Research Article
Volume 15:04, 2024

Journal of Veterinary Science & Technology

ISSN: 2157-7579
Open Access

Toxoplasma gondii among Pregnant Women Attending Antenatal Care at Central Gondar Zone Public Hospital, Northwest Ethiopia: Structural Equation Modeling

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Abstract

Background: Toxoplasmosis, caused by the parasite *Toxoplasma gondii*, is a significant public health concern in Ethiopia due to its high prevalence and associated risk factors. Exploring the mechanism in the causal pathway how risk factors affect *T. gondii* is paramount important to develop targeted, population specific public health interventions to reduce the burden of Toxoplasmosis among pregnant women in the community. Hence, this study aimed to determine the relationship between risk factors and their contribution for development for *T. gondii* among pregnant women attending at Central Gondar Zone Public Hospitals.

Methods: A cross sectional study conducted questioner survey was conducted using questions based on the framework to confirm how the disease is transmitted. A set of rating scale questions was used to measure each model construct. Data was collected using a semi-structured Amharic version questioner. Total of 554 study pregnant women participated in this study. Structural Equation Modeling (SEM) used to explore the mechanism how risk factors affect *T. gondii* using AMOS-version 18. Data entered into SPSS-2020. Each parameter's Cornbrash's alpha was assessed using the average inter-item correlations. The path coefficient used to estimate the coefficient.

Results: The SEM analysis showed that the proposed model was appropriate and the data fit reasonably well ($\chi 2$=131.493, RMSEA=0.176, CFI=0.866, TLI=0.139, IFI=0.871, NFI=0.865, Degrees of freedom=7). The risk factors suggested that both education and residence were associated with increased exposure to cat faeces. Residence was also found to be positively correlated with dust exposure. However, there was an inverse association between education and dog contact. The regression investigation revealed statistically significant associations between residence, dust exposure, and water-related.

Conclusion: The model demonstrates a reasonable fit, suggesting regular awareness creation for toxoplasmosis management techniques, providing baseline information for control and prevention strategies, and improving toxoplasmosis knowledge and epidemiology.

Keywords: *Toxoplasma gondii* • Risk factors • Structural equation model • Pregnant women • Ethiopia

Abbreviations: AGFI: Adjusted Goodness of Fit Index; ANC: Anti-Natal Care; AMOS: Analysis of Moment Structures; CFA: Confirmatory Factor Analysis; CMIN: Chi-square Minimum; CT: Congenital Toxoplasmosis; DF: Degree of Freedom; GFI: Goodness of Fit Index; CFI: Comparative Fix Index; ELISA: Enzyme-Linked Immuno Sorbent Assay; FAT: Immuno Fluorescence Assay Test; IFI: Incremental Fit Index; IgA: Immunoglobulin A; IgE: Immunoglobulin A; IgE: Immunoglobulin G; IgM: Immunoglobulin M; LAT: Latex Agglutination Test; NFI: Normed Fit Index; RDT: Rapid Diagnostic Test; RMSEA: Root Mean Square Error of Approximation; SEM: Structural Equation Modeling; TLI: Tucker-Lewis Index

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Received: 11 July, 2024, Manuscript No. jvst-24-141346; **Editor Assigned:** 13 July, 2024, PreQC No. P-141346; **Reviewed:** 26 July, 2024, QC No. Q-141346; **Revised:** 30 July, 2024, Manuscript No. R-141346; **Published:** 07 August, 2024, DOI: 10.37421/2157-7579.2024.15.252

Introduction

A parasite called *Toxoplasma gondii* lives inside cells and causes a disease called toxoplasmosis [1]. It is a coccidian protozoan parasite in the phylum Apicomplexa. Toxoplasmosis is a prevalent zoonotic illness that affects a diverse range of warm-blooded vertebrates, including humans, as well as several domestic and wild animals [2,3]. It has a worldwide distribution, affecting one-third of the world's population [4]. Toxoplasmosis, a parasitic infection, can infect most warm-blooded species. This parasite has a complicated life cycle. It goes through a sexual phase in the definitive host, which is a cat, and an asexual phase in intermediate hosts, which are humans and other warm-blooded animals [3,5]. Toxoplasma infection has two stages: one is acute toxoplasmosis, which is often asymptomatic in healthy adults. However, symptoms may manifest as a mild, flu-like illness with low-grade fever, malaise, and headache [6,7]. *Toxoplasma gondii* infection poses significant health risks to human beings, particularly pregnant women and the developing fetus or neonates. It can lead to serious and life-threatening outcomes [8]. Infection of *T. gondii* during pregnancy in a pregnant woman can result in depression and is associated with psychiatric problems and adverse pregnancy outcomes, including miscarriage, fetal death, and delayed motor development. In pregnant women, infection was associated with anxiety, depression, and illnesses related to schizophrenia [9]. While the primary infection is mostly asymptomatic in pregnant women, the parasite might cross the placenta and infect the fetus. An infected fetus may have severe complications such as mental retardation, hearing problems, seizures, Chorioretinitis, hydrocephaly, retinochoroiditis, neurological damage or intracranial calcification, seizures, or even fetal death [10,11]. Environmental conditions, nutritional and cultural habits, and hygiene influence toxoplasmosis. Climate conditions can play a vital role in oocyst survival [12]. In addition, infection also occurs through consuming undercooked meat, which carries the tissue cyst form of this protozoan. Sharing needles, blood transfusions, and organ transplants can also spread these parasites [13]. The sero-prevalence of toxoplasmosis displays significant diversity and can vary greatly between countries and even among different geographic regions of the same country. The primary goal of prevention and control efforts is to provide education to those in high-risk populations with the aim of enhancing their knowledge and understanding of the disease [14,15]. The presence of *T. gondii* antibodies was associated with owning cats, having close contact with cats, and consuming meat products, which are risk factors for toxoplasmosis. This is because pregnant women who were not aware of the disease had a higher likelihood of becoming infected. It is important to note that pregnant women are considered a high-risk group for toxoplasmosis [16]. Therefore, it is crucial to conduct studies on preventive measures such as hand hygiene practices, consumption of properly cooked meat and vegetables, cleaning of vegetables, economic, social, and cultural habits, water quality, and sanitation coverage. Raising awareness can help prevent infection and potential difficulties arising from congenital toxoplasmosis, particularly in pregnant women [5,17]. Structural model focus is a combination of factor analysis and multiple regressions to test complex relationships simultaneously and examine the relationship between contracts [18]. After collecting data before applying regression, check reliability and validity. It works on a linear relationship; no single statement construct is required, and data should be normally distributed. Hence, we look at how independent contracts influence dependent contracts, or, in more complex models, how dependent variables influence other dependent variables. The first type of structural modeling examines path analysis (the structural model), which assesses only the relationship between contracts. It is appropriate to examine a path analysis until you have performed a measurement model analysis to determine if your measures are valid. Once the measurement model has been established, we can form composite variables. Then go to output and estimate the result presented, like the Confirmatory Factor Analysis (CFA) for measurement model the unstandardized regression weight significance for structural relationships and with simple path analysis report standardized regression weights so that can compare the strength of relationships and see model fit statistics All comparative fit statistics (CFI, IFI, NFI, TLI chi-square/df test, and RMSEA) show the model fits the data, and we also look at modification indices, the covariance, and the regression weight [19]. If you are going to use SEM, it is always better to use a full structural model, not only measurement items but also structural relationships. No studies on the modeling of *T. gondii* in pregnant women have been conducted in Ethiopia as of yet. So, the point of this study is to look into the relationship between risk factors and how they affect the development of risk so that *T. gondii* control methods can be used on pregnant women at the Central Gondar Zone Public Hospital by using the SEM framework. The results of this study offer fundamental data for planning, implementation, control, and prevention techniques, while also enhancing the understanding and study of toxoplasmosis.

Materials and Methods

Study design and setting

A cross-sectional study was performed to determine the association between risk variables and their impact on the development of risk, with the intention of implementing *T. gondii* control measures among pregnant women at Central Gondar Zone public hospitals.

Study participants

The source population included all pregnant women receiving ANC at Central Gondar Zone Public Hospital. The study population included pregnant women who obtained ANC at Central Gondar Zone Public Hospital during the study period who were sero-positive and sero-negative for toxoplasmosis. We included pregnant women aged 18 to 49 who agreed to participate in the study. We excluded pregnant women who were unable to communicate due to medical reasons from the study.

Theoretical framework

Structural equation modeling is a powerful, multivariate technique that is increasingly used in scientific investigations to test and evaluate multivariate causal relationships. Regression analysis is a statistical method used to quantify the extent to which the independent variable or factors account for the variability observed in the dependent variable. While multiple regression analysis is constrained to using only observable variables, the fundamental ideas of this method can still be applied in structural equation modeling [20]. The statistical analysis technique allows for the examination of research hypotheses by creating models that represent intricate connections between numerous observables (Figure 1). The researchers formulate hypotheses in the structural equation modeling approach, where intervening factors have a mediating role in the relationship between one variable and another. This researcher investigated whether the relationships between measurable and latent variables are unidirectional or bidirectional, using theoretical predictions as a benchmark. Figure 1 illustrates the relationship between the first observed endogenous variable (education, job, residence, ELISA 1, and hand washing before meals) and the observed exogenous variables (cat faces, dog presence, water type, contact with dust farming), as well as the unobserved exogenous variables E1, E2, E3, E4, and E5. The model consists of a total of 14 variables, as illustrated in Figure 1. These variables divide into four categories: endogenous variables (5), exogenous variables (9), unobserved variables (5), and observable variables (9).

Sample size determination and sampling technique

The selection of this sample size was determined by a careful assessment of the practicality of conducting the Structural Equation of Modeling (SEM) and ensuring sufficient statistical power for the planned statistical analyses. Furthermore, it is necessary to have a minimum sample size of 200 for doing structural equation modeling. However, in our study, we have utilized a sample size of 578 [21]. Determine the necessary sample size of 578 for a study

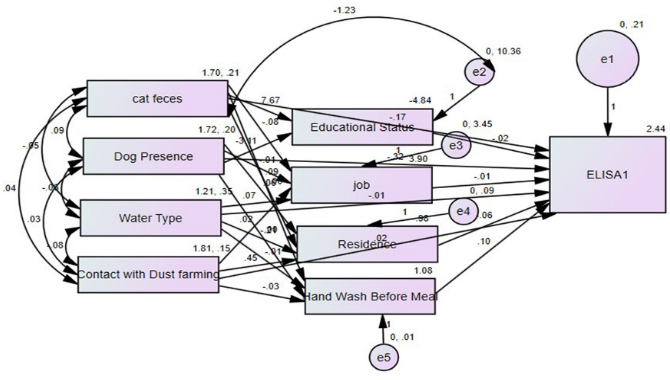

Figure 1. The constructs of the SEM model in the presented factor analysis of the plan to apply *Toxoplasma gondii* control measures.

using Structural Equation of Modeling (SEM) that involves latent variables. This calculation requires information on the estimated effect size, the required p-value, the desired level of statistical power, and the number of observable and latent variables. The calculator determined the minimum sample size needed considering the structural complexity of the model, as well as the minimum sample size needed to detect the specified effect.

Sampling: A sample size of 578 pregnant women from central Gondar public hospital was selected for data collection. A pragmatic assessment of the usefulness of applying Structural Equation Modeling (SEM) and the necessary statistical power for the particular study was used to determine the sample size. According to some experts, the ideal sample size for Structural Equation Modeling (SEM) is between 200 and 500. Pregnant women in the central Gondar public hospitals were sampled from 9 Woreda (Gondar, koladiba, Delgi, Shawura, Arbaya, Degoma, Ambagiyorgis, Sanja and Keraker) the researchers choose Woreda based on budget and the ease of accessibility and feasibility. For data gathering, sample sizes of 554 pregnant women from public hospitals were chosen. The sample size was selected by a practical evaluation of the feasibility of Structural Equation Modeling (SEM) and the statistical power required for the specified study.

Model Specification In the present study, the six basic constructs of the SEM were used to assess *T. gondii* in pregnant women and its control in Central Gondar Zone public hospitals in North-West Ethiopia. In the evaluation of the effect of these factors on control measures against the disease by improving management, the intention to participate in control measures was considered. This is due to the absence of any control measures in practice to measure directly. In the analysis, socio-demographics and variables were used as modifying risk factors for the disease. Furthermore, the preliminary study hypothesized that the measurement model described the relationships among these variables in Figure 1. This has described a model that can account for the observed relationships between education, job, residence, ELISA 1, hand washing before meals, cat faces, dog presence, water type, and contact with dust farming. However, there was a moderated relationship between all variables. Our model accounted for the risk-factor relationship. We calculated how well our model reflected the observed relationships on the parameter path, given the hypothesized relationships. The correlation of all variables was examined, and a path model was built based on the results of the univariate analysis. The fit of the model was examined in terms of Degree of Freedom (DF), Chi-Square Minimum (CMIN), Comparative Fix Index (CFI), and also Root Mean Square Error of Approximation (RMSEA).

Data collection and processing

Questionnaire survey: We developed a questionnaire based on the above mentioned framework. We measured each model construct using questions. We employed a collection of rating scale items to evaluate each model construct (questions). We employed three rating questions to identify the observable risk factors regarding the probability of managing toxoplasmosis. The first question examined the prevalence of toxoplasmosis among various pregnant women. The second question related to the frequency of occurrence of risk variables related to experiences. The third question used a two-point grading scale (yes, no) to determine the control of toxoplasmosis associated with risk factor occurrence. Management and control measures are important for pregnant women to determine the practical relevance of the relationships in the theoretical model for toxoplasmosis control.

Operational definition: Structural equation modeling is measurement and analysis of the correlations between observable and latent variables are done through the use of statistical techniques.

Data management and analysis: Before analysis, we checked the data for completeness. We entered, edited, and cleaned the data into SPSS version 20.0 for analysis. We conducted a logistic regression model to examine the association between dependent and independent variables. We used Analysis of Moment Structures (AMOS) version 18 to conduct confirmatory factor analysis, normality tests, reliability tests, Pearson correlations, path analyses, and descriptive statistics. Additionally, each factor was separately analyzed using a Factor Analysis (FA). Cronbach's alpha, which is a measure of reliability, is computed for each parameter by averaging the inter-item correlations. A frequently accepted significance level of 0.05 is employed in this calculation. The purpose of these appraisals was to provide sufficient guidance for the management of toxoplasmosis. Preventive measures were implemented to mitigate the risk factor for disease control in Central Gondar, Ethiopia. There are eight correlation coefficients among the variables used in the Structural Equation Modeling (SEM) analysis. These variables include cat faces, presence of dogs, type of water, and contact with dust farming, education status, job, residence, and hand washing before meals. There is a connection coefficient that relates the number of cat faces, the presence of dogs, the kind of water, and contact with dust from farming, education status, work, residence, and hand washing before a meal.

Ethical considerations: The study was undertaken after receiving ethical approval from the research and ethics committee of the Institutional Review Board (IRB) at the University of Gondar. Furthermore, the researchers obtained a letter of support from the APHI and Central Gondar Zone health offices. Prior to starting the actual data collection, permission was obtained from the offices of the hospital directors. Furthermore, we obtained informed written consent from the participants after explaining the purpose, benefits, and possible risks of the study. Which assured that participation was on a voluntary basis.

Results

Structural equation modelling

Variable summary: A total of 554 study participants were included, and the questionnaire was designed based on the framework described above. Every model construct was evaluated through a series of questions utilizing a grading system. In the model based on theory, the relationships between variables, both direct and indirect, are combined. Every model construct was evaluated through a series of questions utilizing a grading system. The observed variable (the manifest variable) is the measured variable in the data collection process. In the case of this study, the model has the following observed endogenous variables (education, job, residence, ELISA 1, and hand washing before meals) it hat are linked to the observed exogenous variables (cat feces, dog presence, water type, contact with dust farming) and the unobserved exogenous variables ((E1, E2, E3, E4, and E5):The number of variables in this model is 14; the number of observed variables is 9, the number of unobserved variables is 5, the number of exogenous variables is 9, and the number of endogenous variables is 5. The number of distinct sample moments (54), the number of distinct parameters to be estimated (47), and degrees of freedom (5).

Normality test: Using skewness and kurtosis values, they are examined to determine whether the variables in the data set are normally distributed and tested for normality and “outliers” so that these test values can be found in table form, and the acceptable range of values is less than 3 for skewness and less than 10 for kurtosis. A variable may indicate that its distribution is regularly distributed if its kurtosis value is less than 3.00 [22]. The SEM result was therefore regularly distributed. The components' dependability was methodically assessed prior to the research model's analysis. Items were examined for consistency in order to obtain an appropriate model. An indicator of the distribution's peak and tails is called kurtosis. With short, thick tails, also known as heavy-tailed distributions that indicate few outliers, positive kurtosis indicates extremely peaked distributions (leptokurtic). When the distribution is long and thin and very flat (mesokurtic), indicating a large number of outliers, negative kurtosis is present. When the kurtosis index has an absolute value more than 10.0, it may indicate an issue; values exceeding 20.0 are considered extreme (20). Given that distributions deviate from normality in at least four ways, univariate normality is particularly crucial to take into account. Every variable in our model had a positive skew (Table 1).

Parameter estimation, model evaluation and model comparison

Maximum likelihood estimates: The regression weight estimate result indicates that, when Education goes up by 4, number of CatF goes up by 7, number of Education goes down by 3, Doge goes down by 3, number of Dust goes up by 12, Residence goes up by 0.4, and number of Doge goes down by 0.005. than the rest of the activities. There is less than 0.001 chance of obtaining a critical ratio as high as 12.389 in absolute value. In the regression weight dust and water with residence have significant association. Job with CatF and doge no significant association Education and residence is positively associated with CatF, education negatively influences doge, residence negatively influences water, residence positively influences dust. The model's results are shown in this part in (Table 2).

In this section, the findings of the model are presented in Table 3. Regarding covariance the variables between CatF and doge was estimated to be (0.094), and between doge and number of water is estimated to be (-0.056), water and number of dust are estimated to be (-0.080), CatF and number of water are estimated to be (-0.055), e2 and number of CatF are estimated to be (-1.229), the directional relationship between pairs of variables Positive suggest that when one variable increases, the other were positive effects, while negative indicate an inverse relationship consequences of risk and disease-causing factors. Variance of CatF is .211, .202, .351, .151 indicating how much the values of CatF, doge, water, dust vary around their mean measures the spread of individual variables within the dataset. Correlations are standardized covariance, ranging from-1 and 1 .455, -.210, -.347, .196, represent correlations between pairs of variables a correlation of .455 between CatF and doge suggests a strong positive linear relationship a correlation of .455 between CatF and doge suggests a strong positive linear relationship.

Matrices factor score weights estimates

These estimates represent the relationships between latent factors Dust, Water, Doge, CatF and observed variables HandW, Residence, job, Education each indicated strength and direction of the relationships The weight estimate for HandW in relation to the latent factor Dust is -0.029, for Residence in relation to the latent factor Dust is 0.449 for Education in relation to the latent factor Doge is -3.111. Direct effects refer to the impact of latent factors on observed variables without considering other factors the direct effect of Dust on Education is 7.675. Indirect effects occur through other latent factors or observed variables, consider the path ways from one latent factor to another *via* intermediate variables, the indirect effects of Dust on Education through ELISA1 is -0.170 times 0.103 is equal to-0.018. Total effects combine both direct and indirect effects; the total effect of Dust on Education is 7.675 minus 0.018=7.657. Based on these estimates the results indicated that there was a positive relationship between variables. The findings of the model are presented in Table 4 illustrates the indirect effect of an exogenous independent variable on an endogenous dependent variable.

Model fit summary

All of the risk factors, all the variables that were used in the SEM: education, job, residence, ELISA 1, hand washing before meals, cat faeces, dog presence, water type, and contact with dust farming, have a risk of the total number of the respective items, and the data fits the model reasonably well (Table 5). Fit indices, also known as fit statistics, are metrics used in the Structural Equation Modeling process to evaluate how well the models match the data. For CFI, TLI, IFI, NFI Values close to 1 indicate good fit in our case is 0.866, 0.139, 0.871, and 0.865 respectively suggesting reasonable fit. DM (Degrees of Freedom for Model) is 7, SM (Saturated Model) is 1.000, which means your model doesn't perfectly fit the data and IM (Independence Model)

Table 1. Assessment of normality.

Variable	Min	Max	Skew	c.r.	Kurtosis	c.r.
Education status	1	4	-.526	2.76	-1.172	2.95
Job	1	6	-.035	3.71	-1.645	4.02
Residence	1	2	-1.419	1.75	0.014	1.82
	1	2	-.868	1.66	-1.252	1.74
	1	2	-.974	1.68	-1.055	1.76
	1	2	2.725	1.16	6.191	1.26
	1	2	-1.619	1.78	0.623	1.85
	1	2	-.174	1.50	1.58	1.58

Table 2. Regression weights estimate and critical ratio of SEM on impact of risk.

	Path		Estimate	S.E.	C.R.	P
Education	<---	CatF	7.675	1.905	4.029	***
job	<---	CatF	-0.082	0.196	-0.419	0.676
Residence	<---	CatF	0.089	0.032	2.753	0.006
Education	<---	Doge	-3.111	0.934	-3.33	***
job	<---	Doge	-0.007	0.2	-0.034	0.973
Residence	<---	Water	-0.213	0.024	-8.951	***
Residence	<---	Dust	0.449	0.036	12.389	***
job	<---	Dust	0.02	0.22	0.091	0.927
job	<---	Water	0.066	0.144	0.454	0.65
Residence	<---	Doge	0.056	0.033	1.714	0.087
HandW	<---	Dust	-0.029	0.01	-2.945	0.003
HandW	<---	Water	-0.007	0.007	-1.018	0.309
HandW	<---	Doge	-0.005	0.009	-0.503	0.615
HandW	<---	CatF	0	0.009	-0.033	0.974
ELISA1	<---	Education	-0.019	0.019	-0.997	0.319
ELISA1	<---	job	-0.013	0.01	-1.218	0.223
ELISA1	<---	Residence	-0.057	0.063	-0.903	0.367
ELISA1	<---	CatF	-0.17	0.048	-3.515	***
ELISA1	<---	Doge	-0.318	0.049	-6.477	***
ELISA1	<---	Water	-0.006	0.039	-0.149	0.882
ELISA1	<---	Dust	0.024	0.065	0.373	0.709
ELISA1	<---	HandW	0.103	0.23	0.447	0.655

Table 3. Maximum likelihood estimates from the SEM relationship between variables.

			Estimate	S.E.	C.R.	P
A	Covariance	CatF <--> Doge	0.094	0.01	9.731	***
		Doge <--> Water	-0.056	0.012	-4.843	***
		Water <-->	-0.08	0.01	-7.703	***
		Doge <--> Dust	0.034	0.008	4.522	***
		CatF <--> Dust	0.041	0.007	5.556	***
		CatF <--> Water	-0.055	0.01	-5.684	***
		e2 <--> CatF	-1.229	0.318	-3.871	***
B	Variances	CatF	0.211	0.013	16.629	***
		Doge	0.202	0.012	16.629	***
		Water	0.351	0.021	16.629	***
		Dust	0.151	0.009	16.629	***
		e2	10.358	4.724	2.193	0.028
		e3	3.452	0.208	16.629	***
		e4	0.093	0.006	16.629	***
		e5	0.007	0	16.629	***
		e1	0.207	0.012	16.629	***
C	Correlations	CatF <--> Doge	0.455	-	-	-
		Doge <--> Water	-0.21	-	-	-
		Water <--> Dust	-0.347	-	-	-
		Doge <--> Dust	0.196	-	-	-
		CatF <--> Dust	0.228	-	-	-
		CatF <--> Water	-0.201	-	-	-
		e2 <--> CatF	-0.832	-	-	-

Table 4. Factor score weights estimates from the SEM between dependent and dependent variables.

		Dust	Water	Doge	CatF	HandW	Residence	job	Education
A) Direct Effects	HandW	-0.029	-0.007	-0.005	0	0	0	0	0
	Residence	0.449	-0.213	0.056	0.089	0	0	0	0
	job	0.02	0.066	-0.007	-0.082	0	0	0	0
	Education	0	0	-3.111	7.675	0	0	0	0
	ELISA1	0.024	-0.006	-0.318	-0.17	0.103	-0.057	-0.013	-0.019
B) Indirect Effects	HandW	0	0	0	0	0	0	0	0
	Residence	0	0	0	0	0	0	0	0
	job	0	0	0	0	0	0	0	0
	Education	0	0	0	0	0	0	0	0
	ELISA1	-0.029	0.011	0.056	-0.15	0	0	0	0
C) Total Effects	HandW	-0.135	-0.046	-0.024	-0.002	0	0	0	0
	Residence	0.428	-0.308	0.062	0.1	0	0	0	0
	job	0.004	0.021	-0.002	-0.02	0	0	0	0
	Education	0	0	-1.195	3.009	0	0	0	0
	ELISA1	-0.004	0.006	-0.236	-0.295	0.018	-0.047	-0.047	-0.045

Table 5. SEM of the model fit summary in all variables.

				CFI	TLI	IFI	NFI	
DM	7	.000	18.785	.866	.139	.871	.865	.176
SM	0		.000	1.000		1.000	1.000	
IM	45	.000	135.205	.000	.000	.000	.000	.189

(no relationships between variables) is 135.205, indicating that your model is significantly better than independence. The literature contains a large number of fit indices. The fit indices that are most frequently used are defined below. When conducting structural equation modeling analysis, the sample size was taken into account. Since sample size affects several of the fit indices [23].

Discussion

Toxoplasmosis is a disease caused by the *Toxoplasma gondii* parasite that affects the immune system of pregnant women. People with compromised immune systems are more likely to develop life-threatening consequences. Pregnant women can spread the virus to their fetus. Toxoplasmosis occurs when you come into contact with cat faeces or ingest infected food. Toxoplasmosis affects almost one-third of the global population. AMOS must offer both the coefficient and its related "critical value," which serves as a significance test. A critical value of 1.96 indicates a p-value of 0.05. If the critical ratio is less than 1.96, suggesting a significant Mardia's coefficient, the data can be deemed normally distributed. Given the expected huge sample size in this specific Structural Equation Model (SEM), we may infer that Mardia's coefficient will almost always be statistically significant. As a result, doing a significance test on our own provides really significant information.

Given this, it is recommended to utilize significance tests alongside descriptive statistics, specifically the kurtosis values for particular variables [24]. Kurtosis values with a magnitude less than 3.00 may suggest that a variable follows a normal distribution. Therefore, the result of this SEM analysis exhibited a normal distribution. Previously, the criteria for determining adequate fit were a non-significant Comparative Fit Index (CFI) greater than 0.90 [25] and a Root Mean Square Error of Approximation (RMSEA) less than 0.10, with a maximum upper bound of the 90% Confidence Interval (CI) of 0.10 [26]. While there are still many who adhere to these recommendations, as indicated by the favorable assessment of models with fit indices that are close to or meet these values, it is important for readers to recognize that there is ongoing disagreement among statisticians (and likely among reviewers) regarding what constitutes adequate fit. Study reports that the maximum threshold for RMSEA is 0.06. The results of the Structural Equation Modeling (SEM) indicate that the data fits the model well [25]. The findings show a $\chi 2$ value of 131.493, an RMSEA value of 0.176, CFI value of 0.866, and TLI value of 0.139. The analysis analyses Cronbach's alpha, which is a reliability coefficient, based on the average inter-item correlations for each parameter [27]. Furthermore, the Cronbach Alpha coefficient for Regarding the variables, the between CatF and Doge was estimated to be (0.094), and between Doge and number of water is estimated to be (-0.056), water and number of dust are estimated to be (-0.080), CatF and number of water are estimated to be (-0.055), e2 and number of CatF are estimated to be (-1.229), they were indicated as inverse consequences, and the other were positive effects of risk and disease-causing factors.

Conclusion

Overall, our model shows reasonable fit (considering CFI and IFI) but could be improved (considering TLI and NFI). The Degrees of Freedom (DM) and comparison with Saturated (SM) and Independence (IM) models provide context for evaluating fit. Consider refining our model or exploring additional fit indices to assess model adequacy. The observed exogenous variables have an impact on the observed endogenous variables. Education and residence is positively associated with CatF, education negatively influences doge, residence negatively influences water, and residence positively influences dust. The study employs questionnaires to evaluate various pregnant women across different hospitals at central Gondar Zone, the model must give due attention to risk factors such as ingestion of oocyst found in soil, water, and cats faces or tissue cysts in undercooked meats, fruits, and vegetables to reduce the transmission of *T. gondii* for pregnant women. Therefore, practicing regular awareness creation for control mechanisms, research and development framework regarding management techniques is recommended.

Availability of Data and Materials

For the sake of maintaining patient confidentiality, the raw data will not be shared. Data supporting this research article are available from the corresponding author or first author on reasonable request.

Ethical Approval and Consent to Participate

Approval of Ethical clearance was obtained from the Research and Ethical Review Committee of the University of Gondar with a reference number of VP/RTT/05/280/2022. A permission letter was also given. Each pregnant woman who participated in the study was informed about the purpose, method, expected benefit, and risk of the study. Participants were also informed about their right not to participate or stop the interview at any time. Since it is a cross-sectional study, participating in this study cannot result in any negative consequences for the study participants. Each pregnant woman provided verbal informed consent after receiving information about the study. To ensure confidentiality of the study participant's information, anonymous typing was applied so that the name of the participant and any identifier of participants were not written on the questionnaire.

Contributions of Authors

EW wrote the proposal in addition to contributing to data curation, data collection (investigation), data analysis, validation, resources, software, and manuscript drafting. NB, MB, MM, DFT, AB and RE were involved in the conceptualization proposal's design, data gathering, methodology, supervision, and analysis. EW took part in the data preparation and analysis. Each writer reviewed and edited the finished work and also gave their approval.

Acknowledgement

We would like to extend our heartfelt gratitude to the University of Gondar for providing the opportunity for this study. In addition, the authors thank study participants for providing invaluable information and data collectors and supervisors for their dedicated effort.

Funding

This research didn't receive any grants from any funding agencies.

Publication Consent

Not applicable.

Conflict of Interest

The authors declare that they have no conflict interests.

References

1. Smith, Nicholas C., Cibelly Goulart, Jenni A. Hayward and Andreas Kupz, et al. "Control of human toxoplasmosis." *Int J Parasitol* 51 (2021): 95-121.
2. Gunn, Alan and Sarah J. Pitt. Parasitology: An integrated approach. John Wiley & Sons (2022).
3. Adugna, Biyansa, Zewdu Seyoum Tarekegn, Debasu Damtie and Seleshe Nigatu Woldegebreal, et al. "Seroepidemiology of *Toxoplasma gondii* among pregnant women attending Antenatal Care in Northwest Ethiopia." *Infect Drug Resist* (2021): 1295-1303.
4. Odeniran, Paul Olalekan, Kehinde Foluke Omolabi and Isaiah Oluwafemi Ademola. "Risk factors associated with seropositivity for *Toxoplasma gondii* in population-based studies among immunocompromised patients (pregnant women, HIV patients and children) in West African countries, Cameroon and Gabon: A meta-analysis." *Acta Tropica* 209 (2020): 105544.
5. Marín-García, Pablo-Jesús, Nuria Planas and Lola Llobat. "*Toxoplasma gondii* in foods: Prevalence, control, and safety." *Foods* 11 (2022): 2542.
6. Achaw, Barnabas, Habtie Tesfa, Ayalew Jejaw Zeleke and Ligabaw Worku, et al. "Sero-prevalence of *Toxoplasma gondii* and associated risk factors among psychiatric outpatients attending University of Gondar Hospital, Northwest Ethiopia." *BMC Infect Dis* 19 (2019): 1-8.
7. Layton, John, Danai-Christina Theiopoulou, David Rutenberg and Amro Elshereye, et al. "Clinical spectrum, radiological findings, and outcomes of severe toxoplasmosis in immunocompetent hosts: A systematic review." *Pathogens* 12 (2023): 543.
8. Hadidian, Pateel Sabine. "Overview of congenital toxoplasmosis in pregnant women; Mode of infection, diagnosis, treatment and prevention." PhD diss., 2022.
9. Mangal, S., N. Agarwal and N. Singh. "Toxoplasmosis in Pregnancy." *Infect Pregnancy* (2022): 177-189.
10. Nasiru Wana, Mohammed, Mohamad Aris Mohd Moklas, Malaika Watanabe and Norshariza Nordin, et al. "A review on the prevalence of *Toxoplasma gondii* in humans and animals reported in Malaysia from 2008–2018." *Int J Environ Res Public Health* 17 (2020): 4809.

11. Khan, Imtiaz A., and Magali Moretto. "Immune responses to *Toxoplasma gondii*." *Curr Opin Immunol* 77 (2022): 102226.

12. Alkardhi, Ihsan KA, Hatem Masmoudi, Hayder A. Muhammedand and Hayet Sellami. "Epidemiological study with evaluation of molecular and immunologicalassay for detection of *Toxoplasma gondii* in aborted women." *Cell Mol Biol* 68 (2022): 122-128.

13. Frącz, Gabriela, Klaudia Kuliga, Marcin Kuliga and Kinga Musz, et al. "Could *Toxomplasma gondii* infection be dangerous?-Systematic review." *J Edu Health Sport* 34 (2023): 103-118.

14. Lushina, Mayala, Vivian Mushi, Donath Tarimo and Emmanuel Oladipo Babafemi. "Seroprevalence of *Toxoplasma gondii* and associated risk factors among pregnant women attending antenatal care in Ilala Municipality, Dar es Salaam, Tanzania." (2022).

15. Hariri, Sahar Sadegi, Zahra Heidari, Shahram Habibzadeh and Samira Shahbazzadegan. "Seroprevalence of *Toxoplasma gondii* among Pregnant Women in Ardabil, Iran (2021–2022)." *Iran J Parasitol* 18 (2023): 93.

16. Bieńkowski, Carlo, Małgorzata Aniszewska, Monika Kowalczyk and Jolanta Popielska, et al. "Analysis of preventable risk factors for *Toxoplasma gondii* infection in pregnant women: Case-control study." *J Clin Med* 11 (2022): 1105.

17. Jafari, Mohammad Mahdi, Zahra Azimzadeh Tabrizi, Mohammad Saaid Dayer and Nazanin Atieh Kazemi-Sefat, et al. "Immune system roles in pathogenesis, prognosis, control, and treatment of *Toxoplasma gondii* infection." *Int Immunopharmacol* 124 (2023): 110872.

18. Zhang, Mary F., Jeremy F. Dawson and Rex B. Kline. "Evaluating the use of covariance-based structural equation modelling with reflective measurement in organizational and management research: A review and recommendations for best practice." *Brit J Manag* 32 (2021): 257-272.

19. West, Stephen G., Wei Wu, Daniel McNeish and Andrea Savord. "Model fit in structural equation modeling." *Handbook Struct Equat Model* 2 (2023): 184-205.

20. Kline, Rex B. "Principles and practice of structural equation modeling." *Guilford Publ* (2023).

21. Civelek, Mustafa Emre. "Essentials of structural equation modeling." Lulu.com (2018).

22. Matore, Ewan Mohd and Ahmad Zamri Khairani. "The pattern of skewness and kurtosis using mean score and logit in measuring adversity quotient (AQ) for normality testing." *Int J Future Gen Commun Netw* 13 (2020): 688-702.

23. Shi, Dexin, Taehun Lee and Alberto Maydeu-Olivares. "Understanding the model size effect on SEM fit indices." *Educ Psychol Meas* 79 (2019): 310-334.

24. Pituch, Keenan A. and James P. Stevens. "Applied multivariate statistics for the social sciences: Analyses with SAS and IBM's SPSS." *Routledge* (2015).

25. Goretzko, David, Karik Siemund and Philipp Sterner. "Evaluating model fit of measurement models in confirmatory factor analysis." *Educ Psychol Meas* 84 (2024): 123-144.

26. Corrêa Ferraz, Raul, Alberto Maydeu-Olivares and Dexin Shi. "Asymptotic is better than Bollen-Stine bootstrapping to assess model fit: The effect of model size on the chi-square statistic." Structural Equation Modeling: A Multidisciplinary Journal 29 (2022): 731-743.

27. Youssef, Naglaa, Marina Saleeb, Assem Gebreal and Ramy Mohamed Ghazy. "The internal reliability and construct validity of the Evidence-Based Practice Questionnaire (EBPQ): Evidence from healthcare professionals in the Eastern Mediterranean Region." *Healthcare* 11 (2023): 2168.

How to cite this article: Woldegerima, Eden, Mastewal Birhan, Mequanint Melesse and Destaw Fetene Tesshome, et al. "*Toxoplasma gondii* among Pregnant Women Attending Antenatal Care at Central Gondar Zone Public Hospital, Northwest Ethiopia: Structural Equation Modeling." J Vet Sci Technol 15 (2024): 252.