**Title:** Delay in seeking care for TB symptoms among adults newly diagnosed with HIV in rural Malawi

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**Running head:** Delayed HIV diagnosis among TB symptomatic

**Summary word count:** 198

**Text word count:** 2,397

**Number of References:** 29

**Number of Tables:** 3

**Number of Figures:** 1

**Key words:** Tuberculosis, HIV, health seeking, symptom screening

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**Funding:** The parent study received NIH funding through NIAID (R01 AI093316) and the Johns Hopkins Center for AIDS Research (P30 AI094189), and is registered at ClinicalTrials.gov (NCT01450085)

**Abstract**

**SETTING:** Ten primary health clinics in rural Thyolo district, Malawi.

**OBJECTIVE:** Tuberculosis (TB) is a common initial presentation of HIV infection. We investigated time from TB symptom onset to HIV diagnosis to describe TB health seeking behaviour in adults newly diagnosed with HIV.

**DESIGN:**  We asked adults (≥18yrs) about presence and duration of TB symptoms at the time of receiving a new HIV diagnosis. Associations with delayed health seeking (defined as >30 and >90 days from onset of TB symptoms) were evaluated using multivariable logistic regression.

**RESULTS:** TB symptoms were reported by 416 of 1,265 participants (33%), of whom 36% (150/416) had been symptomatic for >30 days before HIV testing. Most participants (260/416, 63%) were below the poverty line (US$0.41 per household member per day). Patients who first sought care from informal providers had increased odds of delay greater than 30 days (adjusted odds ratio [aOR] 1.6, 95% confidence interval [95%CI] 0.9-2.8) or 90 days (aOR 2.0, 95%CI 1.1-3.8).

**CONCLUSIONS:** Delayed health seeking for TB-related symptoms was common. Poverty was ubiquitous, but had no clear relationship to diagnostic delay. HIV-positive individuals who first sought care from informal providers were more likely to experience diagnostic delays for TB symptoms.

**BACKGROUND:**

HIV and tuberculosis (TB) are the leading infectious causes of adult deaths worldwide and especially in sub-Saharan Africa.1 An estimated 1.2 million (12%) of the 10.4 million people who developed TB worldwide in 2015 had HIV infection.1 The incidence of and mortality from TB increased steeply with the onset of the HIV epidemic and, despite recent gains, TB remains the leading cause of death among people living with HIV.2 TB thus still remains a major challenge.3

TB symptoms are commonly associated with undiagnosed HIV at all levels of the health system.4,5 Compared to TB diagnostics, HIV rapid diagnostic tests are quick, highly accurate, available in point-of-care (POC) format, and more widely decentralised. As such, it is common for HIV to be diagnosed before TB investigations have been started, even when the presenting complaint is consistent with active TB. Lack of rapid POC diagnostics for TB translates into lack of rapid decision making, increasing the number of visits required for TB diagnosis, loss to follow up, and patient costs. Being investigated for TB is also associated with substantial costs to patients, both direct (e.g., food and transport) and indirect costs (loss of wages due to time spent seeking care). Similarly, TB treatment also requiring multiple facility visits6 – and TB is often less widely appreciated in communities relative to HIV.7 People with symptoms such as cough may therefore delay care-seeking for TB, yet may seek diagnosis for HIV. Individuals with newly diagnosed HIV, therefore, represent a group from whom insights into the initial steps in the TB care pathway can be investigated.8

Socioeconomic factors are closely associated with health seeking behaviour9,10, including HIV and TB.11–13 In settings with free health services, such as Malawi, costs can be high relative to monthly income among the poorest sectors of society.14 Catastrophic costs (defined as totaling more than 20% of annual income) occur mostly from onset of TB symptoms to starting treatment, a fundamental driver being the number of clinic visits.14 Interventions focused at reducing delay to diagnosis could reduce not only these costs, but also transmission of both TB and HIV.

A considerable amount of literature has evaluated the time from first TB symptom to TB diagnosis.15,16 Few studies, however, have looked at patient delays from onset of symptom(s) suggestive of TB to the time of HIV diagnosis in a formal health facility. The primary aim of this study was therefore to investigate factors associated with delay from the onset of TB symptom to HIV diagnosis of more than 30 days, among adults newly diagnosed with HIV in a rural primary health care setting in Malawi. A secondary aim was to investigate risk factors for a delay of more than 90 days.

# METHODS

### Study Design and setting of the parent study: CHEPETSA trial

The CHEPETSA study was a cluster randomized trial conducted in 12 rural primary care clinics in Thyolo district, Malawi that enrolled adults with newly diagnosed HIV infection (CHEPETSA, clinicaltrials.gov #NCT01450085). In this parent study, clinics (clusters) were randomized to one of two TB screening algorithms: symptom screening plus sputum smear microscopy and symptom screening plus sputum testing with the Xpert MTB/RIF assay (Cepheid, Inc., Sunnyvale, CA, USA). All study participants were screened for TB symptoms (cough of any duration, fever, recent weight loss, or night sweats17) at enrolment. If at least one TB symptom was reported, participants were asked to give sputum for TB diagnosis with smear microscopy or Xpert MTB/RIF (depending on study arm). If asymptomatic and eligible, participants were initiated on isoniazid preventive therapy for six months. All participants were followed for one year after HIV diagnosis. The primary outcome of the parent trial was all-cause mortality at one year from enrolment.

### Study sample for this analysis

In this analysis, we used enrolment data from participants recruited into the CHEPETSA study. Trial participants were included if they were enrolled on or before April 1, 2015 from ten clinics (five per study arm) and reported one or more of the four TB symptoms listed above at enrolment. Baseline evaluation used standardised questionnaires to elicit demographics (age and sex), time of onset and duration of TB symptoms, asset ownership, smoking status and transit time to clinic. (See Table S1 in supplementary section, Appendix 1, for variables used in asset ownership.)

#### Statistical Methods

We defined delay *a priori* as more than 30 days from onset of TB symptoms to time of HIV diagnosis. By design, HIV diagnosis occurred at the same time as enrolment into CHEPETSA study. Using data collected by self-report on asset ownership, recent purchase of sugar, education level of household head, household cooking over firewood, acreage cultivated, household size, household grows maize and/or tobacco, we created a “wealth score” variable for household wealth, measured using a proxy means test developed for rural populations from the 1998 Malawi Integrated Household Survey (IHS) (see Supplementary section, Appendix 1). This method estimates household consumption (measured as the wealth score) using proxy measures.18 The wealth score was then coded as a binary variable, using a predefined cut off point of 10.47 Malawian kwacha (valued in 1998 currency, thus equal to US$0.41) per person per day.18 Participants with an estimated household consumption below this cut off were classified as severely poor. Age was grouped into three categories: <30 years, 30-40 years and above 40 years. Initial site of care-seeking was dichotomised as clinic/hospital (formal services) versus other (traditional healer/ pharmacist/ none). In this rural setting, pharmacists are generally not formally trained and do not dispense prescription drugs but rather sell non-prescription drugs, as well as other grocery items.

We used logistic regression to explore factors associated with delay, including age group, sex, education, smoking status, employment, time to clinic from home, marital status, mode of transport to clinic, site of first attempted treatment seeking, time from home to clinic, history of previous TB treatment and wealth. We hypothesized that age group, wealth and sex would affect health seeking behaviour8,19 and therefore included these variables *a priori* in all adjusted analyses. In addition, other factors from the univariable analysis with p-values <0.2 were considered in the multivariable analysis and retained if, after adjustment, the p-value remained <0.2. Analysis was also repeated using a secondary outcome of delay of more than 90 days. All analyses were performed in Stata 13 (Stata Corp., College Station, USA).

# Ethical Considerations

The parent trial was approved by the Malawi College of Medicine Research and Ethics Committee, London School of Hygiene & Tropical Medicine Ethics Committee and Johns Hopkins Medicine Institutional Review Board. All study participants provided written consent before enrolment.

# RESULTS:

Overall 1,577 participants from 10 clinics were enrolled into the parent trial on or before April 1, 2015 (Figure 1). Of these, 312 were excluded from further analysis as not having complete data on socio-economic status collected. During screening, 458 (36%) of the remaining 1,307 eligible participants reported one or more TB symptoms at enrolment. Of these, a further 42 participants were excluded due to missing data on delay and/or components of the wealth score, leaving a total of 416 participants for the analysis of delay in seeking care.

Baseline characteristics of the 416 participants are summarised in Table 1. Overall 52% of participants were male, and 60% were under 40 years old. Most participants were severely poor based on the 1998 poverty line (n=260, 63%), had low levels of education (none/primary: n=329, 81%) and had travelled more than one hour from home to get to the clinic (n=294, 71%).

Overall 150 of 416 participants with TB symptoms (36%) reported a delay of >30 days from onset of those symptoms to HIV diagnosis. Seventy-eight (19%) participants reported a delay >90 days.

In multivariable analysis, patients who first sought care from informal (traditional healers and pharmacists) or no other services, as opposed to formal services (clinics or hospitals), had increased odds of delay; this finding was not statistically significant (adjusted OR [aOR] 1.61, 95% CI 0.9, 2.8, p=0.09; see Table 2). When delay was defined as more than 90 days from symptom onset to HIV diagnosis, patients who first sought care from settings other than formal services (clinics or hospitals), had an increased odds of delay (aOR 2.0, 95% CI 1.1, 3.8, p=0.03; see Table 2). Patients from households with five or more members (compared to those with less than five members) had lower odds of delay (aOR 0.7, 95% CI 0.4, 1.2, p=0.16; see Table 2), though this finding was not significant. Delay – whether measured as 30 or 90 days – did not vary significantly according to age group, sex, smoking status, time to clinic from home, wealth, mode of transport, or having previous TB treatment (Table 2).

**DISCUSSION**

This analysis of 416 rural Malawian adults newly diagnosed with HIV and reporting TB symptoms suggests that patients who first seek care from traditional healers and pharmacists may have increased odds of prolonged delay in diagnosis. We also highlight the high prevalence of both extreme poverty (63%) and delay in diagnosis (36% with >30 days delay) in this rural population. This study reports duration of TB symptoms prior to HIV diagnosis, and provides support for the measurement of TB symptoms at HIV diagnosis as a potentially useful approach for assessing delayed care seeking for HIV-TB.

Despite careful consideration of multiple risk factors, we found no significant associations with delayed care seeking, defined using our *a priori* cutoff of >30 days between self-reported onset of TB symptoms and date of HIV diagnosis. When considering prolonged delays (>90 days), seeking assistance from a traditional healer or pharmacist was associated with a doubling of the odds of diagnostic delay. While only 15% of patients first sought diagnosis from traditional healers and pharmacists (as opposed to visiting clinics or hospitals), these individuals accounted for nearly half of all patients who experienced prolonged delays. We did not find evidence of association between first seeking treatment from traditional healers/pharmacists with any other risk factors in this cross-sectional study.

Our findings are consistent with previous work in Malawi by Brouwer et al20 – who found that 37% of TB patients visited a traditional healer before seeking formal medical care, that these patients spent an average of four weeks with traditional healers, and that none of the traditional healers referred patients to the formal healthcare system. These findings suggest that individuals seeking care from traditional healers and pharmacists may be an important group for targeted case-finding interventions, and that further engagement of such informal providers may be required to reduce diagnostic delays in the rural sub-Saharan African setting. Future studies are needed to confirm this finding and also to explore the potential impact of private-sector care on the population-level transmission of TB in Malawi and other similar settings.

Notably, we did not detect an association between extreme poverty and delayed care-seeking for TB symptoms in this population. In most societies, the greatest burden of TB (and increasingly HIV) is experienced by the poorest populations.21,22 HIV in itself is also a powerful risk factor for progression from TB infection to TB disease and a driver of poverty.23 However, despite the very high levels of poverty in our study (with 63% of the study population classified as extremely poor based on a proxy means test benchmarked to the 1998 poverty line), we found no evidence for a difference in diagnostic delays between severely poor and non-severely poor participants. In practice, the majority of participants in this study classified as “not severely poor” would still be classified as extremely poor by most international standards. Thus we may have failed to observe an association between wealth and diagnostic delay in part due to relatively ubiquitous poverty in our study setting.24

Different approaches have been recommended for integrating HIV and TB services so as to provide universal access even to the poorest in all societies.25 Systematic screening of people living with HIV and prompt treatment are principal tools for reducing transmission and controlling spread of TB disease.26 However, despite these longstanding recommendations, the integration of HIV and TB services has been slow,27 and many studies have indicated that much still needs to be done.28,29 The novel approach discussed here –monitoring and reporting of duration of TB symptoms before HIV diagnosis – may provide a useful and readily obtainable metric that could be used to investigate both TB and HIV programme performance relating to prompt offer of HIV testing to all patients reporting TB symptoms. This metric can also provide an indicator of healthcare seeking behavior among people with symptoms suggestive of TB (who may be more likely to present for HIV diagnosis than for evaluation of their TB symptoms).

This study has a number of important limitations. These include our inability to explicitly measure integration of HIV and TB services and potential recall bias in participants’ self-reported time from onset of TB symptoms to HIV diagnosis. Data on the total number of visits made to the formal health sector before HIV diagnosis were not collected. Our epidemiological setting of rural Malawi – while important – is not likely to generalize to urban settings or to those outside of sub-Saharan Africa. Our proxy means test of household wealth benchmarked against a poverty line (i.e., an absolute measure of poverty) may not accurately reflect poverty as actually experienced in this population. Not only was this measure designed to reflect a specific context and time (i.e., Malawi in 1998), but it may be sensitive to participants’ conceptualization of household size or structure. Future studies might consider evaluating relative measures of poverty (in which wealth is compared against that of other members in the same society) to provide a different perspective. Finally, we did not include some variables (for example, seasonality) that may have important effects on delays in seeking care.

In conclusion, we found that about two-thirds of this rural Malawian population newly diagnosed with HIV and reporting TB symptoms met criteria for extreme poverty, and one-third reported delays of more than 30 days from symptom onset to the time of HIV diagnosis. Seeking care with informal providers was associated with extreme delay in care seeking. These data highlight the challenges faced in diagnosing TB among people living with HIV in this setting, provide a metric (duration of TB symptoms at the time of HIV diagnosis) that can be used to evaluate programme performance, and underscore the importance of engaging informal providers if global targets for HIV and TB control are to be met in rural sub-Saharan Africa.

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**Acknowledgements**

LGN performed the data analysis, and drafted manuscript. DWD designed the study protocol and instruments for the parent study, and assisted with technical support for the analysis, MK assisted with data cleaning and analysis, GLB assisted with study design, data quality assurance, and data cleaning. AN assisted with study management and data cleaning, ATC assisted with referencing and proof reading, MM assisted with study implementation logistics, REC, ELC designed the study protocol and instruments for the parent study, ELC assisted with revising manuscript, KF assisted with technical support for the analysis, writing and revising the manuscript. The study was funded by the National Institutes for Health (1R01 AI093316). ELC is funded by a senior fellowship in clinical science (WT 200901/21161Z)

**Fig 1: Study Profile**

**416 included in analyses:**

TB symptomatic participants with socio economic and duration of symptoms data available

¹ All data on socio economic missing (collection of these data started three months into the study using the extended baseline interview);

² Days from onset of TB diagnosis to HIV diagnosis was missing

³ 14 Socio-economic status variables were used to recreate wealth variable using proxy means test,

six participants had missing data on at least one of the 14 variables

1,577 enrolled in parent trial as of 1 April 2015

* Enrolled from 10 clinics
* Completed baseline interview

1,265 eligible participants

* Completed both baseline and extended baseline interview

312 excluded (no data on socio-economic status variables¹)

807 excluded due to lack of TB symptoms 42 excluded due to:

* 36 –with days from TB symptoms to HIV diagnosis missing²
* 6 -incomplete socio-economic status variables³

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1:** Characteristics of HIV positive adults attending primary care clinics, and association with delay from TB symptom onset to HIV diagnosis of more than 30 days (N=416). | | | | | | | | |
| Characteristic | Total (N=416) | Delay (N=150) | Unadjusted | | | Adjusted | | |
| N (col %) | N (row %) | OR | 95% CI | p | OR7 | 95% CI | p |
| **Age group, years** |  |  |  |  |  |  |  |  |
| <30 | 89 (21.4) | 33 (37.1) | 1 (Ref) |  | 0.35 | 1 (Ref) |  | 0.3 |
| 30-40 | 160 (38.5) | 51 (31.9) | 0.79 | 0.46-1.37 |  | 0.74 | 0.42-1.30 |  |
| 40+ | 167 (40.1) | 66 (39.5) | 1.11 | 0.65-1.88 |  | 1.05 | 0.61-1.81 |  |
|  |  |  |  |  |  |  |  |  |
| **Sex** |  |  |  |  |  |  |  |  |
| Male | 218 (52.4) | 86 (39.5) | 1 (Ref) |  | 0.13 | 1 (Ref) |  | 0.82 |
| Female | 198 (47.6) | 64 (32.3) | 0.73 | 0.49-1.10 |  | 1.17 | 0.30-4.50 |  |
|  |  |  |  |  |  |  |  |  |
| **Marital status** |  |  |  |  |  |  |  |  |
| Ever married | 398 (95.7) | 142 (35.7) | 1 (Ref) |  | 0.45 |  |  |  |
| Never married | 18 (4.3) | 8 (44.4) | 1.43 | 0.55-3.73 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Wealth1** |  |  |  |  |  |  |  |  |
| Not severely poor | 156 (37.5) | 57 (36.5) | 1 (Ref) |  | 0.87 | 1 (Ref) |  | 0.42 |
| Severely poor | 260 (62.5) | 93 (35.8) | 1.03 | 0.68-1.56 |  | 1.25 | 0.74-2.08 |  |
|  |  |  |  |  |  |  |  |  |
| **Household size, people** |  |  |  |  |  |  |  |  |
| <5 people | 215 (51.7) | 80 (37.2) | 1 (Ref) |  | 0.61 |  |  |  |
| ≥5 people | 201 (48.3) | 70 (34.8) | 0.9 | 0.60-1.34 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Smoking** |  |  |  |  |  |  |  |  |
| Never smoked | 297 (71.4) | 100 (33.7) | 1 (Ref) |  | 0.11 |  |  |  |
| Smoker/Ever smoked | 119 (28.6) | 50 (42.0) | 0.7 | 0.45-1.08 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Employment** |  |  |  |  |  |  |  |  |
| Non-formal | 256 (61.5) | 89 (34.8) | 1 (Ref) |  | 0.6 |  |  |  |
| Formal | 108 (26.0) | 39 (36.1) | 1.06 | 0.66-1.70 |  |  |  |  |
| Student/Unemployed | 52 (12.5) | 22 (43.1) | 1.42 | 0.77-2.62 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Previous TB treatment** |  |  |  |  |  |  |  |  |
| No | 397 (95.4) | 141 (35.5) | 1 (Ref) |  | 0.29 |  |  |  |
| Yes | 19 (4.6) | 9 (47.4) | 1.63 | 0.65-4.12 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Self-reported general health2** | | | | | | | | |
| Excellent/Good | 122 (29.3) | 38 (31.2) | 1 (Ref) |  | 0.18 |  |  |  |
| Fair/Poor | 294 (70.7) | 112 (38.1) | 1.36 | 0.87-2.13 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Education ³** |  |  |  |  |  |  |  |  |
| None | 60 (14.8) | 21 (35.0) | 1 (Ref) |  | 0.85 |  |  |  |
| Primary (1-8) | 269 (66.4) | 98 (36.4) | 1.06 | 0.59-1.91 |  |  |  |  |
| At least Secondary | 76 (18.8) | 25 (32.9) | 0.91 | 0.45-1.86 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Time to clinic from home, hours** |  |  |  |  |  |  |  |  |
| >2hrs | 151 (36.3) | 58 (38.4) | 1 (Ref) |  | 0.69 |  |  |  |
| 1-2hrs | 143 (34.4) | 48 (33.6) | 0.81 | 0.50-1.31 |  |  |  |  |
| <1hr | 122 (29.3) | 44 (36.1) | 0.9 | 0.55-1.48 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Mode of transport 4** |  |  |  |  |  |  |  |  |
| Walk | 262 (63.4) | 89 (34.0) | 1 (Ref) |  | 0.55 |  |  |  |
| Bicycle | 100 (24.2) | 40 (40.0) | 1.3 | 0.81-2.08 |  |  |  |  |
| Vehicle | 51(12.4) | 19 (37.3) | 1.15 | 0.62-2.15 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **First care seeking 5** |  |  |  |  |  |  |  |  |
| Formal services | 354 (85.3) | 121 (34.2) | 1 (Ref) |  | 0.08 | 1 (Ref) |  | 0.09 |
| Traditional/pharmacy/none | 61 (14.7) | 28 (45.9) | 1.63 | 0.94-2.83 |  | 1.61 | 0.93-2.80 |  |
|  |  |  |  |  |  |  |  |  |
| **Turnaround time, hours:** |  |  |  |  |  |  |  |  |
| *Last clinic visit4,6* |  |  |  |  |  |  |  |  |
| >3hrs | 248 (60.1) | 96 (38.7) | 1 (Ref) |  | 0.38 |  |  |  |
| 2-3hrs | 72 (17.4) | 24 (33.3) | 0.79 | 0.46-1.38 |  |  |  |  |
| <2hrs | 93 (22.5) | 29 (31.2) | 0.72 | 0.43-1.19 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| *Recruitment visit6* |  |  |  |  |  |  |  |  |
| >3hrs | 356 (85.6) | 133 (37.4) | 1 (Ref) |  | 0.37 |  |  |  |
| 2-3hrs | 36 (8.7) | 11 (30.6) | 0.74 | 0.35-1.55 |  |  |  |  |
| <2hrs | 24 (5.8) | 6 (25.0) | 0.56 | 0.22-1.44 |  |  |  |  |
| 1Wealth measured using 1998 proxy means score | | | | | | | |  |
| 2General health was measured by self-report as excellent, good, fair or poor | | | | | | | |  |
| 3missing for n=11 participants | | | | | | | |  |
| 4missing for n=3 participants | | | | | | | |  |
| 5missing for n=1 participant, 6 participants did not go anywhere | | | | | | | |  |
| 6This was measured by time from home to clinic and then back home and waiting time at the clinic | | | | | | | |  |
| 7Adjusted for all variables listed; N=415 | | | | | | | |  |
| OR odds ratio; CI confidence interval | | | | | | | |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2:** Characteristics of HIV positive adults attending primary care clinics, and association with delay from TB symptom onset to HIV diagnosis of more than 90 days (N=416). | | | | | | | | |
| Characteristic | Delay (N=78) | Unadjusted | |  | Adjusted | | |  |
| N (row %) | OR | 95% CI | p | OR7 | 95% CI | | p |
| **Age group, years** |  |  |  |  |  |  | |  |
| <30 | 16 (18.0) | 1 (Ref) |  | 0.11 | 1 (Ref) | |  | 0.48 |
| 30-40 | 23 (14.4) | 0.77 | 0.38-1.54 |  | 0.77 | 0.37-1.60 | |  |
| 40+ | 39 (23.4) | 1.39 | 0.73-2.66 |  | 1.43 | 0.73- 2.82 | |  |
|  |  |  |  |  |  |  | |  |
| **Sex** |  |  |  |  |  |  | |  |
| Male | 45 (20.6) | 1 (Ref) |  | 0.3 | 1 (Ref) | |  | 0.39 |
| Female | 33 (16.7) | 0.77 | 0.47-1.26 |  | 0.49 | 0.09-2.53 | |  |
|  |  |  |  |  |  |  | |  |
| **Marital status** |  |  |  |  |  |  | |  |
| Ever married | 74 (18.6) | 1 (Ref) |  | 0.7 |  |  | |  |
| Never married | 4 (22.2) | 0.8 | 0.26-2.50 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Wealth1** |  |  |  |  |  |  | |  |
| Not severely poor | 33 (21.2) | 1 (Ref) |  | 0.33 | 1 (Ref) | |  | 0.61 |
| Severely poor | 45 (17.3) | 0.78 | 0.47-1.29 |  | 0.84 | 0.45-1.60 | |  |
|  |  |  |  |  |  |  | |  |
| **Household size, people** |  |  |  |  |  |  | |  |
| <5 people | 46 (21.4) | 1 (Ref) |  | 0.15 | 1 (Ref) | |  | 0.16 |
| ≥5 people | 32 (15.9) | 0.7 | 0.42-1.15 |  | 0.69 | 0.41-1.16 | |  |
|  |  |  |  |  |  |  | |  |
| **Smoking** |  |  |  |  |  |  | |  |
| Never smoked | 54 (18.2) | 1 (Ref) |  | 0.64 |  |  | |  |
| Smoker/Ever smoked | 24 (20.2) | 1.14 | 0.67-1.94 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Employment** |  |  |  |  |  |  | |  |
| Non-formal | 47 (18.4) | 1 (Ref) |  | 0.56 |  |  | |  |
| Formal | 18 (16.7) | 0.89 | 0.49-1.62 |  |  |  | |  |
| Student/Unemployed | 13 (25.5) | 1.52 | 0.75-3.08 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Previous TB treatment** |  |  |  |  |  |  | |  |
| No | 76 (19.1) | 1 (Ref) |  | 0.35 |  |  | |  |
| Yes | 2 (10.5) | 0.5 | 0.11-2.20 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Self-reported general health2** | |  |  |  |  |  | |  |
| Excellent/Good | 23 (18.9) | 1 (Ref) |  | 0.97 |  |  | |  |
| Fair/Poor | 55 (18.7) | 1.0 | 0.58-1.70 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Education³** |  |  |  |  |  |  | |  |
| None | 11 (18.3) | 1 (Ref) |  | 0.78 |  |  | |  |
| Primary (1-8) | 52 (19.3) | 1.07 | 0.52-2.19 |  |  |  | |  |
| At least Secondary | 12 (15.8) | 0.84 | 0.34-2.05 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Time to clinic from home, hours** | |  |  |  |  |  | |  |
| >2hrs | 32 (21.2) | 1 (Ref) |  | 0.38 |  |  | |  |
| 1-2hrs | 28 (19.6) | 0.91 | 0.51-1.60 |  |  |  | |  |
| <1hr | 18 (14.8) | 0.64 | 0.34-1.21 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **Mode of transport 4** |  |  |  |  |  |  | |  |
| Walk | 46 (17.6) | 1 (Ref) |  | 0.61 |  |  | |  |
| Bicycle | 22 (22.0) | 1.32 | 0.75-2.34 |  |  |  | |  |
| Vehicle | 9 (17.7) | 1.01 | 0.46-2.21 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| **First care seeking 5** |  |  |  |  |  |  | |  |
| Formal services | 60 (17.0) | 1 (Ref) |  | 0.02 | 1 (Ref) | |  | 0.03 |
| Traditional/pharmacy/none | 18 (29.5) | 2.05 | 1.11-3.80 |  | 2.04 | 1.09-3.81 | |  |
|  |  |  |  |  |  |  | |  |
| **Turnaround time, hours:** | |  |  |  |  |  | |  |
| *Last clinic visit4,6* |  |  |  |  |  |  | |  |
| >3hrs | 52 (21.0) | 1 (Ref) |  | 0.33 |  |  | |  |
| 2-3hrs | 11 (15.3) | 0.68 | 0.33-1.38 |  |  |  | |  |
| <2hrs | 14 (15.1) | 0.67 | 0.35-1.27 |  |  |  | |  |
|  |  |  |  |  |  |  | |  |
| *Recruitment visit6* |  |  |  |  |  |  | |  |
| >3hrs | 71 (19.9) | 1 (Ref) |  | 0.31 |  |  | |  |
| 2-3hrs | 4 (11.1) | 0.50 | 0.17-1.46 |  |  |  | |  |
| <2hrs | 3 (12.5) | 0.57 | 0.17-1.98 |  |  |  | |  |
| 1Wealth measured using 1998 proxy means score | | |  |  |  |  | |  |
| 2General health was measured by self-report as excellent, good, fair or poor | | | | | |  | |  |
| 3missing for n=11 participants | |  |  |  |  |  | |  |
| 4missing for n=3 participants | |  |  |  |  |  | |  |
| 5missing for n=1 participant, 6 participants did not go anywhere | | | | | | | | |
| 6This was measured by time from home to clinic and then back home and waiting time at the clinic | | | | | | | | |
| 7Adjusted for all variables listed; N=415 | |  |  |  |  |  | |  |
| OR odds ratio; CI confidence interval | |  |  |  |  |  | |  |

Supplementary: Appendix 1

The proxy means score was estimated for each participant based on the linear regression model:

log yi 0 1 X1i 2 X2i ,..., k Xki 

where 0, 1, 2,...,k (k = 14) are coefficients provided for in the IHS 1997-98 proxy means test model. The coefficient estimates and description of each explanatory variable for the rural proxy means test model are summarized in Table S1 below. In this Table, unless stated otherwise, variables are coded as binary variables, where 0 denotes a “no” response and 1 a “yes” response.

Table S1: Rural Malawi proxy means test model using 1998 model by Payongayon et al1

|  |  |  |
| --- | --- | --- |
|  | Explanatory variable | coefficient estimates |
| 1 | Purchased sugar in the last two weeks. | 0.152 |
| 2 | Education level of household head: categorical variable on the level of educational attainment: 1 – Standards 1 to 4; 2 – Standards 5 to 8; 3 – Forms 1 or 2; 4 – Forms 3 or 4; 5 – University or higher. | 0.078 |
| 3 | Household cooks over collected firewood. | -0.174 |
| 4 | Total acreage cultivated (per acre) | 0.029 |
| 5 | Household size (per person) | -0.283 |
| 6 | Household size (per person) squared | 0.015 |
| 7 | Number of salaried household members (per person) | 0.098 |
| 8 | Household owns a bicycle | 0.153 |
| 9 | Household owns a fridge | 0.591 |
| 10 | Household grows tobacco | 0.105 |
| 11 | Household owns a bed | 0.263 |
| 12 | No. of cattle owned (per cow) | 0.013 |
| 13 | Household grows hybrid maize | 0.076 |
| 14 | Household owns a car or motor cyle | 0.693 |
| Thyolo district coeffient |  | -0.296 |
| Constant term |  | 2.826 |

From this regression model a log (proxy means test score) was estimated for each participant and converted back to the original scale using the anti-logarithm (exponential) function to give predicted proxy means test score for each study participant.

The predicted wealth scores (on the original scale) were grouped into a binary variable, poor/non- poor, based on predefined cut point using 1998 proxy means test model score. The cut-off point was based on the weighted poverty line for Malawi as a whole (as of March 1998) which was at MK10.47 per person per day, or US$0.41[[1]](#footnote-1). All participants with a predicted wealth score of ≤10.47 were classified poor and those with a score of >10.47 as non-poor.

1. Payongayon E, Benson T, Ahmed A, et al. Simple household poverty assessment models for Malawi: proxy means test from the 1997-98 Malawi Integrated Household Survey. Lilongwe: National Statistical Office of the Government of Malawi; 2006. [↑](#footnote-ref-1)