A National Study to Identify Factors Associated with Default from Tuberculosis Treatment, South Africa, 2002

Results from a case-control study in 8 provinces

Report prepared by the
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ABBREVIATIONS

CDC	**Centers for Disease Control and Prevention**
CI	**Confidence Interval**
DOT	**Direct observed therapy**
DOTS	**Direct Observed Therapy Short Course**
HCW	**Health Care Worker**
MDR	**Multi-drug-resistant**
MRC	**Medical Research Council**
OR	**Odds Ratio**

This report is based on the joint work of MRC and CDC.

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ABSTRACT

Background: In 2002, 215,120 people were registered with tuberculosis (TB) in South Africa; 13% were estimated to have defaulted from TB treatment. Non-adherence to TB treatment can lead to treatment failure or death and development of anti-TB drug resistance. **Methods:** We conducted a national retrospective case control study to identify factors associated with treatment default using TB program data from 2002 and a standardized patient questionnaire. Cases were a sample of registered TB patients that defaulted from treatment. Controls were those who began therapy and were cured, completed or failed treatment. We stratified patients by history of TB treatment (new and re-treatment patients) and constructed two respective multivariate models to identify independent risk factors associated with default. **Results:** We interviewed 926 new patients (160 cases, 766 controls) and 236 re-treatment patients (71 cases, 165 controls). Of these, 670 (58%) were male; the median age was 34 years (range 18–90 years). Significant risk factors associated with default among both new and re-treatment patients included poor health care worker attitudes and changing residence during TB treatment. Among new patients, cases were also more likely than controls to report not receiving adequate counseling about their treatment, feeling ashamed to have TB and seeking care from a traditional healer. Among re-treatment patients, additional strong risk factors associated with default included stopping TB treatment because they felt better and having a previous history of TB treatment non-adherence. **Conclusion:** New and re-treatment patients with a poor patient-provider interaction and those who change residence may be at risk for default. Some risk factors for default differed between new and re-treatment TB patients.

INTRODUCTION

In 2007, South Africa ranked 5th worldwide in terms of total number of TB cases and 2nd in terms of the highest TB incidence rates per capita. The incidence of all reported TB cases has increased almost three-fold between 2000 (344/100,000) and 2007 (948/100,000) and the incidence of reported smear positive TB cases increased from 173/100,000 to 358/100,000 respectively [1, 2]. This increase has been largely attributed to the concurrent HIV epidemic. An estimated 73% of reported TB cases in South Africa are among people living with HIV/AIDS [2]. In both 2005 and 2006, TB was the leading reported cause of death by natural causes [3].

Case detection and implementation of DOTS has increased substantially during this time frame; however, treatment success rates have remained low and default and death rates high [4]. In 2002, the treatment success rate of new smear-positive patients was 68%, with 22% of patients lost to follow up (including 13% defaulting from treatment and 8.5% transferred out or not evaluated) and 9% who had died [1]. Patients who default from treatment are at risk for clinical deterioration and complications, poor outcomes, worsening drug resistance and may continue to be infectious to others [5, 6]. The emergence of drug resistance, developing from poor adherence to anti-TB treatment, has become a serious challenge. South Africa has the highest reported number of MDR TB and XDR TB cases in the Africa region in 2007 [2]. Patients with drug resistant TB are more difficult to treat and also have poorer outcomes [7-11].

There have been several studies to assess potential barriers to adherence and risk factors for default [12-14]. Munro, et. al., conducted a systematic review of qualitative research to understand factors contributing to TB treatment adherence as perceived by patients, caregivers and health care providers. They found that eight major themes were reported including: organization of treatment and care, such as access to services and relationship between provider and patient; interpretation of illness and wellness, including patient interpretation of recovery and recognizing TB as a disease; financial burden, including conflicts between work and treatment, and

pressing financial issues competing with the need to take treatment; personal characteristics, such as substance abuse and religion, and personal motivation; side effects; family, community and household influences, including stigma, providing for family and support [13].

While several published studies have documented risk factors associated with TB treatment default in other countries, there are limited studies on the risk factors associated with TB treatment default in South Africa under DOTS. Research among specific groups of patients on adherence predictors for tuberculosis treatment is needed. South Africa is a unique setting, where the on-going challenge of a co-epidemic of TB and HIV or TB/HIV syndemic, is unparalleled and the health-service sector is increasingly overwhelmed with the burden of disease. Additionally, there are complex economic and environmental conditions including urban migration and high levels of unemployment. These conditions, combined with complex socio-cultural risk factors, may have important influences on TB treatment adherence.

In a retrospective review of district and health facility records in Hlabisa health district, Connolly et. al., identified year of diagnosis, HIV positive status, supervision by village clinic vs. community health worker and being male as risk factors associated with TB treatment interruption [15]. Kharsany, et. al., reported a high default rate (17%) among patients enrolled at a large urban clinic and identified male sex as associated with default in this cohort [16]. Holtz, et. al., found that there was high mortality among defaulters and identified the following risk factors associated with default: smoking marijuana or mandrax, an unsatisfactory opinion about the health care worker's attitude (HCW), not owning a radio, changing residence during MDR TB treatment, and any alcohol use during treatment.

In this study, we aimed to identify factors associated with TB treatment default by retrospectively identifying defaulters (cases) and patients who completed treatment (controls) under South Africa's DOTS program in 2002. We traced patients based on information available at the clinic where they were enrolled and conducted structured interviews to identify patient-level and provider-level

factors associated with TB treatment default and quantified patients' knowledge of TB.

This is the first national-level study to identify risk factors for TB treatment default. We hope that the findings of this investigation will be used to develop innovative case management approaches to ensure treatment completion among TB patients. We also hope the results will inform the National TB Program in South Africa and providers caring for TB patients to adopt effective strategies to encourage and improve TB treatment adherence.

METHODS

Setting and DOTS

The study was performed in 8 out of the 9 provinces in South Africa shown in Figure 1 below. The World Health Organization's DOTS program was first adopted in South Africa in 1998 and scaled up to cover 98% of the population in the country by 2002 [17]. Diagnosis and treatment are free of charge under DOTS and TB services have been decentralized.

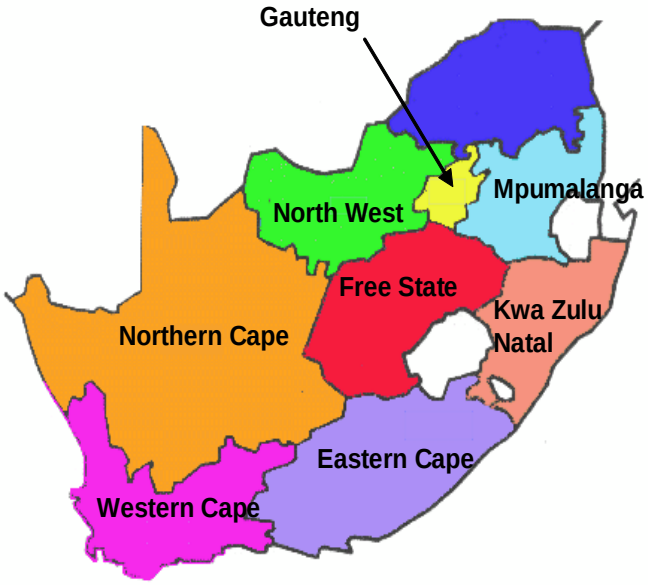

Figure 1. Eight Provinces Participating in the TB Default Study, South Africa

Population and study design

We conducted a questionnaire-based, case-control study among adult persons aged 18 years and older, diagnosed with tuberculosis and enrolled in treatment under DOTS in South Africa between January 1 2002 and December 31 2002. Cases were defined as new and re-treatment TB patients who started then defaulted from a six-month (new) or eight-month (re-treatment) TB regimen. Controls were new and re-treatment TB cases registered during the same period, who started and completed a six-month (new) or eight-month (re-treatment) TB regimen. Controls were matched to cases by quarter and health facility at a ratio of 2 controls:1 case.

As per the WHO standard criteria and the South African National TB Control Practical Guidelines, patients were classified as defaulters and eligible as cases if they had received at least 4 weeks of anti-TB treatment and interrupted TB treatment for two or more months consecutively during their treatment [18, 19]. Controls were patients who completed at least four months of the six-month regimen or six of an eight-month treatment regimen, irrespective of whether treatment was successful (cure, completion, failure). Patients were excluded if they were recorded as having died or transferred, if they were younger than 18 years, if they had multi-drug-resistant TB or if they were prisoners or wards of state. Only patients treated at government or public health facilities were included.

The sample of cases and controls were selected from facility-based national TB registers in 8 provinces and matched by quarter of enrollment and health facility. TB registers from selected health facilities in the 9th province, Limpopo, were not available, thus Limpopo was excluded from the study. Sample selection was conducted by multi-stage sampling. For each of the eight provinces, a list of information for all urban and rural clinics was compiled by the Provincial TB Program including: health facility name, urban or rural designation, the number of new patients enrolled and the number of defaulters in 2002. The number of patients to be sampled at health facilities was then selected by systematic sampling proportional to clinic enrollment size. Paper or electronic TB registers were requested from selected health

facilities and the pre-calculated number of cases was selected randomly from the TB registers. Controls matched by facility and quarter were then selected randomly at a ratio of 2 controls:1 case.

Data collection

Interviewers were hired in each province and trained to collect data from the medical records available at the health facilities and to trace, find, and interview patients for their written informed consent. All interviewers attended a 2-day interviewer skills workshop. The workshop emphasized reading the questions to the patient without extraneous prompting or suggestions. To avoid interviewer bias, the selected interviewers did not know the patients and were not associated with the local health services. Interviewers were supervised on site early in the data collection process by MRC and CDC staff ensuring prompt feedback and corrective measures as needed.

Data collected from the health facilities included demographic information, patient's address, treatment information including dates of TB registration, treatment initiation and completion and treatment outcome. Data quality and final treatment outcomes were reviewed. The interviewers compared the treatment outcome listed in the register against the information in the patient's primary treatment record and personal treatment card and made a final determination of each patient's treatment outcome as specified by the national program guidelines.

Interviewers, skilled in the official local language, used a combination of address information and information from the local staff and DOTS' supporters to trace and locate patients. Prior to administering the questionnaire, interviewers sought written informed consent from patients in their native language. Questionnaires were administered with individual patients using face-to-face interviews. Interviewers were trained to strongly encourage all defaulters, who were successfully traced, to return to the health clinic to be evaluated for TB treatment. In some cases, the patient tracing revealed that the patient had died. The outcome of death, date of death and cause, if available, was recorded. At the end of the interview, interviewed patients were

given a standard food parcel equivalent to approximately $15 for participating in the study.

Data collection tool and questionnaire

An initial questionnaire was developed in English, based on a structured questionnaire used in two previous studies [9]. Additional questions were added at the request of the South African National Tuberculosis Programme to assess the role of food and nutrition in relation to TB treatment adherence. A focus group discussion with a group of TB patients currently on treatment was used to identify key themes potentially relating food or hunger to treatment adherence, including: side effects if patients took treatment on an empty stomach; effect of treatment on appetite; access to food during TB treatment; if providing food would be an incentive for patients to complete treatment and; if lack of food was the cause of stopping treatment. The complete questionnaire was then pre-tested by two focus groups composed of staff nurses and patients under active TB treatment. Modifications were made to reflect consensus recommendations from the focus groups.

The final questionnaire was translated into 10 officially recognized South African languages (Xitsonga, Tshivenda, Siswati, Setswana, Sesotho, Sepedi, IsiZulu, IsiXhosa, IsiNdebele, and Afrikaans) and back-translated into English to evaluate and ensure the quality of translation. Questionnaires were colour coded by language. The final English version of the questionnaire is attached in Appendix A.

The questionnaire consisted of a combination of multiple choice, yes/no, and open-ended questions. Questions were asked to establish patients' demographic and social characteristics, clinical characteristics, health service and treatment experience, TB knowledge, access to food, use of traditional healers and self-reported reasons for defaulting (if applicable). The conceptual framework for treatment adherence and general question domains is illustrated below in Figure 2.

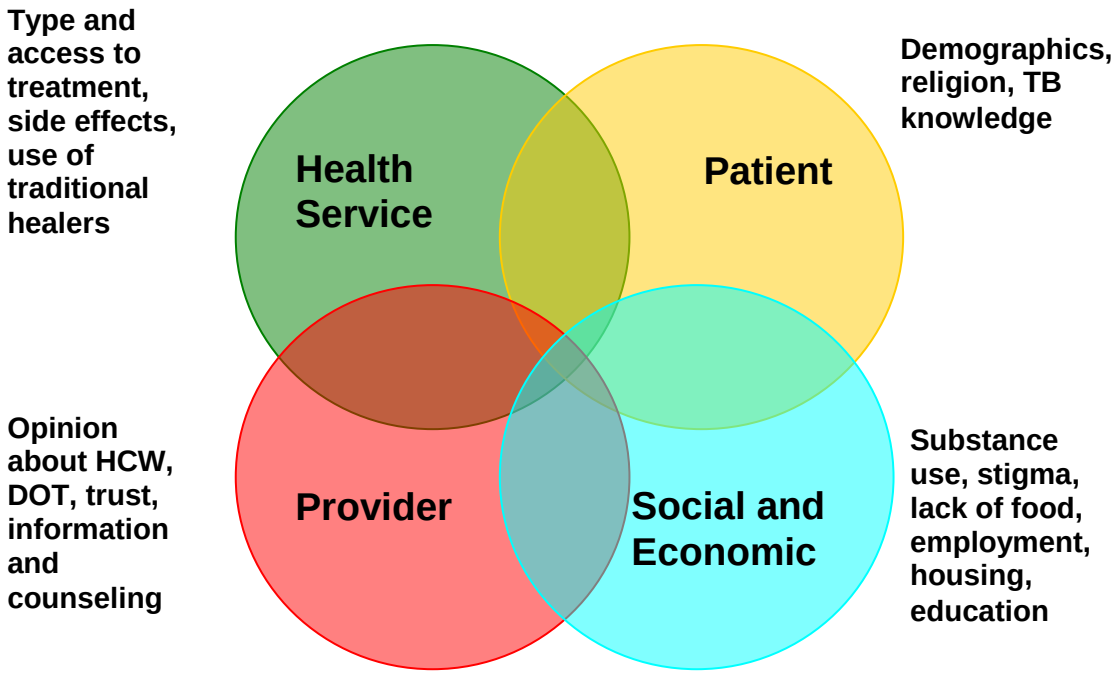

Figure 2. Conceptual Framework for Treatment Adherence and Question Domains

These domains generally cover the five dimensions commonly cited regarding adherence to long-term therapies: socio-economic factors; health care team/health system-related factors; condition-related factors; therapy-related factors and patient-related factors [17].

Sample size

The total sample size was based on an aggregate study sample calculated for each province. A previous history of TB treatment is a recognized risk factor for eventual default from TB treatment [20-22]. Based on historic program data of the proportion of patients from each province who were classified as re-treatment patients (8-27% depending on the province), we calculated a sample size large enough to show at least a 25% difference between cases and controls that would result in a statistically significant odds ratio (OR) of >2.9 with a 95% confidence interval (CI) and a power of 80% for each province. In anticipation of difficulties associated with finding defaulters, the overall sample size was inflated by 75% at the beginning of the study. Based

on these calculations, the target sample size for the 8 provinces was 1055 cases and 2110 controls. The sample size was subdivided, by province, into urban and rural sub-samples to reflect the proportion of urban and rural population living in each province (based on estimates in 2001).

Ethical approval

This study was approved by the Ethics Committee of the Medical Research Council in South Africa and as minimal risk human subjects' research by the Institutional Review Board at the US Centers for Disease Control and Prevention in Atlanta, GA, USA.

Data analysis

Data were entered into an EpiDATA v.3.1 database and analyzed with STATA 8.0 Differences in proportions were analyzed using the Mantel-Haenszel Chi-square (X2) or Fisher's exact test where appropriate. For data not normally distributed, differences in medians were compared using the Wilcoxon rank-sum test. Multivariate logistic regression analysis with forward selection was performed. All variables in the univariate analysis that were significant at $P < 0.20$ were included in the multivariate analysis for the final models. For all statistical tests, a P value of < 0.05 was considered statistically significant. All pairwise interactions of the explanatory variables that were epidemiologically relevant in the model were considered. None were found to be significant.

RESULTS

Sampling outcome

Data collection for the study began in July 2004 and ended in August 2005. Of the 3165 total patient sample size for the 8 provinces included in the study, health records were available for 3079 patients (97%) as shown in Figure 3. Interviewers anecdotally reported that at some clinics archived records had been destroyed or simply could not be located.

In reviewing individual patient treatment cards, interviewers found that a substantial number of cases and controls had outcomes that were misclassified. Of the 1029 patients originally selected as "cases" with available

records, 147 (14%) actually completed treatment and were reclassified as controls. Of the 2050 original "controls", 18 (1%) actually defaulted from treatment and were reclassified as cases.

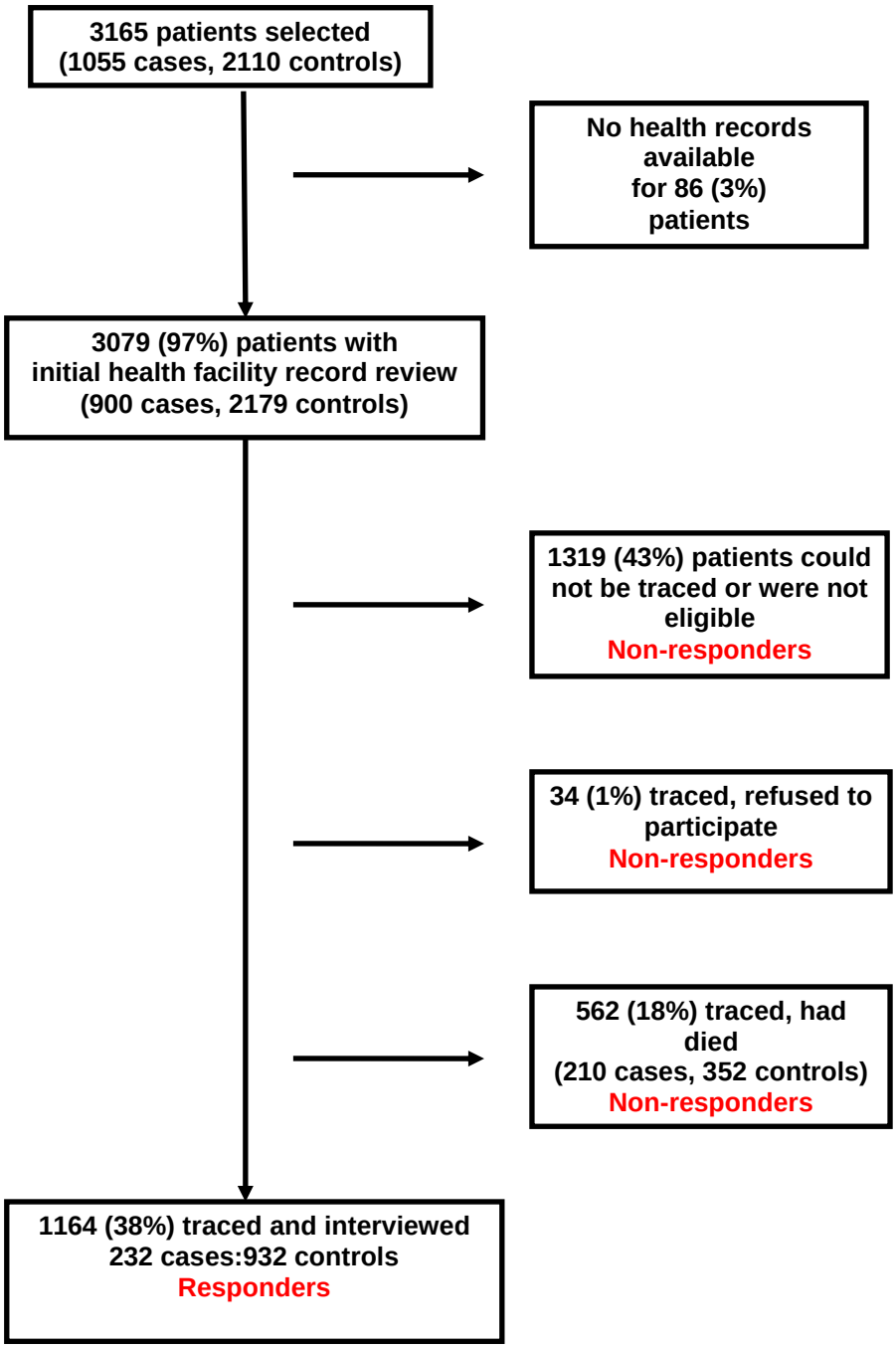

Figure 3. Response Rate

Rates of reclassification for each province are also presented in Table 1. Among the 8 provinces, 6% (Free State) to 20% (Mpumalanga) of cases were reclassified as controls and 0% (Eastern Cape, Mpumalanga) to 3% (Western Cape) of controls were reclassified as cases. Overall, 14% of patients listed as “cases” in the register were found to have been adherent to TB treatment after a review of clinic-based records. A lower proportion of control patients were found to have been misclassified and were actually defaulters (1%). Table 2 summarizes the final treatment outcomes of the patient sample after reclassification of cases and controls, as appropriate. After reclassification, a total of 900 cases and 2179 controls were traced for further investigation. Interviewers used this final classification to administer the questionnaire appropriately to living patients based on their verified outcome or reclassified outcome status.

Table 3A summarizes the patients by province. Most patients came from Gauteng, KwaZulu-Natal and Mpumalanga, as expected, based on the sampling frame provided and the sampling procedure. Table 3B illustrates the proportion of cases and controls interviewed among those initially eligible for the study. Overall, only 1164/3079 (38%) of patients that were traced could be interviewed – with a range of 24% in Gauteng province to 60% in Northern Cape and Western Cape (see Table 3B). The total number of patients interviewed was very low in Gauteng province. Interview staff in Gauteng reported difficulty in tracing patients because, in some cases, whole neighborhoods had relocated, especially in the low-income urban areas. Interviewers were more successful in locating and interviewing controls (43%: Range 29-69%) than they were in locating and interviewing cases (26%: Range 11-46%) ($P < 0.001$) as shown in Table 3B. Table 3C summarizes the ratio of the number of controls interviewed to the number of cases interviewed. The final ratio of controls to cases was 5:1 vs. the original sample selection of 2:1, reflecting the difficulty in locating defaulters.

Response rate

Among the 3079 patients with clinic records, 1164, including 232 cases and 932 controls, were successfully found and consented to be interviewed. Table

4 shows the results of interviewer efforts to attempt to trace, locate and request interviews of all 3079 patients. A large proportion of patients were found to have died, including 210 (38%) cases and 352 (16%) controls (P < 0.001). Few patients refused to be interviewed (34 patients, 1%). An additional 1109 (36%) patients could not be contacted or found or were not eligible, and were not interviewed. Among these, the majority or 216 cases and 398 controls could not be contacted because they moved and/or had an unknown address. Also, 5 patients were found to be <18 years old and were excluded from the interviews. Table 4 also shows the response rate stratified by province. In spite of interviewers' attempts to find patients, the proportion of patients that were not contacted varied from 20% in Northern Cape (24% of cases and 16% of controls) up to 59% in Gauteng (64% of cases and 54% of controls).

Mortality

Among patients with records at the health facility who were traced, we found that 210/900 cases (23%) and 352/2179 controls (16%) were reported to have died. Table 5A summarizes the cause of death among patients who were reported to have died. Among those patients who died, the cause of death was reported for 115 (55%) cases and 177 (52%) controls. The most common cause of death reported was pulmonary TB or a TB-related cause, both among cases and among controls, with a higher proportion of TB deaths among cases than controls (P < 0.001).

Among the 210 cases who were reported to have died, the date of death was known for 115 (55%). Of these, 33 (22%) were reported to have died within 2 months after stopping TB treatment (Table 5). These patients were probably misclassified as defaulters, and were in fact “actual deaths.” The 95 (63%) patients that died more than 2 months after defaulting can be classified as “actual defaulters.” The median length of time to death after the last recorded visit was 7 months, with a range of 0.2-43 months.

Comparing responders and non-responders

We were able to collect minimal data on those patients who refused to be interviewed, had died, or whom we otherwise could not find because of unsuccessful tracing attempts. Tables 6A and 6B compare basic demographic data between the persons interviewed (responders) and not interviewed (non-responders) stratified by case/control status. Among these cases, and compared to non-responders, responders were younger, more likely to be enrolled for treatment at a rural clinic, to be a re-treatment patient, to have extra-pulmonary TB and to default from treatment later in the treatment course (after the first two months). The type of facility where treatment was initiated was similar for responder and non-responder cases.

Table 6B shows that among controls and compared to non-responders, responders were more likely to be enrolled for treatment at a rural clinic, less likely to be admitted for TB treatment and more likely to be a re-treatment patient. The median age and sex of the patients and type of tuberculosis was similar between responder and non-responder controls.

Patients who were reported to have died, could not be contacted or refused to be interviewed were excluded from further analysis.

Results of interviews: comparing responses from cases and controls

Tables 7-29 summarize the main results from the health facility record review and interviews with 1164 patients (232 cases and 932 controls) who were successfully traced and consented to participate.

Demographic and socioeconomic characteristics among interviewed patients

Table 7A summarizes the age distribution of cases and controls stratified by sex. Overall, the median age among cases was younger at 31 years (range 18-87) compared to that among controls, 35 years (range 18-90) (P = 0.007). When stratified by sex, cases were significantly younger compared to controls both among men and among women. Table 7B shows the age distribution and sex stratified by patient category and new and re-treatment patients. Among both new and re-treatment patients, cases were more likely to be male and the median age of cases was younger than controls.

Table 8 indicates most patients were male (66% of cases and 55% of controls), born in South Africa (99% of cases and 98% controls), were single (68% of cases and 65% of controls), black African (81% of cases and 85% of controls), reported practicing religion (91% of cases and 91% of controls), and had one or more children (77% of cases and 81% of controls). Roughly half had a secondary school education or higher (53% of cases and 55% of controls). Living arrangements were similar between cases. Being male was significantly associated with TB treatment default (UOR 1.6, 95% CI: 1.2-2.2).

Table 9A summarizes socioeconomic characteristics that were assessed. Cases and controls were similar in terms of employment, owning material goods and income. A significantly greater proportion of cases than controls reported having missed treatment due to employment difficulties (UOR 16, 95% CI: 9.1-31). When stratified by type of patient, this was especially true among new TB patients (UOR 18.3, 95% CI: 9.6-40) vs. re-treatment patients (UOR 10.2, 95% CI: 2.8-45). Among employed patients, cases were 1.6 times more likely than controls to be employed as laborers than other professions (95% CI: 1.0-2.6). The most frequently reported reasons for missing treatment because of employment difficulties among both cases and controls was: (1) too busy/not enough time to leave work and (2) work was too far from the TB clinic (Table 9B).

TB treatment characteristics

Cases and controls were similar in terms of type and location of facility they attended for treatment. However, cases were less likely than controls to be new patients (UOR 0.5, 95% CI: 0.3-0.7) and more likely to have a previous self-reported history of TB treatment default (UOR 6.9, 95% CI: 3.9-12.0) as shown in Table 10. Cases and controls were also similar in terms of previous history of treatment failure and pulmonary/extra-pulmonary disease.

Mobility of respondents

Table 11 shows mobility characteristics of the respondents. Cases and controls were similar in the number of times they changed residence in the year before starting TB treatment (16% of cases and 12% of controls). However, a higher proportion of cases (16%) reported changing residence during TB treatment than controls (7%) (UOR 2.8, 95% CI: 1.8-4.4). Among patients that had moved, cases were more likely than controls to have missed treatment due to changing residence (UOR 11.5, 95% CI: 3.8-36).

Social characteristics - alcohol, drug use, and prison history

Reporting any alcohol use during treatment (UOR 1.9, 95% CI: 1.3-2.6) and reporting having missed TB treatment due to alcohol use (UOR 4.1, 95% CI: 2.0-8.4) were both significantly associated with treatment default on univariate analysis (see Table 12). Among those who used alcohol, more cases (68%) reported heavy alcohol drinking (3 or more drinks in 1 day) than controls (41%) although the difference was not statistically significant. Only a small proportion of patients, both among cases (6%) and controls, (4%) reported smoking marijuana or mandrax during treatment in this subgroup. Cases were more likely than controls to have missed treatment due to smoking (UOR 5.3, 95% CI: 1.1-25.7). A small proportion of patients reported spending time in prison during treatment (6% among controls and 4% among controls) and there was no significant association to TB treatment non-adherence.

Personal experience with TB treatment

As shown in Table 13, the majority of cases (93%) and controls (95%) interviewed had told someone about their TB diagnosis; however, cases were

more likely than controls to feel ashamed about having TB (UOR 2.3, 95% CI: 1.7-3.1) and more likely to feel ignored or neglected because they had TB (UOR 1.4, 95% CI: 1.0-2.0). Cases were less likely than controls to feel supported by family during treatment (UOR 0.5, 95% CI: 0.3-0.7) and more likely to feel they did not have enough support in general during treatment (UOR 2.3, 95% CI: 1.5-3.5). However, a similar proportion of cases (72%) and controls (74%) reported having received support from persons other than health care workers. Only a few patients felt others had influenced them to stop treatment (3% of cases and 1% of controls).

The role of food and nutrition during TB treatment

Approximately half of cases (52%) and controls (48%) reported depending on others for food and shelter during TB treatment (see Table 14). A similar proportion of cases (22%) and controls (19%) reported receiving food from the clinic while on treatment. Cases were more likely than controls to have spent a day without food during treatment (UOR 1.5, 95% CI: 1.0-2.2); 34% of cases and 28% of controls reported not having enough food to eat during treatment. Over half of the cases (56%) and controls (56%) reported being provided with food to support TB treatment. A high proportion of cases (86%) and controls (80%) agreed that food from the nurses at the clinic would help them to finish their TB treatment and cases were significantly more likely to report agreement (UOR 1.5, 95% CI: 1.0-2.4) with this statement. In addition, cases were more likely than controls to report having to take TB treatment on an empty stomach (UOR 1.6, 95% CI: 1.2-2.3). Of these, many reported side effects (75% of cases and 50% of controls) and cases were more likely to report side effects than controls (UOR 3.1, 95% CI: 1.6-5.9). The majority of cases (85%) and controls (89%) reported that their appetite increased on TB treatment and, among these respondents, cases were more likely to report not having enough food to satisfy their hunger than controls (UOR 1.6, 95% CI: 1.0-2.6). Very few patients among cases and controls reported being denied food or shelter because of having TB.

Use of traditional healers

Table 15 summarizes patients' responses regarding use of traditional healers. Cases (17%) were more likely than controls (7%) to report consulting a traditional healer during TB treatment (UOR 2.8, 95% CI: 1.7-4.3). The median number of traditional healers consulted was 1 (Range, 1-4). Over half of cases (65%) and controls (52%) reported being given treatment by a traditional healer, but this was not significantly different between groups. Cases and controls were also similar in reporting type of traditional medicine/treatment given (purgatives, emetics and other treatments) and less than half (32% of cases and 41% of controls) reported taking the traditional healer's treatment at the same time as TB treatment. A small minority of these patients reported that the traditional healer asked them to stop treatment or they missed TB treatment because of the traditional healer and the proportions were similar between cases and controls. When asked which treatment helped them the most, cases most frequently reported both traditional medicine and standard TB treatment, whereas controls most frequently reported that the standard TB treatment helped most.

Health service characteristics

Cases and control groups both reported a median length of time of 30 days (Range: 0-739 for cases and 0-180 for controls) from when they first felt ill to when they were seen by a doctor (see Table 16). Both groups reported attending a median number of one clinic for their treatment. The majority of cases (65%) and controls (67%) travelled to the health facility on foot and travel time was similar between groups. Approximately 25% of both cases and controls reported being admitted to the hospital for treatment with similar durations of hospital stay.

The waiting time at the clinic reported by patients was similar for cases and controls; 11% of cases and 10% of controls reported having to wait more than one hour for services. Cases were more likely to report that clinic hours were not convenient than controls (UOR 3.2, 95% CI: 2.1-5.0).

DOT and support

Half of cases and controls reported taking treatment without direct supervision despite the fact that they were all enrolled in DOTS (Table 16). Of these, most patients said they were given pills to take alone (98% of cases and 98% of controls). These patients reported most frequently that HCWs gave them pills to take without direct supervision because the HCWs "trusted them" (63% of cases and 76% of controls).

Opinions about health services and health staff

Cases and controls reported marked differences in opinions about experiences with health services and the health staff during their TB treatment (see Table 18). Cases were more likely than controls to report an unsatisfactory opinion about the HCW's attitude (UOR 3.6, 95% CI: 2.1-6.3) and significantly less likely to feel treated with respect. Cases were more likely to report missing treatment because of the HCW attitude (UOR 5.4, 95% CI: 2.8-10.5). Although the reported patients' level of trust of HCWs and the clinics and hospitals was over 90% among cases and controls, a significantly larger proportion of cases reported that they did not trust the HCW (UOR 3.3, 95% CI: 1.5-7.2) and the hospital/clinic (UOR 3.7, 95% CI: 1.9-7.3). Cases were also more likely than controls to report that they did not feel the treatment was working (UOR 13.3, 95% CI: 7.5-24). Even so, the majority of cases (79%) and controls (79%) reported that they thought they would finish taking treatment.

Knowledge of TB

Several questions were asked to ascertain patients' knowledge of TB and TB treatment (see Table 19). Over three-quarters of the patients (75% of cases and 84% of controls) reported that they knew TB treatment took at least 6 months, yet cases were 1.7 times more likely to state they did not know this fact than controls (OR 1.7, 95% CI: 1.2-2.5). Cases were also 1.7 times more likely than controls to report not being told why they had to take medicine for so long (95% CI: 1.2-2.5). Cases (36%) were also more likely than controls (22%) to have not received educational information about TB from the health care worker (OR 1.9, 95% CI: 1.4-27). Among the 140 cases and 706 controls

that did receive health care information and reported on the quality of the information, cases were 18 times (95% CI: 4.5-102) more likely than controls to say the information they were given was not useful, and 3.4 times (95% CI: 2.0-5.9) more likely to say they did not receive enough information. Only 4% of cases and 1% of controls felt that it was not possible to cure TB (UOR 3.0, 95% CI: 1.1-8.0). Similar proportions of cases (63%) and controls (69%) felt they might die from TB.

Table 20 lists the causes of TB as reported by cases and controls interviewed. The most common responses were “bad air”, “germs”, “being near other people with TB”, and “smoking and/or drinking”. A significantly higher proportion of cases than controls reported that they thought witchcraft was a cause of TB (21% vs. 12%, UOR 1.9, 95% CI: 1.3-2.9). Having “HIV/AIDS” was reported as a cause of TB by 7.3% of cases and 5% of controls. A small minority of patients, less than 3% of cases and controls, reported other causes of TB, such as: “ancestor spirits”, “dirt/dust”, “cold weather”, “poor nutrition”, and “poverty” (see Table 20).

Self-reported side effects

Cases (57%) were more likely than controls (45%) to report ever having side effects during TB treatment (UOR 1.6, 95% CI: 1.1-2.2) as shown in Table 20. Among those reporting side effects, similar proportions of cases (66%) and controls (76%) talked to a HCW about their side effects and about half took medicine to feel better (50% of cases and 47% of controls reporting side effects). Cases were more likely than controls to talk to a traditional healer about side effects (UOR 2.9, 95% CI: 1.4-6.1). Although a small proportion of patients reported taking traditional medicine (14% of cases and 2% of controls), cases were 8.4 times more likely to take traditional medicine for side effects than controls (95% CI: 2.9-27). Cases (30%) were 37 times more likely than controls (1%) to stop treatment due to side effects (UOR 37, 95% CI: 12-146).

The most commonly reported side effects are listed in Table 22. The five most common side effects among both cases and controls were: nausea, vomiting,

abdominal pain, headache, and dizziness. Cases were 2.2 times more likely to report abdominal pain and 2.1 times more likely to report headache as a common side effect than controls (95% CI: 1.4-3.6 and 1.3-3.6, respectively). Otherwise, the types of side effects reported by both cases and controls were similar.

When patients were asked “What was the worst side effect you experienced?”, the most frequently reported side effects among cases were: nausea (24%), vomiting (14%), abdominal pain (14%) and headache (11%). Among controls the most frequently reported side effects were: nausea (29%), vomiting (11%), painful buttocks (10%) and skin rashes (9%).

Multivariate analysis

Adjusting for age and sex, variables that were positively and independently associated with being a case patient (defaulter) were reported as not feeling better with TB treatment (Adjusted Odds Ratio [AOR] 10.8, 95% CI: 5.9-20), having a previous history of TB treatment (AOR 1.8, 95% CI: 1.2-2.7), changing residence during TB treatment (AOR 2.2, 95% CI: 1.3-3.7), seeing a traditional healer during TB treatment (AOR 2.0, 95% CI: 1.2-3.5), using any alcohol during TB treatment (AOR 1.7, 95% CI: 1.1-2.5), not receiving counseling or information about TB treatment (AOR 1.6, 95% CI: 1.1-2.4), and having an unsatisfactory opinion about HCW attitudes (AOR 2.9, 95% CI: 1.5-5.5). Family support while taking TB treatment was protective (AOR 0.6, 95%: CI 0.4-0.9). (Table 23).

Analysis of factors associated with default stratified by patient category: new and re-treatment patients

We explored factors associated with default, stratified by new and retreatment patients. We felt that these subpopulations would reveal important differences. Table 24 summarizes the significant variables on univariate analysis stratified by new and re-treatment patient category. Stratifying these data revealed that risk factors for default differed between new and retreatment patients as shown by the different stratum specific odds ratios for the variables listed in Table 24.

Using this information, two multivariate models were created: one for new patients and one for re-treatment patients. Table 25 summarizes these data. Two risk factors were independently associated with both new and re-treatment patients: poor HCW attitude (among new patients: AOR 2.1, 95% CI: 1.1-1.4; among re-treatment patients: AOR 12, 95% CI: 2.2-66) and changing residence during TB treatment (among new patients: AOR 2.0, 95% CI: 1.1-3.7; among re-treatment patients: AOR 3.4, 95% CI: 1.1-9.9). Among new patients additional important risk factors were: not receiving adequate counseling or information during TB treatment (AOR 1.9, 95% CI: 1.2-2.8), having no formal education (AOR 2.3, 95% CI: 1.2-4.2), drinking any alcohol during TB treatment (AOR 1.9, 95% CI: 1.2-3.0), feeling ashamed to have TB (AOR 2.0, 95% CI: 1.3-3.0) and seeing a traditional healer during TB treatment (AOR 1.9, 95% CI: 1.1-3.4). Among re-treatment patients additional important risk factors were: a history of previous TB treatment default (AOR 6.4, 95% CI: 2.9-14), not feeling better with TB treatment (AOR 21, 95% CI: 5.2-84) and agreeing that, if food was by provided, adherence to treatment would have been better (AOR 5.0, 95% CI: 1.3-19).

Questions for defaulters only: new and re-treatment patients

Self-reported attitudes about default among defaulters

There were 160 new TB patients that defaulted from treatment and 71 re-treatment patients that defaulted from treatment (one defaulter had an unknown patient category). Among the 160 new TB patients, 82 (51%) defaulted during the early continuation phase (months 3-4 of treatment), 42 (26%) defaulted within the first 2 months, and 25 (16%) during the late continuation phase (months 5-6/8). Among the re-treatment patients, 33 (46%) defaulted during the early continuation phase, 21 (30%) during the intensive phase, and 15 (21%) during the late continuation phase. Defaulters were asked several specific questions about factors that may have influenced them to stop treatment as summarized in Table 26. Among new defaulters, 30 (19%) reported that side effects experienced during treatment influenced them to stop TB treatment and 24 (15%) reported that not knowing enough about TB had a role stopping TB treatment. Among re-treatment defaulters, 26 (36%) reported not knowing enough about TB influenced them to stopping TB

treatment, 19 (27%) said side effects influenced them to stop treatment. Only 4% of new defaulters and 9% of re-treatment defaulters agreed that other people influenced them to stop treatment.

Self-reported reasons for defaulting treatment

When asked the open ended question “What made you stop taking your TB treatment?”, the top three most commonly reported reasons cited by new defaulters were because they: “felt better”, “the pills gave me side effects”, and “did not have time/were too busy”. Top reasons cited by re-treatment defaulters were they: “felt better”, “the pills gave me side effects” and “did not like taking pills every day”. Patients who cited multiple reasons were asked to specify the most important reason for stopping TB treatment, both new and re-treatment defaulters reported because they “felt better” and that they “didn’t want to lose my job” most frequently (see Table 28).

DISCUSSION

Data quality

In our study, we found the quality of the classification of TB treatment outcome in the original registers to be weak when comparing these data with information available from patient treatment cards and records at health facilities. Among patients whose records at the health facility could be reviewed, 165 (15%) had treatment outcomes reclassified. Achieving and maintaining high data reporting quality is a common challenge for TB programs and requires careful training, on-going supervision and vigilance [21-28]. Other reports highlight the weakness of the recording and reporting system in South Africa [1, 16]. In 2002, the South African National Tuberculosis Control Programme was also in the process of changing from paper-based TB registers to electronic TB registers and this change may have adversely affected the quality of data collected and reported from the TB registers. Even so, the potential benefit of an electronic surveillance system depends heavily on the accuracy of the data entered into it from a reliable, high quality paper-based registry system [29].

Response rate and mortality

Of the 3079 patients whose medical records were sought at the health facilities, 252 (8%) had no records available for review. Study staff reported that, in some instances, clinics destroyed archived patient records greater than 1-2 years old. Only 25% of cases and 43% of controls could be contacted and consented to participate. Other retrospective case control studies have reported similar difficulties in locating patients after they have left care at the TB program, especially defaulters [9, 30-32]. In our study, the majority of non-responders attended urban clinics. Reports from study staff revealed that in urban areas addresses were particularly difficult to find and in some cases whole neighborhoods of informal settlements had moved. This was particularly true in Gauteng province. In a study involving tracing initial defaulting patients from urban clinics in Cape Town, 45% of patients could not be traced because of incomplete address information [33]. A surprisingly large proportion of cases were found to actually have been adherent to treatment or to have died and were reclassified for the analysis. This type of misclassification error has been found in other studies where patients have been traced after leaving the TB program [28].

TB is the most common cause of death among HIV-positive adults living in less-developed countries. Although we do not know how many of the patients in this study were HIV-infected, the estimated prevalence of HIV among TB patients in 2002 in South Africa was 60%. In 2002, HIV testing of TB patients was not widely implemented or recorded and access to HIV care and Ante-retroviral Therapy (ART) was limited. Therefore, HIV-associated TB deaths are likely to have contributed to the high mortality seen among cases (23%) and controls (13%). Based on interview investigations, cases were 1.6 times more likely to have died than controls (UOR 1.6, 95% CI: 1.3-1.9). This finding is consistent with several studies tracing patients who have defaulted from TB treatment and have shown a large proportion were found to have died [32, 34]. Patients may also die of TB after completing treatment if they relapse without receiving additional TB treatment or if they die from TB sequelae which is common among patients co-infected with HIV [35]. Data from our study are consistent with this finding, among patients who were reported to

have died, the leading cause of death was reported as TB-related in 42/210 (42%) of cases and 102/352 (28%) of controls.

Patient and socioeconomic factors

Among demographic characteristics collected, only being male, on univariate analysis was significantly associated with treatment default. Other demographic factors were not found to be associated with default both in univariate analysis as well as the combined multivariate model and stratified models. Demographic factors were not typically modifiable risk factors for TB treatment outcomes; however, male sex has been reported to be associated with default in other studies [12, 16, 22, 31, 36].

Surrogates of wealth included in the questionnaire were not associated with TB treatment default whereas this has been reported in other studies [37]. Unemployment has also been reported as a risk factor for default in other settings [6, 12, 16, 27, 38, 39]. While this association with default was not evident in our study, unemployment was remarkably common among our patients (47% of cases and 52% of controls). Importantly, in the subgroup of employed patients, default was associated with patients missing treatment due to employment. Reasons cited by patients included that they were too busy and did not have enough time, work was too far from the TB clinic, the employer did not allow them to get TB treatment, and some did not want other co-workers to know they had TB. When defaulters were asked about the most important reason for stopping TB treatment, the second most frequently cited cause was that they “didn’t want to lose their job”. Similar findings have been reported in other studies [12, 13]. Among employed patients, cases were also more likely to be laborers than controls. Pinidiyapathirage et. al., also found that being a skilled or unskilled laborer was associated with default among TB patients treated in an urban setting in Sri Lanka [20]. It is possible that these patients did not have a regular income unless they were working and may have had difficulties in balancing the competing priorities of working and attending to their health care. Comprehensive TB treatment programs that have tailored TB treatment to be flexible and accommodate patients’ lifestyles have been shown to be successful in improving TB treatment adherence [12,

40]. Public-private partnerships have successfully implemented DOTS in the workplace. This has been shown to be cost effective, can reduce the direct cost to the TB patient and can facilitate access to quality care [41-44]. Sinanovic et. al., evaluated different types of public-private partnerships in TB control in South Africa including two public-private workplace (PPW) projects. This evaluation showed that the PPW sites were of high quality and had excellent results in TB treatment outcomes of patients with a low default rate [45]. It may be possible to expand successful models of public-private partnership in the work place to engage employers in partnerships with patients and to reduce TB treatment default.

A large proportion of patients could not be contacted because they either moved from their address or were not known at the address listed in health facility records. In the stratified multivariate analysis, changing residence during TB treatment was found to be associated with TB treatment default both among new and re-treatment patients. Among the patients who reported moving, defaulters were more likely to report having missed treatment than controls because of changing residence. Ensuring continuity of TB services among patients who are mobile is challenging. These data emphasize the need to educate patients about the ability to transfer care and requires programs to closely follow-up and effectively refer patients to alternate DOTS treatment sites when needed. Holtz, et. al., previously reported that changing residence was independently associated with MDR TB treatment default among MDR TB patients in South Africa. The association between migration and default has also been cited in other settings [23, 46]. Although we did not specifically ask about homelessness, this has been reported frequently from other studies to be associated with TB treatment non-adherence [6, 12, 47] and housing issues may have contributed to the need to change residence during TB treatment.

Alcohol use was found to be associated with default among new TB patients. Several studies have reported alcohol use or alcohol abuse to be a risk factor for default [5, 22, 23, 27, 48]. While it can be challenging for patients to change this behavior, there have been recent reports of success in using

behavior interventions in primary care settings to reduce patient alcohol use [49, 50]. Of note, very few patients reported using marijuana or mandrax use and this was not associated with default although this has been identified as a risk factor for default among patients treated for MDR TB in South Africa [9].

Among new patients, defaulters were twice as likely as controls to report feeling ashamed or embarrassed about having TB. This has been reported in another study of treatment adherence in the Hablisa district in KwaZulu-Natal [15]. Additional qualitative studies among patients and providers have identified TB stigma as a likely barrier to adherence and highlights that stigma has an important negative role in patient adherence to treatment [51-53]. It is likely that the problem of stigma is compounded when a patient has both TB and HIV, which is common in South Africa [54].

Almost all patients told someone that they had TB. The majority reported having enough support and these findings were similar between cases and controls. Successful interventions such as community education and integrating community involvement in TB control may help to reduce social barriers to TB treatment and stigma [14]. One example of this is the creation of “TB clubs” in Ethiopia which have helped to decrease TB stigma and improve treatment outcomes [14, 54].

Treatment, health service and provider-related factors

Cases and controls were similar in terms of data collected from clinic records including the type of health facilities and TB patient characteristics, such as: where they were treated, if admitted for TB treatment or not and if treatment took place at a clinic in an urban or rural setting. In the stratified multivariate analysis, re-treatment cases were 6.4 times more likely to have a history of TB treatment default than re-treatment controls. Other studies have reported that a previous history of TB treatment and/or a previous history of treatment default are risk factors associated with subsequent default and other poor outcomes [20, 23, 32, 36, 55, 56]. This underscores the urgent need for both preventing first-time defaulters and identifying patients with a history of default as being at high risk for poor outcomes.

The majority of defaulters stopped treatment in months 3-4 of the continuation phase (early continuation phase). This is consistent with findings from a recent literature review of default timing during TB treatment and also described in a recent study among HIV-infected TB patients in Thailand [37, 57]. As patients move from the intensive phase to the continuation phase they may feel better, have less frequent treatment supervision, and thus may be less motivated to continue anti-TB treatment. Notably, a substantial proportion (27% of patients interviewed and 38% of patients that could not be interviewed), defaulted during the intensive phase. Among defaulters that were reported to have died, 83/178 (47%) defaulted during the first two months of treatment. It is possible that the risk factors and reasons for default are different during different stages of treatment.

In terms of access to health services and health facilities, cases and controls reported similar experiences, with the exception of cases being more likely than controls to perceive clinic hours to be inconvenient (univariate analysis only). In contrast, other studies have identified these issues as associated with poor treatment adherence, especially traveling to the clinic in terms of cost, the clinic being too far, or it taking too much time to reach the clinic [31, 38, 58].

Several questions regarding food and nutrition and patients' experience during treatment were asked and responses were similar for cases and controls. About half of the patients were dependent on others for food and shelter, the majority of patients spent at least 1 day or more without food and approximately one third reported lacking enough food to eat while undergoing treatment, highlighting the vulnerability of this patient population. Among re-treatment patients, cases were 5 times more likely than controls to agree that food from the nurse would help them finish TB treatment. Food could be used as an important incentive for TB treatment adherence. Social support programs, including food packets or hot meals and food coupons, have been reported to reduce the likelihood of default in other settings [12, 39, 59].

It is concerning that half of all patients reported that they were not supervised when they took their TB treatment. Even though the majority of cases and controls believed that they were given pills for self-administration because the health worker trusted them, health workers have historically been poor judges at predicting which patients will or will not be adherent to treatment [12]. WHO estimated DOTS population coverage in South Africa was 98% in 2002, but this does not estimate what proportion of patients was engaged in effective facility/clinic or community based DOT [1]. Implementation of TB services has been a challenge in South Africa [60]. Ntshanga, et. al., recently conducted an evaluation of the DOTS program in crisis districts in KwaZulu-Natal and showed poor implementation of DOT where low coverage, low quality and high caseloads were associated with poorer outcomes [26]. There is increasing evidence that decentralizing DOT, adopting patient-centered approaches and improving community participation, including training and recruitment and involvement of community-based workers or lay health workers, is effective at improving adherence. Clarke, et. al., designed a randomized controlled trial among farms in the Western Cape Province with the intervention establishing a lay health worker (LHW) DOT program on farms including: choice of DOT, selection of the LHW from the community, providing incentives, training, and regularly supervising and supporting them. These authors found that that this intervention significantly improved treatment completion among new smear positive patients (but not among a small subset of re-treatment patients) [61].

When asked their opinions about health service and staff, both among new and re-treatment patients, defaulters were more likely to express a negative opinion about health worker attitudes than controls. This was also a significant association found in an MDR TB treatment case control default study in South Africa using similar methodology [9]. The importance of the relationship between the health worker and the patient in enhancing adherence to treatment is well established. Although few studies have reported specifically on patients' satisfaction with health worker attitudes [62] and risk of default, some studies have reported communication barriers or poor communication between patients and providers as being linked to adherence [30, 31].

Perception of this communication may reflect the status of the patient provider relationship and influence patient behavior [63].

Although only a minority of patients reported seeing a traditional healer during TB treatment, this was associated with default among new patients. The use of traditional healers is common in South Africa. Several reports have described how seeking care from traditional healers can delay prompt diagnosis and treatment for TB and can negatively influence morbidity and mortality from TB [64-66]. Some TB case-finding and treatment models have successfully partnered with traditional healers to implement community-based DOTS with good outcomes [67, 68]. Every effort should be made to expand these successful projects, educate and collaborate with traditional healers and involve them in TB control.

Among new patients, cases were significantly more likely to report they were not given adequate counseling or information about TB. Although other questions were asked regarding type and level of knowledge of TB treatment and access to information, cases and controls were similar in their responses. Reported causes of TB were common between groups and some misconceptions included “witchcraft” and “taboo”. A smaller number reported “dirt or dust” and “cold weather”. Other studies have reported associations between TB treatment default and a poor level of understanding/knowledge of TB or low patient satisfaction regarding information provided concerning their illness [31, 47]. In our study, importantly, not having a formal education was also independently associated with default among new patients. This also may compound the problem if patient education materials and methods are not appropriately tailored to a non-literate audience.

Lessons learned from successful intervention trials

Although there are limited rigorous studies of effective single interventions to promote adherence to TB treatment there are intervention studies that have looked at more comprehensive approaches. Before DOTS was widely adopted in South Africa, Dick, et. al., designed a quasi-experimental combined educational and behavioral health education strategy to improve

adherence which included: (1) training clinic nurses in communication skills, emphasizing patient-centered approaches and (2) developing and distributing a tested photo novel including TB treatment information, motivational elements and self-monitoring tools. Two clinics in comparable settings were selected and the intervention implemented in one. Adherence rates to TB treatment were improved at the intervention clinic [69]. In a review of the literature published in 2000 on adherence and DOT, Volmink, et. al., surmised that in addition to the core elements of DOTS (including the element of DOT) there were other key factors that influence a program's success at improving adherence, including: social assistance and incentives; close follow-up and tracing non-adherent patients before they default; patient-centered approaches; enhanced financial and human resources and good program management and supervision [70}.

Recent studies implementing comprehensive patient-centered models in DOTS program settings have been reported to improve adherence. Thiam, et. al., conducted a cluster randomized control trial in Senegal among new smear positive TB patients and showed that a comprehensive intervention including: (1) training to improve communication and counseling between health care staff and patients, (2) decentralization of treatment by involving community health workers, (3) providing flexibility in choice of DOT supporter, and (4) reinforcing supervision activities in remote areas, improved patient adherence.

South Africa faces an advanced TB/HIV syndemic. Integrating TB and HIV care effectively is essential to improve both overall TB treatment outcomes. Ghandi, et. al., recently reported both good TB treatment outcomes and good ARV treatment outcomes when implementing an enhanced, integrated TB and HIV treatment program in KwaZulu-Natal [71]. Key elements of this program were: providing substantial human and material resources to the local TB program reinforcing community-based DOTS; comprehensive adherence education for patients, their DOT supporter and a chosen family member; adverse reaction monitoring and close follow-up. DOT of both anti-TB medication and ARVs was conducted in the patient's home. Lessons learned

from this program should be scaled up elsewhere to ensure good treatment outcomes for both TB and HIV.

CONCLUSIONS

In this first national-level study in South Africa to identify risk factors associated with default among TB patients, a large proportion of patients were found to have died after leaving the TB program. This has been reported in other settings, and is likely to be exacerbated by the on-going TB/HIV syndemic in South Africa. New and re-treatment patients with a poor patient-provider interaction and those who change residence may be at risk for default. Additional key risk factors for default differed between new and re-treatment TB patients. Among re-treatment patients, important risk factors included a patient perception that their TB treatment was not working and having a previous history of TB treatment non-adherence.

Standard 9 of the International Standards of Tuberculosis Care includes creating a treatment environment to promote adherence and monitoring results using a patient centered approach and fostering respect between the patient and provider [72]. There are now several small scale models incorporating patient-centered approaches showing success at achieving good TB treatment outcomes in local settings in South Africa and other countries.

Adequate resources, good program management and supervision and ongoing evaluation are urgently needed to ensure successful scale up and sustainability of these programs. While South Africa faces challenges of an overburdened health system amidst the escalating TB/HIV syndemic, the country has made policy changes and has begun implementing innovative ways to reduce staff shortages, improve staff motivation, and develop new approaches to clinical practice and education [73]. These promising changes provide a fertile ground on which to institute and sustain effective interventions to improve TB treatment adherence.

LIMITATIONS

There were several limitations of this study. The low response rate limits power to draw generalized conclusions. The retrospective nature of the study and self-reported data collected from the patients is subject to recall bias which may reduce the risk estimate. There is an unknown temporal association between the risk factors identified and treatment default. This limits our ability to potentially identify time-points in case management at which different risk factors for non-adherence are more important and where specific types of adherence strategies may have an increased impact. The provider perspective (health care workers and treatment supporters) on default and non-adherence was not included in this study. We collected limited data on health services limiting our ability to assess facility-level factors potentially related to default [26]. HIV data was not collected and not available and may have been a risk factor for non-adherence [15]. Patients with a treatment outcome in the registers reported as “not evaluated” (patients with insufficient program information to determine an outcome) were excluded so additional defaulters may be among this group that were excluded from the sampling frame. Even so, this is the largest study of TB treatment default representing 8 out of 9 provinces in South Africa. The case-control nature of this analytic observational study allowed us to explore several potential factors associated default among TB patients in South Africa.

RECOMMENDATIONS

Risk factors from each of the five dimensions associated with adherence were identified among new and re-treatment patients in our study as associated with default and are potentially modifiable [17]. The Table below summarizes each area with some suggestions regarding potential interventions to improve TB treatment adherence. It is likely that these methods will require substantial dedicated financial and human resources. On-going operations research to evaluate the effectiveness of these interventions and future research regarding novel ways to improve adherence in South Africa should be conducted.

Potential interventions to address TB treatment adherence in South Africa

Dimension of Adherence	New Patients	Re-treatment Patients	Potential Interventions [12, 17, 71]
Social/economic factors	Changing residence during TB treatment No formal education Felt ashamed to have TB	Changing residence during TB treatment Agreed that if food was provided by clinic, adherence to treatment would have been better	Assess social needs of each patient Timely follow-up and early patient tracing by DOT supporters and health staff for those patients missing treatment Effective transfer: educate patients in ability to transfer care; ensure effective transfers to alternate DOTS treatment sites if needed Patient incentives, such as food packets Monitor common side effects and educate DOT supporters and patients on side effect management Engage and partner with communities and traditional healers to understand local cultural beliefs, and involve them in TB control in order to reduce stigma and social barriers to adherence Provide peer support
Health care/health system-related factors	Poor HCW attitude	Poor HCW attitude	Motivate HCWs, program staff and DOT supporters by providing on-going training and ensuring reasonable case loads Emphasize patient-centered care, enroll patients in choosing the best treatment supporter and location of DOT Coach staff in improved patient centered communication and relationship building
Condition-related factors	Did not receive adequate counseling or information		Education on use of medications and tuberculosis and need to attend for treatment Provide effective counseling, develop and use educational tools that are suitable for levels of literacy Involve DOT supporters and family members in education and counseling about TB.
Therapy-related factors		History of previous TB treatment default Did not feel better with treatment	Carefully monitor adherence of patients with a previous history of TB treatment default – they may need additional incentives and motivation to complete treatment. Take defaulter action promptly. Continually assess patient's perceived response to therapy Patient education on duration of treatment Effective supervision and monitoring
Patient-related factors	Drank alcohol during TB treatment		Screen for alcohol abuse and dependence. Incorporate behavior change interventions: consider social skills training, behavior contracting and pharmacotherapy for alcohol treatment Mutual goal setting Memory aids and reminders, use prompts to encourage adherence Incentives and peer support

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TABLES

Table 1. Results of reclassification of cases and controls with TB, 8 provinces, South Africa, 2002

All provinces

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		147 (14%)	882 (86%)	1029
Completed treatment/Control	18 (1%)	--	2032 (99%)	2050
Total	18	147	2914	3079

Eastern Cape

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		10 (11%)	76 (89%)	86
Completed treatment/Control	0 (0%)		178 (100%)	178
Total	0	10	254	264

Free State

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case	--	6 (6%)	94 (94%)	100
Completed treatment/Control	1(1%)	--	193 (99%)	194
Total	1	6	287	294

Gauteng

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		31(15%)	173 (85%)	204
Completed treatment/Control	5 (1%)	--	388 (99%)	393
Total	5	31	561	597

KZN

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		30 (17%)	138 (82%)	168
Completed treatment/Control	3 (1%)		327 (99%)	330
Total	3	30	465	498

Mpumalanga

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		39 (20%)	154 (79%)	193
Completed treatment/Control	0 (0%)		388 (100%)	388
Total	0	39	542	581

Northwest

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		11 (9%)	108 (90%)	119
Completed treatment/Control	2 (1%)		227 (99%)	229
Total	2	11	335	348

Northern Cape

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		9 (12%)	65 (88%)	74
Completed treatment/Control	1 (1%)		157 (99%)	158
Total	1	9	222	232

Western Cape

Category in TB register	Reclassified as Cases	Reclassified as Controls	Not reclassified	Total
Defaulter/Case		11 (13%)	74 (87%)	85
Completed treatment/Control	6 (3%)		174 (97%)	180
Total	6	11	248	265

Table 2. Outcome results as listed in register, after reclassification of cases and controls with TB, 8 provinces, South Africa, 2002.

Final Category	Cure	Complete	Fail	Default	Died*	Unknown	Total
Case	0	0	0	873 (97%)	23 (2.5%)	4 (0.4%)	900
Control	1564 (72%)	544 (25%)	47 (2%)	0	6 (0.2%)	18 (0.8%)	2179
Total	1564	544	47	873	29	22	3079

*listed as defaulter or completer in register, though outcome was marked as 'died,' excluded from final analysis

Table 3A. Location of cases and controls with TB, 8 provinces, South Africa, 2002.

Province	Total Documented	Cases	Controls
Eastern Cape	264	76 (29%)	188 (71%)
Free State	294	95 (32%)	199 (68%)
Gauteng	597	178 (30%)	419 (70%)
KwaZulu-Natal	498	141 (28%)	357 (72%)
Mpumalanga	581	154 (27%)	427 (73%)
Northern Cape	232	66 (28%)	166 (72%)
North West	348	110 (32%)	238 (68%)
Western Cape	265	80 (30%)	185 (70%)
Total	3079	900	2179

Table 3B. Cases and controls interviewed by province, as ratio of those eligible to be interviewed

	Cases + Controls interviewed /eligible for study		Cases interviewed/ cases eligible		Controls interviewed/ controls eligible	
Province	Number	%	Number	%	Number	%
Eastern Cape	132/264	50	35/76	46	97/188	52
Free State	104/294	35	19/95	20	85/199	43
Gauteng	143/597	24	20/178	11	123/419	29
KwaZulu-Natal	174/498	35	32/109	23	142/357	40
Mpumalanga	185/581	32	26/154	17	159/427	37
Northern Cape	139/232	60	25/66	38	114/166	69
Northwest	128/348	37	30/110	27	98/238	41
Western Cape	159/265	60	45/80	45	114/185	62
Total	1164/3079	38	232/668	26	932/2179	43

Table 3C. Proportion of cases interviewed out of cases and controls interviewed, by province

	Ratio of cases interviewed/ cases + controls interviewed	
Province	Number	Percent
Eastern Cape	35/132	27
Free State	19/104	18
Gauteng	20/143	14
KwaZulu-Natal	32/174	18
Mpumalanga	26/185	14
Northern Cape	25/139	18
Northwest	30/128	23
Western Cape	45/159	28
Total	232/932	20

Table 4. Response rate of interviewer investigation after reclassification of cases and controls with TB, 8 provinces, South Africa, 2002.

All provinces

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	232	26	932	43
Contacted, did not consent	13	2	21	1
Reported to have died	210	23	352	16
Not contacted, address not found	144	16	284	13
Not contacted, moved from address/not known at address	216	24	398	18
Not contacted, could not be reached at home	9	1	15	8
Not contacted, other/unknown	176	8	177	1
Total	900	100	2179	100

Eastern Cape

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	35	46	97	52
Contacted, did not consent	0	0	0	0
Reported to have died	16	21	23	12
Not contacted, address not found	0	0	11	6
Not contacted, moved from address/not known at address	20	26	28	15
Not contacted, could not be reached at home	0	0	0	0
Not contacted, other/unknown	5	7	29	15
Total	76	100	188	100

Free State

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	19	20	85	43
Contacted, did not consent	0	0	0	0
Reported to have died	27	28	39	20
Not contacted, address not found	15	16	16	8
Not contacted, moved from address/not known at address	0	0	1	1
Not contacted, could not be reached at home	32	34	49	25
Not contacted, other/unknown	2	2	9	5
Total	95	100	199	100

Gauteng

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	20	11	123	30
Contacted, did not consent	6	3	4	1
Reported to have died	30	17	66	16
Not contacted, address not found	44	25	88	21
Not contacted, moved from address/not known at address	63	35	127	30
Not contacted, could not be reached at home	8	2	3	2
Not contacted, other/unknown	11	2	8	1
Total	178	100	419	100

KZN

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	32	23	142	40
Contacted, did not consent	2	1	0	0
Reported to have died	39	28	83	23
Not contacted, address not found	37	26	79	22
Not contacted, moved from address/not known at address	20	14	34	10
Not contacted, could not be reached at home	0	0	0	0
Not contacted, other/unknown	11	8	19	5
Total	141	100	357	100

Mpumalanga

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	26	17	159	37
Contacted, did not consent	3	2	5	1
Reported to have died	40	26	72	16
Not contacted, address not found	34	22	64	15
Not contacted, moved from address/not known at address	22	14	73	17
Not contacted, could not be reached at home	1	1	1	1
Not contacted, other/unknown	28	18	53	12
Total	154	100	427	100

Northern Cape

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	25	38	114	69
Contacted, did not consent	0	0	4	2
Reported to have died	25	38	21	13
Not contacted, address not found	0	0	2	1
Not contacted, moved from address/not known at address	8	12	11	6
Not contacted, could not be reached at home	0	0	0	0
Not contacted, other/unknown	8	12	14	9
Total	66	100	166	100

Northwest

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	30	27	98	41
Contacted, did not consent	0	0	2	1
Reported to have died	24	22	36	15
Not contacted, address not found	10	9	17	7
Not contacted, moved from address/not known at address	38	35	56	24
Not contacted, could not be reached at home	5	5	10	4
Not contacted, other/unknown	3	2	19	8
Total	110	100	238	100

Western Cape

Characteristic	Cases	Percent	Controls	Percent
Contacted, consented to participate	45	56	114	62
Contacted, did not consent	2	3	6	3
Reported to have died	9	11	12	7
Not contacted, address not found	4	5	6	3
Not contacted, moved from address/not known at address	9	11	14	7
Not contacted, could not be reached at home	0	0	0	0
Not contacted, other/unknown	11	14	33	18
Total	80	100	185	100

Table 5A. Reported cause of death after reclassification among 210 cases and 352 controls with history of TB who were reported to have died after treatment, 8 provinces, South Africa, 2002.

	Cases N=210		Controls N=352	
	Number	Percent	Number	Percent
Cause				
Pulmonary TB or TB related	88	42	102	28
MDR TB	0	0	2	1
HIV/AIDS	3	1	5	1
Natural causes	13	6	34	8
Pneumonia	5	2	8	2
Cancer	2	1	1	1
Renal failure	2	1	1	1
Meningitis	1	1	3	1
Gastroenteritis or diarrhea	1	1	1	1
Accident/violent crime	0	0	7	2
Other respiratory illness	0	0	3	1
Cardiac death	0	0	3	1
Liver failure	0	0	2	1
Cerebrovascular accident	0	0	1	1
Diabetes	0	0	3	1
Depression	0	0	1	1
Unknown	95	45	175	48

Table 5B. Reported mortality, cause of death and time to death among cases, 8 provinces, South Africa, 2002.

Indicator	Number	Percent
Case patients reported to have died	210/900	23
Known cause of death	115/210	55
TB as ‘reported’ cause of death	88/115	77
Known date of death	151/210	72
Died < 2 months before default	33/151	22
Died ≥ 2 months after default	95/151	63
Unknown time	23/151	15
Median length of time to death after last recorded visit (months, range)	7	0.2-43

Table 6A. Comparing characteristics between those cases interviewed and those cases not interviewed, 8 provinces, South Africa, 2002.

	Responders N=232		Non-responders N=668		
	Number	%	Number	%	*p*
Characteristic					
Median age (range)	31 (18-87)		33 (18-78)		0.004*
Gender: Male	154	66	431	65	
Female	78	34	237	35	0.6
Facility where treatment initiated					
Clinic	201 31	87	546	82	
Hospital		13	122	18	0.08
Facility where treatment initiated					
Non-Governmental	8	3	21	3	0.8
Governmental	224	97	847	97	
Rural facility	94	41	203	30	0.004
Urban or semi-urban facility	137	59	465	70	
Admitted for TB treatment					
Yes	80	35	260	41	0.1
No	146	65	373	59	
Facility where TB treatment was completed					
Clinic	201	93	569	94	0.8
Hospital	15	7	39	6	
Type of facility where treatment completed					
Non-Governmental	6	3	9	1	0.2
Governmental	210	97	602	99	
	160	69	541	81	<0.001
New patient	71	31	123	19	
Re-treatment patient					
Previous default: Yes	38	16	47	7	<0.001
No	193	84	617	93	
Disease classification: Pulmonary	213	92	639	96	0.02
Extra-pulmonary	18	8	26	4	
Treatment phase when patient defaulted					
Intensive (first 2 months)	63	27	256	38	<0.001
Early continuation (3-4 months)	116	50	261	39	
Late continuation (5-8 months)	40	17	70	11	
Unknown	13	6	81	12	

* Wilcoxon rank-sum test

Table 6B. Comparing characteristics between those controls interviewed and those controls not interviewed, 8 provinces, South Africa, 2002.

Characteristic	Responders N=932 Number	%	Non-responders N=1247 Number	%	*p*
Median age (range)	35 (18-90)		34 (18-95)		0.3*
Gender					
Male	517	56	698	56	0.8
Female	415	44	549	44	
Facility where treatment initiated					
Clinic	756	81	986	79	0.3
Hospital	176	19	259	21	
Type of facility where treatment initiated					
Non-Governmental	49	5	62	5	0.8
Governmental	883	95	1183	95	
Rural/Urban facility					
Rural	332	36	350	28	<0.001
Urban or semi-urban	600	64	896	72	
Admitted for TB treatment					
Yes	353	38	514	42	0.05
No	569	61	697	58	
Facility where TB treatment was completed					
Clinic	869	93	1140	93	0.9
Hospital	61	7	81	7	
Type of facility where treatment completed					
Non-Governmental	22	2	38	3	0.3
Governmental	909	98	1187	97	
New patient	766	82	1088	87	<0.001
Re-treatment patient	165	18	156	13	
Previousdefault: Yes	26	3	28	3	0.5
No	905	97	1218	98	
Disease classification					
Pulmonary	889	96	1184	95	0.6
Extra-pulmonary	41	5	61	5	

* Wilcoxon rank-sum test

Table 7A. Age distribution and sex of 232 cases and 931 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases (n=232)	Controls (n=931)*	*p*†
Median age (range)	31 (18-87)	35 (18-90)	0.007
Median age by sex			
Men (range)	33 (19-87)	37 (18-80)	<0.001
Women (range)	28 (18-79)	32 (18-90)	0.003

* One person's age was unknown

† Wilcoxon rank-sum test

Table 7B. Age distribution and sex of 231 cases and 931 controls with TB, stratified by patient category (new and re-treatment), 8 provinces, South Africa, 2002*

	New Patients (n = 926)			Re-treatment Patients (n = 236)		
Factor	Cases n = 160	Controls n = 766	UOR 95% CI	Cases n = 71	Controls n = 165	UOR 95% CI
Male	100/160	398/766	1.5 (1.1-2.2)	54/71	118/165	1.5 (1.1-2.2)
Female	60/160	368/766	1.0	17/71	47/165	1.0
Median age	30	34	p = 0.001	33	39	p = 0.003

Note: The patient category was not documented for one case patient

Table 8. Demographic characteristics of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

	Cases		Controls		UOR
Characteristic	Number	Percent	Number	Percent	95% CI
Gender					
Male	154/232	66	517/932	55	1.6 (1.2-2.2)
Female	78/232	34	415/932	45	1.0
Country of birth			909/931		
South Africa	231/232	99	22/931	98	5.6 (0.9-231.)
Other	1/232	1		2	1.0
Practices religion					
Yes	212/232	91	839/921	91	1.0 (0.6-1.8)
No	20/232	9	82/921	9	1.0
Ethnicity					
Black African	187/231	81	791/927	85	0.7 (0.5-1.1)
Other	44/231	19	136/927	15	1.0
Marital status					
Married/partner	73/230	32	328/928	35	0.8 (0.6-1.1)
Single	157/230	68	600/928	65	1.0
Children					
More than 3	79/228	35	377/926	41	0.7 (0.5-1.1)
1-2	97/228	42	371/926	40	0.9 (0.6-1.3)
None	52/228	23	178/926	19	1.0
Formal education level					
Tertiary	9	4	47	5	0.7 (0.3-1.6)
Secondary school	114	49	461	50	1.0 (0.7-1.3)
Primary school	81	35	341	37	0.6 (0.4-1.2)
None	27	12	78	8	1.0
Live alone	39/228	17	132/927	14	1.2 (0.8-1.9)
Live with family	144/231	62	620/925	67	0.8 (0.6-1.1)
Live with partner	40/228	18	139/924	15	1.2 (0.8-1.8)
Live with a friend	22/228	10	78/918	9	1.2 (0.7-1.9)
Live with children	111/230	48	508/916	55	0.7 (0.6-1.0)
Live with coworker	9/226	4	29/908	3	1.3 (0.5-2.8)

Table 9A. Socioeconomic characteristics of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

	Cases		Controls		UOR 95% CI
Characteristic	Number	Percent	Number	Percent	
Owns cattle	12/229	5	40/920	4	1.2 (0.6-2.4)
Owns goats	15/229	7	39/920	4	1.6 (0.8-3.0)
Owns a radio	157/230	68	615/924	67	1.1 (0.8-1.5)
Owns a television	108/230	47	457/923	50	0.9 (0.7-1.2)
Owns a house	118/229	52	476/924	52	1.0 (0.7-1.4)
Employment					
Employed	122/232	53	441/930	47	1.2 (0.9-1.7)
Unemployed	110/232	47	489/930	52	1.0
Of those employed:					
Skilled	85/122	70	282/441	64	1.3 (0.8-2.1)
Non-skilled	37/122	30	159/441	36	1.0
Type of occupation					
Laborer	42/120	35	105/434	24	1.6 (1.0-2.6)
Other	79/120	65	329/434	76	1.0
Income					
≥R1000/month	71/120	40	234/425	57	1.1 (0.7-1.8)
<R1000/month	47/120	60	175/425	43	1.0
Missed treatment due to employment					
Yes	54/122	44	20/438	5	16 (9.1-31)
No	68/122	56	418/438	95	1.0

Table 9B. Self reported reasons for missing treatment because of employment (reported by 53 cases and 18 controls), 8 provinces, South Africa, 2002.

	Cases (n = 53)		Controls (n = 18)	
Cause	Number	Percent*	Number	Percent*
Too busy/not enough time to leave work	30	57	6	33
Work too far from TB clinic	25	47	6	33
Employer did not allow to get TB treatment	17	32	4	22
Did not want coworkers to know	8	15	2	11
Had to move to keep job	3	6	0	0
Side effects interfered with work	2	4	2	11
I felt better	1	2	0	0
Other/unknown	3	5	1	5

* Patients were not limited to one answer, therefore percentages will add up to more than 100%

Table 10. Treatment characteristics of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

	Cases		Controls		UOR
Characteristic	Number	Percent	Number	Percent	95% CI
Facility where treatment initiated					
Clinic	201/232	87	756/932	81	1.5 (1.0-2.4)
Hospital	31/232	13	176/932	18	1.0
Facility where treatment initiated					
Governmental	224/232	97	883/932	95	1.6 (0.7-3.9)
Non-Governmental	8/232	3	49/932	5	1.0
Rural/Urban facility					
Rural	95/232	41	332/932	36	1.2 (0.9-1.7)
Urban or semi-urban	137/232	59	600/932	64	
Admitted for TB treatment					
Yes	80/226	35	353/922	38	0.9 (0.6-1.2)
No	146/226	65	569/922	32	1.0
Facility where treatment completed					
Clinic	201/216	93	869/930	93	0.9 (0.5-1.8)
Hospital	15/216	7	61/930	7	1.0
Facility where treatment completed					
Governmental	210/216	97	909/931	98	0.8 (0.3-2.6)
Non-Governmental	6/216	3	22/931	2	1.0
New patient	160/231	69	766/931	82	0.5 (0.3-0.7)
Re-treatment patient	71/231	31	165/931	18	1.0
Previous default: Yes	38/231	16	26/931	3	6.9 (3.9-12.0)
No	193/231	84	905/931	97	1.0
Previous failure: Yes	4/231	2	9/931	1	1.8 (0.4-6.5)
No	227/231	98	922/931	99	1.0
Disease classification					
Extra-pulmonary	13/226	6	21/910	2	2.6 (1.2-5.5)
Pulmonary	213/226	94	889/910	98	1.0
Stopped taking TB treatment by self-report					
Yes	40/111	36	36/392	9	5.6 (3.2-9.6)
No	71/111	64	356/392	91	1.0

Table 11. Mobility of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
Number of times changed residence in the year before starting TB treatment					
At least once	35/221	16	107/908	12	1.4 (0.9-2.2)
Never	186/221	84	801/908	88	1.0
Changed residence during TB treatment					
Yes	38/230	16	61/922	7	2.8 (1.8-4.4)
No	192/230	84	861/922	93	1.0
If changed residence: Median number of times changed residence during treatment (range)	1 (1-3)		1 (1-9)		p = 0.4*
Missed treatment due to changing residence					
Yes	23/36	64	8/60	13	11.5 (3.8-36)
No	13/36	36	52/60	87	1.0

* Wilcoxon rank-sum test

Table 12. Alcohol use, drug use, and prison history of 232 cases and 932 controls with MDR TB, 5 provinces, South Africa, 1999-2001.

	Cases		Controls		UOR
	Number	Percent	Number	Percent	95% CI
Characteristic					
Any alcohol use during treatment					
Yes	78/225	35	203/917	22	1.9 (1.3-2.6)
No	147/225	65	714/917	78	1.0
Alcohol use stratified					
Daily drinker	5/225	3	17/917	2	1.4 (0.4-4.1)
Occasional Drinker	73/225	33	186/917	17	1.9 (1.4-2.7)
Non-drinker	147/225	65	714/917	78	1.0
If alcohol user:					
3 or more drinks in 1 day					
Yes	51/73	68	116/199	41	1.5 (0.9-2.8)
No	23/73	32	183/199	58	1.0
Missed treatment due to alcohol use					
Yes	25/67	37	24/192	13	4.1 (2.0-8.4)
No	42/67	63	168/192	87	1.0
Smoked marijuana or mandrax during treatment: Yes	14/231	6	38/922	4	1.5 (0.7-2.9)
No	217/231	94	884/922	96	1.0
If smoker:					
Missed treatment due to smoking					
Yes	7/14	50	6/38	16	5.3 (1.1-25.7)
No	7/14	50	32/38	84	1.0
Spent time in prison during treatment					
Yes	13/228	6	36/914	4	1.5 (0.7-2.9)
No	215/228	94	878/914	96	1.0
If prison history:					
Missed treatment due to prison					
Yes	9/13	69	18/34	53	2.0 (0.4-10.5)
No	4/13	31	16/34	47	1.0

Table 13. Personal experience with TB of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
Told someone that they had TB					
Yes	214/230	93	879/928	95	0.7 (0.4-1.4)
No	16/230	7	49/928	5	1.0
Felt ashamed about TB					
Yes	98/227	43	229/918	25	2.3 (1.7-3.1)
No	129/227	57	689/918	75	1.0
Felt ignored or neglected because had TB					
Yes	62/218	28	197/890	22	1.4 (1.0-2.0)
No	156/218	72	693/890	78	1.0
Reported receiving support by non HCWs					
Yes	166/229	72	692/930	74	0.9 (0.6-1.3)
No	63/229	28	238/930	26	1.0
Felt supported by family during treatment					
Yes	171/221	77	792/897	88	0.5 (0.3-0.7)
No	50/221	23	105/897	12	1.0
Felt did not have enough support during treatment	41/211	19	85/884	10	2.3 (1.5-3.5)
Felt had enough support during treatment	170/211	81	799/884	90	1.0
Felt influenced by others to stop treatment					
Yes	7/231	3	13/923	1	2.2 (0.7-6.0)
No	224/231	97	910/923	99	1.0

Table 14. Personal experience with food/nutrition during treatment of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
Depended on others for food and shelter:					
Yes	118/229	52	448/929	48	1.1 (0.8-1.5)
No	111/229	48	481/929	52	1.0
Took tablets: Before eating	27/216	12	143/911	16	0.7 (0.5-1.2)
After eating	189/216	88	768/911	84	1.0
Took TB treatment on an empty stomach					
Yes	73/205	36	226/886	26	1.6 (1.2-2.3)
No	132/205	64	660/886	74	1.0
If yes, side effects: Yes	55/73	75	113/226	50	3.1 (1.6-5.9)
No	18/73	25	113/226	50	1.0
Appetite increased on TB treatment: Yes	194/227	85	819/916	89	0.7 (0.5-1.1)
No	33/227	15	97/916	11	1.0
If yes, Did not have enough food to satisfy hunger	33/144	23	110/716	15	1.6 (1.0-2.6)
Had enough food	111/144	77	606/716	85	1.0
Spent $\geq$ 1 day without food during treatment	161/226	71	741/923	80	1.6 (1.2-2.3)
Never spent a day without food during treatment	65/126	29	182/923	20	1.0
Provided with food to support TB treatment: Yes	128/228	56	515/926	56	1.1 (0.8-1.4)
No	100/228	44	411/926	44	1.0
Lacked enough food to eat during treatment: Yes	77/229	34	28/906	28	1.3 (0.9-1.8)
No	155/229	66	72/906	72	1.0
Food from the nurse would help me finish TB treatment: Yes	178/208	86	668/840	80	1.5 (1.0-2.4)
No	30/208	14	172/840	20	1.0
Received food from clinic while on treatment: Yes	50/230	22	172/924	19	1.2 (0.8-1.7)
No	180/230	78	752/924	81	1.0
Denied food or shelter because of having TB					
Yes	9/228	4	37/921	4	1.7 (0.4-2.1)
No	219/228	96	884/921	96	1.0

Table 15. Use of traditional healers among 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
Saw a traditional healer during treatment: Yes	39/229	17	64/923	7	2.8 (1.7-4.3)
No	64/229	83	859/923	93	1.0
If saw traditional healer:					
Median number of healers seen (range)	1 (1-3)		1 (1-4)		*p* = 0.8
Type of healer seen					
Faith healer	4/38	11	15/62	24	
Herbalist	21/38	55	26/62	42	
Sangoma	13/38	34	21/62	34	
Given treatment by traditional healer: Yes	24/37	65	31/60	52	1.7 (0.7-4.4)
No	13/37	35	29/60	48	1.0
Type of treatment given					
Purgative	6/29	21	5/22	23	
Emetic	6/29	21	3/22	14	
Other	17/29	59	14/22	64	
Took treatment at the same time as TB treatment: Yes	10/31	32	13/34	41	0.7 (0.2-2.5)
No	21/31	68	21/34	59	1.0
Median time treatment taken, days (range)	60 (1-180)		30 (7-365)	7-365	*p* = 0.7
Traditional healer asked them to stop treatment: Yes	6/27	22	5/40	14	(0.4-9.3)
No	21/27	78	35/40	88	1.0
Missed treatment due to traditional healer: Yes	6/26	23	6/26	5	5.3 (0.8-56)1
No	20/26	77	20/26	95	1.0
Whose treatment helped most?					
Traditional healer/herbalist	3/23	14	0	0	
TB HCW	5/23	18	45/54	83	
Neither	6/23	27	0	0	
Both	9/23	41	9/54	17	

* Wilcoxon rank-sum test $p < 0.05$

Table 16. Health service characteristics of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
Median length of time from when patient first felt ill to time seen by the doctor, days (range)	30 (0-739)		30 (0-180)		*p* = 0.9*
Median number of different clinics the patient attended for TB treatment (range)	1 (0-5)		1 (0-7)		*p* = 0.2*
How did they get to the health facility?					
Car	14/230	6	61/915	7	
Taxi/Combi	51/230	22	183/915	20	
Bus	11/230	5	31/915	3	
Bicycle	4/230	2	7/915	1	
Walk	149/230	65	615/915	67	
Other	1/230	1	18/915	2	
Time to get to the health facility					
< 30 minutes	100/227	44	452/911	50	0.8 (0.5-1.4)
30-60 minutes	104/227	46	376/911	41	1.0 (0.6-1.7)
> 1 hour	23/227	10	83/911	9	1.0
Admitted to the hospital for treatment: Yes	56/283	24	227/928	24	(0.7-1.4)
No	227/283	76	701/928	76	1.0
If admitted, how long?					
≥4 months	2/54	4	15/223	7	
3-4 months	8/54	15	38/223	17	
1-2 months	11/54	20	33/223	15	
1 month	1/54	2	15/223	7	
≥1 week <1 month	16/54	30	55/223	25	
<1 week	16/54	30	66/223	30	

* Wilcoxon rank-sum test

Table 16 continued. Health service characteristics of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

	Cases		Controls		UOR 95% CI
Characteristic	Number	Percent	Number	Percent	
If admitted, did you miss TB treatment? Yes	2/55	4	8/227	4	(0.1-5.4)
No	53/55	96	219/227	96	1.0
How much time spent waiting at clinic					
Did not wait	68/213	32	349/864	40	1.0
< 1 hr	121/213	57	428/864	50	1.4 (1.0-1.8)
> 1 hr	24/213	11	87/864	10	1.1 (0.7-1.9)
Were hours convenient					
No	44/212	21	68/908	7	3.2 (2.1-5.0)
Yes	168/212	79	840/908	93	1.0

Table 17. DOT and support characteristics of 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
How did the HCW or DOTS supporter give you your pills?					
Pill bottles	70/230	30	269/925	29	0.8 (0.5-1.1)
Plastic bags	63/230	27	306/925	33	0.6 (0.4-0.9)
Blister packs	24/230	10	133/925	14	0.5 (0.3-0.9)
One at a time	73/23	32	217/925	23	1.0
Take treatment without direct supervision					
No	109/219	50	447/902	50	1.0 (0.7-1.4)
Yes	110/219	50	455/902	50	
If took pills without direct supervision:					
Given pills by HCW to take alone					
Yes	2/110	2	11/451	2	1.4 (0.3-12.7)
No	108/110	98	440/451	98	
If yes, why given pills to take alone					
HCW trusted me	68/108	63	338/447	76	
Given bags of pills	20/108	19	40/447	9	
No one to supervise me	14/108	13	21/447	5	
Pills home for the weekend	9/108	8	25/447	6	
Clinic too far/not accessible	5/108	5	22/447	5	
I was traveling >3 days	5/108	5	17/447	4	
Family member DOT partner	6/108	1	0	0	
Too ill/disabled to go to clinic	4/108	1	0	0	
Work/school	6/108	1	0	0	
Other	6/108	1	0	0	

Table 18. Self-reported opinions about health service and staff, by 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

	Cases		Controls		UOR
Characteristic	Number	Percent	Number	Percent	95% CI
Opinion about the HCW attitude					
Not Satisfactory	29/232	13	35/928	4	3.6 (2.1-6.3)
Satisfactory	203/232	87	839/928	96	1.0
Did HCWs treat you with respect?					
No	21/230	9	22/927	2	4.1 (2.1-8.0)
Yes	209/230	91	905/927	98	1.0
Missed treatment due to HCW attitude					
Yes	24/225	11	20/926	2	5.4 (2.8-10.5)
No	202/225	89	906/926	98	1.0
Trust the HCW					
No	14/223	6	18/913	2	3.3 (1.5-7.2)
Yes	209/223	94	895/913	98	1.0
Trust the hospital/clinic					
No	19/230	8	22/927	2	3.7 (1.9-7.3)
Yes	211/230	92	909/927	98	1.0
Thought treatment made them feel better					
No	50/218	23	20/917	2	13.3 (7.5-24)
Yes	168/218	77	897/917	98	1.0
Thought that they would finish taking treatment					
Yes	164/207	79	704/868	79	1.0 (0.7-1.5)
No	43/207	21	183/868	21	1.0

Table 19. Knowledge of TB among 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
Knew taking treatment for ≥ 6 months					
No	55/219	25	148/905	16	1.7 (1.2-2.5)
Yes	164/219	75	757/905	84	1.0
Told why receiving treatment for ≥ 6 months					
No	104/223	47	273/909	30	1.7 (1.2-2.5)
Yes	119/223	53	636/909	70	1.0
Given information by the HCW					
No	80/225	36	204/921	22	1.9 (1.4-27)
Yes	145/225	64	717/921	78	1.0
If given information Information was useful					
Not useful	10/140	7	3/706	1	18 (4.5-102)
Useful	130/140	93	703/706	99	1.0
Received enough information re: TB					
No	27/138	20	47/713	7	3.4 (2.0-5.9)
Yes	111/138	80	666/713	93	1.0
Felt that it is not possible to cure TB	8/186	4	13/892	1	3.0 (1.1-8.0)
Felt that they might die from TB	138/220	63	629/909	69	0.7 (0.5-1.0)

Table 20. Self-reported responses to query about the cause of TB by 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.*

	Cases N=232		Controls N=932		UOR
Characteristic	Number	%	Number	%	95% CI
Bad air	81	35	341	37	0.9 (0.7-1.2)
Germs	78	34	328	35	0.9 (0.7-1.3)
Being near other people with TB	78	34	326	35	0.9 (0.7-1.3)
Smoking and/or drinking	74	32	280	30	1.1 (0.8-1.5)
Witchcraft	48	21	110	12	1.9 (1.3-2.9)
Not taking TB medicine properly	26	11	85	9	1.3 (0.8-2.0)
Having HIV/AIDS	17	7.3	50	5	1.4 (0.7-2.5)
Taboo	16	7	29	3	2.3 (1.0-4.5)
Bad TB treatment by doctors and nurses	7	3	17	2	1.7 (0.6-4.3)
Ancestor Spirits	4	2	10	1	1.6 (0.4-5.7)
Dirt/Dust	2	1	22	2	0.4 (0.04-1.5)
Cold weather	2	1	18	2	0.4 (0.05-1.9)
Poor nutrition	2	1	14	1	0.6 (0.1-2.5)
Don’t know	1	0.4	4	0.4	1.0 (0.02-10)
Heredity	1	0.4	2	0.2	2.0 (0.03-39)
Milling/grinding	1	0.4	1	0.1	4.0 (0.05-316)
Temporary job	1	0.4	0	0	--
Loss of appetite	1	0.4	0	0	--
Spitting	0	0	10	1	--
Pollution	0	0	6	0.6	--
Sharing utensils	0	0	5	0.5	--
Chemicals	0	0	5	0.5	--
Illegal drugs	0	0	4	0.4	--
Poverty	0	0	3	0.3	--
Stress	0	0	2	0.2	--
Over crowding	0	0	2	0.2	--
Working in mine	0	0	2	0.2	--
Poor immunity	0	0	2	0.2	--
Kissing	0	0	1	0.1	--
Squatter Camp	0	0	1	0.1	--
Wetness	0	0	1	0.1	--
Pregnancy	0	0	1	0.1	--

* Categories not mutually exclusive, percentages will add up to more than 100%

Table 21. Self-reported side effects from TB among 232 cases and 932 controls with TB, 8 provinces, South Africa, 2002.

Characteristic	Cases Number	Percent	Controls Number	Percent	UOR 95% CI
How often had side effects					
Ever	113/199	57	376/832	45	1.6 (1.1-2.2)
Never	86/199	43	456/832	54	
If had side effects:					
Talked to HCW					
Yes	72/109	66	276/361	76	0.6 (0.4-1.0
No	37/109	34	85/361	24	
Took medicine to feel better					
Yes	53/107	50	171/362	47	1.1 (0.7-1.7)
No	54/107	50	191/362	53	
Talked to traditional healer					
Yes	17/107	16	21/346	6	2.9 (1.4-6.1)
No	90/107	84	325/346	94	
Took traditional medicine					
Yes	14/98	14	6/309	2	8.4 (2.9-27)
No	84/98	86	303/309	98	
Stopped treatment due to side effects					
Yes	30/100	30	4/348	1	37 (12-146)
No	70/100	70	344/348	99	

Table 22A. Most commonly reported side effects from TB treatment among 131 cases and 409 controls reporting, 8 provinces, South Africa, 2002.*

Side effect	Cases N = 131		Controls N = 409		UOR 95% CI
	Number	Percent	Number	Percent	
Nausea	73	56	207	51	--
Vomiting	41	31	99	24	--
Abdominal pain	36	27	61	15	2.2 (1.4-3.6)
Headache	32	24	55	13	2.1 (1.3-3.6)
Dizziness	27	21	87	21	--
Skin rash	18	14	65	16	--
Fatigue	16	12	56	14	--
Joint pain	10	8	28	7	--
Sore buttocks	6	5	13	3	--
Diarrhea	6	5	10	2	--
Psychiatric problems	4	3	3	0.7	--
Hearing problems	2	2	5	1	--
Dyspnea	2	2	3	1	--
Injection abscess	2	2	0	0	--
Visual problems	1	0.7	5	1	--
HIV	1	0.7	1	0.2	--
Lymphadenopathy	1	0.7	0	0	--
Drowsy	0	0	4	1	--
Sweats	0	0	4	1	--
Swollen limb	0	0	3	0.7	--
Skin discoloration	0	0	2	0.5	--
Chest pain	0	0	1	0.2	--
Constipation	0	0	2	0.5	--
Hair Loss	0	0	1	0.2	--
Heart burn/GERD	0	0	1	0.2	--
Menstrual irregularities	0	0	1	0.2	--
Dysuria	0	0	1	0.2	--
Mouth sores	0	0	1	0.2	--
Nose bleeds	0	0	1	0.2	--
Red urine	0	0	1	0.2	--
Facial swelling	0	0	1	0.2	--
Jaundice	0	0	0	0	--

* Patients were not limited to one answer, therefore percentages will add up to more than 100%

Table 22B. “Worst side effect” during TB treatment as reported by patients, 8 provinces, South Africa, 2002.

Worst side effect	Cases N = 131		Controls N = 468		UOR 95% CI
	Number	Percent	Number	Percent	
Nausea	35	24	134	29	--
Vomiting	20	14	52	11	--
Abdominal pain	20	14	35	7	
Headache	16	11	27	6	
Sore buttocks	11	8	44	9	--
Skin rash	8	6	41	9	--
Fatigue	4	3	28	6	--
Joint pain	3	2	14	3	--
Diarrhea	2	1	2	0.5	--
Hearing problems	2	1	4	1	
Visual problems	1	0.7	1	0.2	--
Injection abscess	0	0	9	2	--
Other	4	3	14	3	
Not sure	16	11	61	13	--

Table 23. Multivariate Logistic Regression Analysis for Treatment Default, South Africa, 2002.*

Characteristic	8 provinces† Adjusted Odds Ratio 95% CI	*p* value
Age (years)	0.96 (0.95-0.98)	<0.001
Gender		
Male	1.5 (1.0-2.2)	0.02
Female	1.0	
Did not feel better with TB treatment	10.8 (5.9-19)	<0.001
Felt better with TB treatment	1.0	
Previous history of treatment		
Yes	1.8 (1.2-2.7)	0.005
No	1.0	
Changed residence during TB treatment		
Yes	2.2 (1.3-3.7)	0.04
No	1.0	
Saw a traditional healer during TB treatment		
Yes	2.0 (1.1-3.5)	0.009
No	1.0	
Any alcohol use during treatment		
Yes	1.7 (1.1-2.5)	0.01
No	1.0	
Not given counsel or information about TB treatment	1.6 (1.1-2.4)	0.02
Given counsel or information about TB treatment	1.0	
Family supported taking TB treatment		
Yes	0.6 (0.4-0.9)	0.02
No	1.0	
Opinion about HCW attitude		
Unsatisfactory	2.9 (1.5-5.5)	0.001
Satisfactory	1.0	

† Patients with any missing values excluded from multivariate analysis, total n = 193 cases and 838 controls.

*Model built by manual stepwise forward selection

Table 24. Significant variables by patient category (new or re-treatment), unadjusted odds ratios (UOR) and adjusted odds ratios (AOR) (adjusted for patient category), 231 cases and 931 controls with TB, South Africa, 2002.

	New TB Patient					Retreatment TB Patient					Combined	
	Cases (160)		Controls (766)			Cases (71)		Controls (165)				
	Num	%	Num	%	Stratum specific OR (*p*)	Num	%	Num	%	Stratum specific OR (*p*)	UOR 95% CI	AOR 95% CI
No formal education	22/160	14	61/762	8	1.8 (0.02)	5/70	7	17/164	10	0.7 (0.43)	1.4	1.4
Formal education	138/160	86	701/762	92		65/70	93	147/164	90		0.9-2.3	0.9-2.3
History of previous default	n/a		n/a		n/a	26/165	16	38/71	53	6.2 (<0.001)	n/a	n/a
No history of default						139/165	84	33/71	47			
Previously interrupted TB treatment by self report	n/a		n/a		n/a						n/a	n/a
Yes						26/48	54	20/116	17	5.6 (<0.001)		
No						22/48	46	96/116	83			
Changed residence during TB treatment: Yes	22/158	14	49/756	6	2.3 (0.002)	16/71	23	12/165	7	3.7 (<.001)	2.8	2.7
No	136/158	86	707/756	94		55/71	77	153/165	93		1.8-4.2	1.7-4.2
Any alcohol use during treatment? Yes	51/154	33	157/753	33	1.9 (0.001)	27/70	39	46/163	28	1.6 (0.12)	1.9	1.8
No	103/154	77	596/753	21		43/70	61	117/163	72		1.3-2.6	1.3-2.5

Table 24 continued. Significant variables by patient category (new or re-treatment), unadjusted odds ratios (UOR) and adjusted odds ratios (AOR) (adjusted for patient category), 231 cases and 931 controls with TB, South Africa, 2002.

Felt ashamed about TB												
Yes	67/155	43	181/753	24	2.4 (<0.001)	31/71	44	48/164	30	1.9 (0.03)	2.3	2.2
No	88/155	67	572/753	76		40/71	56	116/164	70		1.7-3.1	1.6-3.0
Felt supported by family												
during treatment: Yes	116/153	76	651/736	88	0.4 (<0.001)	54/67	80	140/160	88	0.6 (0.17)	0.5	0.5
No	651/736	24	85/736	22		13/67	20	20/160	22		0.3-0.7	0.3-0.7
Spent $\geq$ 1 day without food												
during treatment												
Yes	39/155	25	141/759	19	1.5 (0.06)	26/70	37	41/163	25	1.8 (0.06)	1.6	1.6
No	146/155	75	618/759	81		44/70	63	122/163	75		0.9-3.3	1.0-2.3
Took TB treatment on an												
empty stomach: Yes	49/142	35	183/725	25	1.6 (0.03)	24/62	39	43/160	27	1.7 (0.08)	1.6	1.6
No	93/142	65	542/725	75		38/62	61	117/160	73		0.9-3.3	1.0-2.3
Food from the nurse would												
help me finish TB												
treatment: Yes	114/139	82	553/688	80	1.1 (0.65)	63/68	93	114/151	76	4.1 (0.003)	1.5	1.5
No	25/139	18	135/688	20		5/68	7	37/151	24		1.0-2.4	1.0-2.3

Table 24 continued. Significant variables by patient category (new or re-treatment), unadjusted odds ratios (UOR) and adjusted odds ratios (AOR) (adjusted for patient category), 231 cases and 931 controls with TB, South Africa, 2002.

Saw a traditional healer while taking TB treatment												
Yes	30/159	19	52/757	7	3.2 (<0.001)	9/69	13	12/165	7	1.9 (0.16)	2.8	2.8
No	129/159	81	705/757	93		60/69	87	153/165	93		1.7-4.3	1.8-4.3
Clinic hours not convenient	32/147	22	60/747	8	3.2 (<0.001)	12/64	19	8/160	5	4.4 (0.001)	3.2	3.4
Clinic hours convenient	115/147	78	687/747	92		52/64	81	152/160	95		2.1-5.0	2.2-5.2
Poor HCW attitude												
Yes	17/160	11	30/763	4	2.9 (<0.001)	12/71	17	5/164	3	6.5 (<0.001)	3.6	3.7
No	143/160	89	733/763	96		59/71	83	159/164	97		2.1-6.3	2.2-6.2
Did HCWs treat you with respect? No	11/158	7	19/761	3	2.9 (0.004)	10/71	14	3/165	2	8.9 (0.002)	4.1	4.1
Yes	147/158	93	742/761	97		61/71	86	162/165	98		2.1-8.0	2.2-7.8
Missed treatment due to HCW attitude: Yes	15/155	10	19/763	25	4.2 (<0.001)	9/69	13	1/162	1	24.2	5.4	5.8
No	140/155	90	744/763	75		60/69	87	161/162	99	<0.001	2.8-11	3.0-11
Did not trust the HCW	9/156	6	14/749	2	3.2 (0.005)	5/66	8	4/163	25	3.3 (0.07)	3.3	3.2
Trusted HCW	147/156	94	735/749	98		61/66	92	159/163	75		1.5-7.2	1.6-6.7

Table 24 continued. Significant variables by patient category (new or re-treatment), unadjusted odds ratios (UOR) and adjusted odds ratios (AOR) (adjusted for patient category), 231 cases and 931 controls with TB, South Africa, 2002.

Did not feel better with treatment	32/150	21	15/754	2	13.3 (<0.001)	18/67	27	5/162	3	11.5 (<0.001)	13.3	12.7
Felt better with treatment	118/150	79	739/754	98		49/67	73	157/162	97		7.5-24	7.3-22
Not told why TB treatment must be taken for ≥ 6 months	73/152	48	225/746	30	2.1 (<0.001)	31/70	44	47/162	29	1.9 (0.02)	2.0	2.1
											1.5-2.8	1.5-3.1
Told why TB treatment must be taken for ≥ 6 months	79/152	52	521/746	70		39/70	56	115/162	71			
Not given counsel or information about TB treatment	53/155	34	163/756	22	1.9 (<0.001)	27/69	39	40/164	24	2.0 (0.02)	1.9	1.9
											1.4-2.7	1.4-2.6
Given counsel or information about TB treatment	102/155	26	593/756	78		42/69	61	124/164	76			
Received enough education about TB at beginning of treatment												
No	17/98	17	44/592	7	2.6 (0.001)	10/39	26	3/121	2	13.6 (<0.001)	3.5	3.6
Yes	81/98	83	548/592	93		29/39	74	118/121	88		2.0-5.9	2.1-6.2

* Fishers exact 2-tailed *p* value

Table 25. Multivariate logistic regression analysis for TB treatment default, stratified by patient category (new, re-treatment), South Africa, 2002*

	New Patients N = 848		Re-treatment Patients N = 211	
Risk Factor	OR	95% CI	OR	95% CI
Poor HCW attitude	2.1	1.1-4.4	12	2.2-66
Changing residence during TB treatment	2.0	1.1-3.7	3.4	1.1-9.9
Did not receive adequate counseling or information	1.9	1.2-2.8	--	--
No formal education	2.3	1.2-4.2	--	--
Drank any alcohol during treatment	1.9	1.2-3.0	--	--
Felt ashamed to have TB	2.0	1.3-3.0	--	--
Saw a traditional healer for TB	1.9	1.1-3.4	--	--
History of previous TB treatment default	--	--	6.4	2.9-14
Did not feel better with treatment	--	--	21	5.2-84
Agreed that if food was provided by clinic, adherence to treatment would have been better	--	--	5	1.3-19

*models adjusted for age and sex

Table 26. Reasons for Stopping Treatment among 160 New TB patient Defaulters and 71 Re-treatment TB patient Defaulters, South Africa, 2002.

	New TB Defaulters n=160		Re-treatment TB Defaulters n=71	
Question	Number	Percent	Number	Percent
Phase of treatment when patient defaulted				
First 2 months	42	26	21	30
Early continuation (month 3-4)	82	51	33	46
Late continuation (month 5-6/8)	25	16	15	21
Unknown	11	7	2	3
Did you ever stop taking TB treatment because you changed residence?				
Yes	14	9	11	15
No	124	77	51	72
Not sure/Unknown	22	14	9	13
Did you ever stop taking TB treatment because you did not have enough food?				
Yes	28	17	15	21
No	118	74	48	68
Not sure/Unknown	14	9	8	11
Did you ever stop taking TB treatment because of lack of support or encouragement?				
Yes, very much				
Yes, a little bit	9	6	10	14
No, not much	15	9	4	6
No, not at all	13	8	7	10
Not sure/Unknown	104	65	41	57
	19	12	9	13
Did other people have an influence or a role in your stopping TB treatment?				
Yes, very much	3	2	2	3
Yes, a little bit	3	2	4	6
No, not much	1	1	1	1
No, not at all	118	74	45	63
Not sure/Unknown	35	21	19	27

Table 26 continued. Reasons for Stopping Treatment among 160 New TB patient Defaulters and 71 Re-treatment TB patient Defaulters, South Africa, 2002

	New TB Defaulters n=160		Re-treatment TB Defaulters n=71	
Question	Number	Percent	Number	Percent
Did any health worker'(s) attitude(s) have an influence or a role in your stopping TB treatment?				
Yes, very much	7	4	7	10
Yes, a little bit	14	9	6	8
No, not much	9	6	5	7
No, not at all	124	77	49	69
Not sure/Unknown	6	4	4	6
Did not knowing enough about TB have an influence or a role in your stopping TB treatment?				
Yes, very much	24	15	15	21
Yes, a little bit	23	14	11	15
No, not much	12	8	12	17
No, not at all	70	44	22	31
Not sure/Unknown	31	19	11	16
Did side effects you experienced influence your stopping TB treatment?				
Yes, very much	7	4	7	10
Yes, a little bit	23	15	12	17
No, not much	11	7	6	8
No, not at all	82	51	30	42
Not sure/Unknown	37	23	16	23

Table 27. Self reported reasons for defaulting among 160 New TB Patients and 71 Re-treatment TB Patients, 8 provinces, South Africa, 2002.

Self-reported Reasons for Defaulting	New TB Patients* n=160		Re-treatment TB patients, n=77	
	Number	Percent	Number	Percent*
I felt better	40	25	19	27
The pills gave me side effects	27	17	11	15
I did not have time, too busy	26	16	7	10
I did not like taking pills every day	22	14	10	14
I didn't think it was important	21	13	5	7
I had to look for a job/money	20	13	6	8
I didn't think it was important	20	13	5	7
I could not afford transport to the clinic	19	12	4	6
I didn't want to lose my job	19	12	7	10
The clinic was too far	18	11	1	1
I thought I was taking pills for too long	16	10	7	10
I could not get time off of work	14	9	2	3
I gave up/I was depressed	14	9	8	11
I forgot to come in for treatment	11	7	8	11
I was not getting any better on treatment	11	7	6	8
I moved around too often	10	6	7	10
I did not get enough treatment support	9	6	6	8
I was drinking alcohol too much	9	6	2	3
I didn't believe I had TB	7	4	3	4
The health care staff treated me poorly	6	4	2	3
I was too busy with family obligations	5	3	3	4
I didn't like being away from family so long	4	3	1	1
Traditional healer told me to stop	4	3	1	1
I went to prison/jail	4	3	1	1
Not sure	4	3	2	3
I had to go back to school	2	1	2	3
A family or friend told me to stop	0	0	1	1

* Patients were not limited to one answer, therefore percentages will add up to more than 100%

Table 28. The most important reason for stopping TB treatment when multiple reasons were cited.

Self-reported Most Important Reason for Defaulting	New TB Patients* n=62		Retreatment TB patients, n=33	
	Number	Percent	Number	Percent*
I felt better	10	16	6	18
I didn't want to lose my job	8	13	7	21
I could not get enough time off work	6	10	1	3
I didn't think it was important	5	8	0	0
I gave up/I was depressed	5	8	1	3
I did not like taking pills every day	3	5	3	9
I had to look for a job/money	3	5	1	3
I thought I was taking pills for too long	3	5	0	0
I was not getting any better on treatment	3	5	0	0
The pills gave me side effects	2	3	1	3
I did not have time, too busy	2	3	1	3
The clinic was too far	2	3	0	0
I was drinking alcohol too much	2	3	0	0
I moved around too often	2	3	0	0
I didn't like being away from family so long	1	2	1	3
I could not afford transport to the clinic	1	2	2	6
The health care staff treated me poorly	1	2	1	3
Traditional healer told me to stop	1	2	1	3
I didn't believe I had TB	1	2	2	6
I had to go back to school	1	2	0	0
I did not get enough treatment support	0	0	3	9
I was too busy with family obligations	0	0	1	3