




# Maternal personal hygiene as a dominant risk factor for diarrhea among toddler in Medan City: a logistic regression analysis

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## ABSTRACT

In Indonesia, toddler diarrhea is still a major public health concern, especially in crowded cities like Medan City. The prevalence of diarrhea in toddlers remains high despite advancements in environmental sanitation, suggesting the impact of additional contributing factors, particularly caregiver behavior. The purpose of this study was to examine the main variables linked to toddler diarrhea incidence, with an emphasis on maternal personal hygiene habits. In this quantitative study, 120 mothers with toddlers ages 24 to 59 months selected through purposive sampling participated in a cross-sectional design. Participants were chosen from Medan City's seven subdistricts with the highest number of toddler diarrhea cases reported. Maternal personal hygiene behavior—which includes knowledge, attitudes, and practices—were the independent variables. Multiple logistic regression analysis was used to determine the most significant factor influencing the incidence of diarrhea in toddlers. The findings indicated that maternal personal hygiene practices were the most significant factor linked to toddler diarrhea incidence among all variables analyzed ( $p = 0.013$ ; Exp.B = 3.387). Diarrhea was 56% more likely to occur in toddlers whose mothers practiced poor personal hygiene. The incidence of diarrhea was not substantially correlated with maternal attitudes or environmental sanitation factors. In conclusion, preventing diarrhea in toddlers in urban environments requires improving maternal hygiene practices, especially handwashing with soap, sterilizing baby bottles and feeding utensils, and preparing safe food and drinking water.

**Keywords:** *Toddler Diarrhea, Mother's Personal Hygiene, Environmental Sanitation.*



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## 1. Introduction

Diarrhea remains one of the leading causes of morbidity and mortality among toddlers in developing countries. The World Health Organization (WHO) reports that more than 525,000 toddler deaths globally each year are attributable to diarrheal diseases, most of which are associated with environmental factors and inadequate hygiene practices (WHO, 2022). Beyond its immediate health impact, diarrhea contributes to growth impairment, malnutrition, and increased social and economic burdens on families. In Indonesia, diarrhea is classified as an endemic disease with the potential to cause outbreaks. Under-five children constitute the most vulnerable age group, frequently experiencing recurrent episodes each year (Ministry of Health of Republic Indonesia, 2018). Medan City, one of Indonesia's major urban centers with high population density, has experienced a substantial increase in diarrhea cases among toddler, rising from 4,561 cases in 2020 to 18,588 cases in 2021. This escalation occurred despite the fact that most households already had relatively adequate basic sanitation facilities, including access to clean water and household latrines.

Preliminary surveys conducted among 25 mothers of toddler in several sub-districts with the highest diarrhea incidence in Medan revealed that most households had access to basic sanitation infrastructure. However, daily personal hygiene practices were not consistently implemented. The initial findings indicated that many mothers did not wash their hands with soap at critical times, did not routinely sterilize feeding

bottles, and paid insufficient attention to the cleanliness of eating utensils and drinking water preparation for their children. These field observations suggest that the availability of sanitation facilities does not necessarily translate into effective hygienic behavior in daily life.

This phenomenon highlights a gap between structural sanitation-based approaches and behavioral approaches centered on personal hygiene practices. While previous studies have emphasized the importance of environmental sanitation in diarrhea prevention, more recent evidence indicates that maternal personal hygiene practices play a more substantial role in determining diarrhea risk among under-five children than environmental factors alone (Arifin, 2022). Nevertheless, most community-based interventions still predominantly focus on sanitation infrastructure provision, whereas evidence suggests that improvements in hygiene behaviors, including maternal practices, remain inconsistent and insufficiently addressed in many (Sophie Boisson, 2017). Evidence from Bangladesh demonstrates that children aged 6–11 months are more likely to experience diarrhea compared to older children. This increased risk is associated with inadequate access to safe drinking water and limited maternal knowledge regarding health and hygiene practices (Kamal, S. M., 2022). A multi-country study involving Indonesia, Cambodia, Myanmar, the Philippines, and Timor-Leste similarly identified child feces disposal practices, breastfeeding patterns, and feeding history as significant risk factors for diarrhea among under-five children (Arifin, 2022)

Based on preliminary survey findings, literature review, and research results, there is a clear need for research-based community engagement that prioritizes the improvement of maternal personal hygiene practices as the dominant risk factor for childhood diarrhea. Therefore, this study aims to analyze the association between maternal personal hygiene practices through knowledge, attitudes, and practices and the incidence of diarrhea among toddlers in Medan City. Particular attention is given to identifying key behavioral risk factors related to inadequate maternal hygiene practices that may contribute to diarrheal disease.

## 2. Methods

This study employed an analytic survey design with a cross-sectional approach. The research was conducted in seven sub-districts of Medan City with the highest incidence of diarrhea among toddlers. A total of 120 mothers with children aged 24–59 months were included as respondents, selected through purposive sampling. The dependent variable was the incidence of diarrhea among toddlers within the past 30 days. Diarrhea was operationally defined according to the standard of the World Health Organization as the occurrence of three or more loose or watery stools within a 24-hour period. Data on diarrhea incidence were obtained through caregiver self-reports using a structured questionnaire with a 30-day recall period to minimize recall bias (WHO, 2022).

The independent variable was maternal personal hygiene behavior, measured through three components: knowledge, attitudes, and practices. Knowledge was assessed using a set of multiple-choice questions related to respondent's understanding of diarrhea factors, including drinking water sources, household latrine use, waste management, and wastewater disposal systems (SPAL). Knowledge was measured using 12 questions with a maximum score of 12. Each correct answer received a score of 1 and incorrect answers received a score of 0. The scores were categorized into three levels, namely low (<40%, score <4), moderate (40–75%, score 4–9), and high (>75%, score >9) (Sugiyono, 2019). Attitudes were measured using a Likert scale (strongly agree to strongly disagree) refers to the respondent's tendency to respond positively or negatively toward diarrhea prevention behaviors. This variable was measured using 10 statements on a Likert scale consisting of strongly disagree (1 point), disagree (2 points), somewhat disagree (3 points), agree (4 points), and strongly agree (5 points), with a maximum score of 50. The attitude categories were defined as poor (<40%, score <20), moderate (40–75%, score 20–37), and good (>75%, score >37) (Sugiyono, 2019). Maternal practices were measured using 10 questions related to daily hygiene behaviors, with response options scored as always (4 points), often (3 points), sometimes (2 points), and never (1 point), resulting in a maximum score of 40. The practice categories were classified as poor (<40%, score <16), moderate (40–75%, score 16–30), and good (>75%, score >30) (Sugiyono, 2019). The measurement of maternal personal hygiene behavior was conducted through interviews and direct observation using a structured questionnaire.

The questionnaire instrument was adapted from previous validated studies and underwent validity and reliability testing prior to data collection. Content validity was assessed by public health experts, while construct validity was evaluated using item-total correlation analysis. The reliability test showed that the instrument was internally consistent, with a Cronbach's alpha coefficient of  $\geq 0.70$  for all components (knowledge, action and practice), indicating acceptable reliability. Data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics were used to summarize respondent characteristics, while inferential analysis was conducted using the chi-square test to examine the association between maternal personal hygiene behavior and diarrhea incidence. A significance level of  $p < 0.05$  was applied.

Data analysis was carried out in stages, beginning with univariate analysis to describe the distribution of variables. Bivariate analysis was performed using the chi-square test to assess the association between independent and dependent variables. Variables with a p-value < 0.25 in the bivariate analysis were considered eligible for inclusion in the multivariate analysis. Multivariate analysis was then conducted using multiple logistic regression with a backward stepwise method to identify the dominant factors associated with diarrhea incidence. A significance level of  $p < 0.05$  was applied in the final model (David W. Hosmer, 2013).

### 3. Results

Table 1. *Distribution of Maternal Toddler Characteristics in Medan City*

Variable	n=120	%
Age		
>25 years	25	20.8
25-35 years	72	60
36-45 years	20	16.7
>46 year	3	2.5
Education		
Junior High School	11	9.2
Senior High School	68	56.7
Bachelor	41	34.2
Occupation		
Work	31	25.8
Housewife	89	74.2
Sex of Toddler		
Male	64	53.3
Female	56	46.7
Age of Toddler		
2 years	63	52.5
3 years	21	17.5
4 years	20	16.7
5 years	16	13.3
Drinking Water Source		
Refill Gallon Water	81	67.5
Boiled Water	39	32.5
Diarrhea Incidence		
Diarrhea	61	50.8
No Diarrhea	59	49.2

Based on Table 1, the majority of respondents were in the early adulthood age group (60%), and most had completed senior high school education (56.7%). Most respondents were housewives (74.2%). The majority of toddlers were male (64%) and predominantly aged 2 years (52.5%). The most commonly used source of drinking water was refill bottled (gallon) water (67.5%). Furthermore, more than half of toddlers (50.8%) were reported to have experienced diarrhea within the past month.

Table 2. *Distribution of Maternal Personal Hygiene Behavior in Medan City*

Variable	n	%
Knowledge		
Low	22	18.3
Moderate	98	81.7
Attitude		
Moderate	109	90.8
Good	11	9.2
Practice		
Moderate	95	79.2
Good	25	20.8

Based on Table 2, the majority of respondents had a moderate level of knowledge with 98 individuals (81.7%). Respondent's attitudes toward personal hygiene were also predominantly categorized as moderate, with 109 individuals (90.8%). Similarly, in terms of practice, most respondents were classified in the moderate category, accounting for 95 individuals (79.2%).

Table 3. The Effect of Maternal Personal Hygiene Knowledge on the Incidence of Diarrhea Among Toddlers in Medan City

	Diarrhea		No Diarrhea		Total		p.value
	n	%	n	%	n	%	
Knowledge							
Low	16	72.7	6	27.3	22	100	0.042
Moderate	45	45.9	53	54.1	98	100	
Total	61	50.8	59	49.2	120	100	

Based on Table 3, the cross-tabulation results indicate that among the 22 respondents with a low level of personal hygiene knowledge, 16 respondents (72.7%) reported that their toddlers had experienced diarrhea, while 6 respondents (27.3%) reported no diarrhea. Among respondents with a moderate level of knowledge (n = 98), 45 respondents (45.9%) reported diarrhea in their children, where 53 respondents (54.1%) reported no diarrhea. Statistical analysis using the chi-square test yielded a p-value of 0.042 ( $p < 0.05$ ), indicating a statistically significant association between maternal personal hygiene knowledge and the incidence of diarrhea among toddlers in Medan City.

Table 4. The Effect of Maternal Personal Hygiene Attitude on the Incidence of Diarrhea Among Toddlers in Medan City

	Diarrhea		No Diarrhea		Total		p.value
	n	%	n	%	n	%	
Attitude							
Moderate	58	53.2	51	46.8	109	100	0.186
Good	3	27.3	8	72.7	11	100	
Total	61	50.8	59	49.2	120	100	

Based on Table 4, the cross-tabulation analysis shows that among the 109 respondents with a moderate level of personal hygiene attitude, 58 respondents (53.2%) reported that their toddlers had experienced diarrhea, while 51 respondents (46.8%) reported no diarrhea. Among respondents with a good attitude (n = 11), 3 respondents (27.3%) reported diarrhea in their children, where 8 respondents (72.7%) reported no diarrhea. The chi-square test yielded a p-value of 0.186 ( $p > 0.05$ ), indicating that there was no statistically significant association between maternal personal hygiene attitude and the incidence of diarrhea among toddlers in Medan City.

Table 5. The Effect of Maternal Personal Hygiene Practices on the Incidence of Diarrhea Among Toddlers in Medan City

	Diarrhea		No Diarrhea		Total		p.value
	n	%	n	%	n	%	
Practice							
Moderate	54	56.8	41	43.2	95	100	0.019
Good	7	28.0	18	72	25	100	
Total	61	50.8	59	49.2	120	100	

Based on Table 5, among respondents with moderate personal hygiene practices, a greater proportion of toddlers experienced diarrhea (56.8%). In contrast, among respondents with good personal hygiene practices, a higher proportion of children did not experience diarrhea (72%). The chi-square test yielded a p-

value of 0.019 ( $p < 0.05$ ), indicating a statistically significant association between maternal personal hygiene practices and the incidence of diarrhea among toddlers in Medan City.

Table 6. Independent Variables Eligible for Multivariate Logistic Regression Model

Variable	p.value
Knowledge of Personal Hygiene	0.042
Practice of Personal Hygiene	0.019

Based on Table 6, the independent variables that met the criteria for inclusion in the multivariate analysis were knowledge and personal hygiene practices. These variables were subsequently entered into a multivariate logistic regression model to predict the incidence of diarrhea among toddlers using the Backward Likelihood Ratio (Backward: LR) method. The results of the analysis are presented in the following table:

Table 7. Results of the Multivariate Multiple Logistic Regression Analysis

Step	Variable	Coefficient (B)	p	Exp.B	95% C.I for OR		OR Change
					Lower	Upper	
1	Constant	-0.944	0.034	0.389			
	Knowledge Personal Hygiene	0.899	0.092	2.456	0.864	6.981	
	Practice of Personal Hygiene	1.027	0.041	2.792	1.041	7.487	
2	Constant	-0.944	0.034	0.389			
	Practice of Personal Hygiene	1.220	0.013	3.387	1.293	8.870	21.3%

Based on the results presented in Table 7, in the first step of the multivariate analysis, both knowledge and personal hygiene practices were entered into the logistic regression model. The findings indicated that the knowledge variable had a p-value greater than 0.05. Therefore, a subsequent analysis was conducted by removing the knowledge variable from the model ( $p = 0.092$ ). However, the exclusion of the knowledge variable resulted in a change in the odds ratio (OR) for personal hygiene practices of more than 10% (21.3%). Since this change exceeded the acceptable threshold for confounding assessment, the knowledge variable was re-entered into the model as a control variable.

Table 8. Final Results of the Multivariate Analysis

Variable	Coefficient (B)	p	Exp.B
Constant	-0.944	0.034	0.389
Practice of Personal Hygiene	1.220	0.013	3.387

Based on Table 8, the personal hygiene practices variable had the highest Exp(B) value (3.387), indicating that maternal personal hygiene practices were the most influential or dominant factor in this study. Furthermore, the results of the multivariate analysis were used to construct a multiple logistic regression equation to estimate the probability of diarrhea incidence among toddlers as follows:

$$p = \frac{1}{1 + 2,7^{-(-0,944+1,220)}}$$

$$p = \frac{1}{1 + 2,7^{-0,277}}$$

$$p = \frac{1}{1 + 0,759}$$

$$p = \frac{1}{1,759}$$

$$p = 0,56 \times 100$$

$$p = 56\%$$

$p$  = Probability of diarrhea incidence

$y$  = Sum of the regression coefficients, including the constant and personal hygiene variables

$e$  = The natural constant (approximately 2.7)

Based on the obtained logistic regression equation, it can be estimated that toddlers cared for by mothers with poor personal hygiene practices have a 56% probability of experiencing diarrhea.

Table 9. Prediction of Diarrhea Incidence Among Toddlers Based on Maternal Personal Hygiene Practices

Variable	Cox&Snell R Square	Nagelkerke R Square
Practice of <i>Personal Hygiene</i>	0.209	0.279

Based on Table 9, the maternal personal hygiene practices variable demonstrated a predictive ability of 27.9% for diarrhea incidence among toddlers.

#### 4. Discussion

The findings of this study indicate that maternal personal hygiene practices represent the most dominant factor influencing the incidence of diarrhea among toddlers in Medan City. This conclusion is supported by the multivariate analysis, which yielded an  $\text{Exp}(B)$  value of 3.387. This result indicates that toddlers cared for by mothers with poor personal hygiene practices were more than three times as likely to experience diarrhea compared to those whose mothers demonstrated good hygiene practices. The estimated probability of diarrhea under these conditions reached 56%, highlighting the substantial contribution of maternal behavior to diarrhea risk.

These findings are consistent with the World Health Organization's report, which identifies inadequate hygiene practices as a primary determinant of diarrheal disease among children in developing countries (WHO, 2022). Bivariate analysis also demonstrated a statistically significant association between maternal personal hygiene practices and diarrhea incidence ( $p < 0.05$ ). This reinforces the importance of daily preventive behaviors, such as handwashing with soap at critical times, maintaining the cleanliness of feeding utensils and baby bottles, and ensuring safe food and drinking water preparation, in interrupting the transmission of diarrhea-causing pathogens. The results are in line with previous studies showing that poor maternal hygiene practices significantly increase the risk of diarrhea among toddlers. Lack of handwashing at critical times, improper water handling, and poor sanitation behaviors were identified as significant predictors of diarrhea among children under five (Jubayer, 2022). Similarly, another study reported that maternal hygiene-related factors, including failure to maintain clean latrine areas and inadequate hygiene practices, were associated with a higher incidence of diarrhea among under-five children (Kabuya, 2019).

In contrast, knowledge and attitude variables did not remain dominant factors in the multivariate model, despite showing associations in the bivariate analysis. This suggests that adequate knowledge and positive attitudes do not necessarily translate into consistent hygienic behavior. Such findings are aligned with health behavior theory, which posits that behavioral change is influenced by multiple determinants, including habits, social environment, and the individual's capacity to translate knowledge into everyday practice (Green, 2005). Similarly reported that hygiene practices exert a stronger influence on diarrhea incidence than cognitive and affective components alone.

The Nagelkerke R Square value of 27.9% indicates that maternal personal hygiene practices explain nearly one-third of the variation in diarrhea incidence among toddlers. Nevertheless, other factors beyond the model may also contribute, including nutritional status, household crowding, environmental cleanliness of play areas, and exposure to infectious sources. This underscores the multifactorial nature of diarrheal disease among children, as documented in epidemiological studies on childhood diarrhea (UNICEF, 2021). These findings are particularly relevant to urban settings such as Medan City, where most households already have access to basic sanitation facilities. However, infrastructure availability has not been accompanied by optimal hygienic practices. Cross-country studies in Southeast Asia have similarly demonstrated that behavioral factors—such as maternal hygiene practices and childcare patterns—are more consistently associated with diarrhea incidence than physical environmental factors alone (Arifin, 2022).

Based on these results, diarrhea prevention strategies among toddlers should prioritize behavior change interventions aimed at strengthening maternal personal hygiene practices. Health education initiatives should extend beyond knowledge enhancement and focus on fostering sustainable hygienic habits through practical demonstrations, family-based mentoring, and reinforcement of community health workers' roles. This

approach aligns with recommendations from WHO and UNICEF, which emphasize the importance of behavior-based interventions in controlling childhood diarrhea (WHO, 2022) (UNICEF, 2021).

## 5. Conclusion

This study concludes that maternal personal hygiene practices constitute the most dominant factor influencing the incidence of diarrhea among toddlers in Medan City. The multivariate analysis demonstrated that children cared for by mothers with poor personal hygiene practices were 3.387 times more likely to experience diarrhea compared to those whose mothers had good hygiene practices, with an estimated probability of 56%. Although maternal knowledge and attitudes toward personal hygiene showed significant associations in the bivariate analysis, these variables did not remain dominant predictors in the multivariate model. This finding suggests that knowledge and positive attitudes are not necessarily translated into consistent hygienic practices. Furthermore, the model's predictive capacity of 27.9% indicates that diarrhea incidence among toddlers is influenced by multiple factors; however, maternal personal hygiene practices remain the primary determinant identified in this study. Based on these findings, diarrhea prevention efforts in urban settings should prioritize behavior change interventions that emphasize sustained improvement in maternal personal hygiene practices. Interventions focusing on consistent and practical hygiene behaviors are expected to yield a more substantial impact in reducing diarrhea incidence among toddlers.

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