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Efektivitas pembelajaran berbasis kelompok sebaya dalam meningkatkan pengetahuan siswa sekolah dasar tentang pemantauan larva di Banda Aceh

Effectiveness of peer group-based learning in enhancing elementary students' knowledge of larval monitoring in Banda Aceh

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Abstract

Background: Dengue Hemorrhagic Fever (DHF) remains a major public health concern in Indonesia, with over 143,000 cases and an incidence rate of 51,5 per 100,000 population reported in 2023. Recurrent outbreaks in Banda Aceh highlight the need for sustainable, school-based prevention strategies. School-age children are highly vulnerable because *Aedes aegypti* mosquitoes bite during the daytime when children are at school.
Objectives: This study evaluated the effectiveness of elementary school peer groups in improving students' knowledge of dengue prevention through a school-based larval monitoring program.
Methods: A quasi-experimental pre–post design was conducted from April to October 2024 among fourth and fifth grade students in six elementary schools in the Kutaraja Sub-district, Banda Aceh City. Guided by Bandura's Social Learning Theory, 36 students were trained as peer educators to teach 120 peers (n = 120) about dengue prevention. Knowledge was measured using a 15-item Guttman scale questionnaire before and after the intervention. Data were analyzed using SPSS, including descriptive statistics, Kolmogorov–Smirnov normality tests, and paired *t*-tests (α = 0,05; 95% CI).
Results: The mean knowledge score increased from 9,43 (SD = 1,27) to 10,16 (SD = 1,34), a significant improvement (mean difference = 0,73; 95% CI: 0,41–1,05; $p < 0,001$).
Conclusion: Peer-group–based health promotion within schools is a promising approach to enhance dengue prevention awareness among children. Strengthening teacher facilitation and embedding structured peer education into school health programs may enhance long-term community participation in dengue prevention and control.

Keywords:
Dengue prevention, elementary student peer group, health promotion, larval monitoring, school-based intervention

Abstrak

Latar belakang: Demam Berdarah Dengue (DBD) tetap menjadi masalah kesehatan masyarakat yang utama di Indonesia, dengan lebih dari 143.000 kasus dan angka insidensi sebesar 51,5 per 100.000 penduduk yang dilaporkan pada tahun 2023. Kejadian luar biasa yang berulang di Kota Banda Aceh menyoroti perlunya strategi pencegahan yang berkelanjutan berbasis sekolah. Anak usia sekolah sangat rentan terhadap infeksi karena nyamuk *Aedes aegypti* aktif menggigit pada siang hari, saat anak-anak berada di sekolah.
Tujuan: Penelitian ini bertujuan untuk mengevaluasi efektivitas kelompok sebaya di sekolah dasar dalam meningkatkan pengetahuan siswa tentang pencegahan DBD melalui program pemantauan jentik berbasis sekolah.
Metode: Penelitian ini menggunakan desain kuasi-eksperimental dengan pendekatan pra–pasca intervensi yang dilaksanakan pada April hingga Oktober 2024 pada siswa kelas IV dan V di enam sekolah dasar di Kecamatan Kutaraja, Kota Banda Aceh. Berpedoman pada *Social Learning Theory* dari Bandura, sebanyak 36 siswa dilatih sebagai pendidik sebaya untuk memberikan edukasi kepada 120 siswa lainnya (n = 120) mengenai pencegahan DBD. Pengetahuan diukur menggunakan kuesioner berskala

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Guttman berisi 15 item sebelum dan sesudah intervensi. Analisis data dilakukan menggunakan SPSS, mencakup analisis deskriptif, uji normalitas Kolmogorov–Smirnov, dan *paired t-test* (α = 0,05; CI 95%).
Hasil: Rata-rata skor pengetahuan meningkat dari 9,43 (SD = 1,27) menjadi 10,16 (SD = 1,34), dengan perbedaan yang signifikan secara statistik (selisih rata-rata = 0,73; CI 95%: 0,41–1,05; p < 0,001).
Kesimpulan: Promosi kesehatan berbasis kelompok sebaya di sekolah menunjukkan potensi sebagai pendekatan yang menarik untuk meningkatkan kesadaran pencegahan DBD di kalangan anak-anak. Penguatan peran fasilitasi guru serta integrasi pendidikan sebaya secara terstruktur ke dalam program kesehatan sekolah dapat meningkatkan partisipasi masyarakat jangka panjang dalam pengendalian DBD.

Kata Kunci:
Pencegahan DBD, kelompok sebaya siswa sekolah dasar, promosi kesehatan, pemantauan jentik, intervensi berbasis sekolah

Introduction

Dengue Hemorrhagic Fever (DHF) remains one of the most significant vector-borne diseases in tropical and subtropical regions, including Indonesia. In 2023, Indonesia recorded 114,720 dengue cases and 894 deaths, with a Case Fatality Rate (CFR) of approximately 0,78%. By April 2024, more than 60,000 cases and 455 deaths have been reported nationwide (WHO, 2024; Ministry of Health, 2022a). These figures demonstrate that dengue continues to present a persistent public health challenge, reflecting the limited long-term impact of conventional vector control methods, such as fogging and insecticide spraying.

In Banda Aceh City, surveillance data show fluctuating dengue incidence over recent years—98 cases in 2021, rising to 366 in 2022, and 186 in 2023, before reaching 400 cases with three deaths in 2024, the highest in five years (Dinas Kesehatan Aceh, 2022; 2023; Munazir et al., 2024). Such variations are not merely epidemiological patterns but often reflect seasonal rainfall, population mobility, and declining community participation in source-reduction programs. Research in Aceh Province and other endemic areas indicates that lapses in household cleaning, water storage management, and community engagement are major contributors to the resurgence of mosquito breeding (Rahmawati et al., 2022; Ginting et al., 2023). This suggests that the persistence of dengue is not solely a biomedical issue but is closely linked to behavioral and environmental determinants that require consistent community involvement.

Health promotion efforts targeting children are particularly important because they play a pivotal role as agents of change within their families and communities. Evidence shows that when children acquire knowledge and skills related to health, they can influence the behaviors of parents, peers, and even broader community networks (Wijaya et al., 2025; Melnyk et al., 2020). School-based interventions have demonstrated that empowering children with health information can lead to measurable improvements in the lifestyle habits of household members, such as healthier eating and increased physical activity (Melheor et al., 2016). Furthermore, children's participation in structured health programs fosters communication about preventive practices and encourages the adoption of these behaviors among adults (Frontiers in Public Health, 2025). Research has also highlighted that children's health behaviors are closely linked to family and social contexts, creating reciprocal influences that reinforce collective well-being (Cai et al., 2022). Overall, these findings affirm that investing in child-centered health promotion benefits individual development and strengthens the health culture at the household and community levels.

Evidence further suggests that Schools serve as strategic entry points for dengue hemorrhagic fever (DHF) prevention because children aged 6–12 years spend a substantial portion of their daytime hours within school environments, increasing their risk of exposure to *Aedes aegypti* bites (Rahmawati et al., 2022). Poor school sanitation, inadequate waste disposal, and improper water storage practices are associated with higher mosquito densities and an increased risk of DHF among students (Ginting et al., 2023). Consequently, integrating health education and environmental management into school programs has been recognized as an effective strategy for enhancing dengue prevention practices (Suhariati & Ruliati, 2022). To maximize effectiveness, health education initiatives should be age-appropriate and developmentally tailored to improve comprehension and encourage sustainable preventive behaviors among children (Kurniawati et al., 2025; Suhariati & Ruliati, 2022).

Although national dengue control programs emphasize community-based larval surveillance and health education, sustaining public participation remains a challenge. The Larvae-Free Index (LFI), a key indicator of prevention success, is often below the national target due to inconsistent engagement of community volunteers and limited behavioral change (WHO, 2023; Ministry of Health, 2022b). In this context, schools represent an underutilized but strategic platform for dengue prevention, as children aged 6–12 years spend much of their daytime in school environments where *Aedes aegypti* mosquitoes are highly active. Poor sanitation, uncovered water containers, and waste accumulation on school grounds are associated with increased mosquito density and larval presence (Suhariati & Ruliati, 2022; Ginting et al., 2023). Health promotion initiatives that actively involve children have shown promise in influencing family and community behaviors. Studies have demonstrated that children can act as effective agents of change when equipped with knowledge and social reinforcement mechanisms (Melnyk et al., 2020; Wijaya et al., 2025). According to Bandura's Social Learning Theory (1986), individuals learn new behaviors by observing, modeling, and receiving feedback from their peers. Applying this concept to school-based programsthrough peer-led learningoffers an interactive and sustainable alternative to teacher-dominated health education. Peer group interventions have been shown to enhance comprehension, motivation, and behavioral adoption more effectively than traditional didactic methods (Kim et al., 2016; Cai et al., 2022).

Despite growing evidence supporting peer education in other health domains, such as nutrition and reproductive health, limited research has explored its potential in dengue prevention in Indonesia. Existing dengue education initiatives in schools remain largely top-down, short-term, and focused on information delivery rather than on behavior transformation. There is a need to evaluate innovative models that integrate peer group learning with practical, participatory activities such as larval monitoring.

Therefore, this study aimed to analyze the effectiveness of a peer group–based learning intervention in improving elementary school students' knowledge and participation in dengue larvae monitoring in Banda Aceh. This study addresses the evidence gap on child-centered, school-based dengue prevention strategies and provides insights into scalable, community-sustained vector control approaches.

Methods

This study adopted a quasi-experimental design with a pre- and post-test approach to evaluate the effectiveness of a peer group–based learning intervention in improving students' knowledge and practices regarding dengue prevention and larval monitoring. The quasi-experimental approach was selected because random assignment and control groups were not feasible in the school setting; however, this design allows for a meaningful assessment of change over time (Creswell, J. W., & Creswell, J. D. 2018).

A preliminary assessment conducted in April 2024 identified the Kutaraja Sub-district in Banda Aceh as the research site. Epidemiological data from the Banda Aceh City Health Office indicated that Kutaraja consistently recorded the highest number of dengue fever cases among the nine city sub-districts. According to the Banda Aceh Education Office, six elementary schools are located in this area, all of which were included as study sites to ensure representativeness.

Eligible participants were students enrolled in grades IV and V. Peer educators were selected based on academic performance, communication skills, leadership qualities, and peer acceptance, as recommended by classroom teachers. A total of 36 peer educators were selected from the six schools. This mixed selection approach minimized potential bias arising from academic ranking alone, ensuring the inclusion of socially influential students.

Peer educators participated in a three-day structured training program facilitated by the research team in collaboration with health promotion officers from the Lampaseh Kota Public Health Centre. The training curriculum was adapted from the WHO School-Based Dengue Prevention Guide (2023) and included (1) fundamental knowledge on dengue hemorrhagic fever (DHF): transmission, symptoms, and prevention; (2) practical techniques for identifying, collecting, and documenting mosquito larvae; and (3) communication and peer facilitation skills for classroom education. Each session lasted 4–5 hours per day and employed interactive methods (lectures, role play, demonstrations, and group discussions). A competency checklist and post-training quiz were used to assess understanding and readiness before the peer educators were deployed.

The intervention targeted 120 students (20 per school) from grades IV and V, selected by teachers overseeing School Health Units (SHU) or physical education programs. These students participated in peer-to-peer education led by trained peer educators under the supervision of teachers, researchers, and Public Health Centre staff. The intervention comprised three standardized components: (1) classroom-based peer learning sessions (2 × 60 minutes per week for three weeks); (2) extracurricular practical activities focused on identifying and eliminating mosquito breeding sites within the school and home environments; and (3) weekly reporting of larval monitoring observations submitted every Saturday to supervising teachers and reviewed by researchers. Standardized activity guidelines, session plans, and reporting forms were distributed to all schools to ensure consistency and faithfulness across sites. The supervising teachers documented attendance, adherence, and implementation quality in weekly monitoring sheets.

Students' knowledge was measured using a 15-item Guttman-scale questionnaire developed according to the national dengue prevention guidelines (Ministry of Health, 2022a). The instrument covered the domains of dengue definition, symptoms, transmission, prevention, mosquito life cycle, and responsibilities of the Larval Monitoring Students. Responses were scored dichotomously (1 = correct and 0 = incorrect). Prior to the study, the content validity was reviewed by three public health experts, achieving a Content Validity Index (CVI) of 0,92**.** The questionnaire was pretested among 30 non-participant students in a neighboring sub-district, yielding a Kuder–Richardson (KR-20) reliability coefficient of 0,83, indicating a good internal consistency.

Data analysis was conducted using IBM SPSS version 25.0**.** Descriptive statistics were used to summarize the frequency and percentage distributions of correct responses. Data normality was assessed using the Kolmogorov–Smirnov test (n = 120), which indicated normal distribution ($p > 0,05$). This justified the use of parametric tests for the analysis. The paired t-test was applied to compare the pre- and post-intervention mean knowledge scores, with a significance threshold of $p < 0,05$ at a 95% confidence interval. Although behavioral outcomes were not quantitatively analyzed, qualitative observations from teachers' weekly reports were reviewed to capture indications of improved hygiene practices and environmental awareness among students.

Ethical approval for this study was obtained from the Health Research Ethics Commission (KEPK)**,** Master of Public Health Postgraduate Program, Muhammadiyah University of Aceh**,** under certificate number 03/EA/KEPK/Unmuha/IV/2024**.** Parental informed consent and school principal permission were obtained prior to participation. All student data were anonymized to protect their confidentiality.

Results

Participant Characteristics

A total of 120 fourth- and fifth-grade students from six elementary schools in the Kutaraja Sub-district participated in the intervention. The mean age of the participants was 10,5 years (SD = 0,7), with 60% females and 40% males. Most participants resided within the Kutaraja Sub-district (67,5%), whereas 32,5% lived outside the area. This geographical distribution indicates that one-third of the students conducted larval monitoring beyond the primary intervention area, potentially influencing the consistency of household-level observations.

Knowledge Scores

Table 1 presents the distribution of correct responses to the 15 knowledge items on dengue hemorrhagic fever (DHF) before and after the peer-led intervention.

Table 1. Correct answers before and after intervention based on DHF knowledge items (n = 120)

Statements	Before		After	
	f	%	f	%
Definition of dengue fever	92	76,7	103	85,8
Mosquitoes that cause dengue fever	110	91,7	118	98,3
Signs and symptoms of dengue fever	60	50,0	64	53,3
How to transmit dengue fever	90	75,0	95	79,2
The way of cocoon life	64	53,3	105	87,5
Time when mosquitoes bite	38	31,7	66	55,0
How to avoid mosquito bites	111	92,5	112	93,3

Get to know the place where you live at home	95	79,2	115	95,8
Preventive measure	102	85,0	114	95,0
Mention efforts of 3M activities	94	78,3	104	86,7
Citing examples of 3M activities	102	85,0	110	91,7
Mention Plus activities	109	90,8	112	93,3
Keeping fish in a pond	78	65,5	107	89,2
Criteria to be a larva monitoring student	113	94,2	114	95,0
Student larval monitoring tasks	43	35,8	64	53,3

Table 2. Paired *t*-test of Students' Knowledge Scores (n = 120)

Intervention	Mean	Std. Deviation	Mean Difference	95% CI	p-value
Before	9,43	1,738	0,73	(0,413 -1,054)	0,001
After	10,16	1,545			

Before the intervention, four items were answered correctly by fewer than 60% of students: mosquito biting time (31,7%)**,** student larval monitoring tasks (35,8%)**,** signs and symptoms of dengue (50,0%), and the larval/pupal life cycle (53,3%)**,** After the peer-led intervention, all items showed improved correct response rates. However, three items—mosquito biting time (55,0%)*,* dengue signs and symptoms (53,3%)*, and* student larval monitoring tasks (53,3%), remained below 60%, suggesting that these domains may require more intensive or repeated instruction.

In contrast, notable gains were observed in understanding the larval life cycle (+34,2%) and keeping fish in ponds (+23,7%), indicating that visual- and practice-based learning components were effective.

Differences in knowledge scores before and after the intervention are presented in Table 2, which shows the results of the paired t-test comparing the mean knowledge scores before and after the intervention. Comparing students' knowledge scores before and after the intervention. Before the intervention through peer-group-based student larval monitoring in elementary schools in the Kutaraja Sub-district, the mean score was 9,43 (SD = 1,74), The findings also highlighted knowledge gaps, particularly regarding mosquito biting times, responsibilities in student larval monitoring, and common symptoms of DHF, Following the intervention, the mean score increased to 10,16 (SD = 1,55). The mean knowledge score increased from 9,43 (SD = 1,74) at baseline to 10,16 (SD = 1,55) after the intervention. The difference of 0,73 points was statistically significant ($p < 0,001$; 95% CI = 0,41–1,05).

Overall, all measured knowledge domains improved after the peer-based intervention, with the largest gains observed in the biological understanding of mosquito development and environmental control practices. Nevertheless, awareness of clinical symptoms**,** mosquito biting patterns, and specific larval monitoring duties remained comparatively low, suggesting that these areas may require reinforcement in future training or the inclusion of more visual and experiential learning approaches to enhance comprehension and recall.

Discussion

The findings of this study indicate that the peer-led larval monitoring and education program produced a statistically significant improvement in students' knowledge of dengue prevention. Although the mean increase was 0,73 points, it nonetheless suggests that peer-group-based learning can be an effective supplementary approach to enhance health knowledge among elementary students. Importantly, this improvement was limited to cognitive outcomes; behavioral and entomological indicators were not assessed in this study, so conclusions about the practical impact should be made with caution.

The peer-led approach is grounded in social learning theory, which posits that individuals acquire new knowledge and behavior by observing, imitating, and interacting with peers. Within the school context, peer groups create supportive environments that facilitate mutual learning, encourage responsibility, and reinforce desirable behaviors through modeling and feedback (Laursen & Birmingham, 2021; Benish-Weisman et al., 2021). When applied to dengue prevention, this framework allows children to internalize hygienic practices, such as identifying mosquito breeding sites and conducting 3M Plus activities, through shared experiences and social reinforcement rather than passive instruction.

Such peer dynamics may explain the observed improvements in understanding mosquito life cycles and environmental control strategies, which were among the most improved domains in this study. The statistically significant increase in knowledge observed in this study suggests that schools can serve as effective platforms for health promotion. Involving children as agents of change not only strengthens their understanding but also extends the benefits to families and communities. Teacher support was crucial for sustaining engagement and ensuring the program's success.

These findings are consistent with previous school-based dengue prevention studies conducted in Vietnam and Brazil, which also demonstrated positive gains in knowledge and participation following peer education intervention (Nguyen et al., 2021; Silva et al., 2022). However, the magnitude of improvement in the present study was smaller, possibly due to the shorter training duration and the absence of repeated reinforcement sessions. Unlike prior studies that incorporated community outreach or home-based larval inspections, this intervention was confined to the school environment, which may have limited the opportunities for broader behavioral reinforcement.

From a public health perspective, the results support the integration of structured peer education into existing school health programs, particularly in endemic urban settings such as Banda Aceh. By engaging students as "Larval Monitoring Cadres," schools can complement the formal vector control activities led by public health agencies. Teacher facilitation and local health center involvement were critical for maintaining program consistency and oversight, emphasizing the importance of multi-sectoral collaboration. Nevertheless, the modest gains observed also highlight that peer-based education should not replace traditional interventions but rather serve as a sustaining component of a broader dengue prevention strategy.

Despite these strengths, this study had some limitations. This study has several limitations. First, the absence of a control group limits the ability to attribute improvements solely to the intervention effect. Second, the follow-up period was short, preventing the assessment of long-term retention or behavioral changes. Third, reliance on self-reported knowledge may have introduced response bias. Finally, the study was limited to six schools in one sub-district, which constrains the generalizability of the findings to other settings in Indonesia.

Future research should include randomized or controlled designs, longer follow-up periods, and additional outcome measures, such as observed behavioral practices, household larva indices, or community-level entomological data. Evaluating the retention of peer educator competencies and assessing cost-effectiveness would also provide stronger evidence to inform large-scale implementations.

In summary, this study demonstrates that peer-group-based larval monitoring can enhance elementary school students' knowledge of dengue prevention. The findings reinforce the potential of peer-led education as a participatory and contextually relevant approach to strengthening community-based dengue prevention.

Conclusion

This study demonstrated that peer-group-based larval monitoring produced a statistically significant, though modest, improvement (mean difference = 0,73) in dengue prevention knowledge among elementary school students in Banda Aceh. The findings suggest that schools, with teacher facilitation, can serve as effective platforms for promoting dengue awareness and early vector surveillance through student participation.

While the results highlight the potential of empowering children as health promoters, the conclusions should be limited to knowledge outcomes, as behavioral and entomological impacts were not assessed. Future programs should consider expanding peer-led activities with teacher training and standardized educational modules to enhance continuity and integration into school routines.

Further research is recommended to evaluate changes in actual practices, larval indices, and entomological outcomes to determine whether knowledge improvement translates into measurable vector control and community-level benefits.

Conflicts of Interest

The authors declare no conflicts of interest in this study.

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