

Original Research Report

THE USE OF COMICS AS A TUBERCULOSIS LEARNING MEDIUM FOR JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

As a tropical country, Indonesia continues to grapple with the prevalence of tuberculosis. This study conducted by the Department of Public Health and Preventive Medicine at Universitas Airlangga, Surabaya, Indonesia, presented a novel approach to prevent tuberculosis through measures tailored to the socio-cultural context of the population. Specifically, this study assessed how effective the use of tuberculosis comics is as an educational tool to inform junior high school students about tuberculosis. This research was quasi-experimental, with a one-group pre-test-post-test design. Seventy junior high school students in Dukun District, Gresik, Indonesia participated in this study. Each participant received a questionnaire consisting of ten questions about tuberculosis. Afterward, tuberculosis education was shared through comics. The post-test was carried out using the same questions as the pre-test. The data were analyzed using the R Program for Windows, version 4.1.3 (Auckland University, New Zealand). The analysis revealed a significant difference between the pre-test and post-test results ($p < 0.0001$). As indicated by the data, comics proved to be an effective method of educating people about infectious diseases, specifically tuberculosis. Here, we introduce an educational tool designed to revitalize the educational method for disseminating knowledge about infectious diseases. Ultimately, comics can increase students' interest in learning about tuberculosis, including its etiology, prevention, and treatment strategies.

Keywords: Tuberculosis; infectious disease; comics; pulmonary disease; preventive medicine

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Highlights:

1. Comics centered around tuberculosis offer a novel method tailored for specific audiences, specifically children or those of school age, to learn about the disease.
2. The tuberculosis comics feature the etiology, prevention, and treatment of tuberculosis conveyed through their unique design.
3. Comics can be an innovative promotional method to support the preventive campaign against tuberculosis.

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* in the lower respiratory system. Since a long time ago, tuberculosis has remained a global health problem, specifically in developing countries. Lung tuberculosis has been reported as the leading cause of mortality among numerous diseases. It has been estimated that 10 million people suffer from lung tuberculosis, largely

originating from eight countries. Notably, Indonesia ranks third globally in terms of the highest incidence of tuberculosis. India, China, the Philippines, Pakistan, Nigeria, Bangladesh, and the Democratic Republic of the Congo are included on the list of countries with the highest incidence of tuberculosis, along with Indonesia ([World Health Organization 2018](#)).

According to global data, since 1995, Indonesia has

exhibited a high incidence rate of tuberculosis. The incidence rate has been increasing by 25.4 per 1,000,000 population each year. The treatment success rate for tuberculosis in Indonesia was approximately 88% in 2017 (Caren et al. 2022). The high prevalence of tuberculosis in Indonesia necessitates attention and intersectoral collaboration. Indonesia, being a tropical country, continues to struggle against tuberculosis as a significant public health problem. However, it also actively supports the global effort to eradicate the disease. The End TB Strategy has been implemented to address the global burden of tuberculosis and to decrease mortality caused by the disease by up to 90% by 2030 in comparison to the rates recorded in 2015. The prevalence of tuberculosis is expected to decrease significantly by 2035, with an 80% reduction compared to 2015. The strategy aims to eliminate catastrophic health expenditures by 2030 (World Health Organization 2019). Subsequently, this global commitment will be implemented in accordance with the national strategy and extended to all the national and regional stakeholders.

The implementation of Indonesia's national tuberculosis strategy was primarily focused on case detection. Indonesia employed active case-finding in certain regions, utilizing the Geographic Information System and a family-oriented approach. Effective implementation of active case-finding requires collaboration between health workers and the community to offer appropriate solutions. The Secretary General of the Ministry of Health encouraged health workers at community health centers to actively evaluate existing health programs (Mahendradhata et al. 2017, Cilloni et al. 2020). Early implementation of active case-finding is crucial to mitigating community transmission. Timely detection of tuberculosis cases can contribute to the successful management of the disease, but cases that are detected late can still be effectively treated (Akessa et al. 2015).

Family members of tuberculosis patients are a vulnerable population for disease transmission. However, families can also play a pioneering role in halting the transmission of tuberculosis by providing unwavering support and care to the patients, thereby boosting the patients' confidence and improving their adherence to prescribed treatment (Chen et al. 2020). This finding is corroborated by data revealing that 52.5% of tuberculosis patients are aware of their symptoms, specifically coughing. The enhancement of tuberculosis knowledge can be achieved by adopting a family-oriented strategy. The family approach is a specialized concept designed for public health centers, which serve as the closest primary healthcare facility to the community. This facilitates individuals in mitigating diseases and improving healthcare provisions. The family

approach also helps existing health programs achieve optimal outcomes through integration and active case-finding (Pai et al. 2016).

In achieving the success of tuberculosis elimination, it is crucial to focus on certain indicators such as case finding, therapy provision, and patient adherence to treatment. The case notification rate is a measure that helps determine the extent of case finding. The data shows new cases in every 100,000 Indonesian population (Ministry of Health of the Republic of Indonesia 2015). According to the National Guidelines for Tuberculosis 2010–2014, the target case notification rate in 2014 was 85 cases per 100,000 population. The tuberculosis case notification rate in East Java, Indonesia, decreased from 204 per 100,000 population in 2020 to 125 per 100,000 population in 2019 (Utomo et al. 2022). During the coronavirus disease (COVID-19) pandemic, the elimination of tuberculosis faced a challenge due to the implementation of movement restrictions. Technology integration should be a priority and applicable to tuberculosis elimination programs. Multiple approaches have been introduced to the community, including telemedicine, the SOBAT TB application, and the EMPATI CLIENT application. These applications have demonstrated advantages in terms of case findings without the need for physical contact during the pandemic. Simple applications can attract the community to download and use the extensive functionalities, such as data recording, data saving, and data reporting. The 2018 internal data from the Gresik Health Office, Indonesia, revealed a total of 44 tuberculosis cases in the Dukun District. MTS Ihyaul Islam, as a school in this district, plays an important role in tuberculosis prevention by providing education through the Sports, Physical Education, and Health Program. In this program, teachers were trained to educate students about the importance of using medical masks to prevent the transmission of airborne diseases when someone exhibits cough symptoms. This study aimed to assess the effectiveness of comics as a tuberculosis learning medium for junior high school students.

MATERIALS AND METHODS

This study was carried out in Dukun District, Gresik, Indonesia. Comics were distributed to students at MTS Ihyaul Islam, an Islamic junior high school in the district. A total of 70 students were included in this study. This research was quasi-experimental with a one-group pretest-posttest design (Siedlecki 2020). The subjects underwent pretest and posttest to assess their knowledge improvement regarding tuberculosis. We selected this school based on its recognition among the majority of locals in Dukun District as their preferred junior high school. This

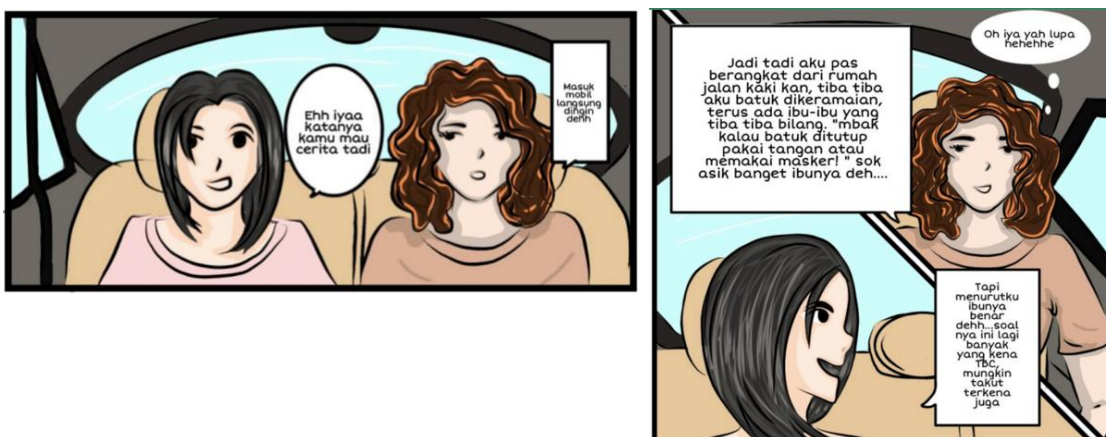
school has been accredited as superior by the Indonesian Ministry of Education.

The comics were presented in the Indonesian language and consisted of seven panels, as shown in

Figures 1, 2, and 3. The comics provided information on tuberculosis disease, including its transmission, clinical manifestation, preventive measures, and treatment strategies (Morel et al. 2019).



Figure 1. Example from the comic: The common clinical manifestation and prevention of tuberculosis.



Figures 2. Example from the comic: One of the preventive measures for tuberculosis.



Figure 3. Example from the comic: Information regarding tuberculosis, including its definition, clinical manifestation, treatments, and preventive measures.

The validity and reliability of the comics were assessed through an assessment process involving four lecturers and four teachers as validators. The assessment yielded a result of 0.8 and 0.81, indicating its validity and reliability, respectively. However, the validators suggested increasing the number of panels, despite the story already being comprehensive. It was suggested that the creator extend the narrative until the completion of the tuberculosis treatment, which typically spans six months. The questionnaire, comprising ten questions in the Indonesian language, was handed to

students (Table 1). We constructed the questionnaire by referring to a previous study and incorporating some modifications (Fuady et al. 2014).

After all participants filled out the questionnaire, the data were recorded and analyzed using the R Program for Windows, version 4.1.3 (Auckland University, New Zealand). The data were noted as statistically significant if they exhibited a $p < 0.05$. The Wilcoxon signed-rank test was carried out to analyze the difference between the pretest and posttest results (Taheri & Hesamian 2013).

Table 1. Questionnaire for assessing individual knowledge about tuberculosis.

No.	Questions
1.	What is tuberculosis? a. An infectious disease caused by the bacterium <i>Mycobacterium tuberculosis</i> b. An infectious disease caused by the virus <i>Mycobacterium tuberculosis</i> c. An inflammatory disease of the pulmonary tract d. A lung infectious disease
2.	Clinical symptoms of pulmonary tuberculosis disease are: a. Cough of ≥ 2 weeks b. Chest pain c. Cough with blood in the phlegm d. Answers a, b, and c are correct
3.	Below is the group with a higher risk of developing tuberculosis disease: a. People with human immunodeficiency virus (HIV)-positive status and other immune diseases b. People who are in close contact with a person suffering from an active and infectious tuberculosis c. People in places with a high risk of tuberculosis transmissions (e.g., public spaces and long-term care facilities) d. Answers a, b, and c are correct
4.	The main examination used to identify tuberculosis in an individual is ... a. X-ray b. Ultrasound c. Three sputum examinations (in the morning or at any time) d. Two sputum examinations (in the morning or at any time)
5.	Tuberculosis drugs should be taken: a. In the morning before eating b. After waking up c. In the morning after eating d. Before bed
6.	Below are the side effects caused by tuberculosis drugs except: a. Hearing disorders b. Reddish urine

	c. Increased blood pressure
	d. Tingling/burning sensation in the feet
7.	Efforts to quickly recover from tuberculosis include... a. Taking medications regularly b. Controlling medications regularly c. Eating nutritious foods d. Answers a, b, and c are correct
8.	The following are included in the prevention and control of tuberculosis risk factors except: a. Getting used to clean and healthy living behaviors and increasing immunity b. Maintaining and improving the quality of the surrounding environment and its adherence to healthy standards c. Implementing tuberculosis infection prevention and control within and outside healthcare facilities d. Reducing awareness of the management of tuberculosis comorbidities
9.	The following activities are usually carried out by tuberculosis cadres, except... a. Providing education to patients about the dangers of pulmonary tuberculosis b. Supervising tuberculosis patients to take medications regularly c. Encouraging patients to undergo regular treatment d. Providing health services by taking tuberculosis drugs from healthcare centers
10.	Who can act as a medication supervisor (<i>pengawas minum obat</i>) for tuberculosis patients? a. Integrated Health Post (<i>Pos Layanan Terpadu</i>) cadre b. Teacher c. Family Welfare Empowerment (<i>Pemberdayaan Kesejahteraan Keluarga</i>) d. Answers a, b, and c are correct

RESULTS

Table 2 presents the demographic characteristics of the 70 junior high school students who participated in this study. The data revealed that the majority of the respondents were female students, specifically 42 individuals (60%). The respondents were predominantly seventh-grade students (35.71%) and aged 14 years (57.14%). Most of the students belonged to the Javanese ethnic group (97.14%).

Table 2. Demographic characteristics of the respondents.

Profiles	N	%
Sex		
Male	28	40
Female	42	60
Age		
13 years old	13	18.5
14 years old	40	57.14
15 years old	17	24.36
Ethnicity		
Javanese	68	97.14
Madurese	2	2.86
Grade		
7 th	25	35.71
8 th	21	30
9 th	24	34.2

The results of this study are summarized in Table 3. The Shapiro-Wilk test revealed that the data from the pretest and posttest exhibited a non-normal distribution. The respondents' lowest and highest values in the pretest were 10 and 70, respectively. Meanwhile, the respondents' lowest and highest values in the posttest were 60 and 90, respectively. After analyzing the data gathered from both tests, it was determined that there was a statistically

significant difference between the pretest and posttest results. This indicated that the students gained more information regarding tuberculosis after receiving education through the use of comics.

Table 3. Pretest and posttest results from 70 junior high school students.

	Low est value	High est value	95% CI	SD	Shapiro-Wilk test	Wilcoxon signed-rank test
Pre-test	10	70	38.8 – 45.1	13.0 3	W=0.9281; p=0.0006	p<0.000 1
Post-test	60	90	75.1 – 79.4	9.15	W=0.8738; p<0.0001	

Legends: SD=standard deviation; CI=confidence interval.

DISCUSSION

Successful control of infectious diseases, specifically tuberculosis, requires a well-planned strategy to address the potential transmission of the disease through interpersonal contacts within the community. Horizontal and vertical programs may be employed as approaches to engage citizens in disease control. Intersectoral collaboration between health officers and citizens can be a promising strategy to increase case finding. This study implemented a health promotion method through the use of comics. Comics are a form of visual art that focuses on conveying key ideas and exploring specific topics. The use of comics can serve as a learning and teaching tool for knowledge sharing, as they provide a visual experience that enhances the reader's comprehension. Two distinct categories of

comics focus on health: (1) comics that center around personal health or the portrayal of illness and (2) comics that present organized information with the aim of educating the reader. The use of comics is an innovative approach to health promotion that can engage the audience. Comics deliver educational messages that cater to the specific needs of the audience. The widespread use of comics in health education has increased significantly in the last decade due to its impact as a means of communication (Ashwal & Thomas 2018, Adnan et al. 2019). Comics provide the ability to simplify complex experiences for the reader. Through artistic illustrations and the creativity of the creator, comics can enhance the comprehensibility of information. This advantage can be utilized to disseminate information about disease prevention to the community (King 2017).

According to the demographic characteristics, our respondents mainly consisted of female students aged 14 years, belonging to the Javanese ethnic group, and in the seventh grade. Tuberculosis is an infectious disease that can affect all age groups, including children at a higher risk. The global data showed that tuberculosis has affected 11% of children worldwide (World Health Organization 2020). This should be considered, and it is also essential to generate interest in health promotion methods. One of the biggest challenges in health communication is delivering sufficient information that can change the health behavior of the target audience. Comics have been known to be effective as health communication media due to their capacity to present scenarios and relevant narratives on specific topics. Health promotion can incorporate multimodal formats, using comics and videos (Willis et al. 2018, Whiting 2020).

Our findings indicated an increase in the posttest results in comparison to the pretest results. This suggests that all students were able to comprehend the content of the comics, which explored the etiology, clinical manifestation, and prevention measures of tuberculosis. Each item in the questionnaire was designed based on the basic concept of tuberculosis (World Health Organization 2018). During the COVID-19 pandemic, innovation in health promotion was required due to the disruption of social activity. As one of the health communication methods, comics can be utilized at both individual and population levels. Children easily grasp the key message of a comic and apply it to their daily lives due to its incorporation of storytelling. Changes in individual behavior concerning tuberculosis can prompt significant shifts at the population level. Narrative communication may help reduce community transmission of a disease. The use of narrative communication is beneficial as a technique for

modifying attitudes and behaviors, which may promote the adoption of healthy lifestyles (Gesser-Edelsburg 2021). A massive change within a community is always initiated by small changes at the individual level. Therefore, it is imperative to prioritize education concerning the disease at all levels. A prior study used comics as a communication medium for infectious diseases, specifically focusing on increasing readers' comprehension of the etiology of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) (Czerwiec 2018). Young people represent the demographic that should be specifically targeted for HIV/AIDS education, as they are the group most susceptible to contracting the virus. Informative, simple, fun, and easy-to-read materials, such as comics, are well-suited for achieving those objectives (Mansur et al. 2023).

Comics can be digitalized to increase their accessibility and expand their readership. Digital comics can be upgraded by integrating animation, narration, music scores, and sound effects, and to some extent, they can be adapted into novels. By addressing current issues such as COVID-19 or other health-related topics, digital comics have the potential to increase accessibility. The effectiveness of comics can be improved if the creator implements Keller's ARCS model, which comprises attention, relevance, trust, and satisfaction (Rakower & Hallyburton 2022). This basic concept can serve as a model for understanding consumers and readers. While it is typical to use solely textual messages to provide health information, using both text and images is a more effective approach. Information presented in textual form can be intimidating, as it may overwhelm readers with a large amount of data. Short-form comics, characterized by a dominance of images and minimal words, offer an efficient means of conveying messages regarding health (Lee et al. 2020).

Mass media communication can stimulate community awareness about the prevention of tuberculosis transmission. A recent study conducted in Ethiopia demonstrated that mass media exposure has the potential to influence the community's knowledge, attitude, and practice concerning the spread of tuberculosis (Gelaye et al. 2020). Digitalization has played a crucial role in supporting the rapid development of technology. Furthermore, blogging has offered emotional benefits to tuberculosis survivors. Individuals who have survived tuberculosis by successfully completing their treatment may act as a source of inspiration and provide guidance to other tuberculosis patients, hence increasing treatment completion rates and adherence (Horter et al. 2014). This study provides preliminary data that can be used to broaden the coverage of tuberculosis education.

Strength and limitations

Our study presented a novel method that could increase the interest of junior high school students in learning about tuberculosis. The use of comics in this study may also raise awareness regarding the transmission of tuberculosis. However, the study had a limited sample size and a rather homogenous population. It is imperative to broaden the scope of this study to encompass different populations with more diversity.

CONCLUSION

Health communication through comics effectively helped the students gain comprehension of the etiology of clinical manifestations, and preventive measures of tuberculosis. It is anticipated that comics can be used as an educational medium in a wider range of institutions, including junior high and elementary schools, to enhance community awareness of tuberculosis.

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Conflict of interest

None.

Ethical consideration

This study received approval from the Ethics Committee of Ibnu Sina Regional General Hospital, Gresik, Indonesia, with registration No. 071/070/437.76.46/2021 on 17/12/2021. Information about the aim of this study was communicated to the student's parents one day before it was conducted. Parental consent was acquired for all students who participated in this study.

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Author contribution

BU contributed to the conception and design of this study, the analysis and interpretation of the data, the drafting of the article, the final approval of the

article, statistical expertise, and funding acquisition. WF contributed to the drafting of the article, critical revision of the article for important intellectual content, and final approval of the article. S contributed to providing study materials, statistical expertise, and funding acquisition. SF contributed to the drafting of the article, the provision of administrative, technical, and logistic support, as well as the collection and assembly of the data. THS contributed to the drafting of the article, critical revision of the article for important intellectual content, and collection and assembly of the data. Lastly, CCK contributed to the final approval of the article, the provision of administrative, technical, and logistic support, as well as the collection and assembly of the data.

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