

Secondhand Smoke as an Indirect Cause of Stunting: A Study at Nipah Health Center in North Lombok

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ABSTRACT

Background: Stunting is a growth and development disorder in children resulting from poor nutrition, repeated infections, and inadequate psychosocial stimulation. Children affected by stunting are more vulnerable to various diseases. Long-term consequences include impaired cognitive and motor development, along with increased healthcare costs. Exposure to secondhand smoke, whether direct or indirect, is believed to contribute to stunting. This study aimed to investigate secondhand smoke exposure as an indirect cause of stunting.

Method: This study used a cross-sectional approach with a sample of 99 children under five years old residing in the Nipah Health Center area, Malaka Village, North Lombok. The sample was taken using stratified proportional random sampling. Descriptive statistics and Chi-square tests were employed to analyze the data and test the research hypothesis.

Result The prevalence of stunting was 38.38%. Although none of the mothers reported smoking during pregnancy, 98.98% of them were exposed to cigarette smoke from their husbands, family members, or neighbors. Exposure occurred multiple times in both home and public environments, typically lasting less than 15 minutes. The statistical analysis showed no significant association between secondhand smoke exposure and stunting. Despite the lack of a statistically significant relationship, exposure to secondhand smoke remains a public health concern. Preventive measures should be prioritized. Health promoters are encouraged to intensify anti-smoking campaigns. Smoking cessation counseling should be delivered door-to-door, particularly targeting households with pregnant women and toddlers. Educational materials such as flyers, short messages, and inspirational stories disseminated via social media platforms like WhatsApp can serve as effective health promotion tools.

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INTRODUCTION

Stunting remains a significant public health concern in many countries, including Indonesia. It is a growth and development disorder in children by chronic malnutrition, recurrent infections, and inadequate psychosocial stimulation. Stunted Toddlers have shorter stature than their peers of the same age. The long-term impacts of stunting are profound, affecting cognitive development and the overall quality of future human resources. It also increases the risk of various degenerative diseases in adulthood, contributing to higher healthcare costs.(1,2)

The World Health Organization (WHO) set a global target to reduce stunting prevalence by 40% by 2013 and further decrease it to 20% by 2025.(3) Indonesia adopted this global target by setting a national target of 14% stunting prevalence by 2024 as the health goals for 2025-2030.(4) Currently, Indonesia ranks fifth globally in stunting prevalence.(5) According to the 2022 National Nutrition Status Survey (SSGI), stunting prevalence in

Indonesia was 24.4%, a decrease from 21.6% the previous year.(6,7) Despite this progress, this figure remains above the WHO's recommended threshold of 20%.(3) The West Nusa Tenggara Health Office reported the following stunting rates in 2023: North Lombok (19.5%), Central Lombok (17.5%), East Lombok (16.7%), Mataram City (15.7%), and West Lombok (13.6%). Additionally, the national malnutrition rate was 17.70%, compared to 26.40% in West Nusa Tenggara (NTB), with West Lombok recording a notably higher rate of 29.94%.(6,7)

The causes of stunting extend beyond inadequate nutrition.(8) According to World Health Organization, direct causes include household and family factors, insufficient food intake, poor breastfeeding practices, and infections.(9) Meanwhile, indirect causes include community and social aspects such as political economy, health and health service facilities, education, society and culture, and agricultural and food supply systems, as well as water, sanitation, and the environment.(10)

Previous studies have reported a correlation between environmental sanitation, smoking behavior, cigarette smoke exposure, and the incidence of stunting. Exposure to cigarette smoke is associated with stunting.(8,11–13) Similar studies have also indicated that the location of exposure, frequency, and the number of cigarettes consumed can double the risk of low birth weight (LBW) and stunting in infants.(14) A study conducted in West Nusa Tenggara in 2024 reported that the husband's smoking habit directly contributed to low birth weight and increased the risk of stunting. This behavior not only affects the husband's own health but also poses a threat to the health of the unborn child.(15)

The 2021 Global Adult Tobacco Survey reported that 2.1 million adults (1.0%) in Indonesia were users of smokeless tobacco.(16) Interestingly, the prevalence of smokeless tobacco use was higher among women (1.1%) than men (0.9%). According to the Central Statistics Agency, in 2024, 30.20% of individuals aged 15 years and older in West Nusa Tenggara had smoked in the past month. However, researchers face challenges in obtaining data on smoking behavior at the household level. Indonesian Health Survey (SKI) in 2023 revealed that 79.65% of individuals aged ≥ 10 years in West Nusa Tenggara smoked indoors, in buildings or rooms.(6)

Closed or semi-open smoking areas still pose a significant risk, as cigarette smoke can spread through ventilation or linger on the smoker's clothing and hair. Residual smoke particles often adhere to surfaces and can be inhaled by non-smokers, including pregnant women, infants, and toddlers. Common exposure sources include public places, transportation, workplaces, and designated smoking areas, all of which contribute to increased exposure to nicotine and toxic heavy metals. When toxic residues are brought into the home, pregnant women and children may experience double exposure.(17,18) Exposure to cigarette smoke, including that occurring outside the home, has been found to negatively affect infant height, contribute to low birth weight, and increase the risk of stunting. These results strengthen the hypothesis that cigarette smoke exposure is significantly associated with stunting. (14,19)

Although similar studies have been conducted, smoking behavior among adult men, both at home and in public places, remains high. This unhealthy behavior contributes significantly to secondhand smoke (SHS) exposure among pregnant women and toddlers. A study by Saenong et al. (2024) used a small sample with a purposive sampling technique, limiting its generalizability. Most studies in Indonesia have utilized instruments to assess smoking behavior, but few have focused specifically on SHS exposure.(20) Maternal exposure to secondhand smoke during pregnancy can have serious

adverse effects on child health. Studies have shown that newborn cotinine levels, an indicator of nicotine exposure, can approach those of active smokers. The fetal period is particularly sensitive to environmental toxins, with tobacco smoke capable of disrupting genetic processes such as cell proliferation, immune function, and epigenetic modifications like DNA methylation. Continued nicotine exposure during pregnancy may result in impaired fetal bone growth due to mechanisms such as nicotine-induced vasoconstriction and fetal hypoxia, ultimately leading to stunting. These mechanisms can also cause persistent changes in the baby, which can affect postnatal development, leading to differences in height.(21) Additionally, cigarette smoke has been shown to interfere with nutrient absorption in children, further compromising growth and development.(11) This study aims to investigate secondhand cigarette smoke exposure as an indirect cause of stunting using a cross-sectional approach.

METHOD

This study is a quantitative study with a cross-sectional approach. The location of the study was in Malaka Village, North Lombok, West Nusa Tenggara, under the jurisdiction of the Nipah Health Center. Data collection took place in February 2025, with the sample consisted of 99 mothers with children aged 0–59 months, selected through stratified proportional random sampling. Inclusion criteria included mothers with toddlers residing in the study area, meanwhile exclusion criteria were toddlers diagnosed with mental disorders such as developmental delay, attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and emotional or behavioral disorders.

The independent variable in this study was cigarette smoke exposure, and the dependent variable was stunting. Secondhand smoke exposure was assessed through several indicators such as smoking behavior during pregnancy, smoking locations (indoors/outdoors), internal sources of exposure (e.g., household members), external sources of exposure (e.g., neighbors, public areas), and frequency and duration of exposure. Data were collected using a structured questionnaire administered by researchers. Smoking behavior during pregnancy was measured by asking whether the mother smoked every day, sometimes, or not at all. The responses were categorized into “not at all” as code 2, and “every day” and “sometimes” as code 1. Exposure-related variables (e.g., location and sources of smoke) were categorized into 3-4 levels. Duration of exposure was estimated using daily activity conversions (e.g., opening/closing doors, approximated to 15 seconds per event), as direct time measurement tools (e.g., stopwatch) were not used.

The primary data on secondhand smoke exposure were obtained using a questionnaire adapted from the 2017 Indonesia Demographic and Health Survey (SDKI), specifically the women's health section (questions 1104-1106), which is internationally validated. Secondary data on stunting were taken from the growth and development monitoring records of toddlers at the Nipah Health Center.

Descriptive statistics (frequencies and percentages) were used to summarize variables. Chi-square tests were applied to analyze the relationship between secondhand smoke exposure and stunting using SPSS version 24. This study was approved by the Ethics Committee of General Achmad Yani University, Yogyakarta, under approval number Skep/052/KEP/II/2025.

RESULT AND DISCUSSION

Table 1. Characteristic of respondents

Characteristic	f	%
Stunting		
Yes	38	38.38
No	61	61.62
Maternal age		
< 20 y	2	2.02
20-34 y	97	97.98
Gender of the toddler		
Male	47	47.47
Female	52	52.53
Minimum Regional Wage (MRW)		
<2,4 million	64	64.65
≥2,4 million	35	35.35
Education level		
Primary school	29	29.29
Junior high school	35	35.35
Senior high school	29	29.29
Bachelor	6	6.06
Mother's Occupation		
Housewife	87	87.88
Seller	4	4.04
Farmer	2	2.02
Worker	6	6.06

Univariate analysis was used to describe the distribution of each variable in terms of frequency and percentage. The descriptive results of the dependent variable (stunting) and the respondents' characteristics are presented in Table 1. Table 1 shows that the prevalence of stunting among toddlers in the *Nipah* Health Center working area was 38 cases (38.38%). Although this figure is lower than the number of toddlers who are not stunted, it remains a cause for concern. Stunting is a serious public health issue that requires sustained and intensive attention to prevent its prevalence from increasing further.(22) The table also presents the demographic characteristics of the

respondents, which include maternal age, toddler's gender, education level, and occupation.

The highest percentages across respondent characteristics were as follows: maternal age 20-34 years (97.98%), male toddlers (52.53%), household income below the regional minimum wage of IDR 2.4 million (64.65%), junior high school education (35.35%), and housewives (87.88%). Bivariate analysis was conducted to examine the relationship between exposure to cigarette smoke and stunting incidence. Statistical significance was determined using a p-value threshold of 0.05. The results of the Chi-square analysis are presented in Table 2.

Table 2. The results of the Chi-square analysis

Variables	Stunting		P-Value
	Yes n (%)	No n (%)	
Smoking during pregnancy			
No	99 (100)	0 (0)	
Yes	0 (0)	0 (0)	
Smoking areas			
Home surrounding	24 (24.24)	33 (33.33)	0.52
Public area	13 (13.13)	24 (24.24)	
Others	1 (1.01)	4 (4.04)	
Internal source of exposure			
Not exposed	1 (1.01)	1 (1.01)	0.52
Husband	20 (20.20)	37 (37.37)	
Family	7 (7.07)	6 (6.06)	
Others	10 (10.10)	17 (17.17)	
External source of exposure			
Neighbors	29 (29.29)	42 (42.42)	0.75
Coworkers	7 (7.07)	15 (15.15)	
Others	2 (2.02)	4 (4.04)	
Frequency of exposure (a week)			
Not exposed	1 (1.01)	1 (1.01)	0.72
1 time	8 (8.08)	17 (17.17)	
> 1 time	29 (29.29)	4 (4.04)	
Duration of exposure			
Not exposed	0 (0.00)	1 (1.01)	0.31
< 15 seconds	21 (21.21)	25 (25.25)	
≥ 15 seconds	17 (17.17)	35 (35.35)	

The components of cigarette smoke exposure assessed in this study included smoking during pregnancy, smoking areas, internal and external sources of exposure, and the frequency and duration of exposure. As shown in Table 2, the analysis indicated no significant association between exposure to cigarette smoke and the incidence of stunting. None of the respondents reported smoking during pregnancy; however, nearly all were exposed to cigarette smoke, primarily from husbands and family members at home. Outside the home, exposure was commonly reported from neighbors and coworkers. The majority of smokers were men, with only a small number of female smokers. Interestingly, only a small proportion of active

smokers reported health complaints. Nonetheless, there was a trend indicating that daily smoking in the past month was associated with an increased rate of health complaints.(23–25) In some cases, daily smoking was also observed among household members whose main role was caregiving.(26)

Consistent with the findings of this study, no significant relationship was found between secondhand smoke exposures and stunting. Similar results were reported in studies conducted in India.(27,28) Several earlier studies also found no significant association between secondhand smoke and stunting incidence. This may be attributed to the low intensity and frequency of smoking by household members, which may have resulted in relatively low exposure levels and, consequently, a reduced risk of smoke-related respiratory issues among children. Other environmental and structural factors may play a more significant role in the incidence of stunting. These include access to clean water, proper waste and feces disposal, and overall environmental hygiene.(29–31)

The present study also found that 65% of families had a monthly income below the provincial minimum wage, indicating potential financial limitations in fulfilling children's nutritional and healthcare needs. The family unit, particularly the socioeconomic status of the parents, is a major determinant of children's growth and development. Children from low-income households are more vulnerable to stunting due to limited access to nutritious food and lower levels of maternal health literacy. This situation is compounded by the fact that the majority of mothers in this study were housewives, indicating that family income relied heavily on the father's employment. Parental occupation is closely tied to household income, which in turn affects the family's purchasing power. An adequate family income enables parents to meet both the primary and secondary needs of their children, including providing a nutritionally balanced diet.(32) Studies have shown that a higher household wealth index is positively correlated with access to quality food, improved healthcare utilization, and a lower risk of stunting.(33–35)

Although this study did not find a statistically significant relationship, a closer examination suggests that exposure to cigarette smoke within the home, particularly from husbands, may be among the more influential factors related to stunting. It is hypothesized that nicotine residue and hazardous chemicals from tobacco smoke adhere to surfaces such as furniture, carpets, walls, clothing, and even pet fur. These particles can later re-enter the air and interact with other indoor pollutants to form new toxic compounds, contributing to a persistent indoor health hazard.(36)

Results indicated that 99% of respondents were exposed to cigarette smoke. Respondents reported that they were unable to avoid exposure, whether at home or in public spaces. Although many had received health education from local health centers regarding the dangers of smoking, they expressed that information specifically related to passive (secondhand) smoking was insufficient. Consequently, exposure to cigarette smoke was not perceived as dangerous. However, they still consider that there is a lack of information related to passive smoking, from which it leads to an assumption that exposure to cigarette smoke was not considered dangerous. A junior high school level of education and working as housewives should not hinder access to health information. In fact, housewives often have more time to enhance their knowledge and skills in adopting healthy lifestyle behaviors. This is supported by prior studies showing that consistent access to health education fosters positive health behavior change.(37,38)

This study has several strengths as it was conducted in West Nusa Tenggara (NTB), a province with a high prevalence of stunting, making the topic locally relevant. Additionally, the study employed a research instrument adapted from the Indonesia Demographic and Health Survey (SDKI), an internationally standardized and validated tool. The sampling method used was stratified proportional random sampling to ensure broad representativeness.

However, the findings of this study contrast with several previous studies that have demonstrated a significant association between cigarette smoke exposure and stunting.(39–41) Other sources of tobacco exposure, such as environmental tobacco smoke (ETS) from workplaces or household members, also have known adverse effects on neonates.(25) Tobacco smoke contains carbon monoxide (CO) and nicotine, both of which can bind with hemoglobin to form carboxyhemoglobin, impairing oxygen delivery and contributing to low birth weight (LBW). Nicotine and CO also cause vasoconstriction and reduced uterine blood flow, further elevating the risk of fetal growth restriction.(42)

Stunting and LBW may be linked to maternal prenatal exposure to secondhand smoke, potentially mediated through inflammatory responses and reduced placental weight. These mechanisms can affect fetal development, and the resulting impact may persist into postnatal life. Inadequate nutrition during pregnancy or early childhood, possibly exacerbated by nicotine exposure, is another underlying factor influencing long-term disease risk. Some biological mechanisms take effect during prenatal injury, while others are associated with metabolic disorders during postnatal catch-up growth.(19)

This study also has several limitations. Variables such as the father's occupation and type of cigarette consumed were not included as covariates, despite their well-documented influence on stunting. Additionally, data regarding the frequency and duration of exposure relied on self-reported information, which is subject to recall bias. For future research, alternative designs such as a case-control study with a 1:2 sample ratio may provide a more accurate assessment of the impact of secondhand smoke on stunting outcomes.

CONCLUSION

Although the findings of this study which was conducted among children under five years old living in the Nipah Health Center area, Malaka Village, North Lombok did not show a statistically significant association between secondhand smoke exposures and stunting, the risks associated with tobacco smoke exposure remain substantial. Therefore, individuals must be encouraged to eliminate this harmful behavior. Health education about the dangers of secondhand smoke and smoking cessation counseling should remain continuous public health priorities. Indicators of a healthy home environment, such as not smoking indoors, not smoking around children, and avoiding smoking in public areas, should be promoted consistently through daily health campaigns. Smoking cessation counseling can be delivered through door-to-door outreach, particularly targeting households with pregnant women and toddlers. Additionally, educational materials, including short flyers, text messages, and inspirational stories, should be distributed through social media platforms such as WhatsApp to enhance reach and engagement. This study recommends conducting future research using a case-control design with a 1:2 sample ratio, incorporating key covariates such as father's income and type of cigarettes consumed, better to assess the impact of secondhand smoke on stunting.

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Conflict of Interest

No potential conflicts of interest relevant to this article were reported

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