

Knowledge, Attitudes, and Behavior to Prevent Transmission of *Toxoplasma gondii* among Cat Owners

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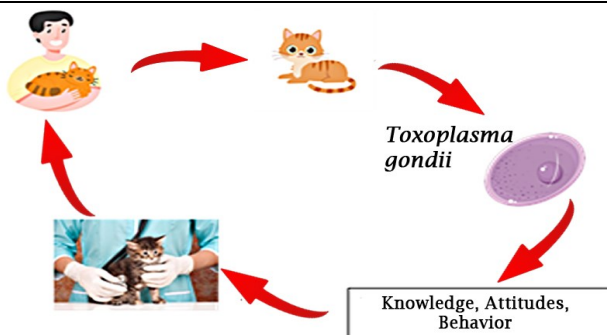
ABSTRACT

Cat owners or keepers are at a heightened risk of contracting toxoplasmosis, making it crucial to take preventive measures against *Toxoplasma gondii* infection (*T. gondii*). However, there are limited studies on knowledge, attitudes, and behavior toward preventing *T. gondii* among cat owners. Therefore, this study aimed to investigate the relationship between knowledge, attitudes, and behavior in preventing *T. gondii* infection among cat owners. To achieve this objective, an analytical observation was conducted using a cross-sectional approach. An online questionnaire was given to cat owners through social media platforms such as Facebook, Twitter, and WhatsApp. Knowledge, attitudes, and behavior of 388 respondents were evaluated using the Spearman Correlation Test. The results showed positive correlations between knowledge and attitudes ($r=0.105$, $p<0.038$), knowledge and behavior ($r=0.141$, $p<0.006$), as well as attitudes and behavior ($r=0.682$, $p<0.001$), towards preventing *T. gondii*. This study indicated significant associations between knowledge, attitudes, and behavior, and highlighted the importance of continuous health promotion and prevention efforts in addressing toxoplasmosis, warranting further study involving wider and larger populations.

ABSTRAK

Pemilik atau pemelihara kucing berisiko tinggi tertular toksoplasmosis. Untuk itu, langkah pencegahan terhadap infeksi *Toxoplasma gondii* (*T. gondii*) menjadi sangat penting. Akan tetapi, saat ini penelitian tentang pengetahuan, sikap, dan perilaku terhadap pencegahan *T. gondii* di kalangan pemilik kucing masih terbatas. Oleh karena itu, penelitian ini bertujuan untuk mengetahui hubungan antara pengetahuan, sikap, dan perilaku dalam pencegahan infeksi *T. gondii* pada pemilik kucing. Penelitian ini merupakan sebuah penelitian observasi analitik dengan pendekatan cross-sectional. Kuesioner online dibagikan kepada pemilik kucing melalui media sosial seperti Facebook, Twitter dan WhatsApp. Pengetahuan, sikap, dan perilaku pada 388 responden dievaluasi menggunakan Uji Korelasi Spearman. Hasil penelitian menunjukkan korelasi positif antara pengetahuan dan sikap ($r=0,105$, $p<0,038$), pengetahuan dan perilaku ($r=0,141$, $p<0,006$), serta sikap dan perilaku ($r=0,682$, $p<0,001$), terhadap pencegahan *T.gondii*. Penelitian ini menunjukkan hubungan yang signifikan antara pengetahuan, sikap, dan perilaku. Selain itu juga menunjukkan pentingnya upaya promosi dan pencegahan kesehatan berkelanjutan dalam mengatasi toksoplasmosis, serta perlunya penelitian lebih lanjut dengan populasi yang lebih luas dan lebih besar sangat diperlukan.

GRAPHICAL ABSTRACT



Keyword

attitudes
cats
health knowledge
toxoplasma
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INTRODUCTION

Cat is the most common pet, surpassing birds, small mammals, ornamental fish, and reptiles (do Vale et al., 2021). This widespread ownership of cats brings numerous benefits, but it also presents societal challenges. One such challenge arises when cats are allowed to roam unsupervised, posing a risk of disease transmission to humans, livestock, and wildlife (Hall et al., 2016). In countries like Indonesia with a significant number of cat owners, it becomes crucial to ensure that appropriate knowledge and information regarding the *Toxoplasma gondii* (*T. gondii*) parasite is available (Ahmad, 2019).

T. gondii is an opportunistic intracellular parasite that causes toxoplasmosis (Kochanowsky & Koshy, 2018). Furthermore, this parasite has a wide range of mammalian hosts and can be transmitted through the consumption of food contaminated with oocysts from infected cat, consumption of undercooked meat containing cysts, transplacental transmission, and gardening without gloves or contact with soil (Almeria & Dubey, 2021; Attias et al., 2020; Smereka et al., 2018). There are three stages in transmission of *T. gondii*, namely tachyzoites (a fast-multiplication form that is characteristically found in acute infections), bradyzoites (a slow-multiplication form commonly associated with chronic infections, originating from tissue cysts), and sporozoites produced in the definitive host during sexual reproduction and are released in the oocyst via cat feces (Attias et al., 2020).

The prevalence of toxoplasmosis in the world varies widely between countries. Approximately 25 to 30% of the human population was infected by *T. gondii*, with pregnant women exhibiting an IgG seroprevalence of about 32.9% (Bigna et al., 2020). Meanwhile, evidence of toxoplasmosis among adults was discovered in tropical African countries, Latin

America, South East Asia, and Northern Europe (Robert-Gangneux & Dardé, 2012). According to a 2015 report by the Centers for Disease Control (CDC), 11% of the population aged 6 and above were infected in the United States. The highest infection rates were typically observed in regions with lower altitudes, and hot and humid climates (Centers for Disease Control and Prevention, 2015). The prevalence of toxoplasmosis in Indonesia has increased in many regions. Several studies indicated that Central Java Region, Makassar, Manado, and Bali, had a rate of 62.5%, 32.6%, 46.9%, and 56.7%, respectively (Polanunu et al., 2021; Retmanasari et al., 2017).

About one-third of domestic and non-domestic cat have been infected by the parasite, and approximately 1 of 50, actively shed *T. gondii* or *T. gondii*-like oocysts (Hatam-Nahavandi et al., 2021). Accidental ingestion of oocysts while cleaning cat litter boxes can increase exposure to *T. gondii* infection. Despite adequate knowledge being considered an important factor in changing behavior, it may not be sufficient to guarantee prevention of this infection. Therefore, proper knowledge is essential to reduce infection rates, eliminate customs and traditions, as well as minimize the risk of being infected (Jung et al., 2017).

Over the past ten years, several studies have investigated knowledge, attitudes, and behavior toward preventing *T. gondii* infection. Furthermore, it has been discovered that possessing adequate knowledge is a crucial factor in driving behavioral change, but may not be sufficient to warrant prevention practice (Ahmad, 2019; Grigg & Kogan, 2019; Yan et al., 2018). However, only a few studies investigated the relationship between knowledge, attitudes, and behavior. This study aimed to examine the relationship between knowledge, attitudes, and behavior to prevent *T. gondii* among cat owners.

Table 1
The Characteristic of Respondents

Characteristic	Frequency	Percentage
Sex		
Male	62	15.98
Female	326	84.02
Age (Mean±SD)		
Region		
Bali	2	0.52
Jawa	343	88.40
Kalimantan	9	2.32
Sulawesi	3	0.77
Sumatera	31	7.99
Working Status		
Working	162	41.75
Not working	25	6.44
Student	201	51.80
Education Level		
Elementary school	2	0.52
Senior high school	83	21.39
University	303	78.09
Number of Cat		
1	121	31.19
2	79	20.36
3	43	11.08
>3	145	37.37
Have Another Pet		
No	252	64.95
Yes	136	35.05
The Other Pet Besides Cat		
Bird	69	50.74
Fish	46	33.82
Mammal	10	7.35
Reptile	11	8.09

METHODS

A cross-sectional study was conducted in November 2022 to assess knowledge, attitudes, and behavior of cat owners to prevent *T. gondii*. The process began by conducting a survey by distributing and broadcasting an online Google Form questionnaire using social media platforms such as Facebook, Twitter, and WhatsApp. The link was shared with Facebook groups, Twitter posts, and WhatsApp Groups associated with cat owners between 18 November and 8 December 2022. Furthermore, the questionnaire consisted of an information sheet, informed consent, personal data questions, and 34 questions on knowledge, attitudes, and behavior. The participants of this study were cat owners who lived in Indonesia and have social networks (Facebook, Twitter,

and WhatsApp). The inclusion criteria were 17 years old, owning a pet cat at home, visiting the pet shop once a year or only when cat was sick, and agreeing to participate. Each participant filled out an anonymous and confidential online questionnaire Google form. Finally, the sample size of 385 was determined using a RaoSoft application.

The survey questions were developed based on a literature review on knowledge, attitudes, and behavior toward *T. gondii* (Andiappan et al., 2014; Grigg & Kogan, 2019; Desta, 2015), and they consisted of closed questions or short answers in Bahasa Indonesia, which were piloted for validity and reliability. The questionnaire was piloted on a non-sample of 40 cat owners to enhance the clarity of the questions and ensure that the time needed to

Table 2
Distribution of Respondents' Answers Based on Knowledge

Question (n = 388)	Correct Answer	
	F	%
1 Toxoplasmosis is a disease that can be transmitted from animals to humans or otherwise	323	83.2
2 <i>T. gondii</i> can be transmitted through infected cat feces	368	94.8
3 A person can be at risk of contracting toxoplasmosis when cleaning cat's litter box infected with <i>T. gondii</i>	342	88.1
4 A person is at risk of getting toxoplasmosis by eating raw/undercooked meat	312	80.4
5 Toxoplasmosis can be prevented by not allowing cat to hunt rodents	358	92.3
6 Toxoplasmosis can be prevented by making sure cat's litter box is changed every day	362	93.3
7 Toxoplasmosis can be prevented by cooking meat until it is cooked through and no pink color is visible	358	92.3
8 Toxoplasmosis can be prevented by thoroughly washing and/or peeling fruits and vegetables before consuming them	321	82.7
9 Toxoplasmosis can be prevented by thoroughly cleaning cutlery after use	354	91.2
10 Only cat can transmit <i>T. gondii</i>	315	81.2
Score of knowledge variable (Mean; Median (Min-Max))	(8.8; 9(0-10))	

Note: n= total respondents; F= frequency; % = percentage

complete the survey was accurate. Among the 50 questions piloted, 34 were valid and reliable.

The questionnaire included characteristics of respondents such as gender, age, level of education, place, and occupation. Additionally, it aimed to collect data related to pets. These included (1) the number of cat owned/kept, (3) other pets than cat, (4) knowledge of *T. gondii* (basic knowledge, risk factors for transmission, prevention) with true and false options, (5) *T. gondii* prevention attitudes with a rating scale answer of 1 to 4, where 1, 2, 3, and 4 represent strongly disagree, disagree, agree, and strongly agree, (6) and prevention behavior of *T. gondii* with a rating scale answer of 1 to 4, representing never, sometimes, often, and always, respectively.

Data were analyzed using SPSS version 25.0 (SPSS, IBM Corporation, New York, NY, USA), and the Kolmogorov-Smirnov test was conducted to determine the normality distribution of each variable. Meanwhile, the Spearman correlation test was used to investigate the relationship between variables. This study was approved by the Health Research Ethics Commission of RSUD Dr. Moewardi with number:

1.352/X/HREC/2022 and the participants digitally signed the informed consent before the study.

RESULTS

The online survey on knowledge, attitudes, and behavior toward prevention of Toxoplasmosis was conducted among 388 respondents, using 34 valid and reliable questions. The average, youngest, and oldest age of the respondents were 23, 17, and 50, respectively. The majority were female (84%) residing in Java (88.4%), and their occupations were students (51.8%), already working (41.8%), and 6.4% were unemployed. Furthermore, most of the respondents were graduates/students in tertiary institutions (78.1%). About 31.2% have 1 cat and 37.4% have more than three cats. A small population also has other pets (35.1%), with birds being the most common (50.7%), as shown in table 1.

The highest and lowest total score of knowledge variables were 10 and 0, as shown in table 2. Most of the respondents answered questions regarding knowledge about *T. gondii* correctly. In terms of attitudes to prevent the

Table 3
Distribution of Respondents' Answers Based on Attitudes

Statement (n = 388)	Answer (%)			
	SD	D	A	SA
1. I will wash my hands after gardening or handling soil	1.55	0.52	7.99	89.95
2. I will wash my hands after changing cat's litter box	1.29	0.52	6.70	91.49
3. I will wash my hands after handling raw meat	1.03	0.77	15.98	82.22
4. I would cook the meat thoroughly before consuming it	0.77	0.26	13.66	85.31
5. I would avoid consuming untreated water	1.03	3.61	13.14	82.22
6. I'm going to the vet for a routine cat health checkup	4.12	31.70	45.88	18.30
7. I will wear personal protective equipment (mask or gloves) when cleaning up cat litter	4.12	18.04	32.22	45.62
8. I don't think sharing a bed with cat is a problem	33.76	40.21	14.18	11.86
9. I will routinely change/clean cat's litter box every day	2.32	6.70	26.80	64.18
10. I will avoid stray cat	33.51	43.56	14.43	8.51
11. I will feed cat dry or commercial food	1.55	5.41	35.82	57.22
12. I will let cat hunt the rodents	5.41	12.89	20.62	61.08
Score of attitudes variable (Mean; Median (Min-Max))	(39.5; 40(18-47))			

Note: SD= Strongly Disagree; D= Disagree; A= Agree; SA= Strongly Agree; n= total respondents; % = percentage

caused diseases, the highest and lowest total scores were 47 and 18. More than 50% showed attitudes which leads to prevention of Toxoplasmosis, as illustrated in table 3. In terms of prevention behavior, the analysis presented the highest and lowest scores of 48 and 26, respectively. Over 70% of respondents showed correct behavior, such as washing hands after changing cat's litter box, cooking meat thoroughly, and avoiding the consumption of untreated water, as shown in table 4.

The Spearman correlation test was conducted due to the non-normally distribution of data. The results showed a significant correlation between knowledge and attitudes toward prevention (p-value = 0.038). The positive correlation direction was observed with a very weak strength of $r = 0.105$. Meanwhile, there was a significant correlation between knowledge and prevention behavior with a p-value of 0.006. The positive direction had a very weak relationship strength of $r = 0.141$. Lastly, knowledge and prevention attitudes had a significant correlation with a p-value of

0.001, as well as a strong relationship strength of $r = 0.682$, as shown in table 5.

DISCUSSION

The respondents in this study were mostly young females residing on the island of Java. These individuals had a good level of education and could answer questions related to knowledge of *T. gondii*. Prevention attitudes and behavior shown were positive with appropriate. The results of this study were in accordance with Yan et al (2018) that good knowledge and level of education impact attitudes and behavior, thereby increasing the prevalence of *T. gondii* prevention in rural and semi-urban communities.

Relationship of T. gondii Knowledge with Prevention Attitudes

Knowledge encompasses everything that is known based on experience, and this occurs in direct proportionality. Variables that affect knowledge can be classified into internal factors such as age and gender, as well as ex-

Table 4
Distribution of Respondents' Answers Based on Prevention Behavior

Statement (n = 388)	Answer (%)			
	SD	D	A	SA
1. I wash my hands regularly after changing cat's litter box	0.52	0.77	8.76	89.95
2. I cook the meat thoroughly before consuming it	0.26	0.77	12.89	86.08
3. I avoid consuming raw milk	2.58	4.90	13.66	78.87
4. I avoid consuming untreated water	1.03	3.61	14.95	80.41
5. I went to the Petshop/Veterinarian for a routine pet health check	30.41	40.21	21.13	8.25
6. I wear personal protective equipment (mask or gloves) when cleaning cat litter boxes	10.31	23.45	24.48	41.75
7. I share a bed with cat	28.61	36.08	18.81	16.49
8. I change/clean cat's litter box every day	3.35	11.86	22.68	62.11
9. I feed cat dry or commercial food	0.00	4.38	24.74	70.88
10. I let the pet cat hunt the rodents	7.47	11.08	23.71	57.73
11. I wear personal protective equipment (mask or gloves) when handling cat	23.71	26.29	23.20	26.80
12. I feed cat with fresh meat	4.90	9.54	23.97	61.60
Score of prevention behavior variable (Mean; Median (Min-Max))	(38.8; 39(26-48))			

Note: SD= Strongly Disagree; D= Disagree; A= Agree; SA= Strongly Agree; n= total respondents; % = percentage

ternal factors including education, work, experience, sources of information, interests, environment, and socio-culture (Esteban-Guitart & Moll, 2014). Meanwhile, attitudes refers to how a person perceives and evaluates something or someone, and it reflects a tendency to respond positively or negatively to ideas, objects, people, or situations (Nota et al., 2014). Furthermore, it is influenced by the environment (whether home, school, or work), experience, and education.

Knowledge and attitudes are often associated with age, gender, education, and occupation. Most of the respondents in this study were female university students with an average age of 23. The respondents are in a productive age where they can easily access and receive information. The majority also have a good education which suggests a close relationship between education and knowledge. These characteristics indicated several factors that can influence knowledge and attitudes toward transmission of *T. gondii* (Andiappan et al., 2014).

The results of this study indicated that there is a significant relationship between knowledge and *T. gondii* prevention attitudes. Sufficient knowledge plays a crucial role in in-

fluencing individual attitudes and behavior. Appropriate knowledge of *T. gondii* infection can reduce the rate and the risk of toxoplasmosis. According to the results of the study conducted on basic knowledge of *T. gondii*, most of the respondents were already aware that *Toxoplasma* could be transmitted through cat feces. This indicated a good level of understanding, particularly related to the mode of disease transmission. Additionally, education can be a protective factor for cat owners and increase their awareness of the importance of cleanliness in preventing various diseases, including toxoplasmosis (Eroglu & Asgin, 2021).

The level of knowledge was expected to change attitudes of respondents toward *T. gondii*. The majority of respondents showed positive attitudes towards preventing transmission of *T. gondii*. These include agreeing to wash their hands regularly after changing the pet cat's litter box, gardening or handling soil, touching raw meat, and using PPE when cleaning pet cat waste. Furthermore, it was strongly agreed to avoid consuming raw or unprocessed food and drinks. Knowledge and attitudes indicated that the respondent already understand the mode of transmission of *T. gondii* and the nec-

Table 3
Distribution of Respondents' Answers Based on Attitudes

Variable	r	p-value	Correlation
Knowledge and attitudes of prevention	0.105	0.038*	Positive
Knowledge and prevention behavior	0.141	0.006*	Positive
Attitudes and prevention behavior	0.682	0.001*	Positive

Note: * = significant correlation

essary prevention measures.

The results aligned with Senosy's (2020) study on the correlation between students' knowledge and attitudes toward toxoplasmosis. Furthermore, it was indicated that females with better knowledge had more positive attitudes. A study by Ibadi (2018) showed that the community needs an accurate and continuous understanding of transmission of toxoplasmosis and its prevention measures. Furthermore, social education also requires good knowledge of changing people's attitudes and preventing toxoplasmosis. Lack of knowledge about this infection is a significant barrier to achieving prevention goals. Therefore, continuous and accurate dissemination of knowledge within the community regarding toxoplasmosis and its modes of transmission is crucial. Fostering good knowledge and social education is important in changing people's prevention attitudes (Tung et al., 2008).

The Relationship of Knowledge and T. gondii Prevention Behavior

Behavior refers to an individual's actions or reactions to external or internal stimuli (Fatima, 2019), and it is influenced by predisposing factors, namely knowledge, attitudes, beliefs, beliefs, and values, enabling factors such as physical environment and facilities/infrastructure, as well as driving/reinforcing factors including attitudes and behavior of related institutions/officials. Infrastructure facilities, such as health workers can play a role in influencing behavior (Rusmanto, 2014). Ac-

ording to the study results, most of the respondents had positive behavior to reduce the risk of *T. gondii* infection. These included washing their hands after changing the pet cat's litter box, cooking meat thoroughly, avoiding consuming raw milk and untreated water and feeding pet cat with dry or commercial food. The respondent's knowledge about the mode of transmission was a significant factor that influenced their adoption of these behavior.

Dissemination of appropriate knowledge by health workers to prevent infection is urgently needed, especially for those who are most vulnerable, such as pregnant females (Chaudhry et al., 2014). A study in a Canadian prenatal clinic showed that educating women about the risk factors for toxoplasmosis by trained personnel improved prevention practices (Di Mario et al., 2015) and prevented serious pregnancy-related complications (Avelino et al., 2014). The results recorded in Brazil indicated that only 23.4% of pregnant women have good knowledge about this disease, especially in the field of prevention, but 58.9% apply appropriate prevention behavior (Moura et al., 2019). Furthermore, knowledge of cat owners correlates with fewer reported behavior problems (Grigg & Kogan, 2019). While the studies of Desta (2015) showed that most pregnant females did not know or were unsure about *T. gondii* parasite, risk factors, symptoms, and time of occurrence of toxoplasmosis infection, knowledge and thoughts towards ensuring public and personal hygiene could prevent all types of infection. Respondents rou-

tinely practice primary prevention behavior, especially maintaining good sanitary conditions.

Relationship between Attitudes and T. gondii Prevention Behavior

One of the predisposing factors in behavior was attitudes (Rusmanto, 2014), and those shown by respondents in dealing with *T. gondii* infection were positive. The respondents agreed on the views or responses in preventing transmission. A positive attitudes can serve as a motivating factor, leading individuals to engage in corresponding positive behavior. Respondents who agreed on attitudes of washing their hands after changing cat's litter box also showed the same behavior. According to the results of this study, there was a significant correlation between attitudes and prevention behavior which had a positive correlation direction with a strong relationship.

The results of this study were in accordance with those of Rhodes et al., 2003 on the correlation between personality and social cognition. Furthermore, it was discovered that attitudes trigger behavior changes. For instance, providing information about the benefits of vaccines can influence individuals to perceive their significance, increasing the likelihood of people choosing to receive the vaccine. Senosy (2020) observed that many students unknowingly avoid risky behavior, despite having a negative attitudes toward toxoplasmosis. Meanwhile, Sazmand et al (2020) highlighted that increased knowledge and positive attitudes do not necessarily result in positive changes in farmer behavior. A recent systematic review recommended hygiene measures to prevent toxoplasmosis during pregnancy. However, the practice of screening for seroconversion in pregnant females varies between countries and remains a topic of debate (Wehbe et al., 2022).

CONCLUSIONS

This study showed that there was a relationship between knowledge, attitudes, and behavior of cat owners toward preventing *T. gondii*. Knowledge about this infection was a factor in determining attitudes and behavior of preventing toxoplasmosis. Furthermore, a positive attitudes will provide appropriate behavior in preventing infection. Therefore, a public health awareness campaign on Toxoplasmosis is needed in the community to prevent transmission.

The followings were the limitations of this study. First, the majority of respondents were located in Java Island, hence, the generalizability for Indonesia still needs to be considered. Second, the questionnaires were only distributed to respondents who used social media, such as WhatsApp, Twitter, and Facebook, excluding cat owners without access to these platforms. Last, since this is a self-administrated online survey, the bias of the provided answer should also be considered. The results of this study highlight important lessons. First, the effort to continue the health promotion and prevention of toxoplasmosis was very important. Second, further advance and comprehensive studies on knowledge, attitudes, and behavior on toxoplasmosis in a wider population need to be conducted.

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AUTHORS' CONTRIBUTIONS

Fajar T. Nurseha designed the study, formulated the concept, collected data, analyzed the data and performed the field work, Yusuf A. Mashuri designed the study, formulated the concept, analyzed the data and revised the manuscript, Eti P. Pamungkasari Reviewed the manuscript, Utiya N. Maulani designed the study, All Authors wrote the manuscript, revised the manuscript, read and approved the final manuscript.

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COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

REFERENCES

- Ahmad, N. (2019). Seroepidemiology of Toxoplasmosis in Human Population with Reference to Its Zoonotic Potential in Sub-Tropical Areas of Pakistan. *Pakistan Veterinary Journal*, 39(02), 211–215. <https://doi.org/10.29261/pakvetj/2019.017>
- Almeria, S., & Dubey, J. P. (2021). Foodborne transmission of Toxoplasma gondii infection in the last decade. An overview. *Research in veterinary science*, 135, 371-385. <https://doi.org/10.1016/j.rvsc.2020.10.019>
- Andiappan, H., Nissapatorn, V., Sawangjaroen, N., Khaing, S. L., Salibay, C. C., Cheung, M. M. M., Dungca, J. Z., Chemoh, W., Teng, C. X., Lau, Y. L., & Mat Adenan, N. A. (2014). Knowledge and practice on Toxoplasma infection in pregnant women from Malaysia, Philippines, and Thailand. *Frontiers in microbiology*, 5, 291. <https://doi.org/10.3389/fmicb.2014.00291>
- Attias, M., Teixeira, D. E., Benchimol, M., Vommaro, R. C., Crepaldi, P. H., & De Souza, W. (2020). The life-cycle of Toxoplasma gondii reviewed using animations. *Parasites and Vectors*, 13(1), 1–13. <https://doi.org/10.1186/s13071-020-04445-z>
- Avelino, M. M., Amaral, W. N., Rodrigues, I. M. X., Rassi, A. R., Gomes, M. B. F., Costa, T. L., & Castro, A. M. (2014). Congenital toxoplasmosis and prenatal care state programs. *BMC Infectious Diseases*, 14(1). <https://doi.org/10.1186/1471-2334-14-33>
- Bigna, J. J., Tochie, J. N., Tounouga, D. N., Bekolo, A. O., Ymele, N. S., Youda, E. L., Sime, P. S., & Nansseu, J. R. (2020). Global, regional, and country seroprevalence of Toxoplasma gondii in pregnant women: a systematic review, modelling and meta-analysis. *Scientific Reports*, 10(1), 1–10. <https://doi.org/10.1038/s41598-020-69078-9>
- Center for Disease Control and Prevention, C. (2015). Parasites - Toxoplasmosis (Toxoplasma infection) Epidemiology & Risk Factors. *Cdc*, 1–2. <http://www.cdc.gov/parasites/toxoplasmosis/epi.html%5C>
- Chaudhry, S. A., Gad, N., & Koren, G. (2014). Toxoplasmosis and pregnancy. *Canadian Family Physician*, 60(4), 334-336. <https://www.cfp.ca/content/60/4/334.full>
- Desta, A. H. (2015). Knowledge, Attitude and Practice of Community Towards Zoonotic Importance of Toxoplasma Infection in Central Afar Region, North East Ethiopia. *International Journal of Biomedical Science and Engineering*, 3(6), 74. <https://doi.org/10.11648/j.ijbse.20150306.12>
- Di Mario, S., Basevi, V., Gagliotti, C., Spettoli, D., Gori, G., D'Amico, R., & Magrini, N. (2015). Prenatal education for congenital toxoplasmosis. *Cochrane Database of Systematic Reviews*, 2015(10). <https://doi.org/10.1002/14651858.CD006171.pub4>
- do Vale, B., Lopes, A. P., Fontes, M. D. C., Silvestre, M., Cardoso, L., & Coelho, A. C. (2021). A Cross-Sectional Study of Knowledge on Ownership, Zoonoses and Practices among Pet Owners in Northern Portugal. *Animals*, 11(12), 3543. <https://doi.org/10.3390/ani11123543>
- Eroglu, S., & Aşgin, N. (2021). Awareness, knowledge and risk factors of Toxoplasma gondii infection among pregnant women in the Western Black Sea region of Turkey. *Journal of Obstetrics and Gynaecology*, 41(5), 714-720. <https://doi.org/10.1080/01443615.2020.1789954>
- Esteban-Guitart, M., & Moll, L. C. (2014). Funds of identity: A new concept based on the funds of knowledge approach. *Culture & Psychology*, 20(1), 31-48. <https://doi.org/10.1177/1354067X13515934>
- Fatima, M. (2019). Types of Human Behavior In Psychology. *Bioscience Pk*, August 2019, 2-4. <https://www.bioscience.com.pk/topics/psychology/item/1311-types-of-human-behavior-in-psychology>
- Grigg, E. K., & Kogan, L. R. (2019). Owners' attitudes, knowledge, and care practices: Exploring the implications for domestic cat behavior and welfare in the home. *Animals*, 9(11). <https://doi.org/10.3390/ani9110978>
- Hall, C. M., Adams, N. A., Bradley, J. S., Bryant, K. A., Davis, A. A., Dickman, C. R., Fujita, T., Kobayashi, S., Lepczyk, C. A., McBride, E. A., Pollock, K. H., Styles, I. M., Van Heezik, Y., Wang, F., & Calver, M. C. (2016). Community attitudes and practices of urban residents regarding predation by pet cats on wildlife: An International comparison. *PLoS ONE*, 11(4), 1–30. <https://doi.org/10.1371/journal.pone.0151962>
- Hatam-Nahavandi, K., Calero-Bernal, R., Rahimi, M. T., Pagheh, A. S., Zarean, M., Dezhkam, A., & Ahmadpour, E. (2021). Toxoplasma gondii infection in domestic and wild felids as public health concerns: a systematic review and meta-analysis. *Scientific Reports*, 11(1), 1–11. <https://doi.org/10.1038/s41598-021-89031-8>
- Ibadi, A. K. (2018). *Health Intervention in Improving the Knowledge and Attitude on Toxoplasmosis Among Pregnant Women With Toxoplasmosis*. <http://www.journalcra.com>
- Jung, B. K., Song, H., Lee, S. E., Kim, M. J., Cho, J., Shin, E. H., & Chai, J. Y. (2017). Seroprevalence and risk factors of toxoplasma gondii infection among cat sitters in Korea. *Korean Journal of Parasitology*, 55(2), 203–206. <https://doi.org/10.3347/kjp.2017.55.2.203>
- Kochanowsky, J. A., & Koshy, A. A. (2018). Toxoplasma gondii. *Current Biology*, 28(14), R770–R771. <https://doi.org/10.1016/j.cub.2018.05.035>
- Moura, I. P. da S., Ferreira, I. P., Pontes, A. N., & Bichara, C. N. C. (2019). Toxoplasmosis knowledge and preventive behavior among pregnant women in the city of Imperatriz, Maranhão, Brazil. *Ciencia e Saude Coletiva*, 24(10), 3933–3946. <https://doi.org/10.1590/1413-812320182410.21702017>
- Nota, L., Santilli, S., Ginevra, M. C., & Soresi, S. (2014). Employer attitudes towards the work inclusion of people with disability. *Journal of Applied Research in Intellectual Disabilities*, 27(6), 511-520. <https://doi.org/10.1111/jar.12081>
- Polanunu, N. F. A., Wahyuni, S., & Hamid, F. (2021). Seroprevalence and associated risk factors of Toxoplasma gondii

- infection among pregnant mother in Makassar, Indonesia. *PLoS ONE*, *16*(6 June), 1–10. <https://doi.org/10.1371/journal.pone.0245572>
- Retmanasari, A., Widartono, B. S., Wijayanti, M. A., & Artama, W. T. (2017). Prevalence and Risk Factors for Toxoplasmosis in Middle Java, Indonesia. *EcoHealth*, *14*(1), 162–170. <https://doi.org/10.1007/s10393-016-1198-5>
- Rhodes, R. E., Courneya, K. S., & Jones, L. W. (2003). Translating exercise intentions into behavior: Personality and social cognitive correlates. *Journal of Health Psychology*, *8*(4), 447–458. <https://doi.org/10.1177/13591053030084004>
- Robert-Gangneux, F., & Dardé, M. L. (2012). Epidemiology of and diagnostic strategies for toxoplasmosis. *Clinical Microbiology Reviews*, *25*(2), 264–296. <https://doi.org/10.1128/CMR.05013-11>
- Rusmanto. (2014). Faktor yang Mempengaruhi Masyarakat dalam Kepatuhan Minum Obat Anti Filaria. *Universitas Islam Negeri Syarif Hidayatullah*. <https://repository.uinjkt.ac.id/dspace/handle/123456789/24113>
- Sazmand, A., Alipoor, G., Zafari, S., Zolhavarieh, S. M., Alanazi, A. D., & Sargison, N. D. (2020). Assessment of Knowledge, Attitudes and Practices Relating to Parasitic Diseases and Anthelmintic Resistance Among Livestock Farmers in Hamedan, Iran. *Frontiers in Veterinary Science*, *7*, 1–9. <https://doi.org/10.3389/fvets.2020.584323>
- Senosy, S. A. (2020). Knowledge and attitudes about toxoplasmosis among female university students in Egypt. *International Journal of Adolescent Medicine and Health*, 1–8. <https://doi.org/10.1515/ijamh-2019-0207>
- Smereka, J., Szarpak, L., Ruetzler, K., Schacham, Y., Smereka, A., Dabrowski, M., Terpilowska, M., Terpilowski, L., & Adam, I. (2018). A multicenter survey on toxoplasmosis knowledge among pregnant women in Poland (the TOWER study). *BMC Pregnancy and Childbirth*, *18*(1), 1–5. <https://doi.org/10.1186/s12884-018-2031-7>
- Tung, W. C., Ding, K., & Farmer, S. (2008). Knowledge, Attitudes, and Behaviors Related to HIV and AIDS Among College Students in Taiwan. *Journal of the Association of Nurses in AIDS Care*, *19*(5), 397–408. <https://doi.org/10.1016/j.jana.2008.04.009>
- Wehbe, K., Pencole, L., Lhuair, M., Sibiude, J., Mandelbrot, L., Villena, I., & Picone, O. (2022). Hygiene measures as primary prevention of toxoplasmosis during pregnancy: A systematic review. *Journal of Gynecology Obstetrics and Human Reproduction*, *51*(3), 102300. <https://doi.org/10.1016/j.jogoh.2021.102300>
- Yan, L., Loganathan, S., & Nimir, A. R. (2018). Knowledge, Attitude and Practice Related to Toxoplasma gondii Infection among Rural and Semi-Urban Community in Malaysia. *Ann Clin Pathol*, *6*(1), 1128. <https://doi.org/10.47739/2373-9282/1128>