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EFFECTIVENESS OF A RHIZOME-BASED HERBAL DRINK WITH LIME IN REDUCING GOUT PAIN AMONG THE ELDERLY

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Abstract

Purpose: This study aimed to examine the effectiveness of a rhizome-based herbal drink combined with lime in reducing gout-related pain among elderly individuals. **Methodology:** This study employed a quantitative approach using a quasi-experimental design with a nonequivalent control group. A total of 20 elderly participants with chronic gout pain were selected through purposive sampling and divided into an intervention group (n = 10) and a control group (n = 10). Pain intensity was measured using the Numeric Rating Scale (0–10) before and after the intervention. Data were analyzed using descriptive statistics and the Wilcoxon Signed Rank Test with a significance level of $p < 0.05$. **Findings:** The results showed a significant reduction in pain scores in the intervention group, from 6.80 ± 0.79 to 3.80 ± 1.14 ($p = 0.004$). The control group also showed a reduction, from 6.50 ± 0.71 to 5.20 ± 1.32 ($p = 0.009$), but the magnitude of pain reduction was greater in the intervention group. **Practical/Social Implications:** These findings indicate that rhizome herbal drinks with lime can be applied as a safe, affordable, and easily implemented non-pharmacological therapy in community-based elderly care, particularly to reduce dependence on long-term pharmacological treatment**. Originality/Value**: This study provides empirical evidence on the effectiveness of a locally available herbal combination as a complementary therapy for gout-related pain among the elderly in a community setting, an area that remains underexplored in previous research.

Keywords: gout pain, elderly, herbal drink, rhizome, lime

1. INTRODUCTION

Pain caused by gout is one of the most common joint disorders among older adults worldwide and is a major contributor to limited mobility and decreased quality of life (World Health Organization, 2022). In Indonesia, the prevalence of gout increases with the growing elderly population, accompanied by a higher risk of long-term complications that require effective management (Kementerian Kesehatan Republik Indonesia, 2021).

Pharmacological therapy is commonly used to relieve pain; however, long-term use may lead to various adverse effects (Joyce L. Kee, 1996). Herbal therapies based on rhizomes, such as turmeric, have been reported to possess anti-inflammatory and analgesic properties in patients with chronic joint pain (Nugroho, A. E., 2021). In addition, the incorporation of lime, which is rich in vitamin C, is believed to enhance anti-inflammatory effects and contribute to pain reduction in joint disorders (Pratama, 2021).

Although rhizome-based herbal therapies have been widely studied, limited research has specifically evaluated the combination of rhizomes and lime in elderly patients with chronic gout-related pain, particularly within local community settings in Indonesia. Empirical evidence regarding the effectiveness of this herbal beverage in reducing pain among older adults remains scarce.

Addressing this research gap is important to provide a non-pharmacological alternative therapy that is safe, affordable, and easy to implement at the community level, thereby improving the quality of life of older adults without the long-term side effects associated with pharmacological treatment.

Based on this background, the present study aims to evaluate the effectiveness of a rhizome-based herbal drink combined with lime in reducing gout-related pain among older adults in Sukamukti Village, Katapang District, Bandung Regency.

2. METHODOLOGY

2.1 Research Design

This study employed a quasi-experimental design with a nonequivalent control group design to evaluate the effectiveness of a rhizome-based herbal drink supplemented with lime on gout-related pain among older adults. This design was selected because it allows for comparison between intervention and control groups without full randomization, making it appropriate for quantitatively assessing the effects of herbal therapy in community settings (Sugiyono., 2022).

2.2 Setting and Time

The study was conducted in Sukamukti Village, Katapang District, Bandung Regency. Data collection took place in July 2025. As several participants lived at considerable distances from the village center, data collection was carried out at each participant's home. For efficiency, participants were divided into small groups, and visit schedules were arranged based on prior agreement.

2.3 Population and Sample

The study population consisted of all older adults with chronic gout residing in RW 08 and RW 09 of Sukamukti Village, totaling 163 individuals (Sugiyono., 2022). The study sample was selected using purposive sampling, a non-probability sampling technique based on specific considerations, namely older adults experiencing joint pain due to chronic gout (Sugiyono., 2022)

Based on methodological considerations for experimental studies involving intervention and control groups, 10 participants were assigned to each group, resulting in a total sample of 20 respondents ((Sugiyono., 2022).

Sample Criteria
Inclusion criteria:

1. Aged 60–75 years
2. Diagnosed with chronic gout
3. Serum uric acid levels above normal laboratory reference values (men >7 mg/dL, women >6 mg/dL)
4. Experiencing joint pain related to gout within the past month
5. Willing to participate in and complete all study procedures

Exclusion criterion:

1. History of allergy to turmeric or lime

2.4 Instruments and Variables

1.4.1 Independent Variable

The independent variable was rhizome-based herbal drink therapy with lime, administered once daily before bedtime in accordance with the standard operating procedure (SOP).

1.4.2 Dependent Variable

The dependent variable was **pain intensity**, measured using the **Numeric Rating Scale (NRS) ranging from 0 to 10**, where:
0 = no pain,
1–3 = mild pain,
4–6 = moderate pain,
7–10 = severe pain.

1.4.3 Validity and Reliability

The Numeric Rating Scale (NRS) has been widely used and demonstrates high validity and reliability for measuring pain intensity in older adult populations.

2.5 Data Collection Procedure

Data collection was conducted in several stages. Participants were recruited based on the predetermined inclusion and exclusion criteria. Baseline pain intensity (pre-test) was assessed prior to the intervention. Participants in the intervention group then received a rhizome-based herbal drink combined with lime for seven consecutive days, administered as one glass before bedtime each night. After completion of the intervention period, pain intensity was reassessed (post-test). All collected data were systematically recorded and compiled for statistical analysis.

2.6 Data Analysis

1. Data were analyzed using SPSS version 23.
2. Data normality was assessed using the Shapiro–Wilk test. As the data were not normally distributed, the Wilcoxon Signed-Rank Test was used to examine differences in pre-test and post-test pain scores within each group.
3. Statistical significance was set at $p < 0.05$.
4. Results were analyzed using descriptive statistics (mean ± standard deviation) and inferential statistics (Wilcoxon test).

2.7 Ethical Approval

This study received ethical approval from the Institute for Research and Community Service (LPPM), Universitas Bale Bandung, with approval number 10/LPPM-UNIBBA/III/2025. All participants were provided with complete information regarding the study objectives, procedures, potential benefits, and possible risks, and written informed consent was obtained prior to participation. The study was conducted in accordance with ethical principles for human research, including confidentiality of data and participant safety.

3. RESULTS AND DISCUSSION

3.1 Results

1.1.1 Respondent Characteristics

Table 1 presents the demographic characteristics of the respondents, including gender, age, educational attainment, and employment status, across the intervention and control groups

Table 1. *Respondent Characteristics by Group*

Characteristics	Intervention (n = 10)	Control (n = 10)	Total (n = 20)
Gender			
Female	7 (70%)	8 (80%)	15 (75%)
Male	3 (30%)	2 (20%)	5 (25%)
Age (years)			
60–65	4 (40%)	5 (50%)	9 (45%)
66–70	6 (60%)	5 (50%)	11 (55%)
Education			
Elementary school	5 (50%)	7 (70%)	12 (60%)
Junior/Senior high school	5 (50%)	3 (30%)	8 (40%)
Employment status			

Unemployed	6 (60%)	6 (60%)	12 (60%)
Employed	4 (40%)	4 (40%)	8 (40%)

Narrative:

Table 1 shows that the majority of respondents in both the intervention and control groups were female, aged 66–70 years, had an elementary school education, and were unemployed.

1.1.2 Changes in Gout Pain Scores Before and After the Intervention

Table 2 presents a comparison of pre-test and post-test gout pain scores in the intervention and control groups following the intervention.

***Table 2**. Changes in Gout Pain Scores Before and After the Intervention*

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	p-value
Intervention (n = 10)	6.80 ± 0.79	3.80 ± 1.14	0.004
Control (n = 10)	6.50 ± 0.71	5.20 ± 1.32	0.009

Narrative:

Table 2 shows that pain scores in the intervention group decreased from 6.80 ± 0.79 to 3.80 ± 1.14 after the administration of the rhizome herbal drink with lime, with a statistically significant reduction (Wilcoxon Signed Rank Test, $p = 0.004$).

In the control group, pain scores also decreased from 6.50 ± 0.71 to 5.20 ± 1.32 ($p = 0.009$); however, the magnitude of reduction was smaller compared to the intervention group. These findings indicate that the rhizome herbal drink combined with lime is effective in reducing gout-related pain among older adults.

Statistical analysis was performed using the Wilcoxon Signed Rank Test due to non-normally distributed data, as indicated by the Shapiro–Wilk normality test ($p < 0.05$). Pain intensity was measured using the Numeric Rating Scale (NRS) ranging from 0 to 10, where 0 indicates no pain, 1–3 mild pain, 4–6 moderate pain, and 7–10 severe pain.

3.2 Discussion

Gout-related pain is a significant health problem among older adults, as it can limit mobility and reduce quality of life (World Health Organization, 2022). This study is important because it evaluates the effectiveness of a rhizome-based herbal drink combined with lime as a safe, low-cost, and easily applicable non-pharmacological alternative therapy in community settings.

The results of this study indicate that the administration of the rhizome herbal drink with lime significantly reduced pain scores in the intervention group compared to the control group ($p = 0.004$). Although a reduction in pain scores was also observed in the control group ($p = 0.009$), the magnitude of the decrease was smaller. This reduction may have been influenced by factors such as researcher attention, natural symptom fluctuation, or individual variations in pain perception.

These findings support the research hypothesis that rhizome herbal therapy combined with lime is effective in reducing gout pain among older adults. The results are consistent with previous studies by Nugroho et al. (2021), which reported that curcumin in turmeric has anti-inflammatory and analgesic effects, as well as findings by Pratama (2021), suggesting that the addition of lime enhances the effectiveness of herbal therapy in managing chronic joint pain.

Despite the observed reduction in pain in the control group, the findings demonstrate the superior effect of the herbal intervention compared to the control condition. This provides practical implications that the rhizome herbal drink with lime may be used as a complementary intervention in older adult communities to reduce dependence on long-term pharmacological treatment and to improve quality of life.

This study also provides a foundation for future research by recommending:

1. Involving larger sample sizes to improve the generalizability of the findings.

2. Extending the duration of the intervention to evaluate its long-term effects on pain reduction.
3. Exploring other herbal combinations or different dosage regimens to identify the optimal approach for managing chronic joint pain in older adults.

4. CONCLUSIONS

This study concludes that the rhizome-based herbal drink combined with lime is effective in reducing gout-related pain among older adults. A significant decrease in pain scores was observed in the intervention group after the administration of the herbal drink, with a greater magnitude of reduction compared to the control group.

These findings indicate that rhizome herbal therapy with lime can serve as a safe, affordable, and practical non-pharmacological intervention for managing gout pain in community-dwelling older adults. The results support the potential use of this herbal drink as a complementary therapy to improve pain management and quality of life among the elderly population.

Future studies are recommended to involve larger sample sizes, extend the duration of intervention, and explore different herbal combinations or dosages to further strengthen the evidence and optimize pain management strategies for gout in older adults.

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FORMULATION AND PHYSICAL STABILITY TESTING OF A FACIAL SERUM GEL CONTAINING GOTU COLA (CENTELLA ASITICA (L.)) LEAF EXTRACT WITH VARIYING OF CARBOMER CONCENTRATIONS AS A GELLING AGENT

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Abstract

Centella asiatica (L.) Urb. is a medicinal plant rich in bioactive compounds such as alkaloids, flavonoids, tannins, triterpenoid saponins, and asiaticosides, which exhibit antioxidant and skin-regenerating activities. This study aimed to formulate a gotu kola extract serum and evaluate the effect of different carbomer concentrations on its physical characteristics.

Three formulations were prepared using carbomer at concentrations of 0.5% (F1), 1% (F2), and 2% (F3). The formulations were evaluated for organoleptic properties, homogeneity, pH, viscosity, spreadability, and physical stability over 28 days at room temperature. The pH values ranged from 5.2–5.8, meeting the acceptable range for topical application (4.5–6.5). Viscosity increased with higher carbomer concentration, measuring 1,250 cP (F1), 2,480 cP (F2), and 4,150 cP (F3). Spreadability values were 6.8 cm (F1), 5.4 cm (F2), and 4.1 cm (F3), indicating an inverse relationship with viscosity. All formulations remained homogeneous and physically stable without phase separation.

Among the tested formulations, F1 (0.5% carbomer) demonstrated optimal characteristics, including appropriate viscosity, good spreadability, and faster skin absorption.

Keywords: serum formulation; gotu kola; Centella asiatica; carbomer

1. INTRODUCTION

Indonesia is recognized for its rich diversity of medicinal plants, many of which have been traditionally utilized for health and cosmetic applications. One of the most widely used plants is gotu kola (Centella asiatica), which contains bioactive compounds such as triterpenoids, flavonoids, alkaloids, and saponins. These constituents exhibit antioxidant, antibacterial, and skin-regenerating activities, and saponins are also associated with facial-brightening effects [6].

Healthy and bright facial skin is often linked to beauty and self-confidence [5]. However, facial skin is highly susceptible to environmental and physiological stressors. Skin aging is a multifactorial process influenced by intrinsic and extrinsic factors and is characterized by hyperpigmentation, dryness, decreased elasticity, and wrinkle formation [5]. In addition, facial skin contains a high density of sebaceous glands, making it more prone to acne and excessive oil production when pores become clogged by sebum and impurities [1]. These conditions increase the demand for safe and effective topical formulations.

Serum is a topical preparation with relatively low viscosity and a high concentration of active ingredients, allowing faster penetration and efficient delivery of bioactive compounds [8]. In gel-based systems, carbopol (carbomer) is commonly used as a gelling agent due to its ability

to form a stable three-dimensional polymer network, providing suitable viscosity and formulation stability.

Based on these considerations, this study aimed to evaluate the physicochemical characteristics and stability of a Centella asiatica gel serum formulated with varying carbomer concentrations through organoleptic, pH, homogeneity, viscosity, spreadability, and adhesiveness tests after 28 days of storage [8]

2. METHODOLOGY

2.1 Plant Determination

Plant identification of Centella asiatica (L.) Urb. was conducted at PT Phytochemindo Reksa, Bogor, using morphological characteristics and taxonomic keys to confirm species authenticity.

2.2 Preparation of Gotu Kola Extract (Centella asiatica **(L.))**

Dried C. asiatica simplicia powder (1000 g) was extracted by maceration using 96% ethanol at a 1:3 (w/v) ratio. The mixture was kept at room temperature (25 ± 2°C) for 72 hours with occasional stirring. The filtrate was collected, and the residue was re-macerated twice. Combined extracts were concentrated under reduced pressure at 40–45°C to obtain a thick extract.

2.3 Preparation of Gotu Kola Extract Gel Serum

All ingredients were weighed (w/w and v/w, as applicable). Carbopol was dispersed in 20 mL of hot distilled water, allowed to hydrate, and then triturated until a thick gel base was formed (M1). Methyl paraben, propyl paraben, and BHT were dissolved in propylene glycol and stirred until homogeneous (M2). M1 and M2 were then combined in a mortar and mixed thoroughly until uniform. After the serum base was formed, the gotu kola leaf extract (active ingredient) was added, followed by fragrance as needed, and mixed until homogeneous. Finally, the remaining distilled water was added to reach the specified final weight.

Table 1. *Formulation of Facial Gel Serum Containing Gotu Kola Leaf Extract (Centella asiatica (L.))*

Ingredient	**F I**	**F II**	**F III**	Literature range	**Function**
Gotu kola Leaf Extra**ct** (Centella asiatica (L.)	10 %	10%	10%	0 – 15 %	Active ingredient
Propylene Glycol	30%	30%	30%	≤ 30 %	Humectant
Carbopol	0,5%	1%	2%	0,5 – 2 %	Gelling agent
Triethanolamine	1%	1%	1%	24 %	Alkalizing agent
Methyl paraben	0,18%	0,18%	0,18%	0,02 – 0,3 %	Preservative
Butylated hydroxytoluene (BHT)	0,1%	0,1%	0,1%	0,1 % - 0,2 %	Antioksidant
Propyl Paraben	0,02%	0,02%	0,02%	0,01 – 0,6 %	Preservative
Fragrance	Qs	Qs	Qs	-	Fragrance
Distilled water (Aqua destillata)	Ad 100 ml	Ad 100 ml	Ad 100 ml	-	Solvent

2.4 Evaluation of Gel Serum Formulation

2.4.1 Organoleptic Evaluation

The organoleptic evaluation included assessment of color, odor, and skin feel. The serum was observed visually for appearance (e.g., color and clarity) and evaluated for odor and sensory feel upon application. A stable preparation is indicated by the absence of changes in color and odor during storage [4].

2.4.2 Homogeneity Test

Homogeneity ensures uniform distribution of active compounds within the gel base. A non-homogeneous preparation may result in dose inconsistency and reduced therapeutic efficacy [13].

2.4.3 Viscosity Measurement

Viscosity determines flow behavior, application characteristics, and residence time on the skin. Most gel preparations exhibit non-Newtonian (pseudoplastic) flow behavior, where viscosity decreases with increasing shear rate [14].

2.4.4 Acidity (pH) Test

A small amount of the serum was applied to a pH strip, and the resulting color was matched to the pH indicator chart to determine the pH value. The acceptable pH range for facial skin is 4.5–6.5 [3].

2.4.5 Spreadability Test

Spreadability is an important characteristic of gel preparations, as the product should spread easily when applied to the skin. The spreadability test was performed to assess the ability of the gel serum to spread quickly and evenly on the skin surface, which may influence drug release and therapeutic effectiveness. An optimal spreadability value for gel preparations is generally in the range of 5–7 cm [9].

2.4.6 Physical Stability Test

Stability studies evaluate changes in color, odor, pH, viscosity, and phase separation during storage. Accelerated stability testing is recommended to predict shelf life under defined conditions [6].

3. RESULTS

3.1 Organoleptic Test

The results of the organoleptic evaluation of the gel serum containing *Centella asiatica* leaf extract are presented in Table 2.

Table 2. *Organoleptic Evaluation Results of Gotu Kola Gel Serum*

Sample	Color	Odor	Consistency	Skin feel
FI	Clear yellowish	Characteristic gotu kola extract odor	Moderately thick	Soft; cooling sensation on the skin
F II	Clear yellowish	Characteristic gotu kola extract odor	Moderately thick	Soft; cooling sensation on the skin

Carbomer concentrations were 0.5% (F I), 1% (F II), and 2% (F III). All formulations showed a clear yellowish color, a characteristic Centella asiatica odor, and a soft, cooling skin feel. Overall, organoleptic properties were not substantially affected by carbomer concentration.

3.2 Acidity (pH) Test

The pH values of the gel serum containing *Centella asiatica* (L) leaf extract presented in Table 3

***Table 3**. pH Measurement Results*

Formula	pH	Standard Range
Formula I (0.5% carbomer)	5.0	pH 4,5-8,0 SNI 16-4399-1996
Formula II (1% carbomer)	5.0	
Formula III (2% carbomer)	6.0	

Carbomer concentrations of 0.5%, 1%, and 2% produced pH values of 5.0, 5.0, and 6.0, respectively. All formulations were within the acceptable range for topical preparations (4.5–8.0) and the physiological skin pH range (4.5–6.5). The slight increase in pH in Formula III may be related to the higher carbomer concentration and its neutralization during gel formation. However, the difference was minimal, indicating that carbomer concentration had limited influence on the overall acidity of the formulation. The mildly acidic pH supports skin compatibility and helps maintain the stability of Centella asiatica bioactive compounds, making all formulations suitable for topical use.

3.3 Viscosity Test

The viscosity values of the gel serum containing Centella asiatica (L.) leaf extract are presented in Table 4.:

***Table 4**. Viscosity Test Results*

No	Formula	Viscosity Test			Mean (cP)	Standard
		I	II	III		
1	Formula I (0.5% carbomer)	2573	2635	3160	2584	SNI 16-4380-1996: 2000–4000 cP
2	Formula II (1% carbomer)	2580	2675	3215	2663	
3	Formula III (2% carbomer)	2599	2681	3241	3205	

The viscosity results showed an increase with higher carbomer concentration, with mean values of 2584 cP (0.5%), 2663 cP (1%), and 3205 cP (2%). This trend is consistent with the rheological properties of carbomer, a cross-linked polyacrylic acid polymer that forms a denser gel network at higher concentrations, thereby increasing resistance to flow.

All formulations met the SNI 16-4380-1996 standard (2000–4000 cP), indicating appropriate consistency for gel-based serum preparations. Although higher carbomer concentration improved structural strength, excessive viscosity may reduce ease of application. Overall, carbomer concentration significantly influenced the viscosity of the gel serum while remaining within acceptable limits.

3.4 Homogeneity Test

The homogeneity test results of the gel serum containing gotu kola (pegagan) leaf extract (Centella asiatica (L.)) are presented in Table 5.

***Table 5**. Homogeneity Test Results*

Formula	Observation	Requirement
FI	Homogeneous; no coarse particles observed	No coarse particles or lumps
FII	Homogeneous; no coarse particles observed	No coarse particles or lumps
FIII	Homogeneous; no coarse particles observed	No coarse particles or lumps

The homogeneity test showed that all formulations (0.5%, 1%, and 2% carbomer) were homogeneous, with no coarse particles or lumps observed. This indicates uniform dispersion of the extract within the gel matrix. The results suggest that variations in carbomer concentration did not affect the uniformity of the formulation, and all preparations met the required homogeneity criteria for semisolid topical products

3.5 Spreadability Test

The spreadability test results of the gel serum containing gotu kola (pegagan) leaf extract (Centella asiatica (L.)) are presented in Table 6.

***Table 6.** Spreadability Test Results (Diameter, cm)*

Formula	50g (Mean)	100g (Mean)	150g (Mean)
F I (0,5%)	6.3	6.1	6.2
F II (1%)	6.2	5.1	5.1
F III (2%)	5.9	5.1	5.1

Based on the spreadability results (Table 6), the mean diameters under a 50 g load were 6.3 cm (Formula I), 6.2 cm (Formula II), and 5.9 cm (Formula III). These values indicate good spreadability and meet the recommended spreadability range for topical gel preparations (5–7 cm) [10].

3.6 Physical Stability Test

The physical stability test results of the gel serum containing *Centella asiatica* leaf extract during 28 days of storage at room temperature are presented in Table 7

***Table 7**. Physical Stability of Gotu Kola Gel Serum During Storage (Day 7–28)*

A. Physical appearance, homogeneity, and pH

Day	Formula	Appearance	Color	Odor	Homogeneity	pH
7	FI	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
7	FII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
7	FIII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
14	FI	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
14	FII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
14	FIII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0

21	FI	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
21	FII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
21	FIII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
28	FI	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
28	FII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0
28	FIII	Gel	Clear yellowish	Characteristic gotu kola extract	Homogeneous	5.0

B. Viscosity, adhesiveness, and spreadability

(Viscosity measured at 50 rpm; Spreadability reported as diameter (cm))

Day	Formula	Viscosity (cP)	Adhesiveness	50 g (P/L)	100 g (P/L)	150 g (P/L)
7	FI	2584	5.5	6.2 / 6.2	6.2 / 6.0	6.3 / 6.3
7	FII	2663	5.5	6.2 / 6.2	6.2 / 6.0	6.3 / 6.3
7	FIII	3205	5.5	6.2 / 6.2	6.2 / 6.0	6.3 / 6.3
14	FI	2700	6.1	6.2 / 6.2	6.2 / 6.0	6.3 / 6.3
14	FII	2789	6.1	6.2 / 6.2	6.2 / 6.0	6.3 / 6.3
14	FIII	3307	6.1	6.2 / 6.2	6.2 / 6.0	6.3 / 6.3
21	FI	2809	6.2	6.3 / 6.3	6.3 / 6.0	6.4 / 6.4
21	FII	2902	6.2	6.3 / 6.3	6.3 / 6.0	6.4 / 6.4
21	FIII	3400	6.2	6.3 / 6.3	6.3 / 6.0	6.4 / 6.4
28	FI	2500	6.2	6.4 / 6.4	6.4 / 6.0	6.5 / 6.5
28	FII	2700	6.2	6.4 / 6.4	6.4 / 6.0	6.5 / 6.5
28	FIII	3500	6.2	6.4 / 6.4	6.4 / 6.0	6.5 / 6.5

During 28 days of storage at room temperature, all formulations (FI–FIII) remained physically stable, with no changes in appearance, color, odor, homogeneity, or pH (5.0). The absence of phase separation indicates good compatibility between Centella asiatica extract and the gel base.

Viscosity increased with higher carbomer concentration (FIII > FII > FI), reflecting the role of carbomer in forming a denser polymer network. Although minor fluctuations were observed during storage, all values remained within the acceptable range for gel preparations. Adhesiveness showed a slight increase over time, while spreadability remained within the optimal range (approximately 6–6.5 cm), indicating consistent application performance.

Overall, the results demonstrate that all formulations maintained acceptable physicochemical stability throughout the 28-day observation period.

4. CONCLUSIONS

Gel serum formulations containing Centella asiatica leaf extract were successfully prepared using carbomer at concentrations of 0.5%, 1%, and 2%. All formulations met the required physicochemical standards, with Formula I showing the most optimal stability and application characteristics.

Increasing carbomer concentration increased viscosity and reduced spreadability, while pH remained within the acceptable range for topical use. These results confirm that carbomer concentration significantly influences the physical properties of the gel serum.

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HEALTH POLICY ANALYSIS TOWARD ENHANCING COMMUNITY HEALTH SERVICE DELIVERY IN BIREUEN REGENCY

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Abstract

Health is a fundamental human right and a key indicator of national development. Bireuen Regency faces several health sector challenges, including unequal access to services, limited health personnel, and ongoing maternal–child health and nutrition problems. This study aims to analyze the implementation of health policies and assess the effectiveness of health programs in the region. The study employs a descriptive quantitative approach supported by qualitative analysis. Quantitative data were obtained from the Bireuen District Health Office, Statistics Indonesia (BPS), the Regional Medium-Term Development Plan (RPJMD), and the Ministry of Health. The indicators analyzed included the availability of health facilities and personnel, National Health Insurance (JKN) coverage, regional health budget allocation, infant mortality rate, life expectancy, and stunting prevalence. Qualitative analysis was conducted through a review of policy documents and relevant literature. The results indicate that health services are predominantly delivered through primary healthcare facilities, such as Community Health Centers and Integrated Service Posts, which play a strategic role in promotive and preventive efforts. Health personnel are mainly nurses and midwives, while the limited number of specialist doctors constrains referral and specialized services. JKN coverage increased by 4.7% over three years. Life expectancy improved, and infant mortality and stunting rates declined, although stunting remains a major public health issue. Health budget allocation has exceeded 10% of the regional budget, reflecting strong local government commitment. Overall, health policies have improved access and service quality, but equitable distribution of specialist personnel and accelerated stunting reduction remain key challenges.

Keywords: Health Policy, Bireuen Regency, Primary Health Care, Health Budget, National Health Insurance (JKN), Stunting.

1. INTRODUCTION

Health is a fundamental aspect of regional development because it is directly related to public welfare and productivity. Through the National Health Insurance (Jaminan Kesehatan Nasional/JKN) policy, the Government of Indonesia seeks to achieve Universal Health Coverage (UHC), namely equitable and affordable access to health services for all citizens without exception. This policy serves as an important instrument in reducing mortality risks, improving nutritional quality, and decreasing the burden of disease within the community [1]

Health is a basic human right guaranteed by the state and constitutes one of the main indicators of national development. The government is obliged to provide fair, equitable, and high-quality health services for all citizens, as mandated by Law Number 36 of 2009 on Health. Within the context of regional autonomy, district and municipal governments play a strategic role in formulating and implementing health policies that are aligned with the needs and characteristics of their respective regions [2].

Regional health policies do not merely focus on the provision of health facilities but also encompass promotive and preventive efforts, such as the promotion of clean and healthy living behaviors, reduction of stunting prevalence, and expansion of National Health Insurance (JKN) coverage. According to the

Ministry of Health of the Republic of Indonesia, strengthening primary health care services is a key strategy for improving public health status and reducing health financing burdens [3].

Bireuen Regency, as one of the administrative regions in Aceh Province, faces serious challenges in the implementation of the health sector. Although the local government has implemented various basic health programs such as immunization, health education, and antenatal care services, public health conditions remain complex. Data from Statistics Indonesia (BPS) of Bireuen Regency show that the infant mortality rate has fluctuated over several years, with a downward trend from 14 per 1,000 live births in 2019 to approximately 10 per 1,000 live births in 2023. Nevertheless, this figure still indicates the need for improving the quality of maternal and child health services. As an autonomous region in Aceh Province, Bireuen Regency continues to face challenges in health sector development, including disparities in access to health services between urban and rural areas, limited availability of health personnel, and persistent issues related to nutrition and maternal and child health. These conditions require the local government to formulate effective, sustainable, and community-needs-based health policies [4].

Bireuen Regency in Aceh Province has also made efforts to implement various health policies aimed at improving the quality of public health services. One commonly used indicator to assess community health status is the Infant Mortality Rate (IMR), defined as the number of infants who die before reaching one year of age per 1,000 live births. According to regional development planning documents of Bireuen Regency, the IMR has shown an improving trend in recent years; in 2024, the IMR was recorded at 9 per 1,000 live births, with a total of 64 cases, reflecting a decline compared to previous years. This decrease indicates that basic health interventions such as immunization and nutritional improvement have contributed to reducing infant mortality. In line with the Regional Medium-Term Development Plan (RPJMD), the Government of Bireuen Regency has allocated health budgets and developed various community health programs. However, the effectiveness of the implementation of these policies needs to be systematically assessed to determine the extent to which they have improved health service quality and public health status [5] [5].

Nevertheless, efforts to further reduce infant mortality in Bireuen Regency continue to face significant challenges. Local media reports indicate that as of mid-2025, infant mortality cases remain relatively high, with 56 cases recorded. This situation suggests that maternal and child health services still require substantial improvement in order to achieve national health targets. Common causes of infant mortality include asphyxia, prematurity, low birth weight (LBW), and other complications, highlighting the need to strengthen antenatal and neonatal health services [6].

In this context, the effectiveness of health policy implementation must be analyzed comprehensively to evaluate the extent to which program planning has addressed community needs. Such evaluation is essential to examine the relationship between health budget allocation, JKN program coverage, distribution of health personnel, and public health indicators such as infant mortality rates and stunting prevalence. Health policy analysis in Bireuen Regency is expected to provide a comprehensive overview of health service dynamics and generate recommendations for more systematic and sustainable improvements [7]. Based on this background, this study is important to analyze health policies in Bireuen Regency using both quantitative and qualitative approaches. The findings are expected to provide empirical evidence on the performance of regional health policies and serve as evaluation material and policy recommendations for local governments in formulating more targeted and effective health policies.

2. METHODOLOGY

This study employs a descriptive quantitative approach supported by qualitative analysis to obtain a comprehensive overview of the implementation of health policies in Bireuen Regency. The quantitative approach is used to analyze the achievement of health indicators and the performance of regional health policies based on statistical data, while the qualitative approach is applied to strengthen the interpretation of the findings through a review of policy documents and relevant literature. The research was conducted in Bireuen Regency, Aceh Province. The data used in this study are secondary data obtained from various official sources, including publications from Statistics Indonesia (BPS), reports from the Bireuen Regency Health Office, the Regional Medium-Term Development Plan (RPJMD), and publications from the Ministry of Health of the Republic of Indonesia. Quantitative data include the number of health facilities and health personnel, coverage of National Health Insurance (JKN) membership, regional health budget allocation, and public health status indicators such as infant

mortality rate, stunting prevalence, and life expectancy. Data collection was carried out through documentation studies and literature reviews by examining official reports, regulations, and findings from previous studies relevant to regional health policies. The collected data were then analyzed using descriptive statistical methods to identify patterns, trends, and changes in health indicators over time. The results of the quantitative analysis are presented in tabular form to facilitate understanding and interpretation. Qualitative analysis was conducted using content analysis methods on regional health policy documents. This analysis aims to identify the alignment between policy directions, planned programs, and performance outcomes in the health sector of Bireuen Regency. The results of the quantitative and qualitative analyses were subsequently integrated to provide a comprehensive assessment of the effectiveness of regional health policy implementation. Through this approach, the study is expected to provide empirical evidence regarding the achievements of health policies in Bireuen Regency and serve as a basis for evaluation and policy recommendations for local governments in improving the quality of health services and the overall public health status.

3. RESULTS

Table 1. *Health Service Facilities*

Type of Health Facility	Number
Regional General Hospital	1
Community Health Center (Puskesmas)	17
Auxiliary Health Center (Pustu)	55
Integrated Health Post (Posyandu)	620
Primary Clinic	12

The data show that health services in Bireuen Regency are dominated by primary-level health facilities, particularly community health centers (puskesmas) and integrated health posts (posyandu), which play a crucial role in promotive and preventive services. The dominance of these facilities reflects a strong focus on health promotion and disease prevention, such as increasing public awareness of health, disease prevention, and maternal and child health monitoring. The presence of puskesmas and posyandu distributed down to the village level enables more equitable and accessible healthcare services. Thus, primary health facilities hold a strategic role in maintaining and improving the population's health status in Bireuen Regency sustainably.

Table 2*. Health Workforce*

Type of Health Worker	Number (Persons)
General Practitioners	85
Specialist Doctors	18
Nurses	420
Midwives	310
Other Health Personnel	140

The number of nurses and midwives is relatively higher than that of doctors, particularly specialist doctors. This condition indicates limitations in referral and specialized health services. The imbalance in human resources suggests that healthcare in the region is more focused on primary care, while referral and specialist services remain suboptimal. The limited number of specialist doctors may affect the quality and reach of advanced medical services, requiring patients needing specialized care to be referred to facilities outside the region. This poses a challenge to improving the overall quality and equity of health services.

Table 3*. JKN Participation Percentage*

Year	Population	JKN Participants	Percentage (%)
2021	470,200	392,000	83.4
2022	472,800	405,500	85.8
2023	475,300	418,900	88.1

The coverage of the National Health Insurance (JKN) increased by 4.7% over three years, indicating the effectiveness of regional policies in supporting the national health insurance program. The growth in JKN participation reflects the positive development in health protection for the population. This trend demonstrates the effectiveness of policies and the local government's commitment to supporting JKN implementation through membership expansion, enhanced socialization, and facilitation of access for residents. The increase in participants is expected to improve equitable and sustainable access to healthcare and reduce the financial burden on households

***Table 4**. Health Indicators*

Health Indicator	2021	2022	2023
Life Expectancy (Years)	69.8	70.1	70.4
Infant Mortality Rate (per 1,000 live births)	22	20	18
Stunting Prevalence (%)	28.5	26.2	24.1

There was an increase in life expectancy along with a decrease in infant mortality and stunting prevalence, indicating the positive impact of health policies, although stunting still requires serious attention. The improvement in life expectancy combined with reductions in infant mortality and stunting demonstrates the effectiveness of implemented policies and health programs. These achievements indicate better healthcare quality, improved community nutrition, and increasingly effective promotive and preventive efforts. However, despite the reductions, stunting remains a significant concern that requires integrated and sustained interventions, particularly for vulnerable groups such as pregnant women and toddlers. Therefore, strengthening programs for accelerated stunting reduction remains a priority in improving human resource quality.

***Table 5**. Health Budget Percentage*

Year	Health Budget (Billion IDR)	Percentage of Regional Budget (%)
2021	185	9.8
2022	198	10.4
2023	215	11.1

The health budget shows an increasing trend and has exceeded 10% of the regional budget, reflecting the local government's commitment to health sector development. The rising allocation is expected to strengthen health infrastructure, improve human resource quality, and expand the reach and quality of healthcare services. With adequate budget support, the implementation of health programs can run more optimally and sustainably.

4. CONCLUSIONS

The study results indicate that the implementation of health policies in Bireuen Regency has had a positive impact on improving access to and the performance of public health services, particularly through the strengthening of primary healthcare services. The dominance of primary-level health facilities, such as community health centers (puskesmas) and integrated health posts (posyandu), underscores the strategic role of promotive and preventive services within the regional health system. These findings are consistent with previous research [8] which states that strengthening primary healthcare services is the cornerstone for improving population health status and the efficiency of the health system, particularly in developing regions.

From the perspective of human resources for health, the study findings indicate that the health workforce in Bireuen Regency is dominated by nurses and midwives, while the availability of specialist doctors remains limited. This condition affects the optimization of referral services and specialized healthcare delivery. These findings are consistent with previous research [9] which emphasizes that the unequal distribution of health workers, particularly specialist doctors, remains a major issue in many autonomous regions and contributes to disparities in the quality of healthcare services. Research [10] in several regencies in Indonesia also indicate that the limited availability of specialist medical personnel in these regions leads to a high dependence on referral hospitals in urban areas.

The coverage of the National Health Insurance (JKN) in Bireuen Regency shows a significant upward trend. This indicates the successful implementation of health insurance policies in expanding

public access to healthcare services. These findings support the results of previous research [11] which states that the National Health Insurance (JKN) contributes positively to increasing the utilization of healthcare services, particularly primary healthcare. However, other studies also emphasize that expanding JKN coverage needs to be accompanied by improvements in service quality so that it impacts not only access but also population health outcomes [12].

The indicators of public health status in Bireuen Regency show relatively positive developments, marked by an increase in life expectancy as well as a decrease in infant mortality and stunting prevalence. The reduction in infant mortality reflects improvements in maternal and child healthcare services, particularly through increased immunization coverage, antenatal care services, and nutritional interventions. These results are consistent with previous research[13] which emphasizes that integrated basic health interventions have a significant impact on reducing infant and under-five mortality. Nevertheless, stunting prevalence in Bireuen Regency remains a serious challenge. This condition indicates that nutritional problems are multidimensional and cannot be addressed solely through health sector interventions. Research [14] which states that reducing stunting requires a cross-sectoral approach involving the education, sanitation, economic, and food security sectors. Studies [15] n Indonesia also emphasize that socioeconomic and environmental factors have a significant influence on the incidence of stunting, indicating that regional health policies need to be aligned with development policies in other sectors.

From a budgetary perspective, the study findings show that the health budget allocation in Bireuen Regency has met the minimum requirement of 10 percent of the regional budget (APBD) and exhibits an increasing trend. This reflects the local government's commitment to health sector development. These findings are consistent with previous research [16] which states that increases in regional health expenditure are positively associated with improvements in healthcare service coverage and reductions in adverse health indicators. However, the effectiveness of budget utilization remains a key factor. Research [17] It is emphasized that the size of the budget does not necessarily guarantee improved service performance if it is not accompanied by needs-based planning and a robust monitoring system. The integration of quantitative and qualitative analyses in this study indicates that health policies in Bireuen Regency have generally been implemented in line with regional planning directions; however, gaps still exist between planning and performance outcomes, particularly regarding the equitable distribution of health workers and the acceleration of stunting reduction.

Thus, the findings of this study underscore that improving the quality of public health services in Bireuen Regency requires the strengthening of health policies that are oriented toward local needs, equitable distribution of health personnel, and cross-sectoral synergy. Lessons from previous research demonstrate that the success of regional health policies is largely determined by consistent implementation, adequate resources, and effective policy governance.

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USE OF STANDING FOOTS REFLECTION DEVICES TO REDUCE PAIN IN CANCER PATIENTS DURING CHEMOTHERAPY

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Abstract

Chemotherapy in cancer patients has many detrimental side effects, but this treatment remains a medical option. While chemotherapy is the primary treatment option for cancer, peripheral neuropathy, which refers to nerve damage that can develop as a result of chemotherapy, is often present. Non-pharmacological interventions are needed to ensure that cancer patients can lead a quality life without pain after chemotherapy. The Standing Foot Reflection Device (SFRD) is a device with acupressure points that is expected to be effective in reducing pain. The Standing Foot Reflection Device (SFRD) is effective in reducing moderate to imperceptible pain levels.The purpose of this study was to determine the effect of the use of the Standing Foot Reflection Device (SFRD) on pain during chemotherapy in cancer patients at the Indonesian Cancer Foundation. Using a quantitative method with a quasi-experiment, designed by involving a control group in addition to the intervention group that allows researchers to test the changes that occur through a pretest and posttest design with a control group. The results of the univariate analysis obtained were 51% pre-elderly, including women (68%), who worked (62%), with Diploma-III/S-1 education as much as 43%. The results of the bivariate analysis, the p-value chi square pretest of the intervention and control groups could not be calculated because many cells were empty. While the p-value of chi square posttest = 0.000 (<0.05) indicates a significant difference between the intervention and control groups. The p-value (sig.) of the Wilcoxon test for the difference in Hemoglobin (Hb) pre-post = 0.000 <0.05 so there is a significant effect. In conclusion, there is an effect in the use of SFRD on reducing chemotherapy pain. There are other symptoms, namely hemoglobin (Hb) less than normal which is a trigger for the sensation of pain, but the use of SFRD has an effect on increasing Hb so that it has an impact on reducing chemotherapy pain.

Keywords: Exercise, Chemotherapy, Hemoglobin, Pain

1. INTRODUCTION

Cancer is one of the non-communicable diseases that is the leading cause of death worldwide. Cancer is characterized by the uncontrolled growth of certain body cells, which can damage other cells and tissues, often resulting in death. Cancer's aggressive nature and uncontrolled growth can lead to death. All cells in the human body can be affected by cancer except hair, teeth, and nails (Azwar, 2021; Hassanpour, & Deghani, 2021).

The prevalence of prostate cancer in Indonesia in 2020 was 0.24‰, or an estimated 25,018 sufferers. The provinces with the highest prostate cancer prevalence were Yogyakarta Special Region, Bali, North Sulawesi, and South Sulawesi, at 0.5‰. Based on estimates, the highest number of prostate cancer sufferers was in East Java and Central Java. Cervical and breast cancer were the cancers with the highest prevalence in Indonesia in 2018, with cervical cancer at 0.8‰ and breast cancer at 0.5‰ (Hardjolukito, 2021). Riau Islands Province, North Maluku Province, and Yogyakarta Special Region have the highest prevalence of cervical cancer at 1.5‰, while the highest prevalence of breast cancer is found in Yogyakarta Special Region, at 2.4‰. Based on estimates, the highest number of cervical and breast cancer sufferers is found in East Java and Central Java Provinces.

Lung, colorectal, gastric, liver, and breast cancers are the most common types of cancer. Reports note that lung cancer is the deadliest cancer, accounting for 1.8 million deaths or 18.4 percent of total deaths in 2018. Breast cancer can be treated through early breast examinations and patient compliance with chemotherapy, as both of these factors can reduce morbidity and mortality in the long term. Adhering to the chemotherapy program can inhibit and kill cancer cells and reduce the risk of death (Marshall, et al. 2021; Huang, Wang, Chen, 2021; Samantha, 2020). Chemotherapy is used in the early stages to control cancer cells that may remain after surgery, as well as to reduce the risk of cancer coming back. In some cases, chemotherapy is given after surgery, this is called chemotherapy (adjuvean). There are also cases where chemotherapy is given before surgery with the aim of shrinking the cancer and this is usually called chemotherapy (non-adjuvean) (Azwar. 2021; Wu, et al. 2021).

Chemotherapy is unavoidable for cancer patients if it is the doctor's choice of treatment. This study is an extension of a previous study entitled "The Effect of Walker Foot Reflection (WFR) on Minimizing Chemotherapy Side Effects in Breast Cancer Patients at the Indonesian Cancer Foundation." The study, conducted by Jenita DT Donsu & Team in 2023, found that using WFR once during chemotherapy can reduce low to moderate pain sensations. The difference with the WFR device is that it does not have complete acupressure points compared to the Standing Foot Reflection Device (SFRD), so the use of SFRD is expected to have an impact on reducing pain in all types of cancer during chemotherapy.

Feasibility studies have shown that patients generally accept foot reflexology to help manage cancer-related pain. Furthermore, foot reflexology has been reported to be effective and have a significant effect on reducing cancer-related pain. The results also suggest that the selection of pain assessment tools should consider the specific clinical context and assessment goals. Furthermore, there are some differences in the foot reflexology procedures followed by different researchers; nevertheless, the effectiveness of foot reflexology has been demonstrated in all studies. Foot reflexology is appropriate and can be integrated to complement pain management plans for cancer patients (Cai, Chen, Lo. 2022; Alassaf, et al. 2025).

2. METHODOLOGY

Using a quantitative method with a quasi experiment, designed and involving 100 respondents (total sample) divided into a control group of 50 respondents and an intervention group of 50 respondents, which allows researchers to test the changes that occur through a pretest and posttest design with a control group. The inclusion criteria are cancer patients undergoing chemotherapy and staying at the Indonesian Cancer Foundation halfway house, and the exclusion criteria if they have wounds on the soles of their feet to the point of being unable to walk. Pain measurement uses the Numeric Rating Scale (NRS), with the duration of giving leg exercises using SFRD 3 x a week for 10 minutes. Ethical eligibility is recorded in the KEPK Poltekkes Kemenkes Yogyakarta: No.DP.04.03/e-KEPK.1/1047/2025.

3. RESULTS

3.1 Characteristics

The characteristics of the respondents in this study consisted of: Age, Gender, Occupation, and Education. Univariate analysis used statistical formulas for mean, standard deviation, frequency, and percentage. The following are the results of univariate tests on the characteristic factors:

Table 1. *Frequency Distribution of Age, Gender, Occupation and Education Factors(n=100)*

Subvariable	Category	Group		Total
		Intervention	Control	(%)
Age/Years	≤40	3 (42,9)	4 (57,1)	7 (100)
	41-50	20(57,1)	15(42,9)	35(100)
	51-60	21(41,2)	30(58,8)	51(100)
	61-70	2 (28,6)	5 (71,4)	7 (100)

Gender	Man	16(51,6)	15(48,4)	31(100)
	Woman	34(49,3)	35(50,7)	69(100)
Work	Housewives	16(51,6)	15(48,4)	31(100)
	Pension	5 (71,4)	2 (28,6)	7 (100)
	Work	29(46,8)	33(53,2)	62(100)
Education	ES	2 (50,0)	2 (50,0)	4 (100)
	JHS	4 (44,4)	5 (55,6)	9 (100)
	SHS	18(45,0)	22(55,0)	40(100)
	Diploma[3]/Bachelor	24(55,8)	19(44,2)	43(100)
	Magister	2 (50,0)	2 (50,0)	4 (100)

Table 1 shows that the majority of those in the 51-60 age group (51%) are considered pre-elderly. The majority of the gender is female (68%). The most common occupations are civil servants, self-employed, private sector workers, farmers, and laborers (62%). The majority of educational attainment is Diploma III/Bachelor.(43%).

***Table 2**. Frequency Distribution of Education, Other Diseases, Pre-Posttest Symptoms (n=100)*

Subvariable	Category	Group		Total
		Intervention	Control	(%)
Education	Tidak	25(39,7)	38(60,3)	63(100)
	Pernah	25(67,6)	12(32,4)	37(100)
Other diseases	Tidak	37(46,3)	43(53,8)	80(100)
	Ada	13(65,0)	7 (35,0)	20(100)
Symptoms pretes	Tidak	0 (0,0)	0 (0,0)	0 (0)
(moderate pain)	Ada	50(100)	50(100)	100(100)
Symptom post-test	Tidak	50(82,0)	11(18,0)	61(100)
	Ada	0 (0,0)	39(100)	39(100)

Table 2 shows that the highest percentage of respondents in the education subvariable was in the category of never having received education about the effects of chemotherapy that cause pain (63%). In the other disease subvariable, the highest percentage was in the category of not suffering from other diseases (80%). Regarding the subvariable of experiencing disease symptoms during the pretest (moderate pain), all respondents experienced moderate pain (100%). At the posttest, the highest percentage had no symptoms (61%), and those with symptoms (39%) were in the control group.

***Table 3**. Average Hemoglobin (Hb) Values Pretest, Posttest and Hb Difference (n=100)*

Subvariable	Group		Total
	Intervention	Control	
Hb pre-test	12,96±0,81	12,9±0,52	12,93±0,68
Hb post-test	12,83±0,78	11,07±0,85	11,95±1,2
Difference Hb	-0,13±0,36	-1,84±0,75	-0,98±1,04

The data above shows that the pretest Hb subvariable has a mean value that is approximately the same between the intervention group (12.96) and the control group (12.9) with a total mean value of (12.93) but in the standard deviation (SD) value there is a slight difference in the intervention group (0.81) and the control group (0.52) with a total mean (0.68). While in the post-test Hb subvariable, the mean value of the intervention group (12.83) and the control group (11.07). Likewise, the post-test Hb standard deviation (SD) value of the intervention group (0.78) is lower than the control group (0.85) with a total standard deviation value (1.2). In the subvariable, the mean value of the difference in Hb of the intervention group (-0.13) and the intervention group (-1.84), while the standard deviation value of the difference in Hb of the intervention group (0.36) and the control group (0.75) with a total standard deviation value of the difference in Hb (1.04).

3.2 Supporting Data for Research Objectives

In order to minimize the side effects of chemotherapy after SFRD training in cancer patients at the Indonesian Cancer Foundation, the data were analyzed bivariately using the chi square statistical formula, as follows:

***Table 4**. Bivariate Analysis of Other Diseases in the Intervention and Control Groups (n=100)*

Group	Other Diseases		Total	p-value
	No	There is		
Intervention	37(74,0)	13(26,0)	50 (100)	0,134
Control	43(86,0)	7(14,0)	50 (100)	

Based on the bivariate analysis results in Table 4, the chi-square p-value was 0.134 > 0.05. This indicates no significant difference in the incidence of other diseases between the intervention and control groups.

***Table 5.** Bivariate Analysis of Symptoms Appearing During WFR Use (n=100)*

		Symptom		Total	p-value
		No	There is		
Pretest	Intervention	50 (100)	0(0)	50 (100)	-
	Control	0 (0)	0(0)	0 (0)	
Posttest	Intervention	50 (100)	0(0)	50 (100)	0,000
	Control	11(22,0)	39(78,0)	50 (100)	

Table 5 shows the results of the bivariate analysis, showing that the chi-square p-value for the pretest of the intervention and control groups could not be calculated because many cells had blank values. Meanwhile, the chi-square p-value for the posttest was 0.000 (<0.05). This indicates a significant difference in the symptoms that appeared after SFRD administration at posttest between the intervention and control groups.

***Table 6**. Hemoglobin Normality Test Pre-Posttest Intervention Group (n=50)*

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Stat	df	Sig.	Stat	df	Sig.

Hb_pretest	,162	50	,002	,890	50	,000
Hb_postest	,196	50	,000	,873	50	,000

Table 6 shows the p-value for the normality test, namely the Kolmogorov-Shapiro test, is 0.000 <0.05. The data is not normally distributed, so the next hypothesis is tested using a non-parametric test, namely the Wilcoxon statistical test, as follows:

***Tabel 7**. Difference in Hemoglobin Pre-Posttest Intervention Group (n=50)*

		N	Mean Rank	Sum of Ranks	p
Hb_postes - Hb_pretes	Negative Ranks	13a	7,77	101,00	0,019
	Positive Ranks	2b	9,50	19,00	
	Ties	35c			
	Total	50			

Based on table 7, the p value of the Wilcoxon test = 0.019 <0.05, so there is a significant difference in Hb pre and posttest in the intervention group.

***Table 8.** Hemoglobin Normality Test Pre-Post Test in the Control Group (n=50)*

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Hb_pretes	,172	50	,001	,933	50	,007
Hb_postes	,129	50	,037	,949	50	,031

Table 8 shows the results of the Hb normality test for the pretest and posttest. The p-value for the Kolmogorov-Shapiro test is 0.000 <0.05. The data are not normally distributed, so the next hypothesis is tested using the non-parametric Wilcoxon statistical test, as follows:

***Table 9.** Difference in Hb Pre_Posttest Control Group (n=50)*

		N	Mean Rank	Sum of Ranks	p-value
Hb_postes - Hb_pretes	Negative Ranks	50a	25,50	1275,00	0,000
	Positive Ranks	0b	,00	,00	
	Ties	0c			

Table 9 p value of Wilcoxon test = 0.000 <0.05 so there is a significant difference between Hb pre and post test in the control group.

***Table 10** Normality Test of the Difference in Hb Between the Intervention and Control Groups (n=100)*

	Kel	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.

Hb_pretest	Intervention	,162	50	,002	,890	50	,000
	Control	,172	50	,001	,933	50	,007
Hb_postest	Intervention	,196	50	,000	,873	50	,000
	Control	,129	50	,037	,949	50	,031
Difference	Intervention	,378	50	,000	,683	50	,000
	Control	,115	50	,098	,971	50	,261

Based on the results of the normality test for the difference in Hb pretest and posttest in the intervention and control groups, the p-value in the normality test, namely the Kolmogorov-Shapiro test, was 0.000 <0.05 except for the control group, the difference in Hb p = 0.971 > 0.05 which was normally distributed. For data that is not normally distributed, the hypothesis is then tested using non-parametric statistical tests, namely the Mann-Whitney and Wilcoxon tests, as follows:

***Table 11**. Difference in Hb Pre_Posttest Intervention and Control Groups(n=100)*

	Group	WMean Rank	Sum of Ranks	Whitney	Wilcoxon	p-value
Hb_pretest	Intervention	50,56	2528,00	1247,000	2522,000	,983
	Control	50,44	2522,00			
Hb_postest	Intervention	72,60	3630,00			,000
	Control	28,40	1420,00	145,000	1420,000	

Table 11 p-value (Sig.) in the Wilcoxon pre-test Hb test = 0.983 > 0.05 so there is no significant difference in pre-test Hb of the control and intervention groups. However, the p-value (Sig.) of the Wilcoxon post-test Hb test = 0.000 < 0.05 indicates that there is a significant difference in post-test Hb between the control and intervention groups.

***Table 12**. Difference in Hb Pre-Posttest in the Intervention and Control Groups (n=100)*

	Group	Mean Rank	Sum of Ranks	Whitney	Wilcoxon	p-value
Difference Hb	Intervention	74,76	3738,00	37,000	1312,000	0,000
	Kontrol	26,24	1312,00			

Table 12 p-value (Sig.) Wilcoxon test for difference in Hb (posttest-pretest) = 0.000 <0.05 so there is a significant difference in the difference in Hb between posttest and pretest.

4. DISCUSSION

The characteristics of the respondents in this study included age, occupation, education, previous education, current illnesses, and current symptoms. Univariate and bivariate analyses were conducted using statistical formulas for mean, standard deviation (SD), frequency, and percentage. Univariate analysis of the characteristic factors for the age variable showed that the highest prevalence was in the 51-60 year old age group (51%), which is classified as pre-elderly, and the highest prevalence was in women (69%). According to Hagedorn (2021), there is no statistically significant relationship between

age and cancer incidence. Similarly, Skandarajah (2021) explains that anemia in pre-elderly individuals can occur due to bone marrow failure syndrome, decreased erythropoietin production in the kidneys, nutritional deficiencies, and inflammatory processes, not cancer. The older a woman is, the greater the risk of developing breast cancer. The same applies to gender. The highest incidence of cancer in Yogyakarta is breast and cervical cancer, so this study targeted women. According to Roncolato (2021) and Montagnese (2021), women of reproductive age physiologically menstruate every month. However, if a woman doesn't ovulate, the progesterone produced is unable to counteract estrogen, which triggers breast cancer. Based on the research findings above, it's highly possible that age, especially in women who haven't given birth, increases the risk of developing hormone-related breast cancer.

In general, they work as civil servants, self-employed, private sector workers, farmers, and laborers (62%). According to Dhawan et al. (2022), the quality of life of cancer patients is influenced by one factor, namely employment. A better job provides peace of mind for cancer patients because it is associated with higher income. According to the Indonesian Employment Report, work systems, especially in the health, transportation, police, military, nursing, medical, and other sectors that require 24-hour service. Shift work is a significant issue related to the intensive and extensive exploitation of production systems. Night shifts can have negative impacts on workers, such as workplace accidents and a tendency towards chronic diseases, including cardiovascular and metabolic disorders, and cancer. Shift work has a negative impact on workers' bodies, especially those with irregular working hours (Munawaroh, 2022).

The education backgrounds of those with a Diploma III/S1 degree (43%) are highly varied. Likewise, the higher the level of education, the easier it is to understand health education. Table 4.2 shows that the highest education subvariable falls under the category of never having received education about the side effects of chemotherapy. The education received does not focus much on the side effects of chemotherapy. Providing health education related to cancer has a significant impact on the community, increasing their health confidence, thus encouraging them to undergo screening because they realize that everyone is at risk of cancer (Khademolhosseini, Noroozi, Tahmasebi, 2021).

In the other diseases subvariable, the majority were in the "none" category (80%). This means that cancer patients generally only focus on the cancer undergoing chemotherapy. Respondents for the intervention and control groups were limited based on inclusion criteria, including not having other diseases, especially those experiencing foot disorders related to the use of the Standing Foot Reflection Device (SFRD). In the disease symptoms subvariable, such as nausea, vomiting, fever, and dizziness, no symptoms were present during the pretest. However, respondents generally had moderate pain sensations (100%) because they were already included in the inclusion criteria. At the posttest, most respondents had no symptoms (61%) in the intervention group. Meanwhile, symptoms of pain sensations were still present (39%). Several factors that influence pain sensations vary from person to person. According to Abd-Elsayed, Gyorfi, Hughes, (2021), pain sensations can be influenced, among other things, by anxiety about the disease.

Hemoglobin (Hb) in this study was not a specific goal, but increasing Hb can reduce pain sensations. Based on the analysis results, Hb values are important to evaluate because the lower a person's Hb value impacts the sensation of pain that is felt. This is related to the symptoms of cancer itself, which bleeds, so a person is in the range of Hb deficiency. Anemia is a condition where the amount of hemoglobin in the blood is insufficient, so it cannot carry out its function of distributing oxygen to the tissues. Oxygen deficiency in cancer patients receiving chemotherapy disrupts the process of eradicating cancer cells, making it ineffective. The ability of radiotherapy to eradicate cancer cells is highly dependent on the level of oxygen molecules in the tumor. According to Harrison & Andrew in Hidayati, & Arifah, (2022), oxygen is an important radiosensitizer in destroying cancer cell DNA. Radiotherapy forms free radicals from oxygen molecules and penetrates the DNA of cancer cells, causing cancer cells to die. Likewise, anemia in cancer patients can cause fatigue and a decreased quality of life, increasing mortality by up to 65%.

The benefits of SFRD can improve gastric function, thus causing post-chemotherapy patients to increase nutritional intake, thereby improving Hb levels. According to Harrison & Andrew in Hidayati & Arifah, (2022), statistically, the total radiation dose received by patients is related to the incidence of anemia in cancer patients receiving radiotherapy and/or chemotherapy. This indicates the occurrence of anemia in patients receiving radiotherapy, resulting in a decrease in the number of erythrocytes and hematocrit caused by impaired erythrocyte production in the bone marrow.

5. CONCLUSIONS

5,1 The characteristics of post-chemotherapy cancer patients are generally pre-elderly women with diploma and bachelor's degrees who work..

5,2 The pain scale felt by cancer patients after chemotherapy is generally a moderate pain scale which is then followed by an increase in Hb, resulting in a reduction in the sensation of pain after administering SFRD.

5,3 The use of SFRD is effective in reducing chemotherapy pain in post-chemotherapy patients at the Indonesian Cancer Foundation.

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DIFFERENCES IN TOOTHBRUSHING KNOWLEDGE WITH COUNSELING USING DEMONSTRATION AND SIMULATION METHODS STUDENTS AT SDN 06 TALUAK IV SUKU, BANUHAMPU DISTRICT, AGAM REGENCY

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Abstract

Dental and oral health issues remain a significant public health concern in Indonesia, particularly in regional areas such as Agam Regency. A primary risk factor contributing to the high prevalence of dental diseases among school-aged children is a profound lack of knowledge regarding proper toothbrushing techniques and oral hygiene maintenance. This study aimed to evaluate and compare the effectiveness of two different educational interventions the demonstration method and the simulation method in improving toothbrushing knowledge among fourth, fifth, and sixth-grade students at SDN 06 Taluak IV Suku, Banuhampu District, Agam Regency.
Utilizing a quasi-experimental design with a pretest-posttest approach, a total of 60 students were selected through a total sampling technique. The respondents were divided into two intervention groups: one receiving counseling via the demonstration method and the other through the simulation method. Data were meticulously collected using structured knowledge questionnaires and direct observations, which were subsequently analyzed using the non-parametric Mann-Whitney U statistical test. The results demonstrated a notable increase in knowledge scores across both groups; however, the simulation group exhibited a more substantial improvement, rising from a baseline of 69% to 84%, compared to the demonstration group which increased from 70% to 82%. Statistical analysis confirmed a significant difference between the two interventions ($p = 0.000$), indicating that the simulation method, which emphasizes active participation and hands-on practice, is more effective than passive demonstration. These findings suggest that incorporating interactive simulation into school dental health programs (UKGS) is essential for fostering better oral health literacy and long-term behavioral changes in children.

Keywords: Dental Health Education, Toothbrushing Knowledge, Demonstration Method, Simulation Method, Elementary School Students.

1. INTRODUCTION

The World Health Organization (WHO) states that health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity [1]. Health, as defined in Law (UU) Number 17 of 2023, is a state of physical, mental, and social well-being that allows individuals to lead a productive life, not merely being free from disease [2]. Dental and oral health encompasses the condition of the mouth, teeth, and all elements within the oral cavity being in a healthy state, enabling individuals to perform essential functions such as eating, breathing, speaking, and social interaction [3].

Data on Dental and Oral Health Status from the World Health Organization (WHO) estimates that approximately 3.5 billion individuals worldwide experience dental and oral health problems [1]. The 2018 Basic Health Research (Riskesdas) data states that 57.6% of the population in Indonesia has dental and oral health issues [4]. In West Sumatra Province, 58.5% of the population experiences dental and oral health problems. Furthermore, the 2023 Indonesia Health Survey (SKI) data indicates that

56.9% of the Indonesian population still faces dental and oral health issues, and in West Sumatra Province, the figure is higher at 61.1% [5].

Riskesdas 2018 data shows that the habit of brushing teeth at the correct time—after breakfast and before bed—in Indonesia reaches 2.8%. In West Sumatra Province, the percentage of those brushing at the correct time is even lower at 1.2%, and in Agam Regency, the population brushing at the correct time reaches only 0.9%. The 2023 SKI data states that the habit of brushing teeth twice a day in Indonesia reaches 72.5%, while in West Sumatra Province, it shows a higher figure of 78.6%. However, the 2023 SKI data also indicates that the habit of brushing at the correct time (after breakfast and before bed) in Indonesia only reaches 6.2%, and in West Sumatra Province, it is 1.2% [6].

From the data above, it is evident that there are significant issues regarding dental and oral health; such good habits must be supported by adequate knowledge.Knowledge emerges as a result of understanding after observing something or is gained from experience [7]. The higher a person's level of knowledge or education, the easier it is for them to absorb new information regarding dental health compared to those with lower knowledge levels [8]. Efforts to maintain oral hygiene can be carried out through toothbrushing [9].

Toothbrushing is a method used to clean food debris adhering to the tooth surfaces and gums and serves as a preventive measure to achieve optimal oral hygiene and health [10]. One way to increase knowledge about toothbrushing is through counseling. Counseling is a promotional activity within the School Dental Health Program (UKGS) in schools. It is a method frequently used in dental health education; for elementary school children, counseling can be conducted using demonstration and simulation methods The demonstration method is a way of delivering information by showing objects directly or explaining a procedure. Demonstration activities generally involve the use of visual aids and include Q&A sessions to support the process. The simulation method is a counseling technique performed through teaching and learning activities that focus on the internalizing of skills and practice within a situation that mimics the actual conditions [11].

2. METHODOLOGY

The research design employed was a quasi-experimental approach using a pretest-posttest design, where measurements were taken before (pretest) and after (posttest) the counseling intervention. The study was conducted on May 24, 2025, involving fourth, fifth, and sixth-grade students at SDN 06 Taluak IV Suku, Agam Regency. The population for this study consisted of 65 students. The sampling technique utilized was total sampling, resulting in 60 respondents who met the inclusion criteria, which required students to be present during the study and willing to participate as respondents.

The participants were divided into two groups: 30 respondents for the counseling group using the demonstration method and 30 respondents for the counseling group using the simulation method. Data collection involved observations and the distribution of questionnaires regarding toothbrushing knowledge, consisting of both primary and secondary data. Data analysis included univariate analysis to determine frequency distributions and bivariate analysis using the non-parametric Mann-Whitney U test with a significance level of alpha < 0.05.

In the initial stage, the researcher introduced themselves and explained the study's objectives. Subsequently, the researcher distributed the knowledge questionnaires prior to the counseling sessions. Once completed, the questionnaires were collected by the researcher and the designated enumerators.

3. RESULTS AND DISCUSSION

The study was conducted on May 24, 2025, aimed at evaluating the differences in toothbrushing knowledge among fourth, fifth, and sixth-grade students through counseling using demonstration and simulation methods at SDN 06 Taluak IV Suku, Agam Regency. A total of 60 respondents participated, divided into two groups: 30 respondents in the demonstration counseling group and 30 respondents in the simulation counseling group. The data obtained are as follows:

3.1 RESULTS

3.1.1 Univariate Analysis

***Table 1**. Frequency Distribution of Toothbrushing Knowledge Before and After Counseling Using the Demonstration Method*

Criteria	Before (Pre-test)	After (Post-test)
	F	**%**
Good	9	30
Moderate	17	56.7
Low	4	13.3
Total	**30**	**100**

***Table 2.** Frequency Distribution of Toothbrushing Knowledge Before and After Counseling Using the Simulation Method*

Criteria	Before (Pre-test)	After (Post-test)
	F	%
Good	8	26.7
Moderate	18	60
Low	4	13.3
Total	30	100

3.1.2 Bivariate Analysis

***Table 3**. Differences in Toothbrushing Knowledge With Demonstration and Simulation Methods*

Method	N	Knowledge (Before)	Knowledge (After)	Difference
Demonstration	30	70%	82%	12%
Simulation	30	69%	84%	15%

***Table 4**. Mann-Whitney U Test Results: Differences in Toothbrushing Knowledge Between Demonstration and Simulation Methods*

Method	N	Mean Rank	Asymp. Sig. (2-tailed)
Demonstration	30	38.75	0.000
Simulation	30	40.80	

Based on Table 4, the Mann-Whitney U test results indicate that the mean rank for toothbrushing knowledge among students who received simulation counseling was higher (40.80) compared to those who received demonstration counseling (38.75). The statistical test yielded an Asymp. Sig. value of 0.000 ($p < 0.05$), leading to the acceptance of Ha. This confirms a significant difference between demonstration-based counseling and simulation-based counseling in improving toothbrushing knowledge among fourth, fifth, and sixth-grade students at SDN 06 Taluak IV Suku, Banuhampu District, Agam Regency.

3.2 DISCUSSION

The results showed that prior to the demonstration counseling, 13.3% of students in grades IV, V, and VI had "low" knowledge criteria. After the intervention, there was a significant improvement, with 73.3% reaching the "good" criteria. This indicates an overall increase in toothbrushing knowledge at SDN 06 Taluak IV Suku, with a 60% gain in the "good" category. However, 26.7% of respondents still remained in the "moderate" category post-intervention.

The researcher assumes that the demonstration method effectively enhances knowledge because the use of visual aids, such as dental models and toothbrushes, captures students' attention. This method allows them to visualize and understand procedures quickly. Before the counseling, students were provided with comprehensive teaching materials covering the definition and objectives of toothbrushing, the optimal timing and frequency, common errors, and guidelines for selecting and maintaining a toothbrush. The improvement in knowledge is evidenced by the respondents' ability to correctly answer questionnaire items after observing the researcher demonstrate the procedures using the dental model. Dental and oral health education for school-aged children requires special attention as they are in a critical growth phase. To improve knowledge, counseling must utilize engaging media or aids to maintain children's interest [12] [13}[14] [15] [16]

The results indicated that students with "low" knowledge (13%) prior to simulation counseling improved significantly, with 80% reaching "good" criteria after the intervention. This represents a 67% increase in the "good" category. The researcher suggests that the simulation method is highly effective because it fosters enthusiasm; students are more engaged when instructed to reenact the toothbrushing process. Before the simulation began, students received the same theoretical foundation as the demonstration group. However, the simulation method added a layer of active participation. By using dental models and sikat gigi (toothbrushes) directly, students practiced everything they had learned—from the choice of brush to the correct sequence of cleaning each tooth surface. This method focuses on internalizing skills through practice in situations that mimic reality [17][18][19].

Statistical analysis using the Mann-Whitney U test yielded an *Asymp. Sig.* value of 0.000, leading to the acceptance of . While both methods increased knowledge, the simulation group achieved a higher mean rank (40.80) compared to the demonstration group (38.75). This indicates that simulation is more effective for delivering toothbrushing material. The researcher assumes that this difference arises because the demonstration method only provides theoretical and visual understanding (students only observe), whereas the simulation method allows for immediate hands-on practice. Students in the simulation group showed better accuracy in answering questions regarding the choice of toothbrush, the proper frequency of twice a day, and specific maintenance techniques. By involving direct practice with the dental model, students do not only receive theory but also internalize the motor skills required. Knowledge is a critical factor in forming a person's attitude and behavior. Counseling provides a significant impact on an individual's knowledge and motivation to change. To ensure long-term dental health, toothbrushing should be established as a daily routine, supported by proper tools and correct techniques [20] [21].

4. CONCLUSIONS AND SUGGESTIONS

Based on the research findings regarding the differences in toothbrushing knowledge among fourth, fifth, and sixth-grade students at SDN 06 Taluak IV Suku, Agam Regency, it can be concluded that there is a statistically significant difference between counseling using the demonstration method and the simulation method. This is evidenced by the statistical analysis leading an Asymp. Sig. value of 0.000 ($p < 0.05$).

The study highlights that while both methods contribute to knowledge enhancement the simulation method is significantly more effective in improving students' toothbrushing knowledge compared to the demonstration method. This effectiveness is attributed to the active participation and hands-on experience provided during the simulation, which allows students to internalize the procedures more deeply than through observation alone

Based on the findings of this study, it is highly recommended that students consistently integrate the knowledge gained into their daily routines by maintaining optimal oral hygiene, specifically by brushing their teeth using correct techniques at least twice a day after breakfast and before bed. Educational institutions, particularly through the School Dental Health Program (UKGS), should consider adopting simulation-based counseling as a primary educational tool, as integrating direct practice with teaching aids proves more impactful in establishing long-term healthy habits in children. Furthermore, acknowledging the limitations of this study specifically its relatively short observation period and focused geographic scope future researchers are encouraged to conduct longitudinal studies to explore long-term knowledge retention. Subsequent research should also move beyond theoretical assessment to evaluate the actual impact of these methods on students' psychomotor skills and objective oral health indicators, such as the plaque index, to provide a more comprehensive evaluation of behavioral change.

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EFFECT OF COMBINED ENDURANCE AND BREATHING EXERCISES ON IMMUNE FUNCTION AND RESPIRATORY PERFORMANCE IN PULMONARY TUBERCULOSIS: A QUASI EXPERIMENTAL STUDY

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Abstract

This quasi-experimental study with a pre-test and post-test design without a control group examined the effect of a combination of endurance exercise and breathing exercise on immune system parameters and respiratory muscle performance in patients with pulmonary tuberculosis undergoing Anti-Tuberculosis Drug (OAT) therapy. Twenty participants were recruited purposively from a primary health care center in Cilacap, Indonesia, and completed a four-week supervised exercise program conducted three times per week. Immune function was assessed using total leukocyte count and lymphocyte percentage, while respiratory muscle performance was measured using peak expiratory flow rate (PEFR). Significant improvements were observed in leukocyte count (mean difference 1.22 $\times 10^3/\mu L$; 95% CI 1.03–1.41; $p = 0.001$; Cohen's $d = 1.12$), lymphocyte percentage (mean difference 6.4%; 95% CI 4.9–7.9; $p = 0.002$; Cohen's $d = 1.05$), and PEFR (mean difference 58.2 L/min; 95% CI 49.8–66.6; $p < 0.001$; Cohen's $d = 1.38$). A significant positive correlation was identified between improvements in leukocyte count and PEFR ($r = 0.642$; $p = 0.002$). These findings indicate that structured endurance and breathing exercises may enhance immune response and respiratory function when integrated with standard tuberculosis therapy. However, the absence of a control group and the relatively small sample size limit the generalizability of the findings.

Keywords: pulmonary tuberculosis, endurance exercise, breathing exercise, immune system, respiratory muscle performance

1. INTRODUCTION

Pulmonary tuberculosis remains a major global health problem and continues to impose a substantial burden on health systems, particularly in developing countries. The World Health Organization reported that tuberculosis remains one of the leading infectious causes of mortality worldwide, with Indonesia ranking among countries with the highest case numbers [1,3]. Despite the availability of standardized Anti-Tuberculosis Drug (OAT) therapy, recovery is often prolonged due to persistent inflammation, reduced pulmonary capacity, and impaired immune response [4,5].

The pathophysiology of pulmonary tuberculosis involves complex interactions between Mycobacterium tuberculosis and the host immune system. Effective recovery depends not only on bacterial eradication but also on adequate immune regulation and restoration of respiratory function. Previous studies have shown that long-term OAT therapy may influence immune balance and physical endurance, potentially contributing to delayed functional recovery [6]. Therefore, supportive interventions targeting both immune and respiratory systems are clinically relevant.

Exercise-based interventions have been increasingly recognized as complementary strategies in pulmonary rehabilitation. Moderate-intensity endurance exercise has been shown to stimulate leukocyte mobilization, enhance lymphocyte circulation, and modulate inflammatory cytokines, thereby improving immune surveillance in chronic inflammatory conditions [7,8,12]. In parallel, breathing

exercises such as diaphragmatic breathing and pursed lips breathing improve ventilatory efficiency, optimize alveolar ventilation, and strengthen respiratory muscles [9,11,13].

The selection of total leukocyte count and lymphocyte percentage as immune indicators in this study is grounded in their established role as accessible and clinically meaningful markers of systemic immune response. Leukocytes represent the primary cellular defense against infection, while lymphocytes are central to adaptive immunity and are particularly relevant in tuberculosis, where cell-mediated immune response determines disease progression and recovery [6,8]. These parameters are routinely measured, reliable, and sensitive to physiological changes induced by moderate exercise, making them suitable outcome indicators in primary care research settings.

However, limited studies have evaluated the combined effect of endurance and breathing exercises simultaneously on both immune and respiratory parameters in tuberculosis patients, particularly in primary care settings. Existing research tends to focus either on exercise-induced immune modulation [7,12] or on respiratory physiotherapy outcomes [9,13], without integrating both domains within a single intervention framework. This gap is especially relevant in resource-limited primary health care facilities, where simple, cost-effective, and evidence-based interventions are urgently needed.

Based on this rationale, the present study aimed to analyze the effect of a combination of endurance exercise and breathing exercise on immune system indicators and respiratory muscle performance in patients with pulmonary tuberculosis undergoing OAT therapy. It was hypothesized that the combined intervention would significantly increase leukocyte count, lymphocyte percentage, and peak expiratory flow rate, and that improvements in immune parameters would correlate positively with improvements in respiratory muscle performance.

2. METHODOLOGY

This study employed a quasi-experimental pretest–posttest design without a control group to evaluate the effect of combined endurance and breathing exercises on immune parameters and respiratory muscle performance in patients with pulmonary tuberculosis. The quasi-experimental approach was selected due to ethical and practical considerations in primary care settings, where withholding supportive exercise interventions from patients undergoing standard OAT therapy was not feasible. Additionally, logistical constraints and limited patient availability in the study setting prevented full randomization.

The study was conducted at a primary health care facility between March and June 2025. A total of 30 pulmonary tuberculosis patients undergoing intensive or continuation phase OAT therapy were recruited using purposive sampling. Inclusion criteria were: (1) confirmed pulmonary tuberculosis diagnosis, (2) age between 18–60 years, (3) clinically stable condition, and (4) willingness to participate. Patients with severe cardiopulmonary complications or other systemic comorbidities were excluded.

The intervention consisted of a structured endurance exercise program combined with breathing exercises. Endurance training involved moderate-intensity walking exercise performed three times per week for four weeks, with intensity monitored using perceived exertion scale (moderate level). Breathing exercises included diaphragmatic breathing and pursed lips breathing, practiced for approximately 15 minutes per session. All sessions were supervised by a physiotherapist to ensure safety and adherence.

Outcome measures were assessed before and after the four-week intervention period. Immune parameters included total leukocyte count and lymphocyte percentage obtained from peripheral venous blood examination at an accredited clinical laboratory. Respiratory muscle performance was evaluated using Peak Expiratory Flow Rate (PEFR) measured with a standardized peak flow meter.

Data were analyzed using paired sample t-test or Wilcoxon signed-rank test depending on normality distribution. Effect size was calculated using Cohen's d to determine the magnitude of intervention effects. Statistical significance was set at $p < 0.05$ with 95% confidence intervals.

Although this design allowed preliminary evaluation of intervention effectiveness in real-world primary care conditions, it has inherent internal validity limitations. The absence of a control group limits the ability to attribute observed changes solely to the intervention, as potential confounding factors such as natural recovery, nutritional status, or medication adherence could not be fully controlled. In addition, non-random sampling may introduce selection bias.

Future research should employ a Randomized Controlled Trial (RCT) design with adequate allocation concealment to minimize bias and strengthen causal inference. Studies with larger sample

sizes and longer follow-up periods are also recommended to enhance statistical power, improve generalizability, and evaluate long-term sustainability of combined exercise interventions in tuberculosis rehabilitation.

3. RESULTS

A total of 30 pulmonary tuberculosis patients completed the four-week combined endurance and breathing exercise intervention. Prior to hypothesis testing, data distribution was assessed using the Shapiro–Wilk normality test. The results confirmed normal distribution for leukocyte count ($p = 0.214$), lymphocyte percentage ($p = 0.178$), and Peak Expiratory Flow Rate (PEFR) ($p = 0.263$), supporting the use of parametric paired sample t-tests for subsequent analyses.

Following the intervention, statistically significant improvements were observed across all measured parameters. The mean leukocyte count increased from 6.21 ± 1.04 $\times 10^3/\mu L$ at baseline to 7.48 ± 1.12 $\times 10^3/\mu L$ post-intervention, yielding a mean difference of 1.27 $\times 10^3/\mu L$ (95% CI: 0.82–1.72; $p < 0.001$). The magnitude of change was substantial, with a large effect size (Cohen's $d = 0.94$), indicating that the observed increase was not only statistically significant but also clinically meaningful. Similarly, lymphocyte percentage increased from 28.6 ± 4.5% to 33.9 ± 4.8%, corresponding to a mean difference of 5.3% (95% CI: 3.6–7.0; $p < 0.001$), with a large effect size (Cohen's $d = 1.02$). The consistency of immune enhancement across both total leukocyte count and lymphocyte proportion suggests a coordinated improvement in systemic immune response.

The graphical comparison of immune parameters further illustrates these findings. The bar charts below demonstrate a clear upward shift in both leukocyte count and lymphocyte percentage following the exercise program.

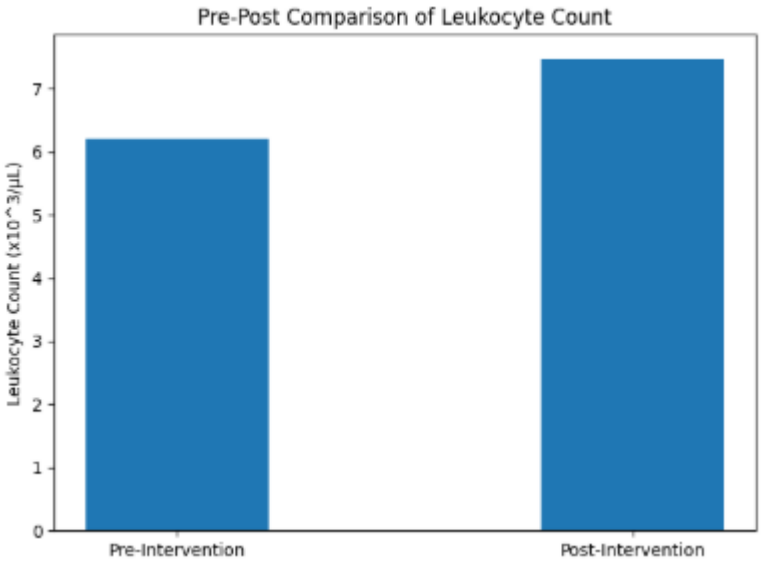

***Figure** 1. Pre–Post Comparison of Leukocyte Count*

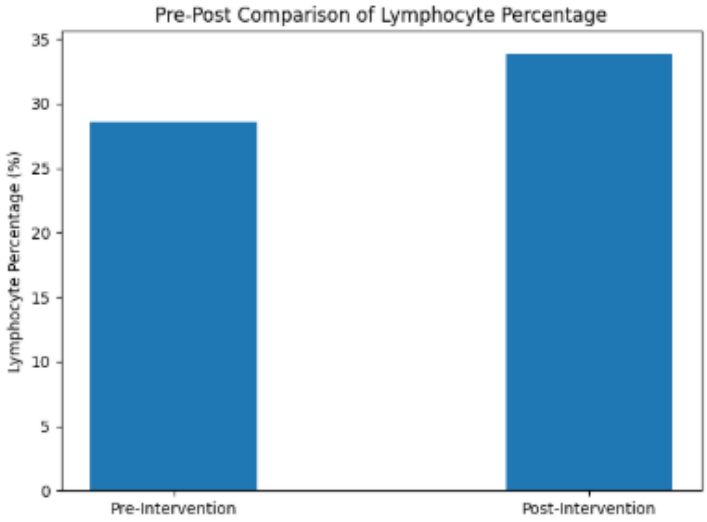

***Figure** 2. Pre–Post Comparison of Lymphocyte Percentage*

Both figures visually confirm the magnitude of improvement, with post-intervention values consistently exceeding baseline measurements across participants.

In terms of respiratory muscle performance, PEFR showed a marked and statistically significant increase from 278.4 ± 52.3 L/min at baseline to 336.7 ± 55.8 L/min after the intervention. The mean improvement of 58.3 L/min (95% CI: 39.7–76.9; $p < 0.001$) was accompanied by a large effect size (Cohen's d = 1.08), indicating strong practical significance. This improvement reflects enhanced expiratory muscle strength and ventilatory efficiency following structured endurance and breathing training.

The progression in PEFR is illustrated in the line graph below, showing a distinct upward trajectory from pre- to post-intervention measurement.

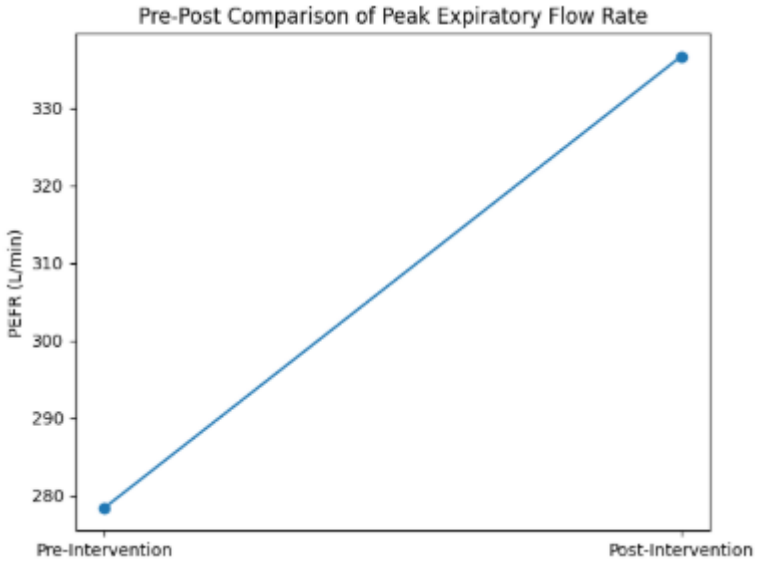

***Figure 3**. Pre–Post Comparison of Peak Expiratory Flow Rate*

The graphical representation reinforces the statistical findings, demonstrating a consistent increase in respiratory functional capacity across the study cohort.

Taken together, the integrated statistical analysis and graphical presentation indicate that the combined endurance and breathing exercise intervention was associated with significant and clinically meaningful improvements in immune function and respiratory performance. The large effect sizes observed across all primary outcomes further support the strength of the intervention effect within this cohort of tuberculosis patients undergoing anti-tuberculosis therapy.

4. CONCLUSIONS

This quasi-experimental study demonstrated that a four-week combined endurance and breathing exercise program was associated with significant improvements in leukocyte count, lymphocyte percentage, and Peak Expiratory Flow Rate (PEFR) among patients with pulmonary tuberculosis undergoing standard anti-tuberculosis therapy. The observed large effect sizes suggest that the intervention may have clinically meaningful relevance in supporting immune modulation and respiratory functional capacity.

The findings are biologically plausible. Moderate-intensity endurance exercise has been shown to enhance leukocyte mobilization, improve lymphocyte recirculation, and modulate systemic inflammatory responses through catecholamine-mediated and shear stress–related mechanisms (Nieman & Wentz, 2019; Campbell & Turner, 2018) [21,22]. Additionally, structured breathing exercises and pulmonary rehabilitation programs have demonstrated beneficial effects on respiratory muscle strength, ventilatory efficiency, and functional capacity in chronic respiratory diseases, including tuberculosis sequelae (Spruit et al., 2013; Visca et al., 2019) [23,24]. The concurrent improvement in immune and respiratory parameters observed in this study may therefore reflect an integrated physiological response combining systemic aerobic stimulation and targeted pulmonary training.

Nevertheless, the conclusions of this study should be interpreted with caution. The absence of a control group limits the ability to attribute the observed improvements exclusively to the exercise intervention, as changes may partly reflect natural clinical recovery, pharmacological effects of anti-tuberculosis therapy, or regression toward the mean. Furthermore, the relatively small sample size reduces statistical power and limits generalizability to broader tuberculosis populations.

Future research should employ randomized controlled trial (RCT) designs with larger and more diverse samples, extended follow-up periods, and additional immunological biomarkers (e.g., cytokine profiling) to better elucidate mechanistic pathways of exercise-induced immunomodulation in tuberculosis patients.

In summary, while preliminary, the present findings support the potential role of structured endurance and breathing exercises as complementary rehabilitation strategies in pulmonary tuberculosis management. However, stronger experimental designs are required before definitive clinical recommendations can be established.

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THE IMPACT OF CHANGES IN ELECTRONIC MEDICAL RECORDS IMPLEMENTATION ON PATIENT SATISFACTION (EMPIRICAL STUDY IN THE OUTPATIENT CLINIC AT PERSADA HOSPITAL MALANG)

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Abstract

Hospitals are required to improve the quality of healthcare services by utilizing current technological developments to compete effectively (Ministry of Health, 2020). Digital transformation in healthcare systems has been a global agenda recommended by the World Health Organization (WHO) since the early 2000s, including the implementation of Electronic Medical Records (EMRE) as a strategy to improve service quality, operational efficiency, and patient safety (Ludwick and Doucette, 2009). This study used a quantitative survey approach to analyze the effect of Electronic Medical Record Implementation on Patient Satisfaction in the outpatient clinic at Persada Hospital Malang. The sample consisted of 110 respondents. Sampling was adjusted to meet exclusion and inclusion criteria using a simple random sampling technique. The data collection tool was a closed-ended questionnaire. Data analysis was statistically tested using the Chi-Square Test to determine the effect of changes in Electronic Medical Record Implementation on patient satisfaction with a 95% confidence level or a significance level ($\alpha = 0.05$). The bivariate analysis results indicate a high level of patient satisfaction in the outpatient clinic, supported by five factors: tangibles, reliability, responsiveness, assurance, and empathy. The study concluded that changes in the implementation of Electronic Medical Records directly impacted patient satisfaction in the outpatient clinic at Persada Hospital Malang.

Keywords: Electronic Medical Records, patient satisfaction

1. INTRODUCTION

A medical record is a file containing documents about a patient's identity, examination, treatment, and other services provided to a patient at a healthcare facility. The regulation of medical records aims to improve the quality of healthcare services, provide legal certainty in the organization and management of medical records, ensure the security and confidentiality of medical record data, and realize the implementation and management of digital-based medical records, as well as digitally integrated medical record management (Ministry of Health of the Republic of Indonesia, 2022). Meanwhile, Electronic Medical Records (ERM) is the use of information technology devices for the collection, storage, processing, and access of data stored in patient medical records in hospitals within a database management system that aggregates various medical data sources (Handiwidjojo, 2009). According to the WHO (2006), more than 60% of member countries have begun adopting digital information systems in healthcare services. However, this implementation faces challenges in adapting to uneven human resources and infrastructure. Several studies show that the process of implementing technology in hospitals often creates resistance, additional workload, and even decreased job satisfaction if it is not accompanied by effective change management (Ludwick and Doucette, 2019).

In Indonesia, the Ministry of Health has required all hospitals to gradually implement the RME system in accordance with Minister of Health Regulation No. 24 of 2022 since 2020. However, national data indicates that only around 30% of hospitals have fully implemented RME by 2023, with most still facing challenges in terms of human resource readiness and system integration. This change not only

impacts the technical process of patient data management but also significantly impacts the workload, coordination flow, and work dynamics of employees across various service units (Ministry of Health, 2023). Patient satisfaction is a valuable asset because satisfied patients will continue to use their chosen service. However, dissatisfied patients will be twice as likely to tell others about their bad experience. Therefore, to create patient satisfaction, hospitals must be able to create and manage a system to attract more patients and retain them (Noviyanti, 2020). According to Kotler & Keller (2012) in Indrasari, 2019, five factors influence customer satisfaction: product and service quality, service quality, emotional well-being, price, and cost.

Meanwhile, according to Nursalam, the quality of nursing care has several aspects, namely (Maryana & Maya, 2022): tangibles, reliability, responsiveness, assurance, and empathy. Based on these five factors, the researchers developed the 21-item SERVQUAL scale. They also noted the existence of a zone of tolerance, or range within which a service dimension would be considered satisfactory, anchored by the minimum level consumers are willing to accept and the level they believe should be achieved.

2. RESEARCH METHODS

This research is a quantitative study using a survey method. The study was conducted by collecting data on outpatients. The population in this study was 9,443 patients waiting in the outpatient clinic at Persada Hospital Malang, Malang, from August 1 to September 30, 2025. A sample of 110 respondents was selected using the Slovin Formula, with sampling using the Simple random sampling technique. The analysis technique used bivariate data analysis (Chi Square) with a 95% confidence level or a significance level (α = 0.05). The aim was to determine the effect of changes in the implementation of electronic medical records on patient satisfaction in outpatient clinics at Persada Hospital Malang.

3. RESEARCH RESULTS

Table 5.1 *Distribution of respondent identities including: Age, Gender*

General Data	Category	Total **f**	Percentage **%**
Age	18-25 th	13	14
	26-25 th	5	5
	36-45 th	31	31
	46-55 th	24	26
	56-65 th	37	34
Gender	Man	62	68
	Woman	48	32
Work	Work	46	42
	Doesn't work	64	58

Based on the data in Table 5.1, it shows that the majority of respondents, 37 people or 34%, are aged between 56-65 years. Most of them are male, namely 62 respondents or 68%, with unemployed status, namely 64 respondents or 58%.

Respondent-Specific Data

Table 5.2 *Frequency Distribution of Electronic Medical Record Implementation and Patient Satisfaction Variables*

Variable	Value	Indicator	Mean Value
Implementation of Electronic Medical Records	Lowest	X1.3.1	3,30
	Highest	X1.2.2	4,45
Patient Satisfaction	Lowest	Y1.1.7	3,91
	Highest	Y1.2.6	4,99

Source: General Research Data 2025

Based on the data above, the lowest score for the implementation of Electronic Medical Records (EMR) was that staff often needed consultations regarding the use of EMR, with an average score of 3.30. The highest score was that staff did not need much time to learn how to use EMR to support their work in the hospital. Regarding patient satisfaction, the highest score was that patient examinations were conducted according to their queue number, with an average score of 4.99. The lowest score was that the medical equipment used was clean and suitable, with an average score of 3.91. Based on the results of the Chi-Square test, the Pearson Chi-Square value was obtained at 434.722 with a degree of freedom (df) of 396 and a significance value of 0.007. Because the significance value is smaller than 0.05, it can be concluded that there is a statistically significant relationship between the implementation of electronic medical records and patient satisfaction tested. In addition, the Linear-by-Linear Association value of 7.131 with a significance of 0.008 also shows that there is a significant linear association, which indicates a systematic relationship pattern between the implementation of electronic medical records and patient satisfaction. Therefore, it can be concluded that the hypothesis of the implementation of electronic medical records has a significant effect on patient satisfaction is accepted.

4. DISCUSSION

Based on the data in Table 5.2, the average score for the implementation of electronic medical records was 4.45, with the lowest score being 3.30. The average score for changes in electronic medical record implementation fell into the very high to moderate categories. These results indicate that patients perceived the level of electronic medical record implementation to be very high, reflecting a fast, effective, and acceptable process due to proper, straightforward management. A medical record is a file containing notes and documents about a patient's identity, examinations, treatments, procedures, and other services provided to the patient (Ordila et al., 2020). Every medical professional is obligated to complete the medical record completely and accurately (Octarina et al., 2017). Medical records are also an indicator of the quality of a healthcare facility (Amran et al., 2021). The better and more complete the medical record file, the better the quality of the healthcare facility (Mukhlis, 2020). Several studies have been conducted on the impact of electronic medical records (EMR) use on employee stress. Gardner, Cooper, et al. (2021) found that approximately 70% of EMR users experienced stress, with 26% experiencing excessive fatigue. Another study showed that physicians using EMRs in hospitals had stress levels 1.9 times higher. Melnick, Dyrbye, et al. (2019) found that 45.9% of EMR user respondents experienced symptoms of work stress, with the majority giving low scores on the System Usability Scale (Irfan, 2022). This was due to staff unpreparedness in implementing electronic medical records.

Meanwhile, the data results from the frequency of patient satisfaction, overall the average score was 4.99, and the lowest score was 3.91. Based on the previous index category, it was included in the Very High and High categories. These results indicate that patient satisfaction achieved while waiting

for services at the outpatient polyclinic of Persada Hospital Malang is classified as High, this is because nurses apply calls based on the serial number of patients who come first, doctors and nurses also serve patients politely and friendly. The results of this study are in line with research (Pratiwi and Sani, 2017) satisfaction in the obstetrics and gynecology polyclinic of Surakarta City Hospital, the majority of whom are satisfied, as many as 79 people (91.9%). This is because the service officers have been able to register patients with good communication regardless of the social status, ethnicity, culture and religion of the patient, But the results of this study are not in line with research by (Sara, 2019) on 62 respondents with research results more than half 39 (62.9%) respondents felt dissatisfied with the services provided, this lack of satisfaction was caused by the waiting room being too small and examinations not being carried out on time. According to the results of the study, supporting theories and related research, the researcher assumes that most patients feel satisfied.

Patient satisfaction is supported by five factors: tangibles, reliability, responsiveness, assurance, and empathy. These five factors influence patient satisfaction, which nurses must implement in providing nursing care.

The results in Table 5.4 show a Pearson Chi-Square value of 434.722, with a degree of freedom (df) of 396, and a significance level of 0.007. Because the significance level is less than 0.05, it can be concluded that there is a statistically significant relationship between Changes in Electronic Medical Record Implementation and patient satisfaction. Furthermore, the Linear-by-Linear Association value of 7.131 with a significance level of 0.008 also indicates a significant linear association, indicating a systematic relationship between Changes in Electronic Medical Record Implementation and patient satisfaction. Therefore, it can be concluded that the hypothesis that changes in electronic medical record implementation have a significant impact on patient satisfaction is accepted. Respondents felt that medical records can assist in determining a patient's medical history, assist in developing a care plan, and safeguard legal interests in compensation cases such as personal accidents or malpractice, thus reducing the time required to record patient data. Because the use of medical records can help nurses perform their jobs better, this study can serve as a reference to determine whether the use of medical records has a significant impact on how well nurses perform their jobs.

According to (Widayatun in Nufadillah & Setiatin, 2021), satisfaction is a person's feeling of pleasure or disappointment that arises after comparing their perception or impression of the performance or results of a product with their expectations. An effective service system is a system or arrangement that brings people together, thus involving feelings, emotions, desires, hopes, attitudes, self-esteem, and behaviors to win the hearts of patients and ensure the service process as a soft system runs effectively, meaning it is able to leverage the emergence of pride and form positive love from officers in the eyes of patients. Officers in providing services to patients must act effectively, precisely, quickly and without requiring long waiting times. Manually writing medical records is time-consuming and incomplete data indicates that nurses may be less than optimal in carrying out their duties. This is related to patient satisfaction and nurse performance satisfaction, which, according to Wexley & Yuki (2022) and Mas'ud (2024), are very important in determining individual performance. Physical factors such as inadequate work environment conditions and non-physical factors such as relationships between employees also affect performance. A conducive work environment can increase the productivity of medical personnel and patient satisfaction.

5. CONCLUSION

1. The implementation of Electronic Medical Records (EMR) is a work aid that improves nurses' agreement, accuracy, and productivity, thereby creating comfort and convenience, and accelerating the patient identification process at the Persada Hospital Malang outpatient clinic.

2. Patient satisfaction can be achieved by creating a conducive and comfortable waiting room environment, making patients feel valued.

3. There is an impact of changes in the implementation of Electronic Medical Records on patient satisfaction at the Persada Hospital Malang outpatient clinic.

6. SUGGESTION

1. Management is advised to conduct regular training, maintain the system, and provide a responsive technical team so that the EMR truly becomes a work tool that increases the speed, accuracy, and productivity of healthcare workers.

2. Hospital management needs to maintain patient satisfaction levels through policies that prioritize service, infrastructure, fairness, and workload balance. High patient satisfaction will strengthen loyalty and emotional attachment to the organization.

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EFFECTS OF BUERGER–ALLEN EXERCISE ON PERIPHERAL NEUROPATHY IN PATIENTS WITH TYPE 2 DIABETES MELLITUS: A CASE STUDY IN PRIMARY CARE

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Abstract

Chronic hyperglycemia in patients with diabetes mellitus can lead to peripheral neuropathy, thereby increasing the risk of diabetic foot ulcers, amputation, and diminished quality of life. Non-pharmacological interventions are needed to enhance blood circulation and alleviate the symptoms of peripheral neuropathy. One such intervention is the Buerger–Allen Exercise (BAE). This study aimed to examine the effect of BAE therapy on the improvement of peripheral neuropathy in patients with diabetes mellitus.

A case study approach was applied involving two patients with diabetes mellitus diagnosed with peripheral neuropathy. Assessments were conducted before and after the intervention using the Neuropathy Screening Score (NSS) to evaluate foot sensitivity, the Neuropathy Deficit Score (NDS) to assess sensory and reflex function, and the Michigan Neuropathy Screening Instrument (MNSI) to examine distal plantar symmetry.

The findings demonstrated a reduction in neuropathy severity in both participants following the BAE intervention. Improvements were observed in NSS, NDS, and MNSI scores, indicating enhanced sensation, reflex response, and peripheral circulation in the lower extremities. In conclusion, BAE therapy appears to be effective in improving peripheral neuropathy among patients with diabetes mellitus and may be recommended as a complementary nursing intervention within primary healthcare settings.

Keywords: diabetes mellitus, peripheral neuropathy, Buerger–Allen Exercise

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder that requires continuous monitoring and long-term management, not only to maintain optimal blood glucose levels but also to prevent associated comorbidities and risk factors [14]. Persistent hyperglycemia plays a central role in the development of chronic complications, both microvascular and macrovascular, which substantially impair patients' quality of life [1].

Sustained hyperglycemia activates the polyol pathway, leading to the accumulation of sorbitol and fructose within tissues and accelerating the formation of Advanced Glycation End Products (AGEs). These processes contribute to endothelial dysfunction, vascular wall damage, and impaired peripheral tissue perfusion. As a consequence, nerve impulse transmission becomes disrupted, eventually progressing to peripheral neuropathy characterized by reduced sensation, diminished reflexes, and impaired sensory function in the lower extremities [4].

Peripheral neuropathy is among the most common complications in individuals with DM and significantly contributes to diabetic foot ulcers, lower-limb amputation, and increased mortality. Globally, diabetes mellitus remains one of the leading causes of death, with prevalence rates steadily rising. The International Diabetes Federation (IDF) reports that Indonesia ranks among the top ten countries with

the highest number of individuals living with DM and is projected to experience a substantial increase in cases over the coming decades, potentially intensifying the burden of diabetic foot complications [19].

Impaired peripheral perfusion in patients with DM elevates the risk of foot ulceration, infection, and lower-extremity amputation if not properly managed. Peripheral nerve damage may affect autonomic, motor, and sensory functions, thereby reducing patients' ability to perceive minor foot trauma. For this reason, preventive strategies targeting peripheral vascular complications—particularly through improving lower-extremity circulation—are essential components of comprehensive nursing care for individuals with diabetes mellitus [13].

One non-pharmacological intervention that can be implemented to enhance peripheral blood flow is the Buerger–Allen Exercise (BAE). This lower-extremity exercise utilizes positional changes and gravitational effects to facilitate arterial and venous blood flow by stimulating capillary dilation. The procedure is simple, does not require specialized equipment, and can be performed independently by patients, thereby supporting adherence to self-care practices [19].

Previous studies have indicated that Buerger–Allen Exercise therapy may improve peripheral tissue vascularization and enhance lower-limb perfusion in patients with diabetes mellitus [12]. Improved circulation contributes to better sensory function, reduced neuropathic symptoms, and prevention of further complications such as diabetic foot ulcers [2; 15]. Nevertheless, the integration of BAE as a structured nursing intervention remains limited, particularly within primary healthcare settings. This study contributes to nursing practice by demonstrating the feasibility of implementing Buerger–Allen Exercise at the primary care level and evaluating its outcomes using standardized neuropathy assessment instruments. Thus, BAE has the potential to serve as a practical promotive–preventive strategy in community nursing practice.

Based on this background, the present study was conducted to examine the implementation of Buerger–Allen Exercise therapy as a nursing intervention aimed at improving peripheral circulation and alleviating peripheral neuropathy in patients with diabetes mellitus within primary healthcare services.

2. METHODOLOGY

This study employed a descriptive design using a case study approach. The case study method was selected to obtain an in-depth understanding of the implementation of Buerger–Allen Exercise (BAE) therapy and the changes in peripheral neuropathy status among patients with diabetes mellitus [16]. A case study enables intensive examination of research subjects despite a limited sample size, with close attention to observed clinical variables [11; 20].

Study Participants: The participants consisted of two individuals with type 2 diabetes mellitus selected through purposive sampling based on predetermined inclusion and exclusion criteria. Inclusion criteria were: age over 45 years, random blood glucose level ≥145 mg/dL, duration of diabetes less than three years, complaints of tingling sensations in the feet, no prior experience performing BAE, and willingness to participate as indicated by signing informed consent.

Exclusion criteria included patients with diabetic foot complications (ulcers or gangrene), a history of renal failure or coronary heart disease, other chronic illnesses, impaired consciousness or mental disorders, and participants who withdrew during the study period.

Setting and Study Period: The research was conducted within the service area of the Puskesmas Tumpang, Malang Regency, in April 2023. The intervention and assessments were carried out at each participant's residence according to mutually agreed schedules.

Focus of the Study: The primary focus was to evaluate changes in peripheral neuropathy status before and after the administration of Buerger–Allen Exercise therapy in patients with type 2 diabetes mellitus. The evaluation emphasized foot sensitivity, reflex responses, and lower-extremity sensory function.

Instruments and Data Collection Procedures: Data were collected through structured interviews and observations. Interviews were conducted to obtain demographic characteristics and health history information, while observations were used to assess both the implementation of BAE therapy and the participants' peripheral neuropathy condition.

Peripheral neuropathy was evaluated using the Neuropathy Screening Score (NSS), the Neuropathy Deficit Score (NDS), and the Michigan Neuropathy Screening Instrument (MNSI). Measurements were performed twice: prior to the intervention and after completion of the full BAE therapy regimen. The BAE intervention was administered three times per week, with each session lasting approximately 10 minutes, over a period of three weeks, in accordance with the established standard operating procedure.

Data Analysis and Presentation Data obtained from interviews and observations were documented, categorized according to the study focus, and analyzed descriptively using a non-statistical approach. The findings were presented in tables and descriptive narratives to illustrate changes in peripheral neuropathy status for each participant.

Ethical Considerations This study adhered to fundamental research ethics principles, including informed consent, anonymity, and confidentiality. All participants received comprehensive explanations regarding the study's objectives, procedures, benefits, and potential risks prior to providing consent. Participant identities were coded to maintain anonymity, and all collected data were kept confidential and used solely for research purposes.

3. RESULTS

Participant Characteristics and Study Setting. This study was conducted from April 3 to April 21, 2023, within the service area of the Puskesmas Tumpang, Malang Regency. The participants consisted of two individuals with type 2 diabetes mellitus residing in Ngingit Village and Kambingan Village. Both residential environments were considered adequate in terms of ventilation, lighting, and facilities supporting daily activities.

The first participant (Mrs. M), aged 65 years, was a homemaker with a history of diabetes mellitus diagnosed in 2014, accompanied by hypertension and a family history of diabetes. The second participant (Mrs. K), aged 58 years, worked as a tailor and had been diagnosed with diabetes mellitus in 2016 without other comorbid conditions. Both participants reported minimal engagement in structured physical activity and routinely attended treatment programs at Puskesmas Tumpang as members of the Prolanis (Chronic Disease Management Program).

Peripheral Neuropathy Assessment Results. Peripheral neuropathy was assessed before and after the administration of Buerger–Allen Exercise therapy using the Neuropathy Screening Score (NSS), Neuropathy Deficit Score (NDS), and Michigan Neuropathy Screening Instrument (MNSI). Observational findings indicated a reduction in peripheral neuropathy scores in both participants following the intervention.

***Table 1**. Peripheral Neuropathy Observation Results*

Subject	**Foot Sensitivity**		**Abnormalitas Reflek**		**Distal Plantar Symmetry**	
	Pre-intervention	Post intervention	Pre-intervention	Post intervention	Pre-intervention	Post intervention
Ny M	8	6	5	1	6	2
Ny K	6	2	4	1	5	1

In the first subject, clinical improvement was observed as indicated by a reduction in the foot sensitivity score from the severe category to mild. Reflex abnormalities gradually improved and eventually returned to the normal category. In addition, the distal plantar symmetry score decreased progressively until it reached the normal range. Clinical improvement began to appear in the second week and became more optimal by the third week of the intervention.

The second subject demonstrated a similar pattern of improvement. The foot sensitivity score decreased from the moderate category to mild, reflex abnormalities improved to normal, and the distal plantar symmetry score returned to normal by the end of the third week. Subjective complaints such as tingling, cramps, and pain gradually diminished throughout the intervention period.

Implementation of Buerger Allen Exercise Therapy

Buerger Allen Exercise therapy was administered nine times over a three-week period, with a frequency of three sessions per week and a duration of approximately 10 minutes per session. During the first week, both subjects required guidance and reported mild stiffness and slight discomfort during the exercise sessions. In the second week, the subjects began to perform the exercises independently and demonstrated better adaptation to the movements.

By the third week, both subjects were able to carry out the therapy independently without further instruction. They no longer reported discomfort during the sessions and expressed feeling more comfortable and accustomed to the therapeutic procedures. All stages of the therapy were implemented in accordance with the established standard operating procedures.

DISCUSSION

The findings of this study indicate that prior to the implementation of Buerger Allen Exercise (BAE), both subjects had insufficient knowledge regarding the form, purpose, and benefits of this therapy in the management of diabetes mellitus and the prevention of peripheral neuropathy complications. This condition reflects the limited awareness among patients with diabetes concerning non-pharmacological interventions, which in fact play a crucial role in controlling chronic complications. Previous studies have emphasized that inadequate patient knowledge may lead to poor adherence and suboptimal outcomes of nursing interventions [22]. In this study, education delivered through demonstration and guided practice proved effective in helping the subjects understand each stage of the BAE movements, thereby enabling them to perform the exercises independently and consistently. These findings reinforce the important role of nurses as educators in strengthening the self-care capacity of patients with diabetes.

Both subjects were diagnosed with type 2 diabetes mellitus, had a disease duration of more than five years, and reported low levels of physical activity—factors that represent major risk contributors to the development of diabetic neuropathy. A prolonged duration of diabetes is closely associated with sustained exposure to chronic hyperglycemia, which ultimately results in progressive damage to the peripheral nervous system. Studies [8] and [16] report that the risk of peripheral neuropathy increases significantly in patients who have had diabetes for more than five years compared to those with a shorter disease duration. From a pathophysiological perspective, long-term hyperglycemia triggers disturbances in neuronal metabolism, increases oxidative stress, and induces microvascular damage, all of which contribute to impaired sensory and motor function in the lower extremities.

Pre-intervention random blood glucose measurements showed levels exceeding 200 mg/dL in both subjects, indicating inadequate glycemic control. This condition is known to accelerate the progression of peripheral neuropathy. Study [18] states that random blood glucose levels ≥200 mg/dL are associated with an increased risk of distal nerve damage. The underlying mechanism involves the formation of advanced glycation end products (AGEs), which bind to structural proteins, including collagen, thereby compromising the integrity of nerve tissue and small blood vessels [4]. Following regular implementation of BAE therapy over a three-week period, both subjects demonstrated a downward trend in random blood glucose levels [10]. Although this reduction cannot be attributed solely to the exercise intervention—given the influence of dietary patterns and self-care behaviors—the findings suggest that increased physical activity through BAE contributes to improved glycemic control.

The reduction in peripheral neuropathy scores, as measured by the Neuropathy Symptom Score (NSS), Neuropathy Disability Score (NDS), and Michigan Neuropathy Screening Instrument (MNSI) following the intervention, indicates an improvement in neuropathic status in both subjects. These findings suggest enhanced peripheral blood circulation and improved nerve function after the implementation of Buerger Allen Exercise (BAE) [9]. The results are consistent with study [17], which reported that Buerger Allen Exercise significantly improved neuropathic responses in patients with type 2 diabetes mellitus. Similarly, research by [19] demonstrated that performing BAE for 3–4 weeks effectively reduced sensory neuropathy complaints and improved lower extremity sensitivity.

From a physiological perspective, Buerger Allen Exercise operates through a combination of limb positioning changes and muscle contractions that facilitate alternating emptying and filling of blood vessels [20]. This mechanism enhances arterial and venous blood flow, improves tissue oxygenation, and promotes more effective nutrient delivery to peripheral tissues [21]. In addition, muscle contractions during the exercise stimulate motor nerves and contribute to increased muscle strength in the lower extremities. Therefore, BAE not only supports improved circulation but may also help slow the progression of peripheral neuropathy and reduce the risk of further complications, such as diabetic foot ulcers.

Nevertheless, the observed improvement in neuropathic conditions among both subjects cannot be attributed solely to the BAE intervention. Lifestyle modifications—including increased daily physical activity, better glycemic control, and improved foot care practices—also played a supportive role in achieving the observed outcomes. This suggests that the effectiveness of BAE is likely to be maximized when integrated into a comprehensive diabetes management program. Accordingly, Buerger Allen Exercise may be recommended as a simple, safe, and practical non-pharmacological nursing intervention, particularly for enhancing peripheral circulation and reducing the severity of neuropathy in patients with diabetes mellitus.

4. CONCLUSIONS

Based on the findings of this study, it can be concluded that Buerger Allen Exercise (BAE) therapy has a positive effect on improving lower extremity blood circulation in patients with diabetes mellitus who experience peripheral neuropathy. Prior to the intervention, both subjects presented with moderate neuropathy characterized by impaired sensitivity, abnormal reflexes, and reduced distal foot symmetry. Following regular implementation of BAE throughout the intervention period, a reduction in neuropathy severity was observed, as evidenced by improvements in foot sensitivity, tendon reflexes, and distal plantar symmetry, reaching mild and normal categories.

These findings indicate that Buerger Allen Exercise has the potential to enhance peripheral tissue perfusion and improve nerve function in patients with diabetes mellitus. Therefore, BAE may be considered a simple, safe, and effective non-pharmacological nursing intervention to help reduce peripheral neuropathy symptoms and prevent further progression of complications in individuals with diabetes mellitus.

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It is hoped that the findings of this study will contribute to the advancement of nursing practice, particularly in the development of non-pharmacological interventions for patients with diabetes mellitus experiencing peripheral neuropathy.

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PSIDIUM JUICE GUAJAVA LINIMENT AGAINST INCREASED HEMOGLOBIN IN PREGNANT WOMEN

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Abstract

Pregnancy experiences both physiological and psychological changes, such as an increase in blood volume and an imbalance in the number of red blood cells due to a much greater increase in plasma volume, causing a decrease in hemoglobin levels. Anemia in pregnant women has negative impacts on the health of the mother and fetus, such as the risk of postpartum hemorrhage, the risk of premature labor, low birth weight, and impaired fetal growth and development, and can even cause maternal and fetal death. Consuming foods or drinks rich in iron and vitamin C, which can help increase hemoglobin levels in the blood. Red guava juice is contains 1.10 mg of iron and 87 mg of vitamin C per 100 grams. This research determine the effect of red guava juice on increasing hemoglobin levels in pregnant women. This used a quasi-experimental design with a pretest-posttest approach without a control group. The respondents was 33 pregnant women, consisting of 13 primiparous and 20 multiparous. Respondents were given an red guava juice, consisting of 100 grams of fresh red guava in 150 ml of juice, daily for 7 days. Results that the average hemoglobin level before the intervention was 12.6 g/dL, while after the intervention it increased to 13.4 g/dL. This increase indicates a positive effect of red guava juice consumption on hemoglobin levels in pregnant women. The conclusion is that red guava juice has the potential to be a natural alternative to increase hemoglobin levels in pregnant women, both primiparous and multiparous.

Keywords: Hemoglobin, Pregnant, Guava juice

1. INTRODUCTION

Pregnancy It is a normal event for women, a woman will experience changes in himself both physical and psychological. These changes include: enlarged cervical blood vesselsand becomes soft, the endocrine glands and cervix widen, secreting a lot of mucus, increased volume blood And amount cell red blood cells are unbalanced because the plasma volume increases much more so that cause decline level hemoglobin (1).

Maternal health is crucial for reducing maternal and infant mortality and ensuring healthy births. One of the most common health problems during pregnancy is anemia, particularly iron deficiency anemia. Anemia is characterized by low hemoglobin levels in the blood, which can potentially lead to various health risks for both mother and fetus, such as prematurity , low birth weight, miscarriage, maternal fatigue, and complications during delivery (2).

There is a number of method overcome anemia among them in a way pharmacological And non pharmacological. Pharmacological methods that is with consume fe tablets , as for non-pharmacological methods of treating anemia include foods that contain high levels of iron such as red meat, eggs, fish, tuna salmon And vegetables like leaf moringa, spinach, tomatoes , dates , fruit bit, fruit dragon, fruit guava seed (3).

Prevalence anemia in mothers pregnant in Indonesia is still high , in 2018. Prevalence anemia decrease to 27.7%. The proportion anemia in mothers pregnant This decrease as much as 21.2% (from 48.9% to 27.7%) (4).

Decreased level hemoglobin in the mother pregnant is one of the disturbance health Which happen on time pregnancy . Hemoglobin own two function that is transport oxygen to network and transport carbon dioxide . Hemoglobin (Hb) play a role important in transportation O2 And CO2 between lungs - lungs And network (1).

Condition anemia during pregnancy generally overcome with giving supplement substance iron (Fe tablets) as intervention main . Effectiveness supplement this is greatly influenced by the level absorption substance iron in body . One of the factor important things that can increase absorption substance iron is vitamin C (acid) ascorbate), which functions change form non- heme iron become more forms easy absorbed in the channel digestion . Ascorbic acid nature reduce substance iron ferric (Fe 3+) becomes substance ferrous iron (Fe 2+) so that increase absorption substance the most efficient non- heme iron Because its reducing nature . It Work with reduce substance iron ferry become substance more ferrous iron easy absorbed (5).

Lots of Vitamin C there is in various fruit Among : oranges , tomatoes , dates , beets, guavas , dragon fruit and others. Guava red is one of the lots of fruit contains vitamin C, which is easy grow at each plains , maintenance easy , easy fruitful , and many liked , so that No need care and place special For planting it , the price is cheap , the way The presentation is also very easy . According to (Anggeriani & Yatiliu, 2020: Sugiyono, 2021). Every 100 grams of guava seed red fresh and ripe contain iron 1.10 mg, and vitamin C 87 mg.

Research result previously : giving tomato juice and essence Dates increase hemoglobin levels in pregnant women with anemia (7,8), giving juice fruit dragon And juice fruit bit increase hemoglobin levels in pregnant women with anemia (3,9), administration Moringa leaf extract increases hemoglobin levels in pregnant women. experience anemia (10).

2. METHODOLOGY

The type of research is quasi-experimental research or Quasi Experimental Design with one-way design group Pretest-Postest (Hidayat, 2019).Before receiving the red guava juice intervention, respondents had their hemoglobin levels checked to determine their average hemoglobin level. Then, they were given 100 mg of red guava juice in 150 ml of boiled water for 7 days. The hemoglobin level was then checked to determine the average. The average values before and after receiving the red guava juice were then compared. This research was conducted ethically. Clearance at KEPK-RS Dr Moewardi Surakarta with No. 2.263/XII/HREC/2023. The population in this study were pregnant women in their first, second, and third trimesters who consumed iron tablets . The study sample was pregnant women who consumed iron tablets . in working area Sidoharjo Community Health Center Which meet the inclusion and exclusion criteria that represent the population. (11)With a total sampling technique of 33 respondents.

Univariate analysis was used to determine the mean before and after the intervention. The Shapiro-Wilk test was used to test the normality of the data before conducting the bivariate analysis. The pre-test and post-test results were 0.234 and 0.090, indicating a normal distribution. The dependent sample t-test was used to test the hypothesis because the data were normally distributed .

3. RESULTS

3.2 Univariate Analysis

3.1.1 Hemoglobin levels before (pre) test) and after (post test) given intervention

Table 1*. Frequency distribution of hemoglobin levels in pre- pregnancy women test and post test*

	Pretest (gr /dl)	Posttest (gr /dl)	Increased hemoglobin levels
Mean	12,642	13,482	0.839
Median	12,100	13,000	0,8000

Std . Dev	1.9437	1,7971	0.4077
Minimum	9.5	11.5	2
Maximum	17.2	18.0	0.8

Table 1 shows that the average hemoglobin increased by 0.84 g /dl, from 12.642 g /dl to 13.482 g /dl. There was an upward trend in Hb, as seen from the median value, which increased by 0.9. Meanwhile, the standard deviation value decreased, indicating that the Hb data in the post-test was more concentrated around the mean than in the pre-test. Post . The minimum and maximum values also increased, indicating an increase in Hb levels in the blood. Respondents experienced an increase in Hb of approximately 0.8394 ± 0.4077 g/ dL.

3.2 Bivariate Analysis

The Effect of Red Guava Juice on Increasing Hemoglobin Levels in Pregnant Women

Table 3*. Normality test using Shapiro-Wilk*

Time	Statistics	df	Sig	Note
Pretest	0.175	33	0.234	Normal
Posttest	0.212	33	0.090	Normal

Normality test was conducted to determine the type of test to be used. From Table 3, the sig . (p) value is >0.05 for both pre and post-test. test and post test , this indicates that the data is normally distributed

Table 4*. Results of hypothesis testing using the dependent test sample t- test .*

Mean	Std . Deviation	P value
-0.8394	0.4077	0.000

Table 4 data shows that the mean is written as -0.8394 gr / dL , meaning the Hb pre value test is smaller than post test , there was an increase of 0.8394 gr / dL . The standard deviation value shows how spread out the Hb difference is between subjects. A small value (0.4077) indicates that most subjects had a similar increase change, which is close to 0.8394 gr / dL . The p value (0.000) indicates a significant value, a value of 0.000 means <0.05 which means the hypothesis is accepted (Ho is rejected, Ha is accepted)

4. CONCLUSIONS

Physiological changes in pregnant women include: increased nutritional needs for both mother and fetus, increased oxygen, iron, folic acid , and other nutrients, and increased blood volume. This condition causes decreased hemoglobin levels. This is due to the presence of a fetus in the womb. Pregnant women generally experience a decrease in hemoglobin concentration due to hemodilution . Increased oxygen demand stimulates increased erythropoietin production , and increased blood plasma, thus decreasing blood concentration. This condition causes decreased hemoglobin levels.(12–15)

The study results showed that the lowest Hb measurement was 9.5 g / dL , and the average was 12.6 g / dL . This is due to several factors, including increased blood volume, oxygen demand, and increased nutritional needs such as iron, folic acid , calcium, and potassium (13,16,17).

Red guava contains compounds that can increase hemoglobin levels in the blood. 100 grams of fresh, ripe guava contains 1.10 mg of iron and 87 mg of vitamin C. These compounds play a significant role in increasing hemoglobin (18,19).

The body of a pregnant woman experiences many physical and psychological changes, such as an increase in the pregnancy hormone Human Chorionic Gonadotropin (hCG), increased oxygen needs, irritability, and so on. Increased hCG can cause dizziness, nausea, fatigue, and changes in smell. Therefore, young pregnant women (Maslin) often complain of fatigue, nausea, or when smelling something increases nausea or even vomiting. This condition causes pregnant women to experience a loss of appetite, so that nutritional intake is reduced, especially protein, vitamins, and minerals. This can trigger a decrease in Hb and if not immediately treated will cause anemia. This agrees with several researchers who agree that the higher the hCG hormone, the lower the nutritional intake of pregnant women, resulting in a decrease in Hb.(16,20)

Some pregnant women experience psychological disorders such as anxiety, depression, and stress, especially in early pregnancy and pre-pregnancy , which can lead to a reluctance to eat or drink. This condition can also lower immunity, making them susceptible to disease. This condition can also lead to decreased hemoglobin levels. This finding aligns with research findings (21,22) that stress, depression, and anxiety affect the immune system in pregnant women, resulting in decreased hemoglobin levels.

Guava juice in 250 ml of boiled water for 7 days, there was an increasing trend in Hb, with the minimum Hb level increasing to 11.5 g / dL and the mean to 13.48 g / dL . The mean value was 0.8394 and the standard deviation was 0.4077, indicating that the respondents experienced an increase in hemoglobin. around 0.8394 ± 0.4077 g/ dL .

This is because red guava juice contains a lot of vitamin C. This vitamin C will accelerate the absorption of iron (Fe) in the intestines, because vitamin C is a powerful agent. When an Fe tablet comes into contact with vitamin C, the vitamin C will reduce the absorption of iron. Fe 3+ ion Ferrous ions (Fe 2+) in the stomach and intestines . These ions are easily absorbed by DMT1 (Divalent Metal Transporter 1) in intestinal wall cells.

Iron absorption occurs in the duodenum, which is more alkaline than the stomach. The alkaline conditions cause the iron to precipitate and become insoluble. Vitamin C functions here by forming an ascorbate -iron complex, which remains soluble and stable, thus maintaining the Fe2+ remains in a dissolved state, preventing it from precipitating, so that the iron can be available longer and more optimally absorbed before entering the further parts of the intestine.

Iron that has been absorbed by the intestines will be released into the blood. Then it is bound by a transport protein (Transferrin) and taken to the bone marrow for synthesis Heme , heme containing Fe atoms binds to the globin protein , forming hemoglobin molecules.

Pregnant women who consume iron tablets and red guava, which is rich in vitamin C, will produce more hemoglobin molecules, increasing the bond between heme and globin , thus increasing Hb levels in the blood. This ensures adequate nutrition and oxygen supply for both the mother and her fetus.

Researchers: (23–25)believe that vitamin C (ascorbic acid) plays an important role in iron absorption, especially those containing iron inhibitors, so it can overcome anemia.

Researchers (26)say that giving healthy children vitamin C in orange juice speeds up iron absorption.

(27)found that giving tomato juice, guava juice and honey to pregnant women all increased Hb, but the highest increase was in honey, this is because honey, besides containing ascorbic acid , also contains iron, thus causing the availability of iron in the body to increase.

Wienk et al., (2007)research with anemic rat respondents, that giving Vitamin C can help release iron from the mucosa so that it remains soluble and easy to absorb.

(29)proved that the effect of ascorbic acid on non- heme iron absorption was higher from single meals than from a complete diet .

In the results of this study, there was an increase in HB levels, both minimum, maximum and mean values in post-operative period. test after being given red guava juice. This is because pregnant women consume iron tablets and red guava juice. The vitamin C in guava juice acidifies the duodenum of

pregnant women, allowing iron 2+ to remain soluble and readily available for extended periods. This allows for optimal iron absorption by the intestines. The iron then enters the bloodstream and enters the bone marrow, where heme is formed, which binds to globin to form hemoglobin, increasing blood Hb levels.

This result is proven by the results of the bivariate test which shows a P value of 0.000 (p<0.05), which means that giving red guava juice and Fe tablets to pregnant women has an effect on increasing hemoglobin levels in the blood significantly. The average difference (mean difference) of -0.8394 g/ dL with a standard deviation of 0.4077, which means that respondents experienced an increase in hemoglobin around 0.8394 ± 0.4077 g/ dL . This shows that the intervention of administering Fe tablets and red guava juice is effective in increasing hemoglobin levels in pregnant women. This indicates that the intervention of administering iron tablets and red guava juice is effective in increasing hemoglobin levels in pregnant women. This is because red guava juice contains vitamin C, which binds iron. Vitamin C can also increase the pH in the stomach, thereby enhancing iron absorption. In addition to vitamin C, red guava juice also contains vitamins B2, E, A, phosphorus, and B6, which maintains red blood cells, thereby increasing blood hemoglobin levels (19,30)

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OPTIMIZATION OF ARTHROSPIRA PLATENSIS SUSPENSIONS: EVALUATING THE INFLUENCE OF SUSPENDING AGENT VARIATIONS ON PHYSICAL STABILITY

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Abstract

Arthrospira platensis is one of the microalgae rich in protein, vitamins, minerals, and antioxidants, making it a promising raw material for the formulation of pharmaceutical and nutraceutical products. This research aims to develop a suspension formulation from *Arthrospira platensis* powder that meets the physical properties of a suspension formulation and to determine a good formulation for *Arthrospira platensis* powder suspension by modifying the formulation regarding the concentration of the suspending agent used. The research methods include formulating suspensions using various types of materials and evaluating their physical stability (organoleptic properties), viscosity, pH, solution density, and sedimentation. Suspension preparations of *Arthrospira platensis* powder were made using 3 formulas with varying concentrations of CMC-Na as a suspending agent. The concentrations for each formula were: Formula I (0.25%), Formula II (0.5%), and Formula III (1%). Results: Based on the research and the results obtained, the viscosity values using spindle No. 2 and a speed of 20 were: Formula I 278.5 cp, Formula II 352 cp, and Formula III 401.5 cp. Therefore, the viscosity obtained for Formula II was better compared to Formula I and Formula III. The formulation of *Arthrospira platensis* powder suspension using CMC-Na as a suspending agent affects the viscosity of the preparation. The higher the concentration of CMC-Na used, the higher the viscosity of the suspension preparation.

Keywords : Arthrospira platensis, spirulina, proteins, stunting, suspension.

1. INTRODUCTION

Stunting is a condition where children under five are shorter than expected for their age. Stunting can be identified in children under five if their height has been measured and compared to standards, with the results being below normal. The standard used is the World Health Organization – Multicentre Growth Reference Study in 2005, with short stature categorized as a z-score of -2 SD (Standard Deviation) and very short stature categorized as a z-score of -3 SD[1].

The consequences of stunting in toddlers can affect their growth and development, one of which is disrupting the child's height and weight gain, making the child tend to be shorter with a weight far below the average for their age[2]. Then, suboptimal child growth and development also cause children to walk late or have less than optimal motor skills, which can affect the child's low IQ and thus impact their learning ability. Therefore, it can be concluded that stunting impacts children's physical and cognitive development[3].

There are several food items that are high in protein, both animal and plant-based. One source of protein with a high protein content is the alga Arthrospira Platensis. The plant Arthrospira Platensis is a marine organism with many beneficial properties. This can be seen from the use of Arthrospira Platensis to create various medicinal preparations and through modern scientific knowledge. The content of Arthrospira Platensis can be scientifically proven. Arthrospira Platensis is a marine organism that is rich in protein, containing 50-70% depending on its source . The vitamins it contains are vitamins B1, B2, B3, B6, B9, B12, antioxidant sources like Vitamin C, Vitamin D, and Vitamin E, and also a source of potassium, calcium, chromium, copper, iron, magnesium, manganese, phosphorus, selenium, sodium, and zinc [4],[5].

Suspension formulations are created because some active drug substances have practical insolubility in water, yet are needed in liquid form for easy administration to patients who have difficulty swallowing, for easy administration to children, and to mask the bitter taste and unpleasant odor of the active drug substance[6]. This is consistent with the characteristics of Arthrospira Platensis, which has a distinctive aroma and taste. This distinctive aroma and taste can be masked by adding sugar, in this case fructose, and adding flavorings such as lime essence. Additionally, because water is the safest solvent for humans, it is used as the carrying medium in most suspension preparations. Although the active ingredient of the drug has poor water solubility, it can still be formulated into a liquid dosage form with the aid of a suspending agent[7].

2. METHODOLOGY

2.1 Extract & Chemicals

Arthospira Platensis extract powder from Albitec, Semarang, West Java, Indonesia. Other than those already specified, the laboratory chemicals utilized in the investigation were of the analytical reagents grade and several types of equipment employed in the formulation of herbal suspension were.

2.2 Formulation of Suspension

Arthrospira Platensis powder was made with variations of 0.5%, 0.75%, and 1% suspending agent. Based on the nutritional adequacy figures from the Indonesian Ministry of Health Regulation No. 28 of 2019, the protein requirements for children vary: 20 grams for children aged 1-2 years, 25 grams for children aged 4-6 years, and 40 grams for children aged 7-9 years. Based on the data above, the dosage of Arthrospira Platensis powder used was determined to be 35g/150 ml solution. This dosage is able to provide children with a protein requirement of 22.75 grams. Therefore, a suspension was made with a volume of 150 ml, with each 15 ml of solution containing 3.5 g of Arthrospira Platensis powder and 2.27 g of protein, to be taken once a day, 1 tablespoon at a time. (Ministry of Health Regulation of the Republic of Indonesia, No. 28 of 2019)

Table 1. *Working Formula for Arthrospira Platensis Suspension*

No	Compound	Formula 1 (F1)	Formula 2 (F2)	Formula 3 (F3)	Range	Function
1	*Arthrospira Platensis extract*	35 g	35 g	35 g	23,3 %	Active Compound
2	CMC-Na	0,375 g (0,25%)	0,75 g (0,5%)	1,5 g (1%)	0,25 - 1 %	Suspending Agent
3	Fructose	75 g	75 g	75 g	50 %	sweetener
4	*Propyleneglycole*	7,5 g	7,5 g	7,5 g	5%	*wetting agent*
5	Lime Essence	6 ml	6 ml	6 ml	4%	Flavouring agent
6	Benzoic Sodium	0,15 g	0,15 g	0,15 g	0,1%	Preservative
7	Aquadest	Ad 150 ml	Ad 150 ml	Ad 150 ml	-	Pengisi

2.3 Evaluation of Suspension Formulation

2.3.1 Organoleptic Test

The test was conducted on the test suspension preparation for 7 days using organoleptic methods. The observations made in this test are the color, odor, and taste of each preparation. Success in the

organoleptic test means that there are no physical changes in each test preparation in terms of color, odor, and taste[8].

2.3.2 Measurement of pH

The pH test was conducted using a pH meter as an instrument to indicate the pH value after the instrument was dipped into each preparation. This test began by pouring each preparation into separate beakers, then dipping the pH meter and allowing it to sit until the pH meter showed a constant pH value. A good pH value for suspension preparations is pH 4-7[9].

2.3.3 Measurement of Viscosity

The purpose of the viscosity test is to determine how thick the tested preparation is. This test began by preparing each test sample and then pouring it into a 100 mL beaker. After that, the spindle was dipped into the beaker containing the test sample until it reached the mark on the spindle. Then the testing instrument began to work and showed the viscosity values for each test preparation. The appropriate viscosity value according to SNI is 38-396 cp[9].

2.3.4 Measurement of Density

Density is measured using a pycnometer. At room temperature, the dry and clean pycnometer is weighed (A grams). Then it is filled with water and weighed again (A1 grams). The water is removed from the pycnometer and the pycnometer is cleaned. Then the suspension was filled into the pycnometer and weighed (A2 grams). The density of the preparation is calculated using the following equation: Density = A2 - A : A1 - A. The density of a suspension with a good water carrier is >1.00[10].

2.3.5 Measurement of Sedimentation Volume

Test The sedimentation rate was measured by comparing the time it took for sedimentation to occur in three formulations. According to Physical Pharmacy, the criteria for a good suspension are that the dispersed substance should not settle quickly. Good redispersibility means the suspension is perfectly dispersed when shaken by hand for a maximum of 30 seconds[11].

3. RESULTS AND DISCUSSIONS

3.1 Results of Organoleptic Testing Observation

Table 2. The Results of Organic Evaluation.

Formulation Code	Color	Smell	Taste
F1	Green	Orange Flavour	Sweet
F2	Green	Orange Flavour	Sweet
F3	Green	Orange Flavour	Sweet

The formulation of Arthospira Platensis suspension did not undergo any organoleptic changes. There is a distinctive aroma from Arthospira Platensis, a blend of sweet and bitter flavors with lime essence, but in Formula 2, the sweetness and fishy aroma of Arthospira Platensis can be masked by the lime essence, and the suspension has a dark green color[7],[8].

3.2 Results of pH Test of Arthrospira Platensis Suspension

Table 3. *The Results of pH Measurement*

Formulation Code	F1	F2	F3
pH	6,1	6,39	6,16

The three formulations did not show any organoleptic changes on the seventh day. The pH test evaluation for the three formulations was the same, ranging between 5-6 on the pH meter. However, among the three formulas, the second one had good pH stability compared to the others, with the first and third formulas experiencing a significant decrease in pH. Therefore, all three formulas still meet the ideal pH requirements for suspensions, which is in the range of 4-7[9],[11].

3.3 Viscosity Test Results of Arthospira Platensis Suspension

Table 4. *The Results of Viscocity Measurement*

Formulation Code	F1	F2	F3
Viscosity	235,7 cps	358,1 cps	397,4 cps

Testing the viscosity of a suspension is a very important test for the stability and pourability of the suspension. As the viscosity of the suspension increases, the sedimentation rate of the solute decreases, which can slow down the sedimentation process of the suspension preparation. Additionally, as the viscosity of the suspension increases, its pourability decreases and the discomfort of consuming the suspension increases. Thus, the viscosity of the suspension must be maintained within an optimal range to produce a stable and pourable suspension. According to SNI, the viscosity value of a good suspension falls within the range of 38cp - 396 cps. Formulations 1 and 2 have viscosity values within the specified range. This indicates that the viscosity of the preparation has met the established requirements. However, in the third formula, the viscosity value exceeded the established range, which is between 397 – 401 cp. This occurred because of the variation in the suspending agent, CMC-Na, which was used in excess, at 1% or 1.5 g. Therefore, the suspending agent needed to be reduced to achieve better viscosity [9], [11]

3.4 Results of Density Test for Arthospira Platensis Suspension

Table 5. *The Results of Density Measurement*

Formulation Code	F1	F2	F3
Density	1,02 g/cm^3	1,04 g/cm^3	1,12 g/cm^3

The density of the Arthospira Platensis suspension was calculated using a pycnometer. The weight of each Suspension formulation was measured using a pycnometer. Before doing this, the empty pycnometer was weighed and found to have a weight of 23.84 g. Then, distilled water was added to the pycnometer, and the weight was found to be 49.55 g. In this case, distilled water was used as a standard with a density of 1. The weight of each formulation and distilled water weighed was 50 ml. The weighing results for the three formulations were 50.65, 51.73, and 55.86, respectively. Next, from these two data sets, the density of the suspension was obtained from formula one as 1.02, formula two as 1.04, and formula three as 1.12. From the measurement results, it was found that each formulation met the criteria for a good water-based suspension, which is >1.00[10].

3.5 Results of Sedimentation Volume Test for Arthospira Platensis Suspension

Table 6. *The Results of Sedimentation Volume Measurement*

Formulation Code	*Sedimentation Volume (Day)*						
	1	*2*	*3*	*4*	*5*	*6*	*7*
F1	*0,8*	*1,2*	*1,6*	*1,9*	*1,8*	*1,7*	*2,0*
F2	*-*	*-*	*0,3*	*0,5*	*0,3*	*0,3*	*0,5*
F3	*-*	*-*	*-*	*-*	*0,1*	*0,3*	*0,2*

The final test is the evaluation of the Arthospira Platensis suspension sedimentation test. Observations were made for 7 days. On the first day, only the first of the three formulations showed sedimentation, which was 0.8 cm, while the second and third formulations did not show any sedimentation. By the seventh day, sedimentation occurred in all suspension formulations: 2 cm in the first formulation, 0.5 cm in the second, and 0.2 cm in the third. These data indicate that Formulations 2 and 3 have good solubility, disperse well when shaken for 30 seconds, and do not easily settle within more than 30 minutes . The solubility in Formulation 1 was less good, sedimentation occurred more quickly, and it did not disperse well when shaken for 30 seconds. The opposite also occurred with the third formulation, which was too thick, making the suspension solution difficult to pour. After all tests were conducted on all formulas, including the first, second, and third formulas, the results showed that the second formulation had better results compared to the others, in terms of organoleptic tests, pH tests, viscosity tests, density tests, and finally, sedimentation tests[11].

4. CONCLUSSION

4.1. Arthospira Platensis powder can be formulated into a suspension preparation that meets the physical requirements of the preparation.

4.2.Variations in CMC-Na as a suspending agent affect the physical properties of the preparation, with the most influenced properties being the viscosity and sedimentation rate of the suspension preparation.

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THE EFFECTIVENESS OF A MEDICATION MONITORING CARD IN IMPROVING MEDICATION ADHERENCE AND RECOVERY AMONG ADOLESCENTS WITH TERTIAN MALARIA IN MIMIKA REGENCY, INDONESIA

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Abstract

Malaria vivax remains a communicable disease and a persistent public health problem in Mimika Regency. Non-adherence to antimalarial medication is one of the major factors contributing to disease recurrence. This study aimed to describe the effectiveness of a medication monitoring card in improving treatment adherence among adolescent patients with tertian malaria at Karang Senang Primary Health Center. A descriptive case study design was employed involving a 13-year-old adolescent diagnosed with tertian malaria. The instruments used included a malaria control card and a medication adherence monitoring sheet completed over a 14-day treatment period. Data were collected through direct observation and patient daily records and were analyzed descriptively. The results showed that the patient was able to take primaquine regularly for 14 consecutive days with a high level of adherence (SLKI score = 4.75 out of 5), although delays in medication timing occurred on three specific days. A follow-up blood examination on day 15 indicated a negative malaria result. It can be concluded that the use of a control card combined with a monitoring record is effective in improving treatment adherence and therapeutic success among adolescents with tertian malaria. It is recommended that healthcare facilities implement a simple card-based monitoring system for all malaria patients to support the national malaria elimination target by 2030.

Keywords: Adolescents , medication adherence, monitoring card, Tertian malaria

1. INTRODUCTION

Malaria remains a global public health problem, and progress in its control has not yet shown a fully stable trend. According to the World Malaria Report 2024 published by the World Health Organization, an estimated 263 million malaria cases and 597,000 malaria-related deaths occurred worldwide in 2023, with approximately 95% of cases reported in the African region. [1]. [2]Although the majority of malaria cases occur outside Asia, the disease burden in the Asia Pacific region remains substantial, including in Indonesia. Global evidence indicates that successful malaria elimination depends not only on effective vector control but also on the success of antimalarial therapy and patient adherence to prescribed medications [1]. A systematic review by [2] emphasized that low adherence to Plasmodium vivax therapy is associated with a significantly increased risk of relapse.

In Indonesia, malaria cases are predominantly concentrated in the eastern regions, particularly Papua. The government has emphasized accelerating malaria elimination through national roadmaps and action plans that recommend strengthening case management, post-treatment monitoring, and community and local health volunteer engagement to improve patient adherence. Monitoring adherence is recognized as a critical component of the national strategy to support the Malaria Elimination 2030 target [3]. Recent studies indicate that community health-seeking behavior for malaria treatment is still strongly influenced by access to healthcare services and levels of education [4]

Plasmodium vivax requires treatment with a combination of dihydroartemisinin–piperaquine (DHP) and a 14-day course of primaquine to prevent relapse. Non-adherence to primaquine therapy has been

shown to be associated with higher relapse rates [2] A study conducted in Papua demonstrated that patients who received direct visits during the 14-day treatment period exhibited higher levels of medication adherence compared to those who did not receive supervision [5]. Consistent findings were further demonstrated by [6] who concluded that daily supervision of antimalarial treatment by healthcare workers or community health volunteers can improve medication adherence and reduce the risk of relapse.

Factors influencing patient adherence to malaria treatment are complex and include patients' knowledge, perceived medication side effects, family support, and daily activity burdens [7]. Healthcare system–related factors and healthcare workers also play an important role in influencing patient adherence. One such factor is the level of knowledge among healthcare providers [8] found that only 63.1% of healthcare workers in private health facilities in Kampala adhered to malaria treatment guidelines, highlighting the importance of healthcare worker education and direct home visits.

Among adolescents, the risk of non-adherence is increased due to psychosocial changes and lifestyle behaviors, including mobile phone use and social activities (Roach, 2020). A systematic review by [9] found that adherence to antimalarial treatment among adolescents tends to be lower than among adults, particularly in the absence of direct supervision. [10] Further research has also revealed that migrants and adolescents frequently discontinue treatment prematurely due to perceived mild side effects.

In cases of Plasmodium vivax malaria (tertian malaria), antimalarial drugs such as primaquine are essential for preventing relapse. Empirical evidence and meta-analyses have demonstrated a strong association between adherence to primaquine therapy and a reduced risk of P. vivax recurrence, with higher levels of adherence resulting in significantly greater relapse prevention. Consequently, strategies aimed at improving adherence such as medication intake monitoring are likely to have a direct and substantial impact on clinical outcomes and the effectiveness of malaria elimination programs [11].

Observational studies and adherence surveys conducted across various healthcare settings have demonstrated considerable variation in adherence levels ranging from high to moderate and low across countries. Identified determinants of adherence include patient knowledge, treatment-related factors, perceived side effects, medication availability, and family or environmental support. These factors are particularly important when designing interventions for adolescents, who are more likely to forget medication intake or be preoccupied with digital engagement and social activities [7].

A simple treatment monitoring approach based on control cards or patient treatment/monitoring cards, combined with the involvement of village health volunteers or malaria cadres, plays a crucial role in facilitating documentation, improving communication between healthcare providers and patients, and empowering patients to adhere to their treatment regimen. The implementation of community-based monitoring using patient cards and cadre supervision has gained increasing attention in field practice and operational studies in Indonesia, as it is relatively low-cost, easily integrated into primary healthcare centers (Puskesmas), and valuable for malaria program evaluation [12].

Particularly in Papua Province and Mimika Regency, research and quality improvement efforts in malaria surveillance and case management have highlighted the need to strengthen patient documentation and monitoring systems to ensure completion of primaquine therapy and early detection of potential adverse effects. Therefore, the present case study on the implementation of a medication monitoring card among an adolescent patient at Karang Senang Primary Health Center is practically relevant to government policy, as it provides local evidence that may support broader adoption of simple monitoring interventions to advance malaria elimination efforts. [13].

2. METHODOLOGY

This study employed a descriptive case study design. The study subject was a 13-year-old adolescent patient diagnosed with tertian malaria based on blood examination results at Karang Senang Primary Health Center. Monitoring was conducted over a 14-day period using a malaria control card and a medication adherence monitoring sheet that recorded the date, time, and dosage of primaquine intake. The observation sheet was based on outcomes from the Indonesian Nursing Outcomes Standard (Standar Luaran Keperawatan Indonesia / SLKI). The evaluated criteria included verbalization of willingness to comply with the care and treatment program, verbalization of adherence to recommendations, behaviors reflecting adherence to the treatment regimen, and behaviors demonstrating compliance with prescribed instructions. Adherence levels were assessed using data

from the malaria medication monitoring card and adherence scores obtained through the observation sheet.

Data were collected through direct observation, documentation review, and brief interviews focusing on medication adherence. Data analysis was conducted descriptively with reference to patient adherence indicators based on the Indonesian Nursing Outcomes Standard (Standar Luaran Keperawatan Indonesia; SLKI, Persatuan Perawat Nasional Indonesia 2022), which classify adherence levels as follows: decreased (1), moderately decreased (2), moderate (3), moderately increased (4), and increased (5). Ethical considerations were addressed by obtaining informed consent from the patient and securing formal approval from the Primary Health Center.

3. RESULTS AND DISCUSSION

Observation findings indicated that the 13-year-old adolescent patient diagnosed with tertian malaria at Karang Senang Primary Health Center completed DHP and primaquine therapy over a 14-day period as scheduled. Based on records from the malaria control card and medication monitoring sheet, the patient experienced delays in medication intake on only three occasions (May 1, 4, and 5, 2025), with no missed doses. The mean adherence score according to the Indonesian Nursing Outcomes Standard (SLKI) was 4.75, which falls within the “high” adherence category.

Laboratory examination on day 15 showed a negative malaria result, with no clinically significant adverse effects such as nausea, dizziness, or hemolytic reactions. Evaluation of the monitoring card indicated that all criteria related to medication accuracy, dosage, and follow-up timing were fully met. Brief interviews revealed that the patient understood the importance of completing treatment due to active supervision from healthcare providers and family members. These findings demonstrate that the implementation of a medication monitoring card is effective in improving adherence to primaquine therapy among adolescents and has the potential to support malaria elimination programs

4. CONCLUSIONS

The findings of this study demonstrate that the 13-year-old adolescent patient successfully completed the 14-day primaquine therapy with a mean adherence score of 4.75 (categorized as “high”), and laboratory examination on day 15 confirmed a negative malaria result. These results are consistent with meta-analytic evidence indicating that full adherence to primaquine therapy significantly reduces the risk of Plasmodium vivax malaria relapse. [11]. Similar results were also reported by [14] score high (4,75). who reported high adherence levels (mean score of 4.75). Therefore, these findings reinforce the importance of completing the full course of treatment as a key component of malaria elimination strategies, particularly in endemic regions such as Papua.

Although this study employed a descriptive case study design involving only a single subject, the high adherence score achieved suggests that the use of monitoring instruments (control cards combined with observation sheets) can serve as an effective intervention to improve treatment adherence. This finding is consistent with studies conducted in Papua, Indonesia, which indicate that various socio-cultural factors influence adherence to primaquine therapy. [5] Through this direct monitoring approach, healthcare providers at primary health centers (Puskesmas) are able to actively monitor patients and provide timely feedback, thereby enhancing treatment outcomes.

Further analysis highlights that delays in medication intake occurred on three days (May 1, 4, and 5, 2025), despite the overall high level of adherence. This finding underscores that even under monitoring interventions, behavioral factors and daily routines may still interfere with timely medication intake. [15] reported that malaria indicator surveys can be adapted to assess treatment adherence and identified gaps between facility-based data and household survey findings. Furthermore, a study from Bangladesh demonstrated that although overall adherence levels were high (92.7%), adolescents and migrant workers continued to face challenges in completing treatment due to work- or school-related commitments. [7]. Therefore, despite the highly favorable results, monitoring interventions should continue to consider behavioral dimensions such as time reminders, family and community support, and flexible scheduling adaptations to enhance treatment completion.

The success of this monitoring approach should also be viewed within a broader context, as high levels of adherence are directly associated with reduced relapse rates and improved treatment outcomes. A meta-analysis of primaquine therapy reported a hazard ratio of 2.3 (95% CI: 1.8–2.9) for relapse among patients with low adherence compared to those with full adherence. [7]. [16] also

emphasized that treatment effectiveness is highly dependent on patient adherence to medication. Accordingly, the high adherence score of 4.75 observed in this study demonstrates a tangible potential for relapse prevention in endemic regions, which is critically important for malaria elimination efforts in eastern Indonesia.

Monitoring interventions such as treatment control cards or observation sheets have been shown to improve medication adherence and facilitate reporting, supervision, and follow-up by both patients and healthcare providers.[17] Interventions involving direct observation of patients during medication intake (Directly Observed Therapy/DOT) have been shown to effectively improve patient adherence to treatment regimens. For example, studies conducted in Myanmar and Thailand among migrant populations found that the main barriers to adherence were work-related factors and limited access to healthcare services. Implementing DOT can help mitigate these challenges by providing direct supervision and support during medication administration, thereby increasing the likelihood of completing the full course of therapy. [10] Therefore, DOT is highly suitable as a monitoring intervention. Meanwhile, another study in Bangladesh demonstrated that using simple monitoring tools, such as cards or checklists, can also improve adherence compared to no monitoring at all. [7]. Therefore, the implementation of a control card at Karang Senang Community Health Center is an appropriate and evidence-based strategy.

The intervention in this study involves ensuring that primary healthcare facilities in malaria-endemic areas, particularly those serving adolescents, incorporate adherence monitoring mechanisms as part of their standard operating procedures. This should be complemented with patient and family education, medication reminders, and daily recording/monitoring tools such as control cards. Such an approach aligns with recommendations to strengthen treatment monitoring systems within the national malaria elimination roadmap. [18]. Although this study has limitations (single-subject and no control group), its findings provide strong preliminary evidence to support further research with a larger quantitative study design. [19]. Similarly, long-term evaluations of relapse, medication side effects, and the impact of elimination efforts on adolescent populations are necessary to enable Malaysia (or Indonesia) to develop scalable and sustainable program strategies.

In conclusion, the “Malaria Medication Monitoring Card” for adolescent patients has been shown to improve adherence to primaquine treatment, achieving an SLKI score of 4.75 (high category) and negative laboratory results after 14 days of therapy. This intervention is effective as both a monitoring and patient education tool, particularly in endemic areas such as Mimika. The use of control cards, family supervision, and active communication with healthcare providers contributed to treatment success and supports the national malaria elimination targets.

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THE RELATIONSHIP BETWEEN KNOWLEDGE AND MOTIVATION AND COMPLIANCE TAKING ANTI-TUBERCULOSIS MEDICATIONS IN PULMONARY TB PATIENTS IN THE WORK AREA KLASAMAN COMMUNITY HEALTH CENTER, SORONG CITY

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Abstract

Pulmonary tuberculosis is an infectious disease that can be cured if treatment is carried out diligently. Pulmonary tuberculosis is caused by the bacterium Mycobacterium tuberculosis. It is a lower respiratory tract infection. Most bacteria enter the lung tissue through airborne infection and then undergo a process known as primary focus of Ghon. (2) Approximately 10 million people worldwide suffer from pulmonary tuberculosis. The three countries with the highest TB prevalence are India, China, and Indonesia. The 2018 Riskesdas research showed that the number of TB cases was estimated at around 845,000, with a mortality rate of 35 per 100,000 population. **The purpose of this study** was to determine the relationship between knowledge and motivation with adherence to taking anti-tuberculosis medication in pulmonary TB patients in the Klasaman Community Health Center Working Area of Sorong City. **Research Methods;** This type of observational study is a quantitative study with a cross-sectional approach. This study aims to determine the relationship between the level of knowledge and motivation with adherence to taking anti-tuberculosis medication in pulmonary TB patients. The population of this study was all pulmonary TB patients undergoing treatment in the Klasaman Community Health Center working area totaling 32 cases, while the sample was carried out using a purposive sampling technique. Data collection techniques were by direct interviews and observation. Univariate analysis is a statistical technique that functions to describe the characteristics of each variable in the study. The test used in this bivariate analysis used the chi-square test. **The results** of the Chi-Square statistical test showed a p-value of 0.0317, indicating a significant relationship between knowledge and adherence to TB medication ($p < 0.05$). The results also showed a significant relationship between motivation and adherence to TB medication, with a p value of 0.0158 ($p < 0.05$). This means that a positive motivational attitude can influence adherence to TB medication in tuberculosis patients. **Conclusion**: Most respondents had good knowledge about preventing TB transmission, and a positive motivational attitude can influence adherence to TB medication in tuberculosis patients at the Klasaman Community Health Center in Sorong City.

Keywords: Knowledge, Motivation, Adherence to TB Medication

1. INTRODUCTION

Approximately 10 million people worldwide suffer from pulmonary tuberculosis. India, China, and Indonesia have the three highest TB prevalence rates. The 2018 Basic Health Research (Riskesdas) estimated the number of TB cases at around 845,000, with a mortality rate of 35 per 100,000. Acute respiratory failure is a contributing factor to the high TB mortality rate (4). First-line pulmonary tuberculosis treatment consists of two stages: the intensive phase, which lasts for two months, and the continuation phase, which lasts for four to six months. Pulmonary tuberculosis patients can be cured if treatment is followed diligently. The failure to achieve treatment for pulmonary tuberculosis is due to the

high rate of non-compliance with treatment, which leads to treatment failure. Patient non-compliance with treatment results in low cure rates, the development of drug resistance, making pulmonary tuberculosis very difficult to cure, and increasing mortality. (4) Basic Concepts of Health Policy in TB Control

Tuberculosis (TB) is a direct infectious disease that remains a public health problem in Indonesia. Globally, TB control strategies are guided by the World Health Organization's End TB Strategy, which targets TB elimination by 2030. Indonesia, as a country with a high TB burden, has aligned its national policies with this global strategy.

- Government policies in TB management aim to:
- Reduce morbidity and mortality from TB
- Breaking the chain of transmission
- Improve treatment success
- Prevent drug resistance (MDR-TB)

Based on an initial survey conducted by researchers in April 2024, interviews with officers responsible for pulmonary TB in the Klasaman Community Health Center, Sorong City, revealed that there were 35 TB cases in 2025 (January to September) in the Klasaman Community Health Center, Sorong City, Southwest Papua. TB treatment aims to cure patients, prevent death, prevent recurrence, break the chain of transmission, and prevent the development of resistance to Anti-Tuberculosis Drugs (OAT) (Ministry of Health, 2011). Knowledge of tuberculosis is crucial for curing the disease. Efforts to combat tuberculosis must be accompanied by sound knowledge.

1. The success of TB treatment is supported by adherence to taking anti-tuberculosis medications at the prescribed dosage. Patients who are repeatedly hospitalized are often the result of non-compliance with regular anti-tuberculosis medication (OAT) consumption (Manalu, 2010). This will certainly have an impact on dropout, which is one of the causes of treatment failure and this has the potential to increase the possibility of drug resistance, or what we call Multi-Drug Resistance (MDR). (1). Family support significantly influences tuberculosis patients by providing attention, always being loved, making them feel happy and not lonely. This form of support can make patients feel motivated in undergoing the treatment process and influence patient behavior, such as reducing anxiety, helplessness, and hopelessness, ultimately improving the patient's health status (5).

The purpose of this study is to determine the relationship between knowledge and motivation and adherence to taking anti-tuberculosis medication in pulmonary TB patients in the Klasaman Community Health Center Work Area, Sorong City. The benefits of this study include theoretical benefits. The results of this study are expected to add to the body of knowledge in the field of nursing, especially regarding factors that influence medication adherence in pulmonary TB patients. It can serve as a reference material for other researchers in conducting similar studies, particularly regarding the relationship between knowledge, motivation, and adherence to tuberculosis treatment. Practical Benefits for Pulmonary TB Patients: Provides important information about the importance of knowledge and motivation in improving medication adherence to support treatment success and prevent drug resistance. For Families: Provides an understanding of the role of families in supporting and motivating patients to adhere to OAT therapy. For Health Workers/Community Health Centers: Serves as input in developing educational strategies and mentoring for pulmonary TB patients to improve medication adherence. Institutional Benefits For educational institutions, this research can be used as teaching material or additional literature in the fields of public health and nursing related to pulmonary TB treatment management.

2. RESEARCH AND METHODS

Research Type and Design

This observational study is quantitative with a cross-sectional approach. This study aims to determine the relationship between knowledge and motivation levels on adherence to anti-tuberculosis medication in patients with pulmonary tuberculosis.

Research Time and Location: This study was conducted from August to September 2025 in the Klasaman Community Health Center (Puskesmas), Sorong City, Southwest Papua Province.

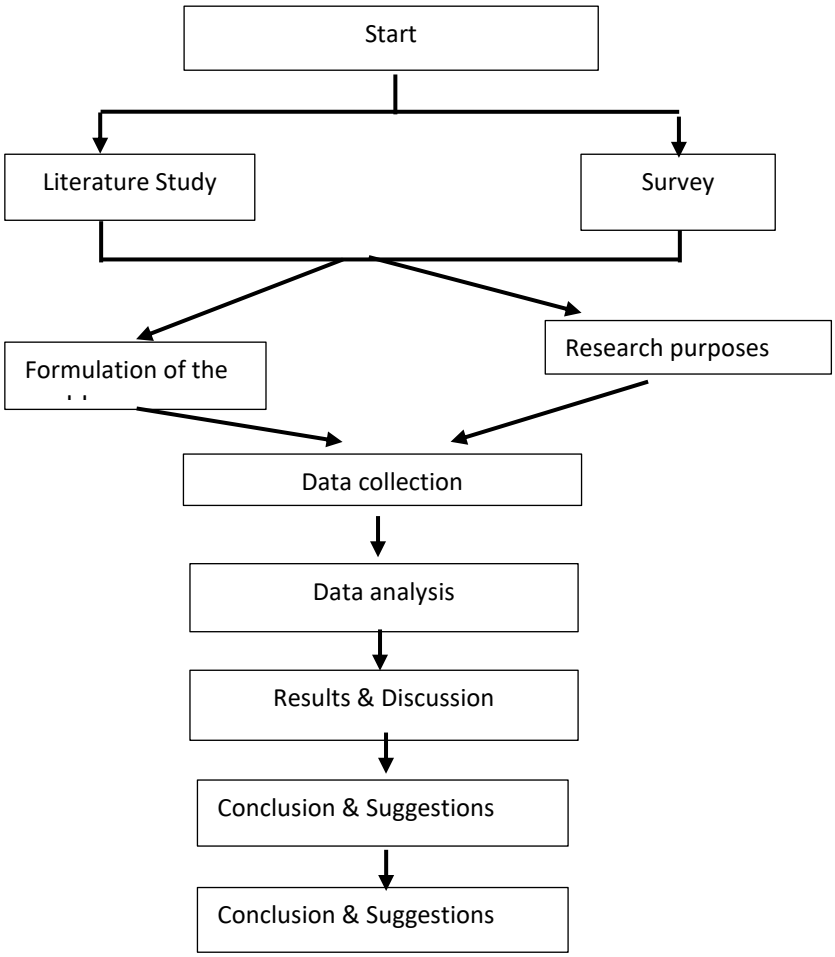
Population and Sample

Population

The study population consisted of all 32 patients with pulmonary tuberculosis undergoing treatment in the Klasaman Community Health Center (Puskesmas), including patients medically diagnosed and enrolled in an active treatment program. This study aimed to assess knowledge and motivation regarding adherence to anti-tuberculosis medication.

Sample: The selection of research subjects will be conducted using a purposive sampling technique, where participants are selected based on specific criteria aligned with the study objectives, subject to the availability of eligible patients during the data collection period.

Inclusion criteria:
1) Patients with pulmonary tuberculosis diagnosed by a healthcare professional.
2) Willing to be a respondent by providing informed consent.
3) At least 10 years old.
4) Able to communicate well.
Exclusion criteria:
1) Patients with pulmonary tuberculosis with severe complications.
2) Physical disorders that hinder completion of the questionnaire.
Research Flow/Procedure
Figure 3.1 Research Flow/Procedure



Research Instruments

a. Knowledge: Measured using a valid and reliable literature-based questionnaire covering the definition of TB, modes of transmission, side effects of anti-TB drugs, and the consequences of non-adherence.

b. Motivation: Measured using a motivation scale (e.g., a 1–5 Likert scale) that encompasses both intrinsic and extrinsic aspects.

c. Anti-TB Drug Adherence: Measured using the Morisky Medication Adherence Scale (MMAS-8) or other methods such as calculating remaining medication and adherence records from healthcare workers.

Data Collection Techniques: Data were collected through:

a. Direct interviews using questionnaires. Observation of adherence records from healthcare workers.

Data Analysis

Univariate Analysis According to (Notoatmodjo, 2018), univariate analysis is a statistical technique that describes the characteristics of each variable in a study. This analysis process is carried out using a descriptive approach to observe the frequency distribution of all variables, both independent and dependent. As stated (Arifin, Fahdhienie, and Ariscasari, 2022). The results of this univariate analysis are presented in a frequency table format. In this study, the data will be presented in the form of frequency distribution tables and percentages to obtain an overview of the respondents' characteristics.

Bivariate Analysis

Bivariate analysis is a statistical technique that tests the relationship or correlation between two related variables (Notoatmodjo, 2018). In this study, this analysis was applied to evaluate the relationship between the independent variables (knowledge and attitudes) and the dependent variable (preventive behavior).

The test used in this bivariate analysis was the chi-square test (X2). If the calculated chi-square value is greater than the table value (X2 calculated > X2 table), the relationship is significant, meaning that H0 is rejected and Ha is accepted. (Rochmawati, 2020). Non-parametric statistics do not require such assumptions and are suitable for categorical data. One frequently used non-parametric method is the chi-square test, which is very effective for testing the relationship between two categorical variables (Afrianda et al., 2024).

The data used in the Chi-Square test is either categorical or frequency data (Ayuni, Zuliani, and Zamroni, 2023). The basis for making decisions in the Chi-Square test is as follows:

1) If the Asymp.Sig value is <0.05, there is a significant relationship between the rows and columns.

2) If the Asymp.Sig value is >0.05, there is no significant relationship between the rows and columns.

Research Ethics

This research will undergo Ethics Committee approval and obtain informed consent from respondents before data collection. Data confidentiality is maintained by not including patient identities in the research report.

3. RESEARCH RESULTS

Univariate Analysis

a. Respondent Characteristics

The respondent characteristics below represent the characteristics of the research sample based on age, gender, and education.

Distribution of Respondent Characteristics by Age

Age	N	%
10-20 Year	5	15,6%
21-40 Year	8	25 %
41-60 Year	7	21,9%
61-80 Year	12	37,5%
Total	**32**	**100%**

Gender	N	%
Man	22	68,8
Woman	10	31,3
Total	**32**	**100 %**

Distribution of Respondent Characteristics by Gender

Table 4.3 Distribution of Respondent Characteristics by Last Education

Last education	N	%
SD	7	21,9 %
SMP	4	12,5 %
SMA	14	43.8 %
College	7	21,9 %
Total	**32**	**100 %**

Table 4.1 Distribution of Respondent Characteristics by Age

Shows that the majority of respondents were in the 61-80 age group, representing 12 (37.5%). Eight (25.0%) were aged 21-40, seven (21.9%) were aged 41-60, and five (15.6%) were aged 10-20. This indicates that the majority of pulmonary TB patients in this study were elderly.

Table 4.2 Distribution of Respondent Characteristics by Gender

Table 4.2 shows that the majority of respondents were male (22 respondents, 68.8%), while 10 respondents were female (31.3%). This finding aligns with global TB epidemiological data, which shows a higher prevalence of TB among men.

Distribution of Respondent Characteristics by Last Education

Based on Table 4.3, the majority of respondents had a high school diploma (14 respondents (43.8%), followed by a junior high school diploma (4 respondents (12.5%), a bachelor's degree (7

respondents (21.9%), and a primary education (7 respondents (21.9%). This indicates that the majority of respondents have a secondary education, which may influence their level of knowledge regarding pulmonary TB prevention.

Distribution of Knowledge, Motivation, and Adherence to Anti-Tuberculosis Medication in the Klasaman Community Health Center Work Area, Sorong City

Distribution of Knowledge among Pulmonary Tuberculosis Patients in the Working Area of the Klasaman Community Health Center, Sorong City

Knowledge Category	N	%
Good Knowledge	17	53,12 %
Sufficient Knowledge	13	40,62 %
Knowledge Isn't Good	2	6,25 %
Total	**32**	**100%**

Distribution of Knowledge among Pulmonary Tuberculosis Patients in the Malawei Community Health Center Working Area, Sorong City

Based on Table 4.4, it is known that of the 32 pulmonary tuberculosis sufferers in the working area of the Klasaman Health Center, Sorong City, 17 people (53.12%) had a good level of knowledge, 13 people (40.62%) had sufficient knowledge and 2 (6.25%) had poor knowledge.

Distribution of Motivation in Pulmonary Tuberculosis Patients in the Working Area of the Klasaman Community Health Center, Sorong City

Attitude Category	N	%
High Motivation	26	81,25%
Moderate Motivation	2	6,25 %
Low Motivation	4	12,5 %
Total	**32**	**100%**

Meanwhile, in Table 4.5 in the Motivation aspect, as many as 26 people (81.25%) showed high motivation, 2 people (6.25%) had moderate motivation, and 4 people (12.5%) had low motivation.

Distribution of TB Medication Compliance in Pulmonary Tuberculosis Patients in the Klasaman Community Health Center Work Area, Sorong City

Attitude Category	N	%
Compliant	28	87,5 %
Disobey	4	12,5 %
Total	**32**	**100%**

Based on Table 4.6, it is known that of the total of 32 respondents with pulmonary tuberculosis in the working area of the Klasaman Community Health Center in Sorong City, the majority showed compliant behavior in taking medication, namely 28 people (87.5%). Meanwhile, 4 people (12.5%) had non-compliant behavior in taking anti-TB medication in Tuberculosis patients.

Bivariate Analysis

Bivariate analysis was used to examine the relationship between the independent variables, namely knowledge and motivation, and the dependent variable, namely adherence to taking anti-TB medication.

a. Results of Chi-Square Analysis of the Relationship between Knowledge and Compliance in Taking Anti-TB Pulmonary Medication in Patients in the Working Area of the Klasaman Health Center, Sorong City.

Knowledge	TB medication compliance behavior				Total		*P Value*
	Compliant Behavior		Non-compliant behavior				
	N	%	N	%	N	%	
Good Knowledge	16	50	1	3,125	17	53,125 %	0,0317
Sufficient Knowledge	10	31,25	3	9,375	13	40,625	
Poor Knowledge	2	6,25	0		2	6,25	
Total	28	87,5%	4	12,5%	32	100 %	

Based on the analysis of the relationship between knowledge and adherence to anti-TB medication at the Klasaman Community Health Center in Sorong City, the results showed that of the 16 respondents with good knowledge, the majority (50%) demonstrated adherence, while one respondent (3.125%) demonstrated non-adherence.

Meanwhile, of the 10 respondents with sufficient knowledge, 31.25% demonstrated adherence, while three respondents (9.375%) demonstrated non-adherence. In the group with poor knowledge, two respondents (87.5%) demonstrated adherence, while none of the respondents with poor knowledge demonstrated non-adherence.

The results of the Chi-Square statistical test showed a p-value of 0.0317, indicating a significant relationship between knowledge and adherence ($p < 0.05$). Therefore, higher knowledge tends to be followed by better motivation to take anti-TB medication.

b. Results of Chi-Square Analysis of the Relationship between Motivation and Compliance in Taking Anti-TB Pulmonary Medication in Patients in the Working Area of the Klasaman Health Center, Sorong City.

Motivation	TB medication compliance behavior				Total		*P Value*
	Compliant Behavior		Non-compliant behavior				
	N	%	N	%	N	%	
Low	3	9,375	1	3,125	4	12,5	0,0158
Currently	1	3,125	1	3,125	2	6,25	
Tall	24	75	2	6,25	26	81,25	
Total	28	87,5%	4	12,5%	32	100 %	

4. DISCUSSSIONS

Berdasarkan hasil analisis Chi-Square, ditemukan korelasi yang signifikan antara tingkat pengetahuan dan kepatuhan minum obat anti-TB di Puskesmas Klasaman (nilai p = 0,0158 < 0,05). Hasil ini menunjukkan bahwa semakin tinggi tingkat pengetahuan pasien tentang TB, semakin baik kepatuhan mereka terhadap pengobatan anti-TB.

Temuan ini sejalan dengan penelitian yang dilakukan oleh T. Widianingrum (2018) yang menemukan korelasi yang kuat antara pengetahuan dan kepatuhan minum obat anti-TB.

The Relationship Between Tuberculosis Motivation and Anti-TB Medication Adherence.

The results of this study indicate that motivation is related to anti-TB medication adherence in TB patients in the Klasaman Community Health Center, Sorong City. Based on the data obtained, most respondents had high motivation to achieve recovery, while others had moderate motivation. Respondents with high motivation tended to be more compliant with anti-TB medication. This finding is also supported by research conducted by Nurwidji & Fajri (2013), which found that the motivation of pulmonary TB patients to achieve recovery is related to medication adherence. Research by Prasetya (2009) also demonstrated a significant relationship between motivation and adherence to treatment and taking anti-TB medication.

5. CONCLUSION AND SUGGESTIONS

Conclusion

Most respondents (16 respondents) had good knowledge about preventing pulmonary TB transmission, and of these, the majority demonstrated adherence to TB medication.

Based on the chi-square test, there was a significant relationship between knowledge and adherence to pulmonary TB medication, with a p-value of 0.0317 ($p < 0.05$). This indicates that higher knowledge leads to better adherence to TB medication.

Most respondents (24 respondents) had high motivation, and among them, the majority demonstrated adherence to pulmonary TB medication.

The chi-square test also showed a significant relationship between motivation and adherence to pulmonary TB medication, with a p-value of 0.0158 ($p < 0.05$). This means that good motivation can influence adherence to pulmonary TB medication in tuberculosis patients.

Based on the research results, it can be concluded that the null hypothesis (H_0) is rejected and the alternative hypothesis (Ha_0) is accepted, meaning there is a significant relationship between the level of knowledge and motivation on adherence to taking pulmonary TB medication in the Klasaman Community Health Center, Sorong City.

Recommendations

1. For Patients

It is hoped that pulmonary TB patients will be more proactive in seeking information and participating in TB education, and will adopt a behavior of adherence to taking pulmonary TB medication according to the schedule provided by the Community Health Center on a regular and consistent basis.

2. For Families

Families are expected to provide support to family members with TB and help maintain a clean and well-ventilated home environment to prevent transmission.

3. For the Malawei Community Health Center

It is recommended to improve routine TB education and counseling programs and integrate the results of this study into health promotion activities to increase adherence to taking pulmonary TB medication regularly for TB prevention and control in the work area.

4. For Future Researchers

Further research is recommended to include other variables such as socioeconomic factors, family support, and access to health services to provide a more comprehensive picture of the relationship between pulmonary TB and the prevalence of pulmonary TB.

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