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## **Analysis of the Relationship Between Contributing Factors and Body Image Among Medical Students**

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Izzatulhasanah, Ganesa Wardana, Nur Upik En Masrika

## **Health System Challenges in Managing Schistosomiasis Among Pregnant Women: A Qualitative Study from an Endemic Indonesian Highland**

Indah Sari Purna Lumeno, Rahmawati Saleh

## **Glucose Content and Glycemic Index of Indonesian Local Foods as Alternative Carbohydrate Sources for Diabetic Patients: Article Review**

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## EDITORIAL PREFACE



Dear Readers,

**A**lhamdulillah, we are pleased to announce the publication of the second edition of the fourth volume of the Jambura Medical and Health Science Journal (JMHSJ), a peer-reviewed journal published by Faculty of Medicine Universitas Negeri Gorontalo. This edition features seven original research articles, one review article, and two case reports contributed by esteemed researchers from various institutions, including Universitas Khairun Ternate, Tarumanegara University Jakarta, Universitas Mega Buana Palopo, Sekolah Tinggi Hukum Militer Jakarta Timur, Universitas Muslim Indonesia, Universitas Haasanuddin, and Universitas Negeri Gorontalo. The diversity of submissions showcases the growing interest in JMHSJ among academics, researchers, and practitioners across Indonesia.

The range of topics presented in this edition is noteworthy, encompassing critical areas such as occupational related disease, psychology aspect of medical students, factors contributing to outcome of cataract surgery, health behavior, parasitic infection on special population, health law, and nutraceutical. In addition, a rare case of Killian-Jamieson Diverticulum and serial case of acute pulmonary embolism were also provided.

We anticipate that future editions will continue to attract a diverse range of articles from various medical fields, reflecting our commitment to advancing knowledge and enhancing the quality of our journal, which has recently achieved accreditation from SINTA 3. We extend our heartfelt gratitude to all contributors and reviewers for their dedication and support. We wish you an insightful reading experience.

Gorontalo, August 2025

**Dr. dr. Muhammad Isman Jusuf, Sp.N**



## TABLE OF CONTENT

- 1. Risk Factors for Low Back Pain among Educational Staff: A Cross-sectional Study at a Single University** **51-61**  
*Wahyuningsih Ratna Sari, Herlina Jusuf, Jusna Ahmad, Vivien Novarina A Kasim, Sri Manovita Pateda*
- 2. Analysis of the Relationship Between Contributing Factors and Body Image Among Medical Students** **62-70**  
*Ismiaty Abdullah, Sunarto Kadir, Cecy Rahma Karim, Margaretha Solang, Sri Manovita Pateda*
- 3. The Relationship Between Clinical Characteristics with Visual Outcome in Post Cataract Surgery at Tidore Islands City Regional Hospital** **71-83**  
*Izzatulhasanah Izzatulhasanah, Ganesa Wardana, Nur Upik En Masrika*
- 4. Killian-Jamieson Diverticulum in a 15-Year-Old Patient: A Rare Pediatric Radiologic Case Report** **84-93**  
*Eny Sanre*
- 5. Comparison of Clean and Healthy Living Behavior Before and After Handwashing Promotion at Tahfidz One Qur'an Islamic Boarding School Jambi** **94-102**  
*Khaila Nur Hakim, Linda S. Budiarmo*

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## TABLE OF CONTENT

- 6. Association Between Personality Types with Emotional Intelligence among First Grade Medical Students** **103-113**  
*Innaya Ayu Setiani, Linda S. Budiarmo*
- 7. Glucose Content and Glycemic Index of Indonesian Local Foods as Alternative Carbohydrate Sources for Diabetic Patients: Article Review** **114-134**  
*Adriani Adriani, Hastuti Hastuti, Rahmat Saleh*
- 8. Health System Challenges in Managing Schistosomiasis Among Pregnant Women: A Qualitative Study from an Endemic Indonesian Highland** **135-155**  
*Indah Sari Purna Lumeno, Rahmawati Saleh*
- 9. Serial Case of Acute Pulmonary Embolism: Different Therapies based on Different Patient Profiles** **156-178**  
*Ilzy Jum Ahmad, Idar Mappangara, Akhtar Fajar Muzakkir*
- 10. Civil Legal Liability of Doctors in Malpractice Cases Due to Violations of Informed Consent** **179-189**  
*Nabita Aulia, Vero Dumonda Silitonga, Edwin Edwin*

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## Risk Factors for Low Back Pain among Educational Staff: A Cross-sectional Study at a Single University

Wahyuningsih Ratna Sari<sup>1,\*</sup>, Herlina Jusuf<sup>2</sup>, Jusna Ahmad<sup>3</sup>, Vivien Novarina A. Kasim<sup>4</sup>, Sri Manovita Pateda<sup>5,6</sup>

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### ABSTRACT

**Introduction:** The work environment can pose risks of accidents or health issues for individuals or groups. Office jobs typically involve light tasks performed while seated at a desk in a well-equipped and comfortable workspace. However, such a work environment can create its own problems for workers, one of which is low back pain (LBP). This study aims to analyze the relationship between risk factors for low back pain among educational staff at Universitas Negeri Gorontalo.

**Method:** This study employed a cross-sectional design. The sample consisted of 186 educational staff at Universitas Negeri Gorontalo, selected using cluster random sampling technique. Data were collected through questionnaires and Rapid Upper Limb Assessment (RULA) observation sheets to assess age, work experience, smoking habits, stress, and work posture. Data analysis used chi-square test to examine the relationships between variables and logistic regression to identify the most influential variables.

**Results:** The statistical analysis showed a significant relationship between LBP and age ( $p = 0.001$ ) and work posture ( $p < 0.001$ ). Other factors such as gender, work experience, smoking habits, and stress did not show a significant relationship with LBP. Age had the greatest influence on LBP ( $\text{Exp (B)} = 0.427$ ).



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**Conclusion:** Age and work posture are factors associated with the occurrence of LBP. Improving sitting posture while working and taking regular breaks to stretch are necessary to reduce the risk of LBP. An appropriate prevention strategy is crucial to protect workers from LBP, which can also lead to increased productivity.

**Keywords:** Age, educator professional, low back pain, work posture

## Introduction

The work environment can pose risks of accidents or health problems for individuals or groups. Office work is often associated with light work that involves sitting behind a desk and being in a building equipped with facilities to support work and comfort for employees. The work environment may contribute to various health issues among employees, notably low back pain (LBP). LBP is a significant health concern that impacts individuals across all age groups and ranks among the top 10 prevalent conditions in developing nations. This condition can lead to mobility challenges, diminished quality of life, adverse mental health effects, restrictions in occupational duties, and social interactions with family and peers.<sup>1</sup> A report by the Riset Kesehatan Dasar (2018) indicates that in Indonesia, the prevalence of LBP diagnosed by healthcare professionals is 11.9%, whereas self-reported diagnoses or symptoms reflect a prevalence of 24.7%. Additionally, subjective complaints of LBP are reported by 83.3% of workers.<sup>2</sup>

The risk factors associated with LBP among workers can be categorized into three primary groups: individual, occupational, and environmental. Marras & Karwowski identify factors that influence the prevalence of LBP, including age, gender, body mass index, work experience, smoking habits, educational attainment, income level, and history of physical activity.<sup>3</sup> These findings align with research that establishes a correlation between age, work experience, workload, ergonomic posture, repetitive actions, and prolonged static work duration with LBP observed in workers at the onion peeling unit in Pasar Angso Duo, Jambi City. Furthermore, academic staff at institutions such as Universitas Negeri Gorontalo are at risk for LBP due to their roles in facilitating educational services. According to Indonesian Law No. 20/2003, Article 39, paragraph 1, educational personnel are tasked with administrative, management, development, supervision, and technical services essential to the educational process.<sup>4</sup> Human resources play a crucial role in organizational implementation, and their health is essential for performance, productivity, and quality. This phenomenon also applies to human resources in higher education institutions.<sup>5</sup>

Based on initial observations, Universitas Negeri Gorontalo has a circular letter No. 1786/UN47.A2/KP/2022 dated July 25, 2022, which outlines the working hours for civil servant educational staff and contract staff. The working hours are Monday to Friday, from 08:00 to 16:30, with a break from 12:00 to 13:00 WITA. As of November 2024, there were 639 educational staff members at the university, distributed across various work units. Some 20 staff members have experienced LBP. They spend most of their working hours sitting at a desk with a bent posture, which can trigger health issues such as LBP. To promote a healthy campus environment, Universitas Negeri Gorontalo participates in the "Healthy Campus" program, aiming to improve health quality in higher education settings. This study is expected to support the program, particularly in early detection of health problems. Therefore, this research aims to analyze the risk factors for LBP among educational staff at Universitas Negeri Gorontalo.

## **Methods**

This research utilized a quantitative methodology with a cross-sectional design. The independent variables examined included age, gender, work experience, smoking habits, work posture, and work-related stress, while the dependent variable focused on LBP. The study population comprised all educational personnel at Universitas Negeri Gorontalo, from which a sample of 186 respondents. The sampling technique used in this study is cluster sampling, which involves dividing the population of educational staff into several clusters based on work units. Then, several work units are randomly selected as research locations, such as faculties and other work units. All educational staff working in these units are used as respondents. Data collection occurred between January and February 2025, utilizing structured questionnaires and RULA observation tools. Prior to implementation, the research instruments underwent validation and reliability testing, yielding satisfactory validity results (Sign. (2-tailed)  $< 0.05$ ) and strong internal consistency (Cronbach's Alpha  $> 0.7$ ) in a separate pilot sample. Data analysis encompassed univariate, bivariate, and multivariate techniques. Univariate analysis was employed to assess the frequency distribution and percentage of LBP risk factors, while bivariate analysis utilized Chi-square tests to explore the associations between independent variables and LBP. Finally, multivariate analysis through logistic regression was conducted to identify factors that concurrently influence the occurrence of LBP. This study had received ethical approval from the Health Research Ethics Committee of the Faculty of Sports and Health, Gorontalo State University with approval number 239A/UN47.B7/KE/2024.

## Result

Table 1 shows that the majority of respondents were aged 36-45 years or late adulthood (59.1%), female (53.2%), had more than 5 years of work experience (60.8%), did not have a smoking habit (69.4%), had non-ergonomic work posture (66.7%), had moderate stress levels (49.5%), and experienced LBP complaints (54.2%).

**Table 1.** Frequency distribution of respondents by age, gender, work experience, smoking habits, work posture, work stress, and low back pain

Variable		Frequency (f)	Percentage (%)
Age	26-35 Years (Early Adulthood)	20	10.8
	36-45 Years (Late Adulthood)	110	59.1
	46-55 Years (Early Elderly)	44	23.7
	56-65 Years (Late Elderly)	12	6.5
Gender	Male	87	46.8
	Female	99	53.2
Work Experience	> 5 Years	113	60.8
	<5 Years	73	39.2
Smoking Habits	Smoker	57	30.6
	Non-Smoker	129	69.4
Work Posture	Ergonomic	62	33.3
	Non-Ergonomic	124	66.7
Stress	Mild	15	8.1
	Moderate	92	49.5
	Severe	79	42.5
Low Back Pain	With Complaints	102	54.8
	Without Complaints	84	45.2

Table 2 presents the findings from the Chi-Square analysis, indicating a significant association between LBP and two factors: age ( $p = 0.001$ ) and work posture ( $p < 0.001$ ). Conversely, other variables, including gender ( $p = 0.231$ ), work experience ( $p = 0.231$ ), smoking habits ( $p = 0.688$ ), and work-related stress ( $p = 0.916$ ), do not demonstrate a statistically significant association with LBP.

**Table 2.** Analysis of the relationship between age, gender, work experience, smoking habits, work posture, work stress, and low back pain among educational staff

Variable		Low Back Pain						P-Value
		With		Without		Total		
		Complaints		Complaints		(N=186)		
		(n=102)		(n=84)				
n	%	n	%	n	%			
Age	26-35 Years	5	2.7	15	8.1	20	10.8	0.001*
	36-45 Years	57	30.6	53	28.5	110	59.1	
	46-55 Years	29	15.6	15	8.1	44	23.7	
	56-65 Years	11	5.9	1	0.5	12	6.5	
Gender	Male	58	31.2	55	29.6	113	60.8	0.231
	Female	44	23.7	29	15.6	73	39.2	
Work Experience	> 5 Years	58	31.2	55	29.6	113	60.8	0.231
	<5 Years	44	23.7	29	15.6	73	39.2	
Smoking Habits	Smoker	30	16.1	27	14.5	57	30.6	0.688
	Non-Smoker	72	38.7	57	30.6	129	69.4	
Work Posture	Ergonomic	15	8.1	47	25.3	62	33.3	<0.001*
	Non-Ergonomic	87	46.8	37	19.9	124	66.7	
Stress	Mild	9	4.8	6	3.2	15	8.1	0.916
	Moderate	50	26.9	42	22.6	92	49.5	
	Severe	43	23.1	36	19.4	73	42.5	

Chi-square test, \*significant at  $p < 0.05$

Table 3 shows that age ( $p = 0.001$ ) and work posture ( $p < 0.001$ ) are variables that significantly influence LBP. Among these two variables, age is the most influential variable on LBP, with an Exp(B) value of 0.427.

**Table 3.** Analysis of knowledge, attitude, and practice scores before and after intervention

Variable	B	S.E	Wald	Df	Sig.	Exp (B)
Age	-0.851	0.254	11.239	1	0.001	0.427
Work Posture	-1.953	0.367	28.304	1	<0.001	0.142
Constant	4.945	0.869	32.366	1	<0.001	140.519

## **Discussion**

### **The relationship between age and low back pain complaints**

The results show that the age group 35-46 years had the highest representation among those with LBP complaints, with 57 respondents, followed by the 36-45 age group with 29 respondents, the 56-65 age group with 11 respondents, and the 23-35 age group with 5 respondents. A noteworthy association exists between age and LBP complaints among the educational staff at Universitas Negeri Gorontalo. This association is substantiated by Chi-Square analysis, which produced a P-value of 0.001 ( $p < 0.05$ ).

Various factors, including lifestyle choices and insufficient physical activity, may influence complaints of LBP among individuals aged 26 to 35. In general, the onset of muscular complaints typically begins during the productive age span of 25 to 65 years, with a noticeable decline in muscle strength occurring around the age of 60. However, in this study, it was surprisingly found that one respondent aged 56-65 years did not experience LBP complaints. This could be attributed to the individual's ability to adapt to their body and lifestyle, a history of healthy living, and pain tolerance. According to the theory of degenerative processes in the human intervertebral disc, degeneration begins around the age of 30, leading to tears, scarring, reduced disc fluid, and permanent narrowing of the disc space, ultimately causing spinal instability. This degeneration reduces the nucleus fluid, decreasing the capacity to withstand loads and pressure during continuous movement, which is rationalization of people over 30 tend to experience complaints related to joints, muscles, and bones.<sup>6</sup>

In line with the research conducted by Saputra, which examined 36 batik workers at Sanggar Batik Semarang. Saputra's study identified a significant association between age and the incidence of LBP, reporting a p-value of 0.020 ( $p < 0.05$ ). The conclusion indicates that individuals aged 35 are more susceptible to developing LBP.<sup>7</sup>

### **The relationship between gender and low back pain complaints**

According to the research findings, 58 male respondents (31.2%) reported experiencing LBP, while 44 female respondents (23.7%) indicated similar complaints. The Chi-Square test results yielded a value of 0.231, suggesting no significant association between gender and LBP among the educational staff.

The absence of a significant relationship may be influenced by the unequal distribution of respondents across gender categories. In this study, males represented the majority with 113 respondents (60.8%), while females comprised 73 respondents (39.2%). Biologically, females exhibit anatomical characteristics such as a wider pelvis, which can influence spinal

biomechanics, whereas males typically possess greater muscle mass, potentially providing some protection against injury. However, these anatomical differences do not straightforwardly translate into LBP complaints. These findings are consistent with research conducted by Aenia et al., which reported a p-value of 1.000 in the analysis examining the relationship between gender and LBP complaints, confirming no significant relationship.<sup>8</sup> Similarly, the study conducted by Nurjannah yielded a p-value of 0.0857 ( $p > 0.05$ ), further supporting the conclusion of no significant association between gender and LBP complaints.<sup>9</sup>

### **The relationship between work experience and low back pain complaints**

According to the research findings, 58 respondents (31.2%) with more than five years of work experience reported LBP complaints, while 44 respondents (23.7%) with less than five years of work experience also indicated similar complaints. The Chi-Square analysis resulted in a p-value of 0.231, with a significance threshold set at  $\alpha = 0.05$ , suggesting no statistically significant relationship between work experience and the incidence of LBP among the educational staff at Universitas Negeri Gorontalo.

The majority of respondents were long-term workers, with 113 respondents (60.8%) having worked for more than 5 years. Each individual has a different level of physical adaptation to their job, which may explain why work experience is not directly related to LBP complaints. If the work environment is designed ergonomically, workers with long work experience can still avoid LBP. Educational staff tend to perform varied tasks, including supporting academic, administrative, and operational activities on campus. This task variation may be one argumentation of work experience does not show a direct relationship with LBP complaints. This investigation aligns with the findings of Yacob et al., who studied 42 nurses in the inpatient unit of Bhayangkara Hospital Level III Manado. Their research revealed no significant correlation between work experience and the incidence of LBP complaints among the participants.<sup>10</sup>

### **The relationship between smoking habits and low back pain complaints**

The majority of participants in this study were non-smokers, with 129 individuals (69.4%) reporting they did not smoke. A total of 30 participants (16.1%) who identified as smokers reported complaints from LBP. The bivariate analysis revealed no significant association between smoking habits and the incidence of LBP, yielding a p-value of 0.688. Interestingly, a higher proportion of non-smokers reported experiencing LBP complaints, suggesting that smoking habits do not have a statistically significant impact on the prevalence of LBP. This finding aligns with the research conducted by Syuhada et al. among tea pluckers in the Ciater Tea Plantation, Subang Regency, which also found no significant relationship

between smoking habits and LBP complaints, as evidenced by a p-value of 0.275.<sup>11</sup>

However, this study contradicts the findings of Arma et al., which reported a significant relationship between smoking habits and LBP complaints among public transportation drivers in Palembang.<sup>12</sup> This discrepancy may be due to the varying types of occupations among respondents in each study. Several studies have suggested that smokers are 1.5 to 2.5 times more likely to experience LBP, potentially due to reduced blood flow and oxygen supply to the spinal tissues. Carbon monoxide from cigarette smoke binds to hemoglobin, hindering and reducing oxygen delivery in the blood. Nicotine in cigarettes also causes vasoconstriction of blood vessels, which supply nutrients to the cells in the intervertebral discs. As a result, the cells in the discs experience nutrient and oxygen deficiencies, making them more susceptible to damage. Additionally, nicotine has a negative impact on osteoblast cells, affecting their proliferation and metabolism, as well as collagen synthesis, ultimately reducing bone mineral density.<sup>12</sup>

### **The relationship between working posture and low back pain complaints**

The study found that 15 respondents (8.1%) with ergonomic working postures experienced LBP complaints, while 87 respondents (46.8%) with non-ergonomic working postures also experienced similar complaints. The Chi-Square test produced a p-value of 0.000 ( $p < 0.05$ ), suggesting a significant association between working posture and LBP complaints. Non-ergonomic postures can cause excessive pressure on the spinal structures, muscles, and ligaments. The nature of educational staff work, which is often administrative and involves prolonged sitting, increases the risk of LBP.

Poor sitting positions, such as slouching or sitting without back support, can cause strain on the lower back muscles and weaken the core muscles that support the spine. Educational staff who sit for prolonged periods without stretching may experience muscle stiffness and LBP. The findings from this study align with those of Bantoro et al., which identified a significant association between working posture and the incidence of LBP among weaving workers at PT. Apac Inti Corpora, with a p-value of 0.022.<sup>13</sup> Moreover, this study corroborates the research conducted by Saputra, which established a notable association between working posture and the prevalence of LBP, reporting a p-value of 0.042.<sup>7</sup> The evidence suggests that improper working postures can increase the risk of musculoskeletal disorders (MSDs) by a factor of three, as these postures necessitate sustained muscular exertion. Furthermore, working postures that engage multiple muscle groups may contribute to work-related health issues, including musculoskeletal complaints, particularly when inadequate body positioning is present.

### **The relationship between stress and low back pain complaints**

Based on the research findings, nine respondents (4.8%) with mild work stress experienced LBP complaints, 50 respondents with moderate work stress experienced similar complaints, and 43 respondents (23.1%) with severe work stress also experienced LBP complaints. The Chi-Square test produced a p-value of 0.916, suggesting no statistically significant association between stress levels and the incidence of LBP among the educational staff at Universitas Negeri Gorontalo.

This may be due to the fact that most educational staff have long working experience as civil servants with stable job status, making them accustomed to handling work stress. The positive impact of stress can motivate educational staff to complete their work optimally. This study is consistent with previous research, which found no significant relationship between work stress and LBP complaints. The reaction to stress can be psychological or physical, and stressed educational staff may exhibit behavioral changes. Coping mechanisms can involve fighting stress or withdrawing, often alternating depending on the situation and type of stress.<sup>9,14</sup>

The limitations of this study include several crucial aspects. Firstly, the population limitation is a concern because the study only involves educational staff within the university environment, limiting the generalizability of the findings to a broader university population. Secondly, the cross-sectional research design means that the relationship between risk factors and LBP complaints can only be described at a specific point in time, thus unable to directly explain cause-and-effect relationships. Thirdly, the data is subjective because it was collected through self-reporting questionnaires, which heavily relies on respondents' perceptions and memory, potentially leading to information bias (both overreporting and underreporting of complaints). Lastly, this study did not involve physical examinations, which means the accuracy in identifying LBP conditions medically is limited due to the absence of clinical examinations or objective posture assessments.

### **Conclusion**

There is a relationship between LBP and age and working posture. Other factors such as gender, work experience, smoking habits, and stress did not show a significant relationship with LBP. Age has the greatest influence on LBP. The present study suggests an improving sitting posture while working and taking regular breaks to stretch are necessary to reduce the risk of LBP. Effective prevention strategies are crucial to protect workers from LBP and increase productivity.

### **Conflicts of Interest**

Nothing to declare

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## Analysis of the Relationship Between Contributing Factors and Body Image Among Medical Students

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### ABSTRACT

**Introduction:** Body image refers to an individual's perception and evaluation of their physical appearance. A positive body image plays a crucial role in enhancing self-esteem, psychological resilience, and overall mental and physical well-being. In contrast, a negative body image has been linked to mental health problems, such as depression and disordered eating. This study aimed to examine the associations between various contributing factors and body image among medical students.

**Method:** A quantitative cross-sectional study was conducted involving 67 medical students, selected through total population sampling. Data collection instruments included the Figure Rating Scale, Global Physical Activity Questionnaire (GPAQ), Dutch Eating Behavior Questionnaire (DEBQ), a 24-hour dietary recall, the Perceived Stress Scale (PSS-10), and the Rosenberg Self-Esteem Scale (RSES) to assess self-confidence. All instruments exhibited acceptable levels of validity and reliability. Data were analyzed using Chi-Square and Binary Logistic Regression Methods.



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**Results:** Significant associations were identified between body image and physical activity ( $p = 0.040$ ), self-confidence ( $p = 0.018$ ), and body mass index (BMI) ( $p = 0.001$ ). Logistic regression analysis revealed that BMI (OR = 1.766,  $p = 0.002$ , 95% CI [0.644–2.888]), self-confidence (OR = 0.311,  $p = 0.045$ , 95% CI [0.099–0.975]), and physical activity (OR = 1.966,  $p = 0.031$ , 95% CI [1.063–3.831]) were significant predictors of body image.

**Conclusion:** Body mass index, self-confidence, and physical activity were significantly associated with body image. The implementation of educational and psychological support programs is recommended to promote healthy self-perception and behavioral patterns among medical students.

**Keywords:** Body image, body mass index, medical, motor activity, self-concept, students

## Introduction

Body image is an internal representation of one's physical appearance, encompassing perceptual, affective, cognitive, and behavioral dimensions. It is shaped by internal beliefs as well as external influences, including cultural standards, peer comparisons, and media portrayals. A positive body image fosters self-acceptance, resilience, and overall well-being, whereas a negative body image may contribute to psychological distress, such as anxiety, depression, disordered eating, and diminished self-esteem.<sup>1</sup>

In recent years, body dissatisfaction, particularly related to shape and weight, has driven a notable increase in aesthetic procedures worldwide. For example, more than 325,000 liposuction procedures were performed in the United States in 2022, reflecting a shift toward altering body shape to conform to perceived ideals rather than enhancing beauty.<sup>2</sup> Such behaviors are often rooted in a psychological discomfort arising from the gap between perceived and ideal body image.<sup>3</sup>

The transition to young adulthood (ages 18–25), a developmental period often experienced by university students, is marked by identity formation and the consolidation of self-concept. Physical appearance becomes a salient concern, particularly within academically demanding environments such as medical schools. Prior studies have noted that confidence levels among young adults are frequently moderate to low, with physical attributes serving as significant influencing factors. Ifdil argued that young adults often assess themselves based on their physical appearance, resulting in dissatisfaction and reduced self-confidence when their body image does not align with societal ideals.<sup>4</sup>

Moreover, the academic pressure faced by medical students—including continuous assessments, prolonged study hours, and limited time for recreation—can exacerbate psychological stress and negatively impact body image. Research by Vicennia et al. found that

a substantial proportion of medical students expressed body dissatisfaction despite having normal BMI values, highlighting the importance of cognitive and psychosocial components in body image formation.<sup>5</sup>

Given the multifactorial nature of body image and its potential determinants, this study aims to investigate the relationships between gender, physical activity, eating behavior, stress level, body mass index (BMI), and self-confidence with body image among medical students.

## **Methods**

This study employed a quantitative, cross-sectional design involving 67 medical students enrolled at Universitas Negeri Gorontalo. A total population sampling method was utilized. Data collection was conducted between November and December 2024.

Data were collected using validated instruments: the Figure Rating Scale to measure body image; the Global Physical Activity Questionnaire (GPAQ) for assessing physical activity levels; the Dutch Eating Behavior Questionnaire (DEBQ) to evaluate restrained, emotional, and external eating patterns; a 24-hour dietary recall to assess nutritional intake; the Perceived Stress Scale (PSS-10) to measure stress levels; and the Rosenberg Self-Esteem Scale (RSES) to evaluate self-confidence. All instruments demonstrated acceptable psychometric properties, with significance values below 0.05 and Cronbach's alpha coefficients exceeding 0.70.

Ethical approval for this study was obtained from the Health Research Ethics Committee of Universitas Negeri Gorontalo (Approval Letter No. 242B/UN47.B7/KE/2024). Participants were informed about the study objectives and procedures, and written informed consent was obtained.

Data was analyzed using three stages: univariate analysis to describe the distribution of each variable; bivariate analysis using the Chi-square test to explore associations between independent variables and body image; and multivariate analysis using binary logistic regression to identify significant predictors. Odds ratios (OR), p-values, and 95% confidence intervals (CI) were reported for each predictor variable.

## **Result**

Table 1 shows the majority of participants were female (79.1%). Most reported engaging in moderate levels of physical activity (68.7%) and exhibited moderate levels of self-confidence (52.2%). A normal body mass index (BMI) was observed in (58.2%) of respondents, while (53.7%) reported having a negative body image perception.

**Table 1.** Distribution of respondent frequencies based on gender, physical activity, eating behavior, stress level, body mass index, self-confidence, and body image (n=67)

Variable		Frequency (f)	Percentage (%)
Gender	Male	14	20.9
	Female	53	79.1
Physical activity	Low	16	23.9
	Moderate	46	68.7
	Severe	5	7.5
Eating behavior	<i>Restraint eating</i>		
	High	43	64.2
	Low	24	35.8
	<i>Emotional eating</i>		
	High	57	85.1
	Low	10	14.9
	<i>External Eating</i>		
	High	17	25.4
	Low	50	74.6
Stress level	Severe	34	50.7
	Low	11	16.4
	Moderate	22	32.8
Body mass index (BMI)	Normal weight	39	58.2
	Underweight	6	9.0
	Overweight	6	9.0
	Obesity	16	23.9
Self-confidence	High	32	47.8
	Moderate	35	52.2
	Low	0	0
Body image	Negative	36	53.7
	Positive	31	46.3

Table 2 demonstrated statistically significant associations between body image and physical activity ( $p = 0.040$ ), self-confidence ( $p = 0.018$ ), and BMI ( $p = 0.001$ ). No significant associations were observed with gender, eating behaviors, or stress levels.

**Table 2.** Analysis of the relationship between body image and gender, physical activity, eating behavior, stress level, body mass index, self-confidence

Variable	Body image						Total (N=67)	P- Value
	Negative (n=36)		Positive (n=31)					
	n	%	n	%	N	%		
Gender	Male	7	10.4	7	10.4	14	20.9	0.753
	Female	29	43.3	24	35.8	53	79.1	
Physical activity	Low	13	19.4	3	4.5	16	23.9	0.040*
	Moderate	21	31.3	25	37.3	46	68.7	
	Severe	2	3.0	3	4.5	5	7.5	
Eating behavior	<i>Restraint eating</i>							
	High	23	34.3	20	29.9	43	64.2	0.957
	Low	13	19.4	11	16.4	24	35.8	
	<i>Emotional eating</i>							
	High	31	46.3	26	38.8	57	85.1	0.796
	Low	5	7.5	5	7.5	10	14.9	
Stress level	<i>External Eating</i>							
	High	12	17.9	5	7.5	17	25.4	0.107
	Low	24	35.8	26	38.8	50	74.6	
	Severe	17	25.4	17	25.4	34	50.7	0.459
Low	12	17.9	10	14.9	22	32.8		
Moderate	7	10.4	4	6.0	11	16.4		
Body mass index (BMI)	Normal weight	27	40.3	12	17.9	39	58.2	0.001*
	Underweight	5	7.5	1	1.5	6	9.0	
	Overweight	1	1.5	5	7.5	6	9.0	
	Obesity	13	19.4	3	4.5	16	23.9	
Self-confidence	High	22	32.8	10	14.9	32	47.8	0.018*
	Moderate	14	20.9	21	31.3	35	37.1	
	Low	0	0	0	0	0	0	

Chi-square analysis, \*significant at  $p < 0.05$

Table 3 shows multivariate logistic regression analysis which confirmed that BMI (OR = 1.766,  $p = 0.002$ , 95% CI [0.644–2.888]), self-confidence (OR = 0.311,  $p = 0.045$ , 95% CI [0.099–0.975]), and physical activity (OR = 1.966,  $p = 0.031$ , 95% CI [1.063–3.831]) were significant predictors of body image. The Nagelkerke  $R^2$  value was 0.421, indicating a moderate explanatory power of the model.

**Table 3.** Logistic regression equation

Variable	Coefficient ( $\beta$ )
Constanta	-3.511
Gender	-0.833
Physical activity	676
Eating behavior	
a. Restrain eating	-0.970
b. Emotional eating	-1.350
c. External eating	508
Stress level	-1.140
Body mass index (BMI)	1.766
Self-confidence	-1.168

## Discussion

### The relationship between gender and body image among medical students

Although female students exhibited a slightly higher prevalence of negative body image compared to their male counterparts, the association was not statistically significant. This finding aligns with previous research suggesting that the uniform academic pressures and stressors experienced during medical training may attenuate gender-based differences in body image perception.<sup>6</sup>

### The relationship between physical activity and body image among medical students

Moderate levels of physical activity were positively associated with body image perceptions. This is consistent with existing literature indicating that physical activity enhances body composition, increases self-efficacy, and reduces stress.<sup>7</sup> However, it is important to note that high-intensity exercise may prioritize performance outcomes over physical appearance, which does not necessarily lead to improved body satisfaction.<sup>8</sup>

### The relationship between eating behavior and body image among medical students

Despite a substantial proportion of participants reporting high levels of restrained,

emotional, and external eating behaviors, none of these factors demonstrated a statistically significant relationship with body image.<sup>9</sup> These findings suggest that while eating behaviors may function as coping mechanisms or methods of dietary control, they do not directly influence body image. Previous studies have posited that such behaviors are more strongly related to affect regulation and are often mediated by body mass index and self-esteem.<sup>10</sup>

### **The relationship between stress levels and body image among medical students**

No statistically significant association was identified between perceived stress levels and body image. This outcome may reflect the presence of adaptive coping strategies among medical students or the normalization of elevated stress within this academic environment.<sup>11</sup>

### **The relationship between body mass index and body image among medical students**

Body mass index emerged as a strong predictor of body image. Students classified as obese exhibited the highest levels of body dissatisfaction.<sup>12</sup> Nonetheless, a notable number of students with normal BMI also reported a negative body image, underscoring that body perception is not solely determined by objective physical metrics but is heavily influenced by subjective ideals and internalized societal standards.<sup>13</sup>

### **The relationship between self-confidence and body image among medical students**

The research findings indicated that among the 67 respondents, the majority exhibited moderate (52.2%) or high (47.8%) levels of self-confidence, with no participants reporting low self-confidence. Negative body image was predominantly observed among students with high self-confidence (22 respondents or 68.8%), whereas positive body image was more common in the moderate self-confidence group (21 respondents or 61.8%)—not 16.2%, as previously stated, suggesting a possible calculation error. The Chi-square test revealed a statistically significant association between self-confidence and body image ( $p = 0.018$ ), indicating that self-perception is meaningfully related to individuals' body image evaluations.

This finding is supported by Clemmens, who reported a positive association between self-confidence and body image. Individuals with higher self-esteem are generally more inclined to perceive their bodies positively, regardless of their actual physical characteristics. However, the presence of respondents with high self-confidence yet negative body image suggests the possibility of cognitive distortions or social pressures that influence body perception independently of overall self-evaluation.<sup>14</sup>

Furthermore, a study by Veldhuis found that within high-pressure academic settings—such as medical schools—students tend to compare themselves against social ideals or their peers. This comparison may distort body image even when overall self-confidence remains relatively high. These findings highlight that body image is a more specific psychological

construct and should not be conflated with global self-esteem.<sup>15</sup>

According to the Body Image Investment Model proposed by Cash et al., self-confidence is one of several psychological domains that influence how individuals interpret and respond to their body image. Those who place a high personal or social value on appearance tend to integrate body image more centrally into their self-concept. Consequently, fluctuations in body perception can directly influence self-confidence, and conversely, shifts in self-confidence can impact body image evaluation.<sup>16</sup>

The limitation of this study is that the majority of respondents were female, with only 20.9% being male. This imbalance in the sample size may limit the generalizability of the research findings to the overall population of medical students.

### **Conclusion**

Physical activity, self-confidence, and body mass index were identified as factors significantly associated with body image. Accordingly, students are encouraged to cultivate a positive body image by focusing on their individual strengths and uniqueness, participating in activities that enhance self-confidence, maintaining positive self-talk, and refraining from making unfavorable comparisons with others.

### **Conflicts of Interest**

Nothing to declare

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## The Relationship Between Clinical Characteristics with Visual Outcome in Post Cataract Surgery at Tidore Islands City Regional Hospital

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### ABSTRACT

**Introduction:** Cataracts are a leading cause of blindness worldwide. The prevalence of blindness due to untreated cataracts remains quite high in Indonesia. In Eastern Indonesia, where there are limited healthcare facilities and scarce published data, this problem is particularly pronounced. Although cataract surgery is an effective intervention for restoring vision, postoperative visual outcomes can vary based on various patient-related clinical factors. No reported studies have addressed this issue in North Maluku. This study aims to analyze how clinical characteristics influence visual outcomes in patients after cataract surgery at Tidore Islands City Regional Hospital.

**Method:** This research employed an observational analytical study with cross sectional design. This study used secondary data recorded at the Tidore Islands City Regional Hospital in 2020–2023 that meets the inclusion and exclusion criteria. The clinical characteristics assessed included age, gender, occupation, cataract stage, postoperative complications, and systemic comorbidities such as diabetes mellitus and hypertension. Visual acuity was measured using Snellen chart and converted into logMAR units for analysis and classification according to WHO criteria. Data analysis was performed using simple logistic regression.

**Results:** Simple logistic regression showed no association between visual outcomes and age ( $p=0.089$ ), gender ( $p=0.160$ ), or occupation ( $p=1.395$ ). Significant associations were observed for cataract stage ( $p=0.014$ ), postoperative complications ( $p=0.004$ ), and presence of comorbidities ( $p<0.001$ ).

**Conclusion:** Age, gender, and occupation were not associated with visual outcomes. Cataract stage, postoperative complications, and comorbidities were significantly associated with outcomes. Diabetes mellitus was the most influential factor.

**Keywords:** Cataract, cataract extraction, comorbidity, diabetes mellitus, visual acuity



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## **Introduction**

Cataract is a condition that affects the eye, causing the previously clear lens to become cloudy, thereby blocking light from entering the retina. The incidence of cataracts is notably high, primarily due to the aging process.<sup>1</sup> Cataracts are the leading cause of severe visual impairment and blindness worldwide. According to data from the World Health Organization (WHO) in 2018, approximately 2.2 billion people experience some form of visual impairment or blindness, with 94 million cases attributed to cataracts.<sup>2</sup> Cataracts are also the primary cause of blindness in Southeast Asia, with an estimated 12 million (30%) people blind and 78 million (32%) visually impaired in 2010.<sup>3</sup>

Indonesia has the highest rate of blindness in Southeast Asia<sup>4</sup>. In response to this, the Rapid Assessment of Avoidable Blindness (RAAB) survey was conducted across 15 provinces in Indonesia from 2013 to 2017. The survey revealed a blindness prevalence of 3%, with 81% of cases caused by untreated cataracts. The highest proportion of untreated cataract-related blindness was found in West Papua (95.5%), followed by Maluku (88.0%) and South Kalimantan (87.7%).<sup>5,6</sup>

The primary treatment for cataracts to prevent blindness is surgery. The aim of cataract surgery is to improve visual acuity.<sup>7</sup> According to WHO guidelines, visual acuity outcomes after surgery are categorized into three groups: good outcome, borderline outcome, and poor outcome.<sup>8</sup>

A study conducted by Sengo in 2023 involving 484 cataract surgery patients found that the majority achieved a good visual outcome (74.3%), followed by borderline outcome (23.5%), and poor outcome (2.2%).<sup>9</sup> Another study by Markos (2020) identified several factors influencing postoperative visual acuity, with age, preoperative vision, and intraoperative complications showing significant associations with visual outcomes ( $p < 0.05$ ).<sup>10</sup>

North Maluku is a region that has not been included in the RAAB survey assessments; therefore, there are no definitive data on blindness rates or visual acuity outcomes.<sup>5</sup> A previous study by Assayidatina (2022) at Dr. H. Chasan Boesoirie General Hospital focused only on the clinical characteristics of outpatients undergoing cataract treatment.<sup>11</sup> Despite extensive research on cataract, comprehensive data on specific clinical characteristics influencing postoperative visual outcomes remain limited, particularly in underrepresented regions such as North Maluku. Based on these considerations, this study aims to analyze how clinical characteristics influence visual outcomes in patients after cataract surgery at Tidore Islands City Regional Hospital.

## **Methods**

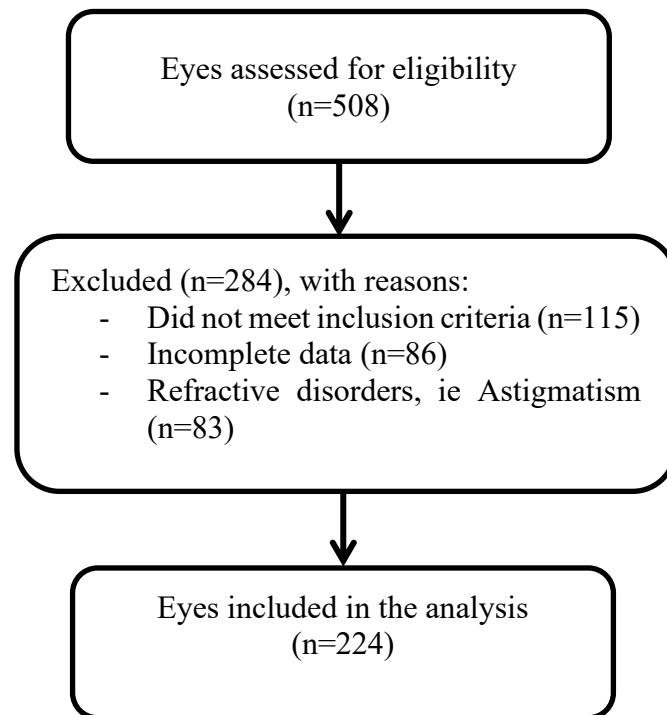
This study is an observational analytic study with a cross-sectional approach. It was conducted to determine the relationship between clinical characteristics and visual outcomes after cataract surgery at Tidore Islands City Regional Hospital during the period of September to November 2023. The study sample consisted of all cataract patients who had undergone surgery, assessed based on the operated eye. The sample size was calculated using Slovin's formula, resulting in 224 samples that met the inclusion and exclusion criteria.

The inclusion criteria were cataract patients aged  $\geq 45$  years with complete medical records containing data such as age, gender, visual outcome, cataract stage, complications, and comorbidities. The exclusion criteria included patients with traumatic cataracts, congenital cataracts, and cataracts accompanied by other media opacity disorders such as refractive errors (myopia, hypermetropia, presbyopia and astigmatism), glaucoma, corneal disorders, retinal disorders, or optic nerve diseases. To minimize potential confounding, patients with astigmatism were excluded during the study design phase, and this variable was not included in the analysis. Visual acuity was measured using Snellen chart and converted into logMAR units for analysis and classification according to WHO criteria.

Data collection was conducted using secondary data obtained from the medical records of post-operative cataract patients at Tidore Islands City Regional Hospital from October 2020 to August 2023. The sampling technique used in this study was simple random sampling. The collected data were processed using the IBM SPSS statistical software and analyzed through univariate, bivariate (simple logistic regression), and multivariate (multiple logistic regression) methods. A significant level of  $p < 0.05$  was considered statistically significant. This study was conducted with permission from Tidore Islands City Regional Hospital, as stated in Letter No. 684/G.8/22/798.10/2023 and the Faculty of Medicine, Khairun University, as stated in Letter No. 2757/UN44.C9/KM.05/2023. All patient data were anonymized by replacing names with initials and using only medical record numbers to ensure confidentiality.

## **Result**

Figure 1 shows the flow diagram of study samples. Initially, 508 eyes from patients who had undergone cataract surgery at Tidore Islands City Regional Hospital were assessed for eligibility. Furthermore, 284 eyes were excluded due to not meeting the inclusion criteria ( $n = 115$ ), having incomplete data ( $n = 86$ ), or having refractive disorders such as astigmatism ( $n = 83$ ). Finally, 224 eyes that met all inclusion criteria were included in the analysis.



**Figure 1.** Flow diagram of cataract sample selection

Table 1 shows most patients were aged 60–74 years (58%), male (55.4%), and worked outdoors (55.4%). The majority had immature cataracts (66.5%), no postoperative complications (83.5%), and no comorbidities (41.1%). Good to borderline visual outcomes were observed in 67% of cases.

Based on the logistic regression analysis presented in Table 2, there were no significant associations between visual outcomes and demographic characteristics such as age, gender, and occupation ( $p > 0.05$ ). However, clinical factors like the stage of cataracts, postoperative complications, and comorbidities (like diabetes, high blood pressure, or both) were significantly associated to patient's visual improvement after surgery ( $p < 0.05$ ), indicating they could affect visual outcomes after cataract surgery.

Data in Table 3 shows the results of statistical analysis using multivariate logistic regression to determine the most influential independent variable on visual outcomes after cataract surgery at Tidore Islands City Regional Hospital. The results showed that the most influential variable was comorbidity of Diabetes Mellitus (DM), with an Exp(B) value of 5.872.

**Table 1.** Clinical characteristics of post-cataract surgery patients at Tidore Islands City Regional Hospital

Variable	Frequency (N = 224)	Percentage (%)
<b>Age</b>		
45-59 years	61	27.2
60-74 years	130	58.0
75-90 years	33	14.7
>90 years	0	0.0
<b>Gender</b>		
Male	124	55.4
Female	100	44.6
<b>Occupation</b>		
Outdoor	124	55.4
Indoor	100	44.6
<b>Visual Outcome</b>		
Good to borderline outcome (0.00-1.00)	150	67.0
Poor outcome (>1.00)	74	33.0
<b>Cataract Stage</b>		
Immature	149	66.5
Mature	75	33.5
<b>Postoperative Complications</b>		
With complications	37	16.5
Without complications	187	83.5
<b>Comorbidities</b>		
Diabetes Mellitus	24	10.7
Hypertension	79	35.3
DM and HT	29	12.9
Neither DM nor HT	92	41.1

DM = Diabetes Mellitus, HT = Hypertension

**Table 2.** Association between clinical characteristics and visual outcomes after cataract surgery

Clinical Characteristics	Visual Outcome Post-Cataract Surgery, n (%)		Simple Logistic Regression	
	Good to borderline outcome	Poor outcome	OR (95% CI)	P-Value
<b>Age</b>				
45-59 years	44 (72.1)	17 (27.9)	0.464 (0.191 – 1.123)	0.089
60-74 years	88 (67.7)	42 (32.3)		
75-90 years	18 (54.5)	15 (45.5)		
<b>Gender</b>				
Male	89 (71.8)	35 (28.2)	0.615 (0.351 – 1.078)	0.089
Female	61 (61.0)	39 (39.0)		
<b>Occupation</b>				
Outdoor	79 (63.7)	45 (36.3)	1.395 (0.792 - 2.457)	0.250
Indoor	71 (71.0)	29 (29.0)		
<b>Cataract Stage</b>				
Immature	108 (72.5)	41 (27.5)	0.483 (0.270 – 0.863)	0.014*
Mature	42 (56.0)	33 (44.0)		
<b>Postoperative Complications</b>				
Present	17 (45.9)	20 (54.1)	2.898 (1.411 – 5.952)	0.004*
Absent	133 (71.1)	54 (28.9)		
<b>Comorbidities</b>				
DM	10 (41.7)	14 (58.3)	6.650 (2.510 – 17.617)	<0.001*
HT	50 (63.3)	29 (36.7)		
DM and HT	14 (48.3)	15 (51.7)		
Neither DM nor HT	76 (82.6)	16 (17.4)		

CI = Confidence Interval, DM = Diabetes Mellitus, HT = Hypertension, OR = Odds Ratio  
Simple logistic regression test, \* $P < 0.05$ , statistically significant

**Table 3.** Multivariate analysis of the relationship between cataract stage, postoperative complications, and comorbidities with visual outcomes after cataract surgery

		Sig.	Exp(B)
Step 1 <sup>a</sup>	Immature	0.065	0.552
	Postoperative Complications	0.008*	2.841
	Comorbidities	0.001*	
	DM	0.001*	5.872
	HT	0.005*	2.818
	DM and HT	0.001*	4.742
	Constant	<0.001*	0.259

DM = Diabetes Mellitus, HT = Hypertension, Exp(B)= Exponential of the Coefficient B (Odds Ratio), Sig.= (*P*-value)

Multiple logistic regression test, \**P*<0.05, statistically significant

## Discussion

### Clinical characteristics of post-cataract surgery patients

Based on patient clinical characteristics data, the most prominent age group was 60–74 years, accounting for 130 eyes (58%). This is consistent with the study by Sidrafiani (2021), which found that the largest number of cataract surgeries occurred among elderly patients aged 60–74 years (39.29%). Older individuals are more prone to systemic conditions such as hypertension and diabetes, and they are also more susceptible to post-surgical complications, which can negatively affect visual outcomes.<sup>12, 13</sup>

In terms of gender distribution, male patients represented a slightly larger proportion, with 124 eyes (55.4%), similar to a study conducted with study by Gde at RSUP Sanglah (2016–2017), which reported 78.1% of post-operative cataract patients were male.<sup>14</sup> Although cataract incidence is generally higher among women, especially after menopause due to declining oestrogen levels, this study observed a predominance of male patients.<sup>15</sup>

Regarding occupation, 124 patients (55.4%) were engaged in outdoor work, a factor known to contribute to cataract development due to prolonged exposure to ultraviolet (UV) light. This finding aligns with research by Allern (2015), which showed that approximately 64.9% of senile cataract cases involved patients who had significant UV exposure from outdoor occupations.<sup>1</sup> UV radiation accelerates cataract formation by generating reactive oxygen species that damage lens proteins.<sup>16</sup>

In terms of visual outcomes, most patients (67%) achieved good to borderline vision

following surgery, while 33% had poor outcomes. This trend is supported with the study by Markos (2020) conducted at Saint Paul's Hospital, where a majority of the 309 eyes analyzed demonstrated good to borderline postoperative vision.<sup>10</sup>

Regarding cataract stage, most cases were diagnosed as immature senile cataracts, which comprised 66.5% of the total cases, whereas mature cataracts made up only 33.5%. This observation aligns with the findings of Gracella (2014), who reported that immature senile cataracts were more prevalent, especially among patients aged 60–69 years (32.5%), whereas mature cataracts were less common in the elderly (only 3.3% in patients aged 80–96 years).<sup>17</sup>

Based on the distribution of post-operative complications, the study showed that more eyes did not experience complications (187 cases, 83.5%) compared to those with post-operative complications (37 cases, 16.5%). This finding is consistent with a study by Nurjanah (2019), which found that more eyes did not experience complications post-surgery (22 cases, 70.9%) compared to those with post-operative complications.<sup>18</sup>

In terms of comorbidities, systemic conditions were commonly observed among the patients: 24 cases (10.7%) had diabetes mellitus (DM), 79 cases (35.3%) had hypertension (HT), 29 cases (12.9%) had both DM and HT, and 92 cases (41.1%) had neither condition. This is consistent with research by Hidayaturahmah in 2021, where the study showed more post-operative cataract eyes had comorbid DM, with 240 cases (51.7%) compared to 224 (48.3%) without DM comorbidity.<sup>19</sup> Both DM and hypertension play a significant role in cataract development. Hypertension affects the protein structure, while DM leads to sorbitol accumulation, which eventually causes vision impairment and worsens cataracts.<sup>7</sup>

#### **Association between clinical characteristics and visual outcomes after cataract surgery**

The bivariate analysis explored the relationship between various clinical characteristics and visual outcomes after cataract surgery. First, no statistically significant relationship was found between age and visual outcome. The proportion of good to borderline vision was relatively high across all age groups: 72.1% in patients aged 45–59, 67.7% in those aged 60–74, and 54.5% in patients aged 75 years or older. Logistic regression analysis showed p-values of 0.089 and 0.160 ( $>0.05$ ), indicating no significant correlation. This is in line with a study by Markos (2020), which reported a similar non-significant result ( $p = 0.091$ ) in patients aged 70–79 years.<sup>10</sup> Although literature suggests that advancing age may be associated with denser cataracts and potentially worse outcomes, this assumption was not statistically supported in the current study.<sup>14</sup>

When it comes to gender, most male (71.8%) and female (61%) patients had good to borderline results, and the logistic regression p-value of 0.089, indicates there is no significant

association between gender and outcomes. These findings align with those of Priyadharshini (2021), who reported that while females showed a higher rate of poor outcomes (67.3%), the result was not statistically significant ( $p = 0.505$ ).<sup>20</sup> Although women have a higher lifetime risk of cataract due to hormonal factors, studies have shown that men may experience a slightly higher likelihood (11%) of reduced visual acuity post-surgery.<sup>21</sup>

Similarly, no significant association was found between occupation and visual outcome. Patients in outdoor jobs had a 63.7% rate of good to borderline outcomes, while those in indoor jobs had a slightly higher rate at 71%. Statistical testing showed a p-value of 1.395 ( $>0.05$ ), indicating no significant relationship. This is consistent with research by Devi (2017), who reported a p-value of 0.516.<sup>22</sup> Although UV exposure from outdoor work is a known cataract risk factor, its direct effect on post-operative visual outcome appears minimal.<sup>23</sup>

In contrast, a significant association was identified between cataract stage and visual outcome. Patients with immature cataracts had better outcomes (72.5%) compared to those with mature cataracts (56%), with a p-value of 0.014 ( $<0.05$ ). This result is consistent with the study by Widagdo (2023), who found that 91.1% of immature cataracts had good visual outcomes, while only 42.8% of mature cataracts did. Immature cataracts are typically less dense and easier to remove surgically, leading to better recovery of vision.<sup>24</sup>

There was also a statistically significant relationship between post-operative complications and visual outcome ( $p = 0.004$ ). Among patients who experienced no complications, 71.1% had good to borderline vision, whereas among those with complications, only 45.9% achieved similar outcomes. The most common complication in this study was intraocular lens (IOL) dislocation.<sup>25</sup> This finding is supported by Sa'at (2022), who reported that 92.3% of patients without complications had better outcomes, and complications such as IOL dislocation can lead to trauma and zonular instability, reducing visual acuity.<sup>21</sup>

Finally, comorbidities showed a strong and significant correlation with visual outcomes. Good to borderline results were found in 41.7% of patients with DM, 63.3% with hypertension, 48.3% with both, and 82.6% among those with neither. Logistic regression analysis yielded p-values of  $<0.001$  for DM, 0.005 for HT, and  $<0.001$  for DM and HT, which all statistically significant. These results agree with Sa'at (2022), who found that 80% of patients with systemic diseases had poor outcomes. Hypertension increases oxidative stress, while DM results in metabolic disturbances such as sorbitol accumulation, both contributing to poorer postoperative vision.<sup>21</sup>

### **Multivariate analysis**

Multivariate analysis was conducted to identify the clinical characteristics most influencing visual outcomes post-surgery. The results indicate that the higher the odds ratio (OR) value for a variable, the greater its influence on the visual outcome post-cataract surgery. This suggests that eyes with a comorbidity of DM have a 5.872 times higher risk of having poor visual outcomes compared to eyes with other clinical characteristics. Therefore, in this study, the most influential factor on visual outcome is the comorbidity of DM. Furthermore, although some studies suggest that high postoperative astigmatism may influence visual acuity, this study excluded such cases in the design phase to reduce confounding bias. Thus, astigmatism was not evaluated as a predictor. It is important to note, however, that visual outcomes may also be influenced by the natural course of postoperative recovery. While most of the healing and stabilization of visual acuity typically occurs within the first few weeks following cataract surgery, complete adaptation particularly in elderly patients or those with systemic comorbidities such as DM may take several months.

This study has limitations, including the use of secondary data, which limits the availability of supporting data; the other visual outcomes were assessed only based on postoperative refraction data without long-term visual follow-up; and it was conducted in only one hospital, thus limiting the generalisability of the findings to a wider population. Additionally, refractive disorders including astigmatism were excluded according to the study's criteria. As a result, their potential influence on visual outcomes was beyond the scope of this analysis.

### **Conclusion**

There is no relationship between age, gender, and occupation with visual outcome, but there is a significant relationship between cataract stage, postoperative complications, and comorbidities with visual outcome. Among these, comorbidity of DM is the most influential clinical characteristic affecting visual outcome.

### **Conflicts of Interest**

Nothing to declare

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## Killian-Jamieson Diverticulum in a 15-Year-Old Patient: A Rare Pediatric Radiologic Case Report

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### ABSTRACT

Killian-Jamieson diverticulum (KJD) is a rare pharyngoesophageal diverticulum arising from a muscular defect in the anterolateral wall of the proximal cervical esophagus, located just inferior to the cricopharyngeus muscle and superolateral to the longitudinal fibers within the Killian–Jamieson area. Its incidence is approximately one-quarter that of Zenker’s diverticulum (ZD), with an estimated prevalence of 0.025% in the general population. Reports in the pediatric population are exceedingly uncommon, suggesting a potential congenital etiology. Although frequently asymptomatic, KJD may present with nonspecific clinical manifestations, most notably dysphagia, as well as globus sensation, regurgitation, or chronic cough. Diagnosis is most reliably achieved with barium esophagography, which demonstrates the characteristic lateral outpouching. Computed tomography (CT) or endoscopy may assist in excluding alternative cervical pathologies. We present the case of a 15-year-old female who underwent open diverticulectomy with cricothyroid myotomy under general anesthesia, with an uneventful postoperative course and no evidence of recurrent laryngeal nerve injury or fistula formation at two weeks of follow-up.

**Keywords:** Barium esophagography, esophageal diverticulectomy, killian-jamieson diverticulum, pediatric dysphagia, recurrent laryngeal nerve



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## **Introduction**

Killian-Jamieson Diverticulum (KJD) is an uncommon pharyngoesophageal diverticulum that originates from a muscular defect in the anterolateral wall of the proximal cervical esophagus, located immediately inferior to the cricopharyngeus muscle and superolateral to the longitudinal muscle fibers of the esophagus, within the region known as the Killian–Jamieson area. KJD is a very rare entity, with an incidence of approximately one-quarter of Zenker’s Diverticulum (ZD) and an estimated prevalence of around 0.025% in the general population.<sup>1</sup> It is even rarer in the child population, with only one article published by Shambayati et al. in 2017, suggesting a possible congenital nature of KJD.<sup>2</sup> It is often distinguished from the more common ZD, which originates from the space in the posterior aspect below the inferior pharyngeal constrictor muscle and above the cricopharyngeus muscle. It also tends to be larger and more symptomatic than KJD.<sup>1</sup>

Although frequently asymptomatic, KJD may present with non-specific complaints such as dysphagia (most often), globus sensation, regurgitation, or chronic cough.<sup>3</sup> In some instances, it is discovered incidentally during imaging studies or neck ultrasonography performed for other indications. The appearance of KJD may mimic a thyroid nodule on neck ultrasonography.<sup>1</sup> Accurate diagnosis typically requires barium esophagography, which demonstrates the lateral outpouching, though computed tomography (CT) or endoscopic assessment may also be used to rule out other cervical pathologies.<sup>4</sup>

Management of KJD depends on the presence and severity of symptoms. Asymptomatic patients may be observed, while symptomatic cases often require surgical excision. A transcervical diverticulectomy with or without esophageal myotomy is the preferred approach due to the proximity of the diverticulum to the recurrent laryngeal nerve (RLN), which mandates meticulous surgical technique to prevent vocal cord paralysis. Endoscopic treatment using a stapler device has also been described as a minimally invasive option in selected cases.<sup>4</sup>

Due to its rarity and potential for misdiagnosis, KJD should be considered in the differential diagnosis of cervical masses or unexplained upper esophageal symptoms, especially when located laterally on imaging.

## **Case**

A 15-year-old female was referred to the Ear, Nose, and Throat (ENT) department with a chief complaint of persistent dysphagia for both solids and liquids for the past month. The complaint began after an incident four years before presentation, where the patient choked while drinking tea. Over time, she experienced recurrent episodes of choking, particularly while drinking and occasionally while asleep. She also reported a persistent sensation of a

foreign body in her throat and occasional odynophagia. However, the complaint was not severe until 2025 when the patient experienced persistent dysphagia.

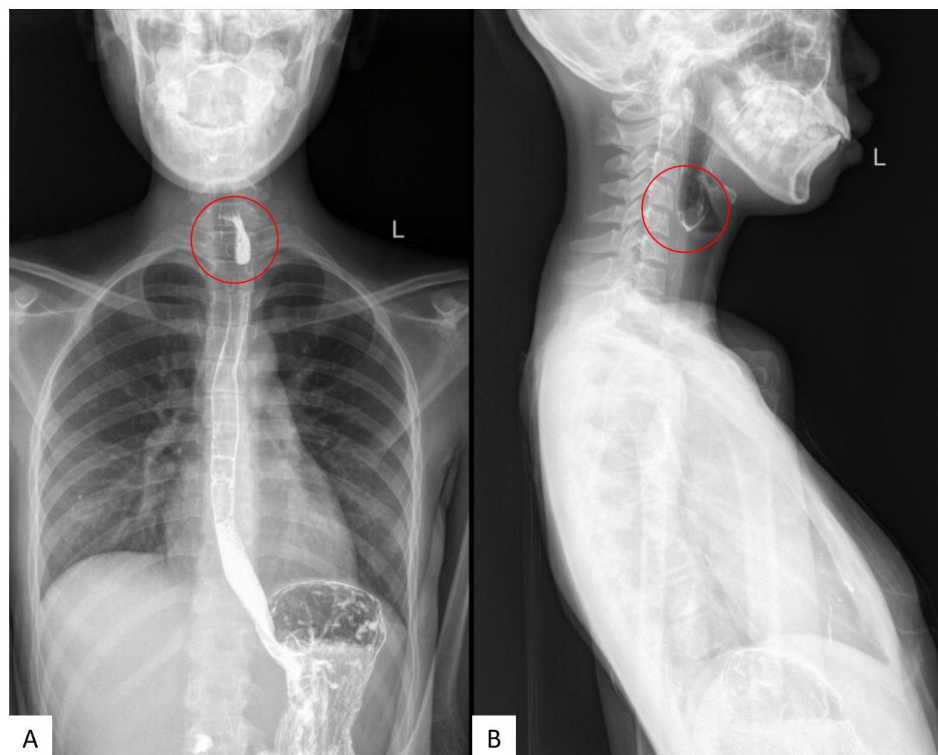
On physical examination, the general condition was fair with a Glasgow Coma Scale (GCS) of 15. Vital signs were within normal limits: blood pressure 110/60 mmHg, pulse rate 90/min, respiratory rate 22/min, and temperature 36.6°C. On the anthropometric status, the patient's body weight was 27 kg, height 146 cm, weight/age 54% (very underweight), height/age 90.6% (normal stature), weight/height 72.9% (malnourished). Physical examination revealed no abnormalities in the head and neck region. The tonsils were graded T1–T1 without hyperemia, and the oropharyngeal mucosa appeared normal. Pulmonary, abdominal, and extremity examinations were unremarkable. Laboratory results showed a hemoglobin level of 12.4 g/dL, white blood cell count of 9,760/ $\mu$ L, and platelet count of 351,000/ $\mu$ L. Based on clinical suspicion of esophageal structural abnormality, further imaging was conducted.

A barium esophagogram revealed proximal esophageal outpouching consistent with KJD, which projected anterolaterally from the proximal cervical esophagus. The estimated size of the outpouching was 0.81 x 2.80 cm. This finding was supported by additional contrast studies (esophagography and abdominal radiography) showing pooling and delayed passage in the proximal esophagus. There was no evidence of tracheoesophageal fistula or gross esophageal obstruction (Figure 1).

Given the persistent symptoms and radiologic confirmation of the diverticulum, the patient underwent functional-saving surgery with open diverticulectomy of KJD with cricothyroid myotomy under general anesthesia. Intraoperatively, the diverticulum was identified lateral to the cricopharyngeal muscle after dissection through the right sternocleidomastoid muscle. The diverticulum was excised, hemostasis was achieved, and the esophageal wall was repaired primarily, followed by a layered closure with sutures. A drain was placed within the surgical site.

The postoperative course was uneventful. The patient was monitored in a non-intensive unit and showed gradual improvement in oral intake. Two weeks after surgery, the patient experienced no hoarseness and could swallow slowly, indicating no postoperative complications such as RLN injury or fistula formation. Postoperative endoscopic examination resulted in reflux esophagitis and gastroesophageal reflux disease (GERD) with cicatric formation at the proximal esophagus.

This case report was conducted by the ethical standards of the ethics committee of our institution. Written informed consent was obtained from the patient's legal guardian for the publication of this case report and any accompanying images.



**Figure 1.** Barium esophagomagduodenography anteroposterior (A) and lateral (B) views of the patient showed a proximal esophageal outpouching (red circle), consistent with Killian-Jamieson Diverticulum.

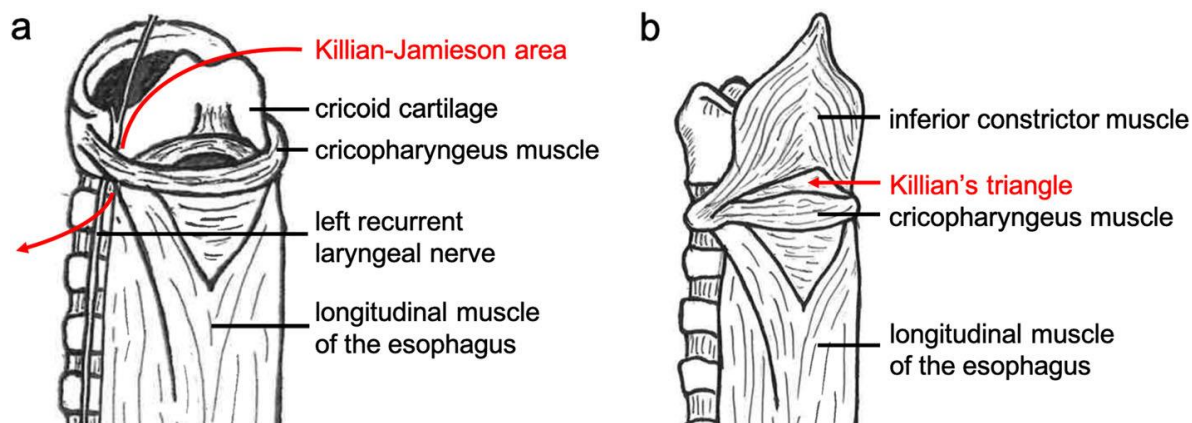
## Discussion

### Anatomy and diagnosis

Killian-Jamieson Diverticulum is an exceptionally rare cervical esophageal outpouching arising through the anterolateral Killian–Jamieson area below the cricopharyngeal muscle and superolateral longitudinal muscle fibers of the esophagus. This location is in intimate proximity to the RLN branches, which traverse the Killian–Jamieson space (Figure 2). By comparison, ZD (posterior hypopharyngeal diverticulum) is roughly four times more common.<sup>1</sup>

The patient characteristics of KJD are similar to those of ZD. Most of both cases are elderly, with an average age of 72 years in KJD and 66 years in ZD. KJD often presents incidentally or with vague symptoms. The prevalence of both cases is 0.025% in KJD and 0.01% in ZD.<sup>4</sup> The incidence of KJD in the pediatric population is unknown due to very scarce literature, with only one case of KJD reported in a 2-year-old patient. The patient presented with dysphagia that started with the introduction of solid food. The patient was initially diagnosed with non-resolving GERD, then later confirmed as KJD with esophagography and upper gastrointestinal endoscopy. It highlights the need for a high index of suspicion in young

patients.<sup>2</sup> Our 15-year-old patient represents an exceedingly rare presentation, underscoring that KJD can present with dysphagia and globus even in the pediatric population, albeit less dramatically than in adults.

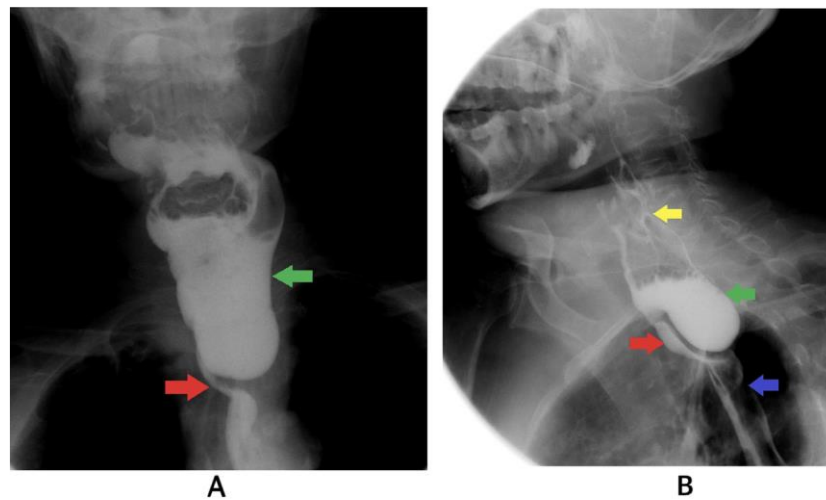


**Figure 2.** Illustration of the muscular gaps serving as the origin of pharyngoesophageal diverticula. (a) The Killian-Jamieson Diverticulum (KJD) originates from a muscular defect in the anterolateral wall of the proximal cervical esophagus, situated just inferior to the cricopharyngeal muscle and superolateral to the longitudinal muscle fibers of the esophagus, within the Killian–Jamieson area. This location is in close proximity to the entry point of the RLN into the larynx. (b) The ZD arises from a muscular gap in the posterior aspect between the inferior border of the inferior pharyngeal constrictor muscle and the superior border of the cricopharyngeal muscle, a region known as Killian’s triangle.<sup>1</sup>

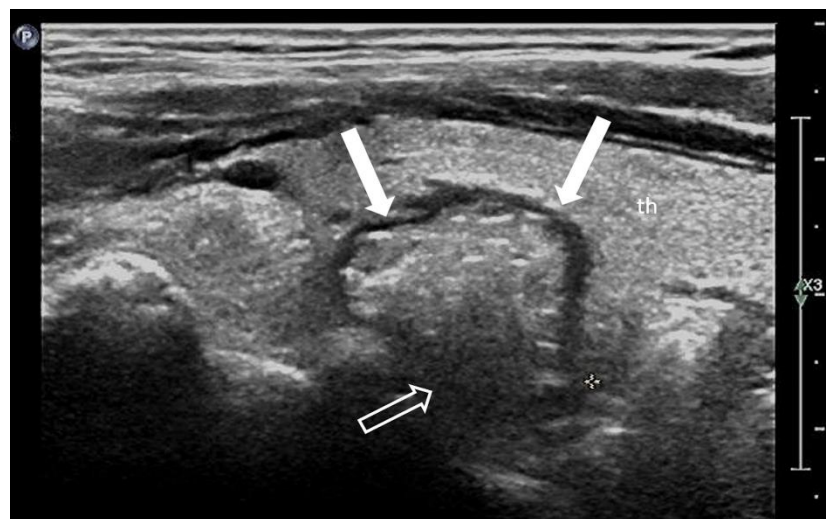
The diagnosis of KJD relies on radiological assessment, as the clinical presentation of KJD is non-specific. Barium esophagography is the modality of choice in diagnosing KJD, followed by ultrasound and cervical CT.<sup>5,6</sup> The anterolateral origin of KJD provides a radiologic clue on esophagography. KJD appears as a lateral cervical pouch projecting inferior to the cricopharyngeal, whereas ZD is a posterior pouch above the muscle (Figure 3).<sup>7</sup> In our patient’s esophagogram, a large anterolateral cervical diverticulum was evident, which is characteristic of KJD.

Diagnostically, KJD can be challenging, especially in younger patients. Because the diverticula are often small (average 1.4 cm) and asymptomatic, they are frequently misrecognized or mistaken for thyroid pathology.<sup>9</sup> Indeed, KJD may appear on ultrasound as thyroid-adjacent cystic or hyperechoic lesions with air artifact. In the first reported KJD on thyroid ultrasound, hyperechoic “lesions with reverberation artifacts” were noted behind both thyroid lobes, raising the suspicion of a thyroid mass (Figure 4). When ultrasound cannot

definitively distinguish a thyroid nodule from a pharyngoesophageal pouch, barium esophagography or CT should be obtained to confirm the diagnosis and avoid unnecessary biopsy.<sup>10</sup>



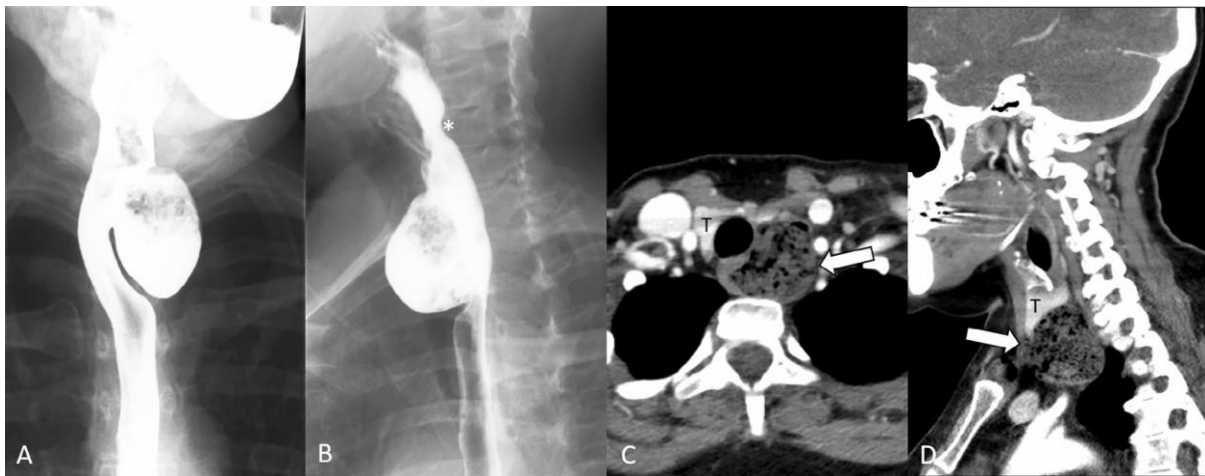
**Figure 3.** Spot images from a barium swallow study. (A) Left-sided esophageal outpouching (green arrow) causing compression and mild displacement of the esophagus to the right. (B) Similar diverticulum (green arrow) with its opening located at the C4–C5 level (yellow arrow), compressing the esophagus (red arrow), while the distal esophagus maintains a normal caliber (blue arrow).<sup>8</sup>



**Figure 4.** Ultrasound of the neck showing reverberation artifacts mimicking thyroid nodules, later identified as KJD.<sup>10</sup>

Contrast-enhanced CT can directly demonstrate an air-filled diverticulum posterior to the thyroid lobe. In one case of presumed Zenker's, CT showed an “air-contained diverticulum arising from behind the left lobe of the thyroid,” alerting the team to a KJD. Thus, combined

imaging (barium esophagography plus cervical CT or ultrasound) is recommended to delineate the diverticulum's location, size, and relation to adjacent structures. Endoscopic examination may reveal the diverticular opening at about 17–20 cm from the incisors on the anterior lateral wall, but caution is required to identify KJD versus Zenker's, as treatment differs. Overall, the literature stresses a low threshold for barium swallow in unexplained cervical dysphagia or globus, even in children, to catch rare entities like KJD.<sup>11</sup> On CT imaging, the relationship to the thyroid gland could be misdiagnosed as thyroid gland pathology or a hypopharyngeal diverticulum (Figure 5).<sup>5</sup>



**Figure 5.** A 57-year-old female with imaging characteristics of Killian–Jamieson diverticulum (KJD). (A) Anteroposterior (AP) esophagogram shows a lateral hypopharyngeal diverticulum. (B) Lateral esophagogram demonstrates the diverticulum arising anterolaterally from the esophagus, just below the cricopharyngeal muscle (\*). (C) Axial CT image showing the diverticulum (white arrow) arising from the left esophagus, immediately inferior to the thyroid gland (T), containing retained food material. (D) Sagittal CT image again demonstrating the diverticulum (white arrow) located just below the thyroid gland (T).<sup>5</sup>

### Treatment and outcomes

The management of symptomatic KJD is surgical, which includes conventional diverticulectomy (67%), endoscopic diverticulectomy (28%), and diverticulopexy (5%). Open surgical diverticulectomy is typically performed via a transverse or vertical cervical incision, with or without concomitant esophagostomy.<sup>6</sup>

The patient in this case underwent open diverticulectomy, and the diverticulum was identified lateral to the cricopharyngeal muscle. Conventional open diverticulectomy remains the standard treatment, as it restores normal pharyngoesophageal anatomy and eliminates the

potential—albeit unreported in KJD—risk of malignant transformation within the diverticulum. For comparison, Herbella et al. reported a prevalence of malignant transformation ranging from 0.3% to 7% in ZD.<sup>6</sup>

In our case and others, the diverticulum was excised with a stapler and a short (3 cm) myotomy was performed to improve esophageal emptying.<sup>5</sup> Several case series have shown that open resection with myotomy provides durable relief of dysphagia. For example, a recent multicenter report found that all KJD patients (albeit <5% of hypopharyngeal diverticula) underwent open transcervical excision, and symptom scores improved significantly postoperatively. Traditional surgery reliably resolves symptoms, but it carries the usual operative risks – notably injury to the RLN given its close relation. Thus, many authors advocate the use of intraoperative neural monitoring or meticulous dissection. Orzell et al. even argue that nerve monitoring should be used “to minimize risk of injury to the RLN” during diverticulectomy. Indeed, in the reported series, no permanent nerve palsy was described when care was taken. In high-risk surgical candidates (e.g., elderly or comorbid), some surgeons have also employed a diverticulopexy (fixation without resection) to avoid extensive dissection, although evidence is limited.<sup>5</sup>

Endoscopic diverticulectomy for KJD is not commonly performed due to the high risk of RLN injury, as the RLN entry point into the larynx corresponds to the base of the diverticulum. This proximity increases the risk of nerve transection and thermal damage. Only a few reports have described successful endoscopic management, including the use of monopolar cautery or carbon dioxide laser to separate the intervening septum, and endoscopic staplers or needle knives to divide the septum.<sup>6</sup>

In the past decade, less-invasive endoscopic techniques have emerged for KJD, modeled on Zenker’s therapy.<sup>5</sup> Endoscopic septotomy can be performed with flexible endoscopes, either using a stapling device or needle-knife instruments. Yun et al. reported on an 88-year-old with KJD treated by flexible endoscopy: under barium swallow guidance, they performed endoscopic diverticulotomy with a surgical stapler, successfully relieving symptoms without recurrent laryngeal injury.<sup>12</sup> Similarly, a small series of flexible endoscopic septotomy (using scissors, clips, or knives) has been published, indicating that a complete septal myotomy (or “diverticulotomy”) may be achieved endoscopically. The potential advantage is avoiding an external neck incision. However, given the narrow anterolateral diverticular neck and nearby nerves, clinicians have expressed caution. Orzell et al. warned of the “potential dangers of endoscopic repair of the RLN” and preferred open excision in their series.<sup>7</sup>

## Conclusion

Killian-Jamieson Diverticulum in the pediatric population is extraordinarily rare, but awareness of its existence is crucial to avoid misdiagnosis. Detailed knowledge of the anatomy (anterolateral location, proximity to RLN) and thoughtful use of imaging (barium esophagography, CT, neck ultrasonography) allow accurate identification. Once diagnosed, treatment can be tailored to the patient. Traditional open transcervical diverticulectomy (with myotomy and nerve monitoring) remains a definitive option, while advanced endoscopic approaches (flexible septotomy) offer effective alternatives in skilled hands. Our 15-year-old patient's successful management highlights both the diagnostic challenges and the expanding therapeutic armamentarium for this uncommon disorder.

## Conflict of Interest

All authors declare that they have no conflicts of interest.

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## Comparison of Clean and Healthy Living Behavior Before and After Handwashing Promotion at Tahfidz One Qur'an Islamic Boarding School Jambi

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### ABSTRACT

**Introduction:** Clean and healthy living behavior (Perilaku Hidup Bersih dan Sehat, PHBS) is essential in improving public health, particularly through handwashing with soap (Cuci Tangan Pakai Sabun, CTPS), which has been proven to prevent infectious diseases effectively. However, this practice remains low in pesantren (Islamic boarding schools) due to limited knowledge and the absence of established habits. This study aims to compare the knowledge and attitudes of santri (students) towards CTPS before and after a health promotion program at Tahfidz One Qur'an Islamic Boarding School Jambi.

**Method:** This study applied a quasi-experimental one-group pretest-posttest design involving 64 students selected through convenience sampling. Data were collected using pretest and posttest questionnaires and analyzed with the Wilcoxon signed-rank test.

**Results:** The results showed a significant improvement in knowledge ( $P=0.000$ ), with an average increase of 3.64, and in attitudes ( $P=0.000$ ), with an average increase of 6.02.

**Conclusion:** The health promotion program effectively enhanced the understanding and shaped positive attitudes of the santri towards the practice of CTPS.

**Keywords:** Clean and healthy living behavior, handwashing with soap, health promotion



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## **Introduction**

Clean and healthy living behaviors (Perilaku Hidup Bersih dan Sehat, PHBS) are an important pillar in efforts to improve public health. A key indicator of PHBS is the habit of washing hands with soap (Cuci Tangan Pakai Sabun, CTPS),<sup>1</sup> which has been proven to be effective in preventing various infectious diseases (ie. diarrhea, infections and skin diseases).<sup>2</sup> World Health Organization (WHO) and United Nations Children's Fund (UNICEF) emphasized the urgency of washing hands with soap as a simple but highly effective preventive measure.<sup>3</sup>

Hand hygiene is very important because our hands are a living place for various microorganisms.<sup>4</sup> Price divided bacteria on the skin of the hands into two types, namely transient flora and resident flora.<sup>5</sup> Transient flora is on the surface of the skin and is easily exposed to pathogenic bacteria through contact with other people or contaminated environments. Meanwhile, resident flora lives in the deeper layers of the skin and cannot be completely removed.<sup>6</sup>

Although usually harmless, these microorganisms can become pathogenic if they enter the body, such as *Salmonella*, *Shigella*, or *Escherichia coli* bacteria that can cause diarrhea if they enter the digestive tract.<sup>5</sup> Therefore, hand hygiene must be maintained as an efficient step and prevention of infection transmission, both in health facilities and in daily activities.<sup>7</sup>

However, in many Islamic boarding schools, awareness and practice of washing hands with soap are still relatively low. Some of the factors that contribute to this low practice include lack of knowledge about the importance of hand washing, the availability of inadequate facilities, and habits that have not been formed.<sup>8</sup> Therefore, health promotion is very crucial to increase awareness and change the behavior of students in maintaining personal hygiene and health.<sup>9</sup>

Health promotion is an effort to strengthen people's insights, attitudes, and behaviors so that they can live a healthier life.<sup>10,11</sup> In Islamic boarding schools, health promotion of handwashing with soap can be carried out through various methods, such as counseling, demonstrations, and the provision of adequate facilities.<sup>12</sup>

The research is expected to be able to contribute to improving the quality of health in Islamic boarding schools with better implementation of PHBS.<sup>13</sup> The results of the research are also expected to be a reference for other Islamic boarding schools in developing effective health promotion programs. In addition, this research can add to the scientific literature related to the implementation of health promotion in the Islamic education environment.

## **Methods**

This study was a quasi-experimental analytical study using a pretest–posttest group design. The research was conducted in December 2024 at the One Qur’an Islamic Boarding School Jambi. The study population consisted of all students in the boarding school, with the affordable population being students present during the study period.

Samples were selected using a non-random convenience sampling technique. Inclusion criteria were students who were enrolled at the school, present at the time of data collection, and willing to participate. Exclusion criteria were students who were absent during the intervention or did not complete the questionnaire. The minimum sample size was calculated using a power analysis formula for a two-mean difference test, resulting in a required sample size of at least 64 participants.

The independent variable was counseling about handwashing, while the dependent variable was students’ knowledge of handwashing. Knowledge was measured using 10 questions scored from 0 to 10, and attitudes were measured using 10 Likert-scale statements. The intervention consisted of health promotion education about handwashing, followed by pretest and posttest assessments.

The main research instrument was a structured questionnaire on knowledge and attitudes toward handwashing with soap. Data collection was carried out primarily through the distribution of paper-based questionnaires, preceded by informed consent. Respondents were asked to fill in their identities and answer knowledge questions before and after the intervention. Interventions are provided in the form of counseling on PHBS in the school environment. The research follows ethical procedures by guaranteeing the confidentiality of identity and consent to voluntary participation.<sup>14</sup>

Data were analyzed using SPSS version 26.0 (IBM, USA) with paired t-tests to assess differences between pretest and posttest scores. Data analysis was carried out univariate and bivariate; The paired T-test was used for normal data and the Wilcoxon signed-rank test for abnormal data, with a significance level of  $P < 0.05$ . The results were analyzed using statistical software and presented in the form of a table and a pretest and posttest comparison narrative.<sup>15</sup>

## **Result**

### **Characteristics of research subjects**

Table 1 shows the baseline characteristics of study subjects. Majority of respondents were female. Meanwhile, the other 22 people (34.4%) were male.

**Table 1.** Distribution and frequency of research subject characteristics by gender.

Gender	Quantity (n)	Frequency (%)
Man	22	34.4
Woman	42	65.6
<b>Total</b>	<b>64</b>	<b>100</b>

### Comparison of pretest and posttest scores of CTPS knowledges at the Tahfidz One Qur'an Islamic Boarding School Jambi

At the Tahfidz One Qur'an Islamic Boarding School in Jambi, the knowledge scores of students before and after the handwashing intervention were analyzed. To ensure the validity of further statistical testing, a normality test was performed using the Kolmogorov–Smirnov method. The results are presented in Table 2. The normality test showed that the significance for the pre-test of knowledge obtained was  $0.200 > 0.05$  and the significance of the post-test of knowledge was obtained at  $0.000 < 0.05$ . This means that the data from the post test result was not distributed normally and then carried out with an alternative to the paired T test, namely the Wilcoxon signed-rank test.

**Table 2.** Normality test with Kolmogorov-Smirnov of knowledge questionnaire.

Knowledge	n	P-value
Pre-test	64	0.200
Post-test	64	0.000

Since the normality test did not meet the assumptions for parametric analysis, the Wilcoxon signed-rank test was used to compare pretest and posttest scores of CTPS knowledge. The results are shown in Table 3. A *P*-value of 0.000 ( $P < 0.05$ ) was obtained. This means that the average knowledge before and after the handwashing promotion at the Tahfidz One Qur'an Islamic Boarding School Jambi was significantly different. The results also showed that there was an average increase of 3.64, from 5.72 to 9.36 score points.

**Table 3.** Results of pre and posttest CTPS knowledge comparison analysis.

Knowledge	n	Mean	Difference	P-value
Pre-test	64	5.72	3.64	0.000
Post-test	64	9.36		

## Comparison of pretest and posttest scores of CTPS attitude at the Tahfidz One Qur'an Islamic Boarding School Jambi

The students' attitudes toward CTPS were also assessed before and after the intervention. To determine whether the data met the assumption of normality, a Kolmogorov–Smirnov test was conducted. The results are presented in Table 4. The results of the normality test were obtained which showed that the significance for the pre-test of knowledge obtained was  $0.001 < 0.05$ , which means that both data results were not distributed normally and were carried out with an alternative to the paired T test, namely the Wilcoxon signed-rank test.

**Table 4.** Normality test with Kolmogorov-Smirnov of attitude questionnaire.

Attitude	n	P-value
Pre-test	64	0.001
Post-test	64	0.000

Since the normality test indicated that the data did not follow a normal distribution, the Wilcoxon signed-rank test was applied to compare pretest and posttest scores. The results are shown in Table 5. A *P*-value of 0.000 ( $P < 0.05$ ) was obtained. This means that the attitude before and after is significantly different in the promotion of handwashing at the Tahfidz One Qur'an Islamic Boarding School Jambi. The results also showed that there was an average increase of 6.02, from 32.78 to 38.80 score points.

**Table 5.** Results of pre and posttest CTPS attitude comparison analysis.

Attitude	n	Mean	Difference	P-value
Pre-test	64	32.78	6.02	0.000
Post-test	64	38.80		

## Discussion

### Characteristics of research subjects

Most respondents were women with percentage of 65.6%. In line with Elmaghfuroh and Hidayat with a similar research topic, namely related to PHBS education in pesantren with the majority of respondents being female students as many as 48 people (64%).<sup>16</sup> In general, women are often associated with traits such as being more meticulous, compliant with rules, more organized, and having a high level of empathy, which contributes to their tendency to carry out PHBS more consistently than men.<sup>17</sup> However, maintaining health is a universal responsibility that is not limited to just one gender. All individuals have the same rights and

obligations.<sup>9</sup>

### **Comparison of pretest and posttest scores of CTPS knowledges at the Tahfidz One Qur'an Islamic Boarding School Jambi**

There was a significant difference in average knowledge between before and after the handwashing promotion at the Tahfidz One Qur'an Islamic Boarding School in Jambi with an average increase of 3.64 from 5.72 to 9.36 score points. A significant increase in students' knowledge about hand washing practices after a health promotion intervention at the Tahfidz One Qur'an Islamic Boarding School in Jambi shows the effectiveness of the health promotion program in increasing awareness of the importance of hand hygiene. In line with Budiwibowo, the knowledge of hand washing before and after the provision of handwashing health promotion is significantly different.<sup>18</sup>

Health promotion regarding CTPS aims to increase a person's understanding of being able to apply handwashing behaviors correctly and consistently in daily activities.<sup>19</sup> Notoatmodjo explained that the acceptance and sustainability of a new behavior is greatly influenced by the level of individual knowledge. This knowledge is formed through a learning process that involves a variety of media or educational tools, so that individuals can more easily understand and adopt the health behaviors conveyed, including CTPS behavior.<sup>12</sup> Knowledge about CTPS needs to be taught consistently both in the school environment, at home, and in public facilities. Individuals who have adequate knowledge tend to respond positively to a health measure. This happens because insight-based behavior has a tendency to be sedentary, considering that knowledge plays a role as the main basis in the formation of behavior.<sup>20</sup>

### **Comparison of pretest and posttest scores of CTPS attitudes at the Tahfidz One Qur'an Islamic Boarding School Jambi**

There was a significant difference in average attitude between before and after the promotion of handwashing at the Tahfidz One Qur'an Islamic Boarding School Jambi with an average increase of 6.02 from 32.78 to 38.80 score points. A significant increase in students' attitudes towards handwashing practices after health promotion interventions at the Tahfidz One Qur'an Islamic Boarding School Jambi shows the effectiveness of health promotion programs in forming positive health behaviors. In line with Khairunnisa et al., where the attitude of washing hands before and after the provision of health promotion is significantly different.<sup>9</sup>

Attitudes reflect an individual's tendency to respond similarly to a particular stimulus.<sup>21</sup> Attitude is a form of internal response that has not yet been realized in real action, which arises

as a result of interaction with a certain stimulus or object.<sup>22</sup> Responses in both positive and negative forms can potentially form behaviors.<sup>23</sup> That reflect acceptance or rejection of health measures, including CTPS behavior.<sup>24</sup> The attitude of students towards the practice of CTPS plays an important role in influencing their tendency to do such actions.<sup>25</sup> Attitude reflects the readiness of an individual to respond to an invitation or information, so that it is an early indicator of the willingness to behave in accordance with their knowledge and values.<sup>26</sup>

## **Conclusion**

The results of the study showed that there was a significant difference between the knowledge and attitude of students about washing hands with soap before and after being given a health promotion program. The average increase in students' knowledge reached 3.64 points, while the average increase in attitude reached 6.02 points. These findings indicate that health promotion programs have proven to be effective in improving both students' knowledge and attitudes regarding the importance of CTPS.

## **Conflicts of Interest**

The authors declare no conflict of interest regarding the publication of this manuscript.

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## Association Between Personality Types with Emotional Intelligence among First Grade Medical Students

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### ABSTRACT

**Introduction:** Medical students are expected to possess various competencies and strong clinical skills to become competent and professional doctors. These demands require not only intellectual ability but also high emotional intelligence, which supports mental resilience, positive thinking, and social adaptability. Emotional intelligence is influenced by several internal factors, including personality type, commonly categorized as extroverted or introverted. The purpose of this study was to examine the relationship between extrovert and introvert personality types with the level of emotional intelligence in students of the Faculty of Medicine, Tarumanegara University, class of 2024.

**Method:** This study employed an observational analytic design with a cross-sectional approach. A total of 194 medical students from the Faculty of Medicine, Tarumanegara University, Class of 2024, were selected using a simple random sampling technique. Data were collected using the Eysenck Personality Inventory (EPI) to assess personality types and the Assessing Emotional Scale (AES) to measure emotional intelligence. Data analysis was conducted using the Chi-Square test.

**Results:** 57.7% of respondents were extroverts, while 43.3% were introverts. In terms of emotional intelligence, the majority (69.1%) were in the high category. The Chi-Square test showed a  $P$ -value of 0.000 ( $P < 0.05$ ), indicating a statistically significant relationship between personality type and emotional intelligence.

**Conclusion:** There is a significant relationship between personality type and the level of emotional intelligence among medical students. Extroverted students tend to have higher emotional intelligence, suggesting that personality traits may influence students' emotional adaptability and resilience throughout their education.

**Keywords:** Emotional intelligence, medical students, personality type



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## **Introduction**

Students are members of a higher education institution who must have responsibility and independence to do academic tasks in accordance with the competency standards determined by the university. Especially for medical students, where they must achieve various competencies and good clinical skills to become competent and professional doctors in the future. Therefore, students need to have a positive way of thinking and psychology, good emotional intelligence, and a strong personality and mentality to complete their education. Students with good emotional intelligence will be able to master any difficult problems in their education, have a positive way of thinking and behavior towards themselves and others, and be able to solve the challenges or obstacles faced, as well as never give up on existing circumstances to achieve the expected educational results.

On the other hand, if a person does not have emotional intelligence, it is usually easy to experience psychiatric disorders, lack emotional control and easily dissolve in sadness when faced with failures in their lives. Therefore, emotional intelligence is needed. A person with emotional intelligence will have a high sense of introspection so that he will not be easily angry, not easily desperate, selfish and always have a sense of openness to face various life problems.<sup>1</sup>

The ability to control emotions so that high emotional intelligence is achieved affects the success of students in living their college life, because there is a lot of evidence that shows that individuals with good emotional intelligence tend to be more successful in various aspects of life.<sup>2</sup> It was found that emotional intelligence accounts for 80% of the determining factors of a person's success and the other 20% is determined by intellectual intelligence.

Gupta et al. concluded that first-year medical students with higher emotional intelligence felt less stress or in other words were able to handle stress more effectively.<sup>3</sup> Individuals with higher emotional intelligence are also able to manage their emotions more effectively in the workplace, academic, and other situations, so they often achieve optimal success.<sup>4</sup>

Low emotional intelligence appears to be correlated with several psychiatric disorders such as depression and failure in education.<sup>5</sup> According to World Health Organization (WHO), depression is a common and quite serious mental disorder that is marked by deep feelings of sadness and loss of interest in daily activities for a long period of time. Depression can affect the way a person thinks, feels, and acts, and can also significantly interfere with the quality of life. Basic Health Research (Riskesdas) 2018 shows that more than 19 million people over the age of 15 experience mental and emotional disorders, and more than 12 million people over the age of 15 experience depression.<sup>6</sup> Chenganakkattil et al. stated that the prevalence rate of

depression among medical students was higher, which was 20.6%, compared to engineering students who had a prevalence of 15.3%.<sup>7</sup> Meanwhile, research at Tarumanagara University showed a prevalence rate of depression of 39.3%, which is a higher number compared to the prevalence of depression reported by WHO and Riskesdas. Where depression is most experienced by first-year students.<sup>8</sup>

Personality type is one of the internal factors that can affect a person's emotional intelligence. In personality theory, personality types are often classified into two main categories, including extroverts and introverts.<sup>9</sup> Individuals with introverted personality types tend to feel uncomfortable in intensive social interactions, overthink without acting, tend to be introverted, have difficulty adjusting to a new atmosphere and have difficulty working with people with different personality types. On the other hand, individuals with extroverted personality types feel uncomfortable if they have to be in silence and tend to like active social interactions and enjoy being in a crowd.<sup>2</sup>

This difference in personality type has a significant impact, especially for students. Individuals with extroverted personality types are more prone to promiscuity, careless behavior, selfishness, and a lack of willingness to give in. Meanwhile, individuals with introverted personality types tend to be antisocial, less confident, less concerned about the environment, and prone to depression. The purpose of this study was to examine the relationship between extrovert and introvert personality types with the level of emotional intelligence in students of the Faculty of Medicine, Tarumanagara University, class of 2024.

## **Methods**

This study is an observational analytical study with a cross-sectional approach, which aims to assess the relationship between two variables at the same time. The research was carried out from February to April 2025 at the Faculty of Medicine, Tarumanagara University. The researcher has obtained permission and ethical approval contained in the research ethical feasibility document, with letter number, Number: 503/KEPK/FK UNTAR/XII/2024 in Jakarta, December 3, 2024.

The subject in this study is a student of the Faculty of Medicine, Tarumanagara University class of 2024. The sampling technique was carried out using the simple random sampling method and obtained a total sample of 194 people. The calculation of the number of samples was carried out based on a two-proportion formula using  $Z\alpha = 1.96$  and  $Z\beta = 0.84$ , as well as the proportion of introverted and extroverted students who had low emotional intelligence of 60% and 40%, respectively. Based on this calculation, the minimum number of

samples was obtained of 194 people.

The inclusion criteria in this study are students of the class of 2024, aged 17–25 years, and willing to become respondents. This study does not use medical record data, but primary data obtained directly from respondents through filling out an online questionnaire using the Google Forms platform. Before filling out, each respondent was given informed consent to guarantee the ethical principles of the research.

The independent variable in this study was personality type (extrovert and introvert) and the dependent variable was emotional intelligence. The operational definition of each variable has been clearly defined, and the grouping of variables based on the measuring tool has been widely validated in various previous studies.

The research instrument used consisted of two types of questionnaires, namely the Eysenck Personality Inventory (EPI) to measure personality type and the Emotional Intelligence Scale (EIS) to measure emotional intelligence. The EPI consists of 24 items that measure the extroversion-introversion dimension, with a scale of Yes/No answers. A score of  $\geq 12$  is categorized as extroverted, while a score of  $\leq 11$  is categorized as an introvert. Scoring is carried out by giving a score of 1 for the appropriate answer (*favourable*) and 0 for the unfavourable, and vice versa for the unfavourable item. Meanwhile, the EIS consists of 33 questions covering four dimensions: *emotional perception*, *emotional assimilation*, *emotional understanding*, and *emotional management*, with a Likert scale of 5 points (1 = strongly disagree, up to 5 = strongly agree). Emotional intelligence is categorized into two, namely high (score 100–165) and low (score 33–99).

Data analysis was conducted bivariately to describe the demographic characteristics of respondents and used the Chi-Square test to see a significant difference between the emotional intelligence levels of introverted and extroverted students. The entire process of data collection and analysis is carried out in accordance with scientific principles and research ethics standards using SPSS (IBM, USA) and Excel (Microsoft, USA).

## **Result**

This research was carried out from February to March 2025 by involving 194 student respondents of the Faculty of Medicine, Tarumanagara University class of 2024 who met the inclusion criteria. After giving informed consent, research was conducted and data on name, age, gender and data on the relationship between extroverted and introverted personality types and emotional intelligence.

Table 1 shows the baseline characteristics of study samples. Regarding gender

characteristics, 143 respondents were female (73.7%) and 51 (26.3%) respondents were male. This indicates that most respondents were female. According to the data, most respondents in this study were 18 years old, namely 101 people (52.1%). Respondents aged 19 years were 68 people (35.1%), 20 years old were 12 people (6.2%), 17 years old were 8 people (4.1%), and 21 years old were 2 people (1.0%). Meanwhile, respondents aged between 22 and 24 years were 3 people (1.5%).

**Table 1.** Baseline characteristics of study samples (N=194).

Respondent Characteristics	Category	Quantity (n)	Percentage
Gender	Man	51	26.3%
	Woman	143	73.7%
Age	17 years	8	4.1%
	18 years	101	52.1%
	19 years	68	35.1%
	20 years	12	6.2%
	21 years	2	1.0%
	22 years	1	0.5%
	23 years	1	0.5%
	24 years	1	0.5%

Table 2 shows the frequency distribution of personality types of study samples. Most of the students of the Faculty of Medicine, Tarumanagara University Class of 2024 have an extroverted personality (57.7%) and another 43.3% have an Introverted personality.

Table 3 reveals the descriptive analysis of emotional intelligence of study samples. A clear distinction in emotional intelligence scores between introverted and extroverted individuals. Extroverts not only outnumber introverts in the sample, but they also demonstrate substantially higher emotional intelligence on average. The mean, median, and mode scores for extroverts consistently surpass those of introverts, indicating a general trend rather than an outlier effect. While the spread of scores (as shown by the standard deviation) is nearly identical in both groups, extroverts show a notably higher baseline—illustrated by their minimum score being above the introverts' average. This highlighted that emotional intelligence tends to be stronger in individuals with extroverted personality traits.

**Table 2.** Frequency distribution of personality types (extroverts and introverts).

Respondent Characteristics		Quantity (n)	Percentage (%)
Personality Type	Introvert	82	43.3%
	Extrovert	112	57.7%
<b>Total</b>		<b>194</b>	<b>100%</b>

**Table 3.** Descriptive analysis of emotional intelligence (N=194).

		Frequency (n)	Percentage (%)
Emotional intelligence level	<b>Low</b>	60	30.9
	<b>High</b>	134	69.1
Emotional intelligence score	<b>Introvert</b>		
	Mean ± SD	103.52 ± 14.90	
	Median (Min-Max)	99.00 (50.00-153.00)	
	<b>Extrovert</b>		
	Mean ± SD	132.64 ± 14.93	
	Median (Min-Max)	131.50 (100.00-165.00)	

SD: Standard deviation

### The difference in the level of emotional intelligence between introverted personality students and extroverted personality types

The difference in the level of emotional intelligence between students with introverted personalities and students with extroverted personality types was analyzed using the Chi-Square test (Table 4). All Chi-Square test assumptions are met, with no expected values below 5. The Continuity Correction was used due to the 2x2 table format. The test yielded a *P*-value of 0.000, which is less than the significance level of 0.05, indicating a statistically significant result. Therefore, it can be concluded that personality type significantly influences students' emotional intelligence.

**Table 4.** Distribution of emotional intelligence levels based on student personality type (introverted and extroverted). Data was analyzed using Chi-square test.

		Emotional Intelligence		Total	<i>P</i> -value
		Low	High		
Personality Type	Introvert	60	22	<b>82</b>	0.000
	Extrovert	0	112	<b>112</b>	
<b>Total</b>		<b>60</b>	<b>134</b>	<b>194</b>	

## Discussion

### Subject characteristics

Based on the research data that has been obtained, it is known that most of the 143 (73.7%) respondents in this study are female and a total of 51 (26.3%) respondents are male. This is in line with the research conducted by Claudia which examines the influence of personality and emotional intelligence. In the study, respondents were dominated by women by 55%.<sup>10</sup> Another alignment study was conducted by Azzahra. In his research on medical students in Jakarta, it was found that the majority of respondents were female.<sup>11</sup>

The characteristics of respondents based on age were known to be mostly 101 (52.1%) respondents aged 18 years, as many as 68 (35.1%) respondents were at the age of 19 years, a total of 12 (6.2%) respondents were 20 years old, a total of 8 (4.1%) respondents were 17 years old, and a total of 2 (1.0%) respondents were 21 years old, and a total of 3 (1.5%) respondents were 22-24 years old. The results of this study are different from the research conducted by Margolang<sup>12</sup>, which examines the relationship between personality type and emotional intelligence in medical students. In the study, most respondents were in the age range of 20-21 years.

Although there were differences in the age range of the respondents, this did not have much effect on studies related to personality type. This is reinforced by a study conducted by Bleidorn et al. which explains that personality types can indeed change over time, but the possibility of personality type changes is small and tends to be stable in early adulthood.<sup>13</sup> According to Kuang et al., the age of 18 years is already included in the adult age category. Based on the journal, it is stated that the adult age range is from 18 to 29 years old.<sup>14</sup>

Most students of the Faculty of Medicine, Tarumanagara University Class of 2024 have an Extroverted personality (57.7%) and another 43.3% have an Introverted personality. This is in accordance with the research conducted by Delendra et al. where the research subject has an extroverted personality type.<sup>15</sup> However, the results of this study are different from the findings made by Azzahra.<sup>11</sup> In her research related to personality type towards Burnout System conducted on medical students, most respondents were introverted personality types (55.2%).

### **The relationship of emotional intelligence levels between introverted personality students and students with extroverted personality types**

The average score of emotional intelligence of the introverted personality type in this study was found to be 103.5 while the average score of the emotional intelligence of the extroverted personality type was 132.6. The minimum score for the emotional intelligence

score of the introverted personality type is 50 and the maximum is 153, while the minimum score for the emotional intelligence of the extroverted personality type is 100 and the maximum score is 165. Based on the results of the Chi-Square test, it is known that  $H_0$  is rejected. This means that there is an influence between personality types on emotional intelligence. This means that extroverted personalities have higher emotional intelligence values compared to introverted personality types.

Emotional intelligence is the ability to recognize, manage, understand, and accept emotions.<sup>16</sup> A person who has good emotional intelligence will be able to cooperate well with others, be able to manage work pressure, have good leadership, and so on. Based on this study, it was found that people who have extroverted personalities have an influence on their emotional intelligence, where the emotional intelligence possessed by extroverts is better than that of introverted types.

Extroverted personalities have high social skills, for example related to fostering social relationships with others. In addition, extroverts get positive energy from the social environment, which strengthens emotional regulation making them have higher emotional intelligence.<sup>17</sup> Therefore, based on their personality traits, extroverted individuals have a greater chance of developing emotional intelligence than introverted individuals.

One of the studies that supports these findings is the study conducted by Antiniene.<sup>18</sup> Individuals with extroverted personalities have a tendency to be highly empathetic, which is one of the signs of a person's emotional intelligence. Research conducted by Subtinanda and Yuliana shows that a person with an extroverted personality also tends to be more responsive to others, so this indicates that the extroverted personality type is more socially sensitive, which also indicates higher emotional intelligence.<sup>19</sup>

The relationship between personality types and emotional intelligence can be seen from research conducted by Cahyaningsih and Firdaus.<sup>20</sup> In the study, it was found that nurses who had a lower extroverted personality experienced burnout while working. This shows that the emotional regulation possessed by the respondents is very good, reinforcing the finding that personality type affects emotional intelligence.

### **Research limitations**

This study examines the scope of students of the Faculty of Medicine, Tarumanagara University 2024 so that the generalization area is limited. In addition, the limitations of other factors also make this research further develop, for example environmental factors such as family background and so on which can also contribute to the formation of emotional intelligence from the students' studies.

## **Conclusion**

This study shows that there is a significant relationship between extroverted and introverted personality types and the level of emotional intelligence possessed by students of the Faculty of Medicine, Tarumanagara University class of 2024. These findings suggest that personality characteristics play an important role in an individual's ability to recognize, understand, and manage emotions, both toward oneself and others. Based on these results, it is recommended that students of the Faculty of Medicine, Tarumanagara University class of 2024 can better recognize their respective personality characteristics and develop aspects of emotional intelligence, such as emotion management and self-reflection. This is important considering that the medical profession requires the ability to serve the community well, which requires high emotional intelligence. In addition, the researcher is expected to examine other variables that affect emotional intelligence, such as academic stress or environmental factors, as well as consider other personality types outside of extroverts and introverts to gain a more comprehensive understanding.

## **Conflicts of Interest**

Nothing to declare.

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## Glucose Content and Glycemic Index of Indonesian Local Foods as Alternative Carbohydrate Sources for Diabetic Patients: Article Review

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### ABSTRACT

**Background:** Indonesian society is highly dependent on white rice as its primary carbohydrate source. However, white rice is known to have a high glycemic index (GI), which can trigger inflammation and contribute to the development of various diseases, including type 2 diabetes mellitus (T2DM). Dietary modifications, such as adopting a low-GI food diet, have been shown to effectively regulate glucose metabolism and improve insulin resistance. The purpose of this study was to review several Indonesian local foods that have the potential as alternative carbohydrate sources for T2DM patients based on carbohydrate value and GI value.

**Content:** Local Indonesian plants have varying GI values and carbohydrate content (7.34-90). The highest to lowest GI values in order are cassava, porang, black potatoes, white rice, sweet potatoes, red rice, corn, sorghum and black rice.

**Conclusion:** These foods contain high to low carbohydrate levels and exhibit lower GI values compared to white rice. Types of local Indonesian plants that have a low GI value and can be used as an alternative to rice for T2DM patients are black rice, sorghum, and corn.

**Keywords:** Diabetes, glycemic index, local food, porang, rice



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## **Introduction**

Diabetes in Indonesia is no longer limited to the elderly and working-age adults but is now increasingly prevalent among school-aged children.<sup>1,2</sup> In 2019, approximately 9.5%, or 488 million adults (20-79 years old) worldwide, had diabetes. This number is expected to continue to increase to 10.2% in 2030 and 10.9% in 2045.<sup>3</sup> This rise in childhood diabetes cases is largely attributed to lifestyles and excessive consumption of fast food, typically high in carbohydrates, salt, and sugar while lacking adequate fiber.<sup>1,2,4</sup> Excessive consumption of high-carbohydrate foods leads to elevated glycemic index (GI) and glycemic load (GL), which ultimately increases blood glucose levels. This triggers oxidative stress while simultaneously raising plasma glucose levels, insulin resistance risk, and hypertension. Without prompt intervention, these metabolic disturbances may progress to various diseases including type 2 diabetes mellitus (T2DM), increased cardiovascular disease risk, female infertility, and colon cancer.<sup>5-7</sup> Furthermore, the prevailing dietary perception in Indonesia that considers rice as the sole staple food significantly contributes to diabetes prevalence. Many Indonesians regard a meal as incomplete without rice consumption. This cultural norm requires urgent attention, as diabetes has become one of the leading causes of mortality in Indonesia. One crucial strategy for diabetes prevention and blood glucose management involves consuming foods with lower carbohydrate content and GI values.

Glycemic index is an indicator used to measure the speed at which food increases blood glucose levels. According to Septiani, carbohydrate-containing foods can be classified into low ( $\leq 55$ ), medium (56-69) and high ( $\geq 70$ ). High-GI foods are typically digested rapidly in the intestines, accelerating postprandial hyperglycemia and increasing the risk of T2DM.<sup>8</sup> Conversely, foods with lower GI values digest more slowly, thereby delaying postprandial hyperglycemia. This mechanism is particularly beneficial for T2DM patients' blood glucose control, as it reduces oxidative stress, which leads to decreased HbA1c, plasma glucose, and cholesterol levels.<sup>9,10</sup> In addition, a diet of foods with low GI lowers the risk of COVID19 as revealed by previous studies in which insulin resistance, due to foods with high GI, is related to the severity of covid19. A person with complications of high blood pressure, hyperglycemia and diabetes has a high risk of death from COVID19.<sup>11,12</sup>

Alternative low-GI carbohydrate sources can be derived from local foods. Current trends indicate a growing consumer preference for staple foods that not only provide satiety but also help regulate blood glucose levels due to their high fiber content. These local food alternatives include maize rice, sweet potatoes, cassava, porang, red rice, and black rice. There have been many in vivo and in vitro studies that have explored the potential of these local foods

as antidiabetic agents. However, comprehensive reviews focusing on their carbohydrate content and GI remain limited. This paper examines the glucose levels and GI values of various Indonesian local foods that serve as alternative carbohydrate sources to rice.

### **Corn Rice**

In several regions of Indonesia, corn serves as a traditional carbohydrate source. As a starchy food, corn contains two essential glucose polymers, namely amylose (10-30% composition) and amylopectin (74-76% composition). Amylopectin's branched-chain structure allows easier enzymatic breakdown by human digestive amylase compared to amylose. Furthermore, corn is rich in dietary fiber, which promotes digestive health, reduces disease risks, and enhances gut probiotic microbiota. These benefits contribute to improved immune function and cancer prevention. In addition to its high fiber content, corn rice is also rich in amino acids, including aspartic acid, glutamic acid, serine, histidine, alanine, tryptophan, and glycine.<sup>13</sup> Other ingredients of this rice are Mg, Fe, Ca, K, P, Cu, Mn and Zn which are beneficial for body health.<sup>14</sup> Corn rice is also known as *berasa batara* (Bulukumba, South Sulawesi), *balabinde* (Gorontalo), *nasi empok* (East Java).

Corn processing is not only limited to boiling and grilling but also be ground into corn rice. The rice can be directly cooked using a rice cooker or cooked like rice. There are two types of corn rice consumed by the public, namely white corn rice and yellow corn rice. Although both are popular, white corn rice has a higher carbohydrate content, moisture content and protein content than yellow corn rice.<sup>15</sup> The difference in color is because yellow corn contains xanthophyll pigment while white corn does not contain xanthophyll.

Corn rice consumption is clinically recognized for its blood glucose-regulating potential in diabetic patients because it has low GI value (Table 1). This therapeutic effect is supported by Luff Schoorl test results (unpublished), which quantified carbohydrate content at 16.90% in white corn rice and 17.35% in yellow corn rice, significantly lower than values measured in white rice, sorghum, and sweet potatoes. This result is different from the findings of Luluhan which stated that corn rice contains 75.64% carbohydrate based on the carbohydrate-by-difference method.<sup>13</sup> This method is different from Luff Schoorl because carbohydrate content is calculated roughly using the formula  $\text{percentage carbohydrate} = 100\% - A$  (protein+fat+water content+ ash content). The Luff Schoorl method itself is the best method for analyzing the amount of carbohydrates in a sample with an error rate of 10% and in accordance with the rules of the Indonesian National Standard (Standar Nasional Indonesia, SNI). Research at the *in vivo* level successfully proved that glycemic levels in people who consume corn rice are lower than people who consume white rice.<sup>16</sup>

**Table 1.** Glycemic index and carbohydrate content from carbohydrate sources.

Carbohydrate sources	Glycemic Index	Category	Carbohydrate content (%)	References
Black rice	30-32	Low		30
Barley	34-70	Low-medium	60-70	31
Sorghum	43	Low	7,34	32
Corn	46-80	Low-high	77,46	33
Red rice	47-76	Low-high	23.03	32-35
Sweet potato	47-78	Low-high	70-89.7	36,37
Potato	55-111	Low-high	40-82	38
Rice white	55-85	Low-high	70-82	39
Black potato	60-62	Medium	18.92	39,40
Porang	67-85	Medium-high	74-76	41,42
Cassava	70-85	High	85-90	43

### Sweet Potatoes

Sweet potato (*Ipomoea batatas*) or vine yam is one of the functional foods widely consumed by Indonesians. Besides being easy to grow, sweet potatoes can be harvested throughout the year, are easy to maintain and rich in nutrients. Based on color, sweet potatoes can be divided into white, orange, purple, and yellow sweet potatoes. Purple sweet potatoes are high in anthocyanins, saponins and carotenoids. Orange sweet potatoes are high in beta-carotene and anthocyanins and are a good source of minerals. White sweet potatoes are high in fiber. Other nutritional contents of sweet potatoes are carbohydrates, fat, protein, vitamins, minerals (Mg, Zn, Ca, P), vitamins (B1, B6, C, E) and fiber.<sup>17-19</sup> Based on the results of the proximate analysis, the four types of sweet potatoes mentioned before have different carbohydrate levels. The highest carbohydrate content was shown by purple sweet potatoes (27.1%), then yellow sweet potatoes (25.7%), orange sweet potatoes (18.5%) and white sweet potatoes (15.1%).<sup>18</sup>

The processing process also affects the carbohydrate content of sweet potatoes (table 2). Roasted red sweet potatoes produce a fairly high carbohydrate value compared to boiled, fried, or steamed.<sup>20</sup> This finding are supported by Bahado-Singh that baking sweet potatoes with their skin intact results in an elevated GI compared to peeled preparations.<sup>21</sup> The loss of moisture during roasting will reduce the formation of resistant starch during cooling resulting in increased GI. Other factors that influence the GI of foods are the type of food, cooking

method, degree of maturity, ratio of amylose to amylopectin, dietary fiber and storage period.<sup>22,23</sup>

Sweet potatoes can be a good alternative food for diabetes therapy because they're rich in nutrients and bioactive compounds that help control blood sugar. Previous study has found that the GI value of sweet potatoes is lower than that of white bread, potatoes and rice, but higher than that of cassava.<sup>24</sup> Based on Table 2, sweet potatoes have a low-high GI value. Furthermore, consuming boiled sweet potatoes for 14 days has been shown to reduce blood glucose levels.<sup>25</sup> Animal studies confirm that pure sweet potato flour (administered at 65 mg/20 g body weight/day for 30 days) also effectively lowers blood glucose.<sup>26</sup> At the cellular level, sweet potatoes exert their glucose-lowering effects through multiple mechanisms: upregulating GLP-1 gene expression, downregulating DPP-4 gene activity, enhancing insulin metabolism, repairing pancreatic damage, inhibiting  $\alpha$ -glucosidase and  $\alpha$ -amylase enzymes, reducing HOMA-IR (insulin resistance), regenerating pancreatic islet cells.<sup>27,28</sup>

### **Cassava**

Cassava (*Manihot esculenta*) remains a staple food crop in several countries, including Indonesia. This is primarily due to its ease of cultivation, drought tolerance, ability to grow in poor soil conditions, and year-round productivity. Most importantly, cassava has a high carbohydrate content. Previous study has shown that 100 grams of cassava contains 35% carbohydrates and 1.2% protein.<sup>29</sup> Likewise, boiled cassava reportedly contains 191 calories, 40 grams of carbohydrates, 1.5 grams of protein, 3 grams of fat and 3 grams of fiber.<sup>29</sup> When compared to other carbohydrate sources, cassava ranks first for the highest carbohydrate content (Table 1), as well as the value of GI. As commonly recognized, cassava starch contains high amylopectin content and numerous enzymatic binding sites. This structural characteristic facilitates rapid hydrolysis during digestion, resulting in high digestibility and consequently a high GI (Table 1).

Cassava contains resistant starch that functions similarly to dietary fiber in the body. This resistant starch slows glucose absorption into the bloodstream, helping to regulate blood glucose levels in T2DM patients. Furthermore, as a soluble fiber, resistant starch contributes to colon health by fermenting into short-chain fatty acids in the large intestine. Beyond its starch content, cassava flour is also rich in polyphenols that exhibit antidiabetic properties through inhibition of  $\alpha$ -amylase and  $\alpha$ -glucosidase enzymes.<sup>44</sup> Another mechanism of cassava flour as an antidiabetes is to decrease the expression of intestinal glucose transporters thereby reducing glucose absorption.<sup>45</sup>

**Table 2.** Food processing and glycemic index value.

Carbohydrate sources	GI value	References
Boiled potato	82	47
Baked potato	72.3	48
Fried potato	63.6	48
Chips potato	56	49
Fresh black potato	61	40
Boiled black potato	60	40
Fried black potato	62	40
Boiled corn	56.19	50
Baked corn	64.57	50
Flavor corn	82	50
Bread corn	68.89	50
Popcorn	66.89	50
Tiwul	59	51
Fresh cassava	47.75	43
Fermented cassava	46.47	43
Boiled cassava	77	43
Sun dried cassava flavor	47.49	43
Steam White rice	21.6	52
Steam white rice after store 12 hours	24.7	52

GI: Glycemic index

Processing techniques significantly affect the GI of all food's ingredients. Boiled cassava contains 14.59% carbohydrates, notably higher than fried cassava (5.77%).<sup>46</sup> This discrepancy arises from prolonged heating duration and elevated temperatures during cooking. High-temperature processing induces starch gelatinization and structural breakdown. Gelatinized starch becomes more susceptible to enzymatic digestion, accelerating glucose release and elevating GI. Despite its carbohydrate content, cassava (GI >70) is not recommended as a dietary alternative for diabetes mellitus (DM) patients due to its high glycemic response.<sup>32</sup>

### Porang

Indonesia is one of the world's producers of porang (*Amorphophallus muelleri*). Porang itself is a type of tuber, the skin of the tuber is bright yellow and there are fine fibers on the

surface. When it is two months old, secondary bulbils/tuber will be found on the leaves and base which resemble frogs. This distinguishes porang from other plants. Porang cannot be eaten raw due to its high oxalate content. Therefore, it must be processed before consumption. Porang is easily found growing wild in nature, known for its high productivity, economic value, and low maintenance requirements for cultivation. Porang is now recognized as a rice alternative due to its low glucose content and high fiber composition. The primary fiber in porang is glucomannan, a polar fiber with a significantly higher molecular weight compared to starch from other carbohydrate sources. Glucomannan's high molecular weight enables it to form fine, crystalline fibers, which are believed to benefit digestive health. However, porang also contains substantial calcium oxalate crystals, which can cause skin irritation and contribute to kidney stone formation. To ensure safe consumption, these oxalate crystals must be removed through thorough washing and soaking with lime water (calcium hydroxide solution) and lime juice prior to preparation.

The high content of glucomannan causes porang to be widely used as a healthy food. In the field of health, porang can control blood sugar levels and is categorized as a food with a medium-high GI value (Table 2). This is proven by giving 200 mg/head of porang flour to experimental animals that can reduce blood glucose levels by 176 mg/dl.<sup>53</sup> Porang has also been reported to increase insulin sensitivity and its effects are comparable to glibenclamide in lowering blood glucose levels.<sup>4,30,55</sup> and increasing *short chain fatty acids* (SCFA) so that it can reduce the risk of coronary heart disease.<sup>56</sup> Given its remarkable potential, it's no surprise that porang-based health foods are now emerging. The use of glucomannan-inulin blends in healthy snacks for obese individuals has been shown to aid weight loss while suppressing increases in cholesterol and triglyceride levels.<sup>57</sup> Similarly, glucomannan-enriched jelly provides longer-lasting satiety compared to regular jelly.<sup>58</sup> Today, porang is incorporated into various food products, including energy bars, whole wheat bread, noodles, nuggets, sausages, and meatballs. Beyond the culinary sphere, its pharmaceutical applications are equally significant, serving as a raw material for capsule shells, emulsion stabilizers, and even as a complementary therapy for diabetes patients.<sup>59</sup>

### **Black Potato**

Black potato (*Plectranthus rotundifolius*), also known as "*umbi kemili*" in Indonesia, remains relatively unknown to the public. This perennial herb from the Lamiaceae family thrives in high-temperature and high-rainfall conditions. Traditionally, it's prepared simply, steamed, boiled, or fried. In recent years, however, processing methods have advanced with the production of black potato flour, which is now being transformed into healthy, body-

friendly snacks. Recent studies confirm that black potato biscuits meet SNI for nutritional quality, making them a viable complementary weaning food for toddlers.<sup>60</sup> Currently, black potatoes are being considered as an alternative food to rice and flour because it has high levels of carbohydrates, nutritional values and minerals and is gluten-free.

The carbohydrate content of black potatoes is 33.7% and higher than ordinary potatoes, as well as the mineral content.<sup>61,62</sup> Specifically, it can be said that in 100 grams of black potatoes there are 70.09 grams of carbohydrates. Previous study stated that black potato flour contains moisture content (8.40%), ash content (2.09%), protein (3.42%), fat (0.79%), crude fiber (4.30%), carbohydrate (85.30%), total starch content (78.85%), amylose (30.22%) and amylopectin (48.63%).<sup>63</sup> In addition, black potatoes also contain various active compounds such as phytosterols, ascorbic acid, thiamine, riboflavin, niacin, calcium, triterpenoic acid, ursolic acid, flavonoids and stigmasterol.<sup>62</sup> The presence of these compounds makes black potatoes a potential food, anticancer, antioxidant and also antihyperlipidemic. Recent research has isolated heptulose, seven-carbon (7-C) sugars, rosmarinic acid and benzyl benzoate from black potatoes. The heptulose compound has ant obesity effects in experimental animal models while rosmarinic acid has effects as an antioxidant and collagen biosynthesis.<sup>64,65</sup> Using *in vivo*, black potatoes reduce glucose levels and increase HDL levels in diabetic animals.<sup>66</sup> This statement is supported by Sethuraman et al. who found that bread made from black potato starch is classified as a low GI food based on *in vivo* tests.<sup>61</sup> However, in this review, black potatoes are included in the foods with a medium GI value because the GI value obtained is 60-62.

### **Sorghum**

Sorghum (*Sorghum bicolor*), a vital cereal crop from the Graminae family, plays a crucial role in global food security. Beyond serving as a staple food, sorghum is also utilized as a bioenergy source, industrial raw material, and livestock feed. Despite its versatility, sorghum remains underutilized in Indonesia as a rice alternative, even though it boasts diverse nutrients and high carbohydrate content. In fact, sorghum contains diverse nutrients and high levels of carbohydrates. Carbohydrates in sorghum are 70-84.06%, protein of 4.7-18%, fat of 0.35-19%, 0.35%, dietary fiber of 1.25%-4.00%, and various minerals.<sup>67,68</sup>

Sorghum has a high carbohydrate content but a low GI (Table 1). Based on the results of Luff-Schoorl's analysis, it was found that the carbohydrate content of sorghum was 42.10% and higher than white rice (29.07%) (personal data not published). However, these findings differ from Diyah et al. which actually states that sorghum has the lowest carbohydrate content (7.34 g/100 gr) compared to some other alternative carbohydrate sources.<sup>32</sup> The observed

variations in the results may be attributed to differences in the sorghum varieties tested. This assertion is supported by Anugrahwati et al., which states that each sorghum variety/genotype exhibits distinct sugar content during growth.<sup>69</sup> Additionally, nutritional differences among various sorghum types depend on genetic variations among sorghum cultivars, environmental conditions, and soil types.<sup>68</sup>

In *in vivo* testing, the GI value of sorghum was relatively low compared to white rice.<sup>32</sup> The low GI value of sorghum is due to the high and diverse total phenolic content of sorghum. Phenolic compounds found in sorghum are luteolin, apigenin, eriodictyol, naringenin and phenolic acids.<sup>70</sup> These phenolic compounds have long been known to be antidiabetic through the mechanism of inhibition of digestive enzymes in the small intestine. An *in vitro* study found that sorghum extract was able to inhibit the activity of the enzymes  $\alpha$ -glucosidase and  $\alpha$ -amylase.<sup>71</sup> The inhibition of these digestive enzymes directly contributes to reduced blood glucose levels, demonstrating sorghum's ability to maintain postprandial glucose homeostasis. Furthermore, animal studies have shown that sorghum supplementation decreases oxidative cellular damage (thereby lowering diabetes risk),<sup>72</sup> while also reducing body mass index and body weight.<sup>73</sup> These findings collectively establish sorghum's dual potential as both an anti-diabetic and anti-obesity functional food.

### **Black Rice**

Black rice (*Zizania aquatica*) is widely cultivated by Indonesian farmers. This unique grain carries several evocative names: forbidden rice, purple rice, lucky rice, emperor's rice, and king's rice, titles rooted in its regal history across Asia, including Indonesia. During ancient dynastic eras, black rice was exclusively reserved for royalty and elites, as it was believed to enhance longevity and vitality. Common people were strictly prohibited from consuming it without royal authorization, reinforcing its status as a "forbidden" superfood of the privileged class.<sup>74</sup> Black rice is now gaining significant attention, not just for its distinctive appearance and culinary appeal, but for its rich profile of bioactive compounds, particularly anthocyanins concentrated in the aleurone layer. These pigments serve as potent combatants against oxidative stress and inflammation, and major contributor in fighting chronic diseases such as cardiovascular disorders, diabetes, and cancer.<sup>75</sup>

The addition of black rice to the daily diet can reduce the risk of various chronic diseases. This is because black rice contains anthocyanins in the form of cyanidin-3-glucoside (C3G) in large amounts. C3G compounds are reported to be hypoglycemic and anti-osteoporosis,<sup>76</sup> inhibit extracellular matrix aggregation, lower inflammatory cytokines and oxidative stress, lower insulin resistance, so that it can be used to prevent diabetic nephropathy

and blood sugar control of DMT2 patients.<sup>77,78</sup> Recent studies have shown that red rice anthocyanins work as antidiabetics through the regulation mechanism of the PI3K/AKT signaling pathway and the intestines of microbiota of the DMT2 model animal.<sup>79</sup>

The nutrition of black rice is quite diverse. Specifically, it can be mentioned that black rice contains carbohydrates (75.80-78.68%), protein (7.44-10.08%), fat (0.22-0.42%), crude fiber 0.06-0.10%, and minerals (0.24-1.77%).<sup>80</sup> However, the crude fiber possessed by black rice is relatively low (<36%) compared to the Food and Drug Monitoring Agency (Badan Pengawas Obat dan Makanan, BPOM) standard (>36%). The low fiber produced may be related to the loss of the fiber layer in the rice aleurone part of the milling process.<sup>80</sup> Recent studies have found that the fiber and protein from black rice are higher than red rice, brown rice, and white rice.<sup>81</sup> Foods with a high protein content have moderate digestibility which helps the slow release of blood glucose. In terms of processing, steamed black rice turns out to have a lower carbohydrate content than red rice, brown rice, and white rice, which is 30-32 and belongs to the low GI category.<sup>82,83</sup> This indicates that black rice can be used as an alternative source of carbohydrates instead of rice.

### **Red Rice**

Despite its nutritional benefits, red rice struggles to gain popularity in Indonesia. Consumers often reject their chewier texture, tendency to turn rancid quickly, and inconvenient cooking properties, requiring more water and time than white rice. Additionally, its milder flavor and firmer bite further reduce appeal among those accustomed to white rice's soft texture.<sup>84</sup> Other contributing factors include its less visually appealing appearance, higher cost, limited market availability, and lack of public awareness regarding its nutritional value. These challenges stem from the minimal processing of red rice, it only undergoes partial milling, allowing the bran layer to remain intact. Ironically, this very bran layer makes red rice nutritionally superior. Bran layer is rich in dietary fiber and essential fatty acids. However, in recent years, the demand for pigmented rice, such as red rice, has begun to attract the attention of the public due to the high awareness of the importance of healthy food. Red rice is a food with a low to high GI value because the GI value obtained is 47-76 (Table 1).

Red rice is claimed to be suitable for people with diabetes and obesity. Red rice contains carbohydrates (73.16-79.58), protein (7.72-9.10%), fat (1-2.07%), crude fiber (0.24-1.77%), total ash (0.43-1.01).<sup>80</sup> Not only that, red rice also contains anthocyanins, carotenoids, tocotrienols and tocopherols which are known to be able to ward off free radicals.<sup>85,86</sup> Previous study has also revealed that red rice contains B vitamins, functional lipids, essential amino acids, phytosterols, phenolic acids, flavonoids, anthocyanins, proanthocyanidins, GABA, and

phytic acid.<sup>84</sup> Phenolic compounds from red rice that have been identified are p-coumaric acid, ferulic acid, methyl ferulic acid, syringic acid, quercetin, catechin and gallic acid.<sup>87,88</sup> These phenolic compounds are associated with various health benefits for humans including anti-obesity and anti-diabetes. As an anti-obesity, red rice works by inhibiting glucose transport into 3T3-L1 fat cells through inhibition of  $\alpha$ -glucosidase and  $\alpha$ -amylase enzymes, modulation of liver and skeletal muscle GLUT4, secretion of skeletal muscle insulin-degrading enzymes thereby reducing insulin resistance of obese patients.<sup>89</sup> As an antidiabetic, red rice reduces hyperglycemia, glucose resistance and glycogen accumulation through decreasing the expression of intestinal glucose transporters.<sup>45</sup> In addition, red rice is high in flavonoids that effectively exert hypoglycemic effects through the inhibition of amylolytic enzymes, namely  $\alpha$ -glucosidase and  $\alpha$ -amylase.<sup>88</sup>

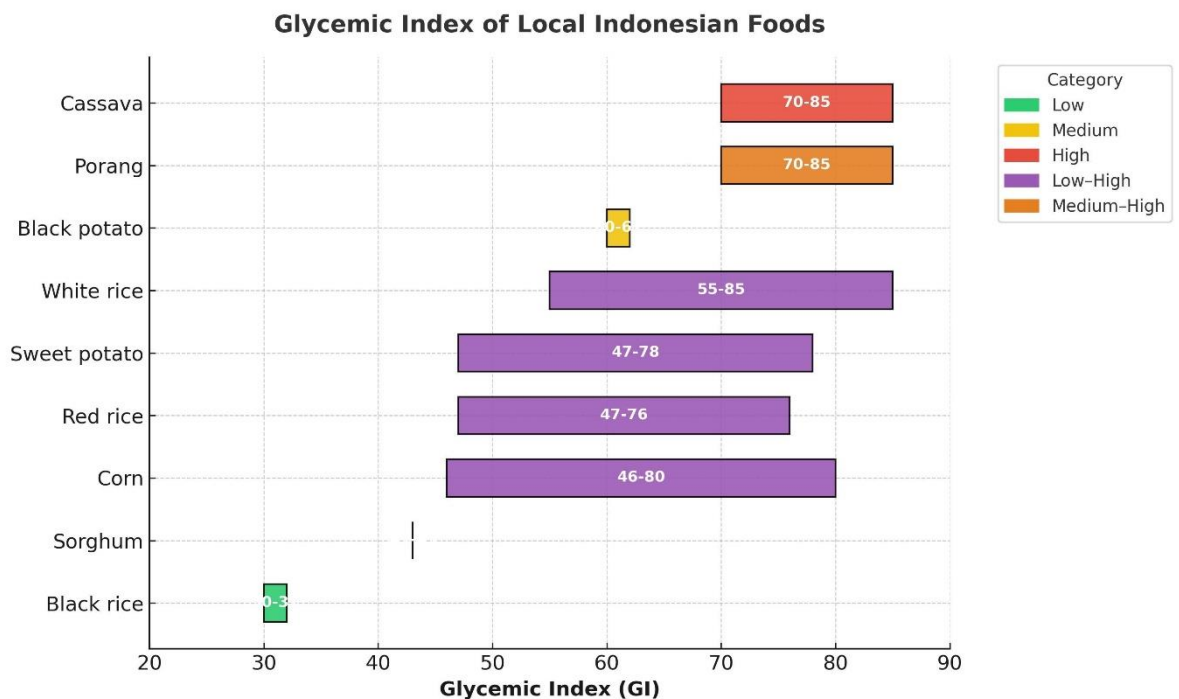
Given the immense potential of red rice, it is not surprising that diversification of red rice products. One innovative approach involves substituting wheat flour with red rice flour, aiming to reduce reliance on traditional wheat flour which is high in carbohydrates and gluten. Several red rice product variations have already emerged in the market, including red rice tea bags, traditional cakes and pastries, *angkak* (red yeast rice) health beverages, and flaked snack products. Moreover, these processed red rice products serve as excellent snack options for diabetes patients due to their low GI, making them both nutritious and diabetes friendly.

### **White Rice**

White rice is a staple food derived from rice (*Oryza sativa L.*) and is the main source of carbohydrates for the Indonesian people and several countries in the world. In addition to glucose, rice also contains protein, iron, zinc, vitamin B6 and magnesium. From various literature, it is known that rice contains a high level of glucose compared to several other sources of carbohydrates (Table 1). This is due to the high amylopectin content in rice, which is around 70% of the total average total starch content.<sup>90</sup> According to Ahmad, foods with high amylopectin content have high digestibility which leads to high GI as well.<sup>91</sup> The glucose level of rice is 25.40 g/100g while the GI value is 82 and higher than red rice, corn, sorghum, cassava, breadfruit and boiled bananas.<sup>32</sup> The high GI value of white rice is associated with an increased risk of diabetes, as well as other diseases. As explained in previous studies, an increase in the daily serving of white rice was associated with an 11% increase in DMT2 risk,<sup>92</sup> cardiovascular disease and cancer.<sup>93,94</sup>

Several methods have proven effective for lowering the glucose content of white rice. Adding pandan leaves and coconut oil during cooking can significantly reduce the rice's glucose levels.<sup>95</sup> Similarly, consuming rice that has been pre-cooled, either at room temperature

or via refrigeration, also helps decrease its glycemic impact.<sup>95,96</sup> This cooling process promotes the formation of resistant starch, which not only lowers digestible carbohydrates but also enhances satiety, helping to control hunger for longer periods. Another study revealed that incorporating virgin coconut oil (VCO) into the rice during preparation, which alters its starch structure and reduces both glucose absorption and calorie content by 10-15%.<sup>97</sup> Storage duration also plays a role because keeping rice in a rice cooker for extended periods gradually lowers its glucose levels.<sup>98</sup> Most importantly, balancing rice consumption with other nutrients like proteins, vegetables, and healthy fats further helps manage post-meal blood sugar spikes. Figure 1 summarizes the discussion regarding GI of Indonesian local foods.



**Figure 1.** Glycemic index values of several local Indonesian foods as alternative carbohydrate sources.

### Conclusion

Local foods such as corn rice, sweet potatoes, cassava, black potatoes, sorghum, porang, red rice and black rice can be used as alternative carbohydrate sources for DMT2 patients. Types of local Indonesian plants that have a low GI value and can be used as an alternative to rice for T2DM patients are black rice, sorghum, and corn.

### Conflicts of Interest

Nothing to declare.

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## Health System Challenges in Managing Schistosomiasis Among Pregnant Women: A Qualitative Study from an Endemic Indonesian Highland

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### ABSTRACT

**Introduction:** Schistosomiasis infection in pregnant women can lead to poor newborn health and reduced birth weight. The present study was conducted on an endemic area, while the risk of pregnant women being exposed to Schistosomiasis in the Napu Highlands is quite high. This study aims to describe the health care system related to Schistosomiasis in pregnant women within the Puskesmas Wuasa working area.

**Method:** This study used a qualitative descriptive approach in the Puskesmas Wuasa working area in Poso Regency. The sample consisted of 11 key informants, including four pregnant women, three health workers, two Schistosomiasis laboratory workers, one head of the Puskesmas, and one official from a related agency. Data were collected through guided interviews.

**Results:** Mass screening for Schistosomiasis occurs annually, but specific screening for pregnant women has not been implemented, despite their support for it. Pregnant women cannot take Praziquantel due to potential fetal risks and regulatory concerns. Positive tests lead to referrals by village midwives to Puskesmas. Additionally, Schistosomiasis insurance for pregnant women is readily accessible, often covered by government insurance, ensuring support for affected individuals.

**Conclusion:** Current health services inadequately support pregnant women in Schistosomiasis -endemic areas, particularly in the Puskesmas Wuasa. The present study highlights the implementation gap in integrating schistosomiasis screening and treatment into antenatal care services within a specific endemic area. Ensuring the safety and regulation of praziquantel as the primary treatment is essential to optimize health services for this vulnerable group.

**Keywords:** Delivery of health care, mass screening, praziquantel, pregnancy, schistosomiasis



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## **Introduction**

Schistosomiasis is a parasitic disease caused by trematode worms belonging to the genus *Schistosoma*, which can present as acute or chronic conditions. In 2016, it was estimated that over 206.4 million individuals required treatment and preventive measures.<sup>1</sup> Among women of reproductive age, approximately 40 million are affected by *Schistosoma* infections, yet the morbidity associated with pregnancy remains inadequately studied. Notably, around 10 million women in Africa were infected with schistosomiasis during pregnancy each year. The disease results in significant nutritional, hematological, and cognitive impairments, leading to considerable morbidity and mortality in the general population. Although research on the effects of schistosomiasis during pregnancy is limited, existing case reports suggest associations with adverse neonatal outcomes and reduced birth weight.<sup>2</sup>

Schistosomiasis in Indonesia is predominantly observed in the Central Sulawesi Province, particularly within the Napu and Bada highlands of Poso Regency and the Lindu highlands in Sigi Regency.<sup>3</sup> The Bada Valley was recognized as an endemic zone for schistosomiasis in 2008.<sup>4</sup> Between 2011 and 2015, the reported prevalence of schistosomiasis among humans in the Napu Highlands was 0.31%, 1.43%, 2.25%, 0.8%, and 1.9%, respectively. This disease is caused by the trematode worm *Schistosoma japonicum*, with the *Oncomelania hupensis lindoensis* snail serving as its intermediate host. Schistosomiasis affects not only humans but also a wide range of mammals, both domestic and wild, which significantly contributes to the persistence of high reinfection rates.<sup>5</sup>

The Napu Plateau, recognized as an endemic region, presents a heightened risk of schistosomiasis exposure for pregnant women. In this setting, a woman's health prior to pregnancy plays a crucial role in influencing both pregnancy outcomes and infant health. Factors such as inadequate nutrition, resilient place attachment, and elevated rates of infectious diseases significantly contribute to maternal and infant mortality, as well as low birth weight (LBW), particularly in less developed nations. Pregnant women with low birth weight, short stature, anemia, or existing infections are at an increased risk of delivering infants with low birth weight.<sup>2</sup>

Integrated healthcare plays a crucial role in managing schistosomiasis infections.<sup>6</sup> Over the past 60 years, China has made significant strides in controlling schistosomiasis, closely linked to the healthcare system's capacity to foster a conducive environment for disease management. This introduction delineates three key phases in the control of schistosomiasis: an initial disease elimination strategy focused on snail control (1950s to early 1980s); a shift toward a chemotherapy-based morbidity control strategy (mid-1980s to 2003); and the

introduction of an integrated control strategy (2004). Each phase emerged under different policy-making conditions. We will analyze these phases to identify five critical issues in disease control within the context of the healthcare system and its recent developments. These issues encompass the policy-making process, cross-sectoral health initiatives, equity and access to healthcare, funding for essential resources, and the enhancement of resource management and planning. Together, these factors inform an agenda aimed at integrating research and capacity-building efforts within China's healthcare framework, ultimately enhancing the environment for effective schistosomiasis control.<sup>7</sup> Therefore, this study aims to assess whether the existing health service system related to Schistosomiasis is sufficient to cover pregnant women in terms of treatment and prevention of Schistosoma worm infections in the Puskesmas Wuasa working area, including diagnosis systems, treatment systems, referral systems, and insurance systems.

## **Methods**

This study uses a qualitative descriptive approach that aims to obtain in-depth information regarding the facts of the health service system, including the diagnosis system, treatment system, referral system and insurance system related to Schistosomiasis in pregnant women in the working area of Puskesmas Wuasa, North Lore District, Poso Regency, Central Sulawesi Province from March to April 2025. The qualitative method was selected due to the limited existing research on pregnant women. This approach enables an in-depth examination of the challenges encountered at the research site. This research protocol has been reviewed and approved by the Health Research Ethics Committee of the Faculty of Medicine, Hasanuddin University, Makassar, on April 9, 2025 (Protocol No. UH19020064).

Informants for this study were selected through purposive sampling based on specific inclusion criteria. Eligible participants included individuals residing within the Puskesmas Wuasa's service area, pregnant individuals, health workers affiliated with the Puskesmas, and the Schistosomiasis Laboratory in Wuasa, as well as those possessing comprehensive knowledge of schistosomiasis. Additional criteria included prior consumption of praziquantel, physical and psychological health, effective communication skills, and a willingness to participate in the study. Participants who were absent during the study period or had recently moved to Wuasa without previous involvement in mass schistosomiasis screening and treatment were excluded from the study. Therefore, the informants of the present study consisted of four pregnant women, three health workers from the Puskesmas Wuasa, two officers from the Schistosomiasis Laboratory, one Head of the Puskesmas, and one decision-

maker from the relevant agency.

Primary data for this study were gathered through guided interviews. Additionally, secondary data were obtained via direct field observations and document analysis, which included Puskesmas annual reports, Health Research Bulletins, medical records, and other relevant materials concerning the research subject. The analyzed data are presented in a descriptive and qualitative matrix format, complemented by explanations that adhere to established guidelines and standards.

## Result

Table 1 shows the baseline characteristics of the informants. All informants had a varied age range, ranging from 28 to 62 years. All the pregnant women informants worked as housewives, with the majority having a high school education. Midwives and nurses constituted most of the health workers in this study.

**Table 1.** Characteristics of health service system informants related to Schistosomiasis in Puskesmas Wuasa working area

No.	Initial	Age (years)	Gender	Working Status	Education Level
1.	Informant Y	28	Woman	Housewife	Senior high school
2.	Informant S	36	Woman	Housewife	Junior high school
3.	Informant S	35	Woman	Housewife	Senior high school
4.	Informant N	30	Woman	Housewife	Senior high school
5.	Informant R	32	Woman	Midwife	Diploma-3
6.	Informant V	29	Woman	Midwife	Diploma-3
7.	Informant O	30	Man	Nurse	Diploma-3
8.	Informant P	39	Man	Schistosomiasis laboratory personnel	Diploma-3
9.	Informant K	62	Man	Schistosomiasis laboratory personnel	Senior high school
10.	Informant E	30	Woman	Deputy head of Puskesmas Wuasa	Bachelor
11.	Informant R	42	Man	Filariasis and schistomiasis program management staff of the Central Sulawesi Provincial Health Office	Bachelor

To describe the environmental conditions, this study presents indicators such as the Percentage of Healthy Homes, the Percentage of Healthy Public Places, and the percentage of clean and healthy living behavior (perilaku hidup bersih dan sehat, PHBS). According to the 2017 report by the environmental health officer, the percentage of healthy homes was 86.54%. This figure has reached the Healthy Indonesia target. The results of the 2017 data validation show that households in the Puskesmas working area used clean water from pipes (100%), dug wells (0%), hand pump wells (0%), rainwater reservoirs (0%), bottled water (0%), and others (0%). Wuasa Village had a PHBS percentage of 67%, relatively higher compared to other villages in the same sub-district. Then, there were three Posbindu buildings, without any other Community-based Health Effort (upaya kesehatan berbasis masyarakat, UKBM) buildings.

### **Schistosomiasis screening and diagnosis system in pregnant women**

Multiple diagnostic methods are available for detecting schistosomiasis, with the Kato-Katz test being a prominent example that utilizes stool samples. Annually, Schistosomiasis Laboratory personnel, in partnership with Schistosomiasis cadres, conduct a mass stool collection program. This testing method is still employed today due to its accuracy, cost-effectiveness, and ease of use.

According to the findings from interviews with informants, there were no objections to the approach of assessing schistosomiasis through mass fecal sample collection.

*"No, it's not bothersome. We're already used to filling the pot (stool sample for examination) for sisto (Schistosomiasis)." (Informant S)*

In a survey of pregnant women regarding schistosomiasis screening, it was indicated that they had not undergone any specific test for schistosomiasis apart from the annual mass screening. One participant, identified as S, expressed concern that she had not witnessed any follow-up actions related to her stool collection results.

*"No, there hasn't been (any Schistosomiasis screening during pregnancy). But I don't know for sure because I've never been checked—since when we're pregnant, we can't take the medication anyway. Even if they took stool samples during pregnancy, no, there's no action taken because they assume that even if we're positive (for Schistosomiasis), we can't take the medicine. If you ask if I'm afraid, yes, of course I'm afraid of getting (Schistosomiasis). But every time there's a stool sample collection, I participate. Whether I'm positive or not, I still (take part)." (Informant S)*

On another occasion, an interview conducted with Informant Y stated the same thing regarding the absence of Schistosomiasis screening for pregnant women.

*"During pregnancy, I never received any examinations outside of mass drug*

*administration, but before pregnancy, I did participate in mass socialization programs." (Informant Y)*

Informant E, who is a representative of the Head of Wuasa Health Center, gave a statement regarding Schistosomiasis screening for pregnant women.

*"We currently don't have a specific Schistosomiasis screening program for pregnant women. However, we conduct health education campaigns in villages about Schistosomiasis, and now there's also the GEMA BERAKSI program directly implemented by the Poso District Health Office. During every Posyandu (integrated health service post) activity, we always provide health education since it involves toddlers, pregnant women, elderly, PTN posts, Posbindu - we conduct comprehensive education through our program teams, and we always include information about Schistosomiasis. Some community members might miss the Schistosomiasis education because they don't attend village activities. Maybe they're pregnant but reluctant to come to Posyandu. We always remind the midwives - that's why we encourage midwives to regularly visit pregnant women, so they can identify any potential cases or health issues among pregnant women." (Informant E)*

In 2014, a confirmed case of schistosomiasis was reported in a pregnant woman from Lanciran village, as revealed by an interview with a village midwife. The midwife noted that she became aware of the positive diagnosis after receiving the results of a community-wide stool test.

*"At either 6 months or 3 months (of pregnancy), when her stool was examined, it came back positive. That area (Lanciran) is indeed a focus region. She had already been tested during the mass screening, so she was reported as positive. But they (the examiners) didn't know she was pregnant. Later when I reviewed the list of positive cases - oh my goodness, this was one of my pregnant patients! So, I had to report it again to the (Schistosomiasis Laboratory)." (Informant R)*

The statement regarding the announcement of the results of this mass examination showed quite similar results based on the results of interviews conducted with informants.

*"They always announce who's positive, right? Every stool examination shows the results, after all. They definitely read out the names of those who test positive. Whether it's another examination or another sample collection... I just hope my name isn't called." (Informant S)*

*"The treatment results aren't publicly announced because community members would typically feel ashamed. Usually only the health workers, volunteers, and their family*

*members are informed. So only those who test positive are notified." (Informant E)*

Regarding the case found in 2014, Informant E stated that it was important to conduct Schistosomiasis screening for pregnant women.

*"Early detection of schistosomiasis in pregnant women is absolutely necessary, so we can determine whether a woman is truly pregnant or if she has schistosomiasis—or both. For the development of a specialized program, even if we only identify one or two cases moving forward, we will still propose the program. Who knows? There might be more undetected cases beyond what we've found. Maybe there are others, and we've only happened to catch one. That's why we're submitting this proposal—to prevent similar incidents from recurring. We shouldn't have to wait for multiple cases; even if one is enough to warrant action. Detection must start from the beginning." (Informant E)*

Furthermore, Informant S also provided feedback regarding Schistosomiasis screening for pregnant women.

*"Personally, I would want and agree to have special screening (for Schistosomiasis in pregnant women). For myself, I would really like that. Ideally, I wish we could still take medication even during pregnancy. Because we also want to stay healthy, right? But of course, we just follow the regulations set by the (government) authorities above us." (Informant S)*

### **Schistosomiasis treatment system in pregnant women**

The schistosomiasis control and eradication program in the Puskesmas Wuasa area includes an annual mass treatment initiative established by the government. Previously, this initiative was conducted biannually, with sessions from January to June and from July to December. However, since 2024, the frequency has been adjusted to once a year, reflecting the increased number of government initiatives aimed at schistosomiasis management.

*"During mass drug administration, the community gathers at one location. For larger villages, since 2024, it's been conducted over two days. Take Wuasa for example - previously divided into 5 stations. Doctors monitored it, and everyone came. In 2024, for instance, they would come to take the (snail fever) medication at 9 AM, with a 4-6 hour interval. They'd return at 3 PM for another dose. For the 2024 Alitupu treatment, I personally monitored the positive cases together with the Puskesmas head - 7 people in total. However, during that mass treatment, they failed the regimen. They only took one dose. When taking the second dose, they vomited. It seems that's why it failed. Now this treatment needs repeating. After stool examination (if still positive), we wait there.*

*The schistosomiasis volunteers wait at their homes. Then we'll check these names again later to see if they're still positive or not. It will be evaluated this year after the stool examination in May. So they take the medication first, then collect stool samples." (Informant P)*

The treatment patterns also varied according to the confession of informant P. Treatment was carried out based on the percentage of individuals who tested positive for Schistosomiasis in each village.

*"During the biannual treatment program, we examine the prevalence rate (percentage of positive cases per village) to identify areas exceeding 1%. For instance, Dodolo at 1.04% requires mass treatment. The challenge is - with only 382 residents and 7 positive cases, they should have fewer than 5 cases to achieve below 0. Something percent. Areas below 1% receive selective treatment, meaning only positive cases and their families receive medication. However, family members under 5 years old are excluded. But for villages reaching 2%, everyone undergoes mass treatment (though still limited to those above 5 years). This 2025 national mass treatment program mandated universal participation - we even had people from Palu return to their hometowns specifically for treatment." (Informant P)*

In a prior account, informant K reported his participation as a test subject in 1972, before the introduction of Praziquantel for snail control in Napu. Following a confirmed diagnosis of Schistosoma infection, a liver biopsy was performed to evaluate the presence of worm eggs in human liver tissue, akin to previous studies conducted on mammals. Informant K had initially been prescribed Ambilhar; however, due to intolerable side effects, he transitioned to Praziquantel for treatment.

*\*"It turns out to be the same as in mammals. Schistosoma eggs were found in my liver. Then I took medication - not the current drug (Praziquantel), but Ambilhar, which I took for 7 days. The dosage was the same as the current treatment. But please excuse me, it made my urine turn yellow, which is why they switched to the current medication. The 7-day regimen depends on the egg count - whether there are many or few eggs, the point is you must complete the 7-day course to fully eliminate the Schistosoma eggs. The dosage depends on body weight - for 50kg, that's 5 tablets divided into two doses of two-and-a-half tablets each, with a strict 5-hour interval between doses that must be precisely timed."\* (Informant K)*

In interviews conducted with informants regarding the treatment of Schistosomiasis in pregnant women, a consensus emerged: all informants agreed that the administration of snail

medicine or Praziquantel should be avoided in pregnant women, breastfeeding mothers, children under 5 years of age, and adults with severe health conditions, such as hypertension, heart disease, and hepatitis. Although some informants reported not having encountered any adverse effects related to Praziquantel in pregnant women, the caution against its use in these vulnerable populations was uniformly emphasized. As highlighted by informant K:

*"For example, if a breastfeeding mother undergoes a stool examination and tests positive (for schistosomiasis), treatment is temporarily postponed. It depends on the mother—if she chooses to take the medication, she must pause breastfeeding for 3 days. Only after 3 days can she resume nursing. During the examination, there's always a doctor overseeing the process who knows the exact protocol. So, if a woman is found to be pregnant, we delay treatment until after delivery." (Informant K)*

*"Actually, if following the medication guidelines, it shouldn't be dangerous for pregnant women. But as healthcare workers, we're advised not to administer it if in doubt. Even doctors refuse to do so. In fact, there might not even be side effects. We just don't want to take the risk. Previously, we lab personnel used to handle the treatment, but due to this being a central government program with inherent risks, things changed. Back then, they (central authorities) asked: 'Are there doctors at the Lab?' We answered: 'No.' So, they concluded that if any undesirable incidents occurred, there would be no one held accountable. That's why treatment administration was transferred to Puskesmas - since every Puskesmas has a responsible doctor. That was the central government's concern. For us lab staff - in our lab there are nine people, but I'm the only nurse. We have no supervising doctor. Naturally, we're apprehensive too. Obviously, if complications arise, doctors won't take responsibility either. But if the Puskesmas implements the treatment, doctors will definitely be accountable." (Informant P)*

Another statement was also expressed by informant O regarding the use of Praziquantel in children under 5 years:

*"For the case in Toe, it involved underage children. We had to treat them, even though technically we shouldn't have. But they were already infected (with schistosomiasis). If we waited another two or three years, it would have been tragic - their bodies were already turning yellow. So, the doctor prescribed pediatric doses. Now they've recovered completely - running around healthy again." (Informant O)*

The observations detailed above indicate that the concerns surrounding Praziquantel are substantiated by its commonly reported side effects, which include dizziness, nausea,

headaches, vomiting, and, in some cases, fainting. Considering these findings, health professionals and relevant authorities have opted to exclude pregnant and breastfeeding women from the mass treatment program for Schistosomiasis. This decision stems from apprehensions regarding the potential adverse effects of Praziquantel on these populations and the associated risks to fetal health. Authorities also seek to mitigate their liability in the event of adverse outcomes among pregnant women who may receive the medication.

*"Why must Schistosomiasis treatment be postponed for pregnant and breastfeeding women? Here's the thing - if we give medication to a pregnant woman and she dies, who takes responsibility? Prevention is better, right? In my 30 years of service, we've always postponed treatment for pregnant and nursing mothers. Even the Head of Health Office said to delay their treatment. Why take the risk? If age or physical condition isn't suitable, we won't risk it either. If we medicate a physically ill patient who then dies, people will blame the snail fever medication, won't they? It could happen, right? Patients do collapse sometimes. It depends on their physical condition - everyone's different. Those with high blood pressure can't take Praziquantel, and those with low blood pressure can't either." (Informant K)*

This doubt has an impact on the treatment of Schistosomiasis in pregnant women exposed to Schistosomiasis in 2014, as stated by informant R, a village midwife.

*"Even the doctor at the Puskesmas said the same thing: 'Don't administer the medication.' But I felt sorry for her when I brought her to the Puskesmas—the only option was to provide vitamin supplements and nutritious food since treatment wasn't possible. So, we just gave her vitamins, and only after delivery would she receive the medication (Praziquantel). (We prohibited) breastfeeding temporarily to avoid any risks to the baby. It was heartbreaking to switch to formula milk, but we had to express her breast milk to prevent engorgement. The baby's birth weight was 2.6 kg—quite small. But we continuously supplemented her with vitamins: B12 injections, appetite stimulants, and iron supplements without pause. Now the child is in kindergarten and healthy. Ideally, if pregnant women could safely take the medication, they would. But if not, we wait until after delivery. Because to this day, the only drug available is still Praziquantel. According to the recent health department briefing (from Dinkes Palu), Praziquantel is dangerous for pregnant and breastfeeding women." (Informant R)*

The researcher then confirmed the truth of the above statement to one of the informants, who was a representative of the Provincial Health Service, regarding the prohibition on giving Praziquantel to pregnant women.

*"Yes, we don't recommend (administering Praziquantel to pregnant women) because we're wary of past incidents. I can't recall the exact year - it happened before I joined this Health Office, and this is information I received from senior colleagues. The case occurred in Napu, where someone tried to induce abortion using Praziquantel. The fetus was expelled. There are no written regulations (SOP) regarding Praziquantel administration. We're simply following our seniors' practices and adhering to existing protocols." (Informant R)*

However, an interesting statement was made by informant V regarding the use of Praziquantel:

*"But during the screening of pregnant women, we encountered many cases where... how should I say it... women with fertility issues? Those who hadn't conceived for years. After taking the snail fever medication (Praziquantel), they became pregnant. This pattern was common. So, we suspect this medication might have fertility-enhancing effects."*

*"There was one case where a woman was already pregnant but didn't know it when she took the snail fever medication. This patient hadn't conceived for 12 years. She had one child before, but the child's development... let's say there were viral complications - the child's growth wasn't optimal. At the time, she was already nearly 3 months pregnant but hadn't realized it. After taking the medication, she later felt fetal movement. A pregnancy test confirmed it. The baby was born healthy. This suggests the medication might have eliminated harmful viruses." (Informant V)*

Continued by informant V who revealed the follow-up to mass treatment of Schistosomiasis in 2024.

*"We actually raised this issue during yesterday's Schisto meeting. You see, during our recent mass drug administration, we achieved nearly 100% community coverage. The Schisto team said there would be a follow-up mass stool examination three months later. But the evidence shows - even at my own house, the sample containers were never collected. This makes us doubt whether the stool screening was truly mass scale. However, the treatment was indeed comprehensive because we handled it directly - over 90% coverage. The remaining were mostly students in Palu or temporarily out of town. Even when they returned, their parents came to collect the medication. So, we reached about 98%, excluding pregnant and breastfeeding women. But the follow-up stool examinations... Moreover, even though their farms are in focus areas (for transmission), people have no choice but to work there for their livelihood. Take*

*Sedoa's case - their house is at the far end, clearly marked as a snail focus area, yet they still graze their buffaloes there." (Informant V)*

In a separate instance, all pregnant participants expressed strong support for providing schistosomiasis treatment during pregnancy. When permitted by healthcare staff, they expressed willingness and awareness in taking praziquantel to mitigate the risk of transmission and infection of *Schistosoma* to their fetuses. One participant, referred to as Y, articulated her aspirations regarding the treatment of schistosomiasis in pregnant women:

*"(Starting before pregnancy) I've already taken the medication three times. I'm willing to take it during pregnancy too, as long as it's permitted by health workers - if it's for my health, why not? When I took the medication, I felt dizzy, nauseous, and uncomfortable. Not exactly a headache, but lightheaded. It seems hard to get the medication because we must wait for mass treatment campaigns. Usually, midwives don't have it. We must wait for scheduled treatments. It would be better if the medication were available at accessible health posts like PUSTU or POLINDES." (Informant Y)*

### **Schistosomiasis referral system in pregnant women**

In an interview with informant E, it was noted that the responsibility for diagnosing and managing schistosomiasis in pregnant women is assigned to the attending midwife. This delegation also extends to the referral process.

*"For Schistosomiasis screening or treatment in pregnant women, to my knowledge, they must first consult their midwife. If the midwife recommends it, they may need to go to the Schistosomiasis Laboratory. When a midwife identifies a case, they report it to the pregnant woman's midwife first, who then notifies the Puskesmas head. Only afterward is the Schistosomiasis Laboratory staff informed if a case is detected. All confirmed Schistosomiasis cases are referred to the Schistosomiasis Laboratory. To determine whether a pregnant woman is infected, a stool test is conducted first. If positive, treatment is provided by the Schistosomiasis team—but only after coordinating with the village midwife, given the pregnancy. Importantly, stool examinations aren't performed by midwives; they're handled exclusively by Laboratory staff." (Informant E)*

However, in the case of Schistosomiasis in a pregnant woman found in 2014, after being confirmed positive, the pregnant woman was immediately referred to the Puskesmas by the village midwife.

*"So, I reported it again there (at the Schistosomiasis Laboratory). I said, 'What's the solution?' Only then did I bring her to the (Puskesmas)." (Informant E)*

Moreover, informant P indicated that the referral process closely resembles that

previously described by informant R. This referral protocol applies to all individuals who seek self-examination at the Schistosomiasis Laboratory, independent of mass stool testing initiatives.

*"So, the process is: for example, community members bring stool samples to the Laboratory, where they're examined. If positive, the Laboratory team issues a referral to the Puskesmas. The Puskesmas then provides treatment." (Informant R)*

### **Schistosomiasis insurance system in pregnant women**

In the Puskesmas Wuasa operational area, a significant proportion of residents possess government health insurance, specifically the Badan Pengelola Jaminan Sosial (BPJS) Kesehatan card. Although the availability of Praziquantel is limited under normal circumstances, during the mass treatment initiative, both informants and other residents were provided the medication at no cost, as the government fully funded the program.

*"Mass screenings are free of charge. But for non-mass screenings, previously my colleagues would accept 'tip' from those who came. However, now we've instructed them to stop this practice, as it would be problematic if journalists found out." (Informant P)*

Informant R indicated that in 2014, the expenses associated with childbirth and medical care for pregnant women exposed to Schistosomiasis were fully covered by BPJS health insurance.

*"It's heartbreaking - they're struggling financially, with the husband just being a farmer. Their home is way out in that remote area too. Thankfully she has BPJS (national health insurance), so the treatment was free." (Informant R)*

## **Discussion**

### **Schistosomiasis screening and diagnosis system in pregnant women**

Pregnant women living in schistosomiasis-endemic regions face a risk of exposure comparable to that of the general population, particularly those engaged in agricultural activities near infested water sources. A case reported in 2014, involving a pregnant woman who tested positive for schistosomiasis, underscores the need for targeted screening or early detection strategies for this vulnerable group, despite the low incidence of cases. It is important to note that further cases may remain undetected, as most were identified incidentally through mass stool screening efforts. This indicates that such screening programs may not sufficiently reach all segments of the population.

Following the Regulation of the Minister of Health of the Republic of Indonesia

Number 21 of 2021, early detection of diseases in pregnant women can be done through minimum standard services known as 10 T, including weighing, measuring upper arm circumference, measuring blood pressure, measuring fundal height of the uterus, calculating fetal heart rate, determining fetal presentation, tetanus immunization, giving iron tablets, routine and special laboratory examinations (blood type examination, Hemoglobin levels, urine protein levels, blood sugar levels, malaria, syphilis, HIV, hepatitis and tuberculosis), and management or handling of cases.<sup>8</sup>

In regions where schistosomiasis is endemic, it is crucial to implement screening for schistosomiasis in pregnant women. This approach is crucial for the early detection and prevention of severe complications associated with schistosomiasis, including anaemia and malnutrition. These conditions can lead to low birth weight (LBW) and premature births. According to Friedman, it is vital to identify and assess the impact of schistosomiasis infection on pregnant women through observational research and therapeutic studies, as this can significantly enhance the quality of newborns in affected areas.<sup>9</sup>

The diagnostic approach for Schistosomiasis starts with the examination of stool specimens using microscopy. The Kato-Katz method, endorsed by the World Health Organisation and currently employed in the Schistosomiasis Laboratory in Napu, is recognised for its accuracy, practicality, and cost-effectiveness. This method, specifically designed for detecting *Schistosoma japonicum*, achieves 100% accuracy.<sup>10</sup> The examination tools utilised were provided at no cost through initiatives supported by the Ministry of Health, the Poso District Office, and the Research and Development Agency, all aimed at enhancing health infrastructure to combat Schistosomiasis in the endemic region of Napu.

Schistosomiasis screening and treatment in the Napu endemic area are conducted annually as part of the government's initiative to mitigate the variable incidence of the disease. The program has demonstrated success, evidenced by a decline in the number of individuals exposed to Schistosomiasis.<sup>11</sup> Consequently, it may be hypothesized that pregnant women in this region are less susceptible to Schistosomiasis exposure. Typically, pregnant women in the service area of the Napu Community Health Centre engage infrequently in activities outside their homes, such as gardening, rice cultivation, or river-related tasks. Nevertheless, some are still obligated to participate in these activities, particularly in villages classified as "focus areas," such as Toe (Dodolo) and Lanciran, which are situated near the coastal fringe of the village.

The case of a pregnant woman exposed to schistosomiasis in 2014 highlights a critical gap in the government's schistosomiasis control programs in the Napu endemic region,

particularly at the Puskesmas Wuasa. Notably, the patient was denied appropriate treatment with praziquantel due to concerns regarding potential adverse effects on the fetus. This situation underscores the necessity for the government to prioritize the health and safety of pregnant women in endemic areas, as they represent a vulnerable group at significant risk of schistosomiasis exposure.

One significant challenge in implementing faecal collection initiatives in the North Lore District is the growing disenchantment among the community regarding the annual faecal collection routine. This decline in engagement has negatively impacted faecal examination coverage in various villages, including Wuasa Village. The coverage of faecal examinations in Wuasa is notably lower than that of treatment due to multiple factors. Notably, the Wuasa community possesses a high level of knowledge and awareness regarding Schistosomiasis, which may contribute to reduced participation. Additionally, the geographical positioning of Wuasa Village—located in the centre of the sub-district—renders it somewhat distanced from disease focus areas. While some community members express satisfaction with the current examination process, a contingent remains that prefers a more adaptable examination schedule.

### **Schistosomiasis treatment system in pregnant women**

Stool tests and mass treatment interventions indicated a significant reduction in the incidence of Schistosomiasis cases across the villages when compared to previous years. However, health officials express concern regarding a potential decline in mass treatment coverage. This apprehension stems from reported side effects of Praziquantel, which include episodes of fainting among recipients.<sup>12</sup> Additionally, the requirement for patients to administer Praziquantel twice daily raises concerns that individuals may experience psychological distress associated with the necessity of repeated medication administration.<sup>13,14</sup>

Praziquantel is considered to have a lower toxicity profile compared to historically utilised medications. The incidence of allergic reactions to praziquantel varies but typically includes symptoms such as dizziness, nausea, headache, vomiting, and, in some instances, fainting. The recommended dosing regimen for praziquantel is based on body weight, at a rate of 60 mg/kg. For instance, a patient with a body weight of 40 kg should receive a total of 2,400 mg per day, which equates to two tablets. The dosage is administered in two divided doses—one in the morning and another in the evening—with a recommended interval of 4 to 6 hours between doses. Patients will take one tablet in the morning and another in the evening.<sup>15</sup>

Extensive research has been conducted on the safety of praziquantel in pregnant women across various countries endemic to schistosomiasis, except for Indonesia. The findings consistently suggest that praziquantel does not pose significant risks to the fetus.<sup>16,17</sup>

Consequently, the Indonesian government, particularly in regions endemic to Napu schistosomiasis, should confidently administer treatment to pregnant women who test positive for the disease. This recommendation is further supported by feedback from pregnant women, who express trust in their healthcare providers and a strong willingness to engage in mass treatment initiatives. Notably, these women are open to receiving praziquantel despite being informed of potential side effects, such as dizziness, nausea, vomiting, and fainting.

Health centre officers have proactively addressed the anticipated side effects associated with the mass treatment program for Schistosomiasis. To mitigate these effects, additional medications such as Paracetamol, Chlorpheniramine Maleate (CTM), Antacids, and Vitamin B6 were administered. This approach is consistent with findings by Tandi, which documented a similar practice during a 2013 treatment initiative in Kaduwaa village, where patients received Paracetamol, CTM, and oral rehydration solutions in response to side effects like fever and allergic reactions following the administration of Praziquantel.<sup>18</sup> The treatment regimen for Schistosomiasis adhered to the technical guidelines established by the Sub-Directorate of P2B2 within the Directorate General of PPM and PLP, Ministry of Health, Republic of Indonesia, reflecting a rational and structured approach.

The prohibition against administering Praziquantel to pregnant women by healthcare professionals in North Lore District lacks a foundation in established regulations. This restriction is rooted in Regulation of the Minister of Health of the Republic of Indonesia No. 19 of 2018 regarding the Eradication of Snail Fever. The regulation comprehensively outlines activities for Schistosomiasis eradication, particularly in Article 13. Paragraph 1 specifies that Mass Prophylactic Drug Administration (Pemberian Obat Pencegahan Secara Massal, POPM) for snail fever is to be implemented for residents aged five and above in endemic regions. Article 13, paragraph 2, further indicates that the administration of POPM is to be deferred for pregnant women and individuals with severe illnesses.<sup>19</sup> However, this regulation does not delineate an exception for the administration of Praziquantel to breastfeeding mothers, making the prohibition against its use in this group unfounded. This situation suggests a possible oversight within the Schistosomiasis endemic area that necessitates urgent rectification through further research into the safety and effects of Praziquantel on breastfeeding mothers in the Napu endemic region.

The association between Praziquantel and fertility can be elucidated through a case report from the Jos Plateau, a known Schistosomiasis-endemic region in north-central Nigeria. A 40-year-old male presented with erectile dysfunction and perceived infertility after a decade of marriage. Although he had a history of alcohol use, he did not engage in drug use that could

affect his sexual function, nor was he a cyclist, which could compromise sperm production. Testicular examinations were unremarkable for nodules; however, sperm analysis revealed oligospermia. A biopsy of the left testicle identified *S. mansoni* eggs within the connective tissue. The patient underwent treatment with Praziquantel and Vitamin C, which effectively resolved his erectile dysfunction and restored sexual productivity within his marriage. The oligospermia was attributed to chronic lymphocytic infiltration and swelling resulting from the presence of worm eggs. This case highlights that early detection and treatment with Praziquantel can prevent infertility related to Schistosomiasis.<sup>20</sup>

### **Schistosomiasis referral and insurance system for pregnant women**

To effectively combat Schistosomiasis, it is essential to not only focus on eradication efforts but also to evaluate the implementation of these activities. This evaluation ensures that, in the event of complications arising from Schistosomiasis in pregnant women or the broader community, the government can optimize the referral system. Additionally, establishing a synergistic and integrated insurance framework will enable affected individuals to access targeted and comprehensive health services.

Following Law Number 40 of 2004 regarding the National Social Security System (Sistem Jaminan Sosial Nasional, SJSN) and Law Number 24 of 2011 about the Social Security Administering Body, BPJS Kesehatan commenced operations on January 1, 2014. As a public legal entity, BPJS Kesehatan is responsible for overseeing a comprehensive health insurance initiative that covers all citizens of Indonesia. The primary objective of this National Health Insurance program is to ensure access to adequate health services for all individuals who either pay contributions or have their contributions covered by the Government.

The BPJS Obstetrics and Neonatal Services aims to ensure comprehensive care during pregnancy, childbirth, the postpartum phase, and the management of post-abortion haemorrhage. It encompasses postpartum family planning services and addresses complications associated with pregnancy and childbirth. Delivery services are organized in a systematic, tiered framework that follows established referral protocols.

Schistosomiasis is among the 155 diseases covered by BPJS Kesehatan at Primary Health Facilities. Consequently, individuals seeking schistosomiasis screening and treatment outside of the scheduled mass or selective treatments can access these services free of charge at registered Puskesmas. The management of complications arising from schistosomiasis will be under the guidelines and policies established by referral hospitals in Palu and other cities collaborating with BPJS Kesehatan.

In the Napu endemic area, the referral system operates as an integrated framework

between the Schistosomiasis Laboratory and the Puskesmas Wuasa. When residents receive a positive Schistosomiasis diagnosis from laboratory personnel outside of scheduled mass screenings, they are subsequently referred to the Puskesmas Wuasa for treatment. For pregnant women, the village midwife communicates the test results to the Schistosomiasis Laboratory for validation. The laboratory staff then refer these cases to the Puskesmas Wuasa for treatment and management under the oversight of the attending physician.

This study possesses several limitations that should be acknowledged. Conducted in a specific setting with a limited sample size, the findings may not be broadly applicable. The research depended on self-reported data obtained through interviews, which could introduce potential bias or inaccuracies. Furthermore, the brief data collection period may not adequately reflect seasonal variations or long-term trends in the management of Schistosomiasis. To corroborate these results, further research is warranted, utilising larger and more diverse samples along with longitudinal data.

### **Conclusion**

The government's Schistosomiasis eradication program has made notable progress; however, it fails to adequately address the health needs of pregnant women in endemic areas, particularly in the Puskesmas Wuasa of Poso Regency. This population is at heightened risk for Schistosomiasis, and current government regulations, as outlined in Minister of Health Regulation Number 19 of 2018, conflict with WHO recommendations for treating expectant mothers. While the government has its reasons for postponing treatment, a collaborative effort involving health organizations is essential for a comprehensive reassessment and solution for pregnant women with Schistosomiasis. Effective management of complications can be achieved through coordinated care, including nutritional support and careful monitoring during pregnancy and delivery. A structured referral system had linked the Schistosomiasis Laboratory with the Puskesmas Wuasa, which facilitates the management of Schistosomiasis under the BPJS Health insurance scheme. This system ensures coverage for delivery costs and enables timely referrals for cases with complications, allowing for appropriate treatment from healthcare providers.

### **Conflicts of Interest**

Nothing to declare.

### **Funding sources**

Nothing to declare.

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## Serial Case of Acute Pulmonary Embolism: Different Therapies Based on Different Patient Profiles

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### ABSTRACT

Pulmonary embolism (PE) is the third leading cause of cardiovascular death. The high mortality rate prompted an analysis of these three-case series to evaluate various treatment options. Case I, a 66-year-old woman with acute shortness of breath and a history of EVLA because of chronic venous insufficiency in the left leg. She had comorbid of hypertension. She was diagnosed with massive PE with unstable hemodynamics. Catheter-directed thrombolysis (CDT) using Alteplase showed significant improvement within 24 hours. Case II, a 45-year-old woman with dyspnea de effort for one month and a 5-year history of hypertension. MSCT angiography showed a significant PE with partial stenosis, pulmonary hypertension, and a bidirectional atrial septal defect. Combination therapy with heparin, sildenafil, and furosemide had been provided but the patient had sudden cardiac death. Case III, a 36-year-old woman with dyspnea on effort after the delivery. Initial echocardiography showed right atrial and left ventricular thrombi. On the second day of treatment, clinical deterioration occurred due to thrombus migration to the pulmonary artery, confirming the diagnosis of acute PE. CDT therapy was performed. A 24-hour evaluation revealed persistent occlusion of pulmonary artery, leading to percutaneous transluminal angioplasty, which successfully restored blood flow. This case series report emphasizes the importance of risk-based therapy, including CDT for high-risk PE, anticoagulation for intermediate- to low-risk PE, and hemodynamic support in cases of shock.

**Keywords:** Clinical deterioration, heparin, pulmonary embolism, thrombolytic therapy, tissue plasminogen activator



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## **Introduction**

Venous thromboembolism (VTE) represents a significant global health issue, with approximately 10 million cases documented annually, contributing to considerable morbidity and mortality. It ranks as the third leading cause of cardiovascular death and is linked to various inherited and acquired risk factors, alongside aging. While the precise incidence of pulmonary embolism (PE), a serious complication of VTE, remains unclear, it is estimated that nearly one-third of hospitalized patients in the United States are at risk for VTE. The diagnosed incidence of VTE stands at roughly 117 cases per 100,000 people, though the actual prevalence is likely higher due to underdiagnosis, often revealed only at autopsy. Moreover, the number of hospital admissions for PE surged from about 60,000 in 1993 (23 per 100,000) to over 202,000 in 2012 (65 per 100,000), with in-hospital mortality rates ranging from 5% to 10%. The clinical outcomes of PE are influenced by the extent of vascular obstruction and its hemodynamic consequences. Understanding the underlying pathophysiology is crucial for effective patient risk stratification and guiding therapeutic interventions.<sup>1</sup>

Between the years 1997 and 2013, global data indicated a rise in the incidence of diagnosed pulmonary embolism, coinciding with a decline in associated mortality rates. This increase in diagnoses is attributed to the greater utilization of advanced imaging techniques, particularly computed tomography pulmonary angiography (CTPA).<sup>2</sup> Despite the reduction in mortality rates observed until 2013, VTE, a precursor to pulmonary embolism, remains the third leading cause of death within cardiovascular disease, following myocardial infarction and stroke.<sup>3</sup> The significant mortality associated with PE has led to the publication of the present three case series that evaluate variations in therapeutic approaches for patients with this condition. These findings aim to serve as a reference for optimizing treatment strategies for PE in the future.

## **Case**

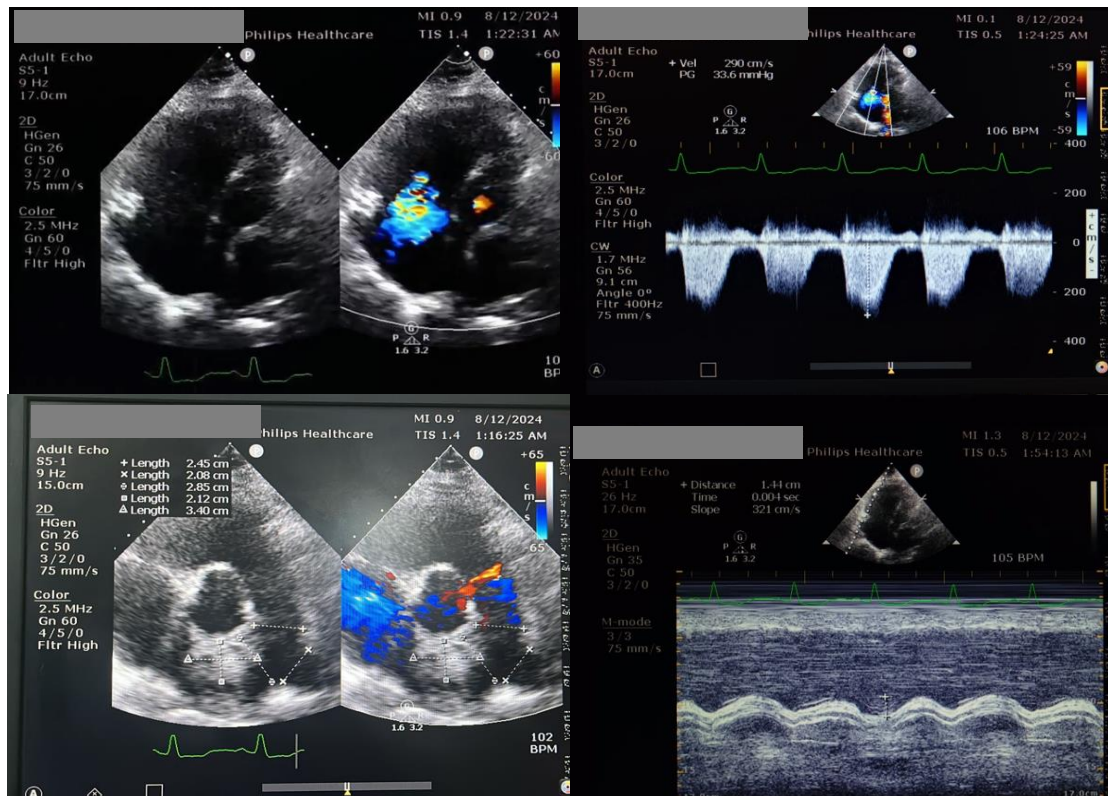
### **Case I illustration**

A 66-year-old female presented with the acute onset of shortness of breath (SOB) 15 hours before admission, with no prior history of respiratory distress. Notably, she reported lower left leg swelling persisting for three weeks, following intermittent episodes over the preceding two months, particularly while sitting with her legs dangling. This swelling was not associated with pain or erythema. Her medical history included cardiovascular risk factors such as hypertension, for which she was prescribed Candesartan 8 mg daily. The patient had a prior hospitalization due to chronic venous insufficiency demonstrated by Doppler examination revealing multiple venous dilations in her left leg. She underwent Endovenous Laser Ablation

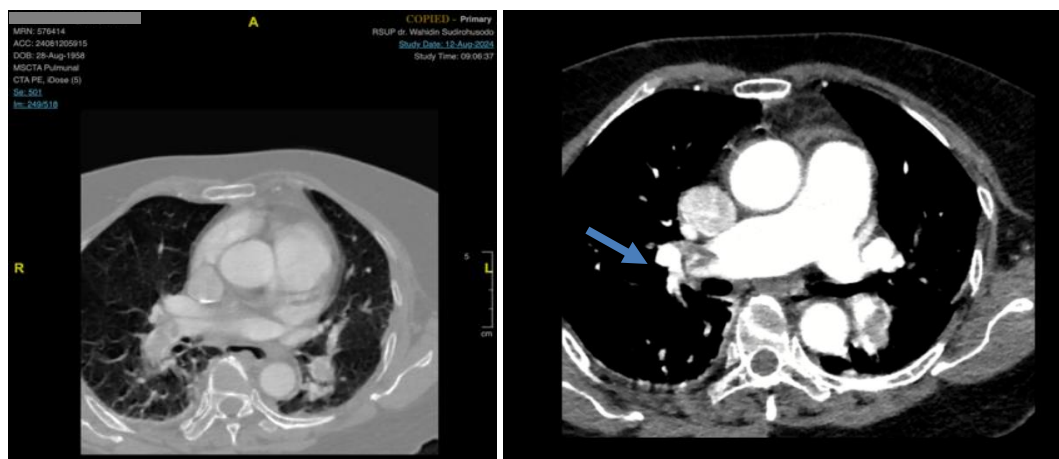
(EVLA) and experience acute heart failure.

The patient was admitted in a conscious state, presenting with a blood pressure of 104/78 mmHg, a pulse rate of 108 beats per minute, a respiratory rate of 30 breaths per minute, a temperature of 36.6°C, and an oxygen saturation of 88% on room air. Conventional respiratory support was initiated using a non-rebreathing mask at 10 Liters per minute, which elevated the oxygen saturation to 98%. Significant findings on physical examination included anemic conjunctivae, elevated jugular venous pressure, and edema of the left lower extremity (with stockings) that was warm to the touch. The patient subsequently developed hemodynamic instability characterized by hypotension (60/40 mmHg). Initial management involved the intravenous administration of 200 cc of fluids, leading to a modest increase in blood pressure to 81/55 mmHg. Inotropic therapy was initiated with dobutamine at 3 mcg/kg body weight/minute and norepinephrine at 0.02 mcg/kg body weight/minute, which resulted in an improved blood pressure reading of 131/80 mmHg. Additionally, the patient received an 80 IU/kg body weight bolus of Heparin followed by a maintenance infusion of 18 IU/kg body weight/hour via a syringe pump.

During the supportive evaluation through electrocardiography (ECG), the patient exhibited sinus tachycardia alongside an S1Q3T3 pattern, indicative of PE. Laboratory findings showed leukocytosis (12,900) and elevated high-sensitivity Troponin I levels. Echocardiography on Figure 1 demonstrated preserved left ventricular (LV) systolic function at 56% (biplane), reduced right ventricular (RV) systolic function with a TAPSE of 1.4 cm, and evidence of diastolic dysfunction. There was dilation of the right atrium (RA) and right ventricle (RV) along with a positive McConnell sign. The LV exhibited a D-shaped morphology, accompanied by massive tricuspid regurgitation and right pulmonary artery (RPA) dilation. A thrombus measuring 3.4 cm × 2.1 cm was observed in the RPA. To corroborate the diagnosis, a contrast-enhanced CTPA was performed and revealed cardiomegaly (left ventricular hypertrophy, LVH) along with evidence of pulmonary hypertension (Figure 2). The scan identified a pulmonary embolism affecting the RPA, specifically in the superior arterial segment, the interlobar pulmonary artery, the lateral basal segment, and the posterior basal segment. Additionally, the left pulmonary artery exhibited emboli in the apicoposterior, anterior, inferior lingula, posterior basal, and lateral basal segments.



**Figure 1.** Initial echocardiogram shows evidence of right ventricular systolic dysfunction along with positive McConnell sign and observed thrombus in the right pulmonary artery.



**Figure 2.** A contrast-enhanced CT pulmonary angiogram was performed, which identified thrombi present in both the right and left pulmonary arteries.

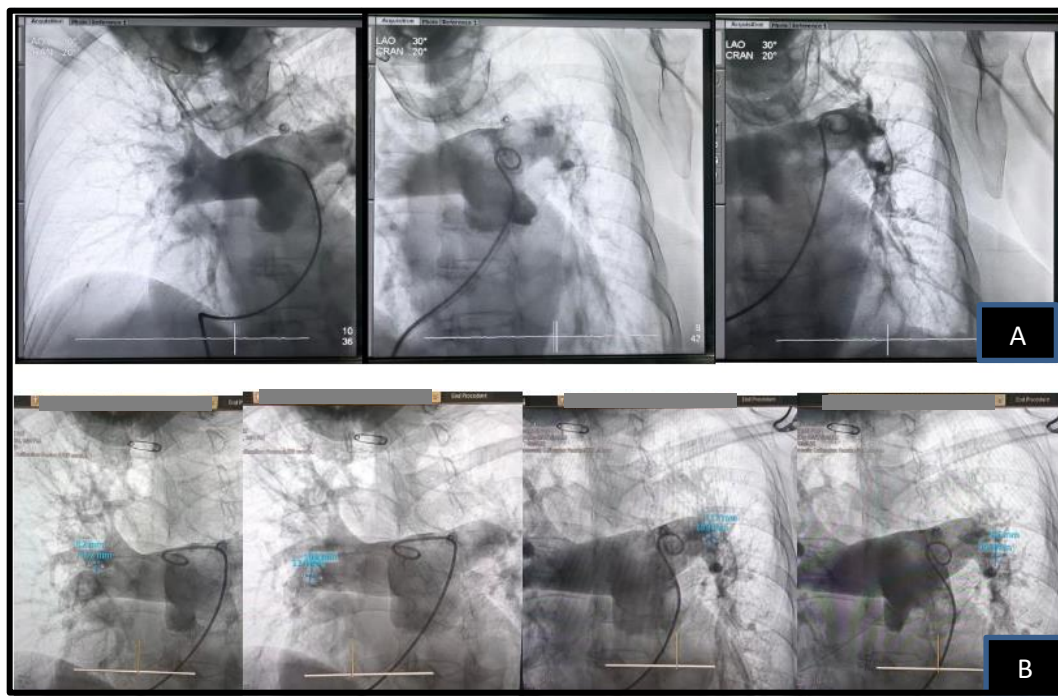
The patient was diagnosed with acute PE accompanied by unstable hemodynamic, prompting the initiation of catheter-directed thrombolysis (CDT) with Alteplase administered at a rate of 0.5 mg/hour via syringe pump. CDT was performed utilizing a 6F pigtail catheter accessed via the femoral vein. Due to facility constraints, the EKOS system was not employed.

The infusion lasted for 24 hours, administering a total of 12 mg of tPA. Post-infusion monitoring of RV systolic function was conducted via echocardiography. To mitigate bleeding risk in this case—given the patient's ARC-HBR 1 Major classification (high bleeding risk)—CDT was selected as the initial approach to minimize bleeding complications. This choice was particularly relevant considering the mortality rate associated with PE post-systemic thrombolysis remains significant (40-50%). Additionally, the thrombus in this patient was confined to the proximal region, further supporting the preference for CDT. Despite a low risk for intracranial bleeding linked to systemic thrombolysis, as indicated by both a PE-CH score of 0 and a BACS score of 0, which suggest a low likelihood of post-thrombolysis intracranial hemorrhage, CDT was deemed the most suitable intervention.

Prior to intervention, pulmonary angiography revealed filling defects suggestive of thrombus at the base of the main pulmonary artery (MPA) and both the left pulmonary artery (LPA) and RPA (Figure 3). A follow-up pulmonary arteriography conducted 24 hours post-CDT indicated a reduction in the size of the filling defects in both the RPA and LPA. Additionally, echocardiographic assessment of right ventricular systolic function, measured by the TAPSE parameter, demonstrated an improvement in right ventricular performance (Initial 1.4 cm to 1.5 cm on Day 1 and 1.7 cm on Day 2). Oxygen saturation increased to 97% on room air. Measurement of the RV/LV ratio and pulmonary artery pressure (PAP) was not conducted in this instance. Additionally, target aPTT monitoring (1.5-2 times the baseline) was omitted due to the prompt decision to proceed with CDT, resulting in no adjustments before the procedure.

### **Case II illustration**

A 45-year-old female was admitted with a one-month history of progressive SOB and dyspnea de effort, accompanied by fatigue during light activities that has intensified over the past month. The patient was referred from an external hospital with a suspected diagnosis of PE and had been started on anticoagulant therapy with Fondaparinux and Dorner. Her cardiovascular history included hypertension for five years, and she was not on any regular medication. Upon examination, her vital signs revealed a blood pressure of 137/67 mmHg, a pulse rate of 125 beats per minute, a respiratory rate of 26 breaths per minute, a temperature of 36.6°C, and an oxygen saturation of 76% on room air. Physical findings included elevated jugular venous pressure (JVP), minimal bilateral leg edema, finger clubbing, and cyanosis.

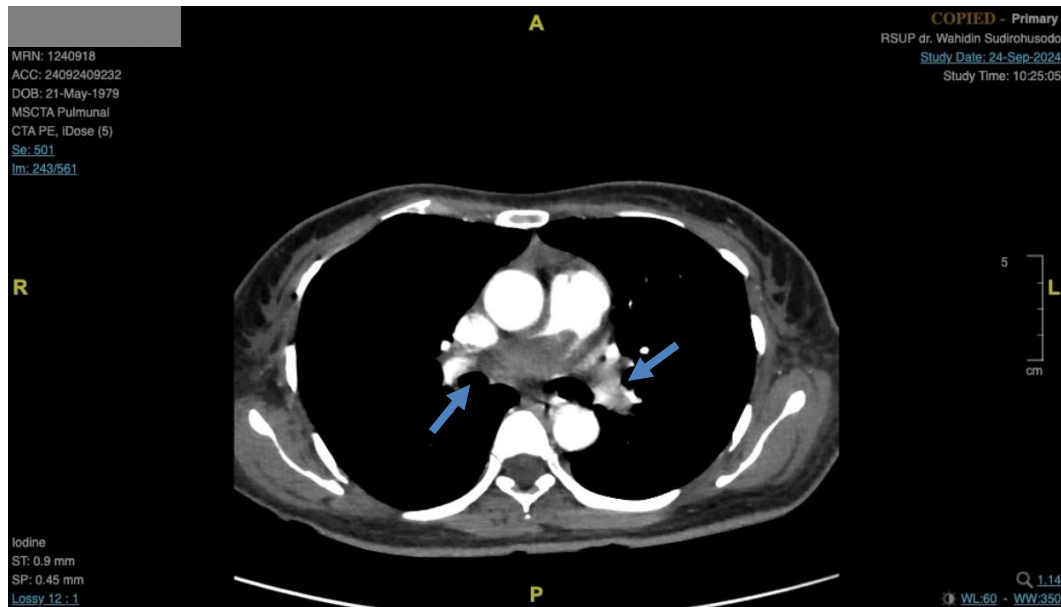


**Figure 3.** Pulmonary arteriography before (A) and after (B) catheter-directed thrombolysis.

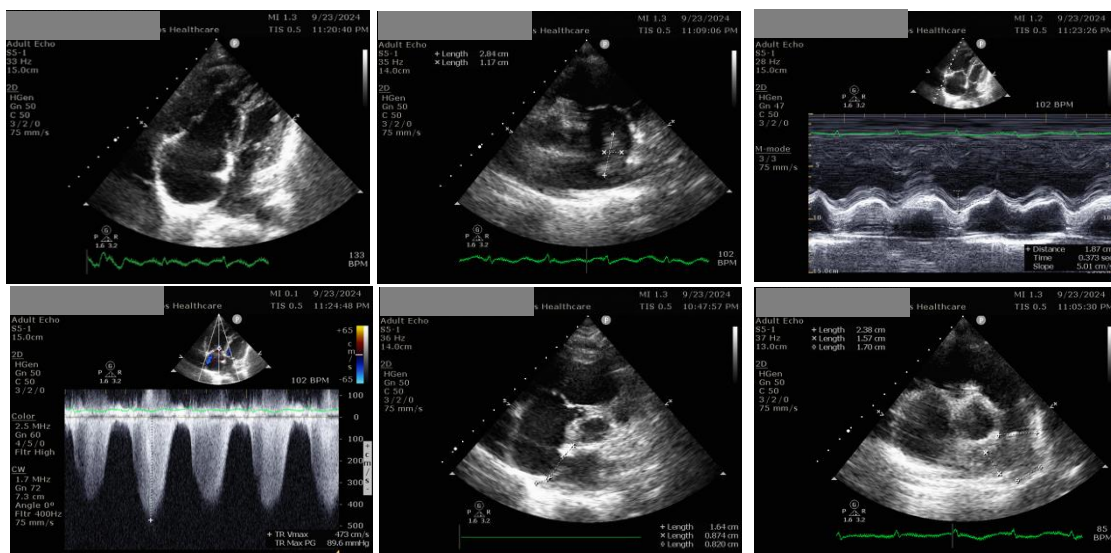
On ECG, the patient exhibited sinus tachycardia and LVH, findings that correlated with the chest radiograph, which demonstrated cardiomegaly with a cardiothoracic ratio of 0.56. Laboratory assessments conducted at the referring hospital revealed leukocytosis (10,600/mcl) and an elevated D-dimer level of 585.46 ng/mL. Subsequently, the patient underwent a chest MSCT scan, which identified filling defects throughout the luminal pathway, extending from the pulmonary trunk to both the RPA and LPA. Notably, these defects remained evident distal to the right pulmonary artery emboli and slightly beyond the left pulmonary artery (Figure 4). An echocardiogram showed dilation of the MPA along with a thrombus within it, a secundum atrial septal defect (ASD) with a bidirectional shunt, as well as RA and RV dilation, while LV and RV systolic function remained normal. A CTPA further confirmed PE in the MPA and both RPA and LPA, resulting in partial stenosis, bilateral pneumonia, and cardiomegaly associated with the ASD (Figure 5).

Upon examination, the patient was diagnosed with intermediate-risk acute PE (Geneva score 5, Wells score 1.5, PESI score 95 points, moderate mortality risk: 3.2-7.1%), pulmonary hypertension type 1 dd/type 4, and a bidirectional shunt due to ASD. A patient with an unknown previous bolus dose of unfractionated heparin (UFH) received continuous heparin infusion at a rate of 18 IU/kg/hour via a syringe pump, along with oral sildenafil 20 mg every 8 hours and intravenous furosemide 40 mg every 24 hours. The patient subsequently suffered a sudden hemodynamic decline following a Valsalva maneuver during defecation. At that time,

peripheral oxygen saturation was observed to be 42-50% in all four extremities, without further diagnostic evaluations, such as echocardiography, ECG, or CT scan. Despite efforts at cardiopulmonary resuscitation, the patient experienced cardiac arrest and was pronounced deceased. The definitive cause of death remained uncertain.



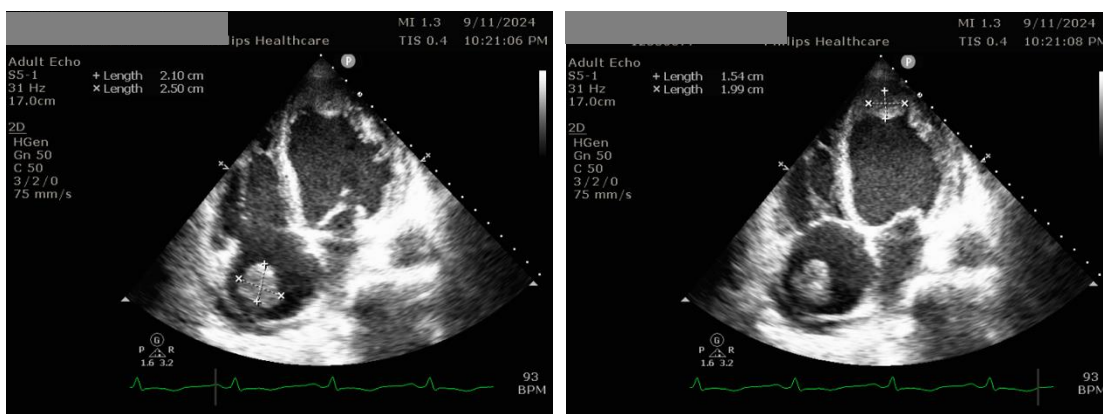
**Figure 4.** CT pulmonary angiography findings revealed a filling defect nearly occluding the entire lumen of the main pulmonary artery, extending from the bifurcation to both the right and left pulmonary artery.



**Figure 5.** Echocardiography results on initial assessment revealed a secundum atrial septal defect.

### Case III illustration

A 36-year-old woman presented with worsening SOB over 10 days prior to admission, associated with orthopnea, exertional dyspnea, and paroxysmal nocturnal dyspnea (PND). She reported a history of SOB during physical exertion, which began after the birth of her third child one month earlier. Upon examination, the patient was hemodynamically stable, with a JVP of +3 cm H<sub>2</sub>O. Auscultation revealed bilateral rhonchi, and physical examination noted ascites with shifting dullness and bilateral pretibial edema. Hb of 10.4 g/dL and thrombocyte of 152.000/mcl were found on laboratory examinations. An ECG revealed sinus tachycardia, poor R-wave progression (PRWP), and LVH with strain, findings that correlated with chest X-ray results indicating cardiomegaly and pulmonary edema. Echocardiography revealed multiple LV thrombi were found with the largest size of 1.54x1.99 cm in the apical LV and RA thrombi measuring 2.1 x 2.5 cm. In addition, the LVEF was 23.9% on BIPLANE analysis (Figure 6).

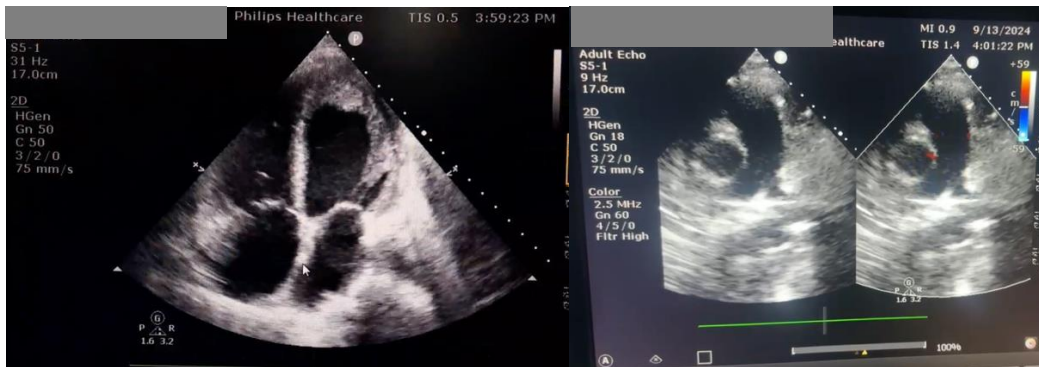


**Figure 6.** Echocardiography revealed a left ventricular ejection fraction of 23.9% alongside multiple thrombi in the left ventricle and a mobile thrombus on the right ventricle.

The patient was diagnosed with New York Heart Association (NYHA) Class IV congestive heart failure, peripartum cardiomyopathy (PPCM), RA thrombus, and multiple LV thrombi. Consequently, she received heart failure management, which included an initial bolus of heparin at a dose of 60 IU/kg body weight, followed by a continuous maintenance infusion of 12 IU/kg body weight per hour via a syringe pump. Targeted aPTT monitoring was conducted, aiming for a range of 1.5 to 2 times the baseline. Initial measurements increased from 29.9 IU to 42.4 IU. The therapeutic target was achieved by the following day, and uptitration was scheduled for the second day.

On the second day of treatment, the patient experienced an abrupt onset of SOB,

accompanied by cold sweats. Oxygen saturation plummeted from 98% to 73%, blood pressure fell to 77/50 mmHg, and the respiratory rate increased to 32 breaths per minute. An echocardiographic evaluation for intracardiac thrombus revealed that a thrombus in the RA had migrated (Figure 7). The patient was subsequently diagnosed with Acute PE.



**Figure 7.** Echocardiography evaluation revealed that a thrombus in the right atrium had migrated.

Pulmonary arteriography demonstrated a filling defect in the RPA, suspected to be a thrombus, resulting in total occlusion of the lower lobe of the RPA (Figure 8). Consequently, thrombolytic therapy was initiated with CDT using Alteplase at a rate of 1 mg/hour for 24 hours. A 6F pigtail catheter was utilized for CDT via femoral vein access. Due to limited resources, EKOS monitoring was not implemented. The CDT was conducted over 24 hours with a total alteplase (tPA) dose of 24 mg. Notably, echocardiographic evaluation of RV systolic function, specifically the TAPSE parameter, was not carried out in this instance. Post-CDT, oxygen saturation increased from 77% to 97% on room air; however, the patient still presented with tachycardia at 130 beats per minute and tachypnea at 25 breaths per minute. Consequently, pulmonary arteriography was repeated to assess flow in the inferior segment of the right pulmonary artery. The RV/LV ratio and pulmonary artery pressure (PAP) were not evaluated. To manage bleeding risk, an evaluation was conducted, resulting in an ARC-HBR score indicative of 1 Major (high bleeding risk), leading to the decision for CDT over systemic thrombolysis. Given that the thrombus remained at a proximal level, CDT was deemed the preferred approach.

Follow-up arteriographic evaluation after this period showed persistent total occlusion of the lower lobe of the RPA. As a result, the procedure was extended to include percutaneous transluminal angioplasty (PTA) targeting the lower lobe lesion. Mechanical thrombectomy with PTA was conducted utilizing a Boston Scientific Mustang balloon catheter measuring 8

mm x 80 mm (135 cm), which gradually inflated to pressures ranging from 10 to 18 atm. Aspiration was not performed due to limitations within the facility, and no stents were deployed during the procedure. The PTA intervention proceeded without any reported intraprocedural complications. The final outcome revealed restored flow to the middle and lower lobes of the RPA, leading to the conclusion of the procedure. Heparinization was recommended for five days. Table 1 summarizes the demographics and clinical timelines for all three presented cases.



**Figure 8.** Results of pre-CDT (A) and post-CDT arteriography accompanied by PTA (B).

## Discussion

### Comparison of diagnosis, severity, and risk stratification of pulmonary embolism between three cases

The diagnosis of PE is grounded in the assessment of clinical presentation and hemodynamic stability. Initially, the identification of PE is guided by the presence of specific symptoms, followed by probability evaluations that incorporate the Pulmonary Embolism Rule-out Criteria (PERC) score, plasma D-dimer levels, and various imaging modalities. These imaging techniques include CTPA, lung scintigraphy (V/Q scintigraphy), pulmonary angiography, magnetic resonance angiography, echocardiography, compression ultrasonography, and computed tomography venography. For patients with stable hemodynamics, this diagnostic algorithm can be undertaken; however, in cases of unstable hemodynamics, direct imaging—such as echocardiography or CTPA—should be prioritized over probability testing.<sup>3</sup>

**Table 1.** Summarization of demographics and clinical timelines of presented cases.

Descriptor	Case 1	Case 2	Case 3
<b>Sex</b>	Female	Female	Female
<b>Age</b>	66 years old	45 years old	36 years old
<b>Comorbidities</b>	Hypertension, NSTEMI, acute heart failure, chronic venous insufficiency	Hypertension, Pneumonia, Cardiomegaly associated with ASD and Eisenmenger syndrome	Congestive heart failure, peripartum cardiomyopathy
<b>Onset-admission-intervention intervals</b>	<b>Onset-admission (cardiac center):</b> 15 hours	<b>Onset-admission (cardiac center):</b> 1 month	<b>Onset-admission (cardiac center):</b> 10 days
	<b>Admission-intervention:</b> 24 hours (admission at weekend)	<b>Admission-intervention:</b> No intervention (Sudden cardiac death before procedure)	<b>Admission-intervention:</b> 2 hours
<b>Key lab values</b>	Leukocytosis 12,900/mcl Elevated hs-Troponin I	Leukocytosis (10,600/mcl) and an elevated D-dimer level of 585.46 ng/mL	Hb 10.4 g/dL, Thrombocyte 152,000/mcl
<b>Imaging findings</b>	Reduced RV systolic function, McConnell sign (+), thrombus at right, left, and base of main PA	Filling defect at entire lumen of MPA, RPA, and LPA  MPA dilation with thrombus, ASD with bidirectional shunt, RA and RV dilation	LVEF 23.9% (BIPLANE), Migrated thrombus from RA, total occlusion of the lower lobe RPA
<b>Interventions performed</b>	CDT + Alteplase	Nil (sudden cardiac death before intervention)	1 <sup>st</sup> : CDT + Alteplase (Nonresponse)  2 <sup>nd</sup> : PTA
<b>Short-term outcomes</b>	Changes in TAPSE (+, 1.4 cm > 1.5 cm Day 1, 1.7 cm Day 2), oxygen saturation (97%)	Oxygen saturation (73%) following with sudden cardiac death	Oxygen saturation (77%>97% room air)
<b>Long-term outcomes</b>	Survive	Not Survive	Survive

ASD: Atrial Septal Defect, CDT: Catheter Directed Thrombolysis, LPA: Left Pulmonary Artery, MPA: Main Pulmonary Artery, NSTEMI: Non-ST Elevation Myocardial Infarct, PA: Pulmonary Artery, PTA: Percutaneous Transluminal Angioplasty, RA: Right Atrium, RPA: Right Pulmonary Artery, RV: Right Ventricle

In cases of acute PE, patients exhibiting unstable hemodynamics are classified into a

high-risk category. Conversely, in patients with stable hemodynamics, severity and risk stratification are assessed based on the presence of RV dysfunction, as detected via echocardiography or CTPA, along with elevated troponin levels. The first and third patients in this report are identified as having acute PE with unstable hemodynamics, meeting criteria for obstructive shock; the first patient presented with hypotension, recording a blood pressure of 60/40 mmHg, while the third had a blood pressure of 77/50 mmHg. The second patient, classified as having intermediate-low severity and risk, exhibited an sPESI score of 1, indicating tachycardia with a heart rate of 125 beats per minute.<sup>2</sup>

Echocardiography is not necessary for diagnosing PE in hemodynamically stable patients; however, it can be utilized to exclude other potential causes of dyspnea. In contrast, in patients with hemodynamic instability suspected of having acute PE, clear indicators of RV pressure overload, particularly with definitive echocardiographic findings such as the 60/60 sign, McConnell sign, or right heart thrombus, warrant immediate reperfusion interventions if a CTPA cannot be performed promptly, especially in cases with high suspicion and no alternative explanation for RV pressure elevation.<sup>3</sup> This was evident in the first case, where the hemodynamically unstable patient presented in shock, prompting echocardiographic evaluation to exclude other potential causes such as cardiac tamponade, acute valve dysfunction, LV dysfunction, aortic dissection, or hypovolemia. Notably, signs of RV dysfunction were identified, including reduced TAPSE and a McConnell sign, along with a thrombus in the RPA. In the third case, a thrombus was discovered in the RA, which subsequently resolved with significant hemodynamic deterioration. Conversely, the second patient, though hemodynamically stable, underwent echocardiography to rule out differential diagnoses contributing to their symptoms. This assessment revealed a bidirectional shunt due to an ASD, which could mimic RV pressure overload, typically associated with pulmonary embolism during RV function evaluation.

In the first case, the patient underwent a CTPA despite being eligible for immediate reperfusion therapy, given the positive McConnell sign observed on echocardiography and the unstable hemodynamics at the time. A CTPA was also conducted for the second patient to further assess the diagnosis of PE in individuals exhibiting a low to moderate probability of PE, along with elevated D-dimer levels. CTPA findings for the first patient revealed filling defects in both the right and left pulmonary arteries, confirming acute PE. Similarly, the second patient's CTPA displayed substantial filling defects throughout the pulmonary trunk and extending into the right and left pulmonary arteries. However, contrast was still evident distally in the RPA and LPA, thereby corroborating the diagnosis of PE. In contrast, the third patient

could not undergo CTPA due to the examination's unavailability during their acute episode of PE. This patient presented with unstable hemodynamics and demonstrated migration of a previously identified mobile thrombus in the RA. CTPA is a minimally invasive diagnostic tool that offers accuracy comparable to traditional pulmonary angiography, with reported sensitivities of 83% and specificities of 96%. In cases deemed to have a moderate to high probability of PE, the positive predictive value of CTPA escalates to 92-96%. This was exemplified in the first patient, classified with high probability, and the second patient with moderate probability, thereby providing conclusive evidence of PE in both cases.<sup>3</sup>

Pulmonary angiography remains the gold standard for diagnosing PE; however, its use has declined due to the high accuracy of CTPA. A definitive diagnosis of acute PE is established when there is direct evidence of a thrombus, characterized by either a filling defect or an interruption of blood flow within a pulmonary artery branch. This was evidenced in the first and third patients who underwent pulmonary angiography, which confirmed the presence of thrombus in the pulmonary artery.

### **Comparison of acute pulmonary embolism therapy selection between the three cases**

The classification of severity and risk stratification for PE is crucial for determining the timing of therapeutic intervention as per the established algorithms.<sup>3</sup> In this case, the first and third patients were assessed using the first algorithm, while the second patient followed the second algorithm—the first patient presented with suspected high-risk acute PE characterized by unstable hemodynamics. An echocardiographic examination was conducted immediately, revealing RV dysfunction. Subsequently, a CTPA was performed after the patient's condition was stabilized with supportive therapies, including norepinephrine and dobutamine. It is recommended that CTPA be conducted promptly once hemodynamic stability is achieved with such support. The CTPA results indicated a filling defect consistent with thrombus in the pulmonary artery, prompting the decision to initiate immediate reperfusion therapy. Notably, RV dysfunction identified via echocardiography alone is considered adequate to commence reperfusion therapy in PE patients with unstable hemodynamics. This was illustrated in the third patient, where echocardiography conducted prior to embolism revealed a thrombus in the RA, further supporting the need for urgent intervention in such clinical scenarios.

In cases where PE is suspected and hemodynamic stability is present, the initial evaluation should include a D-dimer assay, particularly for patients categorized as having a low-to-moderate probability. Should the D-dimer results be elevated, a subsequent CTPA is warranted. Conversely, in patients deemed to have a high probability of PE, CTPA should be prioritized as the first-line diagnostic tool.<sup>3</sup> This approach was exemplified in our second

patient, who, despite stable hemodynamics, was assessed using a probability test that yielded intermediate results. The elevated D-dimer levels prompted a further evaluation with CTPA, which confirmed the diagnosis. Consequently, the patient was initiated on therapy for PE.

In cases of suspected PE accompanied by hemodynamic instability, the preferred approach is primary reperfusion therapy, which may involve systemic thrombolysis or surgical or transcatheter embolectomy. Administration of reperfusion therapy within 48 hours of symptom onset is crucial, as it has demonstrated a significant reduction in both mortality and the risk of recurrent PE.<sup>3</sup> In patients with acute PE, the risk of death and major bleeding complications (intracerebral hemorrhage) is lower with catheter-directed thrombolysis (CDT) compared with systemic thrombolysis. When compared with anticoagulation alone, CDT is associated with a lower risk of death but the same risk of intracerebral haemorrhage.<sup>5-7</sup> This suggests that CDT has a better safety profile than ST, making it recommended as first-line therapy in cases of acute PE.<sup>6,7</sup>

Before initiating primary reperfusion therapy in the initial patient, several supportive measures were implemented. Following the management algorithm for high-risk PE, this patient was identified as a suspected high-risk case. In cases classified as either high or intermediate probability, parenteral anticoagulants should be administered even prior to the availability of diagnostic test results. The preferred anticoagulant options are low-molecular-weight heparin (LMWH) or fondaparinux, as they present a lower risk of major bleeding and heparin-induced thrombocytopenia (HIT) compared to unfractionated heparin (UFH). Current guidelines limit the use of UFH primarily to patients exhibiting significant hemodynamic instability or those on the verge of hemodynamic decompensation who are scheduled to receive primary reperfusion treatment.<sup>3</sup> In the case of the first patient with unstable hemodynamics, the recommended parenteral anticoagulant regimen involved an initial bolus of 80 IU/kg body weight of intravenous heparin. The patient was classified as ARC-HBR 1 Major, indicating a high risk of bleeding. Consequently, CDT was selected over systemic thrombolysis. Despite a PE-CH score of 0 and a BACS score of 0, reflecting a low predicted risk of intracranial bleeding following thrombolysis, CDT was preferred due to the significant mortality associated with PE post-systemic thrombolysis, which ranges from 40-50%. Additionally, the thrombus in this patient remained at a proximal level, further supporting the choice of CDT.

The patient received 200 cc of normal saline intravenously, leading to an increase in blood pressure; however, the patient remained classified as hypotensive. In response, inotropic and vasopressor agents were administered, along with oxygen supplementation, due to desaturation with oxygen saturation levels below 90%. Typically, the initial approach to

manage hemodynamic instability includes enhancing RV preload through intravenous fluid boluses, as demonstrated in the first patient who was given normal saline to address hypotension. Nonetheless, excessive volume resuscitation can exacerbate RV failure by overstretching the RV, heightening wall stress, aggravating RV ischemia, diminishing contractility, and inducing further interventricular septal shift towards the LV. This shift can impede LV filling and systemic cardiac output. An initial trial of intravenous fluids is most effective in patients with no signs of elevated right-sided preload, particularly those with central venous pressure (CVP) under 15 mmHg. In contrast, for patients with a CVP exceeding 15 mmHg, volume administration should be avoided, and the initial intervention should focus on administering vasopressors and inotropics while awaiting definitive therapy.<sup>8</sup> Consequently, as normal saline administration did not improve the patient's hemodynamic status, the subsequent course of action involved administering Norepinephrine and Dobutamine.

In patients with high-risk PE, the ideal agent for hemodynamic support should enhance RV function through positive inotropic effects while ensuring adequate systemic arterial perfusion pressure. Norepinephrine, epinephrine, and dopamine exhibit a dual mechanism, acting as both inotropes and vasopressors.<sup>8</sup> Norepinephrine, in particular, has the capacity to improve systemic hemodynamics by increasing coronary perfusion without significantly altering pulmonary vascular resistance (PVR).<sup>3</sup> Thus, it is recommended as the initial agent for hemodynamic support in patients with high-risk PE. In cases where RV contraction needs to be improved to boost cardiac output, inotropic agents such as dobutamine become essential. Furthermore, the use of vasopressors is critical when administering these inotropic agents to ensure adequate end-organ perfusion.

Thrombolysis with CDT delivers thrombolytic agents directly to the pulmonary artery, utilizing a lower total dose than systemic administration and can be performed with or without ultrasound guidance. The use of ultrasonography in CDT enhances the binding of tPA to fibrin cross-links, accelerating thrombolysis. Small, randomized trials involving patients with intermediate-risk PE have demonstrated that ultrasound-facilitated CDT is more effective in reducing pulmonary artery pressure and right ventricular strain indicators on imaging compared to anticoagulation alone. Dosing regimens reported in various studies range from 8 to 24 mg of tPA administered over 4 to 24 hours.<sup>9</sup> Other analyses indicate that alteplase may be given at doses of 0.5 to 1.0 mg/hour into one or both main pulmonary arteries for durations of up to 24 hours, typically accumulating to a total dose of less than 30 mg and not exceeding 24 hours of infusion.<sup>10</sup> In the first and third patients, neither exhibited absolute contraindications to systemic thrombolysis. However, both presented high-risk bleeding profiles; the first patient

met one major criterion (hemoglobin at 10.2 g/dL) and one minor criterion (eGFR at 54 mL/min/1.73 m<sup>2</sup>), while the second met one major criterion (hemoglobin at 10.4 g/dL). To mitigate the risk of intracerebral hemorrhage, which is associated with systemic thrombolysis, we opted for CDT in these cases, given the low dose of thrombolytic agents employed. Additionally, the patients were treated in a facility equipped with the appropriate infrastructure for CDT, solidifying its selection as the optimal therapeutic approach.

Local CDT enables the targeted infusion of low-dose thrombolytic agents into the pulmonary artery or directly onto the thrombus, with the option to fragment the thrombus prior to drug injection. Thrombolytic agents can be administered through a pigtail catheter for intrathrombus delivery, and nearly all thrombolytics are applicable in this manner. Although definitive evidence is lacking, it is recommended that CDT be initiated within 60 minutes of establishing the indication for the procedure (rather than from the time of PE diagnosis) in patients already at a healthcare facility equipped for CDT. For patients requiring transfer to such a facility, this intervention should commence within 90 minutes of the initial assessment. It is crucial to highlight that the allotted time frame pertains strictly to the clinical indication for CDT, not the diagnostic timeline of the PE. In cases of hemodynamic instability, immediate initiation of CDT is indicated. However, before proceeding with invasive interventions, a CTPA is advisable to evaluate the location of the embolus. Patients with acute lobar or proximal pulmonary emboli derive greater benefit from CDT compared to those with segmental disease. In scenarios where patients are hemodynamically unstable and unable to undergo CTPA, direct pulmonary angiography may be performed ahead of CDT.<sup>10</sup> This approach is consistent with the presentations of the initial and third patients referenced, who exhibited pulmonary emboli in the lobar arteries, highlighting the appropriateness of CDT in such cases.

In the context of performing CDT, it is essential to note that the administration of anticoagulants should continue post-procedure, unless there are absolute contraindications, while consistently monitoring activated clotting time (ACT) or activated partial thromboplastin time (aPTT) values. Currently, there is no clear guideline indicating whether heparin dosing should be adjusted during CDT.<sup>10</sup> Anticoagulants are typically prescribed following a standard 5-day regimen. After CDT, the transition to oral anticoagulants can occur once heparin administration has been completed.<sup>3</sup> Potential complications associated with this procedure include hemodynamic decompensation, respiratory failure, alveolar hemorrhage, pulmonary artery perforation, contrast-induced acute kidney injury, hemolysis, and hematoma formation at the vascular access site. These complications may vary based on the technique and system utilized.<sup>10</sup>

In the first patient, after 24 hours of CDT using rt-PA (Alteplase at 0.5 mg/hour), a follow-up pulmonary angiography demonstrated a reduction in the size of the RPA and LPA filling defects. This was accompanied by clinical improvement and enhanced RV systolic function, as indicated by TAPSE parameters obtained via echocardiography. These findings align with the fundamental objective of acute PE management: reducing RV afterload through the dissolution of pulmonary artery thrombus. Notably, in this case, complete thrombus removal is not typically required to achieve hemodynamic stabilization. Indicators such as increased systemic blood pressure and/or decreased heart rate reflect a reduction in pulmonary obstruction and enhanced RV dimensions and function, as substantiated by the elevated TAPSE values, which can result from partial recanalization. Consequently, in this initial case, reperfusion therapy with CDT can be deemed successful.

In the third patient, pulmonary angiography performed post-CDT using the rt-PA regimen (Alteplase at 1 mg/hour) revealed similar findings to those seen in the pre-CDT angiography. Specifically, a significant filling defect was noted, indicating a total occlusion in the inferior lobe of the RPA. Consequently, the decision was made to proceed with mechanical thrombectomy via PTA. Despite improvements in several hemodynamic parameters, including a mean arterial pressure (MAP) of 83 mmHg without support, the patient was still categorized as having failed reperfusion therapy. This was evidenced by persistent tachycardia and tachypnea, albeit with a slight reduction in severity. Therefore, an escalation in reperfusion therapy was warranted for this patient. Furthermore, research has shown that mechanical thrombectomy leads to a reduced incidence of perioperative bleeding complications and improved hemodynamic outcomes, including decreased pulmonary hypertension and myocardial infarction, compared to CDT. Additionally, long-term rates of chronic pulmonary hypertension and right heart failure were also found to be lower, underscoring the advantages of pulmonary thrombectomy over CDT in this scenario.<sup>11</sup> Although specific guidelines for escalating reperfusion therapy in high-risk acute PE are lacking, evidence suggests that early intervention (within 12 hours) correlates with improved outcomes, characterized by decreased hemodynamic decompensation, reduced intensive care requirements, and shorter hospital stays.<sup>12</sup> In this case, the implementation of early reperfusion management in the third patient had a significant impact on survival outcomes.

In patients with acute PE, "treatment failure" pertains to the ineffectiveness of primary reperfusion or anticoagulation therapies. Currently, there are no specific guidelines to evaluate treatment outcomes, whether in high-risk or non-high-risk categories. The assessment of treatment efficacy involves the monitoring of clinical indicators, including consciousness level,

systemic blood pressure, heart rate, respiratory rate, arterial oxygen saturation, and signs of organ hypoperfusion, such as decreased urine output and elevated lactate levels. Echocardiography may be employed to assess changes in right ventricular function. In hemodynamically unstable patients, the escalation of treatment regarding reperfusion therapy is influenced by several factors, including the availability of equipment, the expertise of the healthcare team, and logistical constraints.<sup>10</sup>

In recent years, mechanical thrombectomy has seen significant advances, enabling intervention without the need for thrombolysis. The primary aim of mechanical thrombectomy is to extract the thrombus from the pulmonary artery. Key indicators of clinical success include hemodynamic stabilization, resolution of hypoxia, and survival rates from PE, which stand at approximately 86.5%.<sup>9</sup> Mechanical thrombectomy utilizing the pigtail catheter for thrombus fragmentation is the predominant catheter-based intervention for acute PE, owing to its widespread availability, ease of use, and cost-effectiveness.<sup>10</sup> In this procedure, a modified pigtail catheter is manually rotated around a guidewire that exits through a side port. This technique can often be enhanced by the incorporation of a peripheral balloon, typically smaller than the arterial lumen's diameter. Such methods are particularly beneficial for hypotensive patients with proximal occlusions, as they facilitate the recanalization of central embolic obstructions, thereby rapidly restoring flow to the occluded pulmonary artery.<sup>13</sup>

The second patient presented with an intermediate probability of PE, which was subsequently confirmed by positive results from CTPA. In the risk stratification process, the patient was categorized as intermediate risk, despite the absence of troponin results, with a PESI class III classification (score of 95) and an sPESI of 1. Consequently, the patient was admitted for monitoring of hemodynamic status and was initiated on a maintenance dose of UFH at 18 IU/kg body weight intravenously, aiming for a target aPTT of 1.5 to 2.3 times the control value.<sup>14</sup> This patient was administered sildenafil to enhance pulmonary hemodynamics and cardiac output, aligning with findings documented in multiple studies. Evidence supports the efficacy of sildenafil in managing pulmonary hypertension, demonstrating benefits in both short-term and long-term outcomes at a dosage of 50 mg every 8 hours.<sup>15,16</sup>

When a patient with normotensive PE progresses to high-risk PE during anticoagulation therapy, this is classified as treatment failure, necessitating the immediate initiation of reperfusion therapy. Current guidelines advise monitoring patients exhibiting RV dysfunction on echocardiography or CTPA, along with a positive troponin test, for the first 2 to 3 days due to the potential for early hemodynamic decompensation and circulatory collapse. However, specific parameters for monitoring have yet to be established. Clinical indicators, such as

persistent or worsening tachycardia, hypotension, elevated respiratory rates, and signs of organ hypoperfusion (e.g., reduced urine output and increased lactate levels), commonly precede hemodynamic collapse. However, deterioration can occasionally occur abruptly without these warning signs. As it stands, there are no concrete criteria for assessing worsening in intermediate-risk PE cases; thus, the evaluation of anticoagulation failure relies solely on the absence of improvement after several days of anticoagulation. In scenarios involving patients with intermediate to high-risk PE, CDT should be considered if no progress is observed within 24 to 48 hours of initial anticoagulation.<sup>10</sup>

The treatment options presented in this report should be considered alongside the distinct triggering factors associated with each case. In the first case, the acute PE occurred following EVLA for varicose veins, a scenario that is rarely documented. A related case report from 2008 by Nwaeijke et al. also highlighted additional confounding risk factors, such as previous great saphenous vein ligation one year earlier, the presence of malignancy, and tributary variceal phlebitis. The patient was managed per British Thoracic Society (BTS) guidelines, given a Wells score of 3 (high-risk), and received intravenous heparin followed by a 6-month course of warfarin post-discharge.<sup>17</sup> Notably, confounding risk factors in our case could include heart failure and hypertension.<sup>18</sup> Despite the high-risk nature of both cases, the patient in this report was treated with more advanced therapy, incorporating CDT with Alteplase, which resulted in clinical improvement. These cases underscore the importance of investigating potential confounding risk factors and underlying causes without undermining the immediate treatment of PE.<sup>17</sup>

In the second case, the incidence of acute PE associated with ASD is relatively uncommon. A national database study revealed that ASD was present in only 0.4% of patients primarily diagnosed with acute PE. However, those with acute PE and concurrent ASD exhibited a heightened risk of adverse outcomes, including stroke, mortality, extended hospital stays, and post-discharge disability. This increased risk correlates with a greater likelihood of chronic kidney disease (CKD), congestive heart failure (CHF), valvular heart disease, peripheral vascular disease, a prior cerebrovascular accident (CVA), episodes of PE, atrial fibrillation/flutter, and obesity. Additionally, the ASD cohort experienced a higher incidence of cardiogenic shock, acute renal failure, and respiratory failure. Consequently, these patients were more frequently managed with advanced interventions such as balloon counter pulsation, extracorporeal membrane oxygenation (ECMO), and blood transfusions, which are critical in addressing acute PE.<sup>19</sup> As illustrated in the second case of this report, rapid deterioration followed the Valsalva maneuver, necessitating resuscitation efforts. The limitation of

resources, particularly ECMO, resulted in suboptimal resuscitation and contributed to an instance of sudden cardiac death in this case.<sup>10</sup>

In the third case presented, the patient exhibited PPCM alongside intracardiac thrombi, which was linked to acute PE. The incidence of acute PE in patients with PPCM is estimated to be between 2% and 6%.<sup>20,21</sup> Conversely, the occurrence of intracardiac thrombi in this population is reported to be 17.9%.<sup>22</sup> Identified risk factors for PE in PPCM patients include elevated coagulation factor levels, diminished activity of protein C and S, impaired fibrinolysis, and reduced LVEF.<sup>21</sup> Furthermore, the formation of intracardiac thrombi is associated with lower LVEF, higher hemoglobin levels, and increased platelet counts.<sup>22</sup> In this case, the patient presented with an LVEF of 23.9%, categorizing them as at risk for both intracardiac thrombus formation and acute PE. Additionally, PE in the context of PPCM is associated with elevated mortality rates. Key predictors of mortality in this condition encompass atrial fibrillation, non-ST elevation myocardial infarction (NSTEMI), chronic kidney disease, and cardiogenic shock.<sup>20</sup> Notably, these factors were absent in this case, suggesting that the implementation of reperfusion therapy may enhance survival outcomes for this patient, especially as treatment escalated from CDT to mechanical thrombectomy.

This case report has several limitations. Complete outcome parameters, including changes in TAPSE, oxygen saturation, RV:LV ratio, and pulmonary artery pressures, were not reported. Furthermore, quantitative changes in thrombus burden on angiography were not reported. Furthermore, long-term follow-up data, including anticoagulant regimen, functional status, and echocardiography and other imaging studies, were not reported.

### **Conclusion**

Pulmonary embolism is a cardiovascular emergency with high mortality that requires immediate treatment based on risk stratification. This case series includes three patients with different profiles: (1) a patient with obstructive shock after an EVLA procedure who was successfully treated with CDT, (2) a stable patient with ASD and pulmonary hypertension who was treated with anticoagulation, and (3) a patient with peripartum cardiomyopathy with a right heart thrombus who required escalation with angioplasty after CDT failed. Lessons learned from this case series report emphasize the importance of risk-based therapy, including systemic thrombolysis or CDT for high-risk PE, anticoagulation for intermediate- to low-risk PE, and hemodynamic support with vasopressors/inotropic agents in cases of shock.

### **Conflict of Interest**

Nothing to declare

### **Funding Sources**

Nothing to declare

### **Ethics and Patient Consent**

This case report was conducted by the ethical standards of the ethics committee of our institution. Written informed consent was obtained from each patient for the publication of this case report and any accompanying images.

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## Civil Legal Liability of Doctors in Malpractice Cases Due to Violations of Informed Consent

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### ABSTRACT

**Introduction:** The purpose of this study is to examine the civil legal liability of doctors in malpractice cases resulting from violations of informed consent.

**Method:** This study employs a normative legal research method, utilizing both statutory and conceptual approaches.

**Results:** The results of the study indicate that informed consent must be given to patients before medical action is taken, and if there is medical negligence in providing medical services, then the doctor who commits the negligence can be held criminally responsible as stated in "Article 1365, 1234, 1320 of the Indonesian Civil Code."

**Conclusion:** Informed consent plays a crucial role for both patients and doctors, and failure to obtain it before a procedure can result in an unlawful act if negligence occurs, leading to harm to the patient.

**Keywords:** Informed consent, malpractice cases, responsibility on civil legal liability



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## **Introduction**

In the current framework of Health Law, the concept of informed consent is not explicitly addressed. Instead, the terms "agreement," "acceptance," or "rejection" of medical interventions are utilized, referring to an individual's decision made after fully understanding the relevant medical information.<sup>1</sup> In the medical field, informed consent is characterized as a patient's explicit permission or agreement to undergo treatment, which the patient must comprehend.<sup>2</sup> According to Article 293 of Law Number 17 of 2023 concerning Health, informed consent refers to any health service action performed by medical personnel and health workers, which is given after the patient has received an adequate explanation.<sup>3</sup> This process is not only an ethical imperative but also a regulatory requirement integral to the routine practice of medicine. Essential components of informed consent include the patient's or family's explicit approval or refusal, a comprehensive explanation of the intended medical procedure, and a declaration that the consent was provided voluntarily, without coercion.<sup>4</sup>

The term "informed consent" is derived from two key components: "informed," which refers to the provision of relevant information, and "consent," denoting the act of giving permission.<sup>5</sup> Therefore, informed consent can be defined as a patient's agreement to undergo medical treatment or care, based on a clear understanding of their diagnosis.<sup>6</sup> In Indonesia, the implementation of informed consent within hospital medical services remains a significant challenge, highlighting the need for improvement in this critical aspect of patient care.<sup>7</sup>

In the course of their professional duties, physicians are required to adhere to the stipulations outlined in Law Number 17 of 2023 concerning Health, specifically in Article 274. This legislation provides a clear framework for informed consent and mandates that medical personnel and health workers must adhere to five essential elements in their practice. Notably, paragraph (b) emphasizes the necessity of securing consent from both the patient and their family before the implementation of any medical interventions. The question of errors is a critical intersection between health Law and criminal Law. Before determining whether an error has occurred, a medical evaluation must be conducted, as the actions of healthcare providers are inherently linked to their professional responsibilities.<sup>8</sup>

Informed consent is a critical safeguard for physicians against allegations of unlawful acts such as malpractice. Legally, informed consent must adhere to the criteria for a valid agreement as outlined in Article 1320 of the Civil Code, which includes mutual consent, the capacity to consent, a defined subject matter, and a lawful purpose. Within the realm of medical services, informed consent constitutes a formal agreement between a physician and a patient, wherein the patient voluntarily agrees to proceed with a medical intervention based on

comprehensive and accurate information provided by the physician regarding the diagnosis, proposed procedure, associated risks, and available alternatives. In this case, informed consent is closely related to the terms of mutual consent as one of the conditions for the validity of an agreement in the Civil Code.

Informed consent embodies the principle of trust within the legal framework governing the doctor-patient relationship. Failure to uphold this principle may lead to legal disputes, including civil lawsuits for breach of contract (as stipulated in Article 1234 of the Civil Code) or claims of unlawful acts (*perbuatan melawan hukum*, PMH) if harm to the patient occurs (Article 1365 of the Civil Code). Consequently, informed consent should be viewed not merely as an administrative formality but as a fundamental aspect of legal protection for physicians and a vital respect for patient rights. In this context, it is essential to differentiate between the concept of contract breach and PMH. At first glance, PMH and contract breach may appear similar since both can lead to lawsuits for damages. However, the fundamental distinction lies in their origins: a breach of contract occurs when one party fails to fulfill an agreement established with another party, which necessitates a prior contractual relationship. Conversely, PMH arises from actions that infringe upon the rights of others or violate one's own legal obligations, even in instances where societal ethics may be compromised.<sup>9</sup>

An illustrative example of inadequate informed consent in medical practice is highlighted by the case of Dr. Ayu, which gained widespread attention in 2013. This incident involved alleged malpractice that resulted in a patient's death following a cesarean section.<sup>10</sup> Article 1365 of the Civil Code states that any unlawful act causing harm to another person obligates the responsible party to compensate for the resulting damages. For instance, if a patient suffers paralysis due to complications from an invasive procedure, yet the physician failed to provide adequate verbal or written disclosures regarding the associated risks, the validity of the patient's consent may be compromised. In such scenarios, the patient or their family can pursue legal action against the physician for negligence, even in the absence of a formal written agreement, as civil Law allows for claims based on PMH without prior contractual obligation.<sup>8</sup>

Informed consent is a fundamental obligation of healthcare professionals, extending beyond mere documentation to encompass the responsibility of providing patients with thorough and accurate information about their medical treatment options. It is essential, except in cases of emergencies that necessitate immediate intervention without the patient's consent. The principle of self-determination underpins the necessity of informed consent, affirming each individual's right to make *autonomous* decisions regarding their own health and bodily

autonomy. Additionally, informed consent functions as a legal safeguard, minimizing the risk of justifying medical procedures that could endanger the health or safety of individuals. From a legal standpoint, it also helps prevent malpractice.<sup>11</sup> Consequently, healthcare providers must obtain an unambiguous expression of consent from patients prior to any medical procedure. Failure to secure informed consent may expose the physician to legal and professional repercussions for their interventions.<sup>12</sup>

Healthcare services are fundamentally designed to deliver both treatment and preventive measures for diseases, grounded in the unique relationship between patients seeking care and physicians dedicated to curing ailments. In this framework, a physician is a qualified individual possessing the necessary medical knowledge and expertise to practice medicine competently and effectively. Conversely, a patient is defined as an individual affected by a medical condition who has entrusted their health management to a physician. Consequently, physicians have an ethical obligation to provide the highest standard of medical care to their patients. Should a physician be found negligent in their practice, they may be subject to civil liability.

Numerous studies have explored the issue of informed consent in medical practice. For instance, research by Damayanti et al. highlights the provisions of the 2023 Health Law regarding informed consent in emergencies, noting that physicians are protected from civil liability when providing life-saving treatment without written consent under such conditions.<sup>13</sup> Wijaya & Kusumaningrum further illustrate that the absence of informed consent can serve as evidence of administrative negligence, potentially influencing criminal penalties for healthcare providers.<sup>14</sup> Additionally, Saputra discusses the civil liability of physicians as outlined in Article 1365 of the Civil Code and violations of Article 45 of the Medical Practice Law, asserting that judicial evaluations of the informed consent process have been inadequate.<sup>15</sup> Fadillah & Sewu indicate that current derivative regulations, such as Government Regulation No. 28/2024, do not sufficiently bolster informed consent procedures, suggesting the need for further legislation to enhance patient protection following the 2023 Health Law enactment.<sup>16</sup> This study aims to analyze the civil liability of both physicians and hospitals within the framework of therapeutic contracts, with a focus on the critical role of informed consent in the formulation of medical agreements.

## **Methods**

This study employed normative legal research to investigate methodologies for gathering library data across various formats, including books, documents, newspapers, articles, regulations, and other relevant sources. The research adopted legislative and

conceptual approaches. The notion of civil legal liability, as discussed in this study, is grounded in the framework proposed by Baghdasaryan (2022). Civil liability refers to the primary obligation that arises in cases of extracontractual liability, or an ancillary obligation stemming from the breach of a primary obligation. From a methodological standpoint, this concept encompasses the enforcement mechanisms of liability, including the identification of liable parties, their respective rights and responsibilities, as well as the extent of their liability.<sup>17</sup> The analysis conducted in this paper was qualitative, utilizing techniques that involve classifying data into distinct categories, presenting findings in narrative form, and formulating conclusions.

## **Result**

### **The relationship between medical malpractice and breach of informed consent**

The primary objective of obtaining informed consent is to uphold human dignity, which is characterized by individual freedom and autonomy. Every patient has the right to make informed choices regarding their medical care. Prior to any intervention, a physician must secure the patient's explicit consent, typically documented through a consent form integrated within the patient's medical record. This written consent is essential, as it ensures compliance with established protocols within healthcare settings.<sup>18</sup> Consequently, the healthcare institution bears responsibility for ensuring that all elements of informed consent are adequately fulfilled. Additionally, the physician who conducts the procedure may face administrative penalties if these requirements are not met.<sup>19</sup>

The therapeutic relationship established between a physician and their patient is fundamental to the concept of informed consent. Both parties possess rights and responsibilities that must be honored. It is essential to recognize various rights while ensuring the fulfillment of corresponding obligations.<sup>20</sup> The relationship between patients and healthcare professionals, which can lead to issues of medical malpractice and informed consent, encompasses all healthcare services as outlined in Article 293, paragraph 1 of Law Number 17 of 2023 on Health. This scope includes activities related to health maintenance, disease prevention, treatment, health recovery, or a combination of these, along with the methodologies employed in service delivery.<sup>21</sup>

### **Civil liability of doctors in malpractice disputes arising from informed consent**

Health is a fundamental human right that must be upheld, promoted, and safeguarded by all health service providers, encompassing government entities, the private sector, and individual practitioners. This principle is articulated in Article 28, paragraph (1) of the 1945 Constitution of the Republic of Indonesia. Furthermore, the right to health is reaffirmed in

Article 4 of Law Number 36 of 2009 on Health, emphasizing its universal applicability to all individuals.

As a public health organization, hospitals have the duty and authority over all medical assistance provided by them. The responsibilities in question include providing affordable and high-quality services, adhering to the principles of safety, inclusivity, non-discrimination, participation, and protection for members of the public, specifically users of medical services. The responsibilities of hospitals as stakeholders in medical services are stated in the provisions of "Article 15 of Law Number 25 of 2009 on Public Services." The objectives of organizing public assistance are to: (a) implement clear boundaries and affiliations regarding the rights, responsibilities, obligations, and authorities of all groups bound by the management of public assistance; (b) implement orderly enforcement of service provision following the general principles of corporate governance and responsible business management; (c) ensure that the performance of public assistance provision is following legal provisions; (d) implement legal protection and legal clarity for the general public in the management of public services.

The responsibilities and authorities of hospitals are outlined in Article 46 of Law Number 44 of 2009 on Hospitals. This article states that hospitals are held legally responsible for any damage resulting from negligence by healthcare professionals within their facilities. Hospital liability arises exclusively in instances of medical malpractice due to negligence or intentional misconduct by healthcare professionals. Under the principle of *vicarious liability*, hospitals are accountable for the negligent actions of their health workers. This responsibility encompasses the quality of care, as dictated by the doctrine of *respondeat superior*, which establishes that the institution is liable for actions undertaken by its staff that result in harm to patients. In cases of negligence by healthcare workers, hospitals can implement various responses, including reporting to the Medical Ethics Committee (MKEK/MKDKI), pursuing mediation, initiating civil lawsuits, or notifying Law enforcement authorities of potential criminal conduct.<sup>22</sup>

## **Discussion**

According to Soejatmiko in Isfandyarie, performing medical procedures without obtaining consent can lead to potential lawsuits from patients, constituting malpractice due to negligence.<sup>23</sup> Valid informed consent requires that patients receive comprehensive information regarding their proposed treatment. Physicians are required to convey, in clear and understandable terms, details about the condition, available treatment options, potential outcomes, and associated risks. Consequently, patients have the right to refuse the treatment

after being informed; this is termed informed refusal.<sup>24</sup> Recognizing human rights helps address issues related to the patient's privacy and decision-making. Before opting for informed refusal, patients must thoroughly understand the implications and sign a refusal form, thereby protecting the physician from liability associated with their decision.

When a patient provides informed consent to a healthcare professional, it reinforces the professional's legal standing. The informed consent document indicates that the patient waives the right to sue if the healthcare provider fails to meet specific obligations. However, it is essential to note that, legally, the patient retains the right to pursue legal action if the healthcare provider, physician, or hospital fails to adhere to acceptable professional standards of care.<sup>25</sup> The core components of informed consent encompass two critical elements: the information supplied by the physician and the patient's agreement to proceed based on that information.<sup>26</sup>

Informed consent, although often perceived as just a signed document, carries significant weight as potential evidence in legal proceedings should a lawsuit arise. It also serves as a protective measure for physicians against patient-initiated claims, particularly when it includes explicit provisions stating that the physician will not face litigation for future complications. In the absence of informed consent, patients may pursue legal action.<sup>27</sup> Patients must be comprehensively educated about all associated risks of the medical procedure, as this understanding is essential to uphold the agreement that they relinquish their right to sue for adverse outcomes that may occur during the procedure.

When delivering medical services, hospitals have responsibilities that can be examined through the lenses of professional, administrative, civil, and criminal Law. The foundation of hospital accountability is the legal relationship established between the hospital as a service provider and the patient as the recipient of healthcare. This relationship is established through a therapeutic agreement that outlines the expectations and obligations of both parties.<sup>28</sup> Specifically, this civil legal relationship underscores the mutual fulfillment of rights and responsibilities. The hospital is obligated to uphold the rights of the patient, while the patient must respect the rights of the hospital. If either party fails to meet these obligations, it may lead to civil litigation or claims for damages from the aggrieved party who believes they have suffered harm.

Civil liability can be pursued against hospitals as legal entities or individual medical personnel, depending on the determination of who committed the error or negligence. This liability encompasses the obligation to compensate for both material and immaterial losses.<sup>29</sup> Unlawful acts within civil Law include actions or omissions that cause harm to patients and violate legal obligations or applicable norms. This highlights that hospitals and medical

professionals bear not only moral responsibilities but also legal liabilities, which can be enforced in court.<sup>30</sup>

As the prevalence of civil liability cases due to medical negligence rises, it is essential to examine this issue through a civil Law lens. Physicians may be deemed culpable for professional errors, such as misdiagnoses or treatment failures, that result in patient harm.<sup>31</sup> When a negligent act satisfies the criteria for an unlawful act (*onrechtmatige daad*) as defined in Article 1365 of the Civil Code—which includes elements of fault, damage, and causation—both doctors and hospitals may be held civilly liable for compensation. Cases of malpractice that align with these criteria are often classified as civil malpractice.<sup>32</sup>

Professional negligence can be classified into two categories: *culpa lata* (*gross negligence*) and *culpa levis* (*minor negligence*). This includes acts of carelessness or failure to adhere to established medical standards. When negligence is established, patients are entitled to seek compensation for both material and immaterial damages.<sup>31</sup> Furthermore, beyond individual physician liability, hospitals can also be held accountable for the actions of their medical staff under the principle of *vicarious liability* as outlined in Article 1367 of the Civil Code. Institutions may face legal action for negligence related to their employees, including issues surrounding informed consent and the inability to follow standard protocols.<sup>33</sup> Compensation awarded to patients typically encompasses reimbursement for medical expenses, lost income (both material and immaterial), and non-economic losses, such as pain and suffering. Legal precedents, including the Supreme Court decision PK/Pdt/515/2011, affirm that physicians can be held liable for malpractice, as evidenced by a ruling for 2 billion IDR in compensation to affected patients as a civil liability measure.<sup>31</sup>

In the context of medical malpractice, Taylor emphasizes the importance of the "4Ds" that must be established for a physician to be held liable: (a) Duty, (b) Dereliction of Duty, (c) Damage, and (d) Direct Causal Relationship. "Duty" entails the physician's obligation to adhere to established professional standards and to obtain informed consent from patients. This process requires that the physician communicate comprehensive information, enabling the patient to grasp the implications of medical actions. Essential elements include the risks involved, potential unexpected outcomes, alternative treatments, and the consequences of forgoing treatment. Regulatory guidelines for informed consent are outlined in "Articles 274 and 293 of Law Number 17 of 2023 concerning Health". "Dereliction of Duty" refers to a breach of these professional standards, determined by the specifics of each case and evaluated by specialists. It is crucial to distinguish between adverse outcomes resulting from complications and those resulting from negligence, as patients may conflate these scenarios.

Establishing that a physician has met their "duty" necessitates proof of negligence. "Damage" encompasses the harm experienced by the patient, including physical, financial, and emotional consequences. Lastly, a "Direct Causal Relationship" implies a clear link between the physician's actions and the subsequent harm inflicted on the patient.<sup>31</sup>

### **Conclusion**

The research highlights the crucial role of informed consent in medical practice, underscoring its importance for both patient protection and legal protection for healthcare providers. Physicians must obtain valid consent before any intervention to prevent legal repercussions, including civil liability for negligence. Adhering to professional standards and ethical guidelines is essential in the informed consent process. Deviations may result in unlawful acts, allowing patients to seek compensation for damages under Article 1365 of the Civil Code. Furthermore, healthcare institutions may face vicarious liability as per Article 1367, reinforcing the importance of diligent consent practices.

### **Conflicts of Interest**

Nothing to declare.

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