisements near educational institutions may reduce students' tobacco use risk: evidence from Mumbai, India. Tob Control 2015;24:e100-7. doi:10.1136/tobaccocontrol-2012-050819
26. Ribisl KM, Luke DA, Bohannon DL, et al. Reducing Disparities in Tobacco Retailer Density by Banning Tobacco Product Sales Near Schools. Nicotine Tob Res 2017;19:239–44. doi:10.1093/ntr/ntw185
27. Stopka TJ, Goulart MA, Meyers DJ, et al. Identifying and characterizing hepatitis C virus hotspots in Massachusetts: a spatial epidemiological approach. doi:10.1186/s12879-017-2400-2
28. Senthilingam M. Chain-smoking children: Indonesia's ongoing tobacco epidemic - CNN. https://edition.cnn.com/2017/08/30/health/chain-smoking-children-tobacco-indonesia/index.html (accessed Nov 17, 2019).
29. Stead M, Eadie D, MacKintosh AM, et al. Young people's exposure to point-of-sale tobacco products and promotions. Public Health 2016;136:48–56. doi:10.1016/J.PUHE.2016.03.032
30. McCarthy WJ, Mistry R, Lu Y, et al. Density of tobacco retailers near schools: effects on tobacco use among students. Am J Public Health 2009;99:2006–13. doi:10.2105/AJPH.2008.145128
31. Evans AT, Peters E, Keller-Hamilton B, et al. Warning Size Affects What Adolescents Recall From Tobacco Advertisements. Tob Regul Sci 2018;4:79–87. doi:10.18001/TRS.4.3.7
32. Prabandari YS, Dewi A. How do Indonesian youth perceive cigarette advertising? A cross-sectional study among Indonesian high school students. Glob Health Action 2016;9:30914. doi:10.3402/gha.v9.30914
33. Sebayang SK, Rosemary R, Widiatmoko D, et al. Better to die than to leave a friend behind: industry strategy to reach the young. Tob Control 2012;21:370–2. doi:10.1136/tobaccocontrol-2011-050223

34. Ng, N., Weinehall, L. Ohman, A. (2007) ‘ If I don’t smoke , I’m not a real man’: Indonesian teenage boys’ views about smoking. Health Educ. Res. 22: 794–804
35. Vardavas CI, Girvalaki C, Lazuras L, et al. Changes in tobacco industry advertising around high schools in Greece following an outdoor advertising ban: A follow-up study. Tob Control 2013;22:299–301. doi:10.1136/tobaccocontrol-2012-050518
36. Kasza KA, Hyland AJ, Brown A, et al. The effectiveness of tobacco marketing regulations on reducing smokers’ exposure to advertising and promotion: Findings from the International Tobacco Control (ITC) Four Country Survey. Int J Environ Res Public Health 2011;8:321–40. doi:10.3390/ijerph8020321
37. Southeast Asia Tobacco Control Alliance (SEATCA). (2019) Current status of tobacco advertising, promotion and sponsorship (TAPS) ban in ASEAN. Online at https://tobaccowatch.seatca.org/index.php/article-13/status-in-asean/ (accessed Aug 30, 2019).
38. Assunta M, Dorotheo EU. SEATCA Tobacco Industry Interference Index: a tool for measuring implementation of WHO Framework Convention on Tobacco Control Article 5.3. Tob Control 2016; 25: 313–8.

Table 1 Characteristics of outdoor tobacco advertisements and school in Semarang, 2018

	n	%
(a) Advertisement by size		
Large	144	4%
Medium	2,882	83%
Small	427	12%
Total	3,453	100%
(b) Advertisement by type		
Billboard	137	4%
Videoboard	7	0.2%
Banner	2,489	72%
Store sign	315	9%
Neon box	78	2%
Poster	376	11%
Sticker	51	1%
Total	3,453	100%
(c) Advertisement by company		
Djarum	1,205	35%
Gudang Garam	636	18%
Norojono	452	13%
KDM (JTI)	321	9%
Bentoel (BAT)	319	9%
Others	305	9%
Sampoerna (PMI)	215	6%
Total	3,453	100%
(d) School by ownership		
Government	399	41%
Private	579	59%
Total	978	100%
(e) School by type		
Primary school (6-12 years)	562	57%
Junior high school (13-15 years)	220	22%
Senior high school (16-18 years)	196	20%
Total	978	100%

Note:

- Large size = 95% billboard and 5% videoboard; Medium size = 87% banner, 11% store sign, and 3% neon box; Small = 88% poster and 12% sticker
- PMI = Philip Morris Indonesia, Norojono = Norojono Tobacco International, KDM (JTI) = Karyadibya (Japan Tobacco Inc.), Bentoel (BAT) = Bentoel International Investama (British American Tobacco), Others = Wismilak Inti Makmur, Sukun, and IUI Indonesia.

Table 2. Advertisements inside and outside of 300-m school buffer in Semarang, 2018

		Advertisements in/out of dissolved school buffer			
		≤ 300 m		> 300 m	
	Total ads	n	% of total ads	n	% of total ads
	[1]	[2]	[3]	[4]	[5]
All schools	3453	2556	74%	897	26%
By ownership					
Government	3453	1768	51%	1685	49%
Private	3453	1709	49%	1744	51%
By level					
Primary	3453	2215	64%	1238	36%
Junior high	3453	541	16%	2912	84%
Senior high	3453	964	28%	2489	72%

Note: m=meter; See Appendix 1 for the dissolved school buffers; Density = number of advertisements per square kilometer. Buffer analysis and calculation were conducted in ArcMap 10.6.

Table 3. Number and proportion of schools with at least one advertisement within school buffers and advertisement hotspot in Semarang, 2018

		Number of schools and % of total with at least one advert within school buffer				Number of schools and % of total within advert hotspot	
	Total	100 m		300 m			
	[1]	[2]	[3]	[4]	[5]	[7]	[8]
All schools	978	324	33%	791	81%	378	39%
By ownership							
Government	399	132	33%	339	85%	150	38%
Private	579	192	33%	452	78%	228	39%
By level							
Primary	562	200	36%	468	83%	216	38%
Junior high	220	44	20%	165	75%	81	37%
Senior high	196	80	41%	158	81%	81	41%

Note: m=meter; Buffer analysis, hotspot analysis, and calculation were conducted in ArcMap 10.6; Hotspot analysis, used Getis-Ord Gi* statistics, show significant cluster of higher number of tobacco advertisements at 95% level of significance. We conducted t-test and chi-square in Stata 15.1 to test the different proportions in columns 3 and 5 by ownership and by level, respectively.

Table 4. Density of advertisement within 100 and 100-300 meters from schools in Semarang, 2018

		Density (SD) per sq km				Comparison		
	Sample	Area 100 m		100-300 m		Difference	Ratio	p-value
	[1]	[2]		[3]		[4]=[2-3]	[5]=[2/3]	[6]
All schools	978	29.6	(57.5)	20.4	(23.5)	9.1	1.45	<0.001
By ownership								
Government	399	28.1	(54.6)	22.0	(24.7)	6.1	1.28	0.033
Private	579	30.6	(59.4)	19.3	(22.6)	11.3	1.58	<0.001
By level								
Primary	562	30.7	(58.4)	20.3	(22.4)	10.4	1.51	<0.001
Junior high	220	18.3	(46.3)	18.4	(23.9)	-0.1	1.00	0.976
Senior high	196	39.0	(64.0)	23.0	(26.0)	16.0	1.70	<0.001

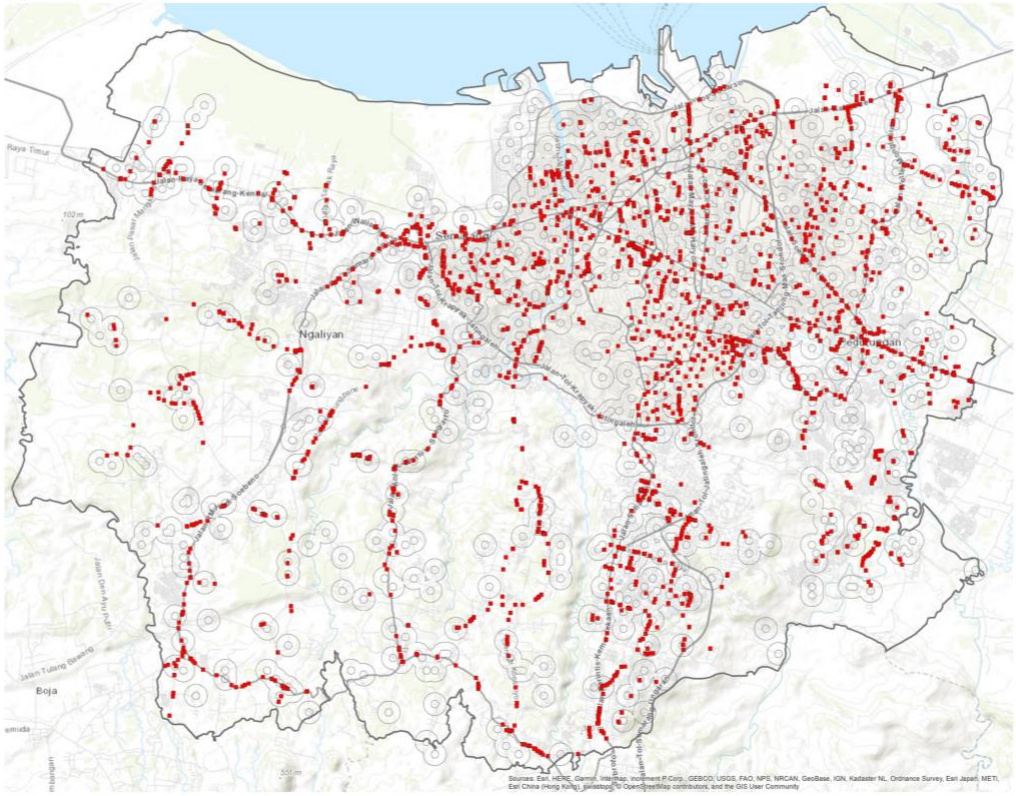
Note: m = meter; km2 = square kilometer; SD=standard deviation. Density is the number of schools per square kilometer. Density calculations were conducted in ArcMap 10.6. P-values show the statistical significance of the difference using the t-test in Stata 15.1.

Figure 1. Samples of advertisements by type in Semarang, 2018

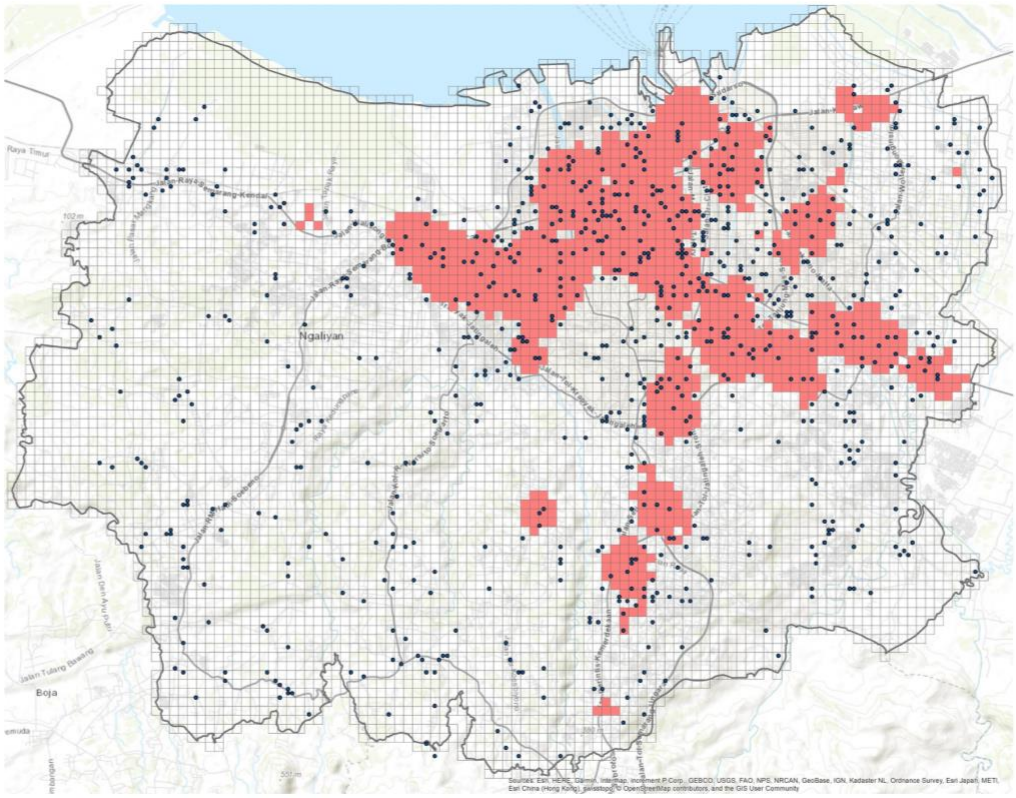
Note: A=video board, B=billboard, C=banner, D=neon box, E=store name board, F=poster

Figure 2. Visibility and hotspots of outdoor tobacco advertisement around schools in Semarang, 2018

(a) Buffer analysis



(b) Hotspot analysis



Note: In panel a, red dots show outdoor tobacco advertisements and grey lines show 100 and 300-meter (dissolved) buffers around schools; In panel b, blue dots show schools and red cells show hot spots that are areas with significantly (95% level) higher density of adverts; Buffer and hotspot analyses we conducted in ArcMap.