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The Effectiveness of Education in Improving Knowledge and Preventive Behaviors Regarding Toxoplasmosis among Non-Health Female Students at the University of Bengkulu

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ABSTRACT

Toxoplasma gondii is a parasite responsible for toxoplasmosis, which demonstrates a high prevalence among women of reproductive age. Limited awareness places female students outside health sciences at an elevated risk of infection. While educational interventions have the potential to enhance both knowledge and preventive behaviors, the relationship between these factors in this population remains insufficiently studied. This research sought to determine the association between knowledge levels and toxoplasmosis prevention behaviors following an educational intervention. Utilizing a quasi-experimental one-group pre–posttest design, 153 participants were involved. Data collection was conducted via questionnaires, with analysis performed using the Wilcoxon test to compare pre- and post-intervention results and the Spearman Rank test to assess the correlation between knowledge and preventive behaviors after the intervention. Findings revealed a significant improvement in knowledge scores, rising from 10.63±3.665 to 16.89±2.456 ($p < 0.001$), as well as in preventive behavior scores, which increased from 36.39±6.560 to 48.80±4.756 ($p < 0.001$). A significant, albeit very weak, positive correlation between knowledge and preventive behaviors was observed ($r = 0.256$; $p = 0.002$). The educational intervention effectively enhanced both knowledge and toxoplasmosis prevention behaviors among non-health sciences female students at the University of Bengkulu, with a notable positive association identified between these variables post-intervention.

Keywords: Knowledge, Preventive Behaviors, *Toxoplasma gondii*

INTRODUCTION

Toxoplasma gondii is an obligate intracellular parasite responsible for toxoplasmosis, a parasitic infection initially identified by Nicolle and Manceaux in the rodent Ctenodactylus gondii in North Africa (Rahmawati et al., 2024). Toxoplasmosis affects both humans and animals, with felines serving as the definitive host. According to the Centers for Disease Control and Prevention (CDC), over 60% of the population in various global regions is infected with toxoplasmosis (CDC, 2024). In the United States, approximately 40 million immunocompetent individuals are affected (CDC, 2025). The prevalence of toxoplasmosis differs based on social, economic, and cultural influences. In Indonesia, toxoplasmosis constitutes a significant public health concern, exhibiting a national prevalence of 48.58%. Regional prevalence rates include 53.15% in Java, 41.93% in Sumatra, 31.43% in Kalimantan, 32.56% in the Lesser Sunda Islands, and 46.08% in Sulawesi and Maluku (Perdana et al., 2025).

Toxoplasmosis is transmitted through several pathways, including the consumption of undercooked food, congenital transmission from mother to child, and contact with pets—especially cats (CDC, 2024). Indonesia leads Asian countries in cat population, accounting for 47%, which could elevate the risk of community transmission of toxoplasmosis if not addressed with sufficient public awareness and preventive measures (Pramardika et al., 2022). Most toxoplasmosis cases are observed in women, a trend influenced by individual behaviors. Compared to men, women are more likely to consume undercooked foods such as satay and steak prepared from meat containing the parasite and exhibit lower compliance with clean

and healthy lifestyle practices, such as proper hand hygiene, particularly after gardening or handling raw meat. Women of reproductive age represent a high-risk group, as infection during pregnancy may result in vertical transmission of toxoplasmosis to the fetus (Sofiana & Kelen, 2018).

Female university students are considered women of reproductive age who may experience pregnancy and childbirth. Toxoplasmosis during pregnancy has the potential to be transmitted to the fetus, presenting risks for complications (CDC, 2024). If acquired in early pregnancy and not adequately managed, infection may result in abortion, fetal chorioretinitis, hydrocephalus, microcephaly, sensorineural hearing loss, motor and cerebellar dysfunction, as well as growth and developmental disorders (Deganich et al., 2023). Female students of reproductive age therefore constitute a high-risk group (Lashal et al., 2024) observed that female students commonly keep cats, neglect washing fruits and vegetables prior to consumption, and eat undercooked meat. Awareness of toxoplasmosis among this population remains limited, especially among non-health-related students. (Ebrahimi et al., 2015) found that only 13.85% of female students at Ferdowsi University of Mashhad were knowledgeable about toxoplasmosis. Similarly, research among female students enrolled in the Biology Study Program at UIN Syarif Hidayatullah Jakarta indicated low levels of knowledge regarding toxoplasmosis (Yani et al., 2022).

Toxoplasmosis is typically asymptomatic; studies indicate that approximately 52% of pregnant women infected with the parasite exhibit no symptoms. The lack of clinical manifestations frequently leads to delayed diagnosis, which often occurs only when complications arise, particularly among pregnant individuals or those with compromised immune systems (Deganich et al., 2023). Prevention strategies for toxoplasmosis primarily involve raising knowledge and awareness within high-risk populations. Relevant knowledge encompasses the biology of the parasite, its life cycle and transmission pathways, associated animal vectors, clinical features, diagnostic methods, and preventive measures (Martini et al., 2020). Health education is recognized as an effective tool for enhancing understanding and promoting behavioral changes in infectious disease prevention. For instance, education initiatives have demonstrated increased awareness and adoption of toxoplasmosis preventive practices in communities such as Gresik (Rohmayani et al., 2021). Despite these successes, current educational programs largely target pregnant women or healthcare professionals, with limited focus on non-health female students. Expanding targeted education efforts to include non-health female students is essential for improving their knowledge and awareness regarding toxoplasmosis prevention. This study is differentiated from previous research by its focus on a specific location and population: non-health female students at the University of Bengkulu. The purpose of this investigation was to assess the relationship between knowledge levels and toxoplasmosis preventive behaviors following an educational intervention among this population.

METHOD

Research Design

This research employed a quasi-experimental pretest–posttest design to examine the relationship between knowledge levels and toxoplasmosis preventive behaviors following an educational intervention among non-health female students at the University of Bengkulu in 2025. Data were collected from participants in seven non-health faculties, including the Faculty of Teacher Training and Education (FKIP), Faculty of Law (FH), Faculty of Economics and Business (FEB), Faculty of Social and Political Sciences (FISIP), Faculty of Agriculture (FP), Faculty of Mathematics and Natural Sciences (FMIPA), and Faculty of Engineering (FT), during September to October 2025.

Variable and Sampling

The independent variable in this study was the level of knowledge about toxoplasmosis among non-health female students, the dependent variable was toxoplasmosis preventive behavior, and education served as the intervening variable. Knowledge level was assessed through a questionnaire adapted from (Hilmi et al., 2023), comprising 20 items on a Guttman scale, while preventive behavior was evaluated using a questionnaire adapted from (Sari & Sudarmaja, 2017), which included 12 items measured by a Likert scale. The study population consisted of undergraduate female students enrolled in seven non-health faculties at the University of Bengkulu in 2025. The required sample size was determined to be 153 participants using the Lemeshow formula. A non-probability sampling technique with a stratified random sampling approach was employed. Inclusion criteria were: (1) female; (2) age greater than 18 years; (3) willingness to

participate as a non-health female student at the University of Bengkulu; and (4) having kept a cat for at least one month. Exclusion criteria comprised non-health female students at the University of Bengkulu who were not actively attending campus activities (due to academic leave or inactive status).

Ethical Approval

Following ethical approval (Ref. No. KEPK.BKL/681/09/2025), the researchers initiated a socialization session to inform participants about subject selection criteria, benefits, objectives, and research procedures, and distributed study forms to prospective respondents. Those willing to participate and meeting both inclusion and exclusion criteria provided written informed consent, confirming their agreement to take part in the study. The research team then administered a pretest questionnaire assessing knowledge and preventive behaviors related to toxoplasmosis. Subsequently, participants received an educational intervention via videos or posters detailing the definition of toxoplasmosis, transmission routes, impacts, complications, and prevention strategies. Three weeks after the intervention, posttest questionnaires were distributed to evaluate changes in knowledge and preventive practices concerning toxoplasmosis. Data analysis was performed using univariate and bivariate methods, specifically Wilcoxon and Spearman tests, employing SPSS for Windows version 27.

RESULT

Univariate Analysis

This study involved 153 female students who were not enrolled in health-related programs. According to Table 1, univariate analysis revealed that the participants' average knowledge score regarding toxoplasmosis before the educational intervention was 10.63 out of 20. Post-intervention, the mean score increased to 16.89. Regarding preventive behaviors towards toxoplasmosis, the mean score prior to the intervention was 36.39 out of 60, which rose to 48.80 after the intervention. Analysis of age characteristics indicated a mean respondent age of 19.56 years and a median of 19, with ages ranging from 18 to 23 years. This age span represents the productive period during which individuals are typically engaged in higher education and possess strong cognitive abilities to assimilate new information, including knowledge and practices related to toxoplasmosis prevention (Nurseha et al., 2023).

Table 1
Distribution of Respondents' Characteristics

Study Respondent Characteristics	Mean	Median	Minimum	Maximum
Knowledge Level				
Pre-test	10,63	11	4	20
Post-test	16,89	18	6	20
Preventive Behavior				
Pre-test	36,39	38	19	54
Post-test	48,80	49	34	58
Age (years)	19,56	19	18	23

According to Table 2, the largest proportion of respondents belonged to the 2024 cohort, comprising 67 individuals (43.78%). The majority were affiliated with the Faculty of Teacher Training and Education (FKIP). These findings align with the minimum sample calculation required for each faculty.

Table 2
Distribution of Faculty and Cohort Characteristics of Study Respondents

Respondent Characteristics	Frequency (n)	Percentage (%)
Faculty		
Faculty of Teacher Training and Education (FKIP)	47	30,7
Faculty of Law (FH)	16	10,46
Faculty of Economics and Business (FEB)	20	13,1
Faculty of Social and Political Sciences (FISIP)	21	13,72

Respondent Characteristics	Frequency (n)	Percentage (%)
Faculty of Agriculture (FP)	21	13,72
Faculty of Mathematics and Natural Sciences (FMIPA)	14	9,15
Faculty of Engineering (FT)	14	9,15
Cohort (Year of Entry)		
2021	5	3,27
2022	30	19,61
2023	24	15,69
2024	67	43,78
2025	27	17,65
Total	**153**	**100**

Bivariate Analysis

According to Table 3, the study results indicate that the mean knowledge score of female students regarding toxoplasmosis prior to the intervention (pre-test) was 10.63 ± 3.665, which increased to 16.89 ± 2.456 following the educational intervention (post-test). The Wilcoxon test confirmed a statistically significant difference between the pre- and post-intervention scores ($p < 0.001$).

In the pre-test phase, 54 participants (35.3%) exhibited good preventive practices, such as handwashing after handling raw meat. Conversely, a majority—84 respondents (54.9%)—demonstrated suboptimal behaviors, including permitting pet cats to roam freely indoors. This observation aligns with (Nurseha et al., 2023), who found that 35.3% of individuals shared sleeping quarters with their cats. Such results indicate that, prior to t*he intervention,* both awareness and implementation of preventive measures against toxoplasmosis were limited due to insufficient knowledge and an incomplete understanding of Toxoplasma gondii transmission risks.

Following the educational intervention, which addressed causes, transmission modes, and prevention methods, respondents' behaviors showed substantial improvement. Post-test data revealed that 137 participants (89.5%) adopted appropriate preventive actions, such as washing hands after cleaning cat feces. This demonstrates heightened awareness of hygienic practices in pet care and corroborates (Velasco-Velásquez et al., 2024), who reported that brief educational programs significantly enhanced knowledge and preventive measures, notably hand hygiene. Nevertheless, 41 respondents (27.8%) continued to allow their cats unrestricted access within their homes, indicating incomplete and inconsistent adoption of recommended behaviors.

Table 3
Bivariate Analysis Using the Wilcoxon Test Comparing Knowledge Levels and Toxoplasmosis Preventive Behaviors Before and After the Educational Intervention

Variable		Students *Mean ± SD*	*p-value*
Knowledge Level	*Pre-test*	10,63±3,665	<0,001*
	Post-test	16,89±2,456	
Difference (Δ) post–pre intervention		6,26±1,209	
Preventive Behavior	*Pre-test*	36,39±6,560	<0,001*
	Post-test	48,80±4,756	
Difference (Δ) post–pre intervention		12,41±1,804	

The analysis results utilizing Spearman's rank correlation test, as detailed in Table 4, indicate a correlation coefficient (r) of 0.256. This reflects a positive relationship of very weak strength between the level of knowledge and preventive behaviors against toxoplasmosis. The positive direction suggests that increased knowledge among

respondents correlates with improved preventive practices.

Table 4
Relationship Between Knowledge Level and Toxoplasmosis Preventive Behavior After the Educational Intervention

Variable	Mean	SD	*P value*	Correlation Coefficient (r)
Knowledge Level	16,89	2,456	0,002	0,256
Preventive Practice Behavior	48,80	4,756		

DISCUSION

The results of these studies demonstrate that educational interventions significantly enhance participants' knowledge, particularly when utilising interactive, participatory approaches rooted in behavioural frameworks such as the Health Belief Model (HBM). Advancing knowledge is a crucial foundational step towards forming improved attitudes and preventive behaviours relating to toxoplasmosis. Individuals who acquire comprehensive information are more likely to adopt clean and healthy lifestyle practices, maintain proper environmental and pet hygiene, and minimise risk factors associated with *Toxoplasma gondii* infection (Rohmayani et al., 2021). Furthermore, respondent characteristics may affect knowledge levels. Older individuals tend to possess greater experience and responsibility, which fosters increased awareness and receptiveness to health-related information. Additionally, respondents from non-health academic backgrounds may exhibit reduced efficacy in information absorption due to limited prior knowledge or interest in zoonotic diseases, potentially resulting in less optimal uptake (El-aal et al., 2021).

These findings suggest an improvement in participants' knowledge levels after the educational intervention. This outcome aligns with (Rahmah et al., 2024), who reported that the "SELAMAT" educational program—focused on Awareness, Education, and Safe Steps to Prevent Toxoplasmosis—delivered via educational videos and leaflets, significantly enhanced knowledge among adolescent girls who own cats. Their study also demonstrated a statistically significant increase in mean knowledge scores after the intervention. The "SELAMAT" program was developed in accordance with the Health Belief Model (HBM), which addresses perceived risk, benefits, barriers, and self-efficacy to promote preventive behavioral change. Therefore, the observed rise in knowledge reflects the efficacy of the educational intervention in increasing individual awareness and comprehension of toxoplasmosis risks and prevention strategies (Rahmah et al., 2024).

Comparable results were documented by (Rohmayani et al., 2021), who found that community education initiatives in Gresik effectively improved understanding of the causes, transmission routes, and prevention methods related to toxoplasmosis. This educational effort utilized interactive counseling, visual media, and group discussions that encouraged active participant engagement. Post-intervention assessments indicated that participants could accurately articulate key information about toxoplasmosis, demonstrating enhanced comprehension compared to baseline.

Analysis of the pre-test questionnaire revealed that the question most frequently answered correctly was "Have you ever heard of toxoplasmosis (toxo/cat infection/cat disease)?", with 118 respondents (77.1%) selecting the correct response. Conversely, 97 respondents (63.4%) incorrectly answered the question "Is toxoplasmosis a disease caused by Toxoplasma gondii?". These findings suggest that while the majority of non-health female students were familiar with the term's toxoplasmosis, cat infection, or cat disease, they lacked knowledge regarding the primary etiological agent. Following the educational intervention, the item "Have you ever heard of toxoplasmosis (toxo/cat infection/cat disease)?" yielded the highest number of correct responses, with 151 respondents (98.7%). This outcome indicates near-universal awareness of toxoplasmosis or related conditions among participants. However, the question "Do individuals infected with toxoplasmosis experience symptoms such as fatigue and headache?" was most answered incorrectly, with 43 respondents (28.1%) providing inaccurate responses.

The study findings indicate a decrease in the number of incorrect responses on the pre-test following the educational intervention. This suggests that the intervention effectively enhanced respondents' knowledge levels. The use of video media provided clear visualizations, facilitating understanding of the material, while pamphlets supplied concise information for easy review. The integration of these two instructional media

improved participants' comprehension and, consequently, their knowledge about toxoplasmosis (Aue et al., 2023). However, future research should consider employing a broader range of educational methods and media, extending the duration of interventions, and tailoring materials to participant characteristics to further optimize educational outcomes (Semnani-Azad et al., 2021).

The study also recorded a significant improvement in toxoplasmosis preventive behaviors after the educational intervention. Specifically, the mean preventive behavior scores among female students increased from 36.39 ± 6.560 before the intervention (pre-test) to 48.80 ± 4.756 post-intervention, with the Wilcoxon test revealing a statistically significant difference ($p < 0.001$). These results demonstrate that participants successfully applied the acquired knowledge to actual preventive behaviors. This outcome aligns with (Velasco-Velásquez et al., 2024), who found brief educational interventions to significantly improve both knowledge and preventative practices related to toxoplasmosis, particularly in handwashing, consumption of boiled water, and washing vegetables with clean water ($p < 0.001$).

Overall, the observed enhancement in preventive behavior underscores the critical role of information dissemination and health education in influencing behavioral change. Educational initiatives increase awareness, understanding, and risk perception regarding *Toxoplasma gondii* infection and its prevention. For example, participants gained new insights into practices such as proper hand hygiene after handling raw meat or cleaning cat feces, and the risks associated with allowing pets unrestricted access indoors. Such improved understanding fosters greater risk perception, thus promoting the adoption of preventive behaviors (Velasco-Velásquez et al., 2024).

Research among cat owners indicates that increased knowledge of toxoplasmosis is associated with improved preventive behaviors. Individuals who possess adequate understanding are more likely to comprehend transmission routes, risk factors, and effective strategies for preventing *Toxoplasma gondii* infection. These findings suggest that educational interventions focused on enhancing awareness can lead to similar positive behavioral changes (Hilmi et al., 2023).

These observations align with prior research establishing a connection between knowledge levels and toxoplasmosis preventive behaviors (Alghafari, 2025; Hilmi et al., 2023). Individuals with greater awareness of the disease and its transmission modes tend to adopt more effective preventive measures. For instance, (Alghafari, 2025) found that respondents demonstrating higher knowledge more frequently engaged in recommended behaviors; specifically, those recognizing the risk posed by gardening without gloves or handling contaminated soil were more likely to practice hand hygiene after gardening than individuals with lower knowledge levels.

It is important to note that the weak association observed is influenced by factors beyond health education alone. According to (Alghafari, 2025), sociodemographic characteristics also contribute to the knowledge-behavior relationship. Women with university-level education were more inclined to undertake hygienic actions such as handwashing after gardening, and participants aged 31–40 exhibited higher knowledge levels compared to those under 30 years old.

Within the framework of the Health Belief Model (HBM), knowledge serves to shape individual perceptions of disease and corresponding preventive behaviors. Sufficient understanding of toxoplasmosis enables individuals to recognize their susceptibility, appreciate the seriousness of the illness, and have confidence in the benefits of prevention. As an individual's knowledge increases, so too does their perceived threat from the disease, which can foster the adoption of preventive measures (Swandi et al., 2024).

CONCLUSION

The findings of this study indicate significant differences in knowledge levels and toxoplasmosis preventive behaviors before and after the educational intervention among non-health female students at the University of Bengkulu (p-value < 0.001). Analysis of the relationship revealed a very weak association between knowledge level and toxoplasmosis preventive behavior post-intervention, as indicated by a correlation coefficient (r) of 0.256. Most participants were female students aged 19 years and primarily from the 2024 cohort.

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