

Integrated Health Screening and Community Empowerment to Address Health Issues and Nutritional Status

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Abstract

Kualeu Village, South Central Timor Regency, faces complex health issues with a toddler stunting rate of 56.55% and low coverage of infectious and non-communicable disease (NCD) case detection. This community service program aimed to increase the detection of new disease cases through integrated health screening and to improve the capacity of cadres and mothers in handling stunting and environmental health. The activities were conducted from 21–23 April 2026 using active screening methods, including AI-based portable X-ray technology, NCD screening, training on locally based complementary feeding (MP-ASI) preparation, baby massage techniques, and larval monitoring cadres (jumantik). The targets were 97 students of Anauban Junior High School and 113 residents at the Kualeu Village Office. Portable X-ray screening detected TB symptoms in 3 students (3.09%) and 4 villagers (3.54%). Malnutrition/underweight was identified in 25.77% of students and 17.70% of villagers. NCD screening among adults at the village office revealed high-risk rates: hypertension (23.01%), abnormal random blood glucose (21.24%), and abnormal uric acid (30.09%). All respondents (100%) tested negative for malaria. Educational activities focusing on MP-ASI training, baby massage, and Jumantik training successfully strengthened participants' knowledge and practical competencies. In conclusion, AI-based portable X-ray technology demonstrates strong effectiveness in enhancing active TB case finding in remote rural areas. The high burden of NCDs and malnutrition underscores the need for integrated follow-up interventions through strengthened primary health services (Posbindu and Posyandu) to support stunting reduction and improve population health outcomes.

Keywords: Portable X-ray, Stunting, Non-Communicable Diseases, Malaria, Kualeu Village.

Abstrak

Desa Kualeu, Kabupaten Timor Tengah Selatan, menghadapi masalah kesehatan kompleks dengan angka stunting balita mencapai 56,55% dan rendahnya cakupan penemuan kasus penyakit menular serta tidak menular (PTM). Kegiatan pengabdian masyarakat ini bertujuan untuk meningkatkan penemuan kasus baru penyakit terintegrasi melalui skrining kesehatan serta meningkatkan kapasitas kader dan ibu dalam penanganan stunting dan kesehatan lingkungan. Kegiatan dilaksanakan pada 21–23 April 2026 dengan metode skrining kesehatan aktif menggunakan X-ray portable berbasis kecerdasan buatan (AI) serta pemeriksaan PTM, pelatihan gizi/MP-ASI lokal, teknik pijat bayi, dan pelatihan juru pemantau jentik (jumantik). Sasaran kegiatan meliputi 97 siswa SMP Anauban dan 113 warga di Kantor Desa Kualeu. Skrining dengan X-ray portable mendeteksi gejala TBC pada 3 siswa (3,09%) dan 4 warga desa (3,54%). Kasus gizi tidak normal/kurang ditemukan pada 25,77% siswa dan 17,70% warga desa. Skrining PTM pada kelompok dewasa di kantor desa mendeteksi angka risiko tinggi: hipertensi (23,01%), gula darah sewaktu tidak normal (21,24%), dan asam urat tidak normal (30,09%). Seluruh responden (100%) menunjukkan hasil negatif untuk malaria. Kegiatan edukasi berupa pelatihan MP-ASI, pijat bayi, dan jumantik berhasil meningkatkan pemahaman serta keterampilan motorik praktis mitra sasaran. Kesimpulannya, Penggunaan teknologi X-ray portable berbasis AI sangat efektif meningkatkan penemuan kasus aktif TBC di wilayah pedesaan terpencil. Tingginya angka PTM

dan kekurangan gizi memerlukan tindak lanjut terintegrasi melalui optimalisasi layanan kesehatan primer (Posbindu dan Posyandu) guna mempercepat penurunan stunting dan peningkatan kualitas kesehatan masyarakat secara berkelanjutan.

Kata Kunci: Alat Rontgen Portabel, *Stunting*, Penyakit Tidak Menular, Malaria, Desa Kualeu.

A. INTRODUCTION

The main causes of the high stunting rate in TTS Regency include extreme poverty, which impacts very low family food security, resulting in very limited access to nutritious food. Due to limited access to clean water and poor sanitation, homes are not always equipped with adequate ventilation and SPAL (Fallo, 2020). Other diseases, such as tuberculosis, hypertension, diabetes, gout, and nutritional status, are also known as comorbidities. Inappropriate parenting patterns among children are associated with low parental education (Picauly & Toy, 2013). Socio-cultural factors, society believes that stunting is not a major problem, short children and low weight are considered normal and hereditary. Another problem is the average number of children, 4-5 children per family, with close birth spacing, and family planning coverage that only reaches 50% of fertile-age couples (PUS). (Boro, 2017; Fallo, 2020; Keban et al., 2023).

Kualeu Village is one of six villages in Mollo Tengah District and covers an area of 99,69 km², with a population of 8,233 people. Mollo Tengah District experiences an average rainfall of 60 days per year, with a maximum temperature of 28-34°C. It is located at an altitude between 100 and 400 meters above sea level, with 15% having a land slope of 0-25 = 21.98% (Badan Pusat Statistik Kabupaten Timor Tengah Selatan, 2025). The number of toddlers who visited the Integrated Health Post in February 2025 was 267; the number of toddlers with low and very low weight status was 121 (45.55%); and the stunting rate was 151 (56.55%). The majority of the population's occupations are farmers (Badan Pusat Statistik Kabupaten Timor Tengah Selatan, 2025).

The Mollo Tengah subdistrict has strong agricultural potential, supported by regional conditions and rainfall that foster the growth of horticultural commodities and medicinal plants. Various villages in this area consistently produce food crops such as curly chilies, bird's eye chilies, potatoes, cabbage, tomatoes, water spinach, and cucumbers, as well as herbal plants such as turmeric, galangal, ginger, temulawak, and lemongrass. The community's economic conditions are also supported by an adequate allocation of Village Funds, with 20 percent of the budget specifically prioritized for programs addressing stunting. Additionally, the majority of the population relies on rice, corn, and peanut cultivation as their primary source of livelihood. Economic and social activities are bolstered by the presence of community organizations that function effectively, particularly through farmers' groups and Micro, Small, and Medium Enterprises (MSMEs) engaged in food processing and vegetable marketing. In addition, Kualeu has an active woman's family welfare group (PKK), a village midwife, village health workers (TKD), and active posyandu cadres. There are two primary referral health centres serving the village, namely Binaus and Oinlasi Public Health Centres (Puskesmas). Six toddler Posyandu operate regularly every month and there is a supplementary feeding programme (PMT) for stunted children that provides milk, mung beans, brown sugar and eggs.

Although its economic and institutional potential is relatively strong, Kualeu Village still faces serious challenges in the area of environmental sanitation. 95% of Kualeu villagers use dug wells as their drinking water source. The quality does not meet physical requirements (cloudy, colored, and tasteless), although the construction has been met (the dug wells are protected). Some households still do not have latrines, and the village does not yet have a household wastewater drainage system (SPAL) that meets health requirements. As a result, stagnant water and unpleasant odours are commonly found in residential areas. Interviews with the village midwife and the head of Binaus Puskesmas indicate that the most common infectious and non-communicable diseases in the village include upper respiratory tract infections (ISPA), myalgia, headache (cephalgia), gastritis, skin allergies, rheumatoid arthritis, lacerations, vulnus laceratum, hypertension, anaemia, and diarrhea.

Based on this situational analysis in Kualeu village, several key problems faced by the community partners have been identified. The case detection rate for new cases of TB, hypertension,

DM, and gout is still low at 20%. Care for toddlers with malnutrition, undernutrition, and stunting is still lacking by 15%. Mothers and Posyandu cadres' knowledge of toddler eating patterns is still lacking, resulting in stunting every year (Kambuno et al., 2020). The stunting rate is still high with 151 children (56.55%). The number of toddlers with low and very low weight is 121 children. There are still 75% of residents who have houses with poor floors and ventilation. SPAL facilities are not yet adequately available, so household liquid waste is still stagnant. And There has never been any training on finding mosquito larvae in puddles and water sources.

The solutions used to address the problems in Kualeu Village refer to the transformation of primary health services and the transformation of health technology. The problems identified in the community and the solutions implemented were grouped into four main areas. The first problem was the low number of active TB findings and other health statuses (DM, AU, nutritional status and hypertension). To address this problem, TB screening and other health checks were conducted with the expected output being an increasing number of new cases found. The innovation or research output was the use of a portable X-ray method. The second problem is the limited knowledge and skills of mothers, posyandu cadres and TKD regarding the care of malnourished, undernourished and stunted toddlers, based on field observations and health worker report. The solution is to conduct training on baby massage techniques and stimulation techniques to support the growth and development of stunted toddlers. The expected output is participants' ability to correctly apply these techniques. The research output are standardized baby massage techniques and growth development stimulation techniques for stunted toddlers.

The third problem is the insufficient knowledge of mothers and Posyandu cadres regarding toddler eating patterns and complementary feeding. The solution is education on toddler dietary patterns and skills training to prepare complementary foods (MP-ASI) from local ingredients. The expected output is participants' ability to explain appropriate eating patterns and prepare varied MP-ASI from local foods. The research output is the development of MP-ASI variations based on local food ingredients. The fourth problem is the lack of public knowledge about the discovery of mosquito larvae. The solution is education and training on finding and managing mosquito larvae. The expected output is the formation of a Jumantik team from Anauban Middle School students. The research output is the utilization of simple mosquito larvae detection methods.

B. METHODS AND IMPLEMENTATION

This community service activity used a cross-sectional screening design combined with health education and skills training. The activities were conducted in Kualeu Village, Mollo Tengah District, in collaboration with the Binaus Community Health Center and the Local Department of Health. The program consisted of five main activities, (1) Socialization with Partners at Binaus Community Health Center involving the Sub-district Head, Health Center staff and Village Apparatus, (2) TB screening and other health checks (DM, AU, nutritional status, malaria and hypertension) among Junior high school students and the General public at the school and village office, (3) training on the care of malnourished toddlers, undernutrition, and stunting for posyandu cadres, the village midwife, TKD and mothers, (4) education and skills training on toddler eating patterns and preparation of complementary foods (MP-ASI) from local ingredients for posyandu cadres, the village midwife, TKD and mothers, (5) education and training to find mosquito larvae.

The target population for the screening component was all residents of Kualeu village who attended the screening event, with a focus on Junior high school students and the General public. Inclusion criteria were residents of Kualeu village or students attending the Junior high school Anauban, willing to participate in the screening, and able to provide verbal informed consent (or consent from parents/guardians for minors). Exclusion criteria were individuals who were ill to undergo examination.

Participants for the screening were recruited through coordination with the sub-district head, village apparatus, school principals and the Binaus Community Health Center. Information about the screening activity was disseminated through community announcements and school channels. Prior to screening, verbal informed consent was obtained from all adult participants as well as parents

or guardians. The consent process included an explanation of the purpose, procedures, benefits and voluntary nature of participation, as well as assurance that personal data would be kept confidential and used only for health service and reporting purposes.

Screening was conducted by a joint team from the community service project and the Binaus Community Health Center, consisting of general practitioners, nurses, midwives, nutritionists, medical laboratory technologists, sanitarians and trained enumerators under the supervision of Binaus Community Health Center. The following tools were used is digital sphygmomanometer, Glucometer, uric acid meter, microtoise, digital scales, Rapid Diagnostic Test (RDT), and X-ray portable. All examiners received a brief standardization session before the activity to ensure uniform measurement techniques.

Blood pressure was measured after at least 5 minutes rest with participants in a seated position. Blood glucose and uric acid were using capillary blood samples according to the manufactures's instructions. Height and weight were measured with participants removing shoes and heavy clothing. Malaria screening was performed using Rapid Diagnostic Test (RDT) malaria from finger prick capillary blood following national guidelines. Screening for TB was conducted using a portable chest X-Ray. Definition of abnormality following national guidelines and standard cut offs. Hypertension was defined as systolic blood pressure > 140 mmHg, diastolic blood pressure > 90 mmHg. Hyperglycaemia was set at random blood glucose $\geq$ 200 mg/dL, and hyperuricaemia at serum uric acid >7.0 mg/dL in men and >6.0 mg/dL in women. Suspected TB was identified by clinical symptoms (cough $\geq$ 2 weeks, night sweats, or unexplained weight loss) and suggestive portable chest X-ray findings, requiring referral for sputum confirmation. Malaria was defined as a positive RDT result. All participant with abnormal screening results received individual counselling and were directed for referral to the Binaus Community Health Center.

C. RESULTS AND DISCUSSION

The activity was carried out over 3 days, namely April 21-23, 2026, involving 97 respondents at Anauban Middle School and 113 at the village office. The characteristics of the respondents are shown in Table 3 below. Females (55.67%) and those aged 13-14 (67.01%) were the largest groups among respondents at Anauban Middle School. Female gender (60.18%) also dominated at the village office location, followed by ages 20-64 years (83.19%) and elderly people, with only 19 people (16.81%).

Table 3. Respondent characteristics.

Characteristics	Total (n,%)
Anauban Middle School	
Gender	
Woman	54 (55.67%)
Man	43 (44.33%)
Age	
13 – 14 years	65 (67.01%)
$\geq$ 15 years	32 (32.99%)
Kualeu Village Office	
Gender	
Woman	68 (60.18%)
Man	45 (39.82%)
Age	
20 – 64 years	94 (83.19%)
$\geq$ 65 years	19 (16.81%)
MPASI Cooking Demo Participants	
Mother has a toddler	15 (57.69%)

Cadre	8 (30.77%)
TKD	3 (11.54%)
Baby Care/Baby Massage Training Participants	
Mother has a toddler	15 (57.69%)
Cadre	8 (30.77%)
TKD	3 (11.54%)
Participants in the Skills Training find mosquito larvae	
Woman	15 (45.45%)
Man	18 (54.55%)

Table 4. Examination results.

Screening Results	SMP Anauban	Kualeu Village Office
Tuberculosis (X-ray portable)		
Radiological findings suggestive of TB	3 (3.09%)	4 (3.54%)
No radiological findings suggestive of TB	94 (96.91%)	109 (96.49%)
Contact history of TB patients		
Yes	5 (5.15%)	6 (5.31%)
No	92 (94.85%)	107 (94.69%)
Smoking History		
Yes	6 (6.19%)	45 (39.82%)
No	91 (93.81%)	68 (60.18%)
Blood Pressure		
TD normal	93 (95.88%)	87 (76.99%)
Abnormal BP	4 (4.12%)	26 (23.01%)
Nutritional status		
Normal Nutrition	72 (74.23%)	93 (82.30%)
Malnutrition	25 (25.77%)	20 (17.70%)
Blood Sugar During		
GDS normal	92 (94.85%)	89 (78.76%)
GDS is not normal	5 (5.15%)	24 (21.24%)
Guric Acid		
AT normal	97 (100%)	79 (69.91%)
AU is not normal	0	34 (30.09%)
RDT Malaria		
RDT negative	97 (100%)	113 (100%)
RDT positive	0	0

The results of the examination are shown in Table 2 below. Examinations using a portable X-ray machine at the school revealed that 3 students (3.09%) exhibited symptoms of TB. Data from interviews also showed that 5 students (5.15%) had a history of contact with TB patients and 6 students (6.19%) had a history of smoking. Most students had normal blood pressure, whereas 4 students (4.12%) showed abnormal blood pressure. There were still 25 students (25.77%) with abnormal nutritional status, 5 students (5.15%) with abnormal GDS, and all had normal uric acid levels and tested negative for malaria.

Different examination data were found at the village office, where the majority of respondents were adults (aged >20 years). The results of portable X-ray photos found 4 people (3.54%) who showed symptoms/suspicions of TB. The interview results also showed that there were 6 people (5.31%) who had a history of contact with TB patients, there were 45 people (39.82%) who had a history of smoking, there were still 26 people (23.01%) who had symptoms of hypertension, 20 people (17.70%) were malnourished, there were 24 people (21.24%) who had symptoms of DM and

34 people (30.09%) who had abnormal uric acid levels. The same thing at the school location, where no malaria parasites were found in the malaria RDT examination (Table 2).

The results of the examination using a portable X-ray are shown in the image below. The reading uses AI technology, and the high AI score results (symptomatic TB) are shown in Photo 1; conversely, Photo 2 shows the low AI score results (no symptoms of TB).

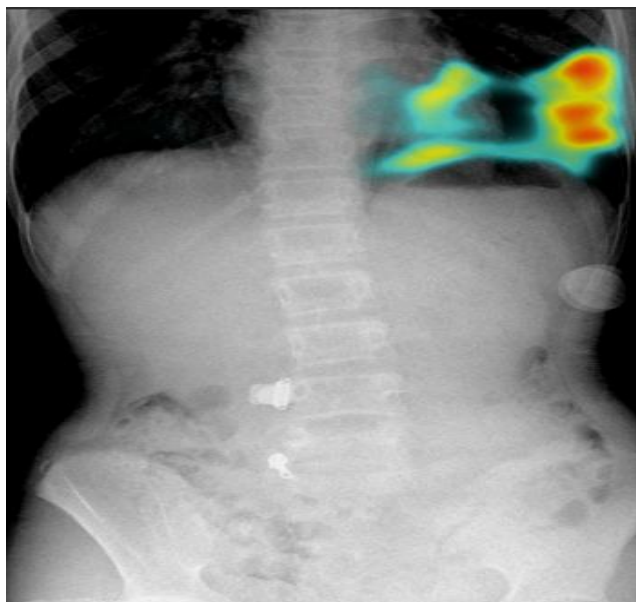


Photo 1. Results of X-ray photo with X-ray, the score shows symptoms of TB.

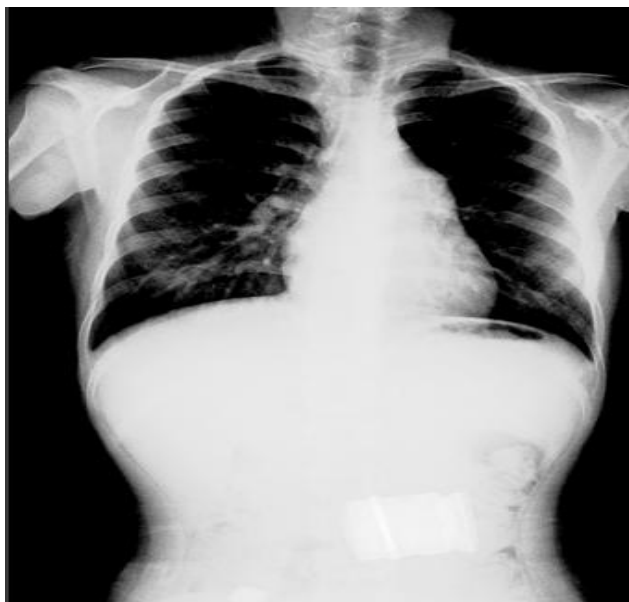


Photo 2. X-ray results with X-ray, AI score shows negative for TB.

Portable X-ray technology in this study offers a significant tactical advantage over conventional passive case-finding methods. This device can reach remote areas or specific populations (such as schools and village offices) without requiring individuals to visit referral health facilities. It enables rapid early detection by providing instant radiological images (Kambuno et al., 2025). Early detection is crucial because patients at Anauban Junior High School often overlook early clinical symptoms, 3 symptomatic subjects were identified (3.09%), while at the Kualeu village office, 4 symptomatic subjects were found (3.54%). This device is also suitable for efficient mass screening, as it can be used for initial screening (triage) prior to molecular confirmation using a Rapid Molecular Test (RMT) (Vo et al., 2021).

The low national rate of new case detection, with an estimated case detection gap of around 50–60%, is associated with limited active screening efforts. The finding that 3.54% of subjects in Kualeu Village showed radiological symptoms indicates that active transmission within the adult population remains high. If these symptomatic patients are not treated promptly, they will continue to serve as active reservoirs of transmission in their surrounding environment (Ku et al., 2021; Sari et al., 2025).

Data show that there were 5 subjects (5.15%) at Anauban Middle School and 6 subjects (5.31%) at Kualeu Village Office with a history of close contact with active TB patients. The risk of active TB is higher in individuals who have close contact with active pulmonary TB patients (Du et al., 2023). Close contacts who do not show radiological signs of active disease are likely to have Latent Tuberculosis Infection (LTBI). Without intervention, approximately 5–10% of them may develop active TB in the future (Krishnan et al., 2023). Identifying individuals with a history of close contact is therefore an important target for the provision of Tuberculosis Preventive Therapy (TPT), particularly among school-aged children and vulnerable adults, to prevent progression to active disease. The nationally low coverage of TPT provision should be addressed through direct outreach to close-contact groups identified during this screening (Kambuno et al., 2025; Rahmalina & Darmawan, 2026; World Health Organization, 2025).

The significant difference in smoking behavior between adolescents at Anauban Junior High School (0.06% smokers) and adults at Kualeu Village Office (39.82% smokers) explains the linear correlation with the high prevalence of TB symptoms at the village level. Cigarette smoke permanently damages the lungs' physical defense mechanisms by paralyzing mucosal cilia and decreasing alveolar macrophage activity. This makes it easier for germs to invade. *Mycobacterium tuberculosis* colonizes and accelerates the progression of latent infection into active TB, which damages the lung parenchyma (Feldman et al., 2024).

The nutritional status condition in NTT is one of the health indicators that has received the most national attention because it is closely related to the prevalence of *stunting*. Screening data showed very alarming rates of malnutrition in both groups: A total of 25 subjects (25.77%) were malnourished in Anauban Middle School; 20 subjects (17.70%) experienced malnutrition at the Kualeu Village Office.

The high rate of malnutrition among school-aged adolescents (25.77%) at Anauban Middle School indicates a long-term threat. Adolescent girls who experience chronic malnutrition (especially Chronic Energy Deficiency/CED) are at high risk of giving birth to babies with Low Birth Weight (LBW) in the future and perpetuating the chain of malnutrition. *stunting* (Fauziyah & Putri, 2023; Pujiyanti et al., 2025). Protein and micronutrient malnutrition reduce cellular immunity (especially T cells and macrophages). This establishes a bidirectional vicious cycle, in which malnutrition increases susceptibility to TB infection, while TB infection exacerbates malnutrition through increased protein catabolism (Franco et al., 2024).

The double burden of disease is clearly evident from the results of non-communicable disease (NCD) screening, particularly among adults at the Kualeu Village Office. The data show a high prevalence of three major degenerative diseases. The figure of 23.01% in adults confirms that hypertension has become a real threat at the rural level. This pattern is heavily influenced by lifestyle, high salt intake, and the high number of active smokers (39.82%) in the village, which triggers blood vessel stiffness (*arteriosclerosis*) (Jareebi, 2024; Tsirimiagkou et al., 2021).

The discovery of more than one-fifth of the adult population (21.24%) with abnormal blood sugar levels is a strong alarm signal for the primary healthcare system. If left untreated, this pre-diabetes or uncontrolled diabetes will trigger systemic vascular damage (micro- and macroangiopathy) and facilitate secondary infections such as pulmonary tuberculosis and UTIs because the high-sugar environment is highly favorable for pathogenic bacteria (Abbas et al., 2022). The high prevalence of hyperuricemia (30.09%) in rural communities is closely associated with the consumption of purine-rich foods. If left untreated, this condition will progress to Gouty Arthritis, which disrupts the physical productivity of working-age people (Uhlig et al., 2023).

Malaria examination using the Rapid Diagnostic Test (RDT) method showed highly positive results. Although East Nusa Tenggara Province has historically been a malaria-endemic area in Indonesia, the zero (0%) result from this active screening demonstrates the success of the malaria elimination program at the local level. This decrease in cases was influenced by the success of the mass distribution of insecticide-treated bed nets, management of stagnant water around residential areas, and the speed of diagnosis and treatment using Artemisinin-based Combination Therapy (ACT) (Herdiana et al., 2025).

However, epidemiological vigilance must be maintained through active and regular surveillance. The absence of active cases during screening does not necessarily mean the mosquito vector is absent. It does not indicate that *Anopheles* mosquitoes have completely disappeared from the NTT region, but rather that the transmission chain of *Plasmodium* parasites is currently at a low or controlled level (Keven et al., 2022; Nalinya et al., 2022).



Photo 3. Tuberculosis Examination Activity with Portable X-ray Phototransmission



Photo 4. Blood sugar examination activities, uric acid, BP measurement, and malaria detection.



Photo 5. Photo of Malaria Screening Activity



Photo 6. Training on Identifying Mosquitoes in Water Sources

The second-day activities were held at the Kualeu Village Office and attended by 113 community members. The event began with an opening by the village head. This was followed by a health check



Photo 7. Blood sugar, blood pressure and uric acid examination activities



Photo 8. TB symptom examination activity and confirmation of X-ray results



Photo 9. Taking a portable X-ray photo



Photo 10. Interview for nutritional status examination and RDT Malaria examination



Photo 11. Cooking demonstration activities and training in making MPASI menus



Photo 12. Massage training activities to stimulate the baby's growth and development

Clinical Action and Policy Recommendations from this community service activity include: 1) TB Case Follow-up: Conduct TCM confirmation examinations on 4 subjects with radiological findings suggestive of TB in Kualeu and 3 subjects in Anauban Middle School. Provide Tuberculosis Preventive Therapy (TPT) immediately to identified close-contact groups. 2) Specific Nutrition Intervention: Provide a recovery Supplementary Feeding Program (PMT) rich in animal protein for 25% of malnourished students at Anauban School to prevent long-term risks of anemia and prospective KEK mothers. 3) Active PTM Posbindu: Activate the Integrated Guidance Post (Posbindu) in Kualeu Village to conduct regular monitoring and treatment management for 23% of hypertension sufferers and 21% of abnormal blood sugar sufferers to prevent complications of stroke and kidney failure.

CONCLUSION

Health screening activities using portable X-ray technology successfully identified 3 subjects (3,09%) with radiological findings suggestive of TB at Anauban Junior High School, and 4 subjects (3,54%) with radiological findings suggestive of TB at Kualeu village office. In addition, cases of non-communicable diseases (diabetes, gout, and hypertension) were also identified, indicating the need to strengthen the primary health care system in managing and following up on these cases. The absence of malaria cases warrants follow-up by monitoring the effectiveness of the mosquito larvae detection training provided to students to ensure vector prevention efforts at the community level.

The high prevalence of undernutrition identified is also a cause for concern. Accordingly, the Binaus Community Health Center and the local Department of Health are advised to integrate these screening results into a system for periodic case monitoring and referral, while the training on preparing complementary foods and infant care that has been conducted should be accompanied by ongoing monitoring by Posyandu volunteers and village midwives to assess its impact on improving nutritional status in Kualeu Village.

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