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Who is more likely to return for TB test results? A survey at three high-burden primary healthcare facilities in Cape Town, South Africa

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ABSTRACT

Background: In low- and middle-income countries with a high burden of tuberculosis (TB), a large proportion of people who are tested for TB do not return to the health facility to collect their test results and initiate treatment, thus putting themselves at increased risk of adverse outcomes.
Methods: This prospective study aimed to identify predictors of returning to the primary health care (PHC) facility to collect TB test results. From 15 August to 15 December 2017, 1105 people who tested for pulmonary TB at three Cape Town PHC facilities were surveyed. Using multi-variate logistic regressions on an analysis sample of 1097 people, three groups of predictors were considered: (i) demographics, health and socio-economic status; (ii) costs and benefits; and (iii) behavioural factors.
Results: Forty-four percent of people tested returned to the PHC facility to collect their test results within the stipulated 2 days, and 68% returned before the end of the study period. Return was strongly and positively correlated with expecting a TB-positive result, cognitive avoidance and postponement behaviour.
Conclusion: Interventions to improve pre-treatment loss to follow-up should target patients who think they do not have TB, and those with a history of postponement behaviour and cognitive avoidance.
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Introduction

Tuberculosis (TB) remains a leading cause of preventable death. Globally, an estimated 1.2 million human immunodeficiency virus (HIV)-negative people died from TB in 2019 (World Health Organization, 2020), with poor and vulnerable individuals being over-represented (Pedrazzoli et al., 2017; Carter et al., 2018). Pre-treatment loss to follow-up (PTLFU) contributes substantially to TB deaths: delayed initiation of treatment places the patient at risk, and increases clinical severity and adverse treatment outcomes (MacPherson et al., 2014; Virenfeldt et al., 2014; Imperial et al., 2018). A systematic review of PLTFU in low- and lower-middle-income countries and countries with a high TB burden estimated that 4–38% of people diagnosed with TB do not initiate treatment following a confirmatory diagnostic test (MacPherson et al., 2014).

This study investigated PLTFU in South Africa, a resource-constrained middle-income country where early initiation of treatment is particularly important because of its high HIV burden and resulting high incidence of TB. In 2019, the incidence rate per 100,000 was 615 (427–835), with 58,000 (34,000–88,000) deaths and a case fatality ratio of 17% (9–27%) (World Health Organization, 2020). PTLFU is estimated to range between 16% and 25%, (Botha et al., 2008a,b), and accounts for more than one-quarter of the total losses from the pool of symptomatic TB test seekers entering the care cascade in South Africa (Naidoo et al., 2017).

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However, to date, there have only been three exploratory studies of the underlying predictors of PTLFU in South Africa, and these were small convenience samples of 18, 41 and 58 individuals (Botha et al., 2008a; Skinner and Claassens, 2016; Claassens et al., 2017).

Despite the prevalence of PTLFU and its high mortality burden, there is a regrettable shortage of literature not only in South Africa but globally. Drawing on the systematic review by MacPherson et al. (2014) and an updated systematic scan of the literature, the present authors were only able to find 29 studies worldwide. These were largely qualitative and exploratory, with low external validity due to small sample sizes, selection biases and retrospective enrolment. Given the paucity of evidence on this important issue, this prospective study is a much-needed addition to what is known about the predictors of PTLFU. This survey captured detailed information on the respondents' perceptions of the costs and benefits of TB diagnosis, as well as self-reported attitudes, traits and behaviours.

Methods

From 15 August to 15 December 2017, 1105 people who underwent testing for pulmonary TB at three Cape Town primary healthcare (PHC) facilities were surveyed, capturing demographics, household living conditions, self-reported attitudes and behaviours, and how they perceived the costs and benefits of TB treatment. This prospective study aimed to identify predictors of returning to the PHC facility to collect test results. The study period was set based on previous studies in this area (Botha et al., 2008a,b), and the facilities were selected with the aim of achieving a sample of at least 1000 TB testers (defined as 'person seeking a test'). Figure 1 shows the data map.

Dependent variable

Testers who returned to the PHC facility to collect the test result before the end of the study period (2 months after the last person had enrolled in the study) were coded as 1 (and if not, they were coded as 0). Each tester's return to the facility was tracked through TB testing and treatment registers kept by the PHC facilities, and electronic administrative data [i.e. the Patient Record and Health Management Information System and ETR.net (Electronic Tuberculosis Register)]. A team of fieldworkers tracked the returning testers in parallel at the three facilities. All testers were called back approximately 4 weeks after their TB test. Where there was no evidence that a tester had returned or where the various sources of information showed discrepancies, the nurses at the TB rooms in the PHC facilities were consulted. To ensure that no testers who returned after the study team had left the facility were missed, the authors returned to the facility to check approximately 1 month and 2 months after the last tester was enrolled in the study. The research team's tracking and checks identified 12/221 cases (5%) in whom it was confirmed that TB-positive testers had wrongly been classified as lost to follow-up. According to administrative records, only 10% (19/202) of the individuals who tested positive for TB and returned for their results had not initiated treatment. The authors' notes and follow-ups indicate that there may have been an additional six TB patients (3%) who were on treatment but were not reflected in treatment records.

Survey questionnaire

A wide range of predictors were drawn from a self-administered survey of patients (in English and in isiXhosa, response rate 84%) in the waiting rooms of three PHC facilities in Cape Town. Survey coverage was monitored by matching the SurveyCTO (Dobility, Inc) questionnaires uploaded to the cloud to handwritten records of presumptive TB cases (i.e. those who tested for TB and were recorded in the register) available in the testing register at each of the three facilities.

Independent variables

The tester's decision to return to the PHC facility to collect their test results involved comparing the immediate costs with the future expected health benefits, as captured by neoclassical economics (which assumes that people make the best decisions and have accurate and full information about the consequences of each option) and by behavioural mediators. This study also measured the predictive power of socio-economic variables. Three categories of predictors were examined: demographics, health and socio-economic status; costs and benefits; and behavioural factors.

Demographics, health and socio-economic status

This predictor group included gender, age categories, education categories, poverty, employment status, HIV status and TB status. Poverty and living conditions were captured with questions on housing (brick house, corrugated iron, other); access to electricity and running water; ownership of a television, fridge, satellite dish, car and mobile phone; sufficient food in the past 3 months; and the need to borrow money to cover transport and mobile phone expenditure in the past 3 months. This survey was merged with routine data on TB and HIV status. As the testers were enrolled in the survey while in the waiting room for TB testing, the sample also includes some individuals who tested negative for TB. 'No answer' or 'Do not know' were categorized as zero, and a 'Missing or unknown' HIV-positive variable was included to capture missing cases.

Costs and benefits

The questionnaire asked the respondents to estimate the direct and indirect costs of their visit, including the time and financial costs of transport to the facility, waiting time at the facility, and whether they had to sacrifice a day's wages to visit the facility. There are no user fees for TB testing and treatment at these facilities in South Africa, but questions about this were included because it was anticipated that some users would not know that diagnosis and treatment are free. In addition, an indicator of whether the TB test was self-initiated, or the tester was referred by a nurse during a PHC facility visit for another purpose, was included.

Behavioural factors

The analysis was augmented by including insights from behavioural health economics (Chandra et al., 2019). A range of behavioural variables that could inhibit return to the PHC facility were included, such as: time discounting, availability bias, expectations, cognitive avoidance, stigma, risk attitude, self-control, stress, and self-reported postponement behaviour. These variable definitions and the underlying rationale for their inclusion are explained in Table 1. Using multiple correspondence analysis, indices were created for cognitive avoidance, stigma, self-control, stress and poverty, standardized to have a mean of 0 and a standard deviation of 1.

Analysis

Three logistic regression models were run: the first excluded both TB and HIV statuses, the second included HIV status, and the third included both TB and HIV statuses. The main univariate statistics on return rates were based on the non-experimental sample (respondents who did not receive the SMS reminders) in the

Table 1
Explanation of behavioural predictors and their measurement.

Variable/predictor	Rationale	Measurement
Time discounting	Time discounting acknowledges that people are impatient and tend to assign a higher value to the present value of benefits and costs cf. benefits and costs in the future. Time discounting is a relevant concept for the decision of testers to return to the PHC facility to collect their test results because it weighs up an immediate time investment (required to collect test results) against the future expected health benefits of knowing your TB status (O'Donoghue and Rabin, 1999; Chabris et al., 2008). Hyperbolic time discounting goes one step further by also allowing for adjustments in the valuation of time as it moves closer to the present. For those who apply hyperbolic discounting, this can create a perpetual time inconsistency, which may lead them to repeatedly postpone return to the PHC facility. For instance, such a tester may think that going to the PHC facility to collect test results tomorrow would be worthwhile, but when tomorrow becomes today, the value of the required time investment of the PHC facility visit increases, and may no longer be seen as a worthwhile way to spend time.	To measure the valuation of time, respondents were presented with two sets of voucher choices, but across two different sets of time periods, the first comparing receipt of the vouchers 3 weeks later with 4 weeks later, and the second comparing now and 1 week later. Vouchers were used to avoid capturing the household's cash needs. First the respondent was asked to choose between receiving a clothes store voucher of R200 ($11) in 3 weeks' time or receiving a decreasing range of higher-value vouchers ranging from R350 to R210 (US$19–US$11) 4 weeks later. This allows the minimum monetary compensation the respondent requires for the additional week's wait to be captured. The second question is identical but the week's wait is into the present, comparing immediate receipt of the voucher with a 1-week wait. These are Questions 3 and 4 in the survey instrument included in the online supplementary material. A variable measuring extreme impatience was defined, which was 1 if the individual preferred to receive R200 now rather than R350 (the maximum offered) 1 week later, and 0 if they preferred to receive R350 1 week later. A hyperbolic discounting variable was also defined, which was 1 when the minimum compensation for waiting 1 week was larger from the perspective of the present moment vs 3 weeks in the future, and 0 otherwise.
Risk attitude	Risk tolerance will affect the assessment of the cost of delaying the collection of test results.	The questionnaire asked respondents to capture their attitude to risk on a 10-point scale using four scenarios: skipping class as a child, compliance with homework as a child, crossing the busy highway or using the bridge, and walking alone at night.
Self-reported postponement behaviour	People who are prone to postponement behaviour are more likely to postpone the collection of their test results.	The study also asked about self-reported postponing behaviour relating to important tasks, such as a school application, a bankcard renewal or an application for a job.
Self-control	People who struggle to make and follow through on deliberate and intentional choices, and tend to follow their short-term impulses, are expected to have more difficulty with returning to the PHC facility to collect their test results.	Brief Self-Control Scale (Tangney et al., 2004)
Stigma	Expectations of the stigma they will face if diagnosed with TB will make respondents less likely to return to the PHC facility.	TB Stigma Scale (Colvin, 2005; Colvin and Mitchell, 2016)
Expectations	The expected probability of a positive TB result is vital for the decision weighing-up current costs against expected future health benefits. If they perceive the probability of having TB as low, they will adjust the expected future health benefits downward accordingly (Chandra et al., 2019). Generally, it has been shown that people tend to place too much confidence in their likelihood of beating the odds (Ferrer and Klein, 2015; Arni et al., 2020).	Please answer yes or no to the following statement: I think I might have TB.
Availability bias	People known to respondents will exert a disproportionate influence on their perceptions and expectations (Golman et al., 2017; Chandra et al., 2019).	Please answer yes or no to the following statement: I know someone who has died from TB.
Cognitive avoidance	Decision making may be affected because of the tendency to ignore new information that is unpleasant to assimilate (Golman et al., 2017).	Cognitive-behavioural Avoidance Scale (CBAS) (Ottenbreit and Dobson, 2004)
Stress	Testers might be overwhelmed by more immediate concerns such as hunger, sick children or job loss, making the collection of test results less of a priority.	Perceived Stress Scale (Cohen et al., 1983)

PHC, primary health care; TB, tuberculosis.

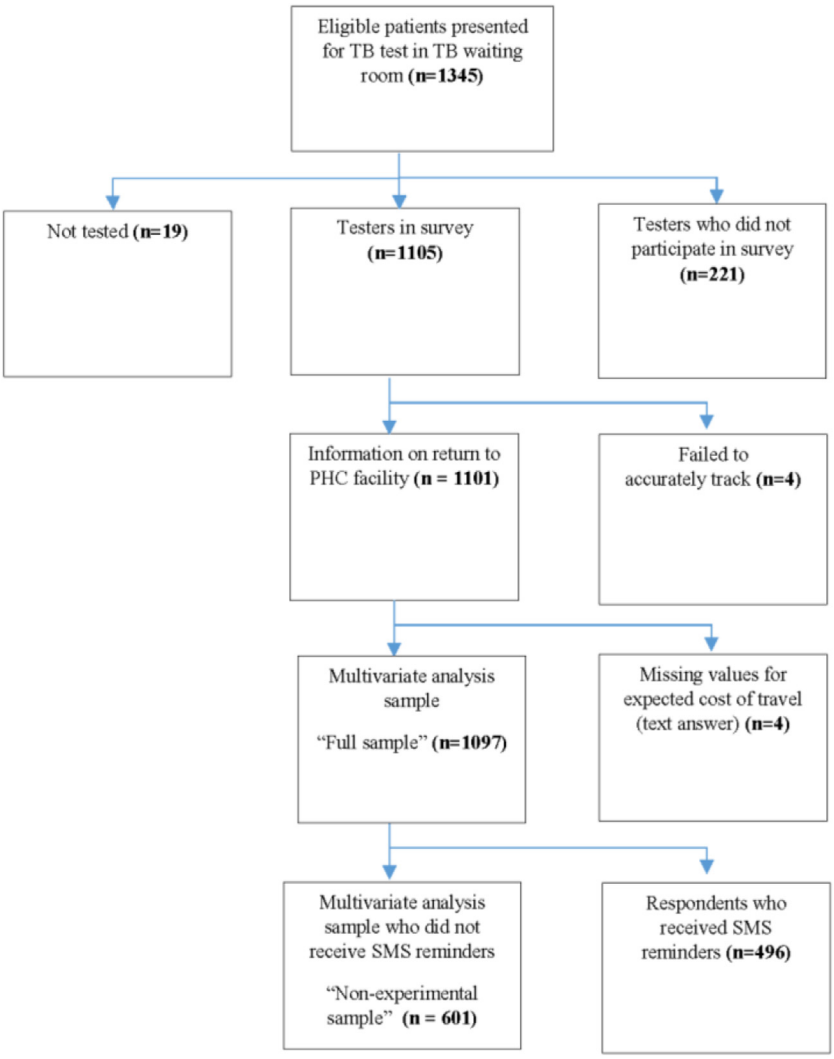

Figure 1. Data Map.

interest of external validity. From 2 October to 15 December 2017, a subset of testers (n=496) received an SMS reminder on the eve of their scheduled return to the PHC facility to collect their test results (Wagstaff et al., 2019). SMS recipients were more likely to return to clinic in the requested 2 days than the control group.

The main multi-variate analysis was estimated on the full sample, controlling for the SMS treatment effect in all specifications. Table A3 (see online supplementary material) provides estimation results excluding testers who received the SMS reminders. Statistical analysis was performed in Stata Version 15.2 (Stata Corp., College Station, TX, USA).

Results

Table 2 provides descriptive statistics of the non-experimental sample (Panel A) and the full study sample (Panel B, including testers who received an SMS reminder to return). Testers were asked to return to the PHC facility to collect their results as soon as the results were available, which was 2 working days after the test. Panel A shows that 68% (64–72%) of the testers in the non-experimental sample returned to the PHC facility to collect their test results within the study's cut-off period (2 months after the end of enrolment). Of these, 44% (40–48%) returned within 2 days, 59% (55–63%) returned within 1 week, 63% (59–66%) returned within 2 weeks, and 65% (61–69%) returned within 4 weeks. The mean delay for the subsample of testers who did return was 3.38 working days [i.e. 5.38 (4.17–6.58) days after testing]. For the full sample (including the experimental sample), the observed rate of return before the end of the study's cut-off period was much higher (74%; 71–76% in Panel B). This was expected due to the effect of an SMS reminder intervention studied in a related paper (Wagstaff et al., 2019) and should thus be interpreted with caution. The distribution of days until return to the PHC facility was skewed to the right for the full sample and the non-experimental sample (the latter is shown in Figure 2).

The full sample and the non-experimental sample featured similar respondent characteristics (Table 2, Panels A and B). In the full sample, 44% (41–47%) were female, and ages ranged from 18 to 86 years. Sixteen percent (14–18%) of the full sample had completed secondary education and 6% (5–8%) had pursued post-school studies. Only 37% (34–40%) were employed. Tests found that 20% (17–22%) were TB positive.

Table 3 shows odds ratios (ORs) from three logistic regression models based on the full sample, with a control for the SMS intervention included but not shown (a detailed breakdown of return rates and single predictors is given in Table A1, see online supplementary material). Panel A includes demographic, socio-economic, cost and benefit, and behavioural predictors, but excludes TB and HIV statuses. Panel B includes HIV status, and Panel C includes both TB and HIV statuses.

Table 2
Descriptive statistics, full sample and non-experimental sample.

Return to PHC facility	Panel A: non-experimental sample (n=601) Mean	Lower CI	Upper CI	Panel B: full sample (n=1097) Mean	Lower CI	Upper CI
Days until return (if returned)	5.38	4.17	6.58	4.22	3.57	4.87
Returned (before end of study period)	0.68	0.64	0.72	0.74	0.71	0.76
Returned in 4 weeks	0.65	0.61	0.69	0.72	0.69	0.74
Returned in 2 weeks	0.63	0.59	0.66	0.70	0.68	0.73
Returned in 1 week	0.59	0.55	0.63	0.67	0.64	0.70
Returned in 2 days	0.44	0.40	0.48	0.52	0.49	0.55
Demographics, health and socio-economic status						
Female	0.45	0.41	0.49	0.44	0.41	0.47
Male	0.55	0.51	0.59	0.56	0.53	0.59
Age 18–20 years	0.028	0.015	0.042	0.03	0.02	0.04
Age 21–30 years	0.21	0.18	0.24	0.21	0.18	0.23
Age 31–40 years	0.32	0.28	0.36	0.30	0.28	0.33
Age 41–50 years	0.23	0.19	0.26	0.24	0.21	0.26
Age 51–60 years	0.15	0.12	0.18	0.16	0.14	0.18
Age ≥61 years	0.065	0.045	0.085	0.06	0.05	0.08
Incomplete primary education	0.18	0.15	0.22	0.17	0.15	0.20
Completed primary education	0.068	0.048	0.088	0.07	0.05	0.08
Incomplete secondary education	0.53	0.49	0.57	0.54	0.51	0.57
Completed secondary education	0.15	0.12	0.18	0.16	0.14	0.18
Post-school studies	0.072	0.051	0.092	0.06	0.05	0.08
Most affluent quintile	0.21	0.18	0.25	0.20	0.18	0.22
Second most affluent quintile	0.2	0.17	0.23	0.20	0.18	0.22
Middle quintile	0.19	0.16	0.22	0.21	0.19	0.24
Second poorest quintile	0.18	0.15	0.22	0.19	0.16	0.21
Poorest quintile	0.21	0.18	0.24	0.20	0.18	0.22
Employed	0.37	0.34	0.41	0.37	0.34	0.40
Unemployed or not in the labour market	0.63	0.59	0.66	0.63	0.60	0.66
Living with HIV	0.39	0.35	0.43	0.39	0.36	0.42
HIV status unknown or negative	0.61	0.57	0.65	0.61	0.58	0.64
HIV status unknown or missing	0.17	0.14	0.2	0.16	0.13	0.18
HIV status known	0.83	0.8	0.86	0.84	0.82	0.87
TB positive	0.2	0.17	0.23	0.20	0.17	0.22
TB status unknown or negative	0.8	0.77	0.83	0.80	0.78	0.83
TB status unknown or missing	0.14	0.11	0.17	0.12	0.10	0.14
TB status known	0.86	0.83	0.89	0.88	0.86	0.90
	Panel A: non-experimental sample (n=601)			Panel B: full sample (n=1097)		
Costs and benefits	Mean	Lower CI	Upper CI	Mean	Lower CI	Upper CI
Waited for ≥1 h	0.56	0.52	0.6	0.59	0.56	0.62
Waited for <1 h	0.44	0.4	0.48	0.41	0.38	0.44
Travelled for ≥1 h	0.032	0.018	0.046	0.03	0.02	0.04
Travelled for <1 h	0.97	0.95	0.98	0.97	0.96	0.98
Paid for travel	0.23	0.2	0.27	0.26	0.23	0.28
No payment for travel	0.77	0.73	0.8	0.74	0.72	0.77
Expected TB treatment costs	0.068	0.048	0.088	0.05	0.04	0.07
Expected no TB treatment costs	0.93	0.91	0.95	0.95	0.93	0.96
Had to take time off work	0.24	0.21	0.28	0.21	0.19	0.23
Did not have to take time off work or not working	0.76	0.72	0.79	0.79	0.77	0.81
Came to PHC facility today for a TB test	0.93	0.91	0.95	0.91	0.89	0.93
Did not come to PHC facility today for a TB test	0.073	0.052	0.094	0.09	0.07	0.11
Behavioural factors						
Thought they had TB	0.73	0.69	0.76	0.78	0.75	0.80
Thought they did not have TB	0.27	0.24	0.31	0.22	0.20	0.25
Impatience (time discounting)	0.36	0.32	0.4	0.36	0.33	0.39
Patience (time discounting)	0.64	0.6	0.68	0.64	0.61	0.67
Hyperbolic time discounting	0.11	0.085	0.13	0.12	0.10	0.14
No hyperbolic time discounting	0.89	0.87	0.92	0.88	0.86	0.90
Availability bias: known TB death	0.57	0.53	0.61	0.63	0.60	0.65
Availability bias: no known TB death	0.43	0.39	0.47	0.37	0.35	0.40
Cognitive avoidance bottom quintile	0.32	0.29	0.36	0.32	0.29	0.34
Cognitive avoidance top quintile	0.22	0.18	0.25	0.20	0.17	0.22
Stigma bottom quintile	0.24	0.21	0.28	0.23	0.20	0.25
Stigma top quintile	0.21	0.18	0.25	0.20	0.18	0.23
Risk bottom quintile	0.21	0.18	0.24	0.21	0.18	0.23
Risk top quintile	0.37	0.33	0.41	0.38	0.35	0.41
Self-control bottom quintile	0.25	0.22	0.29	0.20	0.18	0.23
Self-control top quintile	0.26	0.23	0.3	0.20	0.18	0.22
Stress bottom quintile	0.23	0.19	0.26	0.20	0.18	0.23
Stress top quintile	0.22	0.18	0.25	0.20	0.18	0.22
Prone to delay renewing bank card	0.16	0.13	0.19	0.16	0.14	0.18
Not prone to delay renewing bank card	0.84	0.81	0.87	0.84	0.82	0.86
Prone to delaying school application	0.11	0.09	0.14	0.09	0.07	0.11
Not prone to delaying school application	0.89	0.86	0.91	0.91	0.89	0.93
Prone to delaying job application	0.11	0.09	0.14	0.10	0.08	0.12
Not prone to delaying job application	0.89	0.86	0.91	0.90	0.88	0.92

(*continued on next page*)

Table 2 (*continued*)

Return to PHC facility	Panel A: non-experimental sample (n=601) Mean	Lower CI	Upper CI	Panel B: full sample (n=1097) Mean	Lower CI	Upper CI
Month, PHC facility, SMS reminder	Panel A: non-experimental sample (n=601) Mean	Lower CI	Upper CI	Panel B: full sample (n= 1097) Mean	Lower CI	Upper CI
PHC facility 1	0.47	0.43	0.51	0.43	0.40	0.46
PHC facility 2	0.18	0.15	0.21	0.17	0.15	0.19
PHC facility 3	0.35	0.31	0.39	0.40	0.37	0.43
Received SMS reminder	-	-	-	0.45	0.42	0.48
Did not receive SMS reminder	-	-	-	0.55	0.52	0.58
August	0.29	0.25	0.33	0.16	0.14	0.18
September	0.47	0.43	0.51	0.26	0.23	0.28
October	0.11	0.089	0.14	0.26	0.24	0.29
November	0.095	0.071	0.12	0.24	0.22	0.27
December	0.03	0.02	0.05	0.08	0.07	0.10

PHC, primary health care; TB, tuberculosis; HIV, human immunodeficiency virus; CI, confidence interval.
Note: For the risk quintiles, there are only four distinguishable categories so the highest quintile is the fourth quintile. For categorical variables, the *P*-values are for chi-squared test evaluating the hypothesis independent of entire categorical variable and return to the facility. For the proportions, the *P*-values refer to equality of proportion tests.

Table 3
Logistic regression for return to the primary healthcare facility, full sample.

	Panel A Odds ratio	*P*-value	Panel B Odds ratio	*P*-value	Panel C Odds ratio	*P*-value
Demographics and socio-economic status						
Female	0.73	0.039	0.72	0.038	0.84	0.28
Age 31–40 years (ref. 18–30 years)	1.23	0.62	1.16	0.74	1.04	0.93
Age 41–50 years (ref. 18–30 years)	2.38	0.039	2.22	0.071	2.16	0.10
Age 51–60 years (ref. 18–30 years)	2.23	0.061	2.00	0.12	1.97	0.15
Age ≥61 years (ref. 18–30 years)	2.57	0.031	2.34	0.06	2.28	0.088
Completed primary education (ref. did not complete primary education)	2.94	0.0069	2.67	0.013	2.29	0.035
Incomplete secondary education (ref. did not complete primary education)	1.36	0.14	1.40	0.11	1.24	0.33
Completed secondary education (ref. did not complete primary education)	0.97	0.90	0.93	0.77	0.90	0.71
Post-school studies (ref. did not complete primary education)	0.86	0.65	0.82	0.57	0.72	0.36
Second most affluent quintile (ref. most affluent quintile)	0.98	0.94	1.03	0.92	1.04	0.88
Middle quintile (ref. most affluent quintile)	0.87	0.57	0.86	0.54	0.84	0.47
Second poorest quintile (ref. most affluent quintile)	0.77	0.29	0.80	0.38	0.79	0.36
Poorest quintile (ref. most affluent quintile)	0.69	0.15	0.73	0.24	0.71	0.21
Employed	0.82	0.34	0.81	0.34	0.77	0.25
Living with HIV			1.06	0.75	0.90	0.59
HIV status unknown or missing			0.29	P<0.0001	0.50	0.10
TB positive					5.95	P<0.0001
TB status unknown or missing					0.58	0.23
Costs and benefits						
Had to wait for ≥1 h	0.82	0.20	0.80	0.17	0.80	0.17
Had to travel for ≥1 h	0.62	0.21	0.67	0.31	0.57	0.22
Cost of travel to PHC facility	1.01	0.42	1.01	0.35	1.00	0.81
Expected cost of treatment	1.00	0.47	1.00	0.40	1.00	0.50
Had to take time off work	1.31	0.43	1.37	0.39	1.41	0.35
Lost income because of PHC facility visit	1.00	0.56	1.00	0.61	1.00	0.60
Behavioural factors						
Thought they had TB	1.68	0.0026	1.73	0.0019	1.71	0.0035
Cognitive avoidance	0.79	0.0088	0.77	0.0024	0.80	0.011
Stigma	1.07	0.49	1.04	0.71	1.04	0.69
Risk attitude	0.99	0.87	0.97	0.75	0.97	0.71
Self-control	1.00	0.98	1.00	0.97	0.96	0.68
Stress	0.93	0.51	0.92	0.43	0.86	0.19
Probability of delaying renewing bank card	0.60	0.033	0.62	0.046	0.60	0.031
Probability of delaying school application	1.69	0.10	1.44	0.25	1.58	0.15
Probability of delaying job application	0.64	0.11	0.69	0.18	0.72	0.25
Observations	1097		1097		1097	
Pseudo R^2	0.096		0.13		0.18	

HIV, human immunodeficiency virus; TB, tuberculosis.

There was a negative association between female testers and returning to the PHC facility in Panel A (OR 0.73; *P*=0.039) and Panel B (OR 0.72; *P*=0.038) (Table 3). When controlling for TB status in Panel C, the association became smaller and insignificant (OR 0.84; *P*=0.28), plausibly because females have a significantly lower likelihood of having TB. Of female testers, 15% (12–19%) were TB positive, while 23% (20–27) of male testers were TB positive. Panel A shows that testers aged 41–50 (OR 2.38; *P*=0.039) and ≥61 (OR 2.57; *P*=0.031) years were more likely to return to the PHC facility for their results; however, associations became weaker and insignificant at the 5% level once TB and HIV statuses were included in the models (Panels B and C). Complete primary education increased the likelihood of return substantially across all three models compared with incomplete primary education (Panel A: OR 2.94, *P*=0.0069; Panel B: OR 2.67, *P*=0.013; Panel C: OR 2.29, *P*=0.035). HIV status was insignificantly associated with the likelihood of return. Unknown or missing HIV status reduced the likelihood of return (Panel B: OR 0.29, *P*<0.0001); however, this asso-

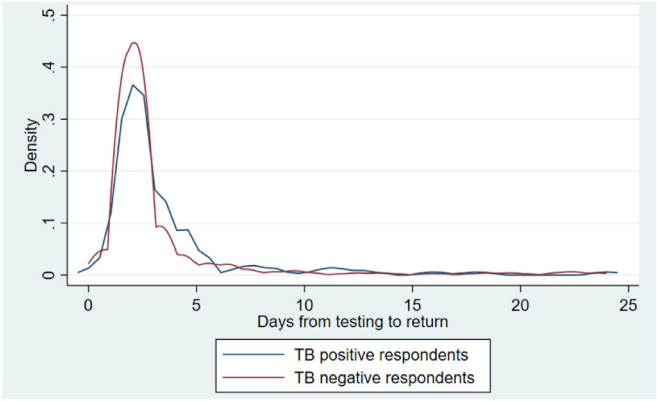

Figure 2. Distribution of working days from testing to return for individuals who tested positive and negative for tuberculosis (TB) and returned for results at the primary healthcare facility for non-experimental samples (n=601).
Note: Working days from testing to return was trimmed at 28 days. Kernel density estimated the probability density function using an Epanechnikov distribution and a kernel halfwidth of 0.5. It should be noted that this graph aims to show the asymmetry of the distribution in return dates for bth TB negative and TB positive respondents. However, the cut-off at 24 working days means that the right hand tail is not shown, and a considerably higher share of TB negative respondents returned after 24 working days cf. TB positive respondents.

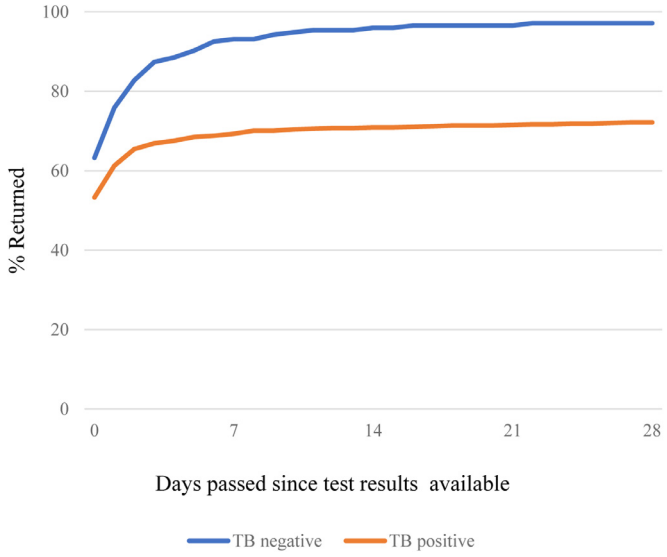

Figure 3. Share of testers who returned to the primary healthcare facility for their results over time from the non-experimental sample (n=601), comparing individuals who tested positive and negative for tuberculosis (TB).
Note: Working days from testing to return was trimmed at 28 days.

ciation became insignificant after controlling for TB-positive status (Panel C: OR 0.50, P=0.10). In Panel C, age, poverty, higher educational indicators and employment were all insignificantly associated with the odds of returning to the PHC facility for their results. The likelihood of individuals who tested positive for TB returning to the PHC clinic was 5.95 times higher than the likelihood of negative cases returning (P<0.0001). Of the TB-positive cases in the non-experimental sample, 93% (90–96%) had returned to the PHC facility by the end of the study cut-off period, compared with 62% (66–72%) of the TB-negative cases; this difference was significant (P<0.0001). Descriptively, the gap between the rate of return of individuals testing TB positive and negative increased as the time since testing increased (Figure 3).

None of the predictors measuring costs and benefits were significantly associated with the likelihood of returning to the PHC facility. Travel time and income-related costs did not predict the likelihood of return significantly.

Testers who thought that they had TB were more likely to return to the PHC facility across all three specifications (Panel A: OR 1.68, P=0.0026; Panel B: OR 1.73, P=0.0019; Panel C: OR 1.71, P=0.0035; Table 3). Thinking that they had TB was not significantly associated with testing positive for TB. Of testers who did not expect to find they had TB, 16% (11–20%) tested positive, which was only slightly lower than the 21% (18–24%) share for testers who did expect to find they had TB (P=0.066). Amongst testers who turned out to be TB positive, inaccurate expectations about their TB status was less likely for people living with HIV (13% vs 23%; P=0.049), those who had lost someone they knew to TB (13% vs 24%; P=0.045), and testers with lower levels of TB stigma (top stigma quintile 35%, bottom stigma quintile 23%; P= 0.00062; Table A2, see online supplementary material).

Testers self-reporting tendencies to cognitive avoidance were significantly and robustly less likely to return to the PHC facility for their results (Panel A: OR 0.79, P=0.0088; Panel B: OR 0.77, P=0.0024; Panel C: OR 0.80, P=0.011). Those who reported delaying the renewal of bank cards were significantly less likely to return across all three specifications (Panel A: OR 0.60, P=0.03; Panel B: OR 0.62, P=0.046; Panel C: OR 0.60, P=0.031). Indicators capturing stigma, risk preferences, self-control and stress were not significantly associated with the likelihood of returning to the PHC facility.

The findings were qualitatively similar when the models were re-estimated using the non-experimental sample (Table A3, see online supplementary material). Two notable differences were that waiting time at the PHC facility and employment status were negatively associated with the likelihood of returning to the PHC facility, suggesting that the SMS reminder may allow respondents to overcome concerns regarding the time costs.

Discussion

To the authors' knowledge, this is the first large-scale survey of TB testers that has made it possible to prospectively and systematically identify predictors of not returning to collect test results. Previous studies have used routine data to estimate the share of PTLFU (Ali et al., 2018; Mugauri et al., 2018) or retrospective data to identify predictors of PTLFU (Htwe et al., 2019). In both cases, researchers had access to only a small set of predictors such as age and gender. This prospective study was able to examine a much larger set of predictors gathered from a waiting room survey in the analysis sample of 1097 testers. This broader set of predictors – including behavioural factors and questions about time and financial costs – adds to knowledge about PTLFU.

Most sociodemographic characteristics were only weakly correlated with returning to the PHC facility in the regression models. Women and specific age groups were less likely to return in bivariate associations and some multi-variate specifications, but the effect weakened after controlling for the highly predictive TB-positive status. It was encouraging to find evidence of a productive mechanism governing return to the PHC facility: individuals who tested positive were significantly more likely to return to the PHC facility. This may be related to TB protocols requiring nurses to follow-up with non-returning individuals who tested positive, but not with non-returning negative cases. However, this is not the only factor at play – a large gap was observed for returning within 2 days (61% for positive cases vs 50% for rest; P= 0.0035) which would be prior to these follow-up calls.

A number of psychological and behavioural factors proved significant. There were robust and significant relationships for expectations about having TB, cognitive avoidance behaviour and self-

reported postponement tendencies (e.g. delayed renewal of a bank card).

Travel time, travel costs and expected treatment costs were not found to play a large role. However, this was a high-density urban community where primary care consultations, TB diagnostics and treatment are available at no cost, so these results would not necessarily apply to rural communities or PHC facilities with user fees. This study did not find that respondents in the poorer quintiles were more likely to delay returning to the facility, but it is necessary to bear in mind that these are poor communities and most TB testers are poor, so this result may be partly because there was little variation in income in this sample.

As this survey only covered three PHC facilities in the Cape Town metropolitan area, further research is needed to examine the validity of these findings in other provinces in South Africa and in other countries. For instance, studies in rural Cameroon and Zimbabwe showed that travel and time costs affected return (Onyoh et al., 2018; Murongazvombo et al., 2019). This is likely to be because the travel and time costs associated with visiting PHC facilities in those countries tend to be higher.

A limitation of this study is the reliance on self-reported data, so the level of awareness of cognitive avoidance and willingness to self-report it may have been captured, rather than cognitive avoidance itself. For instance, it is possible that some testers with a low score for this variable may display substantial avoidance behaviour in reality (Chabris et al., 2008). This is a weakness of a survey-based approach to questions of behaviour. The present results apply to men and women who attend PHC facilities for TB testing. This was the appropriate sample for the research question, but may represent a biased sample of all TB cases (i.e. only representing passive case finding). Finally, the risk that the presence of researchers at the PHC facilities may have improved tester and healthcare worker behaviour, not unlike the Hawthorne effect, is acknowledged. Despite these limitations, the authors believe that this study makes a valuable contribution to knowledge about how TB testers make decisions.

Conclusions

This study found that behavioural traits such as postponement behaviour and cognitive avoidance were associated with higher likelihood of failing to return to the PHC facility. In a narrow and specific sense, it presents a pathway of influence for improving PLTFU in TB. Health workers could probe patients about these traits, and target patients who are prone to cognitive avoidance and postponement behaviour with customized messages and reminders.

More broadly, these findings highlight the importance of including psychological and behavioural factors in clinical studies on health-seeking behaviour, specifically for PLTFU in TB.

This study did not find any evidence for a role of costs and time constraints in this high-density urban setting where PHC facilities are nearby, and consultations, testing and treatment are available at no cost to the patient.

TB-positive status and testers' expectations about having TB played a significant role in the decision to collect TB test results. However, it is a matter for concern that such perceptions are imperfectly correlated to the actual risk, and are thus likely to lead to poor decisions, delays in treatment, and adverse treatment outcomes. Testers who believe that they are unlikely to have TB may therefore be an important subgroup to target in public health education programmes. One option would be that health workers offer patients the option to receive negative results by SMS. This can be helpful in correcting incorrect beliefs amongst TB-positive patients. If TB-positive patients do not receive an SMS, they would know that this means that they are likely to be positive and this should increase their likelihood to return to the PHC facility to collect their test results. Further behavioural research is required on strategies to correct these misaligned beliefs of patients with TB.

Research in context

Evidence before this study

Only 29 peer-reviewed studies on PTLFU were identified. The most recent systematic review and meta-analysis of the literature in low- and middle-income, high-TB-burden countries identified only 23 relevant studies between 1994 and January 2013. On 28 April 2021, the present authors conducted an updated systematic search for peer-reviewed literature (with an unrestricted time period) using PubMed. The following search terms were used: tuberculosis or TB, predict or risk, delay or reduc* or lack, and diagnosis or detection or identification. The PubMed search was augmented by a manual search in Google Scholar and a check of references cited in relevant articles. Disregarding studies that looked at treatment delays broadly, only six further studies that considered PTLFU specifically were identified. As these studies rely on retrospective administrative records, they lack a rich dataset with which to consider behavioural predictors of non-initiation of treatment, such as stress or cognitive avoidance.

Added value of study

This study provides the first survey-based investigation of a broad set of predictors of non-initiation of TB treatment at three PHC facilities in the Cape Town metropolitan area in South Africa, a resource-constrained, middle-income country with high incidence and mortality rates for TB. This study adds to what is known about PTLFU because the survey method tested a broader set of predictors, including behavioural factors and cost considerations, than would be feasible using routine data.

Implications of the study's evidence

This study shows evidence of a psychological and behavioural component: those who believed they were unlikely to have TB, and those who self-reported cognitive avoidance and postponement behaviour had a lower likelihood of returning to the PHC facility to collect their test results. The negative results are also illuminating, providing no support for the hypothesis that PTLFU can be attributed to implicit or explicit costs for the patient. Instead, there is evidence that the decision to return to the PHC facility to collect test results is driven by the perceived benefit mediated through the perceived likelihood of having TB. It is a matter for concern that some TB-positive testers do not return to the PHC facility to collect their test results and initiate treatment because they wrongly believe that they are unlikely to have TB.

Conflict of interest statement

None declared.

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Ethical approval

Stellenbosch University Institutional Review Committee approved the study on 8 November 2016 (Ref. No. SU-HSD-003565, 'A behavioural and economic analysis of TB non-initiation in Cape Town, South Africa').

Author contributions

RB, JC, MC, KM, PN, LR, ED and AW designed the study and instruments. RB, KM and LR led the implementation of the study. RB and AW cleaned the data and asked KM to perform follow-ups where required. RB and AW performed the statistical analysis. RB, LR and MR wrote the first draft of the manuscript. All authors provided reviewed and edited versions of the manuscript, and approved the final manuscript. All authors had access to the data in the study and supported the decision to submit for publication.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2021.10.015.

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