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DETERMINANTS OF NON-ADHERENCE TO DRUG REGIMEN AMONG TB PATIENTS ATTENDING A SPECIALIST HOSPITAL, EDO STATE NIGERIA

***Olajide, Adetunmise Oluseyi,**
RN, RM, RPHN, BNSc, MSc. , Faculty of Nursing Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Oyadiran Gifty O. G.
Lecturer: MSc, BNSc, RNE, RPHN, Faculty of Nursing Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Idemudia, Grace Otuomagie,
RN, RAEN, BNSc, Faith Medplex Hospital, Benin, Edo State, Nigeria

Amoo Patience Ofuoma.
Lecturer: MSc, M.ed, BNSc, RNE, RPHN, FWACN, Faculty of Nursing Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria. Email:

Ajibade, Bayo Lawal,
RN, PhD. Faculty of Nursing Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.

ABSTRACT: *Tuberculosis is one of the leading causes of death globally and in Nigeria that poses a threat. This study examine the determinants of non- adherence to drug regimen among TB patients in a Specialist Hospital, Edo state. The study adopted a descriptive research design. A simple random sampling technique was used in selecting the respondents of the study. The data were collected through the use of questionnaire with reliability index of 0.78. The data collected were analyzed using descriptive statistics of frequency, simple percentage and inferential statistics (chi-square). The findings of the study revealed that 222 (56.6%) respondents do not adhere to drug regimen while 171 (43.5%) does. There was a significant relationship between distance of health facility (p=0.001), waiting time (p=0.000), absence of family support(p=0.000), forgetfulness (p=0.000) , individual's occupation (p=0.000), improvement in TB symptoms(p=0.000) and non-adherence to TB drugs but client provider interaction and TB drug side effect do not have a significant relationship on non-adherence to TB drugs. The study recommends that government should make TB clinic should accessible by building and employing enough health workers. Also, families should be encouraged to support TB patients and TB patients on TB drugs should be educated on the needs to comply with drugs and not to discontinue it even when symptoms improve.*

KEYWORDS: determinant, drugs, non-adherence, tuberculosis,

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INTRODUCTION

Tuberculosis (TB) is one of the global health challenges that is prevalent worldwide and rampart in low and middle income countries. Tuberculosis is a major public health concern that causes mortality though it can be treated (Kooffreh, 2016). Globally, Tuberculosis (TB) is one of the prominent infectious disease competing with Human immune-deficiency virus that poses a public health threat (Ayed & Ayed, 2017; Shimeles et al., 2019) and that can single- handedly cause death. It is cause by a bacteria called mycobacterial tuberculosis although effort use in tackling it has provide a significant impact of reducing morbidity and mortality (Silva et al., 2018; MacNeil, 2019) The risk factors of Tuberculosis include conditions that weakens the immune system such as infection with HIV, cancer, having diabetes, low body weight, substance abuse such as taking tobacco and alcohol, socio economic and behavioral factor, increasing age among others (Zhang et al., 2019; Narasimhan et al., 2013).

Globally about one in three people are infected with Mycobacterium tuberculosis. In lifetime, about 10% of people will come down with tuberculosis (Jurado & Palacios, 2018). Globally, It was documented in 2016 that about 1.40 million HIV positive patients had tuberculosis and about 0.24 million death was recorded. Also, among HIV negative people, the incident of TB was 9.02million and 1.2 million deaths was recorded (Kyu et al., 2018) while in 2017, about 10 million cases were reported and 1.6 million death were recorded in relation to TB (MacNeil, 2019). Nigeria was also documented to be one of the countries with quite large number of TB though with poor documentation of number of death. The statistics is not hardy and mortality review is rarely documented(Musa et al., 2020). It was documented in 2016 that the prevalence of TB among HIV negative people were 27% and its incidence rate was 158 in 100,000 people (Ogbo et al., 2018).

Though, this disease is preventable and curable, one of the challenges in the treatment of tuberculosis is problem of non-adherence to treatment (Krasniqi et al., 2017). It was observed that patient diagnosed to have Tuberculosis have challenges following up with the long therapy of its treatment (Xu et al., 2009). If anti-tuberculosis drugs are taken as prescribed, it exceedingly active and effective (Wurie et al., 2018) and for global effort of TB control to be successful, it is germane that patients on anti-tuberculosis drug must comply with the drug regimen (Valencia et al., 2 017) as non-compliance to anti tuberculosis drugs leads to development of new strain of bacteria, transmission to other people, drug resistance, relapse or poorer outcome of treatment and can eventually leads to death (Gugssa Boru et al., 2017; Tesfahuneygn et al., 2015; Osman et al., 2016; Gube et al., 2018; Wurie et al., 2018; Kulkarni et al., 2013 & Pradipta et al.,2013). Therefore, efforts to enhance treatment must focuses on enhancing adherence to treatment (Xu et al., 2009).

Despite all the efforts to ensure TB is well controlled and free drugs is even given, compliance with TB drugs is noted to be low, there is need to adhere comply to anti-tuberculosis drugs to control the morbidity and mortality related to tuberculosis disease. Some factors are responsible for non-compliance to anti-tuberculosis medication towards a successful fight against this deadly

but preventable and curable disease, hence, this study assessed determinants of non-compliance to anti TB treatment regimen among TB patients in a Specialist Hospital, Edo state, Nigeria.

Objective of Study

The objective of the study was to examine determinants of non- adherence to drug regimen among TB patients in a Specialist Hospital, Edo state.

.**Research Hypothesis**

1. There is no significant relationship between distance of the health facility and non-adherence to drug regimen among TB patients in Central specialist Hospital, Edo state.
2. There is no significant relationship between client-provider interaction and non-adherence to drug regimen among TB patients in Central specialist Hospital, Edo state.
3. There is no significant relationship between waiting time and non-adherence to drug regimen among TB patients in Central specialist Hospital, Edo state.
4. There is no significant relationship between drug side effects and non-adherence to drug regimen among TB patients in Central specialist Hospital, Edo state.
5. There is no significant relationship between absence of family support and non-adherence to drug regimen among TB patients in Central specialist Hospital, Edo state.
6. There is no significant relationship between forgetfulness and non-adherence to drug regimen among TB patients in a specialist Hospital, Edo state.
7. There is no significant relationship between the individual's occupation and non-adherence to drug regimen among TB patients in a specialist Hospital, Edo state.
8. There is no significant relationship between an improvement in TB symptoms and non-adherence to drug regimen among TB patients in a specialist Hospital, Edo state.

METHODOLOGY

Research design

The study adopted a descriptive research design. It assesses determinants influencing non-adherence to drug regimen among TB patients in a Specialist Hospital, Edo, Nigeria.

Research settings

The setting of this study was a specialist hospital in Edo State Nigeria. The hospital has several departments such as medicine, surgery, radiology, Obstetrics and gynecology, peadiatrics, cardiology, dental, optometry, ophthalmology, Medical laboratory and pharmacy. According to statistical data, the total number of TB patient attending Central Specialist Hospital, Edo state is 4050 (males: 2445, females: 1605).

Population of study

The population of for this study was TB patients

Sampling size determination
The sample size was determined using Taro Yamane formular. The total sample size calculated was 393 and respondents were selected using simple random technique

Research Instrument
The study makes use of a self-structured questionnaire as instrument for data collection

Pilot Study
Pilot study was conducted in another setting which has same characteristics with the settings where the main study was carried out using 10% of the calculated sample size.

Validity of the Instruments
The instrument was carefully constructed after reviewing relevant literatures based on the objectives of the study. The sample of the structured questionnaire was given to expert in the field for review and comments, thereby ensuring face and content validity of the research instrument. All corrections were effected before administering the instruments.

Reliability of the Instruments
This was done after the pilot study and the cronbach alpha value was 0.78

Method of Data collection
The management of the hospital and ethical committee were informed and permission was obtained to carry out the study. The respondents were met during their clinic days and the objectives of the study were explained to them and informed consent was signed. The instruments was administered and collected immediately after they were filled.

Procedure for Data analysis
The data was collected and analyzed using SPSS package. Descriptive statistics of frequencies and percentages was used while inferential statistic (chi-square) was used to test the hypothesis. The results were presented in tables.

Ethical Consideration
The researchers obtained Ethical Approval from the Ethics and Research committee of the institution. An informed consent was obtained from respondent. Confidentiality and anonymity were also ensured. Right to withdraw without it having a negative implication was explained to the respondents.

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RESULTS

Table 1: Demographic Characteristics of the Respondents

Variables	Classifications	Frequency	Percentage
Age	Less than 25 years	59	15.0
	26-40 years	168	42.7
	40 years Above	166	42.2
	Total	393	100
Marital Status	Single	99	25.2
	Married	185	47.1
	Divorced	79	20.1
	Widowed	30	7.6
	Total	393	100
Religion	Christian	165	42.0
	Muslim	90	22.9
	Others	138	35.1
	Total	393	100
Level of Education	None	40	10.2
	Primary	100	25.4
	Secondary	124	31.6
	Tertiary	129	32.8
	Total	393	100
Employment status	Employed	80	20.4
	Self- employed	293	74.6
	Unemployed	20	5.1
	Total	393	100

The data presented in Table 1 indicates that majority of the respondents 168(42.7%) were between the age of 24-40 years, 166(42.2%) were 40 years and above and 59(15.0%) were less than 25 years. The analysis based on marital status as presented in Table 4.1 revealed that 185(47.1%) were married, 99(25.2%) were single, 79(20.1%) were divorce and 30(7.6%) were widowed. Also, 165(42.0%) were Christians, 138(35.1%) were in other religion and 90(22.9%) were Muslim. The analysis based on respondents' level of education revealed that 129(32.8%) had attended tertiary education, 124(31.6%) of the respondents had secondary school certificates, 100(25.4%) had primary certificated as their highest level of education and 40(10.2%) of the respondents had none formal education. Based on employment status, 293(74.6%) were self-employed, 80(20.4%) of the respondents were employed and 20(5.1%) were unemployed.

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Table 2: Showing Respondents' Non-adherence to drug regimen

Variables	**Yes**	**No**	**Total**
Non-adherence to drug regimen	222 (56.6%)	171 (43.5%)	393 (100%)

Table 2 shows that 222(56.6%) respondents do not adhere to drug regimen while 171(43.5%) adhere to drug regimen

Table 3: Showing cross tabulation of different variables with non-adherence to drug regimen among TB patients

		Distance to the facility		**Total**		
		Yes	**No**		chi-square value	**p-value**
Non adhearance to drug Regimen	Yes	322(91.2%)	31(8.8%)	353(100.0%)	10.114	0.001
	No	30(75.0%	10(25.0%)	40(100.0%)		
		352(89.6%)	41(10.4%)	393(100.0%)		
		Client-provider intraction				
		Yes	**No**			
Non adhearance to drug Regimen	Yes	315(89.2%)	38(10.8%)	353(100.0%)	1.607	0.196
	No	33(82.5%)	7(17.5%)	40(100.0%)		
Total		348(89.6%)	45(11.5%)	393(100.0%)		
		Waiting time of patient		**Total**		
		Yes	**No**			**p-value**
Non adhearance to drug Regimen	Yes	329(93.2%)	24(6.8%)	353(100.0%)	18.979	0.000
	No	29(72.5%)	11(27.5%)	40(100.0%)		
Total		358(91.1%)	35(8.9%)	393(100.0%)		
		Drug side effect		**Total**		
		Yes	**No**			**p-value**
Non adhearance to drug Regimen	Yes	311(88.1%)	42(11.9%)	353(100.0%)	1.712	0.191
	No	32(80.0%	8(20.0%)	40(100.0%)		
Total		343(87.3%)	50(12.7%)	393(100.0%)		
		Absence of family support		**Total**		
		Yes	**No**			**p-value**
Non adhearance to drug Regimen	Yes	331(93.8%)	22(6.2%)	353(100.0%)	13.086	0.000
	No	31(77.5%	9(22.5%)	40(100.0%)		
Total		362(92.1%)	31(7.9%)	393(100.0%)		
		Forgetfulness		**Total**		
		Yes	**No**			**p-value**
Non adhearance to drug Regimen	Yes	272(77.1%)	81(22.9%)	353(100.0%)	13.086	0.000
	No	23(57.5%)	17(42.5%)	40(100.0%)		
Total		295(75.1%)	98(24.9%)	393(100.0%)		

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		Indvidual Occupation		**Total**		
		Yes	**No**			**p-value**
Non adhearance to drug Regimen	Yes	342(96.9%)	11(3.1%)	353(100.0%)	47.128	0.000
	No	28(70.0%)	12(30.0%)	40(100.0%)		
Total		370(94.1%)	23(5.9%)	393(100.0%)		
		Improvement of TB symptoms		**Total**		
		Yes	**No**			**p-value**
Non adhearance to drug Regimen	Yes	314(89.0%)	39(11.0%)	353(100.0%)	17.666	0.000
	No	26(65.0%)	14(35.0%)	40(100.0%)		
Total		340(86.5%)	53(13.5%)	393(100.0%)		

Table 3 indicates that 322(91.2%) of the respondents were of the opinion that distance of facility influence non-adherence to drug regimen. The chi-square value of 10.114 with p-value of 0.001 indicates that distance of health facility has significant influence on non- adherence to the drug regimen among the respondents. Also, 315(89.2%) of the respondents were of the opinion that client-provider interaction influence non-adherence to drug regimen among TB patients. The chi-square value of 1.607 with p-square of 0.196 indicates that client-provider interaction has no significant relationship with non-adherence to drug regimen among the respondents. Moreover, it can be seen that 329(93.2%) of the respondents stated that waiting time of respondents influence non-adherence to drug regimen among TB patients. The chi-sqaure value of 18.979 with p-value of 0.000 indicates that waiting time of patient has significant relationship on non-adherence to drug regimen among the respondents. In addition to that 311(88.1%) of the respondents were of the view that the side effect of drugs has influence on non-adherence to the drug regimen among TB patients. The chi-square value of 1.712 with p-value of 0.191 indicates that drug side effects have no influence on non-adherence to the drug regimen among the respondents. The outcome of the study also indicates that 331(93.8%) of the respondents responded that absence of familiy support influence non-adherance to drug regimen. The p-value of 0.000 indicates that absence of family support had influence on non-adherence to the drug regimen among the respondents. Table 2 also revealed that 272 of the respondents were of the opinion that forgetfulness influence non-adhearence to drug regimen among TB patients. The chi-sqaure of 13.086 with p-value of 0.000 indicates that forgetfulness has significant relationship on non-adherence to the drug regimen among the respondents. it was also observed that 342(96.9%) of the respondents were of the opinion that individual's occupation has influence on non-adherence to the drug regimen among TB patients. The chi-square value of 47.128 with p-value of 0.000 indicates that there is an influence of individual's occupation on non-adherence to the drug regimen among TB patients. Lastly, 314 (89%) of the respondents reported that improvement in TB symptoms has an influence on non-adherence to the drug regimen among TB patients while the chi-square value of 17.666 with p-value of 0.000 indicates that there is significant relationship between improvement in TB symptoms and non-adherence to the drug regimen among the respondents

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DISCUSSION OF FINDINGS

Table 2 shows that 222(56.6%) respondents do not adhere to drug regimen while 171(43.5%) adhere to drug regimen. This goes in line with a study by Kulkani et al., (2013) that documented 78 (50%) of their respondent were non-adherent to anti-tuberculosis treatment. Table 3 revealed that 322(91.2%) of the respondents reported that distance to the health facility had influence on non- adherence to the drug regimen among TB patients (p = 0.001). This indicates that there is a significant relationship between distance to the health facility and non- adherence to the drug regimen among TB patients. This findings support previous study by Zegeye et al., 2019; Woimo et al., 2017 & Gube et al., 2018) whose findings revealed that distance of health facility is a determinant to non-adherence to the drug regimen. Also, the outcome of the study revealed there is no significant relationship between client-provider interactions and non-adherence to drug regimen among TB patients (p= 0.196). This finding disagreed with previous study by Gussa Boru et al., (2017) whose study found out that lack of client- provider interaction are major barriers to adherence to drug regimen in the study area.

Also from table 2, the Chi-square value of 18.979 with p-value of 0.000 indicates that there is significant relationship between waiting time of patient and non-adherence to drug regimen among TB patients (p= 0.000). This findings is in consonants with previous study by Zegeye et al., (2019) & Gube et al., (2018) whose study revealed that waiting time of greater than one hour as determinants of non-adherence to tuberculosis treatment.

Furthermore, from Table 3, there is no significant relationship between drug side effects and non-adherence to the drug regimen among TB patients (p= 0.191). This disagrees with the study of Krasniqi et al., (2017); Xu et al., (2009) & Gube et al., (2018) in that found side effects of the drugs as major barriers to adherence to drugs regimen. The outcome of this study also revealed significant relationship between absences of family support and non-adherence to the drug regimen among TB patients (p= 0.000). This findings, support previous study by Osman et al., (2016) that identified absence of family support as one of factors that influence non-adherence to anti-tuberculosis drugs among patients. The study also revealed a significance relationship between forgetfulness and non-adherence to the drug regimen among TB patients (p= 0.000). This finding also corroborates with previous findings of Mekonnen & Azagew (2018) and Zegeye et al., (2019) that reported forgetfulness as determinants of non-adherence to tuberculosis treatment. Furthermore, from the outcome of this study, individual's occupation had influence on non-adherence to the drug regimen among TB patients (p=0.000). This also goes in tandem with the study that reported influence of occupation on non-adherence to anti-tuberculosis drugs (Osman et al., 2016). Lastly, it was found out that there was a significance relationship between improvements in TB symptoms and non-adherence to the drug regimen among TB patients in the study (p= 0.000). This support previous study by Ali & Prins (2016) that reported significant relationship between relieve of symptoms and non-compliance to anti-tuberculosis drugs.

CONCLUSION

This study was able to establish that distance of health facility, waiting time, absence of family support, forgetfulness, individual's occupation and improvement in TB symptoms have significance relationship with non-adherence to drug regimen among TB patients while client provider interaction and side influence of TB drugs does not have influence on non-compliance to TB drugs.

Recommendations

Based on the findings of this study, the following recommendations were made:
i) TB clinic should be accessible by building by building of clinic and employing enough health workers.
ii) Also, families should be encouraged to support TB patients
iii) TB patients on TB drugs should be educated on the needs to comply with drugs and not to discontinue it even when symptoms improve.
iv) Awareness should be created on the importance of adherence to drug regimen among TB patient

References

Ali, A. O. A., & Prins, M. H. (2016). Patient non adherence to tuberculosis treatment in Sudan: Socio demographic factors influencing non adherence to tuberculosis therapy in Khartoum State. *The Pan African Medical Journal*, *25*(80), Article 80. https://doi.org/10.11604/pamj.2016.25.80.9447

Ayed, H. B., & Ayed, H. B. (2017). *Extrapulmonary Tuberculosis: Update on the Epidemiology, Risk Factors and Prevention Strategies*. https://doi.org/10.23937/ijtd-2017/1710006

Gube, A. A., Debalkie, M., Seid, K., Bisete, K., Mengesha, A., Zeynu, A., Shimelis, F., & Gebremeskel, F. (2018, February 18). *Assessment of Anti-TB Drug Nonadherence and Associated Factors among TB Patients Attending TB Clinics in Arba Minch Governmental Health Institutions, Southern Ethiopia* [Research Article]. Tuberculosis Research and Treatment; Hindawi. https://doi.org/10.1155/2018/3705812

Gugssa Boru, C., Shimels, T., & Bilal, A. I. (2017). Factors contributing to non-adherence with treatment among TB patients in Sodo Woreda, Gurage Zone, Southern Ethiopia: A qualitative study. *Journal of Infection and Public Health*, *10*(5), 527–533. https://doi.org/10.1016/j.jiph.2016.11.018

Jurado, L. F., & Palacios, D. M. (2018). Tuberculosis: A Risk Factor Approach. *Tuberculosis*. https://doi.org/10.5772/intechopen.73538

Kooffreh. (2016). *Prevalence of tuberculosis in Calabar, Nigeria: A case study of patients attending the outpatients Department of Dr. Lawrence Henshaw Memorial Hospital, Calabar*. http://www.saudijhealthsci.org/article.asp?issn=2278-0521;year=2016;volume=5;issue=3;spage=130;epage=133;aulast=Kooffreh

Krasniqi, S., Jakupi, A., Daci, A., Tigani, B., Jupolli-Krasniqi, N., Pira, M., Zhjeqi, V., & Neziri, B. (2017, November 5). *Tuberculosis Treatment Adherence of Patients in Kosovo* [Research Article]. Tuberculosis Research and Treatment; Hindawi. https://doi.org/10.1155/2017/4850324

Kulkarni, P., Akarte, S., Mankeshwar, R., Bhawalkar, J., Banerjee, A., & Kulkarni, A. (2013). Non-Adherence of New Pulmonary Tuberculosis Patients to Anti-Tuberculosis Treatment. *Annals of Medical and Health Sciences Research*, *3*(1), 67. https://doi.org/10.4103/2141-9248.109507

Kyu, H. H., Maddison, E. R., Henry, N. J., Ledesma, J. R., Wiens, K. E., Reiner, R., Biehl, M. H., Shields, C., Osgood-Zimmerman, A., Ross, J. M., Carter, A., Frank, T. D., Wang, H., Srinivasan, V., Agarwal, S. K., Alahdab, F., Alene, K. A., Ali, B. A., Alvis-Guzman, N., … Murray, C. J. L. (2018). Global, regional, and national burden of tuberculosis, 1990–2016: Results from the Global Burden of Diseases, Injuries, and Risk Factors 2016 Study. *The Lancet Infectious Diseases*, *18*(12), 1329–1349. https://doi.org/10.1016/S1473-3099(18)30625-X

MacNeil, A. (2019). Global Epidemiology of Tuberculosis and Progress Toward Achieving Global Targets—2017. *MMWR. Morbidity and Mortality Weekly Report*, *68*. https://doi.org/10.15585/mmwr.mm6811a3

Mekonnen, H. S., & Azagew, A. W. (2018). Non-adherence to anti-tuberculosis treatment, reasons and associated factors among TB patients attending at Gondar town health centers, Northwest Ethiopia. *BMC Research Notes*, *11*(1), 1–8. https://doi.org/10.1186/s13104-018-3789-4

Musa, B. M., Bashir, H. A., Uloko, A. E., Garbati, M. A., Bakki, B., Gumi, H. S., Yusuf, A., & Bello, M. H. (2020). Mortality pattern among tuberculosis patients on treatment in Nigeria: A systematic review and meta-analysis. *Nigerian Journal of Medicine*, *29*(1), 158–162.

Narasimhan, P., Wood, J., MacIntyre, C. R., & Mathai, D. (2013). *Risk Factors for Tuberculosis* [Review Article]. Pulmonary Medicine; Hindawi. https://doi.org/10.1155/2013/828939

Ogbo, F. A., Ogeleka, P., Okoro, A., Olusanya, B. O., Olusanya, J., Ifegwu, I. K., Awosemo, A. O., Eastwood, J., & Page, A. (2018). Tuberculosis disease burden and attributable risk factors in Nigeria, 1990–2016. *Tropical Medicine and Health*, *46*(1), 1–11. https://doi.org/10.1186/s41182-018-0114-9

Osman, T., Victor, C., Abdulmoneim, A., Mohammed, H., Abdalla, F., Ahmed, A., Ali, E., & Mohammed, W. (2016). *Epidemiology of Substance Use among University Students in Sudan* [Research Article]. Journal of Addiction; Hindawi. https://doi.org/10.1155/2016/2476164

Pradipta, I. S., Houtsma, D., van Boven, J. F. M., Alffenaar, J.-W. C., & Hak, E. (2020). Interventions to improve medication adherence in tuberculosis patients: A systematic review of randomized controlled studies. *Npj Primary Care Respiratory Medicine*, *30*(1), 1–10. https://doi.org/10.1038/s41533-020-0179-x

Shimeles, E., Enquselassie, F., Aseffa, A., Tilahun, M., Mekonen, A., Wondimagegn, G., & Hailu, T. (2019). Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia. *PLOS ONE*, *14*(4), e0214235. https://doi.org/10.1371/journal.pone.0214235

Silva, D. R., Muñoz-Torrico, M., Duarte, R., Galvão, T., Bonini, E. H., Arbex, F. F., Arbex, M. A., Augusto, V. M., Rabahi, M. F., Mello, F. C. de Q., Silva, D. R., Muñoz-Torrico, M., Duarte, R., Galvão, T., Bonini, E. H., Arbex, F. F., Arbex, M. A., Augusto, V. M., Rabahi, M. F., & Mello, F. C. de Q. (2018). Risk factors for tuberculosis: Diabetes, smoking, alcohol use, and the use of other drugs. *Jornal Brasileiro de Pneumologia*, *44*(2), 145–152. https://doi.org/10.1590/s1806-37562017000000443

Tesfahuneygn, G., Medhin, G., & Legesse, M. (2015). Adherence to Anti-tuberculosis treatment and treatment outcomes among tuberculosis patients in Alamata District, northeast Ethiopia. *BMC Research Notes*, *8*, 503. https://doi.org/10.1186/s13104-015-1452-x

Valencia, S., León, M., Losada, I., Sequera, V. G., Quevedo, M. F., & García-Basteiro, A. L. (2017). How do we measure adherence to anti-tuberculosis treatment? *Expert Review of Anti-Infective Therapy*, *15*(2), 157–165. https://doi.org/10.1080/14787210.2017.1264270

Woimo, T. T., Yimer, W. K., Bati, T., & Gesesew, H. A. (2017). The prevalence and factors associated for anti-tuberculosis treatment non-adherence among pulmonary tuberculosis patients in public health care facilities in South Ethiopia: A cross-sectional study. *BMC Public Health*, *17*(1), 1–10. https://doi.org/10.1186/s12889-017-4188-9

Wurie, F. B., Cooper, V., Horne, R., & Hayward, A. C. (2018). Determinants of non-adherence to treatment for tuberculosis in high-income and middle-income settings: A systematic review protocol. *BMJ Open*, *8*(1), e019287. https://doi.org/10.1136/bmjopen-2017-019287

Xu, W., Lu, W., Zhou, Y., Zhu, L., Shen, H., & Wang, J. (2009). Adherence to anti-tuberculosis treatment among pulmonary tuberculosis patients: A qualitative and quantitative study. *BMC Health Services Research*, *9*(1), 169. https://doi.org/10.1186/1472-6963-9-169

Zegeye, A., Dessie, G., Wagnew, F., Gebrie, A., Islam, S. M. S., Tesfaye, B., & Kiross, D. (2019). Prevalence and determinants of anti-tuberculosis treatment non-adherence in Ethiopia: A systematic review and meta-analysis. *PloS One*, *14*(1), e0210422. https://doi.org/10.1371/journal.pone.0210422