

## Original Article

## Knowledge is the most powerful tool in the fight against tuberculosis

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**Abstract**

**Introduction:** In October 2022, after almost two years, tuberculosis reclaimed its first place as the world's deadliest infectious disease, replacing COVID-19. Since knowledge is the most powerful tool to combat any disease, the primary goal of our study was to assess patients' knowledge of tuberculosis and its relationship to their socio-demographic status.

**Methodology:** This cross-sectional study included 1,067 respiratory patients who were surveyed between November 2021 and June 2022 at the Institute for Pulmonary Diseases of Vojvodina (Serbia). They completed a questionnaire designed for this study.

**Results:** The majority of patients (53.7%) were female; over two-thirds (70.8%) were  $\geq 60$  years; every fifth (23.2%) was either with or without primary school; every third (33.3%) was financially poor. Although the majority of patients (97.8%) were aware that tuberculosis is an infectious disease, only 44.2% knew the etiology. Around 3/4 (72.6%) were aware of a tuberculosis vaccine. Hospitalized patients had better knowledge that the vaccine helps prevent tuberculosis than ambulatory patients ( $p = 0.047$ ). Only 16% of patients in both groups knew that tuberculosis incidence is decreasing in Serbia ( $p = 0.074$ ). Good knowledge about tuberculosis was reported by 71.5%. Hospitalized patients showed better knowledge than ambulatory patients ( $p = 0.032$ ). Patients with a higher level of education and higher monthly income were independent predictors of better knowledge of tuberculosis.

**Conclusions:** The study underlines the need to promote knowledge about tuberculosis, particularly among chronic patients, socially vulnerable and refugees, especially in light of the pandemic and emerging economic problems in the region.

**Key words:** knowledge; tuberculosis; patients.

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**Introduction**

Tuberculosis (TB) reclaimed its first place as the world's deadliest infectious killer in October 2022. It took more than two years for TB to return to its former place after it had been replaced by coronavirus disease 2019 (COVID-19) pandemic [1,2].

The pandemic had a negative impact on efforts to battle TB. As a result, the World Health Organization (WHO) reported that TB incidence rose by 3.6% between 2020 and 2021, and the number of annual TB deaths increased for the first time in the last two decades [2-7].

A few studies in the western Balkan region have assessed patients' knowledge of TB (symptoms, spread and therapy) and its relationship to socioeconomic status [8]. However, those studies were conducted more than a decade ago, and TB still remains a major public

health problem, particularly during the pandemic era, and represents the worst security situation since World War II. The Republic of Serbia has taken in a large number of refugees fleeing the war zones in East Europe, Syria, and Afghanistan, as has the rest of Europe. These areas (especially eastern Europe) have a high TB incidence, including resistant forms of TB [6,9].

Since knowledge is the most powerful tool in the fight against any disease, one of the primary goals of our study was to assess patients' knowledge of TB (symptoms, treatment, complications) and its relationship to patients' socioeconomic status based on their education level, employment status, and monthly income. Patients' knowledge about the respiratory symptoms and diseases are crucial for early detection, treatment, and prevention of future TB relapses and

resistant forms. The findings of this study will aid in the development and implementation of an effective information, education, and communication strategy aimed at the population in the coming years.

## Methodology

This cross-sectional study included 1,067 patients (both outpatients and inpatients) treated at the Institute for Pulmonary Diseases of Vojvodina (IPDV) in Sremska Kamenica (Serbia) between November 2021 and June 2022. IPDV is a university-based tertiary health care center and a major referral center in Vojvodina, Serbia's northernmost province. The patients were asked to complete a questionnaire designed specifically for this study by the authors (Supplementary File 1). A similar questionnaire was used in 2012 for a study on TB patients conducted by the first author [8]. Outpatients (ambulatory, AMB) were surveyed in the IPDV's polyclinic service, while hospitalized patients (HOS) were surveyed in the IPDV's hospital facilities. HOS patients were surveyed only after their health status had stabilized after admission to the hospital. Each patient had enough time to read and answer the questions.

The questionnaire consisted of 31 closed-ended questions (questions and sub-questions) about patients' knowledge of TB (its cause, modes of transmission, risk factors, clinical symptoms and treatment). The rest of the questionnaire included eight closed-ended questions regarding basic demographic data and social history, such as gender, age, education level, employment status, monthly income, and personal history such as data on smoking and alcohol usage (Supplementary File 1). Based on the data on TB knowledge, patients were divided into two groups for each parameter: those with "good" knowledge and those with "poor" knowledge. Patients were considered to have good TB knowledge if they correctly answered 19 of 31 questions (61.3%). We used similar percentage level as compared to a similar study from 2012 (more than 60%) [8]. Patients with a monthly income of 330 Euros or less were classified as financially poor, based on the minimum monthly income defined by the National Bank of Serbia and the Republic of Serbia Official Gazette for 2022 [10,11], whereas patients with a monthly income greater than 330 Euros were considered to have a better financial status. Patients who graduated secondary school, college or faculty were classified as those with better education level.

Adult patients (> 18 years) with a respiratory disease and/or respiratory symptomatology were eligible for participation in the study. Respiratory

symptomatology implied that a general practitioner determined the need for a pulmonary examination. Patients who did not complete the questionnaire (one or more answers) were excluded from analysis. Patients with a previous or current TB diagnosis, as well as those referred from other hospitals to IPDV with confirmed TB and/or adverse events during anti-tuberculous therapy (allergic skin reactions, liver dysfunction), were also excluded from the study.

All the information needed for the investigation was obtained using the questionnaire. The information provided by the patients was used exclusively for the purposes of this study. Institutional review and ethics boards of IPDV approved the study protocol (No 5-V/2, 28/Oct/21) and waived the need for informed consent due to the observational study design.

Standard statistical methods for qualitative and quantitative evaluation of the results were applied, including the Mann-Whitney U test, Student's t-test and Chi-square test as appropriate.  $p < 0.05$  was considered as statistically significant. The predictive values of the evaluated variables for good and poor knowledge were evaluated with univariate and multivariate logistic regression analysis. All statistically significant predictors in univariate analysis were included in multivariate logistic regression analysis. All probability values were calculated by assuming a 2-tailed  $\alpha$  value of 0.05 with confidence intervals at the 95% level. All statistical analyses were performed with SPSS for Windows version 25 (SPSS Inc., Chicago, IL, USA).

## Results

### *Socio-demographic characteristics of patients*

The study included a total of 1,067 patients, mostly women (573, 53.7%), with a mean age of 60 ( $\pm$  12.232) years; more than two-thirds of patients were older than 60 years (756, 70.8 %). Most of the patients had a secondary level of education (494, 46.3%), and every fifth was with or without elementary school (248, 23.2%). Every third patient (355, 33.3%) was financially poor, with a monthly income of 330 Euros or less. There were 631 ambulatory patients (329 women, 52.1%) and 436 hospitalized patients (244 women, 55.9%). Among AMB patients, more than a third patients (234, 37.1%) had a secondary level of education, while 31.1% had low socio-economic status. Almost 60% (260) of HOS patients had a secondary level of education, and 36.5% had a low socioeconomic status (Table 1). A total of 182 patients (103 AMB patients and 79 HOS patients) were excluded from analysis because they did not respond to one or more questions on the questionnaire.

*Patients’ knowledge about TB*

The majority of patients in both groups knew that TB is an infectious disease (1,044, 97.8%), but were unsure about its cause (472, 44.2%) (Table 2). Every other patient knew that coughing is the mode of TB transmission (565, 52.9%) and 931 patients (87.3%)

knew that it is a curable disease. Less than three-fourths (775, 72.6%) were aware that a TB vaccine is available, but HOS patients had better knowledge that it helps in TB prevention (HOS, 301 (69.1%) vs. AMB, 376 (59.6%), *p* = 0.047). HOS patients were slightly more aware that alcohol consumption and poor nutrition are

**Table 1.** Socio-demographic characteristics of patients.

Socio-demographic characteristics	Total, n (%)	HOS, n (%)	AMB, n (%)
	1067	436	631
<b>Gender</b>			
Men	494	192 (38.8)	302 (61.2)
Women	573	244 (42.6)	329 (57.4)
<b>Age (years)</b>			
All	AVG 60.05 (SD ± 12.239)	AVG 66.58 (SD ± 9.809)	AVG 53.55 (SD ± 14.655)
< 30	59 (5.6)	15 (25.4)	44 (74.6)
30-60	252 (23.6)	98 (38.9)	154 (61.1)
> 60	756 (70.8)	323 (42.7)	433 (57.3)
<b>Education</b>			
Without school	93 (8.7)	7 (7.5)	86 (92.5)
Primary school	155 (14.5)	90 (58.1)	65 (41.9)
Secondary school	494 (46.3)	260 (52.6)	234 (47.4)
College	133 (12.5)	48 (36.1)	85 (63.9)
University	192 (18)	31 (16.1)	161 (83.9)
<b>Monthly income</b>			
No response	408 (38.2)	161 (36.9)	247 (39.1)
< 330 €	355 (33.3)	159 (36.5)	196 (31.1)
330-560 €	261 (24.5)	107 (24.5)	154 (24.2)
> 560 €	43 (4.0)	9 (2.1)	34 (5.4)

HOS: hospitalized patients; AMB: ambulatory patients; AVG: average; SD: standard deviation; €: euro; n: number of patients.

**Table 2.** Knowledge about TB among HOS and AMB patients (n, %).

Item No.	Question	HOS (n, %)	AMB (n, %)	<i>p</i>
1.	<b>What is the cause of TB?</b>			
	a) Virus	201 (46.1)	266 (42.1)	0.032
	b) Bacteria	162 (37.1)	310 (49.1)	
	c) Fungus	42 (9.6)	12 (2.0)	
	d) None of the above	31 (7.2)	43 (6.8)	
2.	<b>Is TB an infectious disease?</b>			
	a) Yes	424 (97.2)	620 (98.2)	0.092
	b) No	12 (2.8)	11 (1.8)	
3.	<b>How is TB transmitted?</b>			
	a) By hands	118 (27.1)	164 (25.9)	0.064
	b) By sex	5 (1.1)	47 (7.6)	
	c) By towel	85 (19.5)	83 (13.1)	
	d) By coughing	228 (52.3)	337 (53.4)	
4.	<b>Is TB a curable disease?</b>			
	a) Yes	413 (94.7)	518 (82.1)	0.607
	b) No	23 (5.3)	113 (17.9)	
5.	<b>Can the mentioned risk factors can lead to TB?</b>			
	a) Smoking	299 (68.6)	467 (74.1)	0.085
	b) Bad nutrition	388 (88.9)	486 (77.1)	
	c) Alcohol consumption	310 (71.1)	392 (62.1)	
6.	<b>Is there a vaccine against TB?</b>			
	a) Yes	310 (71.1)	465 (73.7)	0.372
	b) No	126 (28.9)	166 (26.3)	
7.	<b>Does the vaccine help to prevent TB?</b>			
	a) Yes	301 (69.1)	376 (59.6)	0.047
	b) No	135 (30.9)	255 (40.4)	
8.	<b>Can some associated diseases contribute to the development of TB?</b>			
	a) HIV infection	274 (62.8)	373 (59.2)	0.095
	b) Diabetes mellitus	255 (58.5)	297 (47.1)	
	c) Tumors	191 (43.8)	284 (45.0)	
	d) Rheumatoid arthritis	213 (48.8)	259 (41.0)	

(Continues on next page)

risk factors for TB development, whereas smoking was mentioned as a TB risk factor equally in both groups ( $p = 0.085$ ). Furthermore, HOS patients had a slightly

better understanding that concomitant diseases (human immunodeficiency virus (HIV) infection, tumors, and diabetes mellitus) could contribute to the onset of TB ( $p$

**Table 2 (continued).** Knowledge about TB among HOS and AMB patients (n, %).

Item No.	Question	HOS (n, %)	AMB (n,%)	<i>p</i>
<b>9.</b>	<b>What are the symptoms of pulmonary TB?</b>			
9.1.	Dry cough			
a)	Yes	345 (79.1)	448 (71.0)	0.279
b)	No	91 (20.9)	183 (29.0)	
9.2.	Cough with expectoration			
a)	Yes	380 (87.1)	512 (81.1)	0.308
b)	No	56 (12.9)	119 (18.9)	
9.3.	Chest pain			
a)	Yes	356 (81.6)	439 (69.6)	0.038
b)	No	80 (18.4)	192 (30.4)	
9.4.	Loss of appetite and body weight			
a)	Yes	371 (85.1)	392 (62.1)	0.030
b)	No	65 (14.9)	239 (37.9)	
9.5.	Fever			
a)	Yes	378 (86.7)	463 (73.4)	0.045
b)	No	58 (13.3)	168 (26.6)	
9.6.	Night sweats			
a)	Yes	374 (85.7)	302 (47.9)	0.022
b)	No	62 (14.3)	329 (52.1)	
9.7.	Stomach pain			
a)	Yes	185 (42.4)	240 (38.1)	0.329
b)	No	251 (57.6)	391 (61.9)	
9.8.	Frequent urination			
a)	Yes	216 (49.5)	231 (36.6)	0.547
b)	No	220 (51.5)	400 (63.4)	
9.9.	Headache and dizziness			
a)	Yes	203 (39.5)	183 (29.1)	0.724
b)	No	233 (60.5)	448 (70.9)	
<b>10.</b>	<b>How long is the treatment of a newly discovered TB?</b>			
a)	2 weeks	12 (2.9)	114 (18.1)	0.032
b)	2 months	76 (17.4)	94 (14.9)	
c)	6 months	194 (44.5)	221 (35.0)	
d)	9 months	141 (32.3)	133 (21.1)	
e)	2 years	13 (2.9)	69 (11.0)	
<b>11.</b>	<b>How many drugs are used to treat TB?</b>			
a)	None	0 (0.0)	0 (0.0)	0.782
b)	One	9 (2.1)	69 (10.9)	
c)	More than one	421 (97.9)	562 (89.1)	
<b>12.</b>	<b>Why is TB being treated for a long period of time and with a greater number of drugs?</b>			
12.1.	To complete cure the disease			
a)	Yes	405 (92.9)	594 (94.2)	0.255
b)	No	31 (7.1)	37 (5.8)	
12.2.	The treatment would cost more			
a)	Yes	69 (15.8)	87 (13.8)	0.255
b)	No	367 (84.2)	544 (86.2)	
12.3.	To avoid complications of the disease			
a)	Yes	349 (80.0)	493 (78.1)	0.255
b)	No	87 (20.0)	138 (21.9)	
<b>13.</b>	<b>What are the possible complications if TB is not completely cured?</b>			
13.1.	Recurrence of the disease			
a)	Yes	322 (73.8)	436 (69.1)	0.193
b)	No	114 (26.2)	195 (30.9)	
13.2.	More severe forms of TB			
a)	Yes	307 (70.4)	403 (63.8)	0.193
b)	No	129 (29.6)	228 (36.2)	
13.3.	Fatal outcomes			
a)	Yes	249 (57.1)	322 (51.1)	0.074
b)	No	187 (42.9)	309 (48.9)	
<b>14.</b>	<b>Is the incidence of TB in Serbia increasing or decreasing?</b>			
a)	Increasing	217 (49.7)	335 (53.1)	0.074
b)	Decreasing	70 (16.1)	102 (16.2)	
c)	It is not changing	149 (34.2)	194 (30.7)	

HOS: hospitalized patients; AMB: ambulatory patients; TB: tuberculosis.

= 0.092). The majority of patients in both groups were well informed about TB symptoms. Less than 50% of those polled correctly identified the duration of TB treatment ( $p = 0.032$ ) and nearly everyone correctly identified the reasons for the duration of TB treatment and the number of drugs used to treat TB. Only 16% of patients in both groups correctly answered that TB incidence is decreasing in Serbia ( $p = 0.074$ ).

*Determinants of patients’ knowledge about TB*

Table 3 shows that 71.5% of all patients had good knowledge of the disease, but HOS patients demonstrated better knowledge ( $p = 0.032$ ). Age, smoking, education level, and monthly income were all significantly associated with patients’ knowledge of TB, while gender and marital status were not. In univariate logistic regression analysis, younger patients, nonsmokers, patients with a higher level of education, a higher monthly income, and hospitalized patients were significant predictors of better TB knowledge (Table 4). In multivariate logistic regression analysis, only patients with a higher level of education and a higher monthly income were independent predictors of better TB knowledge.

**Discussion**

The results of this study demonstrate that majority of respiratory patients (71.5%) were well informed

about TB, especially in the group of hospitalized patients (89.4%,  $p = 0.032$ ). Most patients knew that TB is an infectious disease and were aware of the modes of transmission, prevention (vaccination), risk factors, symptoms, and treatment, but were unaware of the TB incidence in Serbia.

When compared to a similar study from 2012 [8], hospitalized patients in this study demonstrated better knowledge about TB. One possible reason for this could be that hospital patients were able to obtain information about various respiratory diseases, including TB, quickly after admission using the internet and mass media, which are more accessible nowadays than in previous years. Outpatients, on the other hand, had nearly 30% less knowledge than hospitalized patients. The study from Lima (Peru) found a similar lack of TB knowledge among outpatients [12].

The vast majority of patients were aware that TB is caused by microbes. However, 46.1% of hospitalized patients and 42.1% of outpatients stated that TB is caused by a virus. In a previously mentioned study from 2012 [8], patients demonstrated better knowledge regarding this question (58% stated that bacteria are the cause of TB, while 35% thought it was viruses). This disparity in responses can be explained by the fact that we have been in the grip of the COVID-19 pandemic for a long time, and everyone's concern is that viruses can cause most diseases, including TB. The general

**Table 3.** Comparison of poor and good TB knowledge in relation to variables (n, %).

		Poor knowledge	Good knowledge	<i>p</i>
<b>Total</b>	1067	304 (28.5)	763 (71.5)	
<b>HOS</b>	436	46 (10.6)	390 (89.4)	0.032
<b>AMB</b>	631	258 (40.9)	373 (59.1)	
<b>Gender</b>				
Men	494	127 (25.7)	367 (74.3)	0.183
Women	573	174 (30.4)	399 (69.6)	
<b>Marital status</b>				
Yes	661	185 (27.9)	476 (72.1)	0.083
No/Widow	406	119 (29.3)	287 (70.7)	
<b>Smoking</b>				
Yes/Former	545	133 (24.4)	412 (75.6)	0.041
No	522	171 (32.8)	351 (67.2)	
<b>Age (years)</b>				
< 60	311	71 (22.8)	240 (77.2)	0.045
≥ 60	756	233 (30.8)	523 (69.2)	
<b>Education level</b>				
Without school	93	63 (67.7)	30 (32.2)	0.026
Primary school	155	100 (64.5)	55 (35.5)	
Secondary school	494	89 (18.1)	405 (81.9)	
College	133	25 (18.8)	108 (81.2)	
University	192	27 (14.1)	165 (85.9)	
<b>Monthly income</b>				
Not written	408	152 (37.3)	256 (62.7)	0.038
< 330 €	355	89 (25.1)	266 (74.9)	
330-560 €	261	57 (21.9)	204 (78.1)	
> 560 €	43	6 (13.9)	37 (86.1)	

population's low level of health literacy, particularly among those with a lower level of formal education, should also be contemplated in this case [13]. A 2019 study in India found a similar percentage of knowledge regarding the causative agent of TB [14], while only 11% of patients knew the agent in the study from Lesotho [15].

Almost 3/4 of our patients (72.6%) were aware of the existence of the TB vaccine. The HOS group was better informed that vaccination aids in the prevention of TB (HOS, 301 (69.1%) vs. AMB, 376 (59.6%),  $p = 0.047$ ). Although the TB vaccine is administered immediately after birth in Serbia, acceptance of the effectiveness of vaccination in general, including TB vaccine, remains a problem. Mistrust in vaccination has had a particularly negative impact during the COVID-19 pandemic, given the low vaccination rates against COVID-19 in many countries, including Serbia [16]. However, the pandemic has had some positive effects on vaccination. For example, in Serbia, patients with chronic obstructive pulmonary disease (COPD) have improved their attitudes toward seasonal flu vaccination during the current pandemic. Prior to the pandemic, only one-third of COPD patients were immunized against seasonal flu [17]. A study from South Africa showed that only one-third of patients in primary health services agreed that the bacillus Calmette-Guérin (BCG) vaccine could help prevent TB [18], while only 13.5% of pulmonary patients from one Indian study knew that immunization against TB exists [14].

Studies by Staerke (Denmark) [19], Antonio-Arques (Spain) [20] and Almeida Santos (Portugal) [21] showed how important it is to improve TB knowledge among at-risk patients, which may prevent a delay in symptom recognition and thus improve prevention and outcome of the disease. The epidemiological problem with patients with comorbidities who live in large cities where overcrowding is pronounced and there is an increased

risk of contact and spread of infections is particularly relevant. The situation is similar with prisoners [22,23].

The majority of patients in both groups (HOS and AMB) were well informed about the symptoms of TB. Very good knowledge was demonstrated regarding the reasons for the duration of TB treatment and possible complications from TB. These results are very similar to the data from a study by Ilic in 2012 [8]. However, the observed lack of information about the current TB incidence in Serbia was quite surprising. Every other respondent answered that the incidence is increasing, despite the fact that it has been steadily declining for the last 15 years [24]. One of the possible explanations is that people still believe TB is a massive, unsolvable problem that has been going on for decades.

The existence and persistence of stigma accompanies TB and this is the reason for the intensification of information about TB among all categories of the population (students, working population, pensioners), especially among chronic patients [25]. Collin *et al.* [26] while analyzing national strategies for the fight against TB in the EU, found that one of the significant barriers is the lack of knowledge among people.

A very important finding of our study was that independent predictors for good knowledge about TB were patients with a higher level of education and a better monthly income, which correlates with findings from several studies conducted worldwide (China, India, Ethiopia and South Africa) [14,18,27-30]. In contrast, one Malaysian study found no correlation between education level and TB knowledge, which the authors attributed to the fact that most TB patients had access to an efficient health education program, meaning that education level of the patients was not a large determinant of their TB knowledge [31]. The educational level of the patients in our study correlated with that of the general population in the northern

**Table 4.** Predictors of TB knowledge according to logistic regression analysis.

<b>Univariate analysis</b>	<b>RR</b>	<b>95 % CI</b>	<b>p</b>
Marital status (yes)	1.308	0.854-1.769	0.207
Women	0.817	0.493-1.174	0.093
Age < 60 years	0.784	0.573-1.038	0.007
Non-smokers	2.731	1.239-4.306	0.015
Higher education level	0.958	0.692-1.272	< 0.001
Higher monthly income	2.087	0.824-3.455	0.012
<b>Multivariate analysis</b>			
Age < 60 years	0.832	0.591-1.073	0.079
Non-smokers	2.907	1.392-4.412	0.063
Higher education level	0.978	0.703-1.278	0.004
Higher monthly income	2.183	0.856-3.504	0.027

HOS: hospitalized patients; RR: relative risk; CI: confidence interval.

province of Serbia, Vojvodina, according to the censuses of 2011 and 2022 [32].

There are several limitations to this study. First, the data collected from the patients were based on their personal beliefs and memory, which is not always accurate, and the patients may be susceptible to recall bias. Second, we used a modified questionnaire that was originally developed by the authors 11 years ago and conducted the study at only one health center in Vojvodina. Therefore, the results may not be generalizable and comparing our findings to other published studies may be difficult. In addition, there was wide variability of certain observations about patient knowledge made by different researchers. It might be due to different study settings which are culturally less sensitive and largely based on a biomedical framework. Despite these limitations, this is one of the first continuing studies assessing the knowledge of respiratory patients about TB and its relationship to socioeconomic status in this part of the world (Balkan region).

## Conclusions

This study concludes that the overall knowledge of TB was similar to the levels of knowledge found in our previous study in 2012. However, when compared to hospitalized patients, knowledge among outpatients was alarmingly low. The study emphasized the importance of promoting awareness about TB, including TB transmission routes and symptoms, especially among chronic conditions, refugees and the socially vulnerable, in order to help them recognize the disease and seek medical attention as soon as possible.

## References

- Maciel EL, Golub JE, Silva JRLE, Chaisson RE (2022) Tuberculosis: a deadly and neglected disease in the COVID-19 era. *J Bras Pneumol* 48: e20220056. doi: 10.36416/1806-3756/e20220056.
- European Centre for Disease Prevention and Control, WHO Regional Office for Europe (2022) Tuberculosis surveillance and monitoring in Europe 2022 - 2020 data. Available: [https://www.ecdc.europa.eu/sites/default/files/documents/Tuberculosis-surveillance-monitoring-europe-2022\\_0.pdf](https://www.ecdc.europa.eu/sites/default/files/documents/Tuberculosis-surveillance-monitoring-europe-2022_0.pdf). Accessed: 15 February 2023.
- United Nation General Assembly (2015) Transforming our world: the 2030 agenda for sustainable development. A/RES/70/1. Available: <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>. Accessed: 15 February 2023.
- World Health Organization (2015) The end TB strategy. Available: <https://www.who.int/publications/i/item/WHO-HTM-TB-2015.19>. Accessed: 15 February 2023.
- Chakaya J, Khan M, Ntoumi F, Aklillu E, Fatima R, Mwaba P, Kapata N, Mfinanga S, Hasnain SE, Katoto PDMC, Bulabula ANH, Sam-Agudu NA, Nachega JB, Tiberi S, McHugh TD, Abubakar I, Zumla A (2021) Global tuberculosis report 2020 - reflections on the global TB burden, treatment and prevention efforts. *Int J Infect Dis* 113 Suppl 1: S7-S12. doi: 10.1016/j.ijid.2021.02.107.
- Raviglione M, Uplekar M, Weil D, Kasaeva T (2018) Tuberculosis makes it onto the international political agenda for health...finally. *Lancet Glob Health* 6: e20-e21. doi: 10.1016/S2214-109X(17)30449-7.
- World Health Organization (2022) Global tuberculosis report 2022. Available: <https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2022>. Accessed: 15 February 2023.
- Ilic M, Kuruc V, Pavlovic S, Kopitovic I, Kasikovic Lecic S, Zvezdin B, Zaric B, Kojicic M (2012) Tuberculosis in a developing country - how much patients know about disease. *Central Europ J Medicine* 7: 249-257. doi: 10.2478/s11536-011-0124-z.
- Marx FM, Skachkova EI, Son IM, Strelis AK, Urazova OI, Hahn H, Krämer A, Ulrichs T (2009) Control of tuberculosis in Russia and other countries of the former Soviet Union. *Pneumologie* 63: 253-260. doi: 10.1055/s-0028-1119571.
- National Bank of Serbia (2022) Annual Report on Activities and Results. Available: [https://www.nbs.rs/export/sites/NBS\\_site/documents-eng/publikacije/godisnji-izvestaj/annual\\_report\\_2021.pdf](https://www.nbs.rs/export/sites/NBS_site/documents-eng/publikacije/godisnji-izvestaj/annual_report_2021.pdf). Accessed: 15 February 2023.
- Government of Republic of Serbia (2021) Republic of Serbia Official Gazette, No 87/2021 (In Serbian). Available: <https://www.pravno-informacioni-sistem.rs/arrslgl/numberOverview/sgarh/22756>. Accessed: 15 February 2023.
- Penaloza R, Navarro JI, Jolly PE, Junkins A, Seas C, Otero L (2019) Health literacy and knowledge related to tuberculosis among outpatients at a referral hospital in Lima, Peru. *Res Rep Trop Med* 10: 1-10. doi: 10.2147/RRTM.S189201.
- Morrison AK, Glick A, Yin HS (2019) Health literacy: implications for child health. *Pediatr Rev* 40: 263-277. doi: 10.1542/pir.2018-0027.
- Nautiyal RG, Mittal S, Awasthi S, Singh RK (2019) Knowledge about tuberculosis among pulmonary tuberculosis patients: a cross-sectional study from Uttarakhand. *J Family Med Prim Care* 8: 1735-1740. doi: 10.4103/jfmpe.jfmpe\_51\_19.
- Luba TR, Tang S, Liu Q, Gebremedhin SA, Kisasi MD, Feng Z (2019) Knowledge, attitude and associated factors towards tuberculosis in Lesotho: a population-based study. *BMC Infect Dis* 19: 96. doi: 10.1186/s12879-019-3688-x.
- Zivanovic D, Jovin VM, Javorac J, Ilic M, Zelic P (2021) Commentary: registered adverse events following COVID-19 immunization in Serbia. *Eur Rev Med Pharmacol Sci* 25: 6408-6410.
- Ilic M, Kopitovic I, Vulin A, Zvezdin B, Hromis S, Kolarov V, Kuhajda D, vukoja M (2021) Frequency and effects of seasonal flu vaccines on exacerbations of chronic obstructive pulmonary disease in Serbia. *Vojnosanit Pregl* 78: 179-185. doi: 10.2298/VSP181214049I.
- Kigozi NG, Heunis JC, Engelbrecht MC, Janse van Rensburg AP, van Rensburg HCJD (2017) Tuberculosis knowledge, attitudes and practices of patients at primary health care facilities in a South African metropolitan: research towards

- improved health education. *BMC Public Health* 17: 795. doi: 10.1186/s12889-017-4825-3.
19. Staerke NB, Smidt-Hansen T, Oldenborg L, Jensen TT, Weinreich UM, Shakar S, Wejse C, Hilberg O, Fløe A (2021) High yield from repeated testing for tuberculosis among high-risk citizens in Denmark. *Int J Infect Dis* 102: 352-356. doi: 10.1016/j.ijid.2020.10.076.
  20. Antonio-Arques V, Franch-Nadal J, Moreno-Martinez A, Real J, Orcau A, Mauricio D, Mata-Cases M, Julve J, Navas Mendez E, Puig Treserra R, Barrot de la Puente J, Millet JP, Del Val García JL, Vlachos B, Caylà JA (2022) Subjects with diabetes mellitus are at increased risk for developing tuberculosis: a cohort study in an inner-city district of Barcelona (Spain). *Front Public Health* 10: 789952. doi: 10.3389/fpubh.2022.789952.
  21. Almeida Santos J, Soares P, Leite A, Duarte R, Nunes C (2021) Patient and healthcare delays in critical and non-critical pulmonary tuberculosis incidence areas in Portugal: are there differences? *Public Health* 201: 41-47. doi: 10.1016/j.puhe.2021.09.033.
  22. Cords O, Martinez L, Warren JL, O'Marr JM, Walter KS, Cohen T, Zheng J, Ko AI, Croda J, Andrews JR (2021) Incidence and prevalence of tuberculosis in incarcerated populations: a systematic review and meta-analysis. *Lancet Public Health* 6: e300-e308. doi: 10.1016/S2468-2667(21)00025-6.
  23. de Vries G, Aldridge RW, Cayla JA, Haas WH, Sandgren A, van Hest NA, Abubakar I; Tuberculosis in European Union Big Cities Working Group (2014) Epidemiology of tuberculosis in big cities of the European Union and European Economic Area countries. *Euro Surveill* 19: 20726. doi: 10.2807/1560-7917.ES2014.19.9.20726.
  24. Stosic M, Grujicic SS, Grgurevic A, Kuruc V, Ristic L, Antonijevic G, Jevtic M, Plavska D, Vukicevic TA (2020) Trends in tuberculosis notification and mortality and factors associated with treatment outcomes in Serbia, 2005 to 2015. *Euro Surveill* 25: 1900322. doi: 10.2807/1560-7917.ES.2020.25.1.1900322.
  25. Chang SH, Cataldo JK (2014) A systematic review of global cultural variations in knowledge, attitudes and health responses to tuberculosis stigma. *Int J Tuberc Lung Dis* 18: 168-73, i-iv. doi: 10.5588/ijtld.13.0181.
  26. Collin SM, de Vries G, Lönnroth K, Migliori GB, Abubakar I, Anderson SR, Zenner D (2018) Tuberculosis in the European Union and European Economic Area: a survey of national tuberculosis programmes. *Eur Respir J* 52: 1801449. doi: 10.1183/13993003.01449-2018.
  27. Huddart S, Bossuroy T, Pons V, Baral S, Pai M, Delavallade C (2018) Knowledge about tuberculosis and infection prevention behavior: a nine city longitudinal study from India. *PLoS One* 13: e0206245. doi: 10.1371/journal.pone.0206245.
  28. Wu T, He H, Wei S, Pan J, Yang J, Huang S, Gan S, Ye C, Huo H, Tang Z, Feng Q (2022) How to optimize tuberculosis health education in college under the new situation? Based on a cross-sectional study among freshmen of a medical college in Guangxi, China. *Front Public Health* 10: 845822. doi: 10.3389/fpubh.2022.845822.
  29. Gelaw SM (2016) Socioeconomic factors associated with knowledge on tuberculosis among adults in Ethiopia. *Tuberc Res Treat* 2016: 6207457. doi: 10.1155/2016/6207457.
  30. Diriba K, Awulachew E (2022) Associated risk factor of tuberculosis infection among adult patients in Gedeo Zone, Southern Ethiopia. *SAGE Open Med* 10: 20503121221086725. doi: 10.1177/20503121221086725.
  31. Balakrishnan N, Md Monoto EM, Mohd Tohit N, Abdul Wahab A (2021) Knowledge and perception of treatment among tuberculosis patients attending primary care clinics in Malaysia. *J Infect Dev Ctries* 15: 1205-1211. doi: 10.3855/jidc.12891.
  32. The Statistical Office of the Republic of Serbia (2014) The Census of Population in 2011, Households and Dwellings in the Republic of Serbia. Available: <https://www.stat.gov.rs/en-us/oblasti/popis/popis-2011/> Accessed: 15 February 2023.

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## **Annex – Supplementary Items**

### **Questionnaire 1 (side 1/2 of paper)**

#### **1. What causes tuberculosis?**

- a. Virus
- b. Bacteria
- c. Fungus
- d. Nothing

#### **2. Is tuberculosis an infectious disease?**

(YES/NO)

#### **3. How is tuberculosis transmitted?**

- a. Hands
- b. Sex
- c. With a Towel
- d. Coughing

#### **4. Is tuberculosis a curable disease?**

YES NO

#### **5. Can the listed risk factors lead to tuberculosis?**

- a. Consumption of alcohol (YES/NO)
- b. Smoking (YES/NO)
- c. Poor nutrition (YES/NO)

#### **6. Is there a vaccine against tuberculosis?**

(YES/NO)

#### **7. Does the vaccine help prevent tuberculosis?**

(YES/NO)

#### **8. Can some associated diseases contribute to the development of tuberculosis?**

- a. Rheumatoid arthritis (YES/NO)
- b. Diabetes (YES/NO)
- c. Neoplasms (YES/NO)
- d. HIV infection (YES/NO)

#### **9. Circle what you mean by the symptoms of pulmonary tuberculosis.**

- a. Dry cough (YES/NO)
- b. Cough with expectoration (YES/NO)
- c. Chest pain (YES/NO)
- d. Loss of appetite and body weight (YES/NO)
- e. Fever (YES/NO)
- f. Night sweats (YES/NO)
- g. Stomachache (YES/NO)
- h. Frequent urination (YES/NO)
- i. Headache and dizziness (YES/NO)

#### **10. How long is the treatment of a newly discovered tuberculosis?**

- a. 2 weeks
- b. 2 months
- c. 6 months
- d. 9 months
- e. 2 years

#### **11. How many drugs are used to treat tuberculosis?**

- a. Not a single medicine
- b. One c. More than one

**12. Why should tuberculosis be treated for a long time and with a greater number of drugs?**

- a. Completely cured the disease (YES/NO)
- b. Treatment would cost more (YES/NO)
- c. Avoid complications of the disease (YES/NO)

**13. What are the possible complications if tuberculosis is not completely cured**

- a. Recurrence of the disease (YES/NO)
- b. More severe form of tuberculosis (YES/NO)
- c. Fatal outcome (YES/NO)

**14. Is tuberculosis at the state level**

- a. Increasing
- b. Decreased
- c. Does not change

**Demographic questionnaire (side 2/2 of paper)**

**1. Age:** \_\_\_\_\_

**2. Gender**

Male/Female/Other

**3. What school did you complete?**

- a. I didn't finish school
- b. Primary school
- c. Secondary school
- d. College
- e. Faculty

**4. Marital status**

- a. Married
- b. Widowed
- c. Lives alone

**5. Are you employed?**

(YES/NO)

**6. What is your monthly income**

(if you want to answer)? \_\_\_\_\_ (rsd)

**7. Do you consume alcohol?**

(YES/NO)

**8. Do you smoke cigarettes?**

(YES/NO)