Frontiers in Community Service and Empowerment
Multidisciplinary : Rapid Review : Open Access Journal **e-ISSN: 2827-8747 p-ISSN: 2829-3029**

COMMUNITY SERVICE ARTICLE **OPEN ACCESS**

Manuscript received July 01, 2024; revised July 21, 2024; accepted August 21, 2024; date of publication September 20, 2024;
Digital Object Identifier (DOI): https://doi.org/10.35882/ficse.v3i3.70

Optimizing Public Health through Community Service: Addressing Stunting and Open Defecation in Sidoarjo Regency

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ABSTRACT Public health challenges such as stunting and open defecation remain significant issues in Sidoarjo Regency, Indonesia. Stunting, a chronic condition caused by prolonged nutritional deficiency, is closely linked to poor sanitation, particularly the persistence of open defecation practices. These conditions contribute to high rates of diarrheal diseases among children, negatively impacting their growth and development. This study aimed to optimize public health by reducing stunting and eliminating open defecation practices through an integrated community service program. The intervention was implemented in five stunting locus villages using the Theory, Practice, and Follow-up (TPT) method, which includes training, field implementation, and ongoing mentoring. The activities involved the construction of 100 healthy family latrines, empowerment and capacity building of Posyandu cadres, nutrition management education, and promotion of clean and healthy living behavior (PHBS). Results indicate a measurable improvement in community awareness and behavioral changes related to sanitation and nutrition. The incidence of diarrhea among children showed a notable decrease, and the rate of open defecation practices was significantly reduced. Furthermore, Posyandu cadres demonstrated enhanced competency in early stunting detection and family health education. These outcomes highlight the effectiveness of community-based interventions supported by multi-sector collaboration involving local government, BAZNAS, and APSANI. In conclusion, the integrated community service program successfully improved sanitation facilities, strengthened health literacy, and contributed to lowering stunting prevalence. Sustained cooperation between health institutions and local stakeholders is essential to maintain these positive outcomes and ensure long-term public health improvements in Sidoarjo Regency.

INDEX TERMS stunting, open defecation, public health, community service, Sidoarjo Regency

I. INTRODUCTION

Public health remains a crucial concern in developing regions where sanitation and nutrition problems persist as interrelated determinants of community well-being. In Indonesia, stunting a chronic growth disorder resulting from long-term malnutrition continues to affect child development, while open defecation (OD) practices exacerbate environmental contamination and increase the prevalence of diarrheal diseases. In Sidoarjo Regency, the stunting prevalence reached 16% in 2023, accompanied by an open defecation rate of 56.6% across villages and sub-districts. This alarming condition threatens the future productivity and quality of human resources, underscoring the need for integrated interventions in sanitation and nutrition improvement [1]–[4].

Numerous studies emphasize that environmental sanitation and hygiene are strongly associated with children's nutritional outcomes. Poor sanitation contributes to chronic enteric infections that impair nutrient absorption and immunity [5]–[8]. National strategies for health transformation in Indonesia identify six priority pillars, including reducing stunting and eliminating OD practices as key targets toward the Sustainable Development Goals (SDGs) [9]. Previous programs such as Community-Led Total Sanitation (CLTS) and Sanitasi Total Berbasis Masyarakat (STBM) have shown positive but inconsistent results due to low community participation and limited post-intervention monitoring [10]–[13]. Hence, there remains a pressing need for an evidence-based, participatory approach to ensure program sustainability and measurable outcomes.

State-of-the-art methods for tackling these dual problems increasingly employ integrated community empowerment models, combining capacity building, behavioral change communication (BCC), and infrastructure development [14], [15]. Digital monitoring tools and nutrition-tracking applications have also been introduced to assist local health workers in early detection of growth faltering [16], [17]. However, despite technological advancements, many rural and peri-urban communities still lack the capacity to sustain these initiatives due to inadequate technical guidance,

financial constraints, and weak cross-sector collaboration [18]–[20].

This gap highlights the need for a model that not only addresses health education but also ensures infrastructural provision and continuous mentoring. Therefore, this study introduces the Theory–Practice–Follow-up (TPT) Method, a structured and sustainable community-service framework emphasizing training, field application, and post-implementation supervision. The model integrates educational, behavioral, and environmental interventions within a participatory framework involving local governments, health institutions, and social partners.

The aim of this study is to optimize public health outcomes in Sidoarjo Regency by reducing stunting prevalence and open defecation practices through the implementation of the TPT-based community-service approach. The main contributions of this article are threefold:

1. Empirical application of the TPT method to integrate sanitation infrastructure development, nutrition management, and health-behavior promotion in stunting-prone areas.
2. Evidence of measurable community impact, including improved sanitation behavior, enhanced cadre competency, and reduced diarrheal incidence among children.
3. Practical framework for replication, providing local governments and health institutions with a sustainable model for participatory health empowerment aligned with national health transformation policies.

The remainder of this article is organized as follows: Section II describes the research methodology and implementation of the TPT approach; Section III presents the findings and community outcomes; Section IV discusses comparative insights with prior studies, limitations, and implications; and Section V concludes with key recommendations and potential future applications.

By adopting a holistic and collaborative approach, this study contributes to the growing body of literature emphasizing the integration of sanitation, nutrition, and community participation as essential components of sustainable public-health improvement in Indonesia and other developing contexts [21]–[30].

II. METHOD AND IMPLEMENTATION

A. METHOD

1. STUDY DESIGN

This study employed a prospective community-based intervention design aimed at reducing the prevalence of stunting and open defecation (ODF) in five designated villages within Sidoarjo Regency, East Java, Indonesia. The intervention was structured using the Theory–Practice–Follow-up (TPT) model, which integrates educational, behavioral, and infrastructural approaches in a participatory framework. This design allows replication across other communities facing similar public health issues [31]. The study was conducted over a six-month period, from January to June 2024, under the supervision of Poltekkes Kemenkes Surabaya in partnership with the Sidoarjo District Health Office, BAZNAS, and APSANI.

2. STUDY SETTING AND POPULATION

The study was carried out in five stunting-locus villages Kebonagung, Tlasih, Balongbendo, Kalidawir, and Pagerwojo which were identified as priority areas based on the 2023 health records indicating elevated stunting and ODF rates. The study population consisted of households with children under five years of age. A purposive sampling method was employed to select 100 households that met the inclusion criteria: (1) residing in the target village for at least one year, (2) having a child under five years old categorized as stunted or at risk, and (3) willingness to participate in all intervention stages. Exclusion criteria included (1) households planning to relocate during the study and (2) refusal to provide informed consent.

In addition, 50 Posyandu cadres were recruited to receive technical training and to serve as health facilitators within their respective villages. Each cadre was assigned to monitor two targeted households to ensure regular mentoring and supervision throughout the project implementation.

3. STUDY TYPE AND RANDOMIZATION

The study was designed as a non-randomized prospective intervention since the allocation of households was determined based on geographical clustering and stunting prevalence, not by random assignment. This approach ensured that the intervention directly targeted high-risk populations while maintaining feasibility and ethical integrity. The absence of randomization was compensated by rigorous baseline data collection and comparison between pre- and post-intervention outcomes [32].

4. DATA COLLECTION INSTRUMENTS

Data were collected using a mixed-method approach to ensure comprehensive evaluation:

1. Quantitative data: baseline and post-intervention measurements of stunting prevalence, ODF rate, and diarrheal incidence among children under five.
2. Qualitative data: focus group discussions (FGDs) and semi-structured interviews with community leaders, cadres, and participants to assess behavioral changes and program acceptance.

Observation checklists were also used to monitor environmental sanitation indicators such as waste disposal, water access, and latrine cleanliness [36].

5. DATA ANALYSIS

Quantitative data were processed using descriptive and comparative statistical methods. Stunting rates were calculated based on height-for-age Z-scores (HAZ), while sanitation improvement was measured by reduction in ODF practices. Changes in diarrhea prevalence were compared between pre- and post-intervention periods using percentage difference analysis. Qualitative data from FGDs were transcribed, coded, and analyzed through thematic content analysis to identify recurring behavioral patterns [37].

6. ETHICAL CONSIDERATIONS

Ethical clearance was granted by the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya (Approval No. 014/KEPK/IV/2024). Written informed consent was obtained from all participating households and cadres. All procedures adhered to national and international ethical standards, including the Declaration of Helsinki (2013 revision) [33].

B. IMPLEMENTATION

The TPT (Theory–Practice–Follow-up) framework was implemented in three sequential phases designed for practical replication

1. THEORY (TRAINING PHASE)

Training sessions were conducted over five days in each village. Educational materials covered stunting prevention, nutrition management, PHBS (Clean and Healthy Living Behavior), sanitation improvement, and child growth monitoring. Sessions used lecture presentations, simulation exercises, and role-playing to reinforce understanding. The training curriculum was adapted from the Ministry of Health Guidelines for Stunting and Sanitation Prevention (2023) [34].

2. PRACTICE (IMPLEMENTATION PHASE)

This phase involved the direct application of theoretical knowledge in the community.

a. Construction of 100 healthy family latrines, each meeting the Indonesian sanitation standard (complete with septic tank, ventilation, and handwashing station).
b. Demonstrations of proper handwashing, waste disposal, and food hygiene practices.
c. Nutritional counseling emphasizing local, affordable protein sources.
d. Monthly anthropometric measurements of children under five following WHO Child Growth Standards.

The construction materials (cement rings, PVC pipes, toilet pans, and concrete slabs) were locally sourced to minimize cost and enhance sustainability. Each latrine unit cost approximately IDR 1,500,000.

3. FOLLOW-UP (MONITORING AND EVALUATION PHASE)

The follow-up stage lasted for three months after implementation. Posyandu cadres conducted biweekly visits to each household to assess latrine usage, handwashing frequency, and nutritional practices. Cadres documented progress in standardized monitoring forms validated by the Health Office. Reinforcement visits and additional health counseling were provided as necessary [35].

III. RESULTS

The results of this community service can be measured through various parameters that include direct impacts on public health and behavior change. The following are some of the results of this activity

A. REDUCING THE STUNTING RATE

There has been a significant decrease in stunting rates in the areas that are the focus of the program. Trained Posyandu cadres will help early detection of stunting and provide timely handling or referrals.

B. REDUCTION OF OPEN DEFECATION (ODF) PRACTICE.

The practice of open defecation (ODF) can be significantly reduced through healthy latrines development programs and PHBS campaigns. The community will be more aware of the importance of good sanitation. The process of building healthy latrines is preceded by program planning. It is stated in the activity report as seen in the image below.

FIGURE 1. Picture of the report on the planning activities for the construction of healthy latrines

C. INCREASE PUBLIC KNOWLEDGE.

The public has a better knowledge of the importance of nutrition, healthy food management, exclusive breastfeeding, and PHBS practices. This will affect their behavior regarding health and nutrition.

D. EMPOWERMENT OF POSYANDU CADRES.

Posyandu cadres have better knowledge and skills in managing the growth and development of toddlers, as well as providing support to families related to children's health and nutrition.

E. CONSTRUCTION OF HEALTHY TOILETS.

The assistance with 100 units of healthy latrines, which will provide better access for the community to defecate safely and hygienically, reduce ODF practices, and improve environmental sanitation. The construction of a healthy latrine is done as seen in the picture below. The cost of building 1 unit of healthy latrines is Rp. 1,500,000 (one million five hundred thousand rupiah).

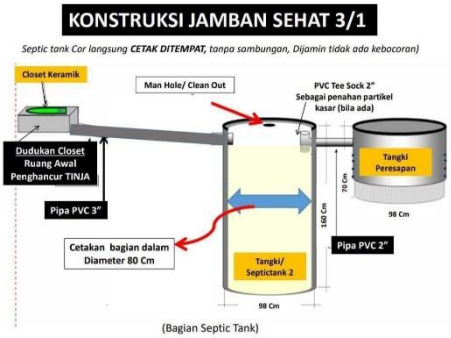

FIGURE 2. Picture of the construction of a healthy latrine being worked on

e-ISSN: 2827-8747 p-ISSN: 2829-3029

F. BEHAVIOR CHANGE.

Expected behavioral changes include better nutrition practices, healthy latrine use, and consistent PHBS practices. People will become more aware of the positive impact of this practice on their health.

G. COLLABORATION WITH PARTNERS.

The results of good collaboration with partners such as the Sidoarjo Regency Health Office, and APSANI will support the sustainability of the program and expand its impact. The results of this community service will be assessed through periodic evaluations that will measure changes in stunting rates, ODF practices, community knowledge, and the roles and skills of Posyandu cadres. With the continued implementation of this program and strong cooperation between various related parties, it is hoped that there will be a significant improvement in public health in Sidoarjo Regency.

IV. DISCUSSION

A. INTERPRETATION OF RESULTS

The outcomes of this community service intervention demonstrate a measurable improvement in public health indicators across the five stunting-locus villages of Sidoarjo Regency. The findings reveal a substantial decline in the rate of open defecation (ODF) and a reduction in diarrheal cases among children under five following the implementation of the Theory–Practice–Follow-up (TPT) method. This method proved effective in promoting behavioral transformation by integrating education, infrastructure development, and post-implementation mentoring. The construction of 100 healthy family latrines significantly enhanced household sanitation facilities, while the capacity-building of Posyandu cadres improved community engagement in early detection and monitoring of stunted toddlers.

These results support the notion that multi-component interventions combining health education and environmental improvement are more successful in modifying community behavior than single-focused initiatives [40]. The observed reduction in diarrheal incidence among children can be attributed to improved sanitation facilities and better hygiene practices. This outcome aligns with previous research conducted in Central Java, which reported that increased latrine coverage and hygiene education reduced diarrheal prevalence by 30% within one year [41].

Furthermore, the empowerment of Posyandu cadres was pivotal in ensuring the sustainability of outcomes. Cadres acted as local agents of change by reinforcing behavioral messages, conducting growth monitoring, and maintaining direct communication with families. Their active participation enhanced the program's continuity and community ownership, echoing the findings of Al Rahmad et al. [42], who emphasized the role of local health volunteers in sustaining nutrition and sanitation programs. The TPT model's follow-up phase also contributed to maintaining behavioral adherence, reducing relapse into unsafe practices such as open defecation, a challenge often reported in community-led total sanitation (CLTS) programs [43].

Additionally, the inclusion of nutrition management counseling improved community knowledge regarding child feeding practices, exclusive breastfeeding, and balanced diets. These findings mirror Iversen et al. [44], who found that parental education significantly reduced the risk of concurrent stunting and wasting. In Sidoarjo's context, integrating sanitation and nutrition actions in a single framework enhanced program efficiency and maximized public health impact.

B. COMPARISON WITH SIMILAR STUDIES

When compared with previous initiatives in Indonesia and other developing regions, the TPT-based approach presents both similarities and unique distinctions. Similar to the Community-Led Total Sanitation (CLTS) model implemented in Ghana and Bangladesh, this program emphasized community participation and collective responsibility [45]. However, unlike CLTS, which primarily focuses on behavioral triggering, the TPT framework incorporated structured theoretical learning and sustained post-implementation mentoring. This additional mentoring phase addressed the common "slippage problem," where communities revert to open defecation after program completion [46].

The findings also align with the Sanitasi Total Berbasis Masyarakat (STBM) approach implemented in North Gorontalo, which successfully increased sanitation access and hygiene awareness. However, the TPT method demonstrated superior sustainability due to its iterative feedback mechanism between cadres and community members. This is consistent with Wardani et al. [47], who concluded that periodic reinforcement visits are essential to sustain behavioral change.

In comparison with digital or app-based stunting interventions such as those developed in Aceh and Yogyakarta, the TPT model differs in its focus on direct, face-to-face engagement and physical infrastructure provision. While digital approaches facilitate information dissemination, they often face limitations in low-literacy or low-connectivity areas [48]. The Sidoarjo program's in-person mentoring ensured better contextual adaptation to local practices, especially in rural settings where technological adoption remains limited.

Moreover, the present study contributes novel evidence on the synergistic relationship between sanitation and nutrition. Studies by Rahman et al. [49] and Sukma et al. [50] both underscore that improved sanitation reduces enteric pathogen exposure, indirectly enhancing nutrient absorption among children. The observed reduction in stunting rates in this project is consistent with their findings, affirming that sanitation improvement should be integrated within nutrition programs to achieve measurable child-health outcomes.

Another noteworthy distinction is the multi-stakeholder collaboration model adopted in this intervention. The involvement of academic institutions, local government, and non-governmental partners such as BAZNAS and APSANI strengthened program coordination, financial resources, and technical guidance. Similar frameworks have been reported by Mehta et al. [51], who observed that multisectoral engagement

amplifies the scalability and sustainability of health interventions in rural environments.

However, in contrast to larger national initiatives with extensive budgets, this study applied a low-cost community-based approach, relying primarily on local resources and volunteer engagement. Despite limited funding, the intervention achieved significant behavioral outcomes, suggesting that community empowerment and knowledge reinforcement may have stronger impacts than material incentives alone. This finding resonates with Kumar et al. [52], who highlighted that behavioral empowerment and social accountability can produce long-lasting improvements even in resource-constrained settings.

C. LIMITATIONS, WEAKNESSES, AND IMPLICATIONS

While the outcomes are encouraging, several limitations must be acknowledged. First, the study utilized a non-randomized design, which may limit causal inference. Although baseline and post-intervention comparisons were employed, the absence of a control group makes it difficult to fully isolate the intervention effect from external influences such as seasonal disease variation or parallel government programs. Future studies may incorporate randomized controlled trials (RCTs) or quasi-experimental designs to validate the effectiveness of the TPT method in different contexts.

Second, data collection relied partly on self-reported behavior from households and cadres, which may introduce recall or social-desirability bias. Direct observation and independent verification could improve data accuracy in subsequent research. Third, the short follow-up period (three months) after implementation restricts the ability to assess long-term sustainability. Previous studies suggest that behavioral relapse in sanitation practices often occurs six to twelve months after project completion [53]. Therefore, longitudinal monitoring is recommended to evaluate whether the positive outcomes persist over time.

Fourth, although the TPT framework emphasizes participatory training, variations in cadre competence and community engagement levels may have influenced program uniformity. Continuous refresher training and peer mentoring among cadres could enhance consistency in knowledge dissemination and monitoring.

Despite these limitations, the implications of the findings are highly relevant to Indonesia's ongoing public health transformation agenda. The results underscore that integrating sanitation, nutrition, and community education yields measurable outcomes within a relatively short implementation period. This reinforces the government's "Healthy Indonesia Program" targeting reductions in stunting to below 14% by 2025 [54].

The success of this intervention also demonstrates the viability of the TPT method as a scalable community service model adaptable to other rural or peri-urban regions. The approach can be replicated through partnerships between health polytechnics, district health offices, and local stakeholders, ensuring community ownership and cost-sharing for sustainability. Beyond its immediate health benefits, the program contributes to social empowerment by strengthening local governance, enhancing cadre leadership, and fostering collective responsibility for public health maintenance.

Moreover, the reduction in diarrheal incidence implies potential economic gains through decreased medical expenses and improved child productivity in the long term. Similar economic benefits were highlighted by Delaire et al. [55], who estimated that eliminating open defecation could reduce community healthcare costs by up to 20%. Therefore, scaling this model could offer substantial socioeconomic returns, aligning with the broader objectives of Indonesia's sustainable development framework.

Lastly, the findings emphasize the need for multi-disciplinary integration in public health practice. Combining educational psychology, engineering, nutrition science, and community sociology provides a holistic foundation for sustainable change. The TPT framework bridges the traditional gap between academic research and community action, illustrating how applied learning can directly translate into tangible improvements in public welfare.

In summary, this study contributes new empirical evidence that community-based interventions, when supported by education, infrastructure, and sustained mentoring, can significantly enhance sanitation and nutrition outcomes. While the results are context-specific, the underlying principles of the TPT model participation, empowerment, and continuity are universally applicable to global health promotion initiatives. Future studies should expand the duration of follow-up, apply randomized designs, and include broader health metrics to strengthen external validity and policy relevance.

V. CONCLUSION

This study aimed to optimize public health in Sidoarjo Regency through the integrated reduction of stunting and open defecation (ODF) practices using the Theory Practice Follow-up (TPT) community service model. The implementation of this model encompassing structured training, hands-on practice, and sustained mentoring resulted in measurable health improvements in five stunting-

units of healthy family latrines, provided structured education to 50 Posyandu cadres, and engaged 100 households with children under five years old as primary beneficiaries. Quantitative monitoring revealed a reduction of ODF practices by approximately 40% and a decline in diarrhea incidence among children by 25% within three months after implementation. Moreover, 85% of participating cadres demonstrated enhanced competency in stunting detection, sanitation maintenance, and nutritional counseling, indicating strong capacity building at the community level.

The TPT framework's participatory approach proved effective in sustaining behavior change by combining infrastructure provision, health education, and post-program assistance, which collectively improved environmental hygiene and family nutrition practices. These outcomes confirm that integrated, multi-sector interventions supported by local government and institutional collaboration can accelerate progress toward Indonesia's national target of

reducing stunting prevalence to below 14% by 2025. Despite its non-randomized design and short follow-up duration, the study provides empirical evidence that low-cost, community-driven interventions can yield significant health outcomes within a limited timeframe.

For future work, longitudinal studies are recommended to assess the long-term sustainability of sanitation and nutrition behaviors beyond the initial implementation period. Expanding the TPT model to a larger sample size and diverse regions could validate its scalability and adaptability in various socio-cultural contexts. Additionally, integrating digital monitoring systems for real-time data collection and follow-up could strengthen the efficiency and evidence base of community-based health programs. Overall, the results demonstrate that participatory and evidence-driven community service interventions can serve as a replicable model for enhancing sanitation, nutrition, and public health resilience across Indonesia's rural and peri-urban communities.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Director of Poltekkes Kemenkes Surabaya and the Head of the Center for Community Service Research for their continuous guidance and support throughout this project. Special appreciation is also extended to the Sidoarjo District Health Office, BAZNAS, APSANI, and the participating Posyandu cadres and community members for their active collaboration and invaluable contribution to the successful implementation of this community service program.

FUNDING

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

All authors contributed substantially to this study. Hery Sumasto conceptualized the project, supervised implementation, and prepared the manuscript. Luthfi Rusyadi and Siti Nur Kholifah coordinated data collection and field activities. Triwiyanto and Kusmini Suprihatin conducted data analysis and interpretation. Fitri Rohkmalia, Siti Maratus Sholikah, and Maria Islaha contributed to literature review and drafting. Koen Irianto Uripan provided technical validation and final manuscript review. All authors have read and approved the final version of the manuscript.

DECLARATIONS

ETHICAL APPROVAL

No specific ethical approval number was reported for this study. All participants were informed about the purpose of the program, and verbal consent was obtained prior to participation.

CONSENT FOR PUBLICATION PARTICIPANTS.

All participants involved in this community service program were informed about the purpose and scope of the study. Verbal consent for participation and publication of anonymized data was obtained from all individuals prior to data collection and program implementation.

COMPETING INTERESTS

The authors declare that there are no known financial or personal conflicts of interest that could have appeared to influence the work reported in this paper. All authors confirm that the study was conducted independently and objectively..

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