Tanzania Journal of Health Research
Volume 16, Number 1, January 2014
Doi: http://dx.doi.org/10.4314/thrb.v16i1.5

Knowledge and perception on tuberculosis transmission in Tanzania: Multinomial logistic regression analysis of secondary data

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Abstract: Tuberculosis (TB) is one of the most important public health problems in Tanzania and was declared as a national public health emergency in 2006. Community and individual knowledge and perceptions are critical factors in the control of the disease. The objective of this study was to analyze the knowledge and perception on the transmission of TB in Tanzania. Multinomial Logistic Regression analysis was considered in order to quantify the impact of knowledge and perception on TB. The data used was adopted as secondary data from larger national survey 2007-08 Tanzania HIV/AIDS and Malaria Indicator Survey. The findings across groups revealed that knowledge on TB transmission increased with an increase in age and level of education. People in rural areas had less knowledge regarding tuberculosis transmission compared to urban areas [OR=0.7]. People with the access to radio [OR=1.7] were more knowledgeable on tuberculosis transmission compared to those who did not have access to radio. People who did not have telephone [OR=0.6] were less knowledgeable on tuberculosis route of transmission compared to those who had telephone. The findings showed that socio-demographic factors such as age, education, place of residence and owning telephone or radio varied systematically with knowledge on tuberculosis transmission.

Keywords: Tuberculosis, transmission, multinomial logistic regression, perception, knowledge, Tanzania

Introduction

The magnitude of Tuberculosis (TB) remains high worldwide especially in developing countries. It is the second killer worldwide after HIV due to its single infectious agent. In 2012, about 8.6 million people had TB and among them, 1.3 million people (15.1%) died (WHO, 2013). In recent years, the vast majority of tuberculosis cases (95%) and deaths (98%) were from developing countries (Ristić *et al.*, 2010). Although all age groups are at risk, the disease mostly affects young adults (Dodor, 2008; Ristić *et al.*, 2010; WHO, 2013). The disease is still an important public health problem in Tanzania with a prevalence of bacteriological TB of 295 per 100,000 adult populations (MoHSW, 2013).

Studies have shown that, a successful tuberculosis control requires proper and timely diagnosis as well as efficacy anti-TB drugs among other factors (Ristić *et al.*, 2010). This suggests that drugs are not only the way of controlling TB but other factors such as knowledge and perception play a role in preventing and controlling TB. The correct knowledge and positive perception of the community towards TB and its management is a prerequisite to early treatment seeking (Mangesho *et al*., 2007).

Early case identification and adherence to treatment regimens are the remaining barriers to successful control. Rubel & Garro (1992) have identified costs of transportation to clinic services, the socio-cultural factors including stigma that attaches to tuberculosis, the high cost of medication, organizational problems in providing adequate follow-up services, and patients' perception to contribute to delays in seeking care among TB patients.

The significance of TB diagnosis is very important in early stages as a complement to early treatment. If not treated in the earliest five years, about 50% of cases die (Dodor, 2008). The delays in seeking care for TB have been associated with stigma. In some parts, it has been considered as a dirty disease which mainly affects poor people (Kilale *et al*., 2008). The TB related pervasive stigma worsens the quality of life of its victims. Because of this, patients may hide their

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Doi: http://dx.doi.org/10.4314/thrb.v16i1.5

symptoms or diagnosis, and feel guilt and shame (Karim *et al.,* 2011). Beliefs about health and the perceived severity of TB are vital determinants of early help seeking and diagnosis (Karim *et al.*, 2011). Misperception of the diseases can create stigma and panic in the community. In addition, lack of awareness or incorrect knowledge may affect timely reporting and poor compliance (Eram *et al.*, 2006).

Because of the importance of knowledge and perception on TB, there have been rigorous studies focusing on knowledge and perception of TB so as to develop strategies to minimize the effects on patient (Dodor, 2008). By taking into account, the role of knowledge and perception in controlling the disease, the objective of this paper was to analyze the knowledge and perception on TB transmission in Tanzania. Multinomial Logistic Regression analysis was considered in order to quantify the impact of knowledge and perception on TB.

Material and Methods

Source of data

The study adopted secondary data from the Tanzania HIV/AIDS and Malaria Indicator Survey of 2007-2008. The study sample consisted of 16,318 individual household members. The study included variables about knowledge and perceptions on ways tuberculosis is transmitted from both individual and household questionnaires of THMIS. In this study, the outcome variable (TB transmission from person to person) had seven categories (through air when coughing, through sharing utensils, through touching a person with TB, through food, through sexual contact, through mosquito bites and do not know). The explanatory variables included having radio, level of education, place of residence, age of respondents, having television, having telephone, respondents' working status, heard of tuberculosis, treatment on tuberculosis and keeping secret when family member gets TB.

Data analysis

The paper adopted both descriptive and inferential analysis. The descriptive analysis was done in order to obtain the preliminary information of the study sample. The frequency distribution tables were initially presented to describe the study sample of the study area. Chi-square was used to assess the distributional characteristics of the data and as the prerequisite information for multivariate analysis. It was used as the test of association at 5% level of significance between the outcome and explanatory variables, only significant variables were retained for further analysis. Later, multinomial logistic regression analysis was applied to give the functional relationship of the variables.

There were *n*=16,318 independent observations with *p=11* explanatory variables. The qualitative response variable has *k*= 7 categories. To construct the logits in the multinomial case, one of the categories is considered as the base level and all the logits were constructed relative to it. Any category can be taken as the base level but in this case, the reference category is response "do not know how TB is transmitted". The category "*do not know*" was taken as the base level in our description of the method. Let π_j denote the multinomial probability of an observation falling in the j^{th} category. The issue of interest was to find the relationship between this probability and the *p*-explanatory variables $X_1, X_2, ..., X_p$. The logistic regression model was then given by:

$$\log_e\left(\frac{\pi_j(x_i)}{\pi_k(x_i)}\right) = \beta_{oj} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + ...+ \beta_{11j}x_{11i} \ , where \ \ j = 1,2,3.....,k-1$$

$$and\, i = 1,2,....,n$$

Whereby:

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x_{1i} = Having radio, x_{2i} = level of education, x_{3i} = place of residence, x_{4i} = age of respondents, x_{5i} = having television, x_{6i} = having telephone, x_{7i} = respondents' working status, x_{8i} = watched/heard HIV education programme on TV or radio in last 12 months, x_{9i} = heard of tuberculosis, x_{10i} = treatment on tuberculosis and x_{11i} = keeping secret when family member gets TB

β_{0j} = Constant and β_{1j}, β_{2j}, β_{3j}, ..., β_{11j} = Coefficients corresponding to explanatory variables.

Since all the π_j's add to unity, the equation above reduces to

$$\log_e\left(\pi_j\left(x_i\right)\right) = \frac{\exp\left(\beta_{oj} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \ldots\ldots + \beta_{pj}x_{pi}\right)}{1 + \sum_{j=i}^{k-1}\exp\left(\beta_{oj} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \ldots.. + \beta_{pj}x_{pi}\right)}$$

Results

Descriptive Analysis

Over half (57.3%) of the respondents were females. About a quarter (24.6%) of the respondents were 15-19 years old. People aged above 45 years accounted for the minority (8.1%) of the respondents (Table 1).

Table 1: Demographic characteristics of respondents (n=16,318)

Covariate	Response	Number	Description Value (%)
Sex	Male	6,975	42.7
	Female	9,343	57.3
Age of respondents	15-19	4,019	24.6
	20-24	2,827	17.3
	25-29	2,445	15.0
	30-34	2,250	13.8
	35-39	1,988	12.2
	40-44	1,473	9.0
	45-49	1,316	8.1
Residence	Urban	3,671	22.5
	Rural	12,647	77.5
Education level	No education	2,882	17.7
	Primary education	10,403	63.8
	Secondary school	2,765	16.9
	Higher education	268	1.6
Employment	No	4,703	28.9
	Yes	11,569	71.1

The findings indicated that the distribution of males and females for the sample was slightly skewed with females and youths accounting for the larger proportion of the respondents. Majority of the respondents had primary level of education (63.8%) as compared to the rest of the respondents. The respondents from rural areas accounted for over three quarters (77.5%) of the total respondents. Those respondents who were either self-employed or employees occupied 71.1% of the total respondents and those who were not working occupied 28.9% of the total respondents (Table 1).

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Table 2: Respondent's possession of radio, television and telephone (n=16,318)

Covariate	Response	Description Value (%)
Has radio	No	5,332(32.7%)
	Yes	10,154(62.2%)
	Not de jure resident	828(5.1%)
Has television	No	13,571(83.2%)
	Yes	1,910(11.7%)
	Not de jure resident	828(05.1%)
Has telephone	No	15,299(93.9%)
	Yes	174(01.1%)
	Not de jure resident	828(05.1%)

The study showed that majority of the respondents owned radio regardless of what type of radio and only a small proportion (11.7%) had a television set. The majority (80.6%) of the respondents agreed that tuberculosis can be cured but over three quarters (76.4%) could not agree to keep secret when family member gets TB (Table 3).

Table 3: Respondents knowledge of Tuberculosis (n=16,318)

Covariate	Response	Description Value (%)
Heard of Tuberculosis	No	787(04.8%)
	Yes	15,529(95.2%)
Tuberculosis is curable	No	1,767(11.4%)
	Yes	12,492(80.6%)
	Don't know	1,232(8.0%)
Keep secret when family member gets TB	No	11,655(76.4%)
	Yes	3,313(21.7%)
	Don't know	282(1.8%)

Bivariate analysis

The findings showed that respondents with age between 15-19 years old were less likely to accept that TB spreads from person to person through air when coughing compared to those who aged 45-49 years old. Those aged between 20-24 years old were less likely to accept that TB spreads through air when coughing compared to those with age between 45-49 years old. The respondents with the age between 25-29 years old were less likely to accept that TB spreads from person to person through air when coughing compared to those with age between 45-49 years old. Those with age between 30-34 years old were less likely to accept that TB spreads from person to person through air when coughing compared to those with age between 45-49 years old. Those with age between 35-39 years old were less likely to accept that TB spread from person to person through air when coughing compared to those with age between 45-49 years old. Those with the age between 40-44 years old were less likely to accept that TB spreads from person to person through air when coughing compared to those with age between 45-49 years old. Respondents aged between 15 and 44 years were less likely than those aged 45 years and above to accept that TB spreads from person to person through air when coughing (Table 5). The respondents who resided in rural areas were less likely to accept that TB spreads from person to person through air when coughing compared to those from urban areas (Table 5).

The respondents who had no education, those with primary and secondary education were less likely to accept that TB spreads from person to person through air when coughing compared to those with highest level of education. Respondents who had radio were more likely

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to accept that TB spreads from person to person through air when coughing compared to those who were not dejure residents.

Table 4: Cross tabulation of outcome variable versus explanatory variables

Covariate	Response	Tuberculosis transmission from person to person							P-value
		A	B	C	D	E	F	G	
Has radio	No	26.8%	34.2%	46.3%	36.1%	41.9%	41.7%	37.5%	0.000
	Yes	67.8%	61.8%	46.3%	59.8%	50.8%	58.3%	58.0%	
	Not dejure resident	05.4%	04.0%	07.3%	04.1%	07.3%	0.00%	04.5%	
Education	No education	10.0%	18.2%	22.2%	28.4%	24.2%	08.3%	23.7%	0.000
	Primary	62.6%	71.0%	63.4%	64.4%	68.5%	25.0%	62.2%	
	Secondary	24.7%	09.9%	12.2%	07.2%	07.3%	58.3%	13.8%	
	Higher	02.8%	0.9%	02.4%	0.00%	0.0%	08.3%	0.3%	
Residence	Urban	27.9%	18.9%	14.6%	15.5%	17.7%	08.3%	16.1%	0.000
	Rural	72.1%	81.1%	85.4%	84.5%	82.3%	91.7%	83.9%	
Age	15-19	25.7%	16.3%	17.1%	14.9%	29.8%	08.3%	25.4%	0.000
	20-24	16.6%	16.5%	26.8%	12.9%	18.5%	00.0%	19.7%	
	25-29	14.2%	17.0%	09.8%	12.4%	18.5%	08.3%	16.3%	
	30-34	14.2%	16.7%	09.8%	12.9%	08.9%	16.7%	13.5%	
	35-39	12.2%	14.2%	14.6%	22.2%	12.1%	25.0%	11.0%	
	40-44	09.0%	10.8%	09.8%	13.4%	08.9%	33.3%	07.6%	
	45-49	08.2%	08.5%	12.2%	11.3%	03.2%	08.3%	06.6%	
Has TV	No	78.9%	86.3%	80.5%	91.2%	87.9%	91.7%	87.7%	0.000
	Yes	15.7%	09.7%	12.2%	04.6%	04.8%	08.3%	07.8%	
	Not dejure resident	05.4%	04.0%	07.3%	04.1%	07.3%	0.00%	04.5%	
Has telephone	No	92.7%	95.3%	92.7%	95.4%	92.7%	100%	95.0%	0.002
	Yes	01.9%	0.7%	0.00%	0.50%	0.00%	0.00%	0.50%	
	Not dejure resident	05.4%	04.0%	07.3%	04.1%	07.3%	0.00%	04.5%	
Currently	No	31.6%	21.5%	22.0%	23.7%	25.8%	16.7%	28.8%	0.000
Working	Yes	68.4%	78.5%	78.0%	76.3%	74.2%	83.3%	71.2%	
Heard of TB	No	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
	Yes	100%	100%	100%	100%	100%	100%	100%	
TB is curable	No	08.7%	13.0%	19.5%	12.4%	35.0%	0.00%	15.0%	0.002
	Yes	87.4%	83.7%	80.5%	81.9%	56.1%	83.3%	70.4%	
	Don't know	03.9%	03.3%	0.00%	05.7%	08.9%	16.7%	14.6%	
Keep secret	No	80.4%	77.9%	82.9%	72.3%	54.1%	91.7%	71.4%	0.000
	Yes	18.8%	21.6%	14.6%	25.5%	43.4%	8.30%	25.2%	
	Don't know	0.70%	0.50%	2.40%	2.10%	2.50%	0.00%	3.40%	

Keys: A=through air when coughing; B=through sharing utensils; C=through touching person with TB; D=through food; E=through sexual contacts; F=through mosquito bites; F=don't know.

The respondents who did not have telephones were less likely to agree that TB spreads from person to person through air when coughing compared to those with telephones. Respondents who were employed were more likely to agree that TB spreads from person to person through air when coughing compared to those who were not employed. The respondents who believed that TB can be cured were more likely to accept that TB spreads from person to person through air when coughing compared to those respondents who did not know if TB is curable. Respondents who believed that TB cannot be cured were more likely to disagree that TB spreads from person to person through air when coughing compared to those who did not know if TB can be cured (Table 5).

The respondents who accepted to keep secret when family member gets TB were more likely to believe that TB spreads from person to person through air when coughing compared to those who were undecided whether to keep secret or reveal to the public. The respondents who were 15-24 years old were more likely to accept that TB spreads from person to person through sharing utensils compared to those aged above 45 years. The respondents who agreed that tuberculosis can be cured were less likely to accept that TB spreads from person to person

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through sharing utensils compared to those who did not know if tuberculosis can be cured. Respondents who agreed to keep secret when family member gets TB were more likely to believe that TB spreads from person to person through sharing utensils compared to those who did not know whether to keep secret or reveal to the public. The respondents with aged 15-24 years old were more likely to accept that TB spreads from person to person through food compared to those >45 years old.

Respondents who agreed that tuberculosis can be cured were less likely to accept that TB spreads from person to person through sexual contacts compared to those who did not know if tuberculosis curable. Respondents who did not have radio were more likely to accept that TB spreads from person to person through mosquito bites compared to respondents who were not dejure residents (Table 5).

Inferential Analysis

Table 5: Multinomial Logistic Regression of the ways Tuberculosis spread from person to person

Variable	Cases	Through air when coughing	Through sharing utensils	Through touching person with TB	Through food	Through sexual contacts	Through mosquito
Respondents age (ref:45-49)	15-19	0.658***	1.508***	0.388	1.336***	2.474	0.195
	20-24	0.501***	1.627***	0.694	1.341***	1.708	0.00
	25-29	0.56***	0.733	0.312	1.438***	2.052	0.385
	30-34	0.716***	0.851	0.371	1.548***	1.33	1.047
	35-39	0.764***	0.898	0.692	1.071	2.089	2.01
	40-44	0.811***	0.907	0.626	0.911	2.271	3.692
Residence (ref: urban)	Rural	0.686***	0.878	1.338	0.853	0.729	3.061
Education (ref: higher education)	No	0.115***	0.455	0.154	0.907	1.33	0.006***
	Primary	0.223***	0.635	0.195	0.195	1.395	0.01
	Secondary	0.32***	0.392	0.158	1.408	1.071	0.17
Has radio (ref: not dejure resident)	No	1.414	1.255	2.474	0.776	0.838	5.243***
	Yes	1.67***	1.395	0.312	0.939)	1.591	1.485
Has television (ref: yes)	No	0.973	0.893	0.396	1.664	1.271	2.097
Has telephone (ref: yes)	No	0.568***	0.827	0.838	0.619	0.838	1.568
Currently working (ref: No)	Yes	1.121***	0.883	0.78	1.101	0.715	1.087
Tuberculosis can be cured (ref: don't know)	Yes	2.099***	0.199***	0.878	1.857	0.654***	0.195)
	No	3.317***	3.959***	0.158	2.552***	1.568	0.525
Keep secret (ref: don't know)	Yes	2.521***	4.146***	1.33	1.104	0.838	3.692
	No	1.86***	3.603	0.973	1.22	1.591)	0.913

Key: values represent odds ratio; *** implies significant at 5% level otherwise not significant; ref implies reference category

The respondents who resided in rural areas were more likely to accept that TB spreads from person to person through touching person with TB (odd=1.338) and through mosquito bites (odd = 3.061) compared to those from urban areas (Table 5).

Respondents who had works, watching HIV programmes, agreed that tuberculosis can be cured, those who own radio, television and telephone all together showed that were more likely

Doi: http://dx.doi.org/10.4314/thrb.v16i1.5

to agree that TB spread from person to person through air when coughing compared to their respective reference groups (Table 5).

Discussions

Generally findings revealed that almost all respondents have heard of tuberculosis and the majority of respondents agreed that the disease is curable. The study showed that majority of the respondents owned radio this is likely to be the most common source of TB information. This implies the radio is an important source of public health information for the majority of people in Tanzania. Similar findings have been reported in India (Palash *et al*., 2012). The knowledge on tuberculosis transmission increased with an increase in age. However, our results differ from a study in Sudan (Mohamed *et al*., 2007) where satisfactory knowledge about tuberculosis was inversely proportional with respondent's age. Like in our study, Mohamed *et al*., (2007) in Sudan found that the knowledge on tuberculosis increases with an increase in level of education. Many respondents in this study had general knowledge about TB which differs with other studies (Khan *et al*., 2006; Mangesho *et al*., 2007; West *et al*., 2008; Tachfouti *et al*., 2012) that found poor knowledge on TB among many respondents. People from urban areas were more knowledgeable on tuberculosis than their counterparts in rural areas. Similar findings have been reported elsewhere in Tanzania (Kilale *et al*., 2008). In a study in Vietnam, gender, occupation, economic status, education, and sources of information were significantly associated with level of TB knowledge (Hoa *et al.*, 2009).

The problem of fear and being ashamed to disclose the fact that one member of the family is suffering from tuberculosis observed a small proportion of the respondents. Like in our study, in a study in India, Sreeramareddy *et al*. (2013) reported that less than a quarter of the study subject would keep it a secret from neighbours if a member of their family got tuberculosis.

In conclusion, the study showed that those with younger ages, lower level of education, people in rural areas, people who did not have television or radio were all less knowledgeable on TB transmission. It is therefore important that more efforts in strengthening public health education are directed to people in rural areas and young individuals taking into account that majority of Tanzanians are living in rural areas and form the largest proportion of the population.

This study based from secondary data obtained from Tanzania HIV/AIDS Indicator Survey in which tuberculosis was only a smaller part of the survey and therefore was limited to few variables related to tuberculosis knowledge and attitudes. The data lacked other important variables like tuberculosis treatments and prevention.

Acknowledgements

We give much thanks to Tanzania National Bureau of Statistics for helping us with data.

Competing Interest

Authors have no competing interest.

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