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ORIGINAL ARTICLE

NEWBORN WEIGHT AND SECOND-HAND SMOKING IN UTERO EXPOSURE: A CASE IN A LOW-MIDDLE INCOME COUNTRY

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ABSTRACT

Smoking exposure among pregnant women is correlated with the risk of low birth weight. The policy factors are believed to contribute to the rate or prevalence of smoking activities. This study aims to simultaneously portray the incidence of low-birth-weight newborns correlated with smoking exposure. The samples were 160 respondents, with 57 and 103 respondents in Hospital A and G respectively. A mixed-method analysis was utilized by combining a retrospective approach to identify the key findings and be equipped with a narrative analysis of the socio-demographic - law enforcement process. The Spearman correlation analysis was used for investigating correlation among variables. Spearman correlation test smoking exposure per day in minutes (rho= -0.595, p<0.001) and the number of smokers (rho= -0.621, p<0.001) for Hospital A, and smoking exposure per day in minutes (rho= -0.681, p<0.001) and the number of smokers (rho= -0.613, p<0.001) for Hospital G. It implied a strong correlation of inverse relationship among those variables. Smoke-free law enforcement is a key point to address, aiming at vulnerable group protection, including pregnant mothers and babies. The local government should consider the effects affected by smoking behavior in the community.

Keywords: *Low birth weight; pregnant women; smoke-free law enforcement; smoking exposure; socio-demographic*

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INTRODUCTION

Approximately 80% of the world's 1.3 billion smokers are from low- and middle-income countries (World Health

Organization, 2023). Every year, tobacco kills about 8 million people, including 1.3 million from secondhand smoke (World Health Organization, 2023). From 2013 to 2018, the number of smokers in Indonesia remained stable; it only declined by about 0.5% (Kementerian Kesehatan Republik Indonesia, 2018). In contrast, the increasing number of early smokers significantly jumped to 9.1% from 7.2% (Kementerian Kesehatan Republik Indonesia, 2018).

Secondhand smoke is associated with adverse health outcomes for pregnant women and their infants. Nicotine reduces uteroplacental circulation, resulting in maternal weight loss and unfavorable fetal outcomes such as small size for gestational age, low birth weight gain, short stature, and the development of fetal neurologic abnormalities (Kataoka et al., 2018). Cigarette smoke caused low birth weight and reduced placental weight during pregnancy due to maternal inflammation. The damaged or underdeveloped placenta is unable to transfer sufficient nutrients and oxygen from the maternal body to the fetus, potentially leading to full-term LBW (Low-birth-weight) (Niu et al., 2016). Although the infants are born full-term, secondhand smoke also increases the risk of a small gestational age (SGA) (Kobayashi et al., 2019; Odendaal et al., 2018). LBW is a significant predictor of infant survival, childhood stunting, and various harmful adult-onset chronic conditions, while being SGA increases the risk of death and other adverse outcomes (Blencowe et al., 2019; Chawanpaiboon et al., 2019; Christian et al., 2013; Katz et al., 2013; Lee et al., 2017).

Based on Indonesia's Basic Health Research from The Ministry of Health (2018), the number of low-birth-weight infants in the Special Region of Yogyakarta and Central Java was above the national number, which was only 4%. The proportion of low-birth-weight babies in Central Java was 4.3%, while the number in Yogyakarta was 7.6%. Yogyakarta has the highest proportion of low birth weights in Indonesia.
To prevent the harmful effects of smoking exposure on vulnerable populations, the government instructed every province to implement smoke-free areas. Several policies in Indonesia have been integrated into tobacco control consumption through smoke-free areas, namely: Government Regulation on Controlling of the Materials contained Addictive Substances in the form of Tobacco Products for Health Reasons known as Government Regulation number 109 of 2012. In addition to strengthening the smoke-free area program on the sub-national levels, the Ministry of Home Affairs and Ministry of Health enacted Joint Ministry Regulation in 2011 to provide indicators and guidance on legal norms to create local laws on smoke-free areas at provincial and regional levels (Indonesian Government, 2012; Minister of Health and Minister of Home Affairs of Indonesia, 2011).

Both Yogyakarta City and Kebumen Regency, where this study was conducted, have been implementing local smoke-free policies since 2017 through Yogyakarta's local regulation No. 2 for 2017 and Kebumen's local regulation No. 10 for 2017. However, the implementation of these policies is not yet effective (A'yuni & Nasrullah, 2021; Andini, Syakdiah, & Kusumawiranti, 2022; Azka, 2020; Institute for Global Tobacco Control, 2019). About 59% and 83% of people in Yogyakarta and Central Java smoked inside the houses or buildings (The Ministry of Health, 2018). More than 75% of Indonesian smokers smoke in front of their nuclear family (wife and children) (Asyary & Veruswati, 2023).

Therefore, this study aims to determine the impact of cigarette smoke on maternal and fetal health, especially on the risk of low birth weight (LBW). Furthermore, this study was conducted to evaluate the effectiveness of the implementation of smoke-free laws in providing better protection for vulnerable groups.

METHOD

Study design

This study used a mixed-method approach, combining quantitative data analysis and a descriptive review of relevant evidence-based findings. Data were analyzed using a retrospective model to re-identify the smoking exposure among pregnant women and the low birth weight.

Sample

This research employed two different data sets to cover a wider population and samples. Two private hospitals, located in the Special Regions of Yogyakarta and Kebumen Regency, were selected to collect the data among mothers with low birth weights. The sample of this research were 160 respondents, adopting total sampling technique and the respondents were grouped as Hospital A (57 respondents) and Hospital G (103 respondents). The inclusion criteria in this study were pregnant women with IUGR, mothers who gave birth to LBW, and premature.

Instrument

The instrument of this research was questionnaire. The questionnaire consists of 12 questions, including the history of smoking before and during pregnancy, the history of secondhand smoke at home or at work, the number of family members who smoke, the number of cigarettes consumed. The quantitative data employed two sets of data from two hospitals to collect larger samples. Each data set contained two variables as covariates: smoking exposure stated in minutes per day and the number of people smoking in a house. Meanwhile, the independent factor was the baby's birth weight.

Data Collection

This research was conducted for 4 months. A serial meeting with the hospital team was conducted to gain the same perception of the characteristics of selected samples. The first step in data collection was sorting the medical records. We collected demographic data on the mothers (age and income), gestational history (gestational age, status of parity, history of abortion, and history of intrauterine growth restriction), labor process (mode of delivery of the last labor, infants APGAR score, infants' birth weight). Mothers with a history of low-birth-weight infants (<2500 grams) are selected for this study. And then we give a questionnaire about smoking exposure to the selected mothers. A follow-up phone call was carried out to complete the data on smoking exposure and the number of in-home smoking people. Prior to data collection, the research team explained the purpose of the study as mentioned in the ethical clearance outlines. All the participants involved in the research agreed to extend their information for research purposes.

Data analysis

Data analysis was applied through Jamovi statistical software for macOS version 2.2.5.0 (The Jamovi Project, Sidney, Australia) (The Jamovi Project, 2021**).** A descriptive review of law enforcement, socio-demographic, and economic aspects was utilized to examine the confounding factors of smoking exposure in the population context.

The quantitative data employed two sets of data from two hospitals to collect larger samples. Further, the three data groups were analyzed using a correlation matrix in regression

analysis. Prior to the correlation analysis, all data were assessed for their normality, and the analysis used was spearman's rho correlation. Data were provided in correlation.

Ethical clearance

The ethical clearance certificate from the Health Ethics Committee of Universitas Aisyiyah Yogyakarta (No. 1681/KEP-UNISA/VIII/2020) declares that the study was carried out in compliance with the ethical principles of the Helsinki Declaration (World Medical Association, n.d.). The researchers have also obtained written informed consent from all the participants.

RESULTS

Data analysis of the first (A) and the second (G) Hospital: Low birth weight and smoking exposure

The data were analyzed through statistical tools (table 1, table 2, and table 3), and the distribution among those data in the first (A) and second (G) groups was not normal. Thus, the correlation regression for these two groups used spearman's rho.

Table 1. Mothers Characteristics

Characteristics	All (n=160)		Hospital A (n=57)		Hospital G (n=103)	
	n	%	n	%	n	%
Mothers' Age (years old)						
<20	5	3.12	1	1.8	4	3.9
20-35	129	80.62	48	84.2	81	78.6
>35	26	16.25	8	14	18	17.5
Parity						
Grandemultigravida	12	7.50	5	8.8	7	6.8
Multigravida	67	41.87	21	36.8	46	44.7
Nullipara	8	5	3	5.3	5	4.9
Primigravida	73	45.62	28	49.1	45	43.7
Comorbidity						
Hypertension	21	13.12	4	7	17	16.5
Other comorbidity	14	8.75	12	21	2	1.9
No comorbidity	125	78.12	41	72	84	81.6
Abortion History						
Yes	23	14.37	13	22.8	10	9.7
No	137	85.62	44	77.2	93	90.3

Table 2. Babies' Characteristics

Characteristics	All (n=160)				Hospital A (n=57)					Hospital G (n=103)				
	n	%	Mean ± SD	Median (Min-Max)	n	%	Mean ± SD	Median (Min-Max)	Saphiro Wilk (p-value)	n	%	Mean ± SD	Median (Min-Max)	Saphiro Wilk (p-value)
Gestational age at birth			37.06 ± 1.45	37 (34-40)			38.08 ± 1.33	38 (35-40)	< .001			36.48 ± 1.18	36 (34-40)	< .001
APGAR Score			8.17 ± 1.29	8 (6-10)			8.77 ± 1.15	9 (6-10)	< .001			7.83 ± 1.25	8 (6-10)	< .001
Birth Weight (grams)			2605.5 ± 408.72	2470 (2100-3765)			2904.211 ± 530.51	2550 (2250-3765)	< .001			2440.194 ± 168.64	2430 (2100-3507)	< .001
Diagnosis														
IUGR	71	44.375			42	73.7				29	28.2			
Preterm	43	26.875			8	14				35	34			
Low Birth Weight Baby	46	28.75			7	12.3				39	37.9			

Table 3. Smoking Exposure and Number of Smokers

	All (n=160)		Hospital A (n=57)			Hospital G (n=103)		
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	Saphiro Wilk (p value)	Mean ± SD	Median (Min-Max)	Saphiro Wilk (p-value)
Daily smoking exposure (minute)	85.36 ± 163.81	52.50 (0-1200)	15.84 ± 30.31	0 (0-120)	< .001	128.83 ± 192.70	65 (0-1200)	< .001
Number of smokers	1.55 ± 1.33	2 (0-4)	0.84 ± 1.08	0 (0-4)	< .001	1.94 ± 1.30	2 (0-4)	< .001

The correlation regression among the two groups indicated a significant correlation between covariates variables (number of smokers in a home and time length of smoke exposure a day) and independent variables (birth weight). In the first hospital (A), **Table 4** shows that the p-value of the number of smokers toward baby birth weight was (0.001) < 0.05, indicating a significant influence on people smoking at a house toward the independent variable, with a spearman's rho -0.62. In addition, the correlation of another covariate, smoking exposure per day in minutes, had a p-value of 0.001 (< 0.05), representing a significant influence on baby birth weight, with negative spearman's rho (-0.59).

The same significant correlation emerged among those variables in the second hospital (G) (**Table 4**), with the negative Spearman's rho in the level of moderate (-0.61) for the correlation of number of smokers and birth weight and high correlation between smoking exposure and birth weight variables (**Table 4**).

Table 4. The correlation between number of smokers and smoking exposure (in minutes) with birth weight in two hospitals

Variables	Hospital A (n=57)		Hospital G (n=103)	
	Birth weight		Birth weight	
	Spearman's rho	p-value	Spearman's rho	p-value
Number of smokers-A	-0.62***	<.001	-0.61***	<.001
Smoking exposure-A	-0.59***	<.001	-0.68***	<.001

DISCUSSION.

Main Findings: LBW as a result of smoking exposure

Smoking during pregnancy and the periconceptional stage has been linked to negative mother and newborn outcomes across the world (Avşar, McLeod, & Jackson, 2021; Maas et al., 2021). It is also responsible for lower weight at birth (the anthropometry at neonatal), birth gestational age, APGAR score and as a risk factor for mortality and morbidity (Amyx et al., 2021; Kalayasiri, Supcharoen, & Ouiyanukoon, 2018; Prince, Umman, Fathima, & Johnson, 2021; Schechter et al., 2020)**.** The biomarker in active and passive tobacco smoke exposure measurement, nicotine and cotinine- as its metabolite, have the availability of crossing the placenta, which these biomarkers further have a direct detrimental effect on the growth of fetal, including the risk of low birth weight (Amyx et al., 2021; Dennis, 2019; Edi, Chin, Woon, Appannah, & Lim, 2021; Xi et al., 2020). Additionally, smoking behavior among expectant mothers in each trimester of pregnancy has increased the proportion of preterm births (Soneji & Beltrán-Sánchez, 2019).

Smoking during pregnancy interferes with fetal growth and birth weight through the following mechanisms: Nicotine, the component of tobacco, has a higher concentration in the placenta (15%) than in maternal blood. Nicotine causes uterine vasoconstriction by inducing maternal catecholamine release. Smoking more cigarettes is linked to a poor Apgar score, premature birth, and low birth weight (Abdallah, Joho, & Yahaya, 2021). Tobacco use has an impact on a newborn's health by raising the risk of hypoxia and infections, which is commonly measured by the Apgar score (Baena-García et al., 2019).

The initial preventive action should be considered to decrease the amount of in-utero smoking exposure, for example, by introducing a smoking cessation program or giving psychosocial intervention to reduce smoking in a pregnancy program (Koivu et al., 2023; Scherman, Tolosa, & McEvoy, 2018) and enforcing the implementation of smoke-free law as a support for tobacco legislation (Mallma, Carcamo, & Kaufman, 2020). Another initiative to prevent second-hand smoke exposure during pregnancy is introducing the World Health Organisation (WHO) recommendation to apply an effective screen of pregnant mothers conducted by health care providers on their smoking status and potential second-hand smoking exposure (Krishnamurthy et al., 2018). There are several possible ways for health care providers to advocate, such as the media campaign to be accessed by smokers as support and helping aids to quit smoking, taxation applied for higher tobacco pricing, and the advocacy for a comprehensive policy on smoke-free (Fallin-Bennett, Scott, Fallin-Bennett, & Ashford, 2019). The health promotion among communities aiming at smoking cessation and enforcing smoke-free laws is very relevant to the current Covid-19 health safety campaign, as smoking is indicated as a risk factor for suffering from the disease and leads to more severe conditions (Sugiyo, Limato, & Handari, 2021).

Implications on Legal Policy

The efforts of the global public health and government have not been optimized to decrease the number of smokers and tobacco exposure to vulnerable groups (second-hand smokers). Overcoming the problems requires strong collaboration among stakeholders to implement better smoke-free laws. Furthermore, participation through community engagement will gain sustainability programs (Indonesian Minister of Health, 2019). Since 2012, tobacco control regulation has been determined as the basic anti-tobacco regulation. It has been going on for more than 10 years, but young smokers still increased to 9,1% in 2018. The percentage had not yet reached the national target of 5,4% (Ministry of Health, 2018). It aligns with the increased numbers of indoor smokers and the numbers of tobacco exposure (second-hand smokers) nationally. In 2018 Indonesia's basic health research showed the number of indoor smokers on average 80,6% (house, workplace and public transportation are the sample location); thus, the numbers of tobacco exposure reached 32,4% for daily routine and 43,1% for the occasion. Furthermore, women are more likely than males to be exposed to tobacco products on a daily basis (34,8% vs. 27,1%) (TCSC-IAKMI, 2020).

Consequently, in 2018 and 2019, the national government periodically distributed circular resolutions to all Indonesian governors, mayors, and regents to overcome the problems (the increasing number of smokers and second-hand smokers). The local governments were mandated strongly to implement smoke-free laws in their territory. In 2018, the points of the mandate in the circulation resolution from the Ministry of Home Affairs were namely; first, local governments (provincials and below levels) have to enact the smoke-free laws referring to all the regulations; second, smoke-free laws were implemented through optimizing the civil police for supervising, monitoring, and evaluating the enforcement of smoke-free laws; and third, the implementation of the smoke-free area in education sector refers to the Indonesia Education and Cultural Ministry

Regulation on 64 of 2015. Additionally, in 2019, the circular letter was distributed while adding new points. The points included smoke-free areas not only prohibited smoking but also had to ban any tobacco advertisement, promotion and sponsorship in those areas and implemented any sanction to the defendant (simple-criminal sanction) in the form of fines or administrative sanctions to give deterrent effects (Minister of Health and Minister of Home Affairs of Indonesia, 2011).

Furthermore, Yogyakarta and Kebumen, where the samples were selected, determined smoke-free laws in 2017 by Yogyakarta's local regulation No. 2 for 2017 and Kebumen's local regulation No. 10 for 2017. However, based on the 2018 National Report of the Indonesian Basic Health Report, the number of indor smokers in Yogyakarta and Central Java was more than 50% (Ministry of Health, 2018). This survey also revealed that the proportion of low birth weights in Yogyakarta (7.6%) and Central Java (4.3%) was above the national number, which was only 4% (Ministry of Health, 2018). This study emphasizes that the evaluation of policies on tobacco control and their enforcement are needed to decrease the number of low-birth-weight newborns.

The number of smokers and low birth weight have a high correlation in Yogyakarta. Smokers increase to>30% of the population. In 2020, the PHBS program showed that 58% (312.269) of households were not achieved the indicators. One of the indicators is not compliance and unachievable (smoking in house). Those indicators decreased by 4% more than before (DIY Health Office, 2020; Ministry of Health, 2020; Yogyakarta City Health Office, 2020).

The prohibition of in-home smoking in Yogyakarta is the worst indicator in the PHBS program that has been 62,58% of not being progressed compared to other indicators such as delivery assisted by health workers of 98,6% and access to clean water of 95,63% in 2019. As a result, the number of low-birth-weight neonates in Yogyakarta has grown at a provincial level from 2019 (6,08%) and 2020 (6,93%). Moreover, we have several low-birth-weight newborns (6,08% of 3,338 live births), all of which have exceeded the national level by 4,0% (2018) (DIY Health Office, 2020; Yogyakarta City Health Office, 2020).

Nevertheless, since 2018, the Local Government of Yogyakarta city has implemented smoke-free laws through socialization, monitoring and evaluation (compliance survey). The government prefers to use persuasive ways (a promotive-preventive mechanism). To gain better implementation, the government determined a special task force to supervise the compliance of smoke-free laws called *Satgas* KTR in 2019. At the end of 2019, *Satgas* KTR has supervised the compliance of smoke-free areas in worker-places of the governmental area: such as 15 departments or OPD, 14 sub-districts, and 45 villages. Moreover, the smoke-free area campaign's effort triggers some hamlets to have declared smoke-free zones (*rukun warga bebas asap rokok*). The number of hamlets self-declared as the smoke-free zone is 230 out of 616 hamlets in Yogyakarta city (DIY Health Office, 2020; Ministry of Health, 2020; Yogyakarta City Health Office, 2020).

Overall, the enforcement of smoke-free laws and regulations requires wider collaboration, continuous implementation, and periodic reports on the supervision to provide rooted and sustainable programs. To overcome any side effects of tobacco consumption and exposure, better global health indicators such as providing a healthy lifestyle, decreasing the number of non-communicable prevalence, and especially preventing low birth weight and neonatal mortality should be realized. Those programs aim to reach Indonesia's sustainable development goals.

Implications on Socio Demography

Cigarette taxation aims to improve health outcomes by reducing cigarette consumption and introducing a smoking cessation program as part of a social marketing campaign in the tobacco control field (Rosilawati, Nurjanah, Sugiyo, Nurmandi, & Habib, 2020; Settele & Ewijk, 2018). The tobacco industry targets youth groups as their marketing target, increasing their smoking prevalence (Rosilawati, Chen, Nurjanah, Sugiyo, & Cheng, 2021). The social condition of the community's daily consumption is an essential indicator in identifying which need is a priority. In relation to it, the Indonesian Central Statistics Agency in 2021 explained that cigarette consumption in Indonesia, based on the "food" category, was placed as the top 3 foods frequently consumed by the community (City and Village) apart from Prepared Food and Beverages, as well as cereals. The data explained that in 2020 the consumption of Cigarettes ranked the second highest (5,99%), while the first position was prepared food and beverages (16,87%), and the third position was cereals (5,45%) (Central Bureau of Statistics, 2021).

Therefore, smoking cessation programs in society are imperative in fulfilling *healthism* requirements among pregnant mothers (Walker et al., 2019). The outcomes of baby birth were affected also by the lifestyle of pregnant mothers which developed during pregnancy (Bagherzadeh et al., 2021). In this context, a pregnant woman is placed as an agency seeking to adapt her lifestyle to her social environment to achieve optimal health. In summary, agency is always bound by a social environment, and personal choices are defined by' social standards or codes' that instruct the individual how to rank their preferences and if they are suitable. It suggests that social activities or interaction were affecting health through the set of healthy lifestyle that covers human actions and daily life behavior (Bagherzadeh et al., 2021)

On the contrary, as Anthony Giddens proposes, we could link health-care systems with environmental conservation by considering it as preventative medicine. In this case, the pregnant woman's health is a structural issue – a complex one that requires collective awareness of the community to fulfill health equality for pregnant women in line with her latest physiological changes (Georgieva-Stankova, 2021; Siqueira, Fracolli, & Maeda, 2019). It is similar to the Foucauldian concept of governmentality, stating that risks and self-regulation are supposed to be endorsed by citizens, who are usually seen as passive actors. t's comparable to Foucault's notion of governmentality, which states that citizens, who are typically viewed as passive actors, should accept risks and self-regulation. The social environment where the expectant mothers lived, provide interactions among pregnant women and the society, and thus provide supportive atmosphere (Bagherzadeh et al., 2021). The initial way could be realized through comprehensive health education for society.

Moreover, based on the above considerations, this analysis attempts to raise the view that the high consumption of cigarettes is related to the weak social structure in fulfilling the health rights of pregnant women. In the context of this research, it can be seen through the significant number of people who continue to smoke even though there are pregnant family members. Regarding this argument, the researchers suggest that future studies can conduct more specific testing.

Furthermore, smoking exposure during pregnancy has been shown to affect a baby's birth weight. It can be prevented by increasing personal, family, and community awareness about the harmful effects of tobacco. Moreover, family members' smoking patterns can increase children's willingness to smoke (Nazir & Almas, 2017). Oral health integrated into smoking cessation campaigns and programs can increase awareness of the negative effects of tobacco use (Nazir & Almas, 2017). Therefore, it is essential for health workers and smoking cessation communities to educate the community about the danger of tobacco. Health workers should educate children on the dangers of smoking to families during the pregnancy program. In addition, the smoking cessation communities should be able to campaign using social media so that the wider community can reach it. By doing so, it will increase the community's awareness of the dangers of smoking exposure for pregnant women.

This research covers the relation among those three variables. However, it needs further exploration on how the other birth outcomes may be impacted from smoking behavior, both active and passively.

CONCLUSION AND RECOMMENDATION

The growing consumption of cigarettes in Indonesia has had several negative impacts on people's health. Reflecting on this study, the consumption of cigarettes was relatively high among families with pregnant mothers, implied by the number of cigarette sticks consumed per day and the length (in minutes) of the smoking exposure per day. The prenatal outcomes, interpreted in the measurement of birth weight, were significantly affected by the quantity of smoking exposure. These findings suggest that policymakers consider health programs to minimize further the economic downturn resulting from the decreasing quality of human resources.

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