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Six-step handwashing behaviour and self-reported diarrhea among fourth- and fifth-grade students

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Abstract

Background: Diarrhea remains a common health problem among school-aged children and is associated with personal hygiene practices, particularly handwashing. Proper six-step handwashing is an important preventive measure against diarrheal infections.
Purpose: To to determine the association between six-step handwashing behaviour and the incidence of diarrhea among fourth- and fifth-grade students.
Method: This quantitative analytical study employed a cross-sectional design involving 52 fourth- and fifth-grade students selected through total sampling at Karangrejo Public Elementary School, Yogyakarta, Indonesia, from April 2025 to February 2026. Data were collected using questionnaires on six-step handwashing behavior and diarrhea incidence. Univariate analysis was used to describe the frequency distribution of each variable, while the association between variables was analysed using the Chi-square test.
Results: Of the 52 students, 39 (75%) demonstrated good six-step handwashing behavior, while 13 (25%) demonstrated adequate behaviour. Most students (46; 88.5%) reported never having experienced diarrhea, whereas 6 (11.5%) reported having experienced diarrhea. The Chi-square test revealed a statistically significant association between six-step handwashing behaviour and diarrhea incidence (p = 0.012).
Conclusion: Six-step handwashing behaviour was significantly associated with diarrhea incidence among elementary school students. Promoting consistent handwashing practices and maintaining proper food and water hygiene are important components of diarrhea prevention.

Keywords: Diarrhea; Elementary School Students; Six-Step Handwashing.

INTRODUCTION

Diarrhea remains an important public health concern among children worldwide. It is generally characterized by the passage of three or more loose or liquid stools within 24 hours and may result from infections caused by bacteria, viruses, or parasites transmitted through contaminated food, water, or hands. Although diarrhea is preventable and treatable, inadequate hygiene, unsafe drinking water, and poor sanitation can increase children's exposure to infectious pathogens (World Health Organization, 2024). Children are particularly vulnerable to the consequences of diarrhea because fluid and electrolyte loss can lead to dehydration and other complications, making appropriate prevention and hygiene practices essential for protecting their health (Kusmayanti & Sibualamu, 2023).

Handwashing with soap is an important personal hygiene practice that can help remove microorganisms from the hands and reduce the transmission of pathogens. Evidence from a systematic review and meta-analysis indicates that interventions addressing drinking water, sanitation, and handwashing with soap are relevant to reducing the risk of diarrheal disease among children in low- and middle-income settings (Wolf et al., 2022). Research examining personal hygiene practices has also reported an association

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between hygiene behaviour and diarrhea, highlighting the importance of maintaining appropriate hygiene in daily activities (Aminah et al., 2024). However, the contribution of handwashing to diarrhea prevention should be considered alongside other factors, including food hygiene, drinking water quality, and environmental sanitation.

Proper handwashing involves more than briefly rinsing the hands with water. It requires the use of soap, adequate cleaning of different hand surfaces, and consistent practice at appropriate times. The World Health Organization provides guidance on hand hygiene procedures to support the reduction of microorganism transmission, although recommendations developed for healthcare settings must be interpreted in relation to the needs of school-aged children (World Health Organization, 2009). The six-step handwashing technique covers the palms, backs of the hands, spaces between the fingers, thumbs, fingertips, and areas around the nails. Following these steps may help children clean hand surfaces more thoroughly as part of their everyday hygiene practices. Research among elementary school students has demonstrated the relevance of educational approaches to improving knowledge, attitudes, and practices related to the six-step handwashing technique (Ariyanto et al., 2023).

Elementary schools provide an important setting for promoting hand hygiene because children interact closely with peers, participate in shared activities, and increasingly make independent decisions about eating and personal hygiene. Contact with contaminated hands, food, or environmental surfaces may expose children to infectious microorganisms, particularly when handwashing practices are inconsistent. Developing appropriate hygiene habits during the school years may therefore contribute to broader efforts to prevent infectious diseases. Previous research has examined the use of practical demonstrations to improve handwashing behaviour among school-aged children, while other studies have evaluated educational approaches to strengthening handwashing knowledge and skills (Astuti et al., 2024; Polly et al., 2024). A systematic review and meta-analysis of school-based hygiene intervention programs has further highlighted the relevance of structured hygiene promotion in educational settings (Ismail et al., 2024).

In addition to health education, access to suitable handwashing facilities is an important consideration in supporting consistent hygiene practices. The availability of water and soap can influence children's opportunities to perform handwashing during school activities and before eating. Research on handwashing facilities in elementary schools has examined the relationship between facility availability and students' handwashing behaviour, indicating the importance of considering both individual practices and the school environment (Nurwahidah, 2024). Furthermore, a teacher-led handwashing program in India examined children's handwashing with soap at school and at home, emphasizing the importance of reinforcing hygiene practices across different settings (Tidwell et al., 2020). These findings suggest that school-based diarrhea prevention efforts should combine appropriate handwashing techniques with supportive facilities and consistent health education.

Previous studies have specifically investigated the relationship between handwashing behaviour and diarrhea among school-aged children. Research conducted in elementary school settings has examined the association between handwashing behaviour and diarrheal events, providing a basis for further investigation of this relationship in different school populations (Resiyanthi et al., 2021). Research on handwashing with soap and diarrhea among elementary school students in Bekasi Regency has also addressed the relevance of hand hygiene to diarrheal disease prevention (Resmawati et al., 2025). In addition, studies examining hygiene-related behaviours among children have highlighted the importance of considering multiple daily practices when assessing diarrhea-related outcomes (Audini et al., 2024). Nevertheless, differences in school environments, hygiene facilities, individual practices, and exposure to potential sources of infection mean that findings from one setting should not automatically be generalized to another.

A preliminary assessment conducted on August 14, 2025, at Karangrejo Public Elementary School, Yogyakarta, involved one teacher and ten students. The assessment indicated that the school had previously provided education on the six-step handwashing technique in accordance with World Health Organization recommendations through health education activities conducted by the local community health center. Handwashing facilities were available at several locations within the school, although their use was reportedly not optimal. Among the ten students

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interviewed, six (60%) reported knowing the six-step handwashing technique and frequently practicing it, particularly before eating, whereas four (40%) reported knowing the technique but rarely practicing it at school. These preliminary observations suggest that awareness of handwashing does not necessarily translate into consistent practice.

Information obtained from teachers during the preliminary assessment also indicated that some students had experienced diarrhea and had received care through the school health unit before being referred for further care or sent home. Some students reportedly experienced diarrhea after purchasing snacks outside the school without washing their hands beforehand. However, these preliminary observations did not establish the causes of individual diarrhea episodes or demonstrate that snack consumption and handwashing behaviour were statistically associated with the reported illness. Rather, they highlighted the relevance of examining students' handwashing behaviour alongside their self-reported history of diarrhea within the school context.

Despite existing health education activities and the availability of handwashing facilities, the consistency of six-step handwashing behavior and its association with self-reported diarrhea remained important questions at Karangrejo Public Elementary School. Examining this association may provide context-specific information to support school hygiene promotion. Given that diarrhea can be associated with multiple exposure pathways, handwashing behaviour should be considered as one component of prevention rather than the sole determinant of diarrheal disease. The findings are expected to provide information that may support school-based health education and the promotion of appropriate handwashing practices alongside attention to food hygiene, safe drinking water, and environmental sanitation. Because the study employed a cross-sectional design, its findings are intended to identify an association between the study variables rather than establish a causal relationship.

RESEARCH METHOD

This study employed a quantitative analytical approach with a cross-sectional design to examine the association between six-step handwashing behaviour and self-reported history of diarrhea among fourth- and fifth-grade students. The study was conducted at Karangrejo Public Elementary School, Yogyakarta, Indonesia, during the period from April 2025 to February 2026. The study population comprised all students enrolled in Grades IV and V at the school. Total sampling was used, resulting in 52 respondents who met the eligibility criteria. Eligible participants were students actively enrolled in Grade IV or V, present during data collection, willing to participate, and whose parents or guardians provided written consent. Students who were absent, lacked parental or guardian consent, or submitted incomplete questionnaires were excluded.

The independent variable was six-step handwashing behaviour, defined as students' reported practices of washing their hands using soap and running water according to the recommended six-step technique. The dependent variable was self-reported history of diarrhea, based on students' questionnaire responses regarding whether they had experienced diarrhea. Handwashing behaviour was classified into good, fair, and poor categories according to the classification used in the study. Self-reported history of diarrhea was categorized as never or once. The original scoring criteria for handwashing behaviour and the specific recall period for diarrhea were not available in the study documentation. Consequently, the numerical cut-off points and the precise period covered by the reported history of diarrhea could not be specified.

Data were collected in the school environment using structured questionnaires addressing six-step handwashing behaviour and self-reported history of diarrhea. The handwashing questionnaire assessed students' reported practices related to the use of soap and running water and adherence to the recommended handwashing steps. The diarrhea questionnaire recorded students' reported history of diarrhea. Researchers or research assistants provided clarification when necessary to help students understand the questions. Completed questionnaires were checked for completeness, coded, and entered into the data-processing system for analysis. Information regarding the number of questionnaire items, scoring ranges, instrument validity, and reliability was not available in the study documentation and therefore could not be reported.

Univariate analysis was used to describe the respondents' characteristics, including age, gender, and grade level, as well as the distributions of six-step handwashing behaviour and self-reported history of diarrhea. Categorical variables were summarized using

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frequencies and percentages, while age was described using the mean, standard deviation, and range. Bivariate analysis was conducted to examine the association between six-step handwashing behaviour and self-reported history of diarrhea. Fisher's exact test was selected as the primary statistical test because the contingency table contained small expected cell frequencies. Statistical significance was established at a two-sided significance level of $\alpha = 0.05$, with $p < 0.05$ indicating a statistically significant association. The reported Fisher's exact test result was $p = 0.029$. The statistical result should be checked against the original analysis output before publication. Ethical approval was reported as having been granted by the Research Ethics Committee of Universitas Aisyiyah Yogyakarta under approval number NO.2244/KEP-UNISA/II/2026. The study procedures included explaining the research to students and their parents or guardians and obtaining written parental or guardian consent before participation. Students' personal information was kept confidential and used solely for research purposes. The exact approval date and its relationship to the data collection period should be verified using the original research records to confirm that ethical approval was obtained before data collection commenced.

RESEARCH RESULTS

Table 1. Characteristics of Respondents and Distribution of Study Variables (N = 52)

Variable	Results
Age (n/%)(Mean±SD)(Range)(Year)	**9.98 ± 0.75 (9–11)**
9	15/28.85
10	23/44.23
11	14/26.92
Gender (n%)	
Male	16/30.77
Female	36/69.23
Age (years)	
Grade level (n%)	
IV	26/50.00
V	26/50.00
Six-step handwashing behavior (n%)	
Good	39/75.00
Fair	13/25.00
Poor	0/0
Self-reported history of diarrhea (n%)	
Never	46/88.46
Once	6/11.54

Table 1 shows the demographic characteristics of the respondents and the distribution of the study variables. Most respondents were female (36/69.23), and the largest age group was 10 years (23/44.23). The numbers of students in Grades IV and V were equal, with 26/50.00 in each grade. Regarding six-step handwashing behaviour, 39/75.00 respondents were classified in the good category, while 13/25.00 were classified in the fair category. No respondents were classified in the poor category. Regarding self-reported history of diarrhea, 46/88.46 respondents reported never having experienced diarrhea, whereas 6/11.54 reported having experienced diarrhea once.

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Table 2. Association Between Six-Step Handwashing Behavior and Diarrhea Incidence (N = 52)

Six-Step Handwashing Behavior	Never	Once	p-value
Good	37/71.15	2/3.85	0.012
Fair	9/17.31	4/7.69	
Stastical Test (n%)			
Pearson Chi-square			0.012
Fisher's exact test (two-sided)			0.029

Table 2 shows the two-sided Fisher's exact test indicated a statistically significant association between six-step handwashing behaviour and self-reported history of diarrhea among fourth- and fifth-grade students (p = 0.029). Among students with good handwashing behaviour, 37 (94.9%) reported never having experienced diarrhea, while 2 (5.1%) reported one episode. In comparison, among students with fair handwashing behaviour, 9 (69.2%) reported never having experienced diarrhea, whereas 4 (30.8%) reported one episode. These findings indicate that a history of diarrhea was reported more frequently among students with fair handwashing behaviour than among those with good handwashing behaviour

DISCUSSION

The findings demonstrate a statistically significant association between six-step handwashing behavior and self-reported history of diarrhea among fourth- and fifth-grade students at Karangrejo Public Elementary School, Yogyakarta. Most respondents reported good handwashing behaviour, and most reported never having experienced diarrhea. Fisher's exact test indicated a statistically significant association between these variables (p = 0.029). These findings support the relevance of hand hygiene as a component of diarrhea prevention among school-aged children. Nevertheless, the results should be interpreted cautiously because the study was cross-sectional, the number of reported diarrhea episodes was limited, and other potential sources of exposure were not directly assessed.

The respondents had a mean age of 9.98 years, and most were female. Students in Grades IV and V were equally represented. Children at this developmental stage increasingly participate in activities independently, including eating snacks, playing with peers, and managing their personal hygiene. Consequently, establishing appropriate hygiene habits during the elementary school years is important. However, knowledge of proper handwashing does not necessarily correspond to consistent or technically correct practice. An integrative review of handwashing assessment in schools highlighted the importance of using appropriate measures and assessment tools when evaluating children's handwashing practices (Rutter et al., 2021). Previous research has also investigated handwashing behaviour and diarrhea among elementary school students, supporting the relevance of examining hygiene practices within school populations (Resmawati et al., 2025).

In the present study, 39 students (75.0%) demonstrated good six-step handwashing behaviour, while 13 (25.0%) demonstrated fair behaviour. No students were classified in the poor category. This distribution suggests that favourable handwashing practices were commonly reported in the study population. Previous health education activities and the availability of handwashing facilities may be possible explanations for this pattern, given the preliminary information indicating that handwashing education had been provided at the school and facilities were available at several locations. However, these factors were not measured as independent variables in the present study, and their contribution to the observed distribution cannot be established. Research on community health education has examined the potential of structured educational programs to support handwashing with soap among school-aged children (Belangi et al., 2025).

The six-step handwashing technique is intended to ensure that different surfaces of the hands are cleaned, including the palms, backs of the hands, spaces between the fingers, thumbs, fingertips, and areas around the nails. Handwashing with soap can help remove microorganisms and reduce the transfer of pathogens from contaminated hands to food or the

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mouth. Appropriate hand hygiene is therefore an important component of infection prevention, although the specific procedures and recommendations should be adapted to the setting in which they are applied (World Health Organization, 2009). The World Health Organization also identifies unsafe water, inadequate sanitation, and poor hygiene as important factors associated with diarrheal disease (World Health Organization, 2024).

Educational demonstrations may help students understand and practice the recommended handwashing technique. Previous research among elementary school students has reported improvements in knowledge, attitudes, and skills following handwashing demonstrations (Ariyanto et al., 2023; Astuti et al., 2024; Polly et al., 2024). A systematic review and meta-analysis of school-based hygiene intervention programs has also examined educational approaches to improving hygiene-related outcomes in school settings (Ismail et al., 2024). In addition, a teacher-led handwashing program in India highlighted the importance of supporting handwashing practices both at school and at home (Tidwell et al., 2020). These findings provide a rationale for continuing school-based hygiene education. However, the present study did not evaluate an educational intervention or measure changes in behavior over time, so it cannot determine whether previous educational activities contributed to the reported handwashing practices.

The distribution of self-reported history of diarrhea showed that 46 students (88.5%) reported never having experienced diarrhea, while six (11.5%) reported one episode. Although the number of reported episodes was relatively small, the finding remains relevant because diarrheal disease can be associated with exposure to contaminated food, drinking water, and environmental sources. Handwashing is one component of prevention, but its contribution should be considered alongside safe drinking water, food hygiene, and sanitation (Wolf et al., 2022; World Health Organization, 2024).

Preliminary information indicated that students used different drinking water sources, including municipal water supplies, wells, and bottled mineral water, and that some purchased snacks outside the school. These observations provide context for understanding potential exposure pathways. However, the study did not test water quality, assess food contamination, or establish whether individual students' drinking water sources or snack-purchasing practices were associated with their reported diarrhea history. Therefore, these factors cannot be identified as causes of the reported episodes. Previous research has examined the relationship between hygiene-related behaviours and diarrhea among children, supporting the consideration of multiple hygiene practices when discussing diarrheal disease prevention (Aminah et al., 2024; Audini et al., 2024).

The association observed in the present study showed a different distribution of reported diarrhea history between the two handwashing behaviour categories. Among students with good handwashing behaviour, 37 of 39 (94.9%) reported never having experienced diarrhea, compared with nine of 13 (69.2%) students with fair behaviour. Conversely, two students (5.1%) in the good behaviour category and four (30.8%) in the fair behaviours category reported one episode. Fisher's exact test indicated that this difference was statistically significant ($p = 0.029$). The findings are consistent with previous research examining the relationship between handwashing behaviours and diarrhea among school-aged children (Resiyanthi et al., 2021; Resmawati et al., 2025).

Nevertheless, the observed association should not be interpreted as evidence that handwashing behavior alone determines whether a child experiences diarrhea. The study did not establish the temporal relationship between handwashing practices and the reported episodes. The specific recall period for diarrhea was also unavailable, making it difficult to determine when the episodes occurred relative to the reported handwashing behaviours. In addition, the study did not control for other potential factors, such as drinking water quality, food handling, sanitation, and exposure to infected individuals. The findings therefore support an association within the study population but do not establish a causal relationship.

From a biological perspective, contaminated hands can serve as a route for the transmission of microorganisms, particularly when children eat or touch their mouths without adequate handwashing. Proper handwashing can reduce this route of exposure, but it cannot eliminate all possible sources of infection. This is consistent with broader evidence examining the role of handwashing and other hygiene interventions in reducing the risk of diarrheal disease in children (Freeman et al., 2014; Wolf et al., 2022).

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The fact that two students with good handwashing behaviours reported diarrhea also illustrates that favorable reported practices do not necessarily prevent every episode of illness.

The findings support a comprehensive approach to hygiene promotion in elementary schools. School health programs can reinforce the six-step handwashing technique, encourage handwashing with soap at appropriate times, and promote access to functioning handwashing facilities. The availability of water and soap is an important practical consideration because children require suitable facilities to translate hygiene knowledge into daily behaviours (Nurwahidah, 2024). School-based programs may also benefit from cooperation among teachers, parents, and community health workers to reinforce consistent hygiene practices in different environments (Belangi et al., 2025; Tidwell et al., 2020). These measures should be accompanied by attention to food safety, safe drinking water, and environmental sanitation rather than relying on handwashing alone.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design does not establish the temporal sequence or causal relationship between handwashing behaviours and diarrhea. Second, the sample consisted of only 52 students from one elementary school, limiting the generalizability of the findings to other school populations. Third, only six students reported one episode of diarrhea, resulting in small cell frequencies and requiring the use of Fisher's exact test. Fourth, both variables were assessed through questionnaires, which may be affected by recall error or socially desirable responses. The specific recall period for diarrhea and the original scoring criteria for handwashing behavior were not available in the study documentation. Finally, potential environmental exposures, including drinking water quality, food hygiene, and sanitation, were not directly measured or controlled in the analysis.

Future studies could include larger samples from multiple schools, clearer operational definitions, validated measurement instruments, and a specified recall period for diarrhea. Direct observation of handwashing practices and assessment of relevant environmental conditions could also help clarify the relationship between hygiene behaviours and diarrheal outcomes. Longitudinal designs would be useful for examining whether handwashing practices precede subsequent episodes of diarrhea. These approaches would provide a stronger basis for understanding the contribution of hand hygiene to diarrhea prevention among school-aged children.

CONCLUSION

Six-step handwashing behaviours was significantly associated with self-reported history of diarrhea among fourth- and fifth-grade students (Fisher's exact test, $p = 0.029$). Students with good handwashing behaviours more frequently reported never having experienced diarrhea than students with fair handwashing behaviours. These findings support the promotion of proper handwashing practices as part of school-based hygiene efforts, alongside attention to food hygiene, safe drinking water, and environmental sanitation. However, the cross-sectional design, small number of reported diarrhea episodes, and reliance on self-reported data mean that the findings should be interpreted as evidence of an association rather than a causal relationship.

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