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ENVIRONMENTAL SANITATION AND COMMUNITY BEHAVIOURS ON THE INFECTIOUS DISEASES AMONG CHILDREN IN PADANG CITY

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Abstract: This study examines the relationship between environmental sanitation conditions, including clean water management, waste disposal, toilet facilities, and community behaviours and the prevalence of infectious diseases among infants and children in Padang City. A cross-sectional observational design was employed, involving 400 randomly selected mothers with children under five years old. Data were collected through structured interviews and field observations and analysed descriptively using statistical software. Environmental sanitation indicators, household waste disposal patterns, and disease prevalence were assessed. Results revealed that 33% of respondents relied on dug wells as a primary water source, with 60% disposing of waste through burning. Infectious diseases such as diarrhoea (31%) and Upper Respiratory Tract Infections (URTI) (30%) were most prevalent. Hygiene behaviours such as handwashing after defecation (61.8%), remained low. Preventive measures against vector-borne diseases showed varied adoption, with 62% using mosquito nets and 23% using repellents. These findings highlight critical gaps in sanitation infrastructure and public health practices. Enhancing access to clean water, improving waste management, and promoting hygiene and preventive measures are vital in reducing the burden of infectious diseases in Padang City.

Keywords: Environmental sanitation, infectious diseases, community behaviours, clean water, Padang.

Introduction

The environment is crucial in determining overall health status, followed closely by individual behaviour. In Indonesia, environmental health efforts are regulated based on Government Regulation No. 66/2014 concerning "Environmental Health" and its implementing regulation, Minister of Health Regulation No. 2 /023 concerning the "Implementation of Environmental Health", which governs environmental health standards, technical requirements, and management practices.

Environmental health refers to maintaining optimal environmental conditions that actively contribute to achieving and sustaining an ideal state of health. This includes several aspects such as housing, waste management (including faecal waste), clean water supply, garbage disposal, and wastewater treatment, which must comply with the provisions of these regulations. Note that environmental factors significantly influence human health, as the condition of the surrounding environment directly impacts many disease-causing agents. As noted by Marni *et al*. (2023), the role of the environment in health is so vital that understanding the causes of disease often necessitates examining factors beyond the human body, thereby underscoring the importance of environmental analysis.

Environmental sanitation is a critical component requiring attention, particularly to clean water facilities, the availability of toilets, wastewater management, garbage disposal, and soil pollution. Inadequate disposal of faeces can directly contaminate food, beverages, vegetables, groundwater, insects, and even body surfaces (Yulius *et al*., 2023; Yulius *et al*., 2024). Hence, effective waste management is crucial for minimising health risks, as poorly managed waste often serves as a food source for disease vectors. For instance, consuming raw vegetables

may facilitate the transmission of diseases from soil contaminated with faecal matter. In addition, the physical conditions of the home environment such as limited ventilation, poor lighting, high humidity, and overcrowding have also been shown to be associated with the incidence of pulmonary tuberculosis caused by *Mycobacterium tuberculosis*. These environmental conditions can facilitate the transmission of Tuberculosis (TB) bacteria within the household, especially in densely populated urban settlements.

Human behaviour, encompassing individual actions represents responses to stimuli related to health and disease (Dewata *et al*., 2023). These behaviours include efforts to maintain and improve health, prevent illness, seek medical care, utilise healthcare services, manage nutrition, and interact with the environment (Asman *et al*., 2023; Wagiyanto *et al*., 2023). Behaviours tied to environmental health involve using clean water, properly disposing of wastewater, managing waste effectively, ensuring healthy housing conditions, and controlling mosquito populations. Health-related behaviour generally includes activities individuals undertake to enhance their well-being such as disease prevention, personal hygiene, careful food selection, and sanitation practices (Simons-Morton *et al*., 2012).

Padang City, the capital of West Sumatra Province has a notable contribution to infant mortality cases. In 2023, several diseases posed significant health challenges for infants. Cases of diarrhoea reached 4,775 across all age groups, with 988 cases reported among children under five. Other than that, Upper Respiratory Tract Infections (URTI) also emerged as a significant concern, with pneumonia contributing to one death in children under five. Additionally, 459 cases of Low Birth Weight (LBW) were recorded, which is a significant health problem because of its strong association with infant mortality. Asphyxia was identified in 1,093 neonatal complication cases while neonatal infections and other complications also remained prevalent. The Padang City Health 2023 report documented 191 infant deaths, including 71 neonatal and 120 post-neonatal deaths. Therefore, environmental factors were discovered to significantly impact child mortality rates, highlighting the critical role of environmental health. This study examines factors associated with environmental sanitation, behaviours, and infections affecting infant and child health. Specific diseases under investigation include diarrhoea, URTI, pneumonia, pulmonary tuberculosis, tetanus, dengue haemorrhagic fever, malaria, and typhoid fever, which are commonly found in the Padang City area.

The occurrence of diseases stems from the interplay between human factors, behaviours, and environmental conditions predisposing individuals to illness (Polis *et al*., 2024). Disease agents, which are components of the environment that disrupt health are often transmitted through intermediary media that form part of the environment. The accumulation of these agents is commonly referred to as pollution.

Environmental components that act as media for disease transmission include air, water, soil, food, animals, insects, vectors, and humans through direct contact (Yanti *et al*., 2023). The extent of human interaction with pathogen-containing environmental components can be assessed through exposure behaviour, which varies among individuals based on specific actions. Meanwhile, pathways for disease agents to enter the human body include the respiratory system, digestive system, and skin surface (Jomova *et al*., 2024).

Diarrhoea and typhoid fever are infectious diseases of the digestive system caused by the contamination of water and food with bacteria or other microbes (Paul, 2024). Typhoid fever is a systemic infectious disease caused by the bacterium *Salmonella enterica* serovar Typhi, which primarily attacks the intestinal tract and spreads through the bloodstream (Upadhyay *et al*., 2025). The disease is transmitted via the faecal-oral route, commonly by consuming contaminated food or drinking water in poor sanitation and hygiene practices (Han *et al*.,

2024). URTI, pneumonia, and pulmonary tuberculosis result from air pollution containing chemical substances, bacteria, or microbes (Al-Maamory & Abd Alnabi Jawed, 2024).

Dengue fever and malaria, on the other hand, are vector-borne diseases transmitted through mosquito bites. Preventing malaria involves avoiding bites from Anopheles mosquitoes, often achieved through personal protective measures such as insecticide-treated bed nets, sprays, and repellents (Olagunju *et al*., 2024). On the other hand, pneumonia is an Acute Respiratory Infection (ARI) with multifactorial causes, including individual risk factors and broader ecological risks (Tüzün *et al*., 2015). Tetanus is a bacterial infection caused by *Clostridium tetani*, commonly found in soil, the intestinal tracts of animals, and their faeces. It enters the human body through wounds and can lead to severe health complications (Tillman, 1978; Düğeroğlu, 2024).

This study examines the relationship between environmental sanitation conditions, including clean water management, waste disposal, toilet facilities, and community behaviours and the prevalence of infectious diseases among infants and children in Padang City. The novelty of this study lies in its comprehensive analysis integrating environmental sanitation factors and behavioural aspects simultaneously about the prevalence of multiple infectious diseases (diarrhoea, ARI, pneumonia, TB, tetanus, dengue fever, malaria, and typhoid fever), specifically among vulnerable groups such as infants and young children in urban settings. This integrated approach has rarely been applied in previous studies conducted in Indonesia, particularly in Padang City.

Methods

This observational study investigates risk behaviours associated with the occurrence of diseases such as diarrhoea, URTI, pneumonia, pulmonary tuberculosis, tetanus, dengue fever, malaria, and typhoid fever. A cross-sectional design was employed. The study population consisted of mothers with infants and/or children under five years old (Lenja *et al*., 2016; Atosona *et al*., 2024; Mekonnen *et al*., 2024). The sample comprised mothers who met the inclusion criteria and were randomly selected using a simple random sampling method.

The minimum required sample size per subdistrict was calculated using the Lemeshow formula (Lemeshow *et al*., 1998). Assuming an estimated proportion of knowledge, attitudes, and behaviours in the population of 50%, the required sample size was determined to be 384.16, rounded to 400. Based on the 2023 Annual Report from the Padang Health Office (Padang Health Office, 2024), the number of children under five (0-59 months) in Padang City was recorded at 77,506.

Referring to this data, the sample of 400 mothers with infants and/or young children was considered adequate to represent the population, ensuring proportional representation from two selected subdistricts. Each subdistrict contributed 200 respondents, reflecting the target area's distribution pattern and population characteristics. Note that data collection involved structured interviews and field observations of factors suspected to influence the transmission of diarrhoea, URTI, pneumonia, pulmonary tuberculosis, tetanus, dengue fever, malaria, and typhoid fever. The collected data were processed and analysed descriptively using statistical software. The proportion of respondents based on sanitation facility ownership and waste disposal patterns is presented in Tables 1 and 2.

Table 1 presents the proportion of respondents based on sanitation facility ownership. The table displays the classification of various type of sanitation facilities, including water for BWT, sources of drinking water, and ownership of clean water and toilet facilities. However, this table does not include specific scores or numerical values following the "Category" column because the table is intended solely to categorise the type of sanitation facilities owned or accessed by respondents. The detailed quantitative data, including the number and percentage of respondents for each category are provided separately in Tables 4, 5, and 6 of

the results sections. This approach was adopted to maintain clarity and focus on categorising sanitation facilities in Table 1. At the same time, the analysis of numerical data was elaborated in Table 2.

Results

Access to Drinking Water and Clean Water

Access to safe drinking and clean water is vital to public health. Hence, understanding the type of water sources utilised by the community in Padang City provides valuable insights into their level of access to safe and dependable water supplies. This information emphasises the community's reliance on various water sources and highlights their potential impact on public health outcomes. For a detailed overview, the results on access to drinking and clean water are presented in Table 3.

Table 1 above shows that 33% of respondents relied on dug wells, making it the most commonly utilised water source. This was followed by 32% who obtained water through piped water systems provided by the LWC. Additionally, 19% relied on bottled water

Table 1: Proportion of respondents based on sanitation facility ownership

Sanitation Facility	Category
Source of water for Bathing, Washing, and Toilet (BWT)	Piped water in LWC
	Pump well
	Dug well
	River
Drinking water source	Bottled water
	Piped water in LWC
	Pump well
	Dug well
	Purchase
Ownership of clean water	Private ownership
Ownership of toilet facilities	Shared/public use
	Private ownership
	Shared/public use
	Unanswered

Note: Local Water Company (LWC).

Table 2: Waste disposal patterns

Waste Management	Number
Collected by officers	41
Disposed of in trash bins	3
Burned	241
Disposed in gardens	59
Disposed of in rivers	48
Buried in pits	2
Others	7
Total	**401**

Table 3: Access to drinking and clean water

Source of Water	Number	Percentage (%)
Piped water in LWC	180	32%
Bottled water	105	19%
Pump well	79	14%
Dug well	183	33%
River	7	1%
Total	**554**	**100%**

Source: Data analysis in 2024

while 14% used pump wells. Of concern, 1% of respondents still depended on river water, which poses significant health risks due to the potential for contamination. These findings emphasise the community's significant reliance on traditional sources such as dug wells and diverse dependency on various water sources for drinking and general use. This data underscores the urgent need to improve access to safer and more reliable water sources to enhance public health outcomes in Padang City. Further details are illustrated in Figure 1.

Study findings indicate that the primary drinking water sources in Padang City are dug wells 33% and water provided by the Local Government-Owned Drinking Water Utility (PDAM) utility 32%. The reliance on dug wells as the primary source of drinking water reflects the limitations of clean water infrastructure in certain areas. According to Odonkor and Mahami (2020), well water sources have a high risk of contamination by *Escherichia coli* bacteria, particularly in areas with poor sanitation. Ashbolt (2004) further noted that limited access to clean water is often associated with an increased prevalence of diarrheal diseases, especially among children. Although most respondents boil their water before consumption 82%, this practice is not universally adopted. Enger *et al*. (2013) emphasised that consistent water treatment can reduce the risk of diarrhoea by up to 40%. These findings align with Article 5 of the Regulation of the Minister of Health No. 2/2023, which requires drinking water to meet environmental health standards (physical, biological, chemical, and radiological parameters) and be protected from contamination sources.

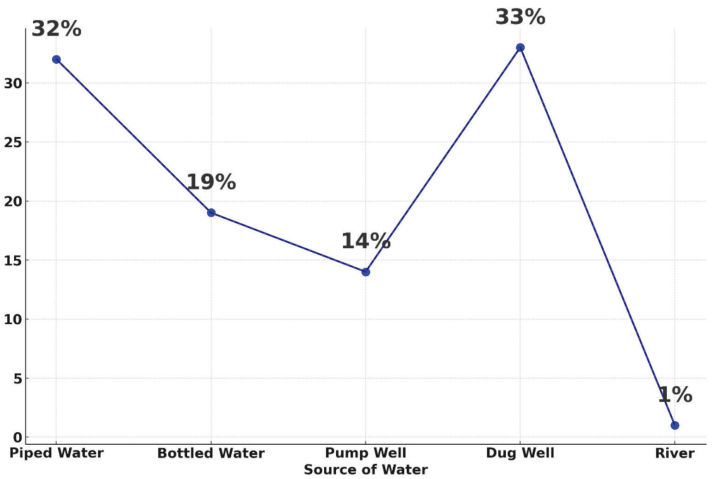

Figure 1: Water source distributions

Hygiene behaviour also remains a challenge in Padang City. While handwashing before meals is relatively high, (81.5%), handwashing after defecation, (61.8%), and after disposing of baby faeces, (54.1%) is still low. White *et al.* (2020) reported that this behaviour is often linked to insufficient public awareness of the importance of handwashing in preventing infectious diseases. Alternatively, Curtis and Cairncross (2003) added that handwashing with soap is among the most effective interventions for reducing the spread of gastrointestinal infections. This condition reflects the importance of promoting hygiene behaviour as mandated in Article 4 of the Regulation of the Minister of Health No. 2/2023, which obligates residents in residential environments to maintain sanitation and implement healthy behaviour practices to prevent disease transmission.

Household Waste Management Patterns

Proper waste management is essential to reducing environmental contamination and preventing health risks. This study evaluated various household waste disposal methods to gain insights into community practices and their potential environmental and public health impacts in Padang City. For a detailed overview, the results on patterns of household waste management are presented in Table 4.

Table 4 presents that 60% of respondents disposed of household waste by burning, making it the most common waste management method. Other prevalent practices included disposal in gardens at 15% in rivers at 12%, which pose environmental and health risks. A smaller proportion of respondents relied on waste collection services at 10% while minimal numbers buried waste in pits at 0% or disposed of it in trash bins at 1%. Additionally, 2% of respondents reported using other waste management methods, indicating a need for further analysis of diverse practices and their implications for public health in Padang City. These behaviours highlight the urgent need for improved waste management systems to reduce environmental and public health risks. Further details are illustrated in Figure 2.

Most communities in Padang City burn household waste, accounting for 60% of the population. This practice pollutes the air with harmful pollutants like carbon monoxide and fine particulate matter. Mandal *et al.* (2020) observed that exposure to smoke from burning waste can lead to respiratory problems, including ARI. Furthermore, 12% of the community dispose of waste in rivers, contaminating water sources and increasing the risk of diarrhoea from consuming polluted water. Ozoh *et al.* (2021) discovered that indiscriminate waste disposal into water bodies degrades groundwater quality and creates breeding grounds for disease vectors. In contrast, only 10% of communities in Padang City utilise formal garbage collection services. This reflects significant gaps in the city's sanitation infrastructure. Mor and Ravindra (2023) emphasised that the availability of

Table 4: Patterns of Household Waste Management

Waste Management	Number	Percentage (%)
Collected by officers	41	10%
Disposed of in trash bins	3	1%
Burned	241	60%
Disposed in gardens	59	15%
Disposed of in rivers	48	12%
Buried in pits	2	0%
Others	7	2%
Total	**401**	**100%**

Source: Data analysis in 2024

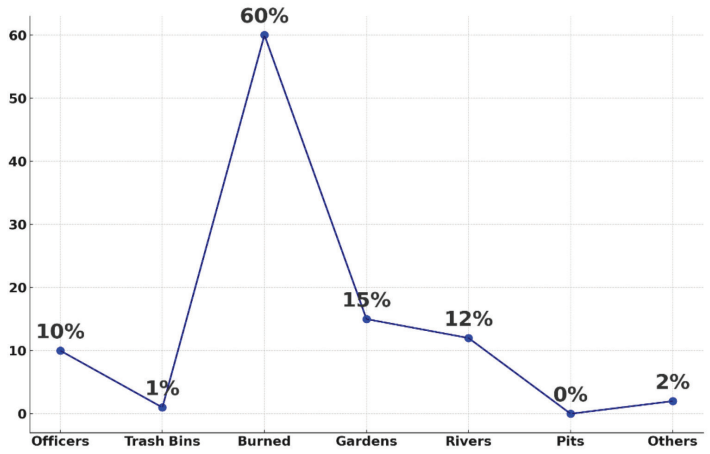

Figure 2: Household waste management

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Prevalence of Infectious Diseases among Infants and Young Children

Infectious diseases remain a significant health concern for infants and young children in the community. This study analysed the prevalence of various infectious diseases to identify the most common illnesses and establish priorities for targeted interventions in Padang City. For a detailed overview, the results on the prevalence of infectious diseases among infants and young children are presented in Table 5.

Table 2 above shows that diarrhoea accounted for the highest proportion of cases, representing 31% of the total 321 cases, making it the most prevalent disease in the population of Padang City. This was followed closely by URTI, which comprised 30% of the cases. Together, these two diseases highlight significant health challenges related to sanitation and respiratory health.

Pneumonia, contributing 18% of the cases was the third most common disease, followed by pulmonary tuberculosis at 9%. These respiratory-related illnesses emphasise the need for improved healthcare services and preventive

Table 5: Infants or young children diagnosed with infectious diseases

Disease	Number	Percentage (%)
Diarrhoea	101	31%
Upper Respiratory Tract Infections (URTI)	96	30%
Pneumonia	58	18%
Pulmonary Tuberculosis	29	9%
Tetanus	8	2%
Dengue fever	0	0%
Malaria	11	3%
Typhoid fever	18	6%
Total	**321**	**100%**

Source: Data analysis in 2024

measures, particularly among vulnerable populations. Typhoid fever and malaria accounted for 6% and 3% of cases, respectively while tetanus made up 2%. Notably, there were no reported cases of dengue fever, which may indicate effective vector control measures or possible gaps in reporting. Further details are illustrated in Figure 3.

Diarrhoea has the highest prevalence among infectious diseases in Padang City, (31%), followed by ARI, (30%), and pneumonia (18%). Unhygienic environmental conditions and limited access to healthcare services predominantly cause these diseases. According to Linda *et al*. (2023), diarrhoea is often caused by consuming contaminated water, consistent with the findings of this study. The World Health Organisation (WHO, 2023) also reported that diarrhoea is a leading cause of death among children under five in developing countries. Note that ARI and pneumonia are primarily attributable to household air pollution. Olagunju *et al*. (2024) explained that burning waste and using solid fuels for cooking increase the risk of respiratory diseases. In Padang City, indoor smoking habits, 46.1% also contribute to the high prevalence of ARI in children. Rahaman *et al*. (2023) observed that children exposed to second-hand smoke are at a significantly higher risk of ARI compared to those in smoke-free environments.

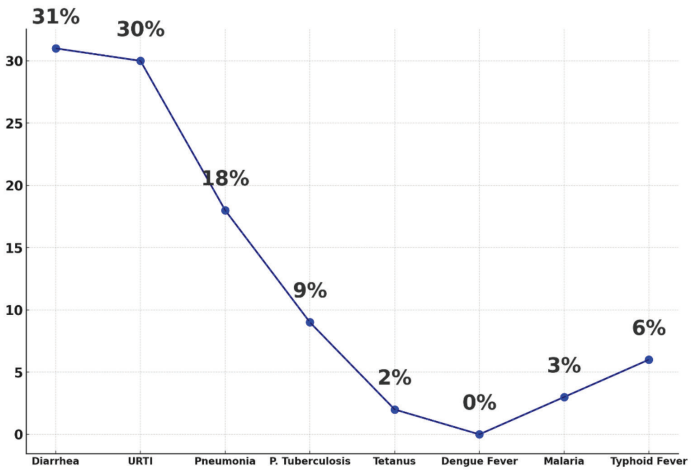

Figure 3: Infants or young children diagnosed with infectious diseases

These findings reinforce the importance of environmental-based disease prevention efforts as regulated in Article 4 of the Regulation of the Minister of Health No. 2/2023, which requires residents to maintain the quality of environmental media such as water, air, and land to meet environmental health quality standards. In addition, Article 5 and Article 6 of the regulation establish specific environmental health requirements for drinking water and indoor air to prevent exposure to pollutants that may cause diarrhoea, ARI, and pneumonia. Therefore, improving access to safe drinking water, reducing air pollution, and promoting smoke-free homes are essential strategies for protecting vulnerable populations, especially children, from infectious diseases in urban areas like Padang City.

Preventive Behaviours for Disease Control

Vector-borne diseases present significant health risks, particularly in regions with high mosquito exposure. This study examined the preventive behaviours adopted by respondents to mitigate these risks in Padang City. The results of preventive behaviours for disease control are presented in Table 6, which provides a detailed overview.

Table 4 above shows that sleeping under bed nets was the most common preventive behaviour, practised by 62% of respondents or 306 individuals. Using repellents ranked second, adopted by 23% of respondents or 114 individuals. Other methods included using mosquito coils, used by 7% or 37 respondents and spraying insecticides, used by 8% or 40 respondents. These findings highlight a reliance on physical barriers and chemical methods to combat vector-borne diseases in Padang City, underscoring strengths and gaps in preventive practices. The relatively low adoption of chemical-based measures such as repellents and spray insecticides suggests potential barriers such as cost or accessibility. This issue warrants further exploration to enhance preventive efforts. Further details are depicted in Figure 4.

Table 6: Preventive behaviours against vector-borne diseases

Behaviour	Number of Respondents	Percentage (%)
Using repellents	114	23%
Using mosquito coils	37	7%
Sleeping under bed nets	306	62%
Using spray insecticides	40	8%
Total	**497**	**100%**

Source: Data analysis in 2024

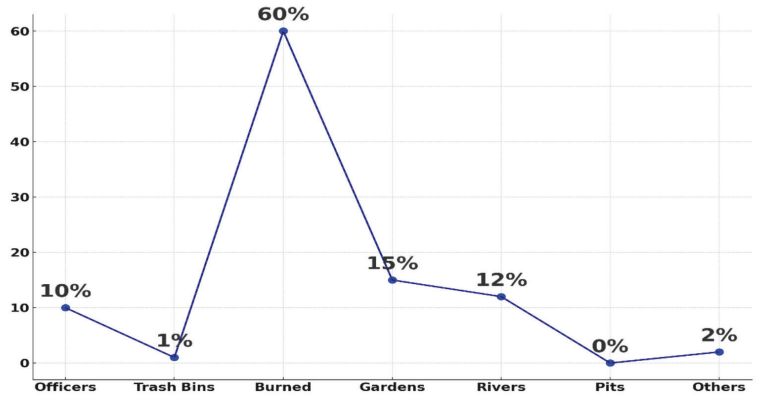

Figure 4: Graph of preventive behaviours against vector-borne diseases

Research findings indicate that sleeping under mosquito nets is the most commonly practised prevention method among respondents in Padang City, with a usage rate of 62%. Mosquito nets serve as an effective physical barrier to prevent mosquito bites. According to Barker *et al.* (2023), insecticide-treated nets can reduce malaria incidence by up to 50% in tropical regions. This finding aligns with the study by Okumu (2017), which highlighted that mosquito nets are a simple, affordable, and effective prevention method. However, adoption rates remain low in some areas due to limited distribution.

The second most common prevention method is repellents, adopted by 23% of respondents. Repellents containing active ingredients such as N,N-Diethyl-Meta-Toluamide (DEET) are frequently used to deter mosquito bites. Ranabhat *et al.* (2024) explained that repellents with higher concentrations offer long-lasting effectiveness. However, their relatively high cost can pose a barrier for some communities. This aligns with the study's findings, indicating that repellent use is still less common than mosquito nets. In contrast, other prevention methods such as mosquito coils (7%) and sprays (8%) are adopted at lower rates. According to Li *et al*. (2020), mosquito coils can pollute indoor air and increase the risk of respiratory problems, particularly in children. The WHO (2023) in Odukanmi *et al.* (2020) also noted that prolonged exposure to smoke from mosquito coils can cause respiratory tract irritation, emphasising the need for regulated and cautious use of these methods.

These findings are strongly aligned with Article 10 of the Regulation of the Minister of Health No. 2/2023, which stipulates that controlling disease vectors and carriers, including mosquitoes, is an essential part of environmental health efforts. The regulation emphasises the need to reduce vector breeding grounds and control their population density to prevent disease transmission. In addition, Article 33 outlines specific strategies for vector control through environmental management and the application of physical, biological, chemical, and integrated methods. Therefore, promoting safe and effective mosquito control measures, improving community awareness, and supporting vector management programs are critical in strengthening environmental health and preventing vector-borne diseases in Padang City.

Conclusions

Based on the research findings, environmental sanitation conditions in Padang City, specifically in clean water management, waste disposal, toilet facilities, and community behaviours, are closely linked to the high prevalence of infectious diseases among infants and children. Dug wells, still widely used as a primary water source, are particularly vulnerable to *E. coli* contamination in areas with inadequate sanitation. Waste disposal practices such as burning waste and dumping into rivers pose significant health risks, notably the increased likelihood of diarrhoea and respiratory illnesses due to pollution and water contamination.

Although handwashing before meals is relatively common, adherence to handwashing after defecation or after disposing of baby faeces remains low, leading to a higher potential for transmitting gastrointestinal infections. This is reflected in the high rates of diarrhoea (31%) and ARI (30%) among young children. Meanwhile, preventive measures against vector-borne diseases such as sleeping under a bed net (62%) show a relatively high adoption rate, even though repellents and insecticides are limited.

Overall, this study highlights the urgent need to improve access to clean water, strengthen waste management systems, enhance public education on healthy behaviours, and provide disease-prevention facilities such as integrated campaigns for bed-net distribution. Policy interventions and better sanitation infrastructure must be prioritised, given their strong association with the high incidence of infectious diseases in infants and children in Padang City. Therefore, improving clean water management and

sanitation facilities and raising awareness about healthy behaviours can significantly reduce the incidence of infectious diseases.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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