International Journal of Integrated Science and Technology (IJIST)
Vol. 3, No. 12 December 2025: 2463-2484

Determining Factors of Typhoid Fever Among Elementary School Children in Cijeungjing Village, Sumedang Regency, West Java

Andriyani Risma Sanggul[1*], Keswari Aji Patriawati[2]
Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia
Corresponding Author: Andriyani Risma: andriyani.risma@uki.ac.id

A R T I C L E I N F O

Keywords: Typhoid Fever, Determinant Factors, Elementary School Children, Handwashing Behavior, Clean Water Facilities

Received : 20, October
Revised : 25, November
Accepted: 20, December

A B S T R A C T

Typhoid fever is an acute infectious disease caused by Salmonella enterica serovar Typhi and remains a major concern among primary school–aged children, particularly in areas with poor sanitation and limited access to safe water. This study aimed to analyze the association between determinant factors and the incidence of typhoid fever among elementary school students in a village of Sumedang District, West Java, in 2025. An analytical cross-sectional design was conducted in January 2025 using primary data collected through a structured questionnaire. A total of 100 children were included using total/accidental sampling. Among respondents, 34% had experienced typhoid fever and 66% had not. Chi-square analysis showed significant associations between typhoid fever incidence and clean water facilities (p=0.024), handwashing before meals (p=0.009), handwashing after defecation (p=0.004), snacking outside the home (p=0.016), and PHBS (Clean and Healthy Living Behavior) knowledge level (p=0.002). No significant relationships were found for latrine facilities, household wastewater disposal, food storage practices, or typhoid fever knowledge (p>0.05). In conclusion, clean water availability, key handwashing behaviors, snacking habits, and PHBS knowledge are significant determinants of typhoid fever among elementary school children, with PHBS knowledge identified as the most influential factor.

DOI: **https://doi.org/10.59890/ijist.v3i12.246**
https://ntlmultitechpublisher.my.id/index.php/ijist

INTRODUCTION

Typhoid fever (abdominal typhus) is an acute systemic infection caused by Salmonella enterica serovar Typhi (S. Typhi) and is transmitted primarily through the fecal–oral route, either via consumption of contaminated food/water or through contact with human sources of infection (including carriers) (Gordon et al., 2023; World Health Organization [WHO], 2023). The disease remains a major public health burden in many developing countries because it is closely linked to limited access to safe drinking water, adequate sanitation, and proper hygiene practices. Consequently, its impact extends beyond clinical outcomes (morbidity and complications) to the social and economic well-being of families and communities (Purba et al., 2016; WHO, 2023). Globally, typhoid fever is estimated to cause 11–21 million cases annually and 128,000–161,000 deaths (a widely cited global estimate), underscoring its substantial contribution to the burden of infectious diseases in endemic regions (Breakwell et al., 2023; Health Protection Surveillance Centre, 2025). Clinically, typhoid fever is typically characterized by prolonged fever accompanied by gastrointestinal complaints and systemic symptoms; in certain circumstances, it may progress to severe complications if treatment is delayed (Gordon et al., 2023; WHO, 2023).

In Indonesia, typhoid fever remains endemic and is repeatedly reported as an important cause of outpatient visits and hospitalization, particularly among school-aged children. The 2018 Indonesia Health Profile recorded 41,081 hospitalized typhoid/paratyphoid cases and 279 deaths (Ministry of Health of the Republic of Indonesia, 2019). Meanwhile, the 2018 Basic Health Research Survey (Riskesdas) reported a typhoid fever prevalence of 1.7%, with the highest prevalence observed among children aged 5–14 years (1.9%) (National Institute of Health Research and Development, 2019). Epidemiological evidence further supports that school-aged children constitute a high-risk group: a multicountry study in Asia that monitored blood culture–confirmed typhoid incidence reported an incidence of 180.3 per 100,000 person-years among individuals aged 5–15 years at an Indonesian site (Ochiai et al., 2008). This finding is particularly relevant because this age range overlaps with primary school children who have higher exposure to street snacks, outdoor activities, and hygiene behaviors that may not yet be consistent.

Previous research indicates that typhoid fever occurrence is influenced by complex determinants that can be broadly categorized into “hardware” factors (access to water and sanitation infrastructure) and “software” factors (hygiene behaviors and food handling practices). Systematic reviews and meta-analyses of case–control studies have demonstrated associations between WASH (water, sanitation, and hygiene) exposures as well as food-related exposures and typhoid fever; however, the magnitude of these associations may vary across settings and indicators, highlighting the need for context-specific evidence based on local characteristics (Goucher et al., 2023; Marchello et al., 2020). In the Indonesian context, Alba et al. (2016) emphasized that major reductions in typhoid incidence could be achieved through improved adherence to adequate handwashing practices, underscoring the importance of behavior change interventions alongside improvements in water and sanitation infrastructure. In addition, consumption of street food and beverages has consistently emerged as a significant risk pathway in many studies, particularly when food safety and hygiene practices in school and residential environments are suboptimal (Alba et al., 2016; Marchello et al., 2020).

Although a number of studies have examined typhoid determinants, there remains a need for more specific evidence at the community (village) level and among primary school children by comprehensively assessing environmental and behavioral determinants within a single analytical framework. Local contextual variation such as the quality of clean water facilities, latrines and fecal disposal, household wastewater disposal, food storage conditions, handwashing habits, and snack consumption behaviors may produce different risk patterns; therefore, prevention recommendations should be developed based on local data to ensure they are appropriately targeted (Goucher et al., 2023; Purba et al., 2016). Cijeungjing Village, Sumedang Regency, West Java, has been reported as an endemic area for typhoid fever, making it important to map determinants among primary school children in order to clarify the "problematic reality" occurring at household and school-environment levels.

Based on this background, this article aims to analyze the association between determinants (clean water facilities, latrines/fecal disposal, household wastewater disposal, food storage conditions, handwashing habits before eating and after defecation, and consumption of snacks from street vendors) and the occurrence of typhoid fever among primary school children in Cijeungjing Village, Sumedang Regency, West Java (January 2025 period), thereby strengthening the scientific basis for more targeted prevention strategies in endemic areas and similar contexts.

LITERATURE REVIEW

Typhoid Fever

Definition and Transmission

Typhoid fever (typhus abdominalis) is an acute systemic infection caused by Salmonella enterica serovar Typhi (S. Typhi). It is transmitted primarily through the fecal oral route, most commonly via ingestion of food or drinking water contaminated with human feces, including contamination originating from symptomatic patients or asymptomatic/chronic carriers (WHO, 2023; Meiring et al., 2023). Because S. Typhi is human-restricted, persistent community transmission reflects breakdowns in environmental health protections especially safe water, sanitation, and hygiene rather than zoonotic reservoirs. Mechanical transfer of contamination (e.g., via flies) may contribute to food contamination, but the dominant pathway remains fecal contamination from human sources entering food and water chains (WHO, 2023; Meiring et al., 2023).

Global and Child-Focused Epidemiology

Typhoid remains a major public health problem in many low- and middle-income settings. WHO estimates that, as of 2019, approximately 9 million people become ill and about 110,000 die from typhoid each year, emphasizing the continuing preventable burden associated with inadequate WASH conditions (WHO, 2023). School-aged children often bear a substantial share of typhoid burden in endemic contexts. In a multicountry Asian surveillance study using blood-culture confirmation, the Indonesian site reported an annual incidence of 180.3 per 100,000 person-years among 5-15 year olds, indicating that primary-school–aged children are an epidemiologically important risk group (Ochiai et al., 2008).

Brief Pathogenesis

After ingestion, S. Typhi crosses the intestinal epithelium, survives and replicates within macrophages, and disseminates via lymphatics to the bloodstream and reticuloendothelial organs, producing systemic illness. This mechanism explains why variables that increase fecal contamination of water/food (environmental "hardware") or increase hand to mouth transfer and unsafe consumption (behavioral "software") are consistently implicated in typhoid transmission (Meiring et al., 2023; WHO, 2023).

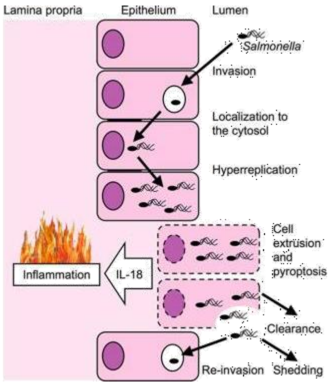

Figure 1. Pathogenesis of Typhoid Fever

Determinants of Typhoid Fever

Clean Water Facilities

Safe water access is a cornerstone of typhoid prevention because contaminated drinking water is a primary vehicle for fecal oral transmission. International guidance emphasizes that improvements in drinking-water safety reduce exposure to S. Typhi at the population level, particularly where centralized water treatment is limited and household-level practices determine microbial risk (WHO, 2023).

Empirical evidence from case control syntheses supports this pathway: systematic review/meta-analysis work shows that higher-risk water exposures and inadequate water safety are associated with increased odds of typhoid, while safer water indicators are protective although effect magnitudes can vary across settings and how "water safety" is defined and measured (Marchello et al., 2020; Kim et al., 2023). Implication for this study variable: "Clean water facilities" should be treated as an exposure proxy capturing both access (source type) and safety practices (e.g., protected source, basic treatment/handling), because either failure point can maintain transmission in endemic villages (WHO, 2023; Marchello et al., 2020).

Latrine Facilities and Feces Disposal

Sanitation particularly safe containment and disposal of human excreta is central to interrupting environmental fecal contamination and reducing fecal oral transmission. Indonesia's STBM regulation explicitly aims to "break the chain of transmission" through pillars that include stopping open defecation and ensuring access to sanitary latrines that meet health requirements (Kementerian Kesehatan RI, 2014). In typhoid-endemic settings, poor latrine conditions can elevate risk through multiple household pathways: contamination of soil and household surfaces, contamination of shallow groundwater, and increased probability that fecal organisms reach hands and food. These mechanisms are consistent with evidence syntheses that repeatedly identify sanitation-related indicators among important determinants, even when effect sizes differ across local contexts (WHO, 2023; Marchello et al., 2020; Kim et al., 2023). Implication for this study variable: "Latrine and feces disposal" represents a structural determinant that shapes background fecal contamination in the household environment and can interact strongly with hygiene behaviors (e.g., handwashing), particularly among children (Kementerian Kesehatan RI, 2014; WHO, 2023).

Household Wastewater Disposal/Drainage (SPAL)

Household liquid waste (from kitchens and bathrooms) can contribute to environmental contamination when drainage is inadequate, producing stagnant wastewater and increasing opportunities for indirect fecal contamination or vector attraction. The STBM regulation explicitly includes household liquid waste management and describes the need to manage wastewater through infiltration wells and household wastewater channels, including separation of flows to reduce environmental risk (Kementerian Kesehatan RI, 2014). Although typhoid is often discussed through drinking water and feces disposal, wastewater management is relevant in endemic villages because it influences the contamination load around the home and the likelihood that children are exposed via play areas, household surfaces, and food preparation environments. This aligns conceptually with the WASH evidence base showing that environmental conditions supporting fecal contamination contribute to typhoid risk (Kim et al., 2023; WHO, 2023). Implication for this study variable: SPAL should be interpreted as a "household environmental contamination control" indicator, complementing latrine status and water safety by describing how contamination may persist or spread around homes (Kementerian Kesehatan RI, 2014; Kim et al., 2023).

Household Food Storage Practices

Food can become contaminated during preparation, storage, and serving, particularly when hands or utensils are contaminated or when food is left uncovered. STBM includes household-level management of drinking water and food as a behavioral pillar, positioning safe food handling and storage as a practical prevention approach in households where environmental contamination is possible (Kementerian Kesehatan RI, 2014). Systematic review evidence also supports that food and beverage exposures are repeatedly associated with typhoid risk in case control studies, underscoring that "food safety at home and outside the home" is not a secondary issue but part of the core transmission pathway in endemic settings (Marchello et al., 2020). Implication for this study variable: "Food storage" is best framed as a mediator between environmental contamination and ingestion especially in households where cooked food may be stored at room temperature or left exposed, increasing contamination opportunities (Kementerian Kesehatan RI, 2014; Marchello et al., 2020).

Handwashing Before Eating

Handwashing with soap is one of the most consistently emphasized protective behaviors against fecal–oral infections. Evidence syntheses indicate that inadequate hygiene is associated with higher odds of typhoid, while improved hygiene indicators show protective associations across settings (Kim et al., 2023; Marchello et al., 2020). In Indonesia, a large risk-factor analysis highlighted that substantial reductions in typhoid incidence could potentially be achieved through adherence to adequate handwashing practices, emphasizing "software" interventions as high-impact strategies alongside infrastructure improvements (Alba et al., 2016). Implication for this study variable: "Handwashing before eating" functions as a direct behavioral barrier that prevents transfer of fecal organisms from hands to food, a pathway particularly relevant for children who eat snacks and meals without supervision (Alba et al., 2016; Kementerian Kesehatan RI, 2014).

Handwashing After Defecation

Handwashing after defecation is a critical control point because it prevents direct fecal contamination of hands from reaching drinking water containers, food, and household surfaces. STBM explicitly lists critical handwashing times and promotes handwashing with soap as a pillar for breaking transmission chains of environmentally mediated diseases (Kementerian Kesehatan RI, 2014). From an epidemiologic perspective, post-defecation handwashing complements sanitation infrastructure: even where latrines exist, inadequate post-defecation hand hygiene can sustain fecal–oral transmission within households, especially among children with frequent hand-to-mouth behaviors (Kim et al., 2023; Marchello et al., 2020). Implication for this study variable: This variable should be analyzed as a "high-proximity exposure control" behavior that can modify the effect of sanitation and environmental conditions on typhoid risk (Kementerian Kesehatan RI, 2014; Kim et al., 2023).

Consumption of Street-Vended Snacks/Food

Out-of-home food consumption, including street-vended snacks and drinks, is frequently implicated in typhoid transmission because food safety controls and hygiene conditions are often variable and exposure occurs repeatedly. In Indonesia, eating food outside the home (e.g., stalls/restaurants) showed a strong association with typhoid risk (Alba et al., 2016). Systematic review evidence supports the broader pattern that food and beverage exposures—particularly those outside controlled household environments—are associated with increased typhoid risk across multiple case–control studies, reinforcing the importance of measuring children's snack-buying habits around schools and neighborhoods (Marchello et al., 2020). Implication for this study variable: "Consumption of street-vended snacks" should be positioned as a proximal ingestion pathway that may remain significant even in households with relatively better WASH infrastructure, especially among school-aged children (Ochiai et al., 2008; Marchello et al., 2020).

Knowledge of Typhoid Fever

Knowledge regarding typhoid transmission and prevention can shape risk by influencing protective behaviors such as safe water handling, food choices, and hand hygiene. In behavioral public health frameworks, knowledge is often conceptualized as an upstream determinant that contributes to adoption and maintenance of prevention practices, particularly when reinforced through community and school-based health promotion (Kementerian Kesehatan RI, 2014). In endemic settings, where exposure opportunities are frequent, knowledge may be especially important for consistent "critical-time" behaviors (e.g., handwashing before eating/after defecation) and safer snack choices—behaviors repeatedly highlighted in typhoid risk-factor studies (Alba et al., 2016; Kim et al., 2023).

PHBS/STBM (Clean and Healthy Living Behaviors)

PHBS-aligned behaviors can be framed coherently using the Indonesian STBM policy, which specifies five pillars—stopping open defecation, handwashing with soap, household drinking-water and food management, solid waste management, and household liquid waste management—aimed at reducing environmentally mediated disease transmission (Kementerian Kesehatan RI, 2014). Accordingly, PHBS/STBM can be treated as an integrative construct linking "hardware" conditions (water, sanitation, wastewater) and "software" behaviors (hand hygiene, food practices) that together determine whether fecal organisms can reach the mouth. This integrated framing is consistent with global guidance emphasizing combined WASH and behavior change approaches for typhoid prevention (WHO, 2023; Marchello et al., 2020).

METHODOLOGY

This study employed an analytical cross-sectional design to examine the association between determinant factors and the occurrence of typhoid fever among primary school students in Cijeungjing Village, Sumedang Regency, West Java, Indonesia. A cross-sectional approach collects exposure and outcome information within a single defined time window, allowing the study to assess relationships between variables and estimate the distribution of determinants in the observed population (Setia, 2016; STROBE Statement, 2007). Data collection was conducted in January 2025, consistent with the time-bounded nature of cross-sectional observational research (Setia, 2016).

The target population comprised all Grade 4 - 6 elementary school students in Cijeungjing Village (N=112). The accessible population consisted of students who were reachable during the study period and met eligibility criteria (n=100). Twelve students were excluded from analysis because they were absent during data collection (n=4) or provided incomplete questionnaire responses (n=8). The final study sample therefore included 100 students, and the study applied total sampling of the accessible population, meaning all eligible and reachable Grade 4–6 students during the study period were included to maximize coverage within the defined setting (Nadeak, B., et al, 2025).

Eligibility criteria were specified to ensure the sample matched the study objectives. Inclusion criteria were: being a Grade 4–6 primary school student in Cijeungjing Village and providing informed consent (with cooperative participation). Exclusion criteria were: students with conditions that substantially impaired their ability to respond (e.g., severe mental or verbal disorders according to the study's operational criteria) and students with incomplete questionnaire responses. The dependent variable in this study was typhoid fever occurrence among students (as defined operationally in the questionnaire), while the independent variables comprised the determinant factors: clean water facilities, latrine facilities and feces disposal, household wastewater disposal/drainage (SPAL), household food storage practices, handwashing before eating, handwashing after defecation, consumption of street-vended snacks/foods, knowledge of typhoid fever, and PHBS (Clean and Healthy Living Behavior) knowledge. These determinants are conceptually aligned with major fecal–oral transmission pathways and are widely recognized in typhoid prevention frameworks emphasizing WASH and behavioral practices (WHO, 2023; Meiring et al., 2023).

Primary data were collected directly from respondents using a structured digital questionnaire consisting of sections on respondent characteristics and items measuring each study variable. Before completing the questionnaire, participants underwent an informed consent process, followed by identification data entry and completion of variable-specific items. For multi-item constructs—PHBS knowledge, typhoid knowledge, handwashing before eating, and handwashing after defecation scores were calculated using the formula Score = (total respondent points/maximum possible points) × 100%, and then interpreted according to the operational definition thresholds specified in the study's definition table. For other determinants (clean water facilities, latrine/feces disposal, SPAL, and food storage), categorization followed a criterion-based rule: if any required item did not meet the predefined standard, the variable was classified as "not meeting criteria," whereas meeting all criteria resulted in classification as "meeting criteria."

Instrument quality was supported through validity and reliability testing. Validity refers to the extent to which an instrument measures the intended construct; item-level validity in questionnaires is commonly examined using item–total correlation approaches, including Pearson product–moment correlation, to assess whether each item correlates adequately with the total score (DeVellis, 2017; Lærd Statistics, n.d.). Reliability refers to measurement consistency; internal consistency for multi-item scales is commonly assessed using Cronbach's alpha, which remains a standard method in health and behavioral research (Cronbach, 1951; Tavakol & Dennick, 2011). In line with common practice, questionnaire scales were considered reliable when Cronbach's alpha met accepted thresholds for internal consistency (Tavakol & Dennick, 2011).

The participant flow followed the total sampling approach: from 112 listed Grade 4 - 6 students, 100 formed the accessible and eligible population and were included in analysis after excluding absences and incomplete responses. The research timeline comprised title and proposal finalization (December), proposal approval (December), instrument development (December), permissions (January), data collection (January), data processing (January), and data analysis (January). Reporting the design, setting, sampling flow, and measurement procedures is consistent with transparency principles for observational studies as recommended by reporting guidance such as STROBE (STROBE Statement, 2007).

RESULTS

Univariate Analysis

Univariate analysis describes the frequency and percentage distribution of each variable, including typhoid fever status, access to safe water, latrine and feces disposal, household waste disposal and wastewater drainage, safe food storage facilities, handwashing habits (before eating and after defecation), consumption of street-vended snacks, knowledge of PHBS, and knowledge of typhoid fever.

Tabel 1. Distribution of Respondents by Typhoid Fever Status (n=100)

Typhoid Fever Status	Number (n)	Percent (%)
Infected with Typhoid Fever	34	34
Not Infected with Typhoid Fever	66	66
Total	**100**	**100**

Based on Table 5.1, 34% of respondents were infected with typhoid fever and 66% were not infected.

Tabel 2. Distribution of Respondents by Availability of Safe Water Source Facilities (n=100)

Safe Water Source Facilities	Number (n)	Percent (%)
Yes	42	42
No	58	58
Total	100	100

Based on Table 5.2, 42% of respondents had safe water source facilities and 58% did not.

Tabel 3. Distribution of Respondents by Latrine & Feces Disposal Facilities (n=100)

Latrine & Feces Disposal Facilities	Number (n)	Percent (%)
Yes	43	43
No	57	57

Total	100	100

Based on Table 5.3, 43% had latrine and feces disposal facilities and 57% did not.

Tabel 4. Distribution of Respondents by Final Waste Disposal & Household Wastewater Drainage Facilities (n=100)

Final Waste Disposal & Household Wastewater Drainage Facilities	Number (n)	Percent (%)
Yes	46	46
No	54	54
Total	**100**	**100**

Based on Table 5.4, 46% had facilities meeting the criteria and 54% did not.

Tabel 5. Distribution of Respondents by Food Storage Facilities (n=100)

Food Storage Facilities	Number (n)	Percent (%)
Yes	69	69
No	31	31
Total	**100**	**100**

Based on Table 5.5, 69% had food storage facilities and 31% did not.

Tabel 6. Distribution of Respondents by Handwashing Habit Before Eating (n=100)

Handwashing Habit Before Eating	Number (n)	Percent (%)
Good	87	87
Poor	13	13
Total	100	100

Based on Table 5.6, 87% reported good handwashing before eating and 13% reported poor handwashing.

Tabel 7. Distribution of Respondents by Handwashing Habit After Defecation (n=100)

Handwashing Habit After Defecation	Number (n)	Percent (%)
Good	85	85
Poor	15	15
Total	100	100

Based on Table 5.7, 85% reported good handwashing after defecation and 15% reported poor handwashing.

Tabel 8. Distribution of Respondents by Consumption of Street-Vended Snacks (n=100)

Consumption of Street-Vended Snacks	Number (n)	Percent (%)
Yes	23	23
No	77	77
Total	100	100

Based on Table 5.8, 23% reported consuming street-vended snacks and 77% did not.

Tabel 9. Distribution of Respondents by PHBS Knowledge Level (n=100)

PHBS Knowledge Level	Number (n)	Percent (%)
Good	92	92
Poor	8	8
Total	100	100

Based on Table 5.9, 92% had good PHBS knowledge and 8% had poor PHBS knowledge.

Tabel 10. Distribution of Respondents by Typhoid Fever Knowledge Level (n=100)

Typhoid Fever Knowledge Level	Number (n)	Percent (%)
Good	52	52
Poor	48	48
Total	100	100

Based on Table 5.10, 52% had good typhoid knowledge and 48% had poor typhoid knowledge.

Bivariate Analysis

Association between Typhoid Fever and Safe Water Source Facilities

Tabel 11. Association between Safe Water Source Facilities and Typhoid Fever (n=100)

Safe Water	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Yes	9	26,5%	33	50%	0,024	0,360	0,146 – 0,887
No	25	73,5%	33	50%			
Total	**34**	**100%**	**66**	**100%**			

Safe water source facilities were significantly associated with typhoid fever (p=0.024). The PR of 0.360 indicates a protective effect.

Association between Typhoid Fever and Latrine & Feces Disposal Facilities

Tabel 12. Association between Latrine & Feces Disposal Facilities and Typhoid Fever

Latrine & Feces Disposal	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Yes	13	38,2%	30	45,5%	0,477	0,743	0,319 – 0,465
No	21	61,8%	36	54,4%			
Total	34	100%	66	100%			

No significant association was observed (p=0.477).

Association between Typhoid Fever and Final Waste Disposal & Household Wastewater Drainage

Tabel 13. Association between Final Waste Disposal & Household Wastewater Drainage and Typhoid Fever

Wastewater Drainage	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Yes	13	38,2%	33	50%	0,263	0,619	0,266 – 0,411
No	21	61,8%	33	50%			
Total	34	100%	66	100%			

No significant association was observed (p=0.263).

Association between Typhoid Fever and Safe Food Storage Facilities

Tabel 14. Association between Safe Food Storage Facilities and Typhoid Fever

Safe Food Storage	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Yes	24	70,6%	45	68,2%	0,805	1,120	0,455 – 2,759
No	10	29,4%	21	31,8%			
Total	34	100%	66	100%			

No significant association was observed (p=0.805).Association between Typhoid **Fever and Handwashing Before Eating**

Tabel 15. Association between Handwashing Before Eating and Typhoid Fever

Handwashing Before Eating	Typhoid (Infected) N	%	Not Infected N	%	p value (Fisher)	PR	95% CI
Good	25	73,5%	62	93,9%	0,009	0,179	0,051-0,636
Poor	9	26,5%	4	6,1%			
Total	34	100%	66	100%			

Handwashing before eating was significantly associated with typhoid fever (p=0.009) and showed a protective effect (PR=0.179).

Association between Typhoid Fever and Handwashing After Defecation

Tabel 16. Association between Handwashing After Defecation and Typhoid Fever

Handwashing After Defecation	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Good	24	70,6%	61	92,4%	0,004	0,197	0,061-0,636
Poor	10	29,4%	5	7,6%			
Total	34	100%	66	100%			

Handwashing after defecation was significantly associated with typhoid fever (p=0.004) and showed a protective effect (PR=0.197).

Association between Typhoid Fever and Consumption of Street-Vended Snacks

Tabel 17. Association between Consumption of Street-Vended Snacks and Typhoid Fever

Street-Vended Snacks	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Yes	3	8,8%	20	30,3%	0,016	0,233	0,061–0,814
No	31	91,2%	46	69,7%			
Total	34	100%	66	100%			

Consumption of street-vended snacks was significantly associated with typhoid fever (p=0.016). As presented, PR=0.233 indicates a protective direction in this dataset.

Association between Typhoid Fever and PHBS Knowledge

Tabel 18. Association between PHBS Knowledge Level and Typhoid Fever

PHBS Knowledge	Typhoid (Infected) N	%	Not Infected N	%	p value (Fisher)	PR	95% CI
Good	27	79,4%	65	98,5%	0,002	0,059	0,007 – 0,506
Poor	7	20,6%	1	1,5%			
Total	34	100%	66	100%			

PHBS knowledge level was significantly associated with typhoid fever (p=0.002) and showed a strong protective effect (PR=0.059).

Association between Typhoid Fever Knowledge and Typhoid Fever Incidence

Table 5.19. Association between Typhoid Knowledge Level and Typhoid Fever

Typhoid Knowledge	Typhoid (Infected) N	%	Not Infected N	%	p value	PR	95% CI
Good	18	52,9%	34	51,5%	0,892	1,059	0,462–2,425
Poor	16	47,1%	32	48,5%			
Total	34	100%	66	100%			

No significant association was observed (p=0.892).

Multivariate Analysis

Multivariate Determinants Associated with Typhoid Fever

Table 5.20. Multivariate Analysis of Determinant Factors Associated with Typhoid Fever

Variable	p value	PR
Safe Water Facilities	0,058	0,340
Handwashing Before Eating	0,038	0,150
Handwashing After Defecation	0,762	0,779
Consumption of Street-Vended Snacks	0,028	0,151
PHBS Knowledge Level	0,025	0,054

In the multivariate model, variables that remained statistically significant were: PHBS knowledge level (p=0.025; PR=0.054), handwashing before eating (p=0.038; PR=0.150), and consumption of street-vended snacks (p=0.028; PR=0.151). Safe water facilities showed a borderline association (p=0.058). Handwashing after defecation was not significant (p=0.762).

DISCUSSION

Magnitude of Typhoid Fever Among Primary School Children

This study identified that 34% of primary school children (grades 4-6) in Desa Cijeungjing experienced typhoid fever (Table 1). This proportion is substantially higher than the provincial figure cited for West Java (2.14%). Importantly, these values reflect different populations and scopes: the present study focuses on a specific child population in a particular village setting, while the provincial estimate represents a broader population coverage. This context may explain the discrepancy and suggests that typhoid fever remains a critical localized public health concern in the study area.

Safe Water Facilities and Typhoid Fever

Bivariate findings (Table 11) demonstrated that access to safe water facilities was significantly associated with lower typhoid fever occurrence (p=0.024; PR=0.360). This supports the biological plausibility that contaminated drinking or domestic water can serve as a transmission route for Salmonella typhi. The direction and significance are consistent with prior studies you cited (e.g., Rakhman, 2009; Pangestu et al., 2022), emphasizing that improved water quality and household-level treatment (boiling/filtration) are essential prevention measures.

In multivariate analysis (Table 20), this variable became borderline (p=0.058), suggesting that its effect may overlap with hygiene behavior and PHBS knowledge, or that the sample size limited precision.

Sanitation Infrastructure (Latrine/Feces Disposal and Wastewater Drainage)

This study did not find significant associations between typhoid fever and latrine/feces disposal facilities (Table 12; p=0.477) or household wastewater drainage/final disposal facilities (Table 13; p=0.263). Although sanitation is widely recognized as an important upstream determinant, several explanations are plausible here:

1. Homogeneity of exposure: many households may share similarly limited sanitation conditions, reducing contrast.
2. Measurement limitations: facility presence may not reflect actual use, maintenance, or hygiene behaviors.
3. Sample size: with n=100, the study may have limited power to detect modest effects.

These results differ from studies you cited (e.g., Lailiyah et al., 2018; Komariah, 2021; Andayani, 2018), which may be attributable to differences in population age structure, setting, and sample size.

Safe Food Storage Facilities

No significant association was found between safe food storage facilities and typhoid fever (Table 14; p=0.805). This aligns with Andayani (2018) as cited in your text. One interpretation is that typhoid transmission in this population may be more strongly driven by hand hygiene and ingestion-related behaviors than by storage infrastructure alone. Additionally, “having” storage facilities may not guarantee correct practices (e.g., covering food consistently, cleanliness, avoiding cross-contamination).

Hand Hygiene Practices

Handwashing behavior emerged as a key protective factor in bivariate analysis:

1. Handwashing before eating (Table 15) was significantly protective (p=0.009; PR=0.179).
2. Handwashing after defecation (Table 16) was also significantly protective (p=0.004; PR=0.197).

These findings are consistent with your cited evidence (e.g., Andayani, 2018; Pangestu et al., 2022; Rosdiana, 2019) and reinforce the role of personal hygiene in preventing fecal–oral transmission.

However, in multivariate analysis (Table 20), only handwashing before eating remained significant (p=0.038), while handwashing after defecation was not (p=0.762). This suggests potential collinearity or shared variance between the two handwashing variables and PHBS knowledge, meaning that when modeled together, the independent contribution of handwashing after defecation may be reduced. It may also reflect reporting bias (over-reporting “good” hygiene) or insufficient variability.

Consumption of Street-Vended Snacks

A statistically significant association was found (Table 17; p=0.016). Notably, the PR shown (0.233) suggests a protective direction in this dataset. This pattern is counter to the common assumption that street-vended foods increase typhoid risk and also differs from the narrative expectation in parts of the draft.

Several plausible explanations may account for this:

1. Reverse causality: children with prior illness history may avoid street foods afterward.
2. Differential reporting: children/parents may underreport street food intake.
3. Unmeasured confounding: children who buy snacks may come from households with better access to pocket money, better hygiene education, or safer food choices/vendors.

In multivariate analysis (Table 20), this variable remained significant (p=0.028; PR=0.151), indicating it still contributed after adjustment, but interpretation should be cautious given the unexpected direction.

PHBS Knowledge and Typhoid Fever

PHBS knowledge was strongly associated with typhoid fever occurrence in bivariate analysis (Table 18; p=0.002; PR=0.059) and remained significant in multivariate analysis (Table 20; p=0.025; PR=0.054). This suggests that PHBS knowledge may function as a broad upstream determinant influencing multiple protective behaviors (e.g., handwashing, food and water safety), thereby reducing infection risk. This is consistent with the study you cited (e.g., Nurdiani, 2024).

Typhoid Fever Knowledge

No significant association was found between typhoid knowledge level and typhoid fever incidence (Table 19; p=0.892). This implies that knowledge specifically about typhoid may not translate into preventive practice, or that general hygienic behavior (captured better by PHBS knowledge and handwashing variables) is more predictive in this child population. Differences from prior research (e.g., Ningsih, 2018) may be due to age composition and contextual differences, as you noted.

Key Determinants in the Multivariate Model

Based on Table 20, the most robust protective determinants were PHBS knowledge, handwashing before eating, and street-vended snack consumption (as coded in the dataset). Among these, PHBS knowledge had the smallest PR (0.054), indicating the strongest protective association in the adjusted model. Safe water facilities showed borderline significance (p=0.058), suggesting possible importance that may reach significance with a larger sample or refined measurement..

CONCLUSIONS AND RECOMMENDATIONS

This study found that the prevalence of typhoid fever among grade 4-6 primary school children in Cijeungjing Village, Sumedang Regency (2025) was 34%, while 66% of students were not infected. Bivariate analysis indicated significant associations between typhoid fever incidence and the availability of safe water facilities (p=0.024; PR=0.36; 95% CI: 0.146–0.887), handwashing before eating (p=0.009; PR=0.179; 95% CI: 0.051–0.636), handwashing after defecation (p=0.004; PR=0.197; 95% CI: 0.061–0.636), consumption of street-vended snacks (p=0.016; PR=0.233; 95% CI: 0.061–0.814), and PHBS knowledge level (p=0.002; PR=0.059; 95% CI: 0.007–0.506). In contrast, latrine and feces disposal facilities (p=0.477; PR=0.743), household wastewater drainage facilities (p=0.263; PR=0.619), safe food storage facilities (p=0.805; PR=1.120), and typhoid fever knowledge level (p=0.892; PR=1.059) were not significantly associated with typhoid fever incidence. In multivariate analysis, PHBS knowledge (p=0.025; PR=0.054), handwashing before eating (p=0.038; PR=0.150), and consumption of street-vended snacks (p=0.028; PR=0.151) remained significant determinants, while safe water facilities showed a borderline association (p=0.058; PR=0.340) and handwashing after defecation was not significant (p=0.762; PR=0.779). Overall, these findings indicate that improving PHBS knowledge and strengthening key hygiene practices supported by adequate water access and school/community-based health promotion are central to reducing typhoid fever risk in this population.

RECOMMENDATIONS

Recommendations for Schools

Schools are recommended to strengthen environmental sanitation and student hygiene practices as key preventive measures against typhoid fever. Practical actions include ensuring the continuous availability of safe water and functional handwashing facilities with soap, especially near toilets and eating areas, and implementing routine health education aligned with PHBS to reinforce critical behaviors. Schools should also institutionalize supervised handwashing at high-risk times (before eating and after defecation) through teacher monitoring or peer-led health cadres. In addition, schools are advised to regulate students' access to street-vended snacks by promoting safe food choices, conducting regular hygiene screening of food vendors around the school, and encouraging students to bring safe meals or snacks from home. These measures should be integrated into existing school health programs (e.g., UKS) and evaluated periodically to ensure sustained compliance.

Recommendations for the Community

The community is encouraged to improve household and neighborhood hygiene practices to reduce fecal oral transmission risks. Families should prioritize safe water use for drinking and cooking, including household-level treatment (e.g., boiling) and safe storage to prevent recontamination. Community members are also advised to maintain hand hygiene as a daily habit, particularly before eating and after defecation, and to promote PHBS-related practices within households. Furthermore, families should pay greater attention to food safety, especially when consuming foods and beverages outside the home, by selecting clean vendors and avoiding foods that are not properly covered or handled hygienically. Strengthening community awareness through health education activities led by local health workers and village stakeholders is recommended to improve knowledge and translate it into consistent preventive practices.

Recommendations for Future Researchers

Future studies are recommended to expand the scope of determinants and apply stronger measurement strategies to improve validity. Given that this study relied primarily on questionnaires, subsequent research should incorporate direct observations and/or environmental assessments (e.g., condition of water sources, hygiene facilities, food handling practices, household sanitation, and food availability at home). Researchers may also consider larger sample sizes, prospective or case–control designs, and microbiological or water-quality testing to better capture exposure pathways and reduce information bias. Examining additional variables such as household crowding, socioeconomic factors, parental practices, school canteen/vending hygiene, and history of vaccination or prior typhoid infection may provide a more comprehensive understanding of typhoid risk among school-aged children.

REFERENCES

Alba, S., Bakker, M. I., Hatta, M., Scheelbeek, P. F. D., Dwiyanti, R., Usman, R., et al. (2016). Risk factors of typhoid infection in the Indonesian archipelago. PLOS ONE, 11(6), e0155286. https://doi.org/10.1371/journal.pone.0155286

Centers for Disease Control and Prevention. (2025). Typhoid and paratyphoid fever. In CDC Yellow Book: Health information for international travel (2026 ed.). https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/typhoid-and-paratyphoid-fever.html

Chowdhury, M. A. J., Shumy, F., Anam, A. M., & Chowdhury, M. K. (2014). Current status of typhoid fever: A review. Bangladesh Medical Journal, 43(2). (Catatan: sitasi di template tertulis 2016; mohon sesuaikan bila sumber yang digunakan berbeda.)

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297–334. https://doi.org/10.1007/BF02310555

DeVellis, R. F. (2017). Scale development: Theory and applications (4th ed.). SAGE Publications.

Health Protection Surveillance Centre. (2025). Typhoid fever & paratyphoid: Factsheet. https://www.hpsc.ie/a-z/gastroenteric/typhoid/factsheet/

Hancuh, M., Walldorf, J., Minta, A. A., Tevi-Benissan, C., Christian, K. A., Nedelec, Y., et al. (2023). Typhoid fever surveillance, estimated incidence and progress towards introduction of typhoid conjugate vaccine—worldwide, 2018-2022. Weekly Epidemiological Record, 98(7).

Kementerian Kesehatan Republik Indonesia. (2014). Peraturan Menteri Kesehatan Republik Indonesia Nomor 3 Tahun 2014 tentang Sanitasi Total Berbasis Masyarakat (STBM). https://peraturan.go.id/id/permenkes-no-3-tahun-2014

Kementerian Kesehatan Republik Indonesia. (2019). Profil Kesehatan Indonesia 2018. Kementerian Kesehatan RI. https://kemkes.go.id/app_asset/file_content_download/profil-kesehatan-indonesia-2018.pdf

Kim, C., Goucher, G. R., Tadesse, B. T., Lee, W., Abbas, K., & Kim, J. H. (2023). Associations of water, sanitation, and hygiene with typhoid fever in case-control studies: A systematic review and meta-analysis. BMC Infectious Diseases, 23, 562. https://doi.org/10.1186/s12879-023-08452-0

Lærd Dissertation. (n.d.). The online research guide for your dissertation and thesis. Lund Research Ltd. https://dissertation.laerd.com/

Lærd Statistics. (n.d.). Cronbach's alpha (α) using SPSS Statistics. Lund Research Ltd. https://statistics.laerd.com/spss-tutorials/cronbachs-alpha-using-spss-statistics.php

Marchello, C. S., Birkhold, M., & Crump, J. A. (2020). Complications and mortality of typhoid fever: A global systematic review and meta-analysis. Journal of Infection. https://www.sciencedirect.com/science/article/pii/S0163445320306903

Meiring, J. E., Khanam, F., Basnyat, B., et al. (2023). Typhoid fever. Nature Reviews Disease Primers, 9(1), 71. https://doi.org/10.1038/s41572-023-00480-z

National Institute of Health Research and Development (NIHRD), Ministry of Health, Republic of Indonesia. (2019). Laporan Nasional Riskesdas 2018. Badan Penelitian dan Pengembangan Kesehatan. (Sering juga disebut Balitbangkes).

Nadeak, B., Manik, J., & Destine, D. (2025). The Effectiveness of Managerial Approaches in Promoting Adolescent Healthy Lifestyles: A Qualitative Study at HKBP Gedong Church. Asian Journal of Basic Science & Research, 7(2), 119-128. https://www.researchgate.net/profile/Decmoon-Destine/publication/393760778_The_Effectiveness_of_Managerial_Approaches_in_Promoting_Adolescent_Healthy_Lifestyles_A_Qualitative_Study_at_HKBP_Gedong_Church/links/68787a26b3294610e9b82ae6/The-Effectiveness-of-Managerial-Approaches-in-Promoting-Adolescent-Healthy-Lifestyles-A-Qualitative-Study-at-HKBP-Gedong-Church.pdf

Ochiai, R. L., Wang, X., von Seidlein, L., Yang, J., Bhutta, Z. A., Bhattacharya, S. K., et al. (2008). A study of typhoid fever in five Asian countries: Disease burden and implications for controls. Bulletin of the World Health Organization, 86, 260–268. https://apps.who.int/iris/handle/10665/270173

Purba, I. E., et al. (2016). Program pengendalian demam tifoid di Indonesia: Tantangan dan peluang. Media Penelitian dan Pengembangan Kesehatan, 26(2), 99–108.

Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. Indian Journal of Dermatology, 61(3), 261–264. https://doi.org/10.4103/0019-5154.182410

STROBE Initiative. (n.d.). STROBE checklists. https://www.strobe-statement.org/checklists/

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., Vandenbroucke, J. P., et al. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines

for reporting observational studies. PLOS Medicine, 4(10), e296. https://doi.org/10.1371/journal.pmed.0040296
World Health Organization. (2023). Typhoid. Fact sheet. https://www.who.int/news-room/fact-sheets/detail/typhoid