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## Examining the Impact of Patient Characteristics and Symptomatology on Knowledge, Attitudes, and Beliefs Among Foreign-born Tuberculosis Cases in the US and Canada

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### Abstract

Foreign-born individuals represent the majority of TB cases in the US/Canada. Little is known about their TB knowledge, attitudes, and beliefs (KAB). Cross-sectional survey was conducted in 22 sites in the US/Canada among foreign-born adults with active TB. Multiple regression was used to examine KAB factors against covariates. Of 1,475 participants interviewed, most answered the

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six knowledge items correctly. Significant predictors of correct knowledge included region of origin, education, income, age, visa status, place of diagnosis, BCG vaccination, and TB symptoms. Significant predictors of higher perceived risk/stigma scores included region of origin, age, place of diagnosis, English fluency, time in the US/Canada, TB symptoms, and household rooms. This study examines associations between TB KAB and patient and disease characteristics in foreign-born individuals in the US/Canada. The findings call for improved health education, along with efforts to reduce stigma and enhance realistic risk assessments.

## Keywords

*Mycobacterium tuberculosis*; Medical care; Survey; KAB; Foreign-born

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## Background

Within the US, tuberculosis (TB) continues to represent a serious public health issue with over 10,000 new cases being diagnosed in 2011. In 2002, the proportion of TB cases reported among foreign-born residents exceeded 50 % for the first time; in 2011, 62 % of TB cases were found in the foreign-born, with a case rate eleven times that of US-born individuals [1]. In Canada, foreign-born individuals also represent the majority of TB cases (64 % in 2005) [2]. Health-protective behaviors, such as the decision to adhere to treatment, are influenced by diverse cultural factors based on individuals' knowledge, attitudes, and beliefs (KAB) [3, 4]. Because foreign-born individuals may come from very diverse backgrounds and thus have very different experiences with TB than those born in the US/Canada, assessing their KAB is exceedingly important.

## Conceptual Framework

Studies conducted with foreign-born individuals residing in the US/Canada have demonstrated that accurate knowledge of TB is related to a higher education level, age, family income, length of time in the US/Canada, and prior experience with TB testing or treatment [5–9]. Many foreign-born individuals perceive that TB may be brought on by a combination of factors, including behavioral factors that stress the body such as cigarette smoking, alcohol consumption, heavy manual labor, poor nutrition, and lack of adequate sleep; or environmental factors such as exposure to germs, contaminated objects or infected patients, unhygienic living conditions, and the inhalation of cold or dirty air [10–12]. Although TB is understood to be infectious, exact means of transmission are unclear [8, 11, 13]. In addition to germ theory, many attribute other factors such as psychological stress, sorcery, retribution for past vices, and sleeping in cold or damp places [14–17].

An additional knowledge gap exists in the relationship between Bacille Calmette-Guerin (BCG) vaccination, tuberculin skin test results, and immunity against illness. Some individuals relate their positive skin test result to receipt of the BCG vaccination [10]. For others, the vaccine is thought to confer lifelong immunity against TB [18]. Such misconceptions are subsequently found to adversely affect patients' adherence to TB and latent TB infection treatment [15].

Patients' perceptions of TB are also tied to concerns regarding their inability to continue work and fear of negative social reactions such as exclusion, stigma, and discrimination. As a result, secrecy around illness is common within immigrant communities and further discourages care seeking [12, 19–22]. Poor interaction with health care workers, perceived lack of confidentiality, and lengthy treatment regimens further augment delays in seeking care [15, 16, 23, 24]. Though medical treatment is generally perceived as a necessary response to disease, self-care techniques, traditional remedies, and consent from family members are frequently seen as crucial first responses to optimal care [14, 25, 26].

Deficiencies in knowledge, misperceptions, and negative attitudes toward TB and TB treatment thus serve as significant barriers to the adoption of preventive health behaviors and the uptake of appropriate treatment for infection. Conversely, greater patient understanding of TB etiology, transmission, and disease management has been associated with positive health-seeking behaviors and better individual experiences with TB [12, 15, 16, 23, 27, 28]. These have been linked to more favorable health outcomes such as higher rates of treatment adherence and completion [15, 16, 27].

The literature on TB KAB has mostly focused on one group of foreign-born cases in a specific region, using unadjusted univariate analyses. This study aims to examine TB KAB in foreign-born TB patients reported across the US/Canada, representing many countries of origin. To understand how patient and disease characteristics impact KAB, we utilized a comprehensive multiple regression approach, along with factor analysis to account for inter-correlations among KAB items. Findings will contribute to the design and implementation of more effective and culturally sensitive strategies for the foreign-born.

## Methods

### Participants

A population-based cross-sectional study was conducted in 22 sites in the US/Canada by the Tuberculosis Epidemiologic Studies Consortium (TBESC); detailed information about the overall study's methodology may be found in Davidow et al. [29]. In the US, sites represented 69 % of reported tuberculosis cases among the foreign-born in 2005 and participants comprised 27 % of foreign-born cases; in Canada, the proportions were 23 and 20 % respectively. Participants in the study were newly reported and verified TB cases within the jurisdiction of the TBESC sites and were born in a country outside the US/Canada. All were interviewed within 180 days of TB diagnosis. While the overall study included children and youth, the present analysis is limited to foreign-born adult TB cases.

### Data Collection

Study personnel were trained to administer questionnaires in English, and with in-person and telephone interpreters if a participant was not fluent in English. Questionnaires and consent forms were translated into ten languages. Interviews with participants speaking 39 other languages were conducted using interpreters [29]. The study was approved by the Centers for Disease Control and Prevention Institutional Review Board (IRB), along with 36 local IRBs. All participants provided written informed consent.

## Measures

Information on participants was collected from hour-long standardized in-person interviews, national TB surveillance data, and federal immigration databases [29]. This study primarily utilized the in-person interview data. The questionnaire explored demographics, socioeconomic status, TB diagnosis and symptoms, health insurance, TB symptoms, health-seeking behaviors, and opportunities for improving detection and diagnosis of TB.

The KAB portion of the questionnaire assessed participants' knowledge about TB transmission, testing, and treatment, along with attitudinal items based on such health psychology constructs as intentions, perceived risk, perceptions of group norms, health locus of control, and perceived costs and benefits [30–33].

## Analysis

Factor analysis was used to identify the latent variable structure of KAB items, resulting in a two-factor solution representing a Knowledge factor and a Stigma/Perceived Risk factor; component variables are noted in Tables 2 and 3. Individual, single-factor, confirmatory factor analyses using Root Mean Square Error of Approximation and Comparative Fit Index values confirm that each factor is an accurate representation of the underlying inter-correlations among the KAB items [34–36].

Responses to items comprising the two factors were combined for each individual to form a knowledge score and a stigma/perceived risk score. These scores were weighted means of the binary correct response indicators, with weights based on scaled variable loadings resulting from confirmatory factor analysis. The following predictors were considered in multiple regression models testing knowledge and stigma/perceived risk: visa status, world region of birth, English fluency, age at diagnosis, race/ethnicity, gender, educational attainment, income, employment status, health insurance status at diagnosis, usual source of care, time in the US/Canada since immigration, diagnosis of diabetes mellitus or HIV, prior history of TB disease, reason for seeking medical care, BCG vaccination status, migration within the US/Canada, and type of health facility where given TB diagnosis.

Model selection employed backward elimination of covariates chosen from a large and diverse set of variables for having significant bivariate associations with knowledge or perceived risk/stigma ( $\alpha = 0.10$ ). Interactions were investigated for logical pairings of remaining covariates (e.g., Income and Education).

The analysis utilized survey design information and site weighting as described in Davidow et al. [29]. All statistical analyses were executed with SAS Version 9.2 (SAS Institute, Inc., Cary, NC), Mplus, [37] and WINSTEPS [38].

## Results

### Characteristics of the Study Sample

The sample of 1,475 participants included more men (59.4 %) than women (Table 1). Participants who were 25–44 years old comprised 45.5 % and 45–64 year-olds comprised 23.9 %. While a substantial group (31.2 %) had less than a 9th grade education, over half

completed high school (54.6 %). Median income was in the \$20,000–29,999 range and 47.0 % were working at time of diagnosis. The largest group originated from East Asia/Pacific Islands (32.0 %); other large groups were from Mexico (24.2 %), Latin America/Caribbean (18.1 %), and Sub-Saharan Africa (12.1 %). Most participants (56.8 %) had permanent visas; 20.1 % were undocumented. By self-report, 53.5 % spoke no English, 9.4 % spoke some English, and 37.1 % spoke English well. The median amount of time spent in the US/Canada was 5–10 years, with 13.5 % having <1 year and 38.2 % having more than 10 years. Almost half (47.3 %) had health insurance when diagnosed with TB. Around half (57.8 %) reported having received BCG vaccine, while 15.5 % could not recall if they had.

### Responses to Knowledge Items

The majority had correct responses to four of the six knowledge items (Table 2). Of the 1,475 respondents, 91.1 % said yes to the question “Do you think medicines can cure TB?” Similarly, a majority knew that a positive tuberculin skin test suggests a danger of developing TB disease (57.7 %) and that medicine could protect a person from TB disease (77.9 %). When asked if a person could have TB disease and not feel sick, 66.0 % agreed (in many but not all cases, this is true). Almost half (49.2 %) knew that BCG vaccination did not confer life-long immunity and 43.3 % stated correctly that TB patients were not cured when symptoms disappeared. However, it is important to note that, with the exception of the first question, a sizeable number could not answer these items.

### Responses to Attitudinal Items

The majority of participants answered both Perceived Risk questions in the affirmative: 61.0 % felt that TB was a big problem for people who came from their country, and 80.3 % viewed TB as a serious issue (Table 3). In contrast, most disagreed with the Stigma items—63.5 % disagreed that they were treated differently by people who knew they had TB and 58.5 % were not concerned that others may find out about their disease. A large majority (79.5 %) were not concerned about being deported for having TB—an important issue for this foreign-born population.

Regarding Group Norms, most felt that family and friends would find it important that they take their medications (92.9 %) and 78.3 % said that they have told people about their disease. Regarding Health Locus of Control and Intentions, most (82.7 %) felt that their own actions would lead to being cured of TB, while 89.1 % disagreed that other things would interfere with completing treatment.

There were five items regarding Care and Treatment which focused on the respondents’ perceptions of TB medical treatment. Large majorities expressed faith in the health care system, with 94.9 % saying that they trusted their doctors and nurses, and 85.8 % saying that their diagnosis was correct. Most (77.6 %) believed that they wouldn’t give TB to other people if they took their medicine. Very few respondents (6.6 %) felt that practitioners of alternative medicine could cure their TB. Regarding side effects, 48.8 % felt concerned, compared to 48.2 % who were not.

### Predictors of Knowledge

Table 4 presents a multiple regression model for TB knowledge. Significant predictors of knowledge included region of origin, education, income, age, visa status, place of diagnosis, BCG vaccination, and TB symptoms. Participants from Mexico and Latin America/Caribbean had significantly higher model-adjusted knowledge scores than those from other world regions. Participants with higher levels of education were more apt to answer the knowledge items correctly—postgraduates were the group with the highest model-adjusted scores (0.593), compared to 0.489 among high school graduates and 0.370 among those with 8th grade education or less. Participants earning in the middle categories of household income (\$20,000–\$29,999 and \$30,000–\$49,999) had significantly higher model-adjusted scores than poorer or wealthier participants.

There was an inverse relation between age and TB knowledge, with 18–24 year-olds having significantly higher model-adjusted scores than other age groups. Significantly higher model-adjusted scores were also found among those with no visa, compared to others. Those who were diagnosed in hospitals, outpatient clinics, municipal/TB clinics, or private doctors' offices had significantly higher model-adjusted knowledge scores than the small number of participants who were diagnosed in other places or could not remember where they were diagnosed. Participants with BCG vaccination had significantly higher model-adjusted scores than others, as did those who experienced two or more TB symptoms compared to those who had one or no symptoms. An interaction between education and income was found—for those with greater education, income levels had less effect on TB knowledge.

### Predictors of Stigma/Perceived Risk

Table 5 presents a multiple regression model for perceived risk/stigma scores associated with TB. Significant predictors of these attitude scores included region of origin, age, place of diagnosis, English facility, time in the US/Canada, TB symptoms, and shared household rooms. Participants from Mexico had significantly higher model-adjusted perceived risk/stigma scores than those from other regions except East Asia/Pacific Islands. Those who were 45–64 years old had significantly higher model-adjusted scores than 18–24 year-olds and those 65 or over. Those who were diagnosed in municipal/TB clinics or private doctors' offices had higher model-adjusted perceived risk/stigma scores than others, as did those who spoke English.

Participants who had been in the US/Canada for 2–3 years had the highest model-adjusted scores, significantly higher than those whose length of stay was 5 years or greater. Those who experienced six to nine TB symptoms had significantly higher model-adjusted scores than others with fewer symptoms. Participants who lived in more crowded settings (one to three rooms) had significantly higher model-adjusted scores than did those with seven or more rooms. An interaction between English fluency and income was found (although income alone was not a significant predictor)—the stigma/perceived risk scores of those who spoke English well were not affected by income while scores for non-English speakers declined as income increased.

## Discussion

Many studies have examined TB KAB in specific groups, either in their home countries or in the US/Canada. This study's contribution is that it includes foreign-born individuals from many countries who have immigrated to the US/Canada and have been diagnosed with tuberculosis. These 1,475 individuals were drawn from 22 sites in the US/Canada. Further, it employs multiple regression to simultaneously explore the impact of a variety of patient and disease characteristics on these individuals' KAB. Results from the knowledge section shows that the majority of participants who provided an answer were able to do so correctly. However, substantial proportions of participants were not able to answer most items.

The regression analysis suggests that TB knowledge was generally higher among groups who may receive more attention around TB issues, such as Mexicans who may benefit from various cross-border service coordination efforts, people who have received the BCG vaccination, and people with a greater number of symptoms. Those with higher levels of education also had more accurate TB knowledge. This was also true of younger people, who may have received health information about TB more recently.

Regarding responses to the attitudinal items, little prior work has been conducted to explore associations between certain attitudes and such desired outcomes as treatment adherence and completion. Most of this study's findings revealed attitudes that would seem to support adherence. Most participants agreed with the Perceived Risk items; the health psychology literature suggests that people who acknowledge their risk are more likely to act upon it [39]. Similarly, the majority agreed with items measuring Group Norms, also suggesting greater adherence through family support and acknowledging one's disease status [40]. Most agreed that their "own actions will determine" their TB cure, while the large majority indicated their intentions to complete treatment by disagreeing with the statement "there are other things that may keep you from finishing your TB treatment."

Personal belief in the efficacy of TB medicines and care was demonstrated by responses to the following items: "you won't give TB to others if you take your medicine," "you trust your doctors and nurses" and the "doctors were correct." Few respondents felt that practitioners of alternative medicine were able to treat TB and most said that they were not concerned about being deported because of their TB status. While most disagreed with questions about stigma ("people who know you have TB treat you differently," "you are concerned that others may find out"), these two concerns were endorsed by a sizeable group—28.9 and 38.6 %, respectively. Regarding side effects, equally-sized groups agreed and disagreed with this concern.

In the regression analysis of perceived risk and stigma, higher scores represented greater feelings of risk and stigma. It is not surprising that such feelings might be more common among those who live in crowded conditions, or who have a greater number of TB symptoms. The attention given to TB among Mexicans also seems to result in greater feelings of risk and/or stigma. The fact that respondents with 2–4 years in the US/Canada felt more risk and stigma is surprising—perhaps new arrivals have too many other concerns to feel highly at risk or are not yet integrated enough to feel stigmatized. A similar

relationship might be found in the fact that 25–64 year-old respondents felt more risk and stigma than either younger or older individuals.

Our study has some limitations. It represents a purposive sample of foreign-born TB patients in the US/Canada and does not include a comparison group. Unlike previous studies, however, it is comprised of a large number of individuals, interviewed in 22 locations where most TB cases among the foreign-born are reported. The study does not incorporate a comparison group of US/Canadian-born cases, largely because the parent study focused on immigration, such as countries of origin, visa status, TB screening opportunities during immigration and other times, and individuals' health-seeking processes. Another limitation derives from the fact that respondents were interviewed in English, along with 39 other languages. A differential item functioning analysis was implemented to examine item difficulty estimates across groups where there is the potential for interpretation differences. However, no clear patterns emerged in how the three English proficiency groups responded to questions, suggesting that language biases were not as problematic as originally thought.

## Conclusion

Comprising the majority of TB cases in the US/Canada, foreign-born individuals are a key target group for those concerned with TB elimination. It is known that this group brings a wide variety of KAB about TB transmission and treatment; however, little effort has been made to examine these factors beyond simple description. This study is a first attempt to uncover associations between TB KAB and patient and disease characteristics. The fact that many participants could not answer knowledge items suggests a role for improved health education for the foreign-born. Findings suggest that further attention needs to be given to measures to reduce stigma and enhance realistic risk assessments for this population.

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**Table 1**

## Participant characteristics (N = 1,475)

	N	%
<i>Sex</i>		
Male	876	59.4
Female	599	40.6
<i>Age (years)</i>		
18–24	239	16.2
25–44	671	45.5
45–64	353	23.9
65+	212	14.4
<i>Education</i>		
8th grade or less (includes no school)	460	31.2
Some high school/secondary school	195	13.2
High school/secondary school graduate	281	19.1
Some college/university	196	13.3
College/university graduate	227	15.4
Postgraduate	100	6.8
Other	11	0.8
Don't know	3	0.2
Refused to answer	2	0.1
<i>Household income (prior to diagnosis)</i>		
<\$10,000	318	21.6
\$10,000–19,999	354	24.0
\$20,000–29,999	209	14.2
\$30,000–39,999	75	5.1
\$40,000–49,999	51	3.5
\$50,000–59,999	28	1.9
\$60,000–69,999	27	1.8
>\$70,000	78	5.3
Don't know/refused	335	22.7
<i>Employed at time of diagnosis</i>		
Yes	693	47.0
No	780	52.8
Don't know	1	0.1
Refused	1	0.1
<i>World region of birth</i>		
Sub-Saharan Africa	179	12.1
Middle East/North Africa	6	0.4
South Asia	156	10.6
Latin America/Caribbean	267	18.1
Mexico	357	24.2

	N	%
East Asia/Pacific Islands	472	32.0
East Europe/Central Asia	28	1.9
Western Europe	10	0.7
<i>Visa status when interviewed</i>		
Undocumented	296	20.1
Temporary	157	10.6
Permanent	837	56.8
No visa required	6	0.4
Unknown <sup>a</sup>	179	12.1
<i>English-speaking ability</i>		
English speaker	547	37.1
Speaks some English	139	9.4
Speaks no English	789	53.5
<i>Length of time in US/Canada (years)</i>		
0–1	199	13.5
1–2	120	8.1
2–3	92	6.2
3–4	92	6.2
4–5	99	6.7
5–10	276	18.7
>10	564	38.2
Missing data	33	2.2
<i>Insurance status when diagnosed</i>		
Yes	697	47.3
No	761	51.6
Unknown	17	1.2
<i>Ever received BCG vaccination</i>		
Yes	852	57.8
No	395	26.8
Don't know	228	15.5

<sup>a</sup>The majority of individuals with unknown visa status were interviewed in New York City where a City Ordinance prohibited questions about visa status

Table 2

Individual TB knowledge items (N = 1,475)

Questions about TB knowledge	Yes		No		DK	
	N	%	N	%	N	%
Do you think medicines can cure TB?	1,343	91.1	21	1.4	111	7.5
Do you think people are cured of TB as soon as their symptoms disappear? <sup>a,b</sup>	533	36.1	639	43.3	303	20.5
Does a positive skin test mean that a person is in danger of getting TB disease? <sup>b</sup>	851	57.7	338	22.9	286	19.4
Do you think a person can have TB disease and not feel sick?	973	66.0	289	19.6	213	14.4
Do you think medicines can protect you from TB disease? <sup>b</sup>	1,149	77.9	140	9.5	186	12.6
Do you think BCG vaccine can protect you from TB for your whole life? <sup>a,b</sup>	272	18.4	725	49.2	478	32.4

<sup>a</sup>Correct response is “no”<sup>b</sup>Indicates individual variables comprising the knowledge factor

**Table 3**

**Individual TB attitude and belief items (N = 1,475)**

Questions on attitudes and beliefs	Yes		No		DK		NA	
	N	%	N	%	N	%	N	%
<i>Perceived risk</i>								
Do you think TB is a big problem for people who come to the US/Canada from your country? <sup>a</sup>	900	61.0	390	26.4	182	12.3	3	0.2
Do you think TB is as serious as other worries in your life? <sup>a</sup>	1,185	80.3	252	17.1	38	2.6	—	—
<i>Stigma</i>								
Do people who know that you have TB treat you differently? <sup>a</sup>	426	28.9	937	63.5	112	7.6	—	—
Are you concerned that others may find out you have TB? <sup>a</sup>	569	38.6	863	58.5	43	2.9	—	—
When you went for TB treatment, were you afraid you might be sent back to the country you came from? <sup>a</sup>	242	16.4	1,173	79.5	36	2.4	24	1.6
<i>Group norms</i>								
Do your family and friends think it is important that you take your TB medicines?	1,370	92.9	50	3.4	32	2.2	23	1.6
Have you told people close to you that you have TB?	1,155	78.3	304	20.6	8	0.5	8	0.5
<i>Health locus of control</i>								
Do you think your own actions determine whether you will be cured of TB?	1,220	82.7	139	9.4	116	7.9	—	—
<i>Intentions</i>								
Are there other things going on in your life that may keep you from finishing your TB treatment?	114	7.7	1,314	89.1	34	2.3	13	0.9
<i>Care and treatment</i>								
Do you trust your doctors and nurses to give you the best treatment for your TB?	1,399	94.9	37	2.5	39	2.6	—	—
Do you believe your doctors were correct when they told you that you had TB?	1,265	85.8	106	7.2	104	7.1	—	—
Do you think that if you take your TB medicine, you won't give TB to other people?	1,145	77.6	209	14.2	121	8.2	—	—
Do you think that people who are not doctors—like herbalists, acupuncturists, <i>curanderas</i> , and shamans—can cure your TB?	97	6.6	1,172	79.7	206	14.0	—	—
Are you are afraid of bad effects from your TB medicine?	720	48.8	711	48.2	44	3.0	—	—

<sup>a</sup>Indicates individual variables comprising the Stigma/perceived risk factor

Predictors of knowledge score

Table 4

Independent variables	N	Unadj mean	Adj mean	Adj mean 95 % CI	Beta	P value	Grouping <sup>a</sup>
<i>World region of birth</i>							
South Asia	156	0.583	0.450	0.422–0.536	-0.1435	<0.001	B
Sub-Saharan Africa	179	0.517	0.473	0.409–0.538	-0.1494	<0.001	B
Mideast/N Africa/Europe/Central Asia	44	0.571	0.481	0.387–0.575	-0.1419	0.004	B
East Asia/Pacific	472	0.461	0.450	0.405–0.496	-0.1722	<0.001	B
Latin Amer/Caribbean	267	0.582	0.583	0.530–0.637	-0.0395	0.146	A
Mexico	357	0.577	0.623	0.569–0.676	–	–	A
<i>Education</i>							
8th grade or less	460	0.431	0.370	0.317–0.423	–	–	C
Some high school	195	0.503	0.433	0.370–0.497	0.3231	0.004	B, C
High school graduate	281	0.519	0.489	0.430–0.548	0.4664	<0.001	B
Some coll/univ.	196	0.606	0.554	0.493–0.615	0.3940	<0.001	A
Coll/univ. graduate	227	0.608	0.557	0.430–0.548	0.4416	<0.001	A
Postgraduate	460	0.674	0.593	0.509–0.677	0.4600	<0.001	A
Other/DK/Ref	16	0.544	0.608	0.527–0.688	0.0951	0.117	A
<i>Household income</i>							
<\$10 K	318	0.540	0.496	0.431–0.560	0.2140	<0.001	B
\$10 K–\$19,999	354	0.522	0.481	0.425–0.538	0.2317	<0.001	B
\$20 K–\$29,999	209	0.562	0.595	0.538–0.652	0.1802	0.005	A
\$30 K–\$49,999	126	0.557	0.569	0.507–0.630	0.3704	<0.001	A
>\$50 K	133	0.661	0.491	0.423–0.560	–	–	B
DK/Ref	335	0.449	0.457	0.392–0.522	0.1448	0.012	B
<i>Age group</i>							
18–24	239	0.575	0.589	0.535–0.643	0.1514	<0.001	A
25–44	671	0.578	0.526	0.485–0.568	0.0888	0.001	B
45–64	353	0.550	0.506	0.453–0.559	0.0685	0.012	B
65+	212	0.377	0.438	0.376–0.499	–	–	C
<i>Visa</i>							

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Independent variables	N	Unadj mean	Adj mean	Adj mean 95 % CI	Beta	P value	Grouping <sup>a</sup>
Undocumented	296	0.543	0.592	0.529–0.655	0.0880	0.003	A
Temporary	157	0.672	0.463	0.403–0.522	-0.0417	0.125	B
Unknown	179	0.503	0.500	0.440–0.561	-0.0038	0.883	B
Permanent/none req'd	843	0.522	0.504	0.465–0.544	-	-	B
<i>Place of diagnosis</i>							
Hospital/outpatient clinic	790	0.533	0.538	0.503–0.573	-0.0094	0.622	A
Private doctor	246	0.582	0.589	0.539–0.639	0.0413	0.110	A
Other	69	0.428	0.434	0.365–0.504	-0.1133	0.002	B
DK	16	0.298	0.465	0.336–0.595	-0.0821	0.211	A, B
DOH/TB clinic	354	0.514	0.548	0.506–0.590	-	-	A
<i>BCG vaccination</i>							
No	395	0.435	0.472	0.423–0.520	-0.1253	<0.001	B
DK/Ref	228	0.447	0.476	0.422–0.530	-0.1206	<0.001	B
Yes	852	0.597	0.597	0.554–0.640	-	-	A
<i>Number of TB symptoms</i>							
1	229	0.480	0.491	0.436–0.545	0.0177	0.496	B
2–5	760	0.552	0.538	0.494–0.582	0.0650	0.004	A
6–9	233	0.589	0.558	0.503–0.612	0.0851	0.003	A
None	253	0.470	0.473	0.420–0.526	-	-	B

An interaction was found between education and income. These results are not presented in the table but are summarized in the text Adjusted R<sup>2</sup> = 0.2157

BCG Bacille Calmette-Guerin vaccine, DOH Department of Health

<sup>a</sup> Adjusted means across levels of a covariate are significantly different (alpha = 0.05) if they have different letters



**Table 5**

Predictors of stigma/perceived risk score

Independent variables	N	Unadj mean	Adj mean	Adj mean 95 % CI	Beta	P value	Grouping <sup>a</sup>
<i>World region of birth</i>							
South Asia	156	0.431	0.280	0.222–0.338	-0.1561	<0.001	C
Sub-Saharan Africa	179	0.352	0.296	0.241–0.350	-0.139	<0.001	C
Mideast/N Africa/Europe/Central Asia	44	0.359	0.303	0.229–0.376	-0.1330	<0.001	C
Latin Amer/Caribbean	267	0.433	0.392	0.334–0.449	-0.0440	0.043	B
East Asia/Pacific	472	0.431	0.411	0.358–0.463	-0.0251	0.245	A, B
Mexico	357	0.479	0.436	0.375–0.496	-	-	A
<i>Age group</i>							
18–24	239	0.407	0.332	0.277–0.388	0.0044	0.876	B
25–44	671	0.426	0.370	0.322–0.419	0.0432	0.074	A, B
45–64	353	0.417	0.380	0.327–0.433	0.0517	0.030	A
65+	212	0.361	0.328	0.266–0.391	-	-	B
<i>Place of diagnosis</i>							
DOH/TB clinic	354	0.442	0.392	0.352–0.431	-	-	A
Private doctor	246	0.414	0.390	0.348–0.432	-0.0015	0.947	A
Hospital/outpt. center	790	0.401	0.350	0.316–0.384	-0.0421	0.019	A, B
DK	16	0.388	0.325	0.143–0.506	-0.0674	0.467	A, B
Other	69	0.359	0.307	0.234–0.380	-0.0851	0.018	B
<i>English-speaking ability</i>							
English speaker	547	0.393	0.382	0.330–0.434	0.1836	<0.001	A
Some English	139	0.381	0.351	0.294–0.409	0.2738	<0.001	A, B
No English	789	0.430	0.324	0.274–0.375	-	-	B
<i>Time from arrival to interview (years)</i>							
<1	199	0.440	0.376	0.311–0.440	0.0721	0.005	A, B
1–2	120	0.433	0.364	0.295–0.433	0.0605	0.044	A, B, C
2–3	92	0.470	0.406	0.336–0.477	0.1027	<0.001	A
3–4	92	0.457	0.384	0.311–0.457	0.0802	0.009	A, B
4–5	99	0.419	0.348	0.274–0.422	0.0446	0.154	A, B, C

Independent variables	N	Unadj mean	Adj mean	Adj mean 95 % CI	Beta	P value	Grouping <sup>a</sup>
5-10	276	0.406	0.331	0.273-0.390	0.0277	0.175	B, C
>10	564	0.382	0.303	0.250-0.357	-	-	C
Missing	33	0.378	0.288	0.208-0.368	-0.0155	0.652	C
<i>Household income</i>							
>\$10 K	318	0.454	0.380	0.320-0.440	0.1771	<0.001	A
\$10 K-19,999	354	0.417	0.359	0.303-0.415	0.1449	<0.001	A
\$20 K-29,999	209	0.395	0.356	0.293-0.418	0.1304	0.002	A
\$30 K-49,999	126	0.390	0.319	0.253-0.385	0.1088	0.087	A
>\$50 K	133	0.364	0.356	0.293-0.419	-	-	A
DK/Ref	335	0.404	0.347	0.291-0.402	0.1654	<0.001	A
<i>Number of TB symptoms</i>							
1	229	0.359	0.302	0.246-0.358	-0.0212	0.383	C
2-5	760	0.407	0.348	0.297-0.399	0.0251	0.209	B
6-9	233	0.510	0.437	0.380-0.494	0.1136	<0.001	A
None	253	0.388	0.323	0.267-0.379	-	-	B, C
<i>Crowding (no. of rms)</i>							
1-3	758	0.438	0.388	0.343-0.433	-	-	A
4-7	627	0.392	0.361	0.316-0.406	-0.0270	0.064	A
>7	63	0.295	0.293	0.223-0.363	-0.0949	0.002	B
Missing	27	0.438	0.062	0.237-0.480	-0.0297	0.616	A, B

An interaction was found between English fluency and income. These results are not presented in the table but are summarized in the text Adjusted R2 = 0.0943

DOHDepartment of Health

<sup>a</sup> Adjusted means across levels of a covariate are significantly different (alpha = 0.05) if they have different letters