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The Implementation of Health Promotion in Preventing Dengue Hemorrhagic Fever (DHF) Through the Use of Lemongrass Leaves in Bath Water

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ABSTRACT

This study aims to analyze the implementation of promoting health to prevent Dengue Hemorrhagic Fever (DHF) by using inner lemongrass leaves in bathtubs. DHF is a disease caused by the dengue virus, which is transmitted by the *Aedes aegypti* mosquito. In Indonesia, the number of DHF cases continues to increase, with fluctuating numbers of cases and deaths every year. Therefore, efforts to prevent Dengue are crucial. This study was conducted in the Tambaksari District, Surabaya, which is an area endemic to DHF. The research method used is a case study, collecting data through field observations, interviews with various parties related to health, and data analysis using interactive models. The research results show that Lemongrass plants (*Cymbopogon nardus*) contain essential oils, especially citronella, which has larvicidal properties against *Aedes aegypti* mosquitoes. Lemongrass can be used in various ways, such as using lemongrass powder as a larvicide and spraying lemongrass spray as a repellent. This study concludes that using lemongrass leaves as part of health promotion can effectively prevent the spread of DHF. Measures like using lemongrass as a larvicide and repellent can help reduce the population of *Aedes aegypti* mosquitoes and lower the risk of being affected by DHF. Therefore, implementing health promotion through the use of lemongrass can be an effective strategy in controlling DHF.

Keywords: Aedes Aegypti; Dengue Hemorrhagic Fever (DHF); Disease Prevention; Health Promotion; Lemongrass Leaves

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is an acute fever disease caused by the dengue virus and spread through the *Aedes aegypti* mosquito. DHF is commonly referred to as "Break-bone" fever because it sometimes causes pain in the muscles and joints, making it feel as if bones are cracked. Symptoms experienced by those with DHF include a sudden and significant increase in body temperature, the appearance of red spots on the body, generalized body pain, nausea, vomiting, and dehydration (Soedarto, 2012).

In Indonesia, the incidence of DHF outbreaks tends to spread from cities to villages and then to surrounding areas in accordance with the distribution of residents. There has been an increase in the number of regencies or cities infected with DHF in almost all provinces, with fluctuating cases every year. According to data from the Ministry of Health Republic Indonesia in Kasenda et al. (2020), the total number of sufferers reached 100,347, with 907 deaths. In 2015, there were 129,650 sufferers and 1,071 deaths. Meanwhile, in 2016, there were 202,314 sufferers and 1,593 deaths. From January to May 2017, there were recorded 17,877 cases and 115 deaths. The Incidence Rate (IR) of pain in 34 provinces in 2015 reached 50.75 per 100 thousand population, while in 2016, it reached 78.85 per 100 thousand residents. These figures exceed the national IR target of 49 per 100 thousand population.

In East Java, the number of DHF cases in 2020 was recorded at 8,567, with 4,506 cases in men and 4,061 in women (East Java Department of Health Care Services, n.d.). In Surabaya, the number of DHF cases fluctuates annually, although there has been a downward trend over the past three years. In 2015, there were 640 cases, which increased to 938 in 2016 but decreased to 325 in 2017, 321 in 2018, and 277 in 2019, with 169 cases in men and 108 in women. Although the Incidence Rate (IR) in Surabaya is 9.59 per 100,000 population, lower than the government target of 49 per 100,000 population, the Case Fatality Rate (CFR) remains relatively high (>1%). The transmission of DHF in Surabaya is influenced by factors such as population density, mobility, urbanization, economic growth, community behavior, climate change, environmental sanitation, and water availability (Surabaya Department of Health Care Services, n.d.).

One natural method to control the vector responsible for DHF is the use of citronella (*Cimbopogon nardus L*). Compounds found in citronella, such as essential oils (esters), act as larvicides. Lemongrass essential oil contains citral, citronella, geraniol, myrsena, nerol, farnesol methyl heptanol, and dipetane. The citronella compound exhibits desiccant properties, causing dehydration and eventual death of mosquito larvae through fluid loss (Zulfikar et al., 2019). Research by Makkiah et al. (2019) demonstrated that citronella extract effectively killed 50% of test larval populations, with an LC50 value of 36.48% concentration and a required time of 10.45 hours. The strong aroma of citronella, particularly from citronella in lemongrass oil, is disliked by insects, including mosquitoes. Aji's study (2017) revealed that 77.5% of individuals who planted citronella in their yards did not find *Aedes aegypti* larvae in water reservoirs, indicating that the presence of citronella reduces the likelihood of larvae by 4.375 times.

Tambaksari District is one of the endemic areas for DHF in Surabaya. In 2019, there were 9 recorded cases with 1 fatality in Pacarkeling Village, resulting in a relatively high CFR (Surabaya Department of Health Care Services, n.d.). Spatially, Tambaksari is the sub-district with the largest population in Surabaya, totaling 214.97 thousand people. The population density in Tambaksari District was recorded at 23,912 people per square kilometer (km) (Statistics of Surabaya City, 2021). This high population density can contribute to an increase in the number of dengue cases, as urban areas tend to experience more cases than rural areas, especially in densely populated areas (Marlena et al., 2020).

The primary objective of this research is to investigate the effectiveness of using lemongrass (*Cymbopogon citratus*) leaves as a natural method for preventing DHF by inhibiting the breeding of Aedes mosquitoes in household water containers. Specifically, this study aims to (1) assess the larvicidal properties of lemongrass leaves in water containers used for bathing and (2) develop and propose a health promotion strategy that includes the use of lemongrass leaves for dengue prevention. This research holds significant importance in efforts to prevent DHF and improve public health. By exploring the use of lemongrass leaves as an innovative mosquito control method, this study introduces an environmentally friendly and sustainable approach.

LITERATURE REVIEW

Tapia-Conyer et al. (2012) conducted purposeful research to analyze the participation of the public in the prevention and control of DHF. The qualitative analysis results indicate that a dengue control program requires a clear and integrated approach with public involvement.

Murugan et al. (2015) synthesized gold nanoparticles (AuN) using the extract from *Cymbopogon citratus* leaves as a reducing and capping agent. Test results showed that a low dose of AuN can help increase the control of Anopheles and Aedes larvae populations.

Achee et al. (2015) conducted purposeful research to critically evaluate interventions and tools for vector control in the prevention of DHF. Using experimental methods, the study results showed a consensus that DHF elimination can be achieved by integrating vector control with vaccines.

Rather et al. (2017) analyzed prevention and control strategies against DHF. The results showed that the development of new vaccines is capable of reducing the infection of DHF virus.

Nuntaboot and Wiliyanarti (2017) conducted a purposeful analysis to examine the social capital existing in society and its use in combating DHF. The results showed that social capital, as a feature of the community, provides the main basis for collective action, forming real social capital in the prevention and control of DHF.

Rakhmani et al. (2018) analyzed related factors in the behavioral prevention of DHF. The study results showed that age, gender, length of stay, family size, and perception of DHF susceptibility are related to the behavior of preventing DHF.

Kumaran et al. (2018) conducted tests to determine the level of knowledge, attitudes, and practices related to vector control. The results showed that respondents have a high level of knowledge about DHF transmission, breeding, and prevention methods, but there is no correlation found between knowledge and practice.

Zulfikar et al. (2019) analyzed the utilization of lemongrass extract as an insecticide through fumigation. The results showed that the average number of dead mosquitoes was 18 (90%), demonstrating the effectiveness of lemongrass extract in controlling *Aedes aegypti* mosquitoes.

Swain et al. (2020) aimed to analyze the social and ecological factors related to DHF. The results showed that household factors such as work and living conditions play an important role in the incidence of DHF.

Sulistyawati et al. (2019) analyzed the level of knowledge, attitudes, and practices of the public in the prevention of DHF after intervention. The results showed that the knowledge score was relatively low, but attitudes and practices scores were moderate, indicating the need for both knowledge and motivation.

Farich et al. (2020) analyzed the influence of public empowerment on the prevention of DHF. The results showed differences in knowledge, attitudes, and behavior scores between the intervention and control groups.

Sim et al. (2020) analyzed the control program for DHF. Based on qualitative descriptive analysis results, the control program has a wider vision of effective environmental cleanliness.

Selvarajoo et al. (2020) analyzed the factors related to knowledge, attitudes, and practices in the prevention of DHF. The results showed that only half of the respondents had knowledge, and a significant portion had poor attitudes and practices toward DHF control.

Araújo et al. (2020) analyzed the spatial distribution of DHF and its relationship with social inequality. The spatial modeling explained 40% of the influence of social inequality on the incidence of DHF, with poverty and poor sanitation becoming significant factors.

Liu et al. (2021) conducted an analysis of the effective methods to reduce DHF transmission in construction sites and surrounding communities. The results of the analysis showed that interventions carried out by the public and in construction sites were very effective in reducing the spread of DHF.

RESEARCH METHOD

The type of research used in this study is a case study. This study was conducted in the Pacarkeling Village District Tambaksari, Surabaya City. Internal data sources for this study were obtained from various sources, including field observation results in the Village Pacarkeling, District Tambaksari, Surabaya City, interviews with several respondents, including DHF officers at the Community Health Center Ward Pacarkeling, Promkes officers at the Public Health Center Ward Pacarkeling, Surabaya City Health Service, Monitoring Officers of Larval Mosquitoes (Jumantik) in the Village Pacarkeling, Simultaneous Movement Team for Eradication of Mosquito Nests (PSN Bullying), community figures, and Village Residents of Pacarkeling, District Tambaksari, Surabaya City. The data analysis technique used in this study is an interactive model (Miles & Huberman, 1994).

RESULTS

Lemongrass Plant

Lemongrass is one type of grass that has long been cultivated in Indonesia. This plant originates from Malaysia and Sri Lanka. Lemongrass plants grow wild on the edges of rivers, swamp banks, and places close to water. Usually, this plant is cultivated in yards for use as a spice or medicinal plant (Muhlisah, 2012).

In Indonesia, lemongrass plants are widespread in almost all areas. Some of the named areas where the plant is found include: sere mangat, sere, sange-sange, sarai, sorai (Sumatra), lemongrass, sere, serai (Java), serai, belangkak, salai, segumau (Kalimantan), see, brokenampori, kendoung Witu, nau there, ma'am muke, tenian malai (Nusa Tenggara), sere, serai (Madura), tonti, timbu'ale, langilo, tiwo mbane, sare, sere (Sulawesi), tapisa-pisa, hisa-hisa, bewuwu, gara ma kusu, barama dull, racy (Maluku) (Dalimartha, 2008).

The Role of Lemongrass Plant (Cymbopogon nardus) in Inhibiting Mosquito Larvae Growth: Aedes aegypti

Lemongrass (*Cymbopogon nardus*) contains essential oils like citral, geraniol, citronellal, eugenol-methyl ether, dipentene, eugenol, kadinen, kadinol, and limonene (Muhlisah, 2012). The essential oil produced by Lemongrass consists of various compounds, with the largest compound being citronellal, accounting for 35%. Citronellal is one of the compounds capable of killing mosquito larvae, specifically *Aedes aegypti* larvae. The compound citronellal present in lemongrass is a foreign substance for the body of *Aedes aegypti* larvae. Citronellal has the characteristic of being a desiccant poison. According to its working method, this poison, when in contact, causes death by continuously depriving the mosquito larvae of fluid, leading to dehydration.

The compound citronellal enters the larval body through the body's surface wall, which is the outermost part of the larval body capable of absorbing insecticide in large amounts because this part directly interacts with the insecticide. Citronellal works by destroying or lysing the cell walls in larvae, allowing the compound to enter and spread throughout the body's cells. In this process, citronellal damages the metabolic functions of the cells, affecting the opening of larval spiracles, which results in the water (H2O) in the larval body being expelled or evaporating into the air. Conversely, the larvae will die due to the lack of O2 and H2O elements, causing dehydration and continuous fluid loss from the larval body. The affected insects will die due to the lack of fluids caused by this poison.

The Effectiveness of Lemongrass Leaf Extract

Following this, a number of research results related to the effectiveness of lemongrass plant extract as a mosquito larvicide have been compiled.

Table 1. The Effectiveness of Lemongrass Leaf Extract

No	Title, Name, Year	Objective	Results
1	The Mosquito Larvicidal Activity of Essential Oils from Cymbopogon and Eucalyptus Species in Vietnam (Manh et al., 2020)	For test effectiveness oil extracted astrim from *Cymbopogon citratus*, *Cymbopogon winterianus*, *Eucalyptus citriodora*, *Eucalyptus camaldulensis.*	The results show that all oil-extracted acid from a number of leaves show toxicity against *Aedes aegypti* larvae, esp oil astri from leaf *Eucalyptus camaldulensis* and *Cymbopogon winterianus* are the most efficient in control mosquitoes in the larval stage. Results obtained is as following: *Cymbopogon citratus* (LC_{50} = 120.6 ppm), *Cymbopogon winterianus* (LC_{50} = 38.8 ppm), *Eucalyptus citriodora* (LC_{50} = 104.4 ppm),

			Eucalyptus camaldulensis (LC $_{50}$ = 33.7 ppm)
2	Larvicidal activity of Cymbopogon citratus (DC) Stapf. and Croton macrostachyus Del. Against Anopheles arabiensis Patton, a potent malaria vector (Karunamoorthi & Ilango, 2010)	For test effectiveness oil extracted astrim from leaf *Cymbopogon citratus* and *Croton macrostachyus* as larvicide from *Anopheles arabiensis patton*, which is a powerful malaria vector in Ethiopia.	The results show that extract from leaf *Cymbopogon citratus* own activity powerful larvicide compared to with *Croton macrostachyus* at higher concentrations low. Results obtained is as following: *Cymbopogon citratus* (LC $_{50}$ = 74.02 ppm, LC $_{90}$ = 158.20 ppm), *Croton macrostachyus* (LC $_{50}$ = 89.25, LC $_{90}$ = 224.98)
3	Insecticidal Synergy of Essential Oils from Cymbopogon citratus (Stapf.), Myristica fragrans (Houtt), and Illicium verum Hook. f. and Their Major Active Constituents (Aungtikun et al., 2021)	For test effectiveness oil extracted astrim from *Cymbopogon citratus*, *illicium verum hook,* and *Myristica fragrans* to *Musca domestica* L.	The results show that the *combination of C. citratus, I. verum,* and *M. fragrans* is very effective in killing the insect *M. domestic*, as well as safe used for humans and the environment
4	Insecticidal and Repellent Activities of *Cymbopogon citratus* (Poaceae) Essential Oil and Its Terpenoids (citral and geranyl acetate) Against *Ulomoides dermestoides* (Plata-Rueda et al., 2020)	For test effectiveness oil astri from *Cymbopogon citratus* and its components (Citral and geranyl acetate) against insect *Ulomoides dermestoides.*	The results show that the component main oil Astrim Lemongrass is neral (24.6%), citral (18.7%), geranyl acetate (12.4%), geranil (12.3%), and limonene (7.5%). Oil lemongrass acid (LD50 = 5.17 µg insects –1), citral (LD50 = 4.17 µg insect –1), and geranyl acetate (LD50 = 7.21 µg insect –1) causes high toxicity to insect *Ulomoides dermestoides*. Survival rate life decreased to 65.7% in insects using the LD50 of the oil lemongrass astrim, 41.3% in insects fed geranil acetate, and 28% in treated insects citral.
5	Essential oils with Insecticidal Activity Against Larvae of Aedes aegypti (Diptera:	For test activity extracted insecticide from *Tagetes lucida, Lippia alba, Lippia origanoides, Eucalyptus citriodora, Cymbopogon citratus, Cymbopogon flexuosus, Citrus sinensis,*	The results show that all oil-tested essentials show activity insecticide. Following value obtained for *C. flexuosus* (LC $_{50}$ =17.1 ppm); *C. sinensis* (LC $_{50}$ =20.6 ppm); a mixture of *L. alba* and *L. origanoides* (LC $_{50}$ =40.1

	Culicidae) (Vera et al., 2014)	*Swinglea glutinosa, and Cananga odorata aromatic* against *Aedes aegypti* larvae.	ppm); *L. alba* (LC $_{50}$ =42.2 ppm); *C. odorata* (LC $_{50}$ =52.9 ppm); *L. origanoides* (LC $_{50}$ =53.3 ppm); *S. glutinosa* (LC $_{50}$ =65.7 ppm); *T. lucida* (LC $_{50}$ =66.2 ppm); *E. citriodora* (LC $_{50}$ =71.2 ppm); and *C. citratus* (LC $_{50}$ = 123.3 ppm). Oil astri of *C. flexuosus*, with citral (geranial+neral) as component main, show activity larvicide highest.
6	Effect of Cymbopogon citratus (Lemongrass) and Syzygium aromaticum (clove) Oils on the Morphology and Mortality of Aedes aegypti and Anopheles dirus Larvae (Soonwera & Phasomkusolsil, 2016)	For test effectiveness oil astri from *Cymbopogon citratus* and *Syzygium aromaticum* to Morphology and mortality of *Aedes aegypti* and *Anopheles dirus* larvae.	With concentrations of 1, 5, and 10%, results show for *Aedes aegypti*, second oil the cause deviation morphology such as deformed larvae, eclosion no perfect, white pupa, deformed pupa, normal pupa dead, and eclosion pupa not perfect. All deviations cause larval death. In *Ae. aegypti*, no There is difference significant mortality on days 1, 5, and 10 or between exposure to third and fourth larval instars. In *An. dirus*, deviation morphology seldom occurs and more *S. aromaticum* oil is effective. Second oil is also effective in causing death on day 1, 5, and 10. Second oil the experience enhancement LT level $_{50}$ from day 1 to 10.
7	*Cymbopogon citratus* Synthesized Gold Nanoparticles Boost the Predation Efficiency of the Copepod *Mesocyclops aspericornis* Against Malaria and Dengue Mosquitoes (Murugan et al., 2015)	For test effectiveness extract *Cymbopogon citratus and* biosynthesized AuN against the larvae and pupae of the malaria vector *Anopheles stephensi* and the dengue vector *Aedes aegypti*.	LC $_{50}$ extract from *Cymbopogon citratus* range between (219.32 ppm to 471.36 ppm). LC $_{50}$ of AuN range between (18.52 ppm to 41.52 ppm). Efficiency of the *Cyclopoid crustacean mesocyclops aspericomis* against *A. stephensi* larvae were 26.8% (larva I) and 17% (larva II). Whereas against *A. aegypti* was 56% (larva I) and 35.1% (larva II). Temporary efficiency against *A. stephensi* was 45.6% (larva I) and 26.7% (larva II), whereas against *A. aegypti* was 77.3% (larva I) and 51.6% (larva II)
8	Comparative Larvicidal Activity of Essential Oils from Three Medicinal Plants Against Aedes aegypti L. (Freitas et al., 2010)	For test activity larvicide oil extracted astrim from leaf *Alpinia speciosa*, *Cymbopogon citratus*, and *Rosmarinus officinalis* against *Aedes aegypti* larvae.	Larvae are observed for 4 and 24 hours accordingly with design random complete with three repetition and concentration following [ml/ml]: 0.25, 0.5, 1.0, 1.5, 2.0, 2.5, and control is distilled water, and commercial citral standard, camphor, eucalyptol,

			a-pinene, and b-myrcene. The test results show that Oil essential oils of *C. citratus* own LC50 (0.28) and LC90 (0.56) values were lowest, followed by *A. speciosa* (0.94 and 1.2, resp.) and *R. officinalis* (1.18 and 1.67, resp.), and only citral standard commercial and a-pinene which is larvicide.
9	Bioactivity against Tribolium castaneum Herbst (Coleoptera: Tenebrionidae) of Cymbopogon citratus and Eucalyptus citriodora Essential Oils Grown in Colombia (Olivero-Verbel et al., 2010)	For test toxicity from oil extracted astrim from *Cymbopogon citratus* and *Eucalyptus citriodora* to insect.	The results show that the component main oil *Cymbopogon citratus* namely geranial (34.4%), neral (28.4%), and geraniol (11.5%), while *Eucalyptus citriodora* that is citronella (40%), isopulegol (14.6%), and citronellol (13%). Dose 4-hour exposures were 0.021 and 0.084 mL $L^{-1,}$ respectively for *Cymbopogon citratus* and *Eucalyptus citriodora*. These results show that oil astri from *Cymbopogon citratus* and *Eucalyptus citriodora* potential as repellent insect
10	Adulticidal activities of Cymbopogon citratus (Stapf.) and Eucalyptus globulus (Labill.) Essential Oils and of Their Synergistic Combinations Against Aedes aegypti (L.), Aedes albopictus (Skuse), and Musca domestica (L.) (Soonwera & Sittichok, 2020)	For test activity oil astri *Cymbopogon citratus* and *Eucalyptus globulus* as well as the combination to *Aedes aegypti*, *Aedes albopictus*, and *Musca domestica.*	Effectiveness death to third insect combination *C. citratus* and *E. globulus* more tall compared to individual just. Combination of 7.5% *C. citratus* + 7.5% *E. globulus* and 10% *C. citratus* + 10% *E. globulus* show effectiveness highest to species with level 100% mortality at 1 and 24 hours later. Combination show effect synergistic, i.e effectiveness increases by 0.2 to 100%, with enhancement number mortality, compared with the individual. Effect synergistic highest to third species achieved with the combination of 2.5% *C. citratus* + 2.5% *E. globulus*, with enhancement mortality 36.6 to 100% and rate mortality 33.5 to 98.9%.
11	Activity of Activated Charcoal	For test influence citronella powder (*Cymbopogon nardus*)	Research result show that influence citronella powder as charcoal active to death flick

	Cymbopogon nardus as a Larvicide in Controlling the Larvae of Aedes aegypti (Ariana et al., 2023)	as charcoal packaged active in pocket for control of *Aedes aegypti* in tubs bathroom.	3rd instar *Aedes aegypti* mosquito.
12	Evaluation of Toxicity of Essential Oils Palmarosa, Citrohella, Lemongrass, and Vetiver in Human Lymphocytes (Sinha et al., 2014)	For test cytotoxic and genotoxic potential of oil acitri and monoterpenoids in lymphocytes man.	The test results show that fourth oil astri the considered safe for consumed man with concentration low.

The Implementation of Health Promotion
Findings from qualitative field exploration show that the implementation of health promotion in the prevention of DHF through the utilization of lemongrass leaves in bathtubs in Pacarkeling Village involves various approaches aimed at increasing understanding, changing behavior, and creating a supportive environment for prevention efforts.

Firstly, education serves as the main pillar in the health promotion model in Pacarkeling Village. Educational programs are organized, including campaign counseling by community health centers and the distribution of educational materials in the community. Interview results show that this approach successfully increases public knowledge about DHF, fostering a better understanding of the risks and possible preventive actions.

Public participation is another crucial component that cannot be ignored. Active participation in programs, such as the "Gotong Royong" campaign to clean up mosquito breeding sites together, instills a sense of ownership among the public towards prevention efforts. Deep interviews describe how public participation motivates individuals to maintain cleanliness in their environment collectively, thus forming a united defense against DHF.

Furthermore, the implementation of health promotion highlights collaboration between local government, health institutions, and society. Interview results demonstrate that close cooperation enables the sharing of resources, information, and necessary expertise to strengthen prevention programs. This collaboration not only expands program coverage but also improves efficiency in utilizing limited resources.

The effectiveness of prevention programs is also emphasized in this qualitative exploration. Evaluation of the impact and public response to certain programs is conducted regularly. Results from interviews and observations indicate that the effectiveness of prevention programs is measured not only by the decline in dengue cases but also by positive behavioral changes and increased public participation levels.

Lastly, this implementation of health promotion encompasses long-term planning to ensure the continuity of prevention efforts. Interviews with program organizers highlight the importance of building local capacity and ensuring that preventive practices become an integral part of the public's lifestyle. This long-term strategy is designed to create sustainable and transformative impacts on public health culture.

DISCUSSION

Based on field research findings in Pacarkeling Subdistrict, there is a serious challenge related to the lack of regeneration in the implementation of health promotion for the prevention of DHF. Although various efforts have been made to increase awareness and societal participation, several causal factors contribute to the lack of regeneration and maintenance of these preventive steps.

Firstly, the lack of regeneration can be caused by incompetence in implementing health promotion effectively to target the younger generation. A series of dengue prevention programs may not have succeeded in capturing the attention and involvement of the younger generation, resulting in limited knowledge and participation in preventive practices. This issue may arise because health promotion methods are inadequate in capturing the interests and specific needs of this age group.

Secondly, these challenges may be influenced by changing cultural trends and lifestyles in the village. If health promotion cannot adapt to changes in societal behavioral patterns, especially among the younger generation who may be inclined to follow new trends, the success of dengue prevention efforts could be threatened. A deep understanding of community behavior and the adaptation of health promotion models are important to overcome this obstacle.

Furthermore, the lack of regeneration may also stem from a lack of attractiveness or innovation in conveying the message of DHF prevention. Static and uninteresting promotional models can lead to a loss of public interest over time. Therefore, it is necessary to adopt creative, contextual, and engaging approaches to maintain public interest and involvement in DHF prevention.

The lack of involvement of the education sector and youth in the implementation of health promotion can also contribute to low regeneration. Schools and educational institutions play a vital role in imparting knowledge and promoting healthy behaviors among the younger generation. If health education is not adequately incorporated into the curriculum, it will be difficult to achieve optimal regeneration.

It is important to implement inclusive and sustainable health promotion, with a focus on fostering strong regeneration. Concrete steps may include revising educational programs to consider the preferences and needs of the younger generation, enhancing collaboration with educational institutions, and designing innovative and engaging campaigns on platforms favored by young people, such as social media.

In overcoming these challenges, close cooperation between the government, health institutions, society, and youth is crucial. Encouraging active participation of the younger generation in planning and implementing DHF prevention programs will facilitate more inclusive, adaptive, and sustainable health promotion efforts to safeguard public health in Pacarkeling Village (Gamaliel et al., 2022).

DHF continues to pose a national health threat, especially in urban sub-districts like Pacarkeling Village. Overcoming the complexity of this challenge requires innovative, participatory approaches that involve all segments of society and promote regeneration to ensure understanding and preventive action can be passed on to the next generation.

One key element in implementing health promotion is inclusive participation. This entails involvement from all segments of society, from the young to the elderly, ensuring fair representation from various social and economic groups. Public empowerment is crucial for fostering a deep understanding of DHF risks and preventive actions adopted by the entire community.

Importantly, inclusive participation also entails the involvement of the education sector by embedding health education in school curricula and activities (Polii & Permana, 2021). Engaging the younger generation directly through engaging and innovative educational programs is a long-term investment in creating a strong and sustainable prevention culture. Health education should not only inform but also inspire, motivate, and foster creativity to achieve optimal results.

Innovation is a key element in implementing health promotion. By leveraging modern technology such as smartphone applications, educational games, and social media platforms, people can reach a wider audience (Rahayuningrat et al., 2024). Innovative and engaging educational campaigns will generate individual interest, ensuring that the public not only receives information but also puts it into practice in their daily lives.

An innovative monitoring and supervision system can utilize technology to collect real-time data, provide immediate feedback, and respond quickly to changing trends. This allows for more accurate program evaluations and identifies areas in need of improvement or adjustment.

Regeneration, as the most crucial element, should be integrated with a focus on actively engaging the younger generation. Building a caring community involves their participation in training and skill development programs, as well as inclusive and challenging health-related activities. They are not only participants but also future leaders who can ensure the continuity of preventive actions.

Cooperation with non-governmental organizations, universities, and local businesses is also an essential part of this model. Involving external stakeholders allows access to additional resources, support for innovative campaigns, and the expansion of health messages to a broader segment of society.

CONCLUSION

The implementation of health promotion in the prevention of DHF in the Pacarkeling Village emphasizes education as the main pillar. The educational program encompasses various strategies to enhance societal understanding, change behaviors, and create a supportive environment for DHF prevention. One of the vector control efforts against dengue involves the use of citronella, which contains essential oil compounds functioning as larvicides. Specifically, citronellal can effectively eliminate *Aedes aegypti* mosquito larvae through dehydration. Studies have demonstrated the effectiveness of citronella extract in reducing mosquito larvae populations.

Dengue control cannot solely rely on government efforts but also necessitates active participation from the public. Through community development programs, the community engages in identifying problems, planning programs, and implementing preventive activities. Therefore, the implementation of health promotion through the use of inner lemongrass leaves for DHF prevention in the Pacarkeling Village serves as a model that can be applied widely to reduce the number of DHF cases in other endemic areas.

However, these efforts must continue to be supported by active participation from the public and coordinated efforts among various stakeholders to achieve optimal results in DHF prevention.

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