Available *online* at : http://ejurnal.stikesprimanusantara.ac.id/

Jurnal Kesehatan

| ISSN (Print) 2085-7098 | ISSN (Online) 2657-1366 |

DOMINANT RISK FACTORS OF TYPHOID FEVER AMONG INDIVIDUALS AGED 5-19 YEARS IN BUNYU ISLAND, NORTH KALIMANTAN

Aisyah Amatullah Al Muwaffaqah[1], Ajeng Tias Endarti[2], Brian Sri Prahastuti[3]

[1,2,3]Program Studi Magister Kesehatan Masyarakat, Fakultas Kesehatan Masyarakat, Universitas Mohammad Husni Thamrin, Jakarta, Indonesia.

ARTICLE INFORMATION

Received: 10 September 2025
Revised: 30 September 2025
Accepted: 09 October 2025
Available online: 30 November 2025

KEYWORDS

Typhoid fever
dominant risk factors
children and adolescents
handwashing with soap
sanitation

CORRESPONDING AUTHOR

***Corresponding author, email:**

Aisyahamatullah7@gmail.com

ABSTRACT

Typhoid fever remains a major public health concern in Indonesia, particularly in areas with limited access to clean water and sanitation, such as Bunyu Island. Children and adolescents aged 5-19 years constitute the most vulnerable group. This study aims to analyze the dominant risk factors associated with the occurrence of typhoid fever among this age group in the working area of Bunyu Island Community Health Center (Puskesmas Pulau Bunyu).

A case-control design was employed, involving 24 cases (individuals with a history of typhoid fever within the past six months) and 96 controls (without typhoid fever). Data were collected through interviews using structured questionnaires and analyzed using chi-square tests and multiple logistic regression.

The multivariate analysis identified four dominant factors significantly associated with typhoid fever incidence: male sex (OR=5.863; 95% CI=1.828-18.801), poor handwashing with soap habits (OR=4.506; 95% CI=1.298-15.644), risky snacking behavior (OR=4.181; 95% CI=1.305-13.395), and substandard waste disposal facilities (OR=4.028; 95% CI=1.312-12.363). Collectively, these variables accounted for 38.3% of the variation in typhoid fever incidence.

In conclusion, inadequate hygiene behavior and poor environmental sanitation, compounded by sex factors, are the main determinants of typhoid fever among children and adolescents on Bunyu Island. Preventive efforts should focus on promoting proper handwashing practices, controlling risky food consumption, and improving waste management systems.

INTRODUCTION

Typhoid fever is a systemic infectious disease caused by *Salmonella enterica serovar Typhi (S. typhi)* and continues to pose a significant public health problem in developing countries, including Indonesia [1]. The disease is endemic, and transmission occurs primarily through food and beverages contaminated with the feces of infected individuals, strongly influenced by environmental sanitation conditions and personal hygiene practices [2][3]. Clinically, typhoid fever is characterized by prolonged

DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

fever, headache, abdominal pain, digestive disturbances, and, in severe cases, may lead to serious complications such as intestinal perforation, sepsis, and even death if not properly managed [4][1]. However, the clinical manifestations of typhoid fever are often difficult to distinguish from other acute febrile illnesses in endemic areas, making laboratory confirmation generally necessary for diagnosis. Delayed diagnosis or inadequate therapy can potentially increase mortality rates [5][6].

Globally, the World Health Organization (WHO) estimates that typhoid fever causes 9-20 million cases and over 110,000 deaths annually, particularly in regions with limited access to clean water and adequate sanitation [7][1]. In Indonesia, prevalence ranges from 350 to 810 per 100,000 population, with an annual incidence of approximately 1.6%, making it one of the five most common infectious diseases and the 15th leading cause of death across all age groups [8][9][10].

Bunyu Island in North Kalimantan is an endemic area where typhoid fever has consistently ranked among the top three major infectious diseases over the past three years. This situation is closely linked to challenges in accessing clean water. Limited availability of clean water forces most residents to rely on rainwater or purchase water from wells [11]. Such conditions directly increase the risk of contamination in food and beverages, which serve as the main transmission routes of *S. typhi* [12]. It aligns with the WHO's (2023) statement that typhoid fever incidence is higher in populations lacking adequate access to clean water and proper sanitation [1].

Surveillance data indicate an increase in cases from 108 in 2022 to 168 in 2023 (a 55.6% rise), followed by a decrease to 125 cases in 2024. Age distribution shows that individuals aged 5-19 years account for the largest proportion of cases (53.61%) compared to other age groups [13], likely due to higher outdoor activity, frequent consumption of street food, and lower hygiene practices in this age group [14][15].

Previous studies have identified several risk factors for typhoid fever, including inadequate handwashing with soap (HWWS) practices, consumption of risky foods, poor environmental sanitation, and low parental knowledge [15][16][17]. Additionally, sociodemographic factors such as age, sex, education, and occupation also contribute [18][19]. However, most studies are general in nature, and few focus specifically on island regions with limited resources, such as Bunyu Island, which is a remote archipelago characterized by restricted access to clean water, limited healthcare facilities, and relatively high typhoid fever incidence.

Although several effective treatment and prevention strategies are available, improving water quality, sanitation, and personal hygiene is considered key to preventing typhoid fever, given that *S. typhi* is transmitted through water or food contaminated with feces. Therefore, understanding the risk factors for typhoid fever transmission is essential [20].

Based on these considerations, this study was conducted to analyze the dominant risk factors associated with typhoid fever among children and adolescents aged 5-19 years in the working area of Bunyu Island Community Health Center (Puskesmas Pulau Bunyu). This study is expected to provide valuable insights into the behavioral and environmental determinants that most strongly influence typhoid fever incidence and to strengthen the foundation for developing more effective prevention strategies in endemic areas.

METHOD

This study employed a case-control design with a quantitative approach, conducted in the working area of the Bunyu Island Community Health Center (Puskesmas Pulau Bunyu), Bulungan Regency, North Kalimantan, from August 2024 to January 2025. The study population comprised all residents aged 5-19 years. The case group consisted of patients diagnosed with typhoid fever within the past six months, based on medical records at the community health center, confirmed through physical examination and laboratory testing (widal test). The control group included neighbors of the same age group who had not suffered from typhoid fever or other illnesses with similar symptoms, such as diarrhea, during the same period. The total sample consisted of 120 respondents (24 cases and 96 controls), determined using a two-proportion hypothesis test with a 95% confidence level and 80% test power.

DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

Sampling was carried out using purposive sampling with specific inclusion and exclusion criteria. This technique carries a potential for selection bias. Therefore, several mitigation strategies were applied. First, the control group was matched with the case group by age category and residential environment to ensure comparability. Second, respondent recruitment followed the chronological list of cases recorded at the community health center to minimize selection bias, limited to individuals aged 5-19 years whose residential addresses could be verified. Third, data collection was conducted by trained enumerators using standardized instruments to maintain consistency during interviews. For respondents aged 5-11 years, interviews were conducted together with the child's mother or guardian, with specific questions focused on behavioral aspects, such as handwashing with soap (HWWS) and snacking habits. For adolescent respondents aged 12-19 years, interviews were conducted directly with the participants while still accompanied by their mothers or guardians. Questionnaires were completed by the respondents and subsequently validated by their parents.

The research instrument consisted of a structured questionnaire that had previously undergone validity and reliability testing. Validity testing employed Pearson's Product-Moment correlation with an r table value of 0.349; out of 70 items, 60 were declared valid. Reliability testing using Cronbach's Alpha yielded results of 0.876 for HWWS behavior (very high), 0.773 for clean water availability (high), 0.577 for waste disposal facilities (moderate), 0.855 for snacking habits (very high), and 0.953 for parental knowledge (very high), indicating that the instrument was suitable for use.

The dependent variable was the incidence of typhoid fever. Independent variables included demographic factors (age, sex, education, occupation, income), behavioral factors (handwashing with soap, snacking habits), environmental factors (availability of clean water facilities, waste disposal facilities), and parental knowledge about typhoid fever.

Data analysis was performed using SPSS version 22.0 through the following stages: (1) univariate analysis to describe respondents' characteristics, (2) bivariate analysis using the chi-square test to examine relationships between variables, and (3) multivariate analysis using multiple logistic regression to identify dominant risk factors. Several variables showed odds ratio values with wide confidence intervals (for example, education: OR=3.927; 95% CI=0.490-31.457), indicating limitations related to sample size or unbalanced data distribution. This was noted as one of the study's limitations.

RESULTS

This study involved 120 respondents aged 5-19 years, comprising 24 cases (20%) and 96 controls (80%). The majority of respondents were aged 5-11 years (54.2%), female (53.3%), had a low education level (87.5%), engaged in low-level occupations (69.2%), and had a monthly income of less than IDR 3,000,000 (68.3%). More than half of the respondents reported poor handwashing habits with soap (HWWS) (53.3%) and risky snacking behaviors (54.2%), with inadequate access to clean water (44.2%) and waste disposal facilities (48.3%). Most parents had adequate knowledge of typhoid fever (65%).

Table 1. Univariate Analysis of Typhoid Fever Incidence Among Individuals Aged 5-19 Years in the Working Area of Bunyu Island Community Health Center

Variable	Number (n)	Percentage (%)
Typhoid Fever		
Cases (With Typhoid Fever)	24	20
Controls (Without Typhoid Fever)	96	80
Age		
5 - 11 years	65	54.2
12 - 19 years	55	45.8
Sex		
Male	56	46.7
Female	64	53.3
Education		
Low (None, Elementary, Junior, and Senior High School)	105	87.5
High (Higher Education: Diploma/Bachelor's Degree)	15	12.5
Occupation		

 DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

Low (Fishermen, Laborers, Housewives, Small Traders, Farmers, Couriers)	83	69.2
High (State-Owned Enterprise Employees, Entrepreneurs, Civil Servants, Teachers, Private Employees, Contractors, Government Officials)	37	30.8
Income		
Low (<3.000.000)	82	68.3
High (>3.000.000)	38	31.7
Handwashing with Soap (HWWS)		
Poor	64	53.3
Good	56	46.7
Clean Water Facilities		
Inadequate	53	44.2
Adequate	67	55.8
Waste Disposal Facilities		
Inadequate	58	48.3
Adequate	62	51.7
Snacking Habits		
Risky	65	54.2
Not Risky	55	45.8
Parental Knowledge		
Poor	2	1.7
Moderate	78	65.0
Good	40	33.3

Source: Primary Data, May 2025

The results of the bivariate analysis showed that age, education, occupation, income, and clean water facilities were not significantly associated with the incidence of typhoid fever ($p > 0.05$). Conversely, significant associations were found with sex ($p = 0.001$; OR = 6.059), handwashing with soap (HWWS) habits ($p = 0.002$; OR = 5.909), waste disposal facilities ($p = 0.025$; OR = 3.258), snacking habits ($p = 0.039$; OR = 3.128), and parental knowledge ($p = 0.042$; OR = 2.931).

Table 2. Bivariate Analysis of Typhoid Fever Incidence Among Individuals Aged 5-19 Years in the Working Area of Bunyu Island Community Health Center

Variable	Typhoid Fever Incidence						P-Value	OR	95% CI
	Cases		Controls		Number				
	F	%	F	%	f	%			
Age									
5-11	15	62.5	50	52.1	65	54.2	0.492	1.533	0.612 - 3.841
12-19	9	37.5	46	47.9	55	45.8			
Sex									
Male	19	15.8	37	30.8	56	46.6	0.001	6.059	2.084 - 17.620
Female	5	4.2	59	49.2	64	53.4			
Education									
Low	23	19.2	82	68.3	105	87.5	0.301	3.927	0.490 - 31.457
High	1	0.8	14	11.7	15	12.5			
Occupation									
Low	19	15.8	64	53.3	83	69.1	0.348	1.900	0.650 - 5.554
High	5	4.2	32	26.7	37	30.9			
Income									
Low	18	15	64	53.3	82	68.3	0.589	1.500	0.543 - 4.146
High	6	5	32	26.7	38	31.7			
HWWS									
Poor	20	16.7	44	36.7	64	53.4	0.002	5.909	1.878 - 18.590
Good	4	3.3	52	43.3	56	46.6			
Clean Water Facilities									

DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

Variable	Typhoid Fever Incidence						P-Value	OR	95% CI
	Cases		Controls		Number				
	F	%	F	%	f	%			
Inadequate	14	11.7	39	32.5	53	44.2	0.183	2.046	0.825 - 5.073
Adequate	10	8.3	57	47.5	56	55.8			
Waste Disposal Facilities									
Inadequate	17	14.2	41	34.2	58	48.4	0.025	3.258	1.237 - 8.582
Adequate	7	5.8	55	45.8	56	51.6			
Snacking Habits									
Risky	18	15	47	39.2	65	54.2	0.039	3.128	1.143 - 8.560
Not Risky	6	5	49	40.8	55	45.8			
Parental Knowledge									
Poor	2	1.7	0	0	2	1.7	0.042	2.931	1.038 - 8.277
Moderate	17	14.2	61	50.8	78	65			
Good	5	4.2	35	29.2	40	33.3			

Source: Primary Data, May 2025

The logistic regression analysis revealed four variables that significantly influenced the incidence of typhoid fever: sex, handwashing with soap (HWWS) habits, waste disposal facilities, and snacking habits. Males were found to have a 5.86 times higher risk compared to females (p = 0.003; 95% CI: 1.828-18.801). Respondents with poor HWWS habits had a 4.5 times higher risk (p = 0.018; 95% CI: 1.298-15.644). Inadequate waste disposal facilities increased the risk fourfold (p = 0.015; 95% CI: 1.312-12.363). Meanwhile, risky snacking habits increased the likelihood of typhoid fever by 4.18 times (p = 0.016; 95% CI: 1.305-13.395).

Table 3. Final Results of Logistic Regression Analysis

Variable	B	*P-Value*	OR Exp (B)	95% CI Lower Upper
Sex	1.769	0.003	5.863	1.828 - 18.801
HWWS	1.505	0.018	4.506	1.298 - 15.644
Waste Disposal Facilities	1.393	0.015	4.028	1.312 - 12.363
Snacking Habits	1.431	0.016	4.181	1.305 - 13.395
Constant	-5.127	0.000	0.006	

Source: SPSS 22 Output, Processed Data, June 27, 2025

The model feasibility test (Omnibus Test) yielded a Chi-square value of 33.293 ($p < 0.001$), indicating that the model was statistically appropriate for use. The Nagelkerke R^2 value of 0.383 suggests that these four variables collectively explain 38.3% of the variation in typhoid fever incidence, while the remaining 61.7% is influenced by other factors not included in the model.

The resulting logistic regression equation is as follows: Y = -5.127 + 1.769 (sex) + 1.505 (HWWS) + 1.393 (waste disposal) + 1.431 (snacking habits).

For example, a male respondent with poor HWWS practices, inadequate waste disposal facilities, and risky snacking habits would yield a logit (Y) value of 0.971. The probability of typhoid fever occurrence for this combination of factors is estimated at 72.5%, indicating a high risk of infection under these conditions.

DISCUSSION

This study demonstrates that male sex, poor CTPS habits, risky snacking, and inadequate waste disposal are the dominant risk factors for typhoid fever among children and adolescents aged 5-19 years in Bunyu Island. These findings are consistent with previous studies in endemic areas, highlighting personal hygiene and environmental sanitation as key determinants of *Salmonella typhi* transmission [15][17].

Male sex was identified as a dominant factor, with males having a 5.86 times higher risk of contracting typhoid fever than females. This may be attributed to behavioral differences. School-age boys tend to have greater freedom, spend more time outdoors, and are less attentive to personal hygiene practices

 DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

such as washing hands before meals, compared to girls. Boys also tend to purchase food from street vendors more frequently [21][22][23]. Biological factors may also contribute. Mustofa et al. (2020) noted that sex-based differences in immune response influence disease susceptibility: adolescent females have higher IgG2/IgG2b antibody levels due to estrogen, while males show lower antibody levels because of testosterone's immunosuppressive effects [24][25][26].

Contrastingly, previous studies by Ulfa & Handayani (2018) and Gultom (2017) found no association between sex and typhoid fever. Gultom (2017) suggested that typhoid can affect all ages and sexes, with hygiene practices being more relevant than sex. However, boys' greater outdoor activity and lower hygiene adherence explain their elevated risk. Although sex is non-modifiable, it remains essential in risk analysis, with practical interventions focused on modifiable behavioral and environmental factors [18] [27] [28]. Since sex is a non-modifiable factor, practical interventions should focus more on behavioral and environmental aspects that can be improved.

Handwashing with soap (HWWS) was also found to have a significant association with typhoid fever incidence, representing the most crucial modifiable factor for prevention. Respondents with poor HWWS practices were 4.5 times more likely to develop typhoid fever than those with good practices, aligning with global literature identifying HWWS as one of the most effective interventions for reducing water- and food-borne diseases [1].

It is assumed that individuals aged 5-19 years, especially younger children, are not yet accustomed to proper hand hygiene practices, such as scrubbing between fingers, under nails, and around wrists. Dewi et al. (2023) similarly found that typhoid fever patients commonly failed to wash their hands with soap or adequately clean their fingers and nails, allowing *S. typhi* bacteria to remain on the skin [17].

Children and adolescents, who frequently engage in activities outside the home or at school, may not consistently follow correct HWWS practices, increasing their exposure risk. Moreover, inadequate sanitation facilities and insufficient hygiene education both at home and school exacerbate vulnerability to infection [20][29]. Field observations revealed that many schools, public spaces, and recreation areas on Bunyu Island lack proper handwashing facilities. In several locations, washbasins were found without soap or running water, and in some cases, no facilities were available at all. The limited availability of standard-compliant HWWS facilities likely contributes to the high incidence of typhoid fever in this area.

This result is consistent with the findings of S. Husna (2020), who reported a significant relationship between handwashing behavior and typhoid fever among children. Similarly, Gunawan et al. (2022) found a significant correlation between personal hygiene and typhoid fever among adolescents, reinforcing that hygiene behaviors, particularly HWWS, are critical factors in typhoid prevention [16][15].

This study also found a significant association between waste disposal facilities and typhoid fever incidence among individuals aged 5-19 years. Respondents with inadequate waste disposal systems had a 3.26 times higher risk of infection than those with adequate facilities. Similarly, respondents with risky snacking habits had a 3.13 times higher likelihood of developing typhoid fever compared to those with safer eating habits.

Most respondents used non-standard waste containers that were uncovered, non-waterproof, and rarely emptied by waste management officers. These conditions lead to decaying waste accumulation, environmental contamination, and the proliferation of disease vectors such as flies and rodents [30][31]. Field observations supported this finding: open dumps were frequently found near recreational areas and public roads, with waste piles remaining for over a week near food vendors selling uncovered food. Such conditions allow flies to transfer pathogens from garbage to food, thereby increasing the risk of *S. typhi* transmission. Risky snacking behavior further aggravates the situation.

Children and adolescents on Bunyu Island frequently purchase food from schools or roadside stalls without considering hygiene. Younger children (5-11 years) are more influenced by peers and have limited ability to judge food cleanliness, whereas adolescents (12-19 years) are driven by independence and lifestyle choices, yet both groups tend to overlook hygiene [32].

Field observations also revealed that many food vendors operate near open dumps, dusty roads, or areas contaminated with animal waste. Food items are often left uncovered, exposing them to contamination from dust and flies. Additionally, free-ranging livestock near food stalls increases contamination risks. In

DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

such conditions, the combination of unhygienic food consumption, poor waste disposal, and inadequate HWWS practices reinforces typhoid transmission pathways among the 5-19 age group.

This finding aligns with those of Pangestu et al. (2023) and Dewi et al. (2023), who also reported a significant association between waste disposal management and typhoid fever incidence [17][31]. Likewise, studies by N. Khairunnisa et al. (2022) and Bakhtiar et al. (2020) identified a relationship between risky snacking habits and typhoid fever among school-age children [33][34].

Although parental knowledge was initially found to be significantly associated with typhoid fever in the 5-19 age group, with parents possessing low knowledge levels being 2.93 times more likely to have affected children, its effect became non-significant after adjusting for dominant variables. This may be due to a gap between knowledge and practice, where available information is not consistently applied because of cultural habits, behavioral patterns, or limited resources [35][36].

No significant associations were found between age, education, occupation, income, or clean water availability and typhoid fever incidence. This is likely due to the homogeneity of respondent characteristics and the limited sample size, which may have obscured variations in risk. Additionally, protective factors such as health education programs, clean water from monitored refill stations, and Puskesmas (community health center) hygiene campaigns may have contributed to lowering incidence. Theoretically, however, low education, occupation, and income levels still play an indirect role by limiting access to health information, clean water, sanitation, and nutritious food [37]. Moreover, unsafe water storage practices, such as uncovered wells and rainwater tanks observed in Bunyu Island, can contribute to *S. Typhi* contamination [12]. Although statistically non-significant, age, socioeconomic conditions, inadequate water facilities, and parental knowledge remain important indirect determinants for typhoid prevention.

The interaction between sex, HWWS, snacking habits, and waste management appears to reinforce each other in elevating typhoid risk. Male children who are more active outdoors often consume contaminated snacks without proper HWWS, compounded by poor environmental sanitation and waste management that serve as transmission pathways. Logistic regression modeling indicated that this combination of factors increased the probability of typhoid fever by 72.5%, highlighting the synergistic effect of behavioral and environmental factors. Therefore, public health interventions should prioritize promoting proper HWWS practices, monitoring food hygiene among school vendors, and improving community waste management systems.

This study has several limitations. Medical records were often incomplete, and disease surveillance systems in North Kalimantan remain weak, leading to potential underreporting of typhoid cases. Recall bias may have occurred during interviews due to differences in understanding or honesty among respondents. The relatively small sample size may limit the precision of estimates, and the questionnaire, although developed based on relevant theory, was not a standardized instrument. Additionally, variations in questionnaire administration between children aged 5-11 years (assisted by parents) and adolescents aged 12-19 years (self-administered) may have introduced age-related response bias.

CONCLUSIONS

This study demonstrates that Typhoid fever incidence among 5-19-year-olds in Bunyu Island is significantly influenced by four dominant factors: male gender, poor handwashing habits with soap (CTPS), risky snacking, and inadequate waste disposal. Combined, these factors increase the probability of typhoid infection to 72.5% according to the logistic regression model. The findings highlight the pivotal role of personal hygiene and environmental sanitation in typhoid transmission, making them primary targets for preventive interventions.

Prevention strategies should focus on health education in schools and community health centers, the provision of handwashing facilities with soap, and strengthened household waste management supported by local authorities. Parents and communities should supervise children's snacking habits, encourage packed meals, and implement proper waste disposal. Future studies are recommended with larger sample sizes and inclusion of additional variables such as nutritional status, water quality, and immunization history to enhance typhoid risk factor analysis.

AUTHOR CONTRIBUTIONS

 DOI: http://dx.doi.org/10.35730/jk.v16i3.1411

Aisyah Amatullah Al Muwaffaqah contributed to the conceptualization, methodology, data collection, data analysis, validation, and preparation of the manuscript. Ajeng Tias Endarti and Brian Sri Prahastuti provided supervision, critical review, and guidance throughout the research and writing process.

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to the academic advisors, Dr. Ajeng Tias Endarti, SKM., M.CommHealth and Dr. dr. Brian Sri Prahastuti, MPH, for their valuable guidance, constructive feedback, and continuous support throughout the research process. Special thanks are extended to the Head of Puskesmas Pulau Bunyu, all health staff, and the community members who participated as respondents in this research.

The author also gratefully acknowledges the Faculty of Public Health, Universitas Mohammad Husni Thamrin Jakarta, for providing the facilities and academic environment that made this research possible. Finally, the author expresses heartfelt appreciation to her beloved parents and family for their prayers, encouragement, and endless support during the study period.

REFERENCES

[1] WHO, "Typhoid," 2023, Accessed: Jun. 05, 2024. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/typhoid

[2] S. Brockett, M. K. Wolfe, A. Hamot, G. D. Appiah, E. D. Mintz, and D. Lantagne, "Associations among water, sanitation, and hygiene, and food exposures and typhoid fever in case–control studies: A systematic review and meta-analysis," *American Journal of Tropical Medicine and Hygiene*, vol. 103, no. 3, pp. 1020–1031, Sep. 2020, doi: 10.4269/ajtmh.19-0479.

[3] H. Verliani, I. Laily Hilmi, and Salman, "Faktor Risiko Kejadian Demam Tifoid di Indonesia 2018-2022: Literature Review," Jawa Barat, Dec. 2022. Accessed: May 23, 2024. [Online]. Available: https://jurnal.jomparnd.com/index.php/jkj

[4] D. Piovani, G. Figlioli, G. K. Nikolopoulos, and S. Bonovas, "The global burden of enteric fever, 2017–2021: a systematic analysis from the global burden of disease study 2021," *EClinicalMedicine*, vol. 77, Nov. 2024, doi: 10.1016/j.eclinm.2024.102883.

[5] M. Molly Hancuh, M. Jenny Walldorf, M. Anna A. Minta, M. Carol Tevi-Benissan, D. Kira A. Christian, and M. Yoann Nedelec, "Typhoid Fever Surveillance, Incidence Estimates, and Progress Toward Typhoid Conjugate Vaccine Introduction — Worldwide, 2018–2022," *Lancet Glob Health*, vol. 10, no. 72, pp. e978–e988, Jul. 2023, doi: 10.1016/S2214-109X (22)00119-X.

[6] C. S. Marchello, M. Birkhold, and J. A. Crump, "Complications and mortality of typhoid fever: A global systematic review and meta-analysis," *Journal of Infection*, vol. 81, no. 6, pp. 902–910, Dec. 2020, doi: 10.1016/j.jinf.2020.10.030.

[7] WHO, "Typhoid," *World Health Organization (WHO).*, 2018.

[8] Kemenkes, "Pedoman Pengendalian Demam Tifoid," *Keputusan Menteri Kesehatan Republik Indonesia.* , 2006.

[9] Riskesdas, "Laporan Nasional Riskesdas 2007 [National Report on Basic Health Research 2007]. ," *Kementerian Kesehatan Republik Indonesia*, pp. 1–384, 2007.

[10] J. F. J. Tobing, "Demam Tifoid," *Highlight Info Annotations Notebook JOURNAL ARTICLE*, vol. 8, no. 2, Jul. 2024, doi: 10.37817/ikraith-humaniora.v8i2.

[11] Kepala Desa Bunyu Selatan, "Kasih Bunyu Bertepuk Sebelah Tangan," Kompas.id. Accessed: Jun. 06, 2024. [Online]. Available: https://www.kompas.id/baca/ekonomi/2024/03/02/kasih-bunyu-bertepuk-sebelah-tangan

[12] J. E. Meiring and P. I. Johnston, "Editorial Typhoid Fever: A Reduction and a Resurgence," Aug. 01, 2023, *American Society of Tropical Medicine and Hygiene*. doi: 10.4269/ajtmh.23-0286.

[13] Puskesmas Pulau Bunyu, "Laporan Surveilans Epidemiologi Tahun 2025. Bulungan: Dinas Kesehatan Kabupaten Bulungan.," 2025.

[14] Ikatan Dokter Anak Indonesia, "Pedoman Pelayanan Medis," 2009.

[15] A. Gunawan, I. A. Rahman, A. Nurapandi, N. Chandra Maulana, and S. Muhammadiyah, "Hubungan Personal Hygiene Dengan Kejadian Demam Typhoid Pada Remaja di Wilayah Kerja Puskesmas Imbanagara Kabupaten Ciamis," Ciamis, Jul. 2022.
[16] S. Husna, "Hubungan Perilaku Hidup Sehat Dengan Kejadian Demam Thypoid Pada Anak di Rumah Sakit Umum Daerah Lamaddukelleng Kabupaten Wajo," *Jurnal Ilmiah Mappadising*, vol. 2, 2020, [Online]. Available: http://ojs.lppmuniprima.org/index.php/mappadising
[17] A. P. Dewi, E. Heryanto, and A. Suryadinata, "Hubungan Higiene Perorangan Dan Sanitasi Lingkungan Dengan Kejadian Demam Tifoid Di Desa Air Paoh Wilayah Kerja Uptd Puskesmas Sukaraya Tahun 2023," Dec. 2023.
[18] Rahmawati Ria, "Faktor Risiko Yang Memengaruhi Kejadian Demam Tifoid di Wilayah Kerja Puskesmas Binakal Kabupaten Bondowoso," *Medical Technology and Public Health Journal (MTPH Journal*, vol. 4, no. 2, 2020.
[19] wahyudi Rahmat and A. Kartin, "Demam Tifoid dengan Komplikasi Sepsis: Pengertian, Epidemiologi, Patogenesis, dan Sebuah Laporan Kasus," Dec. 2019.
[20] C. Kim, G. R. Goucher, B. T. Tadesse, W. Lee, K. Abbas, and J. H. Kim, "Associations of water, sanitation, and hygiene with typhoid fever in case–control studies: a systematic review and meta-analysis," *BMC Infect Dis*, vol. 23, no. 1, Dec. 2023, doi: 10.1186/s12879-023-08452-0.
[21] P. Boakye Okyere *et al.*, "Risk factors for typhoid fever: A systematic review (Preprint)," *JMIR Public Health Surveill*, Oct. 2024, doi: 10.2196/67544.
[22] Nurleli and N. Rahmi, "Pengaruh Umur dan Jenis Kelamin Terhadap Kejadian Demam Tifoid Pada Pasien Rawat Inap di Rumah Sakit Tingkat II Iskandar Muda Kota Banda Aceh," 2023.
[23] Herawati M and Ghani L, "Hubungan Faktor Determinan Dengan Kejadian Tifoid di Indonesia Tahun 2007," *Media Peneiti dan Pengembangan Kesehatan*, vol. XIX, no. 4, 2009.
[24] F. L. Mustofa, R. Rafie, and B. Megamelina, "Hubungan Faktor Determinan Dengan Kejadian Demam Tifoid Pada Pasien Rawat Inap Di Rumah Sakit Pertamina Bintang Amin Tahun 2018," 2020.
[25] P. Rio *et al.*, "Sex Differences in Immune Responses to Infectious Diseases: The Role of Genetics, Hormones, and Aging," Jun. 01, 2025, *Multidisciplinary Digital Publishing Institute (MDPI)*. doi: 10.3390/diseases13060179.
[26] S. L. Surman *et al.*, "How Estrogen, Testosterone, and Sex Differences Influence Serum Immunoglobulin Isotype Patterns in Mice and Humans," *Viruses MDPI*, vol. 15, no. 2, Feb. 2023, doi: 10.3390/v15020482.
[27] F. Ulfa and O. W. Handayani, "Kejadian Demam Tifoid di Wilayah Kerja Puskesmas Pagiyanten," Semarang, Apr. 2018. [Online]. Available: http://journal.unnes.ac.id/sju/index.php/higeia
[28] M. Gultom, "Karakteristik Penderita Demam Tifoid yang Dirawat Inap di Rumah Sakit Santa Elisabeth Medan Tahun 2016. J Univ Sumatera Utara, https://jurnal.usu.ac.id/index.php/gkre/article/viewFile/19390/9070," 2017.
[29] S. Vanderslott, M. T. Phillips, V. E. Pitzer, and C. Kirchhelle, "Water and Filth: Reevaluating the First Era of Sanitary Typhoid Intervention (1840-1940)," *Clin Infect Dis*, vol. 69, pp. S377–S384, Oct. 2019, doi: 10.1093/cid/ciz610.
[30] N. asifa Harun, B. Yulianto, and N. Nurhapipa, "Kondisi Sanitasi Lingkungan Di Kelurahan Meranti Pandak Kecamatan Rumbai Pesisir Kota Pekanbaru Tahun 2020," *Media Kesmas (Public Health Media)*, vol. 1, no. 2, pp. 72–84, Nov. 2021, doi: 10.25311/kesmas.vol1.iss2.37.
[31] D. Pangestu, Y. Marita, and E. Candra, "Hubungan Kebiasaan Mencuci Tangan, Sumber Air Bersih, dan Kondisi Tempat Sampah Dengan Kejadian Demam Tifoid," *Indonesian Journal of Health and Medical*, vol. 3, no. 4, Oct. 2023.
[32] H. Nuruzzaman and F. Syahrul, "Risk Analysis of Typhoid Fever Based on Personal Hygiene and Street Food Consumption Habit at Home," *FKM_UNAIR*, Aug. 2016, doi: 10.20473/jbe.v4i1.74-86.
[33] N. Khairunnisa, N. Rany, and E. K. Kursani, "Hubungan Kebiasaan Jajan Dengan Kejadian Demam Typhoid Pada Anak Usia Sekolah di Rawat Inap RSUD Petala Bumi Provinsi Riau Tahun

2020," *Media Kesmas (Public Health Media)*, vol. 1, no. 3, pp. 816–824, Jan. 2022, doi: 10.25311/kesmas.vol1.iss3.134.

[34] R. Bakhtiar, A. Novianto, M. Gazali, J. Sidiq, E. Setyoadi, and E. Fitriany, "Hubungan Faktor Risiko Mencuci Tangan Sebelum Makan, Sarana Air Bersih, Riwayat Tifoid Keluarga, Kebiasaan Jajan Diluar Rumah Dengan Kejadian Tifoid di Wilayah Kerja Puskesmas Palaran Samarinda," *Jurnal Kedokteran Mulawarman*, vol. 1, no. 1, 2020.

[35] S. N. Cholifah, "Hubungan Tingkat Pengetahuan Tentang Kesehatan Dengan Kejadian Demam Tifoid Pada Orang Dewasa Di Puskesmas Balerejo Kabupaten Madiun," Madiun, 2018. Accessed: Aug. 24, 2024. [Online]. Available: https://repository.stikes-bhm.ac.id/278/1/58.pdf

[36] R. Kartika Sari, S. Zahro, E. Budi Cahyono, and M. Ali, "Hubungan Tingkat Pengetahuan Keluarga Tentang Pencegahan Demam Tifoid Dengan Kejadian Demam Tifoid," Jepara, Jun. 2024. [Online]. Available: http://journal.stikeskendal.ac.id/index.php/Keperawatan

[37] Andayani and Fibriana A, "Kejadian Demam Tifoid di Wilayah Kerja Puskesmas Karangmalang," Banyumas, 2018. [Online]. Available: http://journal.unnes.ac.id/sju/index.php/higeia

DOI: http://dx.doi.org/10.35730/jk.v16i3.1411