Factors determining household expenditure for tuberculosis and coping strategies in Tajikistan

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Abstract

Objective: To investigate factors influencing expenditure levels and the use of potentially detrimental coping strategies among tuberculosis (TB) patients. For the purpose of the present study, potentially detrimental coping strategies included borrowing money and selling assets.

Design: Questionnaire survey with an initial and a follow-up interview of each adult new pulmonary TB case registered over a period of four months. Conducted in twelve districts with DOTS in Tajikistan, one of the poorest countries in the world.

Results: Patients and their households faced mean expenditures of US$396 related to a TB episode. In multivariate mixed-effect regression models, the main determinants of out-of-pocket payments–either over the whole course of the disease or after enrolment in DOTS treatment–were 'complementary treatment' besides the anti-TB drugs, duration of hospitalization and treatment delay. Hereby, complementary treatment refers mainly to vitamins and rehydrating infusions. Sex showed no association with expenditure. To cope with the costs of illness, two thirds of patients employed a potentially detrimental coping strategy. TB patients raised on average US$23 through credits, US$57 through borrowing money without interest and US$102 through selling assets.

Conclusion: The catastrophic out-of-pocket payments faced by TB patients are correlated with i) receiving complementary treatment, ii) delay to treatment and iii) duration of hospitalisation. The widespread use of potentially detrimental coping strategies illustrates that TB constitutes a substantial risk of impoverishment. More parsimonious use of complementary treatment and hospitalisation could reduce illness-related costs for patients and should be carefully considered.

Keywords: household costs of disease, direct costs, economic coping strategies, former Soviet Union

Introduction

Tuberculosis (TB) patients often encounter high costs during the course of their disease–despite anti-TB chemotherapy offered for free in most settings (Saunderson 1995, Habib & Baig 2006, Kamolratanakul *et al.* 1999, Wyss *et al.* 2001, Aspler *et al.* 2008, Jackson *et al.* 2006). Anti-TB drugs are indeed provided for free in most areas of the Former Soviet Union, but patients have to pay for other services including additional medicines, x-rays and laboratory services (Mosneaga *et al.* 2008). In Tajikistan, household costs of an episode of TB amounted to c. US$4900 purchasing power parity (PPP), of which US$1840 PPP (38%) were TB-related expenditure (Ayé *et al.* 2010a). Expenditure and loss of income associated with TB may push already poor households deeper into poverty (Russell 2004) and have been identified as a major barrier to TB services (Wei *et al.* 2009). Several studies observed differing costs depending on socio-economic status and hospitalization (Russell 2004, Kamolratanakul *et al.* 1999, Saunderson 1995); others have shown that the provision of treatment observation influences costs to the patients (Saunderson 1995, Floyd *et al.* 1997). The only study so far that statistically tested such observed differences, found clinic-based observation of treatment, longer patient-delay and male sex to be the main determinants of higher household costs in urban Zambia (Aspler *et al.* 2008). Overall, the factors associated with high TB-related costs are still poorly understood.

Several authors have pointed out that the investigation of household costs of disease is incomplete if coping strategies employed by households are ignored (Russell 2004, McIntyre *et al.* 2006). The most immediate response to illness-related costs is to use cash income and savings, but this option is not available to all households (McIntyre *et al.* 2006, Russell 1996). Further common coping strategies are borrowing and selling assets. Borrowing can increase the level of debt; sale of assets decreases the resilience to future economic shocks (Russell 2004). This is particularly true for the sale of productive assets, because this reduces future household income. While there are many more coping strategies (cf. Sauerborn *et al.* 1996, Obrist *et al.* 2007), available studies emphasize that selling productive assets and taking out loans often negatively affect future income and can lead to impoverishment (Russell 2004, Leive & Xu 2008, McIntyre *et al.* 2006, Russell 1996). For the purpose of this article, the term “detrimental coping strategies” refers to selling assets and taking out loans. The present study aimed at identifying determinants of TB-related out-of-pocket payments and the use of detrimental coping strategies in Tajikistan.

Methods

Study setting and data collection

WHO (2009) estimated TB incidence in Tajikistan for the year 2007 at 231 cases per 100’000. Roll-out of the internationally recommended strategy for TB control, DOTS, was ongoing and coverage reached 100% by the end of 2007. However, hospitalization rates remain high: 58% in a study in ten

districts (Thierfelder *et al.* 2008). This study made use of cost data collected alongside two studies investigating i) delay to TB treatment and ii) the timing of costs of illness (Ayé *et al.* 2010b, Ayé *et al.* 2010a). The studies were conducted in twelve districts representing urban, rural, lowland and mountainous settings. All adult (≥15 years) new pulmonary TB patients who were registered in the twelve districts in the period from 1st December 2006 until 31st March 2007 were eligible. The study participants received TB treatment according to the national guidelines of Tajikistan. This involved an intensive phase of treatment lasting two months and a continuation phase lasting four months. If sputum smear conversion was not achieved after two months, the intensive phase was prolonged by one month.

The research team visited patients in hospital or at home during the intensive phase of treatment, obtained written informed consent and administered the first questionnaire. Three to four months later, a follow-up questionnaire was applied to the same patients. The questionnaires included detailed questions about the costs incurred, economic coping strategies and household assets. The first questionnaire asked about the period from first symptoms to onset of treatment and the intensive phase. The follow-up questionnaire asked about the continuation phase. For analysis, we extrapolated costs from the day of the interview until the end of the respective phase.

Statistical analysis

Three statistical models were built in order to achieve the objectives of the present study and are described below. The three outcome variables were: i) total TB-related expenditure, ii) TB-related expenditure after onset of treatment and iii) TB-related detrimental coping strategies.

All analyses were conducted in Stata IC/10.1 (Stata Corporation, USA, 1985-2008). We applied multiple imputation to our dataset to deal with missing observations as recommended by Manca & Palmer (2005) for similar problems and in order to avoid the problems of complete-case analysis (Schafer 1997). We built a wealth index based on 18 asset variables (Filmer & Prichett 2001). Details on these two steps have been presented elsewhere (Ayé *et al*. 2010a).

The factors influencing direct costs to households were identified through a mixed-effects linear regression. We reduced the number of repeated significance tests by identifying a basic model at the outset and by considering only a limited number of predictor variables (Grafen & Hails 2002). We built our basic model around five variables. A variable identifying individual DOTS centres had to be included in the model based on the design of the survey and was included as a random effect. Three variables that had previously been shown to influence household costs were identified from the literature, namely sex (Aspler *et al.* 2008), socio-economic status (Russell 2004, Kamolratanakul *et al.* 1999) and hospitalization (Saunderson 1995, Russell 2004). Socio-economic status was included as a

continuous variable, the wealth index described above. Hospitalization, one of the case management factors of main interest, was also included as a continuous variable, namely the log-transformed duration of the hospital stay in days. The fifth variable, the second of the main variables of interest relating to TB case management, was a binary denoting patients that had received complementary treatment, including medication for perceived iatrogenic problems. Two further variables were considered in addition to the basic model: the sputum smear result and the total delay from onset of symptoms to treatment–both as proxies for the severity of disease and as continuous variables. Both the length of hospital stay and the delay until onset of treatment were log-transformed because the relationship was expected to have the shape of a saturation curve rather than a linear increase. The full model was run, its validity was checked by visually examining the residual errors and then the model was simplified by excluding factors with $p>0.2$. However, the five factors defined from the outset were retained even if their p-values were above the threshold (Grafen & Hails 2002).

In order to test more specifically the influence of a case management decision on the costs incurred subsequent to this decision, a similar mixed-effects regression model was built, but the outcome variable included only those expenditures that were incurred after the onset of anti-TB chemotherapy (referred to as "during treatment" below). This model was built in order to test the influence of hospitalisation and the use of complementary treatment on TB-related expenditures. The decision, whether to hospitalise or whether to use complementary treatment is usually taken at the beginning of TB-treatment and cannot have any influence on expenditure made prior to treatment. Also, clinicians may want to know, what influence different strategies of case management have on the patient's household economy. Explanatory variables and criteria for model simplification were identical to the previous model.

Further, we built a mixed-effects model on the amount of funds mobilized through detrimental coping strategies. Taking out loans (with or without interest) and selling assets were considered detrimental coping strategies, but not the use of household income, savings and funds received as donations from family, friends and other well-doers. For the analysis, we did not differentiate between productive and non-productive assets, because the pilot study had shown that by far the largest part of asset sales concerned productive assets, most commonly lifestock. The explanatory variables in the model on detrimental coping strategies were the same as in the models on expenditure, but an additional variable was considered, a binary identifying patients who had worked in Russia until falling ill. This was included because it was thought that it could have a major influence on the amount of cash available at the household level.

For all three models, we plotted the residuals and checked visually whether they were approximately normally distributed. Residuals were close to normally distributed when expenditure data (first two

models) were log-transformed and when funds mobilized through detrimental coping strategies (third model) were root-transformed.

The study has received ethical approval from the Ministry of Health of Tajikistan.

Results

The study identified 282 eligible patients. Reasons for drop-out and demographic characteristics of the 204 patients who consented and were interviewed are listed in Tables 1 and 2, respectively.

Expenditure over the whole course of disease

As reported previously (Ayé *et al.* 2010a), mean expenditure for an episode of TB amounted to US$396 (±standard deviation US$357; median US$282). The full multivariate linear regression model for total expenditure was run and simplified as described in the methods section. The factor 'sputum smear result' was excluded. The final multivariate regression model showed that the delay until onset of treatment and complementary treatment were the main determinants of expenditure (Table 3). On average, a doubling of the delay led to an increase in total expenditure by 17%. Receiving complementary treatment led to an increase in total expenditure by a factor of 2.10. Complementary treatment most commonly included Aloe Vera 1% 1ml, glucose 5% infusion, vitamin C 1% 1ml, vitamin B1, B6 and B12 (in single and compound formulation), calcium gluconate 10% 10ml, and Polyvinylpyrrolidone 6% infusion. There was a statistical tendency for increased costs with longer hospital stay ($p=0.073$).

A slight departure from linearity was observed in the influence of the sputum smear result on total expenditure. A sensitivity analysis with sputum smear result as a categorical variable showed fully consistent results.

Expenditure during anti-TB therapy

The regression model on expenditure during treatment could not be simplified. The delay was not significantly associated with direct costs during treatment. However, receiving complementary treatment and duration of hospital stay were associated with increased expenditure during treatment and this was highly significant (Table 4). Receiving complementary treatment led to 2.12 times higher expenditure during treatment. Patients hospitalized for one week had 50% higher expenditure compared to patients who were not hospitalized. Patients hospitalized for two months had 5.6% higher expenditure than patients who were hospitalized for one week only.

There was no statistical relationship between sex and expenditures during treatment. Also the factor sputum smear result showed no statistical relationship with expenditure in either of the two models.

Coping strategies

The most common coping strategies were the use of household income, donations received and selling assets (Table 5). The highest amounts were raised through household income and selling assets, namely on average US$226 (±23.8) and US$102 (±13.3). Two thirds (65.7%) of patients relied on a detrimental coping strategy to handle the costs of TB. The mean total amount for all detrimental coping strategies was US$182 (±20.8).

The mixed-effects linear regression did not show any statistically significant relationships (Table 6). There was a weak statistical tendency (p=0.096) for patients with higher wealth indices to raise less money through detrimental coping strategies. Patients who had returned from Russia due to their TB showed a statistical tendency (p=0.069) for raising more funds through detrimental coping strategies than patients who had not been to Russia.

Discussion

Limitations

The present study used an analytic descriptive design and hence it is not possible to definitely conclude that a statistical relationship constitutes a causal link. Like other studies investigating household costs of illness, we also had to rely on self-reported costs. Consequently, recall and reporting bias cannot be excluded (e.g. Saunderson 1995). We limited recall bias by means of conducting two interviews, which reduced recall time. Interviewers were trained to recognize unusually high costs for specific items and to ask back comparing the reported costs to local prices for comparable items. Another limitation is that we have only analyzed two coping strategies, while many more exist (Obrist *et al.* 2007). We have focused on those financial coping strategies that bear risks for future impoverishment.

Expenditure

The main factors leading to higher expenditure related to TB were receiving complementary treatment, longer hospital stay and longer treatment delay. The latter two factors were each highly significant factors for higher costs in the relevant and appropriate reference period, respectively, but only showed a statistical tendency ($p<0.1$) in the other time period. For hospitalisation, the period during treatment is appropriate for analysis, because hospitalisation usually happens during treatment and cannot be expected to influence expenditures that had happened previously. The influence of hospitalisation was substantial, patients hospitalised for two months having more than 1.5 times as high costs as patients who were not hospitalised at all. Longer delay was associated with higher expenditure over the whole course of the disease. A similar finding was made in Lusaka, Zambia, where longer patient delay led to higher costs (Aspler *et al.* 2008). Including two proxies for severity

of disease had very little influence on the estimated coefficients or significance levels of different factors–with the exception of the factor hospitalization in the model on costs during the whole episode. It seems unlikely that these findings be confounded by severity of disease. The strong influence of complementary treatment is most likely related to a tradition among Tajik (and other post-Soviet–Mosneaga *et al.* 2008) TB doctors to frequently prescribe additional medication, often several types of drugs. An additional reason could be that doctors supplement their meager incomes through prescribing and/or selling additional drugs. It has been described for other post-Soviet countries, that doctors practice in public premises but for private revenue (Mosneaga *et al.* 2008). The use of additional medication in our study population exceeds international standards by far (WHO 2003) and its rationality is doubtful. For the patients, additional medication is associated with the costs of the drugs themselves, and with traveling to the health facility for a prescription and to the pharmacy. Reducing the use of complementary treatment and of hospitalization could be simple measures to decrease the costs to TB patients in Tajikistan. Expenditure was not associated with sex in either of the two models. The p-values were high and the two estimated coefficients in the opposite direction. Men and women incurred similar expenditure over the course of disease in this study.

Coping strategies

About two thirds of households employed at least one detrimental coping strategy. The mean amount raised was US$182. This high amount suggests that costs associated with an episode of TB push affected households deeper into poverty. The proportion of households employing detrimental coping strategies is higher than found in 15 African countries, where among hospitalized patients (independent of diagnosis), about 50% reported borrowing and/or selling assets (Leive & Xu 2008). Most commonly, the assets sold were cattle, sheep or goats. These are productive assets and confirm our choice to treat sale of assets as a potentially detrimental coping strategy.

While none of the investigated factors was significantly associated with detrimental coping strategies, some aspects are worth discussing. The factor “migration to Russia” showed a tendency towards higher use of detrimental coping strategies–rather contrary to expectation. It was assumed that patients who recently returned from Russia would on average have more cash available, because wages are several times higher in Russia than in Tajikistan. However, the data showed a tendency only and should be interpreted with care. The long treatment delays experienced by migrants developing TB in Russia could have contributed to higher costs (Ayé *et al.* 2010b).

In conclusion, patients and their households face major expenditure during an episode of TB and two thirds of affected households employ detrimental coping strategies that potentially impair future income. Hence household costs of TB are catastrophic. Both sexes experience similar expenditure in this setting. The main factors associated with higher expenditure are receiving complementary

treatment in addition to anti-TB chemotherapy, longer treatment delay and longer stay in hospital. Complementary treatment, which is probably questionable on medical grounds in many patients, had the strongest effect–more than doubling expenditure. Hospitalisation also had a strong influence, mainly on the expenditure during treatment. Reducing additional medication and limiting hospitalization are simple interventions at the level of case management that could lead to lower expenditure for patients. In view of the high costs, such mitigation strategies are urgently needed. Similar health system characteristics and the common use of complementary treatment for TB patients suggest that this factor would also play a role for TB patients in other post-Soviet countries (Mosneaga *et al.* 2008). Studies on the impact of these measures on treatment outcomes in the local context would be highly informative.

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Figures & Tables

Table 1. Reasons for drop-out

Reason	Number of cases (% of drop-outs)
Wrong or insufficient address	18 (23)
Not found at home or in hospital when visited	17 (22)
Died	5 (6)
Initial defaulter	3 (4)
Already in continuation phase when visited	25 (32)
Did not consent	10 (13)
Total	**78 (100)**

Table 2. Characteristics of the 204 study participants

Age [years]	**15 to 24**	**25 to 34**	**35 to 44**	**≥45**
Women	34	23	15	17
Men	44	40	15	16
Total	78	63	30	33

Profession	**House-wife**	**Migrant worker†**	**Farmer**	**Petty trade**	**Un-employed**	**Other**
Women	52	1	11	3	9	14
Men	0	30	13	19	20	32
Total	52	31	24	22	29	46

Setting	**Urban**	**Peri- and semi-urban**	**Rural**
Women	8	3	78
Men	1	8	106
Total	9	11	184

†These patients had returned after labour migration to Russia.

Table 3. Results of the mixed-effects linear regression on total expenditure (in US$, log-transformed); n=204

Factor	**Coefficient/ slope**	**S.E.§**	**p-value**	**fmi†**
sex	0.147	0.132	0.263	0.160
wealth index	0.0449	0.0347	0.196	0.130
days in hospital (log-transformed)	0.0163	0.00910	0.073	0.131
delay in days (log-transformed)	0.231	0.604	*** <0.0005	0.151
complementary treatment	0.744	0.280	** 0.008	0.128
intercept	3.91	0.392	*** <0.0005	0.139
DOTS centre (estimate for variance-covariance matrix)	-1.17	0.420	N/A	0.178

§S.E.=standard error

†fmi=fraction of missing information. The fmi is a measure of the information contained in the missing data in a multiply imputed dataset (Schafer 1997).

*denotes significance levels

Table 4. Results of the mixed-effects linear regression on expenditure during anti-TB chemotherapy (in US$, log-transformed); n=204

Factor	Coefficient/ slope	S.E.§	p-value	fmi†
sex	-0.0586	0.128	0.646	0.141
wealth index	0.0344	0.0357	0.335	0.204
sputum smear result	0.0796	0.0613	0.196	0.260
days in hospital during treatment (log-transformed)	0.0256	0.00945	** 0.007	0.192
delay in days (log-transformed)	0.0994	0.0601	0.099	0.178
complementary treatment	0.752	0.299	* 0.012	0.261
intercept	3.98	0.419	*** <0.0005	0.236
DOTS centre (estimate for variance-covariance matrix)	-0.947	0.332	N/A	0.123

§S.E.=standard error

†fmi=fraction of missing information. The fmi is a measure of the information contained in the missing data in a multiply imputed dataset (Schafer 1997).

*denotes significance levels

Table 5. Frequency and extent of use of different coping strategies by TB patients; n=204

	Proportion of users among patients (%)	Mean (in USD)	S.E.	Median among users of strategy (in USD)
Detrimental coping strategies				
Credit	8.41	22.68	7.80	195.28
Loan	29.97	56.93	15.44	78.57
Asset sales	49.26	101.93	13.29	190.29
Total detrimental strategies	65.70	181.54	20.80	207.81
Non-detrimental coping strategies				
Use of household savings	30.46	63.20	11.08	145.78
Household income	67.39	226.38	23.78	275.35
Donations	48.01	38.85	5.53	48.91
Total non-detrimental strategies	92.28	328.44	24.34	281.80
Total all strategies	**99.10**	**509.97**	**31.05**	**438.33**

Table 6. Results of the mixed-effects linear regression on detrimental economic coping strategies (in US$, root-transformed); n=204

Factor	Coefficient/ slope	S.E.§	p-value	fmi†
sex	-4.82	3.09	0.120	0.286
wealth index	-1.22	0.733	0.096	0.200
sputum smear result	8.19	4.49	0.069	0.365
days in hospital during treatment (log-transformed)	0.269	0.196	0.170	0.273
complementary treatment	3.31	5.67	0.559	0.135
intercept	16.5	5.91	0.005	0.143
DOTS centre (estimate for variance-covariance matrix)	2.83	0.048	N/A	0.427

§S.E.=standard error

†fmi=fraction of missing information. The fmi is a measure of the information contained in the missing data in a multiply imputed dataset (Schafer 1997).