# Tuberculosis Treatment Adherence among Patients Taking Anti-TB Drugs in Kilifi County, Kenya

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## Summary

**INTRODUCTION**

**TB treatment adherence is proven to be the single factor associated with TB treatment success. Poor treatment adherence increases the spread of new TB cases and the likelihood of developing MDRTB. Thus, this study aimed to determine factors influencing TB treatment adherence in Malindi Subcounty, Kilifi County Kenya.**

**MATERIALS AND METHODS**

**The study adopted a cross-sectional study design. A Structured standardized questionnaire from the Morisky medication adherence scale and Focus group discussion were used to collect data. Purposive sampling was used to select 8-high burden facilities, we used descriptive statistics and multiple logistic regression to analyse the data.**

**RESULTS**

**Two hundred and thirty-five (235) patients were sampled. TB treatment adherence level was 75% in Malindi sub-county. Living with family (OR =3.01; CI: 1.45-6.25, P=0.003), basic knowledge on TB (OR; 4.078, CI: 2.039-8.154, P=0.001), perceived severity (OR=2.186, CI: 1.088-4.393, P=0.028) and perceived susceptibility (OR=0.477, CI: 0.303-0.752, P=0.001), patient satisfaction (OR; 1.824, CI: 1.257-2.647), P=0.002) and enrolment of TB patients to support groups (OR; 0.353, CI: 0.438-1.538), P=0.031) were factors associated with TB treatment adherence**.

**CONCLUSION AND RECOMMENDATION**

**Factors like family support, basic knowledge of TB and patient support increase TB treatment adherence.**

**We recommend community advocacy on TB, policies on integration of TB services and enrolment of TB patients to support groups to increase TB treatment adherence.**

***Keywords*:** *Tuberculosis, Treatment Adherence, Kilifi, Kenya*

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## Introduction

Tuberculosis (TB) is the leading cause of single infectious agent deaths globally, surpassing malaria and human immune-deficiency virus (HIV/AIDS) [1]. Despite TB being a treatable, curable and preventable disease, there has been a very minimal decline in TB incidence (less than 2%) in the past years, with over 4 million cases neither diagnosed nor treated [1]. Tuberculosis eradication is one of the targets of Sustainable Development Goal (SDG) three which was recently constituted to address limitations in TB care, involving the community at large other than just focusing on decentralizing TB care in health facilities.

TB treatment adherence is proven to be a single factor associated with treatment outcome as evidenced through the three-phase III trials of fluoroquinolone [2]. Despite there being standard international guidelines adopted by different countries in TB diagnosis, monitoring and treatment, most patients are exposed to programs that are poorly organised and monitored [3]. Poor adherence to TB treatment is often associated with treatment interruption, low quality of treatment drugs, and health care workers' incorrect prescriptions [5,6,7]. The most common reason for non-adherence is patients not knowing what causes TB, how it is transmitted and its prevention, which results in poor health-seeking behaviour towards adherence to medication [8]

It is estimated that TB cases in Kenya are much higher than previously reported with a case notification rate of 158/100000 persons and approximately half of those cases reported are missed each year [5]. Even though TB treatment in Kenya is free, other TB management services such as chest X-rays are paid for. There is also a need to maintain a balanced diet with vitamin supplementation during medication, rendering TB care costly.

Kilifi County has a case notification rate of 189/100000 persons in 2019 which is higher than the national standing [9]. Malindi sub-county reported a treatment success rate of 68% and treatment cure rate of 60%, which are way below the national target of 90% [10]. Lost to follow up (LTFU) is a common cause of non-adherence to medication in Kilifi County. Malindi sub-county reported high and increasing LTFU cases of 3% (15) in 2016, to 8% (42) in 2017, and to 23% (87) in 2018 [10]. This rising trend of LTFU is alarming and has been a major contributor to non-adherence to the treatment regimen, which contributes to increased new TB cases and increased development of MDR-TB [9,11]. Kenya National TB guidelines define TB treatment success rate as such: 90% cure rate, less than 5% LTFU, <5% TB deaths and 0% patients. TB treatment adherence is complex and multifaceted on its own, but to be able to achieve the national targets of TB control, we have to be able to understand the factors that prevent patients from completing their medication and those factors that help them complete their treatment.

In this study, we adopted two theories, Health Belief Model by IM Rosenstock [11] and Socioecological Model by Urie Bronfenbrenner [13]. These two theories were adapted because both models have tenets that are relevant and compatible with the study objectives. To improve TB treatment adherence, interventions that maximise perceived benefits and reduce perceived barriers should be implemented, cues of actions being support from the patient environment, friends and family [12, 13]. Health Belief Model (HBM) has six constructs of perceived susceptibility, perceived severity, health motivation, perceived benefits, perceived barriers, and cues for action, which are key in predicting and explaining behavioural alongside attitude factors during TB treatment adherence [11].

Treatment adherence is the most important factor in determining TB treatment success rate. A better understanding of factors that influences treatment adherence will aid in

the formulation of better interventions, strategies and policy addressing non-adherence to TB drugs. This will result in better adherence to TB treatment, leading to an increased treatment success rate hence reducing TB incidences and the development of MDR-TB. The study will be targeted to health care workers and TB advocates on better interventions in the management of TB, towards a world free from TB.

## Materials and Methods

The study adopted a descriptive cross-sectional study design to assess TB treatment adherence among patients taking anti-TB drugs in Malindi sub-county, Kilifi County. TB treatment adherence was the dependent variable and socio-demographic characteristics, level of knowledge, behavioural and health facility factors were the independent variable. There are no standard criteria for defining adherence in TB management, so the researchers defined non-adherence as cases that missed more than or equal to 10% of the total prescribed medication both during the intensive and continuation phase. We administered a standard questionnaire from Morisky Medication Scale and counter-checked monthly appointments to measure adherence.

### *Study population*

The study population included all the TB patients registered in the TB4 register attending the TB clinic in Malindi sub-county. We included all-TB patients taking anti-TB treatment drugs, either in the intensive or continuation phase, enrolled in the past six months, aged above 18 years, and consented to participate in the study. TB patients who were critically ill at the time of the study, patients unable to hear or speak, and those who declined to participate in the study were excluded from the study.

### *Sampling Techniques and Sample Size*

We used finite correction formula for a population <10,000 to get a sample size of 213 participants. We added 10% of the calculated sample size to cover for any incomplete interviews to give 235 participants. Space assumptions were made at a 95% confidence interval and 5% standard error. A purposive sampling technique was used to select eight facilities with a high number of registered TB patients. The facilities cue for 448 patients (99.5%) of the total TB patients in the Subcounty. Systemic random sampling was used to select patients who would participate in the study with a fixed $K^{th}$ of 2. In Malindi District Hospital, 148 patients were selected (Table 1. Appendix I).

### *Data Collection instruments*

Structured questionnaires and five focused group discussions were used to collect primary data. Structured questionnaires consisted of four parts: socio-demographic information, level of knowledge, behavioural factors and the Morisky Medication adherence scale. Morisky medication adherence scale 4-item (2018) was used to measure treatment adherence. Those who scored 0 were scored to have high adherence, a score between 1-2 as medium adherence and a score more than 3 are scored as to have poor adherence to TB treatment. Ten per cent of the sample size was pre-tested in Kilifi North Subcounty. Secondary data was reviewed from the TB management register (TB 4) at the respective health facilities, patients' appointment cards, and the TIBU system (electronic management system for TB).

### *Data analysis*

Data were analyzed using SPSS version 20.0. Descriptive and inferential statistics were used with P-Values of 0.05 showing statistical significance. We used multiple logistic regression to identify factors associated with TB treatment adherence and further backward regression analysis to identify the confounders. Further, their level of knowledge was assessed as for each question, a correct answer was scored 1, and 0 for a wrong response. The highest score was six.

Those who scored 6 were categorized as having good knowledge of TB, those who scored between 3-5 had average knowledge, and those who scored 2 and below were classified as having poor knowledge. Deliberations from the FGDs were analyzed by thematic analysis.

### *Ethical consideration*

We sought clearance and approval from Kenyatta University, Kenyatta University Ethics and Review committee (Ref: PKU/2122/11266), ethical clearance from research permit from National Commission for Science and Technology (NACOSTI) (Ref: NACOSTI/P/20/5926) and approval from Kilifi County government. Researchers sought oral and written consent from the study participants.

## Results

### *Socio-demographic characteristics of the respondents*

Two hundred and thirty (230) patients were interviewed, corresponding to 98% of the sample size of 235 during October 2020. Of the respondents, 57% (130) were male and 43% (100) were female. The study subjects had a mean age of 36 years (SD 16). The majority, 70 (31%) of participants' ages ranged between 18 to 27 years and forty-seven (47%) were married.

About 66% of the population had primary education or no formal education. Most of the participants were either unemployed (45%) or self-employed (39%). Approximately ninety-eight (83%) of the participants spent less than $4 on food daily, while 82% lived with their families, with the remaining 18% living alone (Appendix III).

### *TB treatment adherence*

Morisky Medication adherence scale (MMSA) has an adherence scale of 0. From MMSA, 172 (75%) of the respondents had a score of 0 (100%) full adherence to TB medication, 45 (20%) responded to have scored between 1-2, categorized as average treatment adherence, while those who scored more than 3 are categorized to have poor TB treatment adherence. Thus, the adherent level was at 172 (75%), while 58 (25%) were non-adherent to TB treatment.

From the FGD, Common reasons for not adhering to treatment included: lack of social support, feeling of being cured and ignorance, forgetting to take medication, medication side effects of TB drugs, limited knowledge on treatment adherence, Refusal to seek care, belief its witchcraft, no time on their routine work until they are very ill, not knowing a lot about TB, negligence from caregivers and uncaring caregiver, stigma from friends and family, feel healthier, hopelessness, drugs make you have a lot of energy and laziness in refill

Strategies that could be used to increase TB treatment adherence were identified. These included training caregivers on TB care, taking medications at the hospital, especially those defaulting, home visits by health care workers, close monitoring by caregivers, support from the family directly observed therapy (DOTS), follow-up from community health volunteers (CHVs), decentralize medication collection sites to nearest dispensaries, defaulters be traced and followed, isolation of defaulters, collective approach from village elder and family DOTS.

### *Relationship between Socio-demographic factors and TB treatment adherence*

From the findings, 53% (92) of males were adherent to TB treatment and 47% (80) of the women were adherent. Fifty-one per cent (87) of those who were married were adhering to treatment, while 49% (85) of either single, divorced, and/or widowed were also adhering to treatment. The highest adherence was among those aged 28-37 years at 49%. On occupation, 54% (93) of employed were adherent to treatment. one hundred and sixteen (57%) of the respondents had primary education or none. Of the respondents who

lived with their families, 87% (150) were adherent to TB treatment.

Those living with their families were three times more likely to adhere to treatment than those living alone (OR =3.01; CI: 1.45-6.25, P=0.003). Sex, age group, marital status, level of education, occupation, and amount used for food daily had no statistical significance to TB treatment adherence. (Refer to table 2; statistically significant variables are in bold).

**Table 1:**
***TB Medication adherence***

| Variable | Frequency | Percentage |
|---|---|---|
| Adherence to TB treatment | | |
| Full adherence | 172 | 75% |
| Average adherence | 45 | 20% |
| Poor adherence | 13 | 5% |
| Adherence to TB treatment | | |
| Adherent | 172 | 75% |
| Non-adherent | 58 | 25% |

***Table 2:***
***Relationship between Socio-Demographic Factors and TB Treatment Adherence***

| Variable. | Treatment outcome | | | P-value |
|---|---|---|---|---|
| | Adherent N (%) | Non-adherent N (%) | Odds Ratio (CI 95%) | |
| **Sex** | | | | |
| Male | 92 (53%) | 38 (66%) | 0.588 | 0.097 |
| Female | 80 (47%) | 20 (34%) | (0.315-1.1) | |
| **Marital status** | | | | |
| Married | 87 (51%) | 22 (9%) | 0.707 | 0.294 |
| Single/Divorced/widowed | 85 (49%) | 36 (16%) | (0.366-1.354) | |
| **Age Group (years)** | | | | 0.382 |
| 18-27 | 60 (35%) | 21 (36%) | 0.848 | |
| 28-37 | 85 (49%) | 25 (43%) | (0.585-1.228) | |
| 38-47 | 10 (6%) | 7 (12%) | | |
| 48 and above | 17 (10%) | 5 (9%) | | |
| **Occupation** | | | | 0.815 |
| Employed/self-employed | 93(54%) | 33 (57%) | 1.081 | |
| Non-employed | 79 (46%) | 25 (43%) | (0.563-2.076) | |
| **Level of Education** | | | | |
| None/Primary | 116(67%) | 35 (60%) | 0.735 | 0.326 |
| Secondary/college | 56(33%) | 23 (40%) | (0.397-1.359) | |
| **Amount of food used for food daily** | | | 0.934 | 0.830 |
| 0-200 | 62 (36%) | 20 (34%) | (0.5-1.744) | |
| 201-400 and above | 110 (64%) | 38 (66%) | | |
| **Do you live with your family?** | | | | **0.003** |
| Yes | 150 (87%) | 39 (67%) | 3.01 | |
| No | 22 (13%) | 19 (33%) | (1.45-6.25) | |

## *Level of Knowledge on TB treatment*

On knowledge of TB, 106 (46%) of the respondents stated that a bacterium causes TB and 223 (97%) agreed that TB is transmittable from one person to another. Further, 214 (93%) mentioned at least one symptom of TB. The respondents who knew what causes TB were three times more likely to adhere to TB treatment than those who don't, while those who knew who could get TB were five times more likely to adhere to treatment. There was a significant association between what causes TB (OR=3.139; CI: 1.564-6.297, P= <0.0001) and who can get TB (OR=5.465, CI: 1.507-19.818, P= 0.010) are associated with treatment adherence (Refer to Table 3). Those who had a high level of knowledge were four times more likely to adhere to TB treatment unlike those who don't. Level of knowledge has a significant statistical association with TB treatment adherence (OR; 4.078, CI: 2.039-8.154, P=0.001) (Appendix II).

Some of the misconceptions around TB as identified by participants in the FGD included: that it is caused by heavy work, alcohol use, tobacco use/smoking, heredity/follows certain lineages, one must be HIV positive to have TB, it is a sign of witchcraft.

***Table 3:***
***Relationship between level of Knowledge on TB treatment and TB treatment adherence***

| **Variable.** | **Medication outcome** | | | **P-value** |
|---|---|---|---|---|
| | Adherent N (%) | Non-adherent N (%) | Odds Ratio (CI 95%) | |
| **What causes TB?** | | | | |
| Bacterium | 90 (52%) | 15 (26%) | 3.185 | |
| Virus/Smoking and/or alcohol/ Others (Heavy work) | 82 (48%) | 43 (74%) | (1.646-6.162) | **0.001** |
| **Is TB transmittable from one person to another person?** | | | | |
| Yes | 167(97%) | 55(95%) | 1.055 | 0.746 |
| No | 5 (3%) | 3 (5%) | (0.765-1.455) | |
| **How is TB transmitted from an infected person?** | | | | |
| Through infectious cough and sneezing droplets | 147 (85%) | 45 (76%) | 0.704 | 0.111 |
| Don't know | 25 (15%) | 13 (24%) | (0.458-1.084) | |
| **In your opinion, who can get TB?** | | | | |
| Anybody | | | | |
| Others(only alcoholic people/poor people/drug users/HIV patients/Others) | 166 (96%) 6 (4%) | 49 (84%) 9 (16%) | 0.689 (0.502-0.948) | **0.022** |
| **How do you think TB can be treated?** | | | | |
| Anti-TB drugs | 161(94%) | 52 (90%) | 0.938 | 0.485 |
| Others inclusive traditional medicine | 11 (6%) | 6 (10%) | (0.783-1.123) | |
| **The duration of completing treatment?** | | | | |
| 6 months | 157 (91%) | 57(99%) | 1.514 | 0.196 |
| Others (8,12, I don't know.) | 15 (9%) | 1 (1%) | (0.807-2.837) | |

## *Behavioural factors influencing TB treatment adherence*

In perceived severity, the majority 133 (58%), of the population had a moderate perception of the severity of the illness. Ninety-four (41%) of the respondents had a high perception of the severity of the illness; this group stated that not adhering to/ completing TB treatment could affect their lives, families, and community.

In Perceived susceptibility, respondents had a high perceived susceptibility 156 (68%) of the possibility of protecting themselves by adhering to treatment.

In perceived barriers, 99 (43%) of the respondents have never heard people talking ill about people with TB and 140 (61%) have never been treated badly or seen people with TB being sent away, perceived as a barrier towards treatment adherence.

In Perceived benefits, one hundred and sixty-eight (73%) people agreed to "if I take my TB medications daily, I will reduce risk of TB recurrence and developing MDR TB". 24% had a moderate perception of benefit. For cues to action, one hundred and ninety-three (84%) of the respondents were ready to take action regarding their health during and after treatment. For self-efficacy, one hundred and twenty-nine (56%) respondents were ready to take charge in the prevention of TB, while 71 (31%) were moderately self-efficient in TB control.

## *Relationship between behavioural factors and TB treatment adherence*

Respondents who perceive TB as severe were twice more likely to adhere to TB treatment.

***Table 4:***
***Relationship between Behavioural Factors and TB Treatment Adherence***

| Variable | Medication outcome | | | P-value |
|---|---|---|---|---|
| | Adherent N (%) | Non-adherent N (%) | Odds Ratio (CI 95%) | |
| **Perceived severity** | | | | |
| High | 65 (38%) | 13(22%) | 2.186(1.088-4.393) | **0.028** |
| Moderate | 106 (62%) | 44 (76%) | | |
| Low | 1 (0%) | 1 (2%) | | |
| **Perceived Susceptibility** | | | | **0.001** |
| High | 107 (62%) | 48 (83%) | 0.477 (0.303-0.752) | |
| Moderate | 63 (37%) | 9(15%) | | |
| Low | 2(1%) | 1 (2%) | | |
| **Perceived Barriers** | | | 0.937 (0.525-1.674) | 0.826 |
| Always | 2(1%) | 1 (2%) | | |
| Sometimes | 79 (46%) | 24 (41%) | | |
| Never | 91 (53%) | 33(57%) | | |
| **Perceived Benefits** | | | | |
| Agree | 131 (76%) | 38 (66%) | 1.301 (0.932-1.814) | 0.122 |
| Neutral | 4 (3%) | 2 (3%) | | |
| Disagree | 37 (21%) | 18 (31%) | | |
| **cue to action** | | | 1.328 (0.902-1.954) | 0.151 |
| Yes | 148 (86%) | 45 (78%) | | |
| Neutral | 23 (14%) | 11 (19%) | | |
| No | 1 (0%) | 2 (3%) | | |
| **Self-efficacy** | | | 1.298 (0.817-2.062) | 0.27 |
| Always | 25 (14%) | 5 (9%) | | |
| Sometimes | 46 (27%) | 25 (43%) | | |
| Never | 101 (59%) | 28 (48%) | | |

Further, perceived severity (OR=2.186, CI: 1.088-4.393, P=0.028) and perceived susceptibility (OR=0.477, CI 0.303-0.752, P=0.001) were associated with treatment adherence (Table 4). From FGD, Behavioural factors like not understanding the advantages of adhering to treatment, ignorance during the treatment period, and perceived severity were associated with treatment adherence

## *Health facility factors influencing TB treatment adherence*

The amount of money spent to and from the hospital had a mean of 145 KSH with the majority paying a range of 0-100 KSH at 93%. The patients spent an average of 20 minutes refilling their medication at health facilities, with 96% of them spending between 0-20 minutes. Two hundred and twenty-five (98%) of the respondents were given medication free of charge at the government facilities, with 97% acknowledging they get medication during their monthly visits. One hundred and five (46%) of the respondents extensively explained their illness at the health facility. One hundred and seventy-five (76%) were very satisfied with the way health personnel explained the need to adhere to treatment. Six per cent (5) of the patients are enrolled in TB support groups. With 54% (93) of the adherent category been visited by CHVs on matters of TB. Patient satisfaction (OR; 1.824, CI: 1.257-2.647), P=0.002) and Enrolment of TB patients to support groups (OR; 0.353, CI: 0.438-1.538), P=0.031) have a significant statistical association with TB treatment adherence (Table 5).

**Table 5:**
***Relationship between Health Facility Factors and TB Adherence***

| Variable | Treatment outcome | | odds ratio(CI 95%) | P-value |
|---|---|---|---|---|
| | Adherent | Non-adherent | | |
| **Cost to and from Hospital in KSH** | | | | |
| 0-100 | 104(60%) | 39(67%) | | |
| 101-200 | 44(26%) | 15(26%) | | |
| 201-300 | 15(9%) | 1(2%) | 1.226 | 0.304 |
| 301-400 | 9(5%) | 3(5%) | (0.831-1.809) | |
| **During the last visit, how long did it take before being attended to?** | | | | |
| 0-20 mins | 112(65%) | 44(76%) | | |
| 21-40 mins | 53(31%) | 12(21%) | | |
| 41-60 mins | 6(3%) | 0 (0%) | 1.264 | 0.395 |
| 61 mins above | 1(1%) | 2(3%) | (0.737-2.169) | |
| **Patient's satisfaction** | | | | |
| High | 83 (48%) | 15 (26%) | 1.824 | **0.002** |
| Medium | 51 (30%) | 20 (34%) | (1.257-2.647) | |
| Low | 38 (22%) | 23 (40%) | | |
| **Are you in any TB treatment support groups following up on TB treatment adherence?** | | | | **0.031** |
| Yes | 2(1%) | 3(5%) | 0.353 | |
| No | 170(99%) | 55(95%) | (0.137-0.911) | |
| **Has a community health volunteer ever visited you at home on matters of TB?** | | | | |
| Yes | 93 (54%) | 28 (48%) | 0.839 | |
| No | 79 (46%) | 30 (52%) | (0.438-1.538) | 0.571 |

From FGD, health facility factors like rude health care professionals, long-distance, difficulty in diagnosing TB, and no medicines always especially those for reducing side effects were associated with patients not adhering to TB treatment. CHVs care was selective to pulmonary TB patients (PTB) positive patients only.

## Discussion

### *TB treatment adherence*

The study findings indicated that 75% of the respondents were adhering to TB treatment. This was way below the national target and End TB Strategy 2035 targets of 90% treatment coverage, 90% active case finding and 90% treatment success rate [14]. The findings on adherence compare to those from studies conducted in Northwest Ethiopia and Southern Ethiopia [15, 16]. However, these findings are lower than those from studies done in Homa-Bay-Kenya (92%), Khartoum (86%) [17,18] and higher than studies of Northwest Nigeria (70%) and South Korea (56%) [19, 20]. Some of the common reasons this study found to be associated with non-adherence to treatment include lack of social support, feeling of being cured and ignorance, forgetting to take medication and being far from home, alcoholism, and other side effects of TB drugs. This agrees with studies done in Northwest Nigeria, Asmara Eritrea and Uganda [19,21, 22].

### *Individual factors influencing TB treatment adherence*

We found that more men than women were affected by TB among the study participants. Other studies have suggested that men are more likely to be affected due to predisposing factors like biological differences of TB, access to healthcare facilities and risk factors associated with TB [22,25]. Most reports indicate that men are 1.6. times more at risk of contracting TB than women globally. The findings showed that the most affected age group is the productive group of 18-40 years at 71%, probably due to their increased exposure to risk factors and behavioural factors [1, 11,14,16]. Patients who lived with their families were three times more likely to adhere to TB medication during the treatment period. Factors like living with family provide moral support to patients, reduce stigma, and encourage the patient to be more adherent [16,22,23]. The level of knowledge on what causes TB, duration of treatment and transmission are significantly associated with TB treatment adherence. Over time, resources have been allocated to address factors related to TB adherence; however, this cannot be achieved without correct knowledge of treatment adherence [1,16,21,22,25].

### *Behavioural factors influencing TB treatment adherence*

Findings from this study indicated that perceived severity and perceived susceptibility are factors associated with TB treatment adherence. This agrees with studies that patients who have a high perception of TB severity and susceptibility are more likely to adhere to TB medication [26,27,28]. Patients' beliefs on perceived susceptibility, perceived severity, perceived barriers, perceived benefits, cues to action and self-efficacy are influenced by knowledge, attitude and practices towards adhering to TB medication [12,27]. This could be explained using the Health Belief Model which is commonly used to describe and explain health behaviour factors that result from personal beliefs or perceptions in ways that can be done to reduce its occurrence or event. The model is influenced by the individual perception in obedience towards taking action to reduce threats and considering benefits over losses.

### *Health facility factors influencing TB treatment adherence*

From the results, health facility factors like patient satisfaction and whether a patient is enrolled on TB support groups were significantly associated with TB treatment adherence. Patient satisfaction at the health facility in terms of service provision positively

influences adherence to treatment [29]. Other than patient satisfaction, other factors like drug stock-outs, cost, long waiting time during refill and poor relationships with health care workers are factors associated with TB treatment adherence [30,31].

## Limitations of the Study

Tuberculosis in Kilifi County was associated with HIV/AIDS, witchcraft, and curses and was highly stigmatized. The study used self-administered questionnaires as intermediate variables to define process-oriented measures of treatment adherence making TB patients fear to disclose more information during the treatment period and or decline to be interviewed. However, appointment-keeping cards were used to compliment the questionnaires. The data was collected during the Covid 19 pandemic, this lengthened the data collection period than anticipated whilst observing the ministry of health preventive guidelines.

## Conclusion

In conclusion, factors like patients living with family, increasing basic TB knowledge in the community, high perceived severity and perceived susceptibility, reduced stigma and overall patient satisfaction with service delivery could increase TB treatment adherence. Family support reduces patients' feelings of stigma and hence increases adherence. Community and patients' knowledge of what causes TB, how it is transmitted and its signs and symptoms are key in improving TB treatment outcomes. An increase in knowledge could influence behavioural factors which further influence personal perceptions on the need to adhere to treatment.

Increase knowledge and active TB support groups influences stigma and societal support during the treatment regime. Patients' perception and satisfaction while receiving TB care are important in providing moral support.


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### *Conflicting interest*

All the authors agree to the contents of this paper and there is no conflict of interest.

### *Author contribution*

Conceptualization-Nancy Chebet, Methodology-Nancy Chebet, Original draft writing and editing-Nancy Chebet, Review proposal and project- Mr D. Sanga, Dr G.O Otieno, A. Yoos, G.Wanjau, Review proposal, project and mentorship- Dr Joyce Kirui


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## *Data Availability*

The data that support the findings of this study are available within the scope of the study. The raw data that support the findings are available from the corresponding author upon request due to the sensitivity of the data.

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# Appendices

## *Appendix I*

**Table 1:**
***Probability Sampling Frame***

| Name of the Facility | No. of patients | Proportion | No of Patients selected |
|---|---|---|---|
| Malindi District Hospital | 282 | 0.6295 | 148 |
| Tawfiq Muslim Hospital | 43 | 0.096 | 23 |
| David Kariuki Medical Centre | 37 | 0.0826 | 19 |
| Municipal Health Centre | 36 | 0.0804 | 19 |
| The Omar project | 17 | 0.0379 | 9 |
| Ganda Dispensary | 12 | 0.0268 | 6 |
| Jambo Clinic | 11 | 0.0246 | 6 |
| Malindi Care Services Limited | 10 | 0.0223 | 5 |
| Total | 448 | | 235 |

## *Appendix II*

**Table 3:**
***Summary of level of Knowledge on TB and TB Treatment Adherence***

| Variable. | Treatment outcome | | | df | P-value |
|---|---|---|---|---|---|
| | Adherent N (%) | Non-adherent N (%) | Odds Ratio (CI 95%) | | |
| Knowledge on TB | | | | | |
| Low | 3 (2%) | 3 (5%) | 4.078 | 1 | **<0.001** |
| Average | 90 (52%) | 46 (79%) | (2.039-8.154) | | |
| High | 79 (45%) | 9 (16%) | | | |

## *Appendix III*

**Table 2:**

***Socio-demographic Characteristics of the respondents (n=230)***

| Variable | Frequency | Percentages |
|---|---|---|
| **Sex** | | |
| Male | 130 | 57% |
| Female | 100 | 53% |
| **Age group** | | |
| 18-27 | 70 | 31% |
| 28-37 | 65 | 28% |
| 38-47 | 55 | 24% |
| 48-57 | 16 | 7% |
| above 58 | 24 | 10% |
| **Marital status** | | |
| Married | 109 | 47% |
| Single | 97 | 42% |
| Divorced/widowed | 24 | 11% |
| **Level of Education** | | |
| No formal education | 38 | 17% |
| Primary | 113 | 47% |
| Secondary | 64 | 28% |
| College/University | 15 | 6% |
| **Occupation** | | |
| Employed | 35 | 15% |
| Self-employed | 90 | 39% |
| Unemployed | 105 | 46% |
| **Amount of money used daily** | | |
| 0-200 | 82 | 35% |
| 201-400 | 111 | 48% |
| 401-600 | 31 | 13% |
| 601-above | 6 | 3% |
| **Live with Family** | | |
| Yes | 189 | 82% |
| No | 41 | 12% |