Determinants of Treatment Interruption among Pulmonary Tuberculosis Patients in Select Health Facilities in Embu County, Kenya

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ABSTRACT

Tuberculosis (TB) is an airborne disease which is highly transmissible from one person to another. The transmission occurs through airborne particles which are released when an infected person coughs, sneezes, spits, laughs or shouts. The re-emergence of tuberculosis has become a major problem in the world of public health. Estimates project that at least a third of the global human population has the tubercle bacillus where nine million of these progress to active form of tuberculosis annually, and two million succumb to the disease in the same period. HIV prevalence in the African resulted in a sharp rise in TB cases incidence in 2003. The general objective of the research is to establish determinants of treatment interruption among pulmonary tuberculosis patients from various health facilities in Embu County, which the researcher the researcher found by studying the socio-demographic features, socio-economic and behavioral determinants of the patients and also assessing the health care issues that could be contributing to the treatment interruption of TB patients. The researcher used retrospective causal study design method to determine how the various independent variables (determinants) affect the dependent variable. The study used a two-stage sampling where each selected facility will be considered as a cluster. In the first stage, stratified random sampling was used, while in the second stage a systematic sampling method was used to select every n^{th} record from the files in the selected health facilities from the first stage. Probability proportionate to size sampling was employed in the second stage to determine the number of records to be sampled in each health facility. The tool of choice in this study will be the questionnaire which will be subjected to validity and reliability tests before deployment. The data was collected, and analyzed using Epi info. The analysis included descriptive analysis for the variables in the dataset, followed by logistic regression to determine the odds ratio of each factor in its effect to the dependent variable (treatment interruption). A retrospective causal study design was conducted using a structured questionnaire on 300 TB patients in various health facilities in Embu County from February to May 2022. The odds ratios (OR) were calculated by comparing defaulters and non-interrupters in terms of the socio-demographics, socio-economics, healthcare factors and behavioral determinants. Interruption from treatment was significantly associated with males, Education level, income, family support, information on diagnosis, pill burden and adverse effect of drugs. In this study it showed that patients especially males below 30years of age, with low education status, low economic status, those without family support, patients with limited knowledge on the disease, those taking other medications, those suffering from side effects, were more likely to interrupt treatment in Embu County.

Key words: *Tuberculosis, Treatment Interrupters, Socio-demographic Determinants, Socio-economic Determinants, Healthcare Factors, Behavioral Determinants*

1.0 Introduction

Tuberculosis (TB) is a chronic disease that infects human beings as well as animals. The cause of TB is any of the different members belonging to the family of bacteria known as *Mycobacteriacae*. After the initial infection has occurred, the characteristic tubercles form in the lungs and other body tissues. The tissues mostly affected by TB are the parenchyma tissue in the lungs although, it may affect other tissues including the hair follicle and the keratinous skin. The disease is not only curable but also preventable (Rodriguez, 2009). TB is an airborne disease. The transmission occurs through airborne particles which are also known as droplet nuclei. These droplets are very small with a diameter of 1–5 microns (MOH Kenya., 2013a). The droplets are released when an infected person coughs, sneezes, spits, laughs or shouts. They may remain suspended in the air for a number of hours and can only be transmitted if they are inhaled by an uninfected individual. It is estimated that of the total world's population, a third is infected with latent TB. This means that the persons are not yet ill and therefore cannot transmit the disease (Zumla et al, 2013). Once the particles are inhaled, they travel through the airways and are trapped by the mucus in the upper parts of the breathing system.

Treatment of TB is begun after a person is tested for the disease through a number of available clinical tests among them radiography (chest X-rays), Gene Xpert or microscopy methods. The treatment involves using different drugs that are taken in combination. The combinations help in the prevention of drug resistance to either of the drugs administered. Complications that can arise from TB infection include lung abscess, fibrosis of the lungs, tuberculosis meningitis and tuberculosis peritonitis. Embu county has had a problem dealing with Tuberculosis patients who do not complete their medication as required and hence put the rest of the population at risk of infection with the highly contagious disease. In a recent incident which highlights this problem, 18 persons suffering from TB were being sought through a court order so that they may be confined to wards for TB treatment and observation. The county director of health attributed the non-completion to economic constraints where the patients have to fend for their families instead and may in the process lack time to visit the doctor or even take medication. (Githinji, October 2019). In this regard, the researcher is undertaking the study with the aim to help the Embu County department of health, understand what determinants contribute to treatment interruption and how best to deal with this demographic.

2.0 General Objective

The general objective of the research is to establish the determinants of treatment interruption among pulmonary tuberculosis patients in select health facilities in Embu County.

2.1 Specific Objectives

I. To determine the socio-demographic characteristics of patients that contribute to treatment interruption among pulmonary tuberculosis patients in select health facilities in Embu County.

II. To find out the socio-economic determinants that contribute to treatment interruption among pulmonary tuberculosis patients in select health facilities in Embu County.

III. To assess the health care factors that contribute to treatment interruption among pulmonary tuberculosis patients in select health facilities in Embu County.

IV. To determine the behavioral determinants that contribute to treatment interruption among pulmonary tuberculosis patients in select health facilities in Embu County.

3.0 Results

3.1 Univariate analysis

A total of 300 questionnaires were issued to data collectors, out of which 282 were returned. Four questionnaires were rejected due to inconsistencies, not being dully filled and lack of unique identifiers, the remainder (278) were analyzed. The socio-demographic characteristics of the subjects interviewed are shown in Table 1

Table 1: Characteristics of patients treated for TB in Embu County by interruption status; 2021

Variable	Total n (%)	Interrupters n (%)	Non-interrupters n (%)
Total subjects	278(100)	59(21.22)	**219(78.78)**
Sex			
Female	89(40.87)	22(57.29)	**67(30.59)**
Male	189(59.13)	37(62.71)	**152(69.41)**
Age			
18-24	54(19.42)	10(16.95)	**44(20.09)**
25-34	103(37.05)	26(44.07)	**77(35.16)**
35-44	73(26.25)	16(33.33)	**57(26.02)**
45-54	33(11.87)	4(27.12)	**29(13.24)**
55-64	8(2.88)	3(5.08)	**5(2.28)**
Over 65	7(2.52)	0(0.0)	**7(3.20)**
Marital status			
Cohabiting	23(8.27)	3(5.08)	**20(1.15)**
Married	181(65.11)	41(58.97)	**140(55.75)**
Single	38(13.67)	9(29.49)	**29(36.21)**
Widow/ Widower	36(12.95)	6(8.97)	**30(5.75)**
Education level			
No Formal Education	14(5.04)	4(1.4)	**10(3.6)**
Primary	32(11.5)	28(10.1)	**4(1.4)**
Secondary	151(54.3)	0(0.00)	**151(54.3)**
University/College	81(29.1)	27(9.7)	**54(19.4)**

Variable	Total n (%)	Interrupters n (%)	Non-interrupters n (%)
Religion			
Atheist	31(11.2)	5(2.56)	**26(11.87)**
Catholic	82(29.5)	17(28.81)	**65(29.68)**
Muslim	42(15.1)	12(20.34)	**29(13.24)**
Protestant	124(44.6)	25(43.37)	**99(45.21)**
Occupation			
Employed	31(11.2)	1(1.69)	**30(13.70)**
Farmer	91(32.7)	41(69.49)	**50(22.83)**
Large Scale business	60(21.6)	2(3.39)	**58(26.48)**
Small scale business	95(34.2)	15(25.42)	**80(36.53**
Residence			
Mbeere North	63(22.6)	9(15.25)	**54(24.66)**
Embu East	72(25.9)	20(33.90)	**52(23.74)**
Embu West	87(31.3)	19(32.20)	**68(31.05)**
Mbeere South	56(20.14)	11(18.64)	**45(20.55)**
Monthly Income			
0-20000	114(41.01)	55(93.22)	**59(26.94)**
20001-50000	150(53.96)	4(6.78)	**146(66.67)**
50001-100000	12(4.32)	0	**12(5.48)**
Over 100000	2(0.72)	0	**2(0.09)**
Smokers			
No	244(87.77)	36(61.02)	**208(94.97)**
Yes	34(12.23)	23(38.98)	**11(5.03)**
Alcohol use			
No	261(93.88)	50(84.75)	**211(96.35)**
Yes	17(6.12)	9(15.25)	**8(3.65)**

3.2 Bivariate factor analysis

Several factors were found to significantly influence patient interruption. These factors were divided into socio-demographic, socio-economic, healthcare and behavioral determinants.

3.2.1 Socio-Demographic Determinants

Table 2 presents bivariate analysis of socio-demographic factors.

From the analysis, accompanied by family member OR (95% CI) 29.136 (13.7 – 66.4) was determined to have significant influence on treatment interruption. Sex, OR (95% CI) 1.347 (0.730-2.355), Age, OR (95% CI) 0.7786 (0.478-1.395), and HIV status, OR 1.1097 (0.587-2.158) did not significantly (P>0.05) influence treatment interruption.

Table 2: Bivariate analysis of Sociodemographic Factors among TB patients Embu County, 2021

Exposure variable	Interrupters n (%)	Non-interrupters n (%)	Prevalence Odd's Ratio	95% CI (P-Value)
Sex				
Female	22(37.29)	67(30.59)	1.347	**0.730-2.455**
Male	37(62.71)	152(69.41)		**(P=0.412)**
Age				
Below 30 years	29(49.15)	94(42.92)	0.7786	**0.478-1.395**
Above 30 years	30(50.85)	125(57.08)		**(P=0.479)**
Family member accompanied				
Yes	10(16.95)	188(85.84)	29.136	**13.7-66.4**
No	49(83.05)	31(14.16)		(P=0.000)
HIV Status				
Positive	16(27.12)	64(29.22)	1.1097	**0.587-2.158**
Negative	43(72.88)	155(70.78)		**(P=0.87681)**

3.2.2 Socio-Economic Determinants

A reporting of not employed was also associated with increased risk of interruption, OR (95% CI) 9.165 (2.672-9.344) (P<0.05). Those who were above primary were protected from interrupting OR (95% CI) 0.058 (0.027-0.122) (P<0.05) as were those who were earning an income of over 20,000, OR (95% CI) 0.027 (0.008-0.07) (P<0.001). As represented in Table 3 below.

Table 3: Bivariate analysis of Socioeconomic Factors among TB patients Embu County, 2021

Exposure variable	Interrupters n (%)	Non-interrupters n (%)	Prevalence Odd's Ratio	95% CI (P-Value)
Employed				
Yes	1(1.69)	30(13.70)	9.165	**1.68-192.**

Exposure variable	Interrupters n (%)	Non-interrupters n (%)	Prevalence Odd's Ratio	95% CI (P-Value)
No	58(98.31)	189(86.30)		(P=0.0179)
Education level				
Above Primary	27(45.76)	205(43.10)	0.058	**00.027-0.122**
Primary and below	32(54.24)	14(56.90)		(P=0.000)
Personal monthly income				
Over 20,000	55(93.22)	59(26.94)	0.027	**0.008-0.07**
Below 20,000	4(6.78)	160(73.06)		(P<0.001)

3.2.3 Healthcare Related Factors

Presented in Table 4 are results for bivariate analysis of healthcare determinants. Patients who experienced side effects did not differ in likelihood of interrupting treatment, OR (95% CI) 2.467 (1.345-4.524) (P<0.05). However, those who reported as not having to take too many pills (pill burden) were protected from interruption, OR (95% CI) 0.0278 (0.012 – 0.059) (P<0.05). The findings from the current study revealed that being informed of the diagnosis prior to initiation of therapy, OR (95% CI) 0.009 (0.02-0.0029) (P<0.05) were protective against interruption.

Table 4: Bivariate analysis of facility related factors among TB patients in Embu County, 2021

Exposure variables	Interrupters n (%)	Non-interrupters n (%)	Prevalence Odds Ratio	95% CI (P-Value)
Information on diagnosis				
Yes	5(8.47)	200(91.32)	0.009	**0.02-0.0029**
No	54(91.53)	19(8.68)		(P=0.000)
Experienced side effects				
Yes	5 (8.47)	192(87.67)	0.0134	**0.004-0.034**
No	54(91.53)	27(12.33)		(P=0.000)
HCWs attitude				
Bad	52(88.13)	20(9.13)	71.56	**29.84-191.9**
Good	7(11.86)	199(90.87)		P=0.0000
Waiting Time				
>1hr	44(74.58)	10(4.57)	59.27	**25.68-147.1**
<1hr	15(25.42)	209(95.43)		P<0.001

Exposure variables	Interrupters n (%)	Non-interrupters n (%)	Prevalence Odds Ratio	95% CI (P-Value)
Distance to Health Facility				
Above 4KM	51(86.44)	23(10.50)	52.85	**23.07-192.9**
Below 4KM	8(13.56)	196(89.50)		P<0.001
Pill Burden				
No	12(20.34)	198(90.41)	0.0278	**0.012-0.059**
Yes	47(79.66)	21(9.59)		P<0.001

3.2.4 Behavioral Determinants among TB patients

Table 5 presents bivariate analysis of patient behavioral factors. Alcohol use was found to have a major risk on interruption, with those who reported as not taking alcohol having an OR (95% CI) of interruption of 0.2122 (0.075-0.5912) (P<0.001). Non-smokers had a 0.87 (P<0.001) times lower risk of interrupting as compared to smokers. Those who reported being ashamed because of having TB (stigma) 2.1335 (1.866-5.739) and those who perceived disease severity as mild at diagnosis, OR (95% CI) 70.4225 (1.424-144.381) (P<0.05) did not have a significant risk of defaulting.

Table 5: Bivariate analysis of Behavioral Factors among TB patients in Embu County, 2021

Variable	Interrupters (%)	Non-interrupters (%)	OR	CI (P-Value)
Were you at any time ashamed because you had TB				
No	15(25.42)	208(95.43)	0.0186	**0.007-0.499**
Yes	44(74.58)	11(4.57)		P<0.01
Smoking				
No	36(61.02)	208(94.98)	0.0839	**0.0338- 0.1969**
Yes	23(38.98)	11(5.02)		(P<0.01)
Alcohol				
No	50(84.75)	211(96.35)	0.2122	**0.075-0.5912**
Yes	9(15.25)	8(3.65)		(P=0.002)
Perceived disease as mild				
No	59(100)	218(99.54)	0.0142	
Yes	0(0.00)	1(0.46)		(P=0.603)

3.3 Stratified analysis

Stratification was conducted in the analysis to check if there is confounding and/or effect modification. This was used as a measure to control for multiple confounders. Stratified analysis revealed that age had an effect modification on the smoking status of the respondents (Table 6). We noted that there was some level of dependence between the independent variables. We therefore used forward selection to select variables that had the highest effect on the treatment interruption outcome for use in multivariate analysis. The final model is as shown in the next section.

Table 6: Stratified analysis of TB patients' smoking status in Embu County by interruption status, 2021

Do you smoke	Interrupters	Non-interrupters	Prevalence Odds Ratio	95 %CI
All				
Yes	9	8	3.848	**1.963-7.544**
No	59	211		
Below 40				
Yes	5	3	10.636	**3.954-28.610**
No	22	147		
Above 40				
Yes	4	5	1.204	**0.432-3.360**
No	35	64		

3.4 Multivariate analysis of factors associated with TB treatment interruption

Forward sequential elimination method was employed in carrying out unconditional regression analysis as shown in Table 7. This showed that Personal income AOR (95% CI) 7.3 (0.4955-17304.7), level of education AOR (95% CI) 92.6061 (0.4955-17307.7), support by family members accompanying patients AOR (95% CI) 0.0170 (0.0007 – 0.4082), experiencing side effects from drugs issued AOR (95% CI) 245.4147 (3.1998 – 18822.83) and attitude of health care workers AOR (95% CI) 0.0168 (0.008 – 0.3754) were independently associated with TB treatment interruption. This meant that these five factors were the most significant determinants of TB treatment interruption in Embu County.

Table 7: Unconditional Logistic Regression

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
ACCOMPANIED (YES/NO)	0.0170	0.0007	0.4082	-4.0737	1.6213	-2.5127	0.0120
INFORMED_DIAGNOSIS (YES/NO)	0.0101	0.0004	0.2558	-4.5928	1.6478	-2.7872	0.0053
PRIMARY_AND_BELOW (YES/NO)	92.6061	0.4955	17307.7429	4.5284	2.6687	1.6968	0.0897
LESSTHAN20K (YES/NO)	7.3000	0.2744	194.1740	1.9879	1.6740	1.1875	0.2350
SIDEEFFECTS (YES/NO)	245.4147	3.1998	18822.8304	5.5029	2.2143	2.4852	0.0129
HCW_ATTITUDE (GOOD/BAD)	0.0168	0.0008	0.3754	-4.0873	1.5854	-2.5780	0.0099
CONSTANT	*	*	*	0.1249	2.1551	0.0579	0.9538

Convergence:	Converged		
Iterations:	9		
Final -2*Log-Likelihood:	16.5763		
Cases included:	278		
Test	Statistic	D.F.	P-Value
Score	233.3688	6	0.0000
Likelihood Ratio	270.8182	6	0.0000

Only 11.15% of the study participants were in formal employment, meaning for the rest of them, getting funds for transport and other opportunity costs was a burden. This was made worse by the fact that for TB patients, the practice is to collect drugs weekly during the first 8 weeks of treatment. For the low-income cadres, this stretched the patient's budget and could have led to interruption. The influence of finance was further confirmed in the current study wherein patients who had a personal monthly income of over Kshs 20,000 had lower chances of interrupting (OR 0.027) compared with those with lower incomes. Muture *et al.,* (2011) found patients with lower income to be 4.5 times more likely to default. Similar findings of the socio-economic influence on treatment interruption were also recorded in Ethiopia (Demissie and Kebede, 1994; Tadesse *et al*., 2013) and Ghana (Dodor & Afenyadu, 2005). Our study has demonstrated that higher education level is associated with lower likelihood of interruption of TB treatment (OR 0.058). Studies conducted in Kenya (Muture et al., 2011, Kimani et al., 2021) Sudan (Ali, 2016) and Ethiopia (Zegeye et al., 2019) have similarly associated illiteracy with TB treatment interruption. These findings are consistent with known facts about education as a social determinant of disease and related risks (Winkelby et al., 1992). Higher formal education is likely to influence lifestyle,

psycho-social skills and values that may protect individuals against poor health behaviors such as treatment interruption.

Participants who were informed of diagnosis were protected from interruption (POR 0.009). Having more accurate information about the disease being treated meant they were able to make rational decisions from an informed point of view. The knowledge about the disease enabled them to opt for adherence since they understood the dangers associated with default. Waiting time of more than one hour greatly increased the likelihood of interruption of treatment; (POR 59.27). Waiting time is an important determinant for those seeking most health care services (Thompson, Yarnold, Williams, & Adams, 1996). Long waiting time discouraged clients from making subsequent return visits. Similar findings were recorded in Tamatave, Madagascar (Comolet et al., 1998). In their study, however, distance was not found to significantly affect default, unlike in the present study which found that those who live more than 4 KM from the treatment centre more likely to interrupt treatment (POR 52.85). Distance has also been reported by Boateng *et al.,* (2010) to significantly affect default of TB treatment.

Satisfaction with the care offered at the treatment site and workers significantly affected interruption with patients who found the HCW to have bad attitude more likely to interrupt their treatment (POR 71.56). The importance of this relationship and its influence on adherence to treatment is well established. A few studies have reported specifically on patient's satisfaction with health worker attitude and service provision and risk of default (Holtz et al., 2006; WHO, 2003). Perceived communication quality or lack thereof may reflect the status of the patient provider relationship and influence patient behavior (Munro et al., 2007). Among healthcare related factors, respondents who did not experience side effects were protected from interruption (POR 0.0134). Boateng *et al.,* (2010) also found that adverse effects were associated with default. It is understood that experiencing side effect discouraged patients from taking drugs. As indicated by the finding on the similar studies, this caused intolerance to treatment and may have made patients to consider alternative treatment options. Patients who did not take too many pills were protected from treatment interruption (POR 0.0278). This is in contrast to those who took more than one prescription which increases their chances of experiencing side effects due to the many pills and were thus prone to abandoning some of the drugs. The patients could also have just forgotten to take one of the prescribed pills since they were simply too many.

From the results, the odds of interruption were 0.2122 times among those who did not take alcohol and 0.0839 times lower among those who were non-smokers. These findings agreed with the findings of several other studies done elsewhere. For instance, studies carried out in Mumbai demonstrated that smoking during treatment was significantly associated with non-adherence in the newly diagnosed patients (POR 8.2), while alcohol consumption was significant in those that were not new in the cross- sectional study (POR 4.8) (Bagchi et al., 2010). Respondents who perceived their disease at diagnosis as severe were 0.0142 times less likely to interrupt as opposed to those who viewed their disease as mild. This could be explained by the fact that those who considered their disease as more advanced put in more effort to follow their prescribed treatment. These patients did so with the fear of the disease advancing further, ultimately leading to death. On the contrary, those who considered their malady as mild did not have much motivation to adhere to treatment. Apart from patient perception, stigma was found to significantly influence interruption. Patients who reported not being ashamed of TB (POR 0.0186) were less likely to interrupt their treatment. This association of stigma was also sustained by the finding in other studies such as a study in Madagascar (Comolet et al., 1998) about patients who "felt that TB was

a shameful disease." In that study, stigma associated with TB and HIV/AIDS acted as a barrier to adherence since the patients were not free to disclose their condition. They hid from family members and thus ended up not getting the desired support. This ultimately led to non-adherence.

5.0 Discussions and Conclusions

5.1 Discussions

Treatment interruption has been one of the major obstacles to treatment management and has indeed been an important challenge for TB control. Inability to complete the prescribed regimen is an important cause for treatment failure, relapses, acquired drug resistance and perpetuation of on-going transmission of infection. Over the years there has been increasing emphasis on DOT to ensure adherence, wherein each dose of treatment is given under the observation of a health worker or a family member. The adoption of DOT has yielded impressive results with higher treatment success being reported both from developing and industrialized countries alike (Jaggarajamma *et al.,* 2007). Treatment interruption is a precursor to defaulting; and thus, gives a better insight of what happens to patients prior to defaulting. The overall interruption rate in Embu County was 21.2%. This meant that approximately one in every 5 patients interrupted treatment. This rate was higher than that which was found in a similar study in Nigeria (Ibrahim et al., 2014) in which 19% of the patients interrupted treatment, but lower than one in Eastern Cape Province of South Africa (47.5%) by Kandel *et al.,* (2008). The high interruption rate could be attributed to the increasing TB burden due to HIV/Aids pandemic against a low health workforce (Muture *et al.*, 2011). This has made pre- treatment counseling unlikely to be sufficient. The inadequate knowledge would subsequently lead to high interruption rates.

Majority of the TB patients were males and aged between 25-34 years. This age bracket was also the most reported among interrupters. The non-interrupters reported the highest frequency in the same age group. The mean age of the patients was 34 years with a median age of 32 years. This constituted the most economically active group, a good indicator of the economic effect of TB on the health of the work force. These results were similar to what was found by Ibrahim *et al.* (2014) in Nigeria where a male preponderance was 61%, a mean age of 37.6 years and a high prevalence in age of 25-44 years were found. Most of the patients in the present study had low levels of education, with over 70% having secondary or lower education. These proportions were higher among interrupters, pointing to the fact that education was an important factor in determining interruption of treatment. Some scholars such as Hussain *et al.* (2003), argued that formal education was only a proxy for low socio-economic status. The most reported occupation was small scale business. This did not seem to have a bearing on the risk of TB infection but rather the prevalent economic activity in the County. Most of the respondents reported personal incomes of between Kshs 20,000 and Kshs 50,000 per month. The low economic status was associated with poor social amenities, overcrowding and poor ventilation (Corbett et al., 2003). It was also found that 6% of the patients used alcohol while 12% were smokers. In a study on smoking and TB in Hong Kong (Leung et al., 2003), it was demonstrated that TB patients were more likely to have smoked than population controls. This concurred with the findings of a systemic review (Lin, Ezzati, & Murray, 2007). More aggressive lung involvement was also found among smokers in the Hong Kong setting. Alcohol and smoking increased the risk of TB infection via their immune suppressor effect that increased the risk of activation of dormant TB. Determinants of treatment interruption were grouped into sociodemographic factors, socioeconomic factors, health care factors and behavioral factors by bivariate analysis. The distribution of risk factors and crude

prevalence odds ratio (PORs) for treatment interruption for each of the factors were examined and the factors that were significant statistically identified and are discussed below.

From the analysis, social support was found to be important in this study. Patients who were reported to have been supported during the course of treatment were less likely to interrupt treatment. This was supported by the fact that those who were not accompanied by a family member in any of the visits had more likelihood of interrupting treatment, OR 29.136. Similar findings on social support were documented in Ghana (Boateng, Kodama, Tachibana, & Hyoi, 2010) where family support was associated with reduced risk of defaulting treatment (OR 0.29). The effect of good social support could be explained by the fact that patients accompanied by relatives were less likely to experience stigma. They were also likely to be reminded to take their pills in case they forgot and were given financial and moral support to complete treatment. Being accompanied by relatives made disclosure easy, and thus any co-morbid conditions that may affect the patient, could be easily discussed and screened. In some facilities, patients accompanied by spouses were given priority. This led to increased male involvement in maternal and child health services. Sex and Age did not significantly affect interruption. The findings on age and sex agreed with Ibrahim *et al*., (2014). Age and marital status were found not significantly associated with compliance in a study in Ndola, Zambia by Kaona *et al*., (2004). However, this finding differed with studies in Bangladesh and Syria (Begum *et al.,* 2001; Karim *et al.*, 2008), the difference could have been due to some factors intrinsic in the population considered in the Asian studies.

Only 11.15% of the study participants were in formal employment, meaning for the rest of them, getting funds for transport and other opportunity costs was a burden. This was made worse by the fact that for TB patients, the practice is to collect drugs weekly during the first 8 weeks of treatment. For the low-income cadres, this stretched the patient's budget and could have led to interruption. The influence of finance was further confirmed in the current stu./+dy wherein patients who had a personal monthly income of over Kshs 20,000 had lower chances of interrupting (OR 0.027) compared with those with lower incomes. Muture *et al.,* (2011) found patients with lower income to be 4.5 times more likely to default. Similar findings of the socio-economic influence on treatment interruption were also recorded in Ethiopia (Demissie and Kebede, 1994; Tadesse *et al*., 2013) and Ghana (Dodor & Afenyadu, 2005). The influence of finance can be unpacked from an economic evaluation of the cost of TB from the patients' perspective. Economists think of cost as "consequences of choices" hence the decision to allocate money towards an illness makes these funds unavailable for food, education, clothing or housing. Apart from the cost of drugs and investigation (provided by the Government of Kenya) the patient still has to deal with costs such as transport, proper nutrition, indirect costs such as loss of wages and other associated opportunity costs. Our study has demonstrated that higher education level is associated with lower likelihood of interruption of TB treatment (OR 0.058). Studies conducted in Kenya (Muture et al., 2011, Kimani et al., 2021) Sudan (Ali, 2016) and Ethiopia (Zegeye et al., 2019) have similarly associated illiteracy with TB treatment interruption. These findings are consistent with known facts about education as a social determinant of disease and related risks (Winkelby et al., 1992). Higher formal education is likely to influence lifestyle, psycho-social skills and values that may protect individuals against poor health behaviors such as treatment interruption. Patients with less education might have less understanding about TB disease and importance of adherence to treatment. For the benefit of all patients, it is imperative that clinical messages are simplified to suit patients with lower education level. Nyi and Chuah (2001) from Malaysia reported that educational level is not associated with TB treatment interruption. This contrast may be due to differences in study design.

Participants who were informed of diagnosis were protected from interruption (POR 0.009). Having more accurate information about the disease being treated meant they were able to make rational decisions from an informed point of view. The knowledge about the disease enabled them to opt for adherence since they understood the dangers associated with default. Waiting time of more than one hour greatly increased the likelihood of interruption of treatment; (POR 59.27). Waiting time is an important determinant for those seeking most health care services (Thompson, Yarnold, Williams, & Adams, 1996). Long waiting time discouraged clients from making subsequent return visits. Similar findings were recorded in Tamatave, Madagascar (Comolet et al., 1998). In their study, however, distance was not found to significantly affect default, unlike in the present study which found that those who live more than 4 KM from the treatment centre more likely to interrupt treatment (POR 52.85). Distance has also been reported by Boateng *et al.,* (2010) to significantly affect default of TB treatment. Most patients live far away from the treatment centers. Living far from treatment sites acted as a barrier to adherence since there was poor road network and the means of transport were unreliable. Access was made worse during the rainy season. This in turn increased the cost of transport, straining the household budget further. Studies have documented several costs associated with TB treatment that are incurred by patients (Barter, Agboola, Murray, & Bärnighausen, 2012). Patients were thus faced with a challenge of allocation of the little available resources in which case other competing interests overrode seeking treatment. The patients then ran out of drugs since they could not access the treatment center.

Satisfaction with the care offered at the treatment site and workers significantly affected interruption with patients who found the HCW to have bad attitude more likely to interrupt their treatment (POR 71.56). The importance of this relationship and its influence on adherence to treatment is well established. A few studies have reported specifically on patient's satisfaction with health worker attitude and service provision and risk of default (Holtz et al., 2006; WHO, 2003). Vijay et. Al (2010) found similar poor provider patient relationship factors associated with default among new smear positive TB patients. Some studies have reported communication barriers or poor communication between patients and providers as being linked to poor adherence (Mishra et al., 2010; Comolet et al.,1998). Perceived communication quality or lack thereof may reflect the status of the patient provider relationship and influence patient behavior (Munro et al., 2007). Among healthcare related factors, respondents who did not experience side effects were protected from interruption (POR 0.0134). Boateng *et al.,* (2010) also found that adverse effects were associated with default. It is understood that experiencing side effect discouraged patients from taking drugs. As indicated by the finding on the similar studies, this caused intolerance to treatment and may have made patients to consider alternative treatment options. Patients who reported to not having to take too many pills were protected from treatment interruption (POR 0.0278). This is in contrast to those who took more than one prescription which increases their chances of experiencing side effects due to the many pills and were thus prone to abandoning some of the drugs. The patients could also have just forgotten to take one of the prescribed pills since they were simply too many.

From the results, the odd of interruption was 0.2122 times among those who did not take alcohol and 0.0839 times lower among those who were non-smokers. These findings agreed with the findings of several other studies done elsewhere. For instance, studies carried out in Mumbai demonstrated that smoking during treatment was significantly associated with non-adherence in the newly diagnosed patients (POR 8.2), while alcohol consumption was significant in those that were not new in the cross- sectional study (POR 4.8) (Bagchi et al., 2010). In urban Morocco, Cherkaoui *et al*., (2014) showed that smokers had 6.6 times higher chances of defaulting compared

to non- smokers. The study in Morocco did not establish the same with respect to alcohol use (Cherkaoui et al., 2014a). Muture *et al*., (2011) also found that those who used alcohol were 6.28 times more likely to default compared to those that did not. The association of alcohol with TB is twofold. Individuals who take alcohol frequently could be more likely to be drunk at the time when they are required to take their next dose. This makes them forget swallowing their pills. Alcohol abuse also interferes with sleep pattern, impairs judgment and induces amnesia (Ambrose *et al*., 2001; Brower, 2001; Vetreno *et al*., 2011; Messing., 2014). This can cause patients to forget appointments and interfere with compliance to the TB treatment therapy. Another axis to the interaction is that most of the alcoholics take local brews or second-generation liquor since they cannot afford the more refined expensive drinks. These are sold in congested establishments, increasing the risk of infection among the other patrons due to poor ventilation. Both alcohol and tobacco use lower immunity, thereby predisposing subjects to re-activation with TB. Alcohol use is also associated with liver damage (Albano., 2006; National Health Service., 2013) hence concomitant use of anti-TB drugs and alcohol will increase liver damage and thus lead to higher chances of side effects (Gülbay et al., 2006). This will in turn lead to treatment interruption due to increased drug intolerance.

Respondents who perceived their disease at diagnosis as severe were 0.0142 times less likely to interrupt as opposed to those who viewed their disease as mild. This could be explained by the fact that those who considered their disease as more advanced put in more effort to follow their prescribed treatment. These patients did so with the fear of the disease advancing further, ultimately leading to death. On the contrary, those who considered their malady as mild did not have much motivation to adhere to treatment. Apart from patient perception, stigma was found to significantly influence interruption. Patients who reported not being ashamed of TB (POR 0.0186) were less likely to interrupt their treatment. This association of stigma was also sustained by the finding in other studies such as a study in Madagascar (Comolet et al., 1998) about patients who "felt that TB was a shameful disease." In that study, stigma associated with TB and HIV/AIDS acted as a barrier to adherence since the patients were not free to disclose their condition. They hid from family members and thus ended up not getting the desired support. This ultimately led to non-adherence. To control for confounding, a forward sequential elimination method was employed in carrying out unconditional regression analysis. The final model showed that being accompanied by relatives, information on diagnosis, level of education, personal income, presence of side effects and perception of health care workers attitude independently influenced interruption of TB treatment in Embu County. This meant that in order to address treatment interruption in the county, these were the most important factors to be considered.

5.2 Conclusions

This study has shown that most patients who interrupted were aged below 34 years (55%) with a peak prevalence in the 25-34 age group. It was also noted that the majority of the TB patients used alcohol during treatment. The study established the proportion of treatment interruption in Embu County as 21.2%. This high interruption rate could be attributed to lack of knowledge on the disease and the prescribed treatment as shown by the high proportion of patients that shied away from seeking treatment on perception of the disease as mild. However, apart from the patients' perspective, too many pills, suffering from side effects, low education status and poor economic status were among the main reasons for abandoning treatment. The factors that were associated with treatment interruption in Embu County were; social support by family members, information on diagnosis, level of education, personal income, presence of side effects and perception of health

care workers attitude.

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