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Research Paper

Progress of smoke-free policy adoption at district level in Indonesia: A policy diffusion study

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ABSTRACT

Background: Even though Indonesia has not ratified the Framework Convention on Tobacco Control (FCTC), district and provincial stakeholders are increasingly adopting smoke-free policies (SFPs). This study aimed to 1) assess whether local SFP adoption in Indonesia followed a horizontal or vertical diffusion pattern and 2) identify district characteristics that are associated with the SFP adoption.

Methods: Policy documents enacted during 2004–2015 were compiled from 33 provinces and 510 districts in Indonesia. First, we described the geographical distributions of the policy adoption. Second, we ran logistic regression to assess the associations of district SFP adoption with having adjacent districts that had adopted SFPs (i.e. horizontal diffusion) and being situated in a province that had adopted SFPs (i.e. vertical diffusion). Third, the associations between district characteristics (population density, GDP, tobacco production) and SFP adoption were assessed using logistic regression.

Results: By 2015, a total of 17 provinces and 143 districts had adopted SFPs. Districts with SFPs were more concentrated in the western part of Indonesia. Adoption was more likely in districts of which adjacent districts had already adopted SFPs (OR: 2.02; 95%CI: 1.26–3.23), and less likely when the province had already adopted SFPs (OR: 0.19; 95%CI: 0.11 – 0.34). Adoption was more likely in districts with higher GDP (OR high vs low GDP: 3.28; 95%CI: 1.80–5.98) and higher population density (OR high vs low density: 6.57; 95%CI: 3.63–11.9). High tobacco production showed a strong inverse association with SPF adoption (OR high vs. no production: 0.36; 95%CI: 0.17–0.74).

Conclusions: Smoke-free policy adoption in Indonesian districts followed a horizontal diffusion pattern, with poorer and rural districts lagging behind in their policy adoption. Our results indicate that local-level policy development is important for smoke-free policy adoption in countries with decentralised governments, but that effective advocacy is needed to counteract tobacco industry interference.

Introduction

The burden of smoking is high in many low- and middle-income countries (LMICs) as two-thirds of current smokers globally live in these countries (WHO, 2011). The development of tobacco control policies is therefore especially important in these countries. The adoption of smoke-free policies for indoor public spaces is among the first steps, preventing second hand smoke inhalation and encouraging smoking cessation (Akhtar, Haw, Currie, Zachary, & Currie, 2009; Fichtenberg & Glantz, 2002; Fong et al., 2006). In Southeast Asia, there has been some success in adopting smoke-free policies. Thailand adopted smoke-free policies in public places in 2010 following the signature and ratification of the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) in 2003–2004, and smoking prevalence has consequently decreased (Levy, Benjakul, Ross, & Ritthiphakdee, 2008; Ministry of Public Health Notice, 2010). As many countries in the world have not yet adopted smoke-free policies, understanding the diffusion pattern and the factors that contribute to policy adoption would help accelerate future smoke-free policy adoption across LMICs.

Indonesia is an interesting case for the study of smoke-free policy adoption for four reasons. First, Indonesia has the highest male smoking prevalence worldwide, with 67.4% of males being regular smokers in 2013 (Kristina, Endarti, Prabandari, Ahsan, & Thavorncharoensap, 2015), and the highest rate of exposure to second-hand smoke, with 79% of children under the age of 15 years being exposed to second-hand smoke (Mbulo et al., 2016). Second, Indonesia has not signed and

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ratified the FCTC and lacks on important policies from the MPOWER package (Hurt, Ebbert, Achadi, & Croghan, 2012). For example, Indonesia has low tobacco taxes, does not fully ban tobacco promotion and sponsorship, and lacks anti-smoking information campaigns. Although some tobacco control policies have been introduced more recently (e.g., a partial advertising ban on broadcasting media, pictorial health warning labels, and quit line services), Indonesia's tobacco control is lagging behind other Southeast Asian countries (Gupta et al., 2016). Third, the Indonesian government is strongly decentralised with autonomy of district governments to independently propose and adopt smoke-free policies. Fourth, Indonesia has an active tobacco industry, which has economic interest in preventing governments from adopting tobacco control policies at the national and sub-national level.

There are two ways in which policy adoption can diffuse across different regions: horizontally and vertically. Rogers (2003) suggests that policy diffusion may follow a horizontal approach in which bordering geographical areas influence one another, such as the case of policy diffusion from city-to-city or state-to-state (Rogers, 2003). According to Rogers' model, policy adoption can spread geographically over time, from innovator areas that adopt the policy first to laggard areas that are last to adopt (Rogers, 2003). Complementary to Rogers' horizontal diffusion theory, Shipan & Volden, 2008 suggest that vertical policy diffusion can occur across different levels of government– national, provincial and local governments– or from international organizations to countries (Shipan & Volden, 2008, Shipan and Volden, 2012). Vertical diffusion may have a positive impact if adoption of policy at a higher government level encourages adoption at a lower government level, or negative impact, if higher-level adoption discourages lower-level adoption.

In Indonesia, both horizontal and vertical diffusion of tobacco policy are plausible. Indonesia is a large archipelago state with approximately 500 districts and 17,000 Islands that may create a barrier in smoke-free policy diffusion and implementation. The governmental decentralization from national to local governments at district level may have driven horizontal diffusion because it has created more privileges for district stakeholders to develop local policies without dependency to provinces or country-level stakeholders. Districts with stronger economies or with larger cities and high population density are considered more likely to take a leading role in adopting smoke-free policies. Vertical diffusion from provinces to districts is also probable. A national tobacco control regulation, which also guides local stakeholders to develop smoke-free policies, was introduced in 2012 (Government Regulation No 109/2012 about Securing Additive Substance in The Form of Tobacco Products for Health, 2012Government Regulation, 2012Government Regulation No 109/2012 about Securing Additive Substance in The Form of Tobacco Products for Health, 2012). Provincial governments cannot legally impose the adoption of the policy at district level, but due to the existing hierarchy in the governments positive vertical policy diffusion may occur if the province serves as an example to its districts to learn from.

This study aimed to 1) assess whether smoke-free policy diffusion in Indonesia followed a horizontal or vertical pattern; and 2) identify district characteristics that are associated with smoke-free policy adoption. We collected and analysed all smoke-free related policy documents up to 2015 from 33 provinces and 510 districts of Indonesia to determine the year of smoke-free policy adoption at the district and province level. For the first aim, we examined the association of policy adoption at the district level with the timing of smoke-free policies in adjacent districts and the province in which the district is situated. For the second aim, we studied associations between district policy adoption and population density, GDP per-capita, and tobacco production of the district.

Table 1
Description of total and the cumulative percentage of districts that adopted smoke-free policies over years.

Year	Total district (N)	District with policy		
		Cumulative total	Cumulative Percentage	
			Moderate policies	Strong policies
2005	436	7	1.6	0
2006	436	8	1.8	0
2007	461	10	2.2	0
2008	493	12	2.2	0.2
2009	493	22	3.9	0.6
2010	493	32	5.7	0.8
2011	493	42	6.9	1.6
2012	504	57	7.9	3.4
2013	507	81	10.3	5.7
2014	510	110	12.7	8.8
2015	510	143	15.1	12.9

Methods

Data sources

Documents on smoke-free policies in all provinces and districts in Indonesia were systematically searched during February–June 2016. As Jakarta was the first province to implement smoke-free policy in 2005, a systematic search was limited for documents dating back to 2004 and up to 2015. Policy documents were accessed through the online database of the Network of Documentation and Legal Information (*Jaringan Dokumentasi dan Informasi Hukum (JDIH)*) which included legal documents of 31 provinces and 311 districts. (Presidential regulation No 33/2012, 2012). We checked whether two provinces and 199 districts that did not deposit documents in JDIH were listed in the list of provinces and districts with smoke-free policies compiled by the Ministry of Health, 2014. Both provinces and 164 of these districts were not on the list and, therefore, were assumed as not to have adopted smoke-free policies. Of the remaining 35 districts, policy documents were requested from local authorities to determine when smoke-free policies were adopted. Seven districts shared their policy documents and two districts confirmed that they did not have smoke-free policy yet. The 26 districts that did not respond to our multiple attempts via several forms of communication were assumed not to have adopted smoke-free policies.

Variables

Dependent variable: District-level smoke-free policy

We used the earliest policy document that specified the implementation of smoke-free policy to determine the year of adoption. Documents on amended smoke-free policies were used to identify a potential strengthening of the policies. We used the smoke-free public spaces subscale of the Tobacco Control Scale (TCS) to quantify the strength of smoke-free policies at provincial and district level. The subscale includes questions on bans on smoking in workplaces, cafés and restaurants, public transportation, educational institutions, health facilities, and cultural places (Joossens & Raw, 2014). We used the original smoke-free TCS score which range 0–22 as presented in Appendix A Table A1 to calculate the strength of policy adoption. In a dichotomous variable, we distinguished districts without a smoke-free

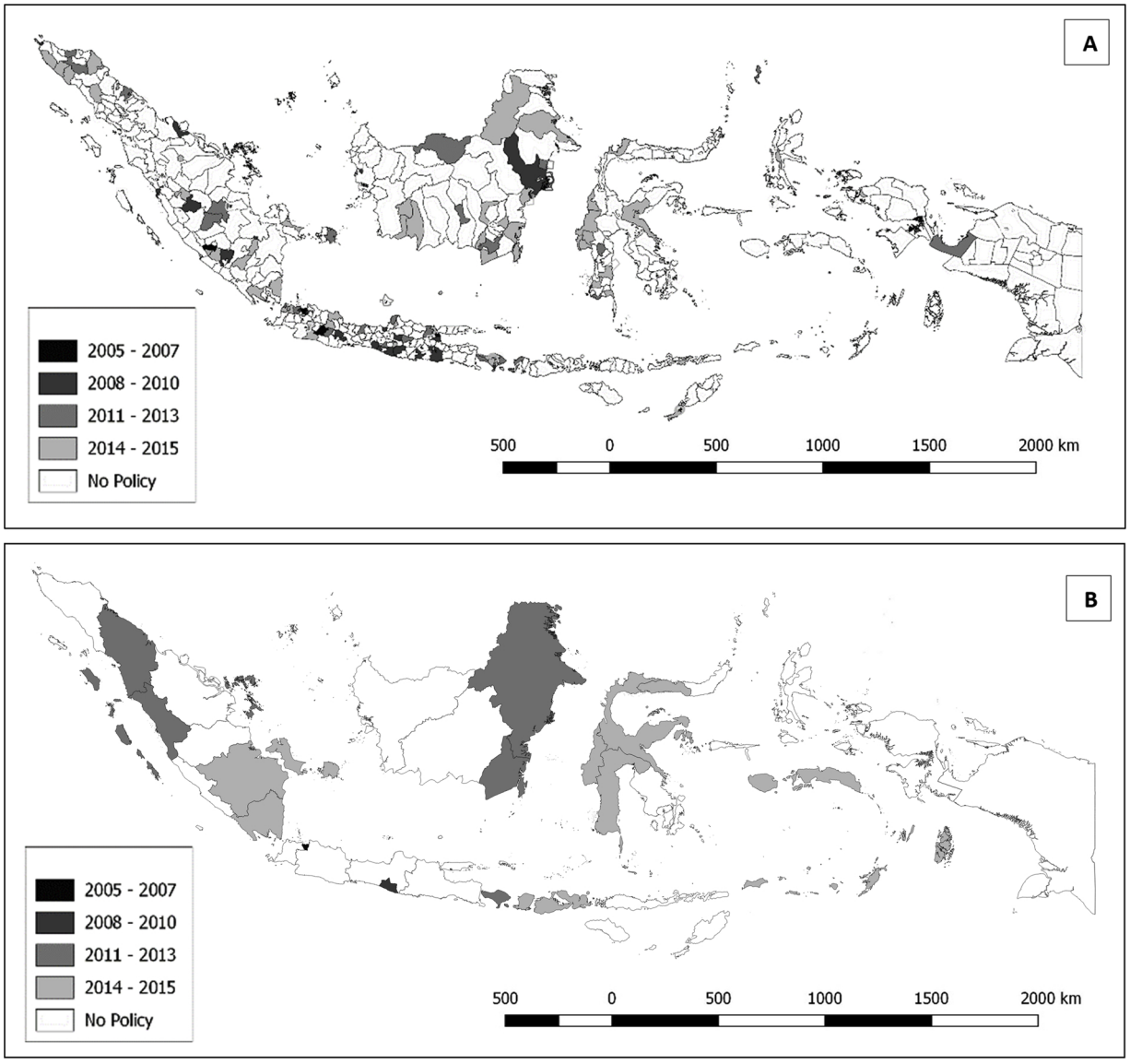

Fig. 1. Geographical distribution of smoke-free policy adoption over time in districts (A) and provinces (B) of Indonesia.

policy from districts with any smoke-free policy (≥1 points on TCS). In a categorical variable, districts were categorised as having no smoke-free policies, moderate smoke-free policies (1–11 points) and strong smoke-free policies (≥12 points). The distinction between the latter two categories was based on the median score (12 points) among districts with any smoke-free policy.

Independent variables

Smoke-free policy in adjacent districts

For each district, the adoption of smoke-free policies in adjacent (i.e. bordering) districts was determined. For districts that adopted a smoke-free policy, we distinguished those with one or more adjacent districts that adopted a smoke-free policy at least a year earlier (coded 1) and other districts were coded 0. For districts that did not adopt a smoke-free policy, we distinguished those that had any adjacent districts adopting a smoke-free policy at any time in the period (coded 1) and other districts were coded 0.

Provincial-level smoke-free policy

For each district, the adoption of smoke-free policies in the province was determined. For districts that adopted a smoke-free policy, value 1 was given to those districts situated in a province that adopted a smoke-free policy at least a year earlier than the district, while value 0 was given to those located in a province that adopted a smoke-free policy in the same year or after the district, or that did not adopt a smoke-free policy. For districts that did not adopt a smoke-free policy, value 1 was granted to districts in a province that adopted a smoke-free policy at any time in the period, and value 0 to those situated in a province that did not adopt a smoke-free policy at any time in the period.

Other district characteristics

We used the Indonesian Statistics Bureau report in 2015 to derive the district population density and GDP per-capita (BPS, 2017). Based

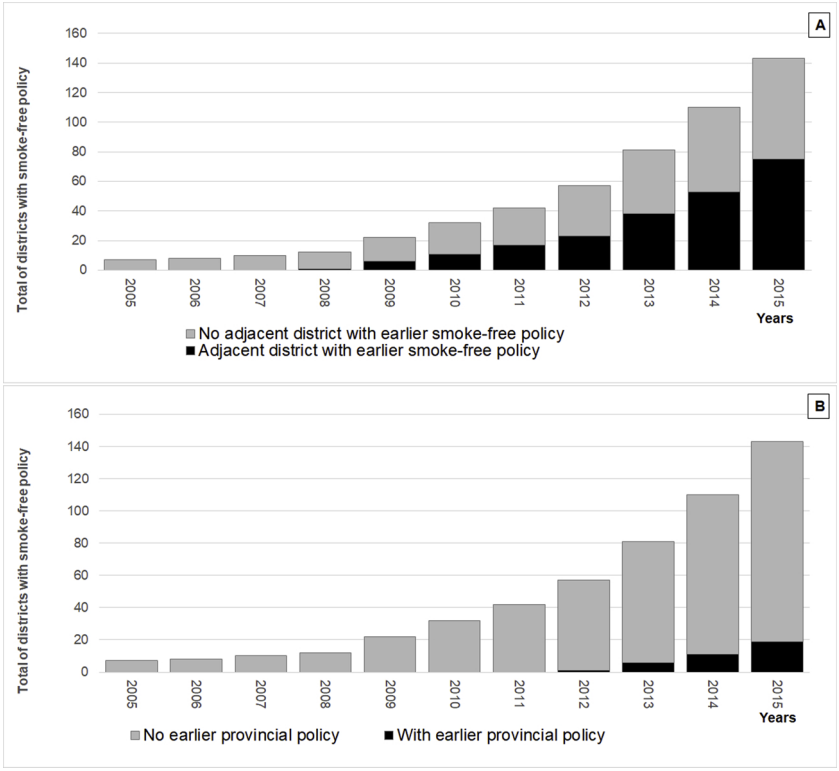

Fig. 2. Total of districts that adopted smoke-free policies in each study year (2005–2015), by adjacent districts (A) and earlier provincial smoke-free policy where districts situated (B).

on their population density, districts were classified into tertiles of districts with low (less than 62.4 people/km^2), intermediate (62.4 people/km^2–484.1 people/km^2), and high (more than 484.1 people/km^2) population density. For GDP per-capita, districts were grouped into the tertiles of districts with low GDP per capita (less than 1,485 USD), intermediate (1,485–2,440 USD) and high (more than 2,440 USD). Data on the volume of harvested tobacco per inhabitant on district level was obtained from the Indonesia's Ministry of Agriculture to distinguish districts into no tobacco production, low production or high production (Directorate General of Estate Crops, Ministry of Agriculture, Indonesia, 2016). We used the median production (0.258 kg/person) among districts with any production as the cut point between low (below median) and high (above median).

Data analysis

First, we described for each year the cumulative number of districts that adopted smoke-free policies. Second, we mapped the presence/absence of smoke-free policies in districts and provinces geographically over time. Third, the annual cumulative number of districts that adopted smoke-free policies was described according to adjacent district policy, provincial smoke-free policy, GDP per-capita, population density, and local tobacco production over time. Lastly, we analysed the associations of district policy adoption with adjacent district policy and provincial smoke-free policy, and with other district characteristics including population density, GDP, and tobacco production. We ran two logistic regression models; a binary logistic regression analysis with 'any smoke-free policy' as the dependent variable, and a multinomial logistic regression with the three categories for strength of smoke-free policies as the dependent variable (no policy was the reference). Regression models simultaneously included all variables (i.e. adjacent district policy, provincial policy, population density, GDP, and tobacco production) to control for confounding.

A sensitivity analysis was conducted to assess the result when 26 districts for which information on their policy status was missing were excluded from the regression analysis. The results of this sensitivity analysis were very similar to those of the main analysis (see Appendix A Table A2).

Results

Patterns of smoke-free policy diffusion in Indonesia

Over the study period during 2004–2015, 143 out of 510 districts (28.0%) adopted smoke-free policies (15.1% adopted moderate policies and the remaining 12.9% adopted strong policies). Table 1 presents the cumulative number of districts adopting smoke-free policies over time. It illustrates that the number of districts adopting policies increased each year. Moderate policies had been adopted earlier and these shared a larger proportion in all years. Adoption of strong policies commenced in 2009 and the share of strong policies increased over time.

Fig. 1 shows the geographical pattern of smoke-free policy adoption. Districts adopting policies earlier – the so-called innovator districts– were mainly situated in the western part of Indonesia (on Sumatra and Java Island). In the eastern part of Indonesia (Papua, Maluku, Sulawesi, and Nusa Tenggara), there were fewer districts that had adopted smoke-free policies by 2015. In contrast, the adoption of provincial smoke-free policy seemed to be balanced between west and east although policy

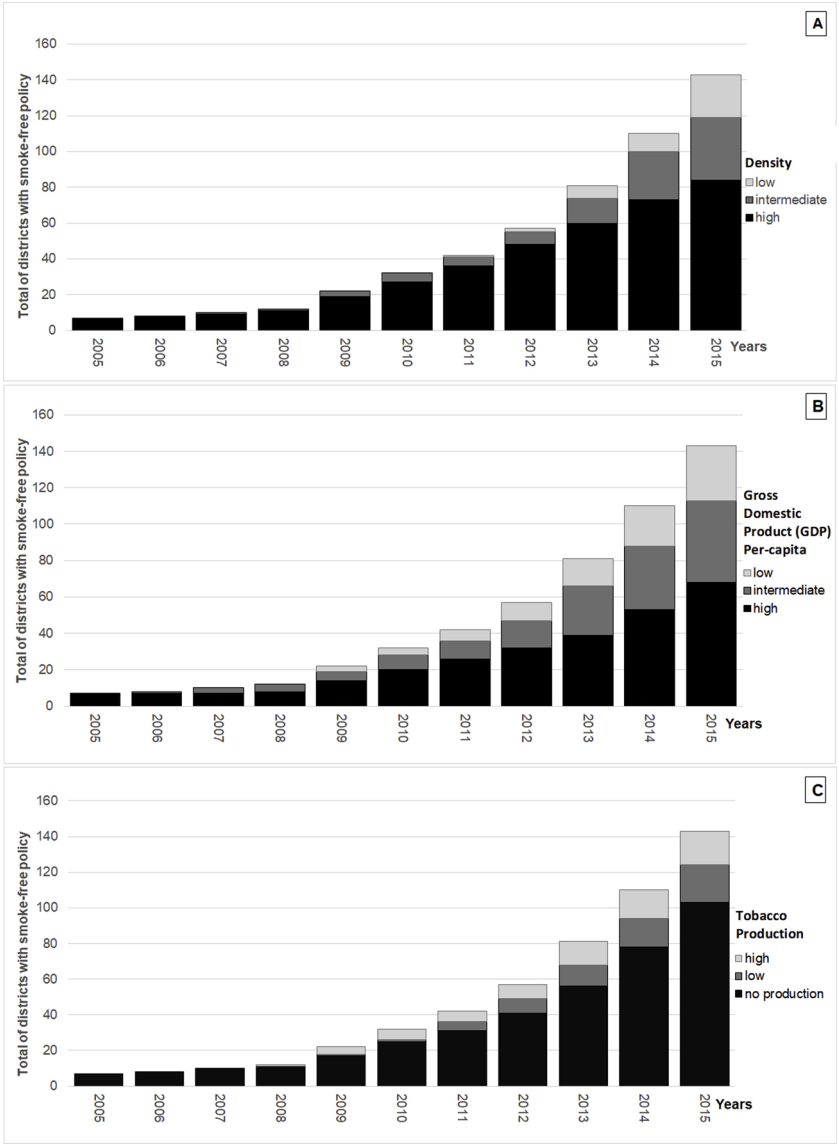

Fig. 3. Total of districts in Indonesia that adopted smoke-free policies in each study year (2005–2015), by district characteristics: district density (A), district GDP per-capita (B), and district tobacco production (C).

adoption at province-level showed earlier adoption in western part and later adoption in eastern part.

Since 2008, the adoption of policies rapidly increased over time in districts that had adjacent districts with smoke-free policies (Fig. 2). A much later (only since 2012) and much slower increase in the share of districts, which were situated in provinces with smoke-free policies, adopting the policies. Most of the districts which adopted the policy throughout the study period were districts with high population density, high GDP, and no tobacco production (Fig. 3). Districts with lower density and GDP mostly adopted smoke-free policies later in the study period between 2013 and 2015.

Factors associated with smoke-free policy adoption in Indonesia

Table 2 shows associations of population density, GDP per-capita, and tobacco production with smoke-free policy adoption. Having adjacent districts that implemented smoke-free policies earlier was associated with higher odds of policy adoption in the district (OR = 2.02; 95% CI: 1.26–3.23). Earlier provincial adoption of smoke-free policy was associated with lower odds of district policy adoption (OR = 0.19; 95% CI: 0.11–0.34). The same pattern was found for the adoption of moderate and strong smoke-free policies.

Odds of policy adoption were higher in districts with moderate (OR = 2.67; 95%CI: 1.42–5.04) and high (OR = 6.57; 95% CI: 3.63–11.88) density, compared to those with low density. Odds of adoption were higher in districts with moderate (OR = 2.15; 95%CI: 1.20–3.86) and high GDP (OR = 3.28; 95% CI: 1.80–5.98), compared to those with low GDP. Although low tobacco production was not associated with adopting smoke-free policies (OR = 0.76; 95%CI: 0.38–1.50), high production was strongly associated with lower odds of

Table 2
Description of the percentage of districts that adopted smoke-free policies up to 2015, and odds ratios with 95% confidence intervals from logistic regression analysis with district smoke-free policy adoption as the outcome.

	N districts	Any smoke-free policy		Moderate smoke-free policy		Strong smoke-free policy	
		% with any smoke-free policy in 2015	Adjusted OR(95%CI)*	% with moderate smoke-free policy in 2015	Adjusted OR(95%CI)*	% with strong smoke-free policy in 2015	Adjusted OR(95%CI)*
Total	510	28.0		15.1		12.9	
Smoke-free policy in adjacent districts							
No	301	22.6	1.00	13.0	1.00	9.6	1.00
Yes	209	35.9	2.02 (1.26 – 3.23)	17.7	1.74 (0.95 – 3.16)	18.2	2.33 (1.30 – 4.17)
Earlier provincial smoke-free policy							
No	341	36.4	1.00	20.9	1.00	15.5	1.00
Yes	169	11.2	0.19 (0.11 – 0.34)	2.9	0.10 (0.04 – 0.25)	8.3	0.30 (0.15 – 0.59)
District characteristics in 2015							
Population density							
Low	170	14.1	1.00	7.0	1.00	7.1	1.00
Moderate	170	20.6	2.67 (1.42 – 5.04)	7.7	2.18 (0.91 – 5.28)	12.9	2.99 (1.35 – 6.63)
High	170	49.4	6.57 (3.63 – 11.9)	30.0	8.19 (3.85 – 17.43)	19.4	5.05 (2.34 – 10.91)
GDP per-capita							
Low	170	17.6	1.00	9.4	1.00	8.2	1.00
Moderate	170	26.5	2.15 (1.20 – 3.86)	11.2	1.78 (0.81 – 3.87)	15.3	2.49 (1.19 – 5.19)
High	170	40.0	3.28 (1.80 – 5.98)	24.1	3.66 (1.71 – 7.80)	15.9	2.88 (1.33 – 6.24)
Tobacco production							
No production	362	28.5	1.00	15.2	1.00	13.3	1.00
Low	74	28.4	0.76 (0.38 – 1.50)	16.2	0.85 (0.36 – 2.02)	12.2	0.67 (0.28 – 1.57)
High	74	25.7	0.36 (0.17 – 0.74)	12.2	0.31 (0.12 – 0.80)	13.5	0.42 (0.16 – 0.98)

*Adjusted models were controlled for all variables in the table (earlier provincial policy, adjacent districts, population density, GDP per-capita, and tobacco production).

policy adoption (OR = 0.36; 95%CI: 0.17–0.74). The pattern was similar for the adoption of moderate and strong smoke-free policies.

Discussion

Key findings

By 2015, 17 provinces and 143 districts had adopted smoke-free policies. At district level, adoption of smoke-free policies was more concentrated in western Indonesia, but this was not clearly observed for provincial policy adoption. Earlier adopted smoke-free policies were weaker than later adopted policies. Adoption was more likely in districts of which adjacent districts had adopted smoke-free policies, and less likely when the province had adopted smoke-free policies. Policy adoption was more likely in districts with high GDP and high population density. High tobacco production had a strong inverse association with smoke-free policy adoption.

Potential limitations

This study has some limitations which should be taken into account in the interpretation of its findings. First, we classified the strength of policies based on an adaptation of the TCS that did not take implementation and enforcement into account. Policies that are strong on paper do not always translate into properly enforced and effectively implemented policies in practice. Smoke-free policies would only affect smoking behaviour when well implemented and complied to. Second, we cannot rule out that neighbouring provinces would influence district' policies and this may have led to some overestimation of the influence of neighbouring districts and underestimation of the influence of provinces. However, we expect this to be a minor limitation, because there are few provinces which have adopted smoke-free policies earlier than districts, including those districts that border those provinces.

Interpretation of the results

Local smoke-free policies in Indonesia diffused between adjacent districts which is consistent with Rogers' theory of horizontal diffusion (2003). According to this theory, the period of policy diffusion classifies adopters into five different groups of innovators, early adopters, early majority, late majority, and laggards, defined by the cumulative percentage as the cut points (Rogers, 2003; Shipan & Volden, 2008). Our findings suggest that in Indonesia, innovator districts (2.5%) commenced policy adoption in 2005, the early adopters (15%) followed from 2008 and the early majority began adopting smoke-free policies since 2013. Our estimates indicate that, if current trends were to continue in the future, the late majority (50%) would have started adopting smoke-free policies in 2018, and the laggards (84%) in 2023.

The horizontal diffusion of smoke-free policy adoption between districts is in line with studies suggesting that stakeholders often learn from nearby districts to develop policies because they are more visible as a successful example (Krause, 2011; Shipan & Volden, 2012; Sundqvist, Frank, & Puumalainen, 2005; Toshkov, 2013; Yaveroglu & Donthu, 2002). Because Indonesia is an archipelago state, this adoption may easily occur within geographical clusters, as observed within western and eastern Indonesia. This is also consistent with Baptista (2000) who found faster diffusion of innovation within geographical clusters (Baptista, 2000).

In Indonesia, districts with higher GDP and higher population density were more likely to adopt smoke-free policy. This is consistent with results from Henriksen et al. (2008), Pampel (2010), and Bosdriesz, Willemsen, Stronks, and Kunst (2016) (Bosdriesz et al., 2016; Henriksen et al., 2008; Pampel, 2010). In regions with high population density, having fewer open-air outdoor spaces may trigger stakeholders to restrict and control indoor smoking (Chapman, 2000; Levy, Friend, & Polishchuk, 2001). Moreover, as the average educational level is usually higher in districts with higher GDP per-capita (Bosdriesz et al., 2016), people who live in these districts may have higher awareness of problems caused by smoking, and the acceptance of and support for smoke-free policy may therefore be higher in these districts.

Districts that produced tobacco were less likely to adopt smoke-free policies and if they adopted the policies, it was much later than in districts without tobacco production. Districts with high tobacco production were generally poorer (Achadi, Soerojo, & Barber, 2005), which gives them a double disadvantage at progressing tobacco control policies. A high economic contribution of the tobacco industry is a barrier in the adoption of tobacco control policies; industry lobbying may therefore lengthen the decision making process, especially in areas with higher tobacco production (Achadi et al., 2005; Knight & Chapman, 2004; Pierce, White, & Emery, 2012; Toshkov, 2013). The tobacco industry has argued alleged economic loss among tobacco farmers, less governmental revenue, and more unemployment due to disruptions in tobacco manufactures if tobacco control policies would be adopted (Radjab, 2013). According to Achadi et al. (2005), urban areas and areas without tobacco production generally receive less economic benefit from the tobacco industry (Achadi et al., 2005) and therefore may have a stronger position to counter the tobacco industry lobby against smoke-free policy adoption.

Although we expected positive vertical diffusion from provinces to districts, our study indicated that districts were less likely to adopt smoke-free policies when provincial policies were adopted. The inverse association implies that the presence of provincial policies may have discouraged district legislators to adopt district policies because they may voluntarily implement the provincial policy and then perceive district policies as redundant. This is consistent with a study by Shipan and Volden (2006) (Shipan & Volden, 2006), who propose why there is negative vertical diffusion in the US. In the US, local stakeholders (i.e. in counties or cities) are required to implement state policy and cannot adopt a new local policy under existing state policy. The vertical diffusion may however be less direct in the Indonesian setting, as described by Shipan and Volden (2006). Indonesian district policy makers are not legally required to implement provincial policy (Nasution, 2016). Independent of whether or not provincial policy has been implemented, district-specific smoke-free policies may be adopted, which may diverge from provincial policies. However, the inverse association may also reflect a difference in the difficulty of adopting smoke-free policies at the provincial-level and district-level. Tobacco industry lobbying has been found to be much stronger at the provincial level than at the district level (Juanita, 2012; Shipan & Volden, 2006). Therefore, districts may adopt policies at a faster rate than provinces, resulting in a negative association. This difference in adoption speed was found in some Latin American countries, where tobacco industry interference was much stronger at the state level than the local level (Sebrié, Schoj, & Glantz, 2008).

The decentralization of government in Indonesia has resulted in very limited hierarchical authority over lower-level governments to adopt policies (Nasution, 2016), and therefore a provincial policy does not dictate a district policy. Given the stronger influence of the tobacco industry at the higher level of government, decentralization has indirectly aided smoke-free policy adoption in Indonesia. The horizontal diffusion process in Indonesia resembles processes in the USA and some Latin American countries, where local governments have a high

autonomy over policy adoption (Giovino, 2007; Sebrié et al., 2008). This is different from European countries where vertical policy diffusion processes, due to the strong hierarchical authority in the government system, are more dominant (Mlinarić et al., 2018). The importance of local policies therefore largely depends on the political structure of the country.

Implications

In a decentralised government system, sub-national settings play an important role to accelerate the achievement of tobacco control policy goals. Approaching local-level stakeholders to adopt smoke-free policy is likely to be more efficient in such government systems rather than encouraging higher-level stakeholders, because local stakeholders generally have more authority in policy development and less opposition (Nasution, 2016). Local-level stakeholders would especially need anti-tobacco advocacy groups to actively debunk the tobacco industry's economic arguments against smoke-free policies. This is particularly important in rural settings, where the tobacco industry may exert power over the local policy process. More efforts are needed to stimulate the horizontal learning process between districts against the tobacco industry resistance. Creating a tobacco control network consisting of district leaders, especially those in poor and rural areas which were lagging behind in smoke-free policy development, can accelerate the policy diffusion process. Advocacy may also help in adopting more comprehensive smoke-free policies.

We identified three groups of countries to which lessons from our findings from Indonesia may be generalizable, as they are likely to face similar factors that hinder advancement in tobacco control. First, countries that have not signed the FCTC (e.g., Andorra, Dominican Republic, Eritrea, Liechtenstein, Malawi, Monaco, Somalia, and South Sudan), or have signed but not ratified FCTC (e.g., Argentina, Cuba, Haiti, Morocco, Switzerland and USA). Second, countries with strong tobacco industries presence including Brazil, Argentina, Malawi, Pakistan, Zimbabwe, Turkey, and Tanzania. Third, countries with decentralised governments such as Brazil, India, South Africa, Ethiopia, Mozambique, Uganda, Bolivia, and Pakistan. Further studies may explore which universal and country-specific factors that hamper the tobacco control progress influence the diffusion of tobacco control policies in other LMICs.

Conclusions

This study demonstrates that the diffusion of local smoke-free policies in Indonesia followed both vertical, bottom-up from district to province, and horizontal patterns, between adjacent districts. Our study shows the importance of local-level policy development for smoke-free policy diffusion in a decentralised government. As a consequence of strong horizontal diffusion, some areas, especially the poor and rural areas or areas with strong presence of the tobacco industry, lag behind in the adoption process. Hence, diffusion of smoke-free policy adoption in these areas should be encouraged, for example through an effective advocacy network, to counteract the tobacco industry's interference in the tobacco control programme.

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Appendix A

Table A1
Tobacco Control Scale Calculation for Smoke Free Area.

Smoke free area		Score
Workplaces (max. 10)		
	Complete ban, no smoking room/area allowed	10
	Complete ban, with closed, ventilated, designated smoking rooms	8
	Indoor smoking room without strict rules/outdoor smoking area allowed	4
Cafes and restaurants (max. 8)		
	Complete ban without exceptions	8
	Complete ban, but with closed, ventilated, designated indoor smoking rooms	6
	Indoor smoking room without strict rules/outdoor smoking area allowed	4
Public transports (max. 2)		
	Complete ban in all public transportation without exceptions	2
	Designated smoking rooms allowed	1
Public places: educational institution, health facilities, cultural places (max. 2)		
	Complete ban without exceptions	2
	Designated smoking rooms/outdoor smoking area allowed	1

Table A2
Results for the sensitivity analysis in which the 26 districts for which information on their policy status was missing were excluded from the regression analysis.

	N districts	Any smoke-free policy		Moderate smoke-free policy		Strong smoke-free policy	
		% with any smoke-free policy in 2015	Adjusted OR(95%CI)*	% with moderate smoke-free policy in 2015	Adjusted OR(95%CI)*	% with strong smoke-free policy in 2015	Adjusted OR(95%CI)*
Total	484	29.5		15.7		13.8	
Smoke-free policy in adjacent districts							
No	283	24.0	1.00	13.8	1.00	10.2	1.00
Yes	201	37.3	2.06 (1.28 – 3.33)	18.4	1.80 (0.98 – 3.30)	18.9	2.35 (1.30 – 4.25)
Earlier provincial smoke-free policy							
No	328	37.8	1.00	21.6	1.00	16.2	1.00
Yes	156	12.2	0.19 (0.11 – 0.35)	3.2	0.09 (0.04 – 0.25)	9.0	0.30 (0.15 – 0.60)
District characteristics in 2015							
Population density							
Low	163	14.8	1.00	7.4	1.00	7.4	1.00
Moderate	158	22.2	2.87 (1.51 – 5.46)	8.2	2.36 (0.97 – 5.72)	13.9	3.20 (1.44 – 7.13)
High	163	51.5	7.14 (3.90 – 13.1)	31.3	8.90 (4.13 – 19.16)	20.2	5.51 (2.53 – 11.99)
GDP per-capita							
Low	158	19.0	1.00	10.1	1.00	8.9	1.00
Moderate	165	27.3	2.01 (1.12 – 3.63)	11.5	1.66 (0.76 – 3.64)	15.8	2.33 (1.11 – 4.89)
High	161	42.2	3.18 (1.72 – 5.86)	25.5	3.52 (1.63 – 7.60)	16.8	2.80 (1.28 – 6.13)
Tobacco production							
No production	340	30.3	1.00	16.2	1.00	14.1	1.00
Low	73	28.8	0.66 (0.33 – 1.31)	16.4	0.73 (0.30 – 1.75)	12.3	0.59 (0.25 – 1.40)
High	71	26.8	0.31 (0.15 – 0.66)	12.7	0.27 (0.10 – 0.70)	14.1	0.37 (0.15 – 0.91)

*Adjusted models were controlled for all variables in the table (earlier provincial policy, adjacent districts, population density, GDP per-capita, and tobacco production).

References

Achadi, A., Soerojo, W., & Barber, S. (2005). The relevance and prospects of advancing tobacco control in Indonesia. *Health Policy, 72*(3), 333–349. https://doi.org/10.1016/j.healthpol.2004.09.009.

Akhtar, P. C., Haw, S. J., Currie, D. B., Zachary, R., & Currie, C. E. (2009). Smoking restrictions in the home and secondhand smoke exposure among primary school-children before and after introduction of the Scottish smoke-free legislation. *Tobacco Control*. https://doi.org/10.1136/tc.2009.030627.

Baptista, R. (2000). Do innovations diffuse faster within geographical clusters? *International Journal of Industrial Organization, 18*(3), 515–535. https://doi.org/10.1016/S0167-7187(99)00045-4.

Bosdriesz, J. R., Willemsen, M. C., Stronks, K., & Kunst, A. E. (2016). Tobacco control policy and socio-economic inequalities in smoking in 27 European countries. *Drug and Alcohol Dependence, 165*, 79–86. https://doi.org/10.1016/j.drugalcdep.2016.05.020.

BPS (2017). *Statistics Indonesia.* Retrieved fromhttps://www.bps.go.id/.

Chapman, S. (2000). Banning smoking outdoors is seldom ethically justifiable. *Tobacco Control, 9*(1), 95. https://doi.org/10.1136/tc.9.1.95.

Directorate General of Estate Crops, Ministry of Agriculture, Indonesia (2016). In T. I. Y. Soependi, Y. Arianto, W. K. Zuraina, E. Pudjianto, A. Udin, N. Kurniawati, & S. N. Damarjati (Eds.). *Tree crop Estate statistics of Indonesia 2013–2015*.

Fichtenberg, C. M., & Glantz, S. A. (2002). Effect of smoke-free workplaces on smoking behaviour: Systematic review. *BMJ, 325*(7357), 188. https://doi.org/10.1136/bmj.325.7357.188.

Fong, G. T., Hyland, A., Borland, R., Hammond, D., Hastings, G., McNeill, A., & Driezen, P. (2006). Reductions in Tobacco Smoke Pollution and Increases in Support for Smoke-Free Public Places Following the Implementation of Comprehensive Smoke-Free Workplace Legislation in the Republic of Ireland: Findings from the ITC Ireland/UK Survey. *Tobacco Control, 15*(suppl. 3), iii51. https://doi.org/10.1136/tc.2005.013649.

Giovino, G. A. (2007). The tobacco epidemic in the United States. *American Journal of Preventive Medicine, 33*(6, Supplement), S318–S326. https://doi.org/10.1016/j.amepre.2007.09.008.

Peraturan pemerintah nomor 109 tahun 2012 Tentang Pengamanan Bahan yang mengandung zat adiktif berupa produk tembakau (Government regulation of the republic of indonesia No. 109 of 2012 concerning materials that contain addictive substances in tobacco products), 109 C.F.R. (2012).

Gupta, R., Malhi, R., Patthi, B., Singla, A., Jankiram, C., Pandita, V., & Prasad, M. (2016). Tracking WHO MPOWER in South East Asian region: An opportunity to promote global tobacco control. *Journal of Indian Association of Public Health Dentistry, 14*(2), 218–223. https://doi.org/10.4103/2319-5932.183808.

Ministry of Health, Republic of Indonesia (2014). *Fakta tembakau: Bunga Rampai Dan Permasalahannya di Indonesia (English: Tobacco facts: Potpourri and the problems in Indonesia).* Jakarta: Tobacco Control Support Center – IAKMI (The Indonesian Public Health Association).

Henriksen, L., Feighery, E. C., Schleicher, N. C., Cowling, D. W., Kline, R. S., & Fortmann, S. P. (2008). Is adolescent smoking related to the density and proximity of tobacco outlets and retail cigarette advertising near schools? *Preventive Medicine, 47*(2), 210–214. https://doi.org/10.1016/j.ypmed.2008.04.008.

Hurt, R. D., Ebbert, J. O., Achadi, A., & Croghan, I. T. (2012). Roadmap to a tobacco epidemic: Transnational tobacco companies invade Indonesia. *Tobacco Control, 21*(3), 6–12. https://doi.org/10.1136/tc.2010.036814.

Joossens, L., & Raw, M. (2014). *The tobacco control scale 2013 in Europe.* Retrieved from Brussels, Belgium.

Juanita (2012). Smoking free area policy: Opportunities and threats. *Jurnal Kebijakan Kesehatan Indonesia, 01*(No. 2), 112–119.

Knight, J., & Chapman, S. (2004). "A phony way to show sincerity, as we all well know": Tobacco industry lobbying against tobacco control in Hong Kong. *Tobacco Control, 13*(suppl. 2), ii13. https://doi.org/10.1136/tc.2004.007641.

Krause, R. M. (2011). Policy innovation, intergovernmental relations, and the adoption of climate protection initiatives by U.S. Cities. *Journal of Urban Affairs, 33*(1), 45–60. https://doi.org/10.1111/j.1467-9906.2010.00510.x.

Kristina, S. A., Endarti, D., Prabandari, Y. S., Ahsan, A., & Thavorncharoensap, M. (2015). Burden of cancers related to smoking among the indonesian population: Premature mortality costs and years of potential life lost. *Asian Pacific Journal of Cancer Prevention : APJCP, 16*(16), 6903–6908. https://doi.org/10.7314/APJCP.2015.16.16.6903.

Levy, D. T., Benjakul, S., Ross, H., & Ritthiphakdee, B. (2008). The role of tobacco control policies in reducing smoking and deaths in a middle income nation: Results from the Thailand SimSmoke simulation model. *Tobacco Control, 17*(1), 53. https://doi.org/10.1136/tc.2007.022319.

Levy, D. T., Friend, K., & Polishchuk, E. (2001). Effect of clean indoor air laws on smokers: The clean air module of the simsmoke computer simulation model. *Tobacco Control, 10*(4), 345. https://doi.org/10.1136/tc.10.4.345.

Mbulo, L., Palipudi, K. M., Andes, L., Morton, J., Bashir, R., Fouad, H., ... Espaignet, E. (2016). Secondhand smoke exposure at home among one billion children in 21 countries: Findings from the Global Adult Tobacco Survey (GATS). *Tobacco Control, 25*(e2), e95. https://doi.org/10.1136/tobaccocontrol-2015-052693.

Ministry of Public Health Notice (Volume 19) 2010: Designation of names and types of public places that shall protect the health of non-smokers and designating all or part of such public places as smoking areas or tobacco-free areas, under the non-smokers' health protection act of 1992, 2010.

Mlinarić, M., Hoffmann, L., Kunst, A. E., Schreuders, M., Willemsen, M. C., Moor, I., ... Richter, M. (2018). Explaining mechanisms that influence smoke-free implementation at the local level: A realist review of smoking bans. *Nicotine & Tobacco Research*. https://doi.org/10.1093/ntr/nty206 nty206-nty206.

Nasution, A. (2016). *Government decentralization program in Indonesia. ADBI working paper 601.* Retrieved from Tokyohttps://www.adb.org/publications/government-decentralization-program-indonesia.

Pampel, F. (2010). Divergent patterns of smoking across High-income nations. In: National research council (US) panel on understanding divergent trends in longevity in High-income countries. In P. S. Crimmins EM, & B. Cohen (Eds.). *International Differences in Mortality at Older Ages: Dimensions and Sources*. Washington (DC): National Academies Press (US).

Pierce, J. P., White, V. M., & Emery, S. L. (2012). What public health strategies are needed to reduce smoking initiation? *Tobacco Control, 21*(2), 258. https://doi.org/10.1136/tobaccocontrol-2011-050359.

Peraturan Presiden nomor 33 tahun 2012 tentang jaringan dokumentasi dan informasi hukum nasional (Presidential Regulation no 33/2012 concerning network of national documentation and law information). 33 C.F.R. (2012).

Radjab, S. (2013). *Impact of tobacco control on economic, social and culture.* Jakarta, Indonesia: Serikat Kerakyatan Indonesia (SAKTI) and Center For Law and Order Studies (CLOS).

Rogers, E. M. (2003). *Diffusion of innovations.* New York: Free Press.

Sebrié, E. M., Schoj, V., & Glantz, S. A. (2008). Smokefree environments in Latin America: on the road to real change? *Prevention and control: the official journal of the World Heart Federation, 3*(1), 21–35. https://doi.org/10.1016/j.precon.2007.09.001.

Shipan, C. R., & Volden, C. (2006). Bottom-up federalism: The diffusion of antismoking policies from U.S. Cities to states. *American Journal of Political Science, 50*(4), 825–843. https://doi.org/10.1111/j.1540-5907.2006.00218.x.

Shipan, C. R., & Volden, C. (2008). The mechanisms of policy diffusion. *American Journal of Political Science, 52*(4), 840–857. https://doi.org/10.1111/j.1540-5907.2008.00346.x.

Shipan, C. R., & Volden, C. (2012). Policy diffusion: Seven lessons for scholars and practitioners. *Public Administration Review, 72*(6), 788–796. https://doi.org/10.1111/j.1540-6210.2012.02610.x.

Sundqvist, S., Frank, L., & Puumalainen, K. (2005). The effects of country characteristics, cultural similarity and adoption timing on the diffusion of wireless communications. *Journal of Business Research, 58*(1), 107–110. https://doi.org/10.1016/S0148-2963(02)00480-0.

Toshkov, D. (2013). Policy-making beyond political ideology: The adoption of smoking bans in Europe. *Public Administration, 91*(2), 448–468. https://doi.org/10.1111/j.1467-9299.2012.02075.x.

WHO (2011). *WHO report on the global tobacco epidemic, 2011 - warning about the dangers of tobacco.* World Health Organization.

Yaveroglu, I. S., & Donthu, N. (2002). Cultural influences on the diffusion of new products. *Journal of International Consumer Marketing, 14*(4), 49–63. https://doi.org/10.1300/J046v14n04_04.