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Original Article

Which Patients Are Able To Adhere to Tuberculosis Treatment? A Study in a Rural Area in the Northwest Part of Turkey

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SUMMARY: The purpose of this study was to investigate various factors, including demographical, socio-economical, clinical and radiological features, of adherent and nonadherent patients with tuberculosis (TB) who were admitted to a university hospital between 1998 and 2003. One hundred and one patients (65.5%) and 53 patients (34.5%) met the criteria of adherence and nonadherence, respectively. A higher rate of adherence was observed among females than males (79.2 versus 58.4%, respectively, $P = 0.012$). Older patients were more nonadherent ($P = 0.008$). The adherence rate in non-smokers was significantly higher than that of smokers (81.4 and 52.4%, respectively, $P = 0.000$). Patients who underwent "family screening" were more adherent (75.7%) than those (39.5%) who did not ($P = 0.000$). Patients with pleurisy had higher adherence rates (81.3%), followed by patients with pulmonary TB (65.0%), while patients with extrarespiratory TB had the lowest adherence rates (45.5%) ($P = 0.024$). The presence of cough was significantly associated with adherence ($P = 0.049$). A significantly higher adherence rate was observed in patients without hemoptysis ($P = 0.001$). A univariate logistic regression confirmed that age, smoking, family screening, type of TB, cough and hemoptysis had significant independent effects on the adherence to treatment of TB. High-risk patients may be identified and interventions tailored to promote adherence before concluding that the patient is willfully refusing treatment.

INTRODUCTION

A major contributor to the reemergence of tuberculosis (TB) is a lack of adherence to anti-TB therapy. A number of reviews have looked at adherence to TB treatment as well as adherence in general (1-3). Successfully controlling TB will require that we fully understand all the factors involved in a patient's ability to adhere to treatment as well as our assumptions about what adherence and nonadherence mean. Nonadherence to anti-TB therapy has been a persistent problem throughout the world, including both developing and industrialized countries. Several studies from industrialized countries have shown that alcohol usage, low educational level, low annual income (4), younger age, and longer duration of treatment (5,6) were associated with nonadherence, whereas adherence was higher among patients with TB who were initially hospitalized and those who returned for follow-up within 4 weeks of initiation of therapy (6). In developing countries, adherence to TB therapy seems to be related to shorter home-to-clinic distances (7,8), the use of short-course therapy, whether or not the patient returns for a repeat smear, and whether the patient is reevaluated in the same unit and district (9). Poverty, difficulty supporting the family, the fear of injections, the fear of having to ask for financial support from employers, the fear of loss of employment (3), and the fostering of health-damaging beliefs (1) were all associated with nonadherence to TB therapy in developing countries.

Different results have been obtained with regard to the relationship between patient adherence and variables such as age, gender, and clinical and laboratory status of disease from various studies (1,5,6,8-13). Nonadherence to TB treatment leads to serious results such as delayed sputum conversion, higher relapse rates, and emerging drug resistance. According to the World Health Organization (WHO) report in 2004, the population of Turkey was 70,318,000, the total number of TB cases reported to WHO was 18,043, and the case notification rate was 26 per 100,000 people (14). In addition, the data collected from several local and regional studies indicate that the emergence and rapid growth of multidrug-resistant (MDR) TB has become a matter of great concern (15,16).

The concept of directly observed therapy (DOT) in TB was developed in an attempt to enhance patient adherence to chemotherapy, which is crucial for the successful management of the disease at both the individual and community levels. Although DOT was introduced in Turkey in 2002, the coverage rate of DOT is still less than 10% of the total population (17).

There have been only a few studies on adherence to TB treatment in Turkey (18,19). It was shown that previous treatment history and nonhospitalization were found to be related to nonadherence. Since the study of Sevim et al. was conducted in a TB ward with 32 beds that were all reserved for male patients, the relation between gender and adherence was overlooked (18).

This retrospective study will compare and contrast some of the factors – including demographical, clinical and radiological features – of adherent and nonadherent TB patients in a university hospital in Duzce in the northwest part of Turkey. If our analysis distinguishes well between the two groups, it will be important to identify which dimensions have the greater impact on patient adherence and which are appropriate to serve as a basis for planning educational and health promotive interventions. It is therefore essential to identify characteristics that are associated with adherence to anti-TB medications so that patients at risk for nonadherence can

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be identified and adherence-promoting interventions can be developed.

MATERIALS AND METHODS

This retrospective review was conducted using medical and nursing records of adult patients treated at the Chest Department of Duzce Medical School between October 1998 and October 2003. The Duzce Medical Schoool is located in a rural area in northwest Turkey; its Faculty of Medicine was established in 1997 and its clinical services were started in 1998. The records of 160 patients with either pulmonary/pleural or extrarespiratory TB were evaluated. Six of the patients who were diagnosed with pulmonary TB and started on anti-TB treatment were found to be infected with bacilli that had developed drug resistance to one or more of the medications used during treatment, and were therefore excluded from the analysis. The details of demographic factors such as age, gender, place of residence, site of disease, symptoms of disease, bacteriology, histology, roentgenogram, drug treatment, alcohol and cigarette consumption data, previous TB history and family history were available for all patients. Clinical and demographical data were obtained from several sources: medical records, clinical laboratories, and the Duzce Bureau of Tuberculosis Control. The medical records were reviewed by the same trained investigators and physicians.

This study also reflected the effects of two sequential earthquakes on TB. The earthquakes hit the northwest part of Turkey in August 1999 and in November 1999, each registered 7.4 on the Richter scale, and caused an estimated 20,000 deaths.

Definitions: Adherence denotes the regular taking of the prescribed medication.

Nonadherence was defined as not keeping clinic appointments for at least 2 consecutive months or 3 or more months in the course of 1 year. Patient who refused treatment from the start were also considered nonadherent (20,21).

Newly diagnosed TB was defined as patient who has never had treatment for TB, or who has taken anti-TB drugs for less than 1 month (17).

Previously treated cases were the ones including relapse, treatment after default, and treatment after failure (17).

Extrarespiratory TB was defined as TB of organs other than the lungs and pleura.

Diagnosis of patients: Those patients who were found to be acid-fast bacilli (AFB)-positive on at least two sputum examinations, those who were AFB-positive on one sputum examination and who had radiological findings compatible with active lung TB, and those who were found to be AFB-positive on one sputum examination and had positive cultures were classified as 'smear positive'; those patients who were AFB-negative on at least three sputum examinations and had positive cultures were classified as 'culture positive'; and those patients in whom smear and culture were negative on at least three sputum examinations and also in whom radiological improvement was observed following TB treatment were classified as 'bacillary-negative'. Those cases in whom specimens taken from extrapulmonary organs showed histopathological findings that were consistent with TB, and those in whom bacilli were isolated directly and/or by tissue culture were defined as having 'extrapulmonary TB'.

Treatment protocols: New cases were treated according to the guidelines of the National Tuberculosis Control Program – namely, with the use of isoniazide (H), rifampin (R), pyrazinamide (Z), ethambutol (E), or streptomycin (S) during the initial phase and with the use of H plus R during the continuation phase. Relapsing TB was treated with five anti-TB drugs, i.e., H, R, Z, E, and S, during the 2 months of the initial phase, and then with H, R, Z, and E for 1 month and H, R, and E for 5 months.

None of the patients were under DOT, since our region is still outside the coverage area of the DOT program.

Statistical analysis: For statistical analysis SPSS 10-0 software (SPSS, Chicago, Ill., USA) was used. Categorical data were compared using the Mantel-Haenszel chi-square or Fisher's exact test. Continuous variables were tested by using the Student's *t* test. A *P* value less than 0.05 was accepted as statistically significant. All variables showing a significant relationship on the bivariate tests were included in the logistic regression model. One-way analysis of variance (ANOVA) was used to compare means of three or more samples.

RESULTS

One hundred and one patients (65.5%) and 53 patients (34.5%) met the criteria of adherence and nonadherence, respectively. The mean age of adherent patients was 42 ± 17 (16 - 82) years, while that of the nonadherent patients was 50 ± 18 (17 - 80) years, and the difference was statistically significant ($P = 0.008$).

The distribution of patient frequencies by demographical and socioeconomical features in the adherent and nonadherent groups is shown in Table 1.

A higher rate of adherence was observed among females than males (79.2 versus 58.4%, respectively. $P = 0.012$). The ratio of smokers among females was 15.1% (8/53) while it was 75.2% (76/101) among males. The adherence rate in non-smokers (81.4%) was higher than that of smokers (52.4%), and this difference was statistically significant ($P = 0.000$). Patients who underwent "family screening" had a higher rate of completion of TB treatment (75.7%) than those (39.5%) who did not ($P = 0.000$). Other socioeconomic parameters, such as alcohol consumption, level of education, social security status, hospitalization, place of residence, type of occupation, marital status, family TB history, contact with TB, and initiation of treatment according to earthquake were not associated with adherence.

The mean age of primary school-educated patients (50 ± 16) was significantly higher than those of secondary-high school-educated (40 ± 18) and college-educated patients (39 ± 18) ($P = 0.003$, one-way ANOVA).

The adherence rates of patients over the years 1998 to 2003 are shown in Figure 1.

The rate of the adherence decreased at the time of earthquakes in 1999 and increased steadily thereafter, although this change in adherence did not reach the level of statistical significance.

The clinical, radiographical, and microbiological results of the adherent and nonadherent groups are shown in Table 2.

There was a statistically significant difference in the type of TB between the adherent and nonadherent groups ($P = 0.024$). Patients with pleurisy had higher adherence rates (81.3%), followed by patients with pulmonary TB (65.0%), and patients with extrarespiratory TB (45.5%). The number of "new cases" with pulmonary TB, pleurisy, and extrarespiratory TB was 72/100, 31/32, and 21/22, respectively.

The predominant symptoms in pulmonary TB were cough

Table 1. Demographical and socioeconomical features of adherent and nonadherent groups

	n (%)	Adherence		*P*
		Yes *n* (%)	No *n* (%)	
Gender				
Male	101 (65.6)	59 (58.4)	42 (41.6)	
Female	53 (34.4)	42 (79.2)	11 (20.8)	0.012[1)]
Smoking				
No	70 (45.4)	57 (81.4)	13 (18.6)	
Yes	84 (54.6)	44 (52.4)	40 (47.6)	0.000[1)]
Alcohol consumption				
No	133 (86.4)	89 (66.9)	44 (33.1)	
Yes	21 (13.6)	12 (57.1)	9 (42.9)	0.460
Education				
Primary school	79 (51.3)	47 (59.5)	32 (40.5)	
Secondary-high school	60 (38.9)	41 (68.3)	19 (31.7)	0.108
College	15 (9.8)	13 (86.7)	2 (13.3)	
Social Security				
No	51 (33.1)	34 (66.7)	17 (33.3)	
Yes	103 (66.9)	67 (65.0)	36 (35.0)	0.495
Hospitalization				
No	106 (68.8)	66 (62.3)	40 (37.7)	
Yes	48 (31.2)	35 (72.9)	13 (27.1)	0.272
Residence				
Rural	74 (48.1)	51 (68.9)	23 (31.1)	
Urban	80 (51.9)	50 (62.5)	30 (37.5)	0.497
Occupation				
Housewife	31 (20.1)	25 (80.6)	6 (19.4)	
Office worker	47 (30.5)	32 (68.1)	15 (31.9)	0.073
Farmer	76 (49.4)	44 (57.9)	32 (42.1)	
Marital status				
No	27 (17.5)	19 (70.4)	8 (29.6)	
Yes	127 (82.5)	82 (64.6)	45 (35.4)	0.659
Family TB history				
No	117 (75.9)	74 (63.2)	43 (36.8)	
Yes	37 (24.1)	27 (73.0)	10 (27.0)	0.325
Family screening				
No	43 (27.9)	17 (39.5)	26 (60.5)	
Yes	111 (72.1)	84 (75.7)	27 (24.3)	0.000[1)]
Contact with TB				
No	126 (81.8)	81 (64.3)	45 (35.7)	
Yes	28 (18.2)	20 (71.4)	8 (28.6)	0.518
Initiation of treatment regarding to earthquake				
Before	9 (5.8)	7 (77.8)	2 (22.2)	
During	12 (7.8)	5 (41.7)	7 (58.3)	0.154
After	133 (86.4)	89 (66.9)	44 (33.1)	

Results are expressed as number of cases and percentages.
[1)]: $P < 0.05$, frequencies were compared by chi-square test.

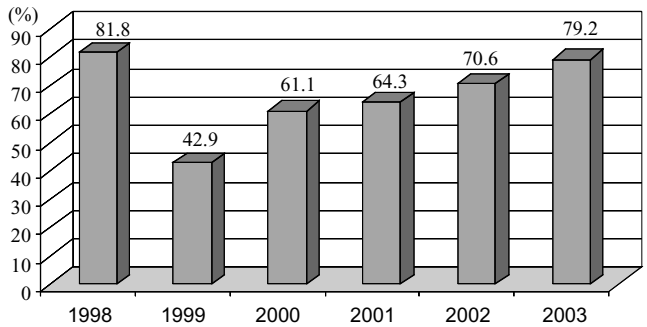

Fig. 1. Adherence rates of patients between 1998 and 2003.

Table 2. Clinical, radiographical and microbiological features of adherent and nonadherent groups

		Adherence		*P*
		Yes *n* (%)	No *n* (%)	
Site of disease				
Pulmonary	100 (64.9)	65 (65.0)	35 (35.0)	
Pleurisy	32 (20.8)	26 (81.3)	6 (18.8)	0.024[3)]
Extrarespiratory	22 (14.3)	10 (45.5)	12 (54.5)	
Definitions of cases				
New cases	124 (80.5)	86 (69.4)	38 (30.6)	0.045[3)]
Previously treated cases	30 (19.5)	15 (50.0)	15 (50.0)	
Symptoms				
Cough				
No	29 (18.8)	14 (48.3)	15 (51.7)	0.049[3)]
Yes	125 (81.2)	87 (69.6)	38 (30.4)	
Sputum				
No	61 (39.6)	40 (65.6)	21 (34.4)	1.000
Yes	93 (60.4)	61 (65.6)	32 (34.4)	
Dyspnea				
No	88 (57.1)	59 (67.0)	29 (33.0)	0.733
Yes	66 (42.9)	42 (63.6)	24 (36.4)	
Night sweating				
No	73 (47.4)	44 (60.3)	29 (39.7)	0.235
Yes	81 (52.6)	57 (70.4)	24 (29.6)	
Weight loss				
No	88 (57.1)	53 (60.2)	35 (39.8)	0.124
Yes	66 (42.9)	48 (72.7)	18 (27.3)	
Hemoptysis				
No	130 (84.4)	93 (71.5)	37 (28.5)	0.001[3)]
Yes	24 (15.6)	8 (33.3)	16 (66.7)	
Chest pain				
No	98 (63.6)	62 (63.3)	36 (36.7)	0.483
Yes	56 (36.4)	39 (69.6)	17 (30.4)	
Radiology				
Cavity				
No	117 (75.9)	82 (70.1)	35 (29.9)	0.047[3)]
Yes	37 (24.1)	19 (51.4)	18 (48.6)	
Infiltration				
No	62 (40.2)	45 (72.6)	17 (27.4)	0.167
Yes	92 (59.8)	56 (60.9)	36 (39.1)	
Pleural effusion				
No	115 (74.6)	72 (62.6)	43 (37.4)	0.242
Yes	39 (25.4)	29 (74.4)	10 (25.6)	
Fibrosis				
No	118 (76.6)	80 (67.8)	38 (32.2)	0.321
Yes	36 (23.4)	21 (58.3)	15 (41.7)	
Bilateral involvement[1)]				
No	96 (72.7)	69 (71.9)	27 (28.1)	0.291
Yes	36 (27.3)	22 (61.1)	14 (38.9)	
Smear acid fast bacilli				
Negative[2)]	18 (18.0)	16 (88.9)	2 (11.1)	0.028[3)]
Positive	82 (82.0)	50 (61.0)	32 (39.0)	
BCG scar				
No	47 (30.5)	33 (70.2)	14 (29.8)	
Yes	44 (28.6)	27 (61.4)	17 (38.6)	0.670
No information	63 (40.9)	41 (65.1)	22 (34.9)	

[1)]: Extrarespiratory TB excluded. [2)]: Among the smear negative patients 13 of them were "culture positive", whereas 5 of them were "bacillary negative". Results are expressed as number of cases and percentages.
[3)]: $P < 0.05$. Frequencies were compared by chi-square test.

Table 3. Evaluation of independent effects of various parameters on the adherence to treatment of TB by logistic regression analysis

Variable	n = 154	Adherence (n)		P	Logistic Regression	
		Yes	No		Coefficient	P
Age (mean±SD)		42 ± 17	50 ± 18	0.008[1)]	–0.035	0.008[3)]
Gender						
Male	101	59	42	0.012[2)]	–0.022	0.970
Female	53	44	11			
Smoking						
No	70	57	13	0.000[2)]	1.495	0.006[3)]
Yes	84	44	40			
Family screening						
No	43	17	26	0.000[2)]	–2.040	0.000[3)]
Yes	111	84	27			
Definitions of cases						
New cases	124	86	38	0.045[2)]	1.301	0.024[3)]
Others	30	15	15			
Cough						
No	29	14	15	0.049[2)]	–1.909	0.001[3)]
Yes	125	87	38			
Hemoptysis						
No	130	93	37	0.001[2)]	2.040	0.001[3)]
Yes	24	8	16			
Cavity						
No	117	82	35	0.047[2)]	–0.097	0.864
Yes	37	19	18			
Smear acid fast bacilli						
Negative	18	16	2	0.028[2)]	2.365	0.132
Positive	82	50	32			

[1)]: $P < 0.05$, by Student's t test. [2)]: $P < 0.05$, by chi-square test. [3)]: $P < 0.05$, by logistic regression analysis.

(93/100) and sputum production (85/100), while those of extrarespiratory TB were night sweating (7/22) and weight loss (5/22). The predominant symptoms in pleurisy were cough (25/32), chest pain (20/32), and dsypnea (20/32).

The presence of cough was significantly associated with adherence (69.6 versus 48.3%, respectively. $P = 0.049$). A significantly higher adherence rate was observed in patients without hemoptysis (71.5%) than in those with hemoptysis (33.3%). Of the adherent patients, 70.1% had no lung cavity on roentgenogram, whereas patients with a cavity had significantly ($P = 0.047$) lower adherence rates (51.4%). Among cavitary patients, hemoptysis was observed in 11/37 (29.7%) while it was observed in 13/117 (11.1%) of noncavitary patients ($P = 0.017$). The number of patients with hemoptysis in the "new" and "previously treated" case groups was 17/124 (13.7%) and 7/30 (23.3%), respectively. That of cavitary patients was 22/124 (17.7%) and 15/30 (50.0%), respectively.

The presence of sputum, dyspnea, night sweating, weight loss, and chest pain were not associated with adherence. With respect to the relationship between radiological appearance (infiltration, pleural effusion, fibrosis) and adherence, no statistically significant relation was found, except for the association between adherence and cavity. There was a significant relation between the results of the smear AFB test and adherence ($P = 0.028$). No association was found between BCG scar and adherence ($P > 0.05$).

The independent effects of various parameters on the adherence to TB therapy were evaluated by univariate logistic regression analysis (Table 3).

Univariate logistic regression showed that age, smoking, family screening, the type of TB, cough, and hemoptysis had significant independent effects on the adherence to TB treatment.

DISCUSSION

Nonadherence to anti-TB treatment is the single most serious problem in TB control. Unfortunately, health care providers and researchers have tended to see nonadherence as a patient problem, ignoring environmental, structural and operational factors. Experienced US TB controllers anecdotally estimate that the rate of medication nonadherence ranges from 20 to 80% and may be as high as 100% in some groups (22). Johansson et al. have therefore suggested that a comparison between adherent and nonadherent patients would contribute to a better understanding of the problem of nonadherence (3).

The role of certain socioeconomic and demographic factors, such as age, gender, social status, smoking status, alcohol consumption, annual income, and education on the adherence to TB treatment has been studied in several reports. The results have been controversial, and have yielded a lot of unintegrated findings about single determinants (1,4,23,24). Patient characteristics cannot be controlled or significantly altered to improve treatment adherence. However, better knowledge of the features associated with poor adherence could help to identify groups at risk of defaulting and lead to improved patient education (21,25).

Although most studies have found no significant relation between younger age and nonadherence to TB treatment (6-8,10,21), several studies have identified such a relation (25-27). In the present study, older patients were more nonadherent

than younger ones. In a study by Ormerod and Prescott (5), the best adherence was observed in those aged over 60 years, and the worst in young adults aged 15-29 years. They speculated that the better adherence in older patients might be due to their perception of the serious import of a diagnosis. The poorest adherence in older patients of our study may have been due to their low education level.

Even though there is no consensus among the studies investigating gender-associated adherence to TB treatment (28,29), it is hypothesized that one explanation for studies showing women to be more compliant with TB treatment is that barriers to diagnosis of TB in women screen out those women most likely to default from treatment. Those who overcome diagnostic barriers are highly motivated and are thus most likely to comply with treatment. Barriers to adherence especially relevant for women include lack of time, cash, transportation, and replacement labor, whereas alcohol consumption plays an important role as a barrier to adherence in men (11). Nonpregnant women are believed to be more adherent than men (8,30-32). The present study revealed that females were more adherent to TB treatment than men. But a univariate logistic regression model showed that smoking rather than gender had a significant independent effect on the adherence to TB treatment. The cause of this difference between males and females was the gender difference in smoking. Insufficient knowledge and individual cost during treatment were reported as the main obstacles to adherence among men (poor patient adherence), while sensitivity to interaction with health staff and stigma in society (poor health staff and system adherence) were reported as the main obstacles among women (32). The results of our study were comparable to those of a study in Ghana, in which women who were active traders or who had control over their own income were found to be more adherent to TB treatment (8). The results of the present study showed that further, larger studies investigating the relation between gender and adherence to treatment of TB will be needed in this rural area.

The present study showed a significant difference in TB-treatment adherence between nonsmokers (81.4%) and smokers (52.4%). Several studies evaluating the relationship between smoking and adherence to TB treatment have shown unexpected results. In a study from Thailand, among 21 patients who were nonadherent to TB treatment, 36.4% stopped smoking for personal reasons (10). In another study, more than one-third (38%) of the noncompliants reported that they had given up one or more unhealthy practices – i.e., 20% had stopped smoking, 8% had quit drinking alcohol and 16% had quit chewing tobacco (1). In the same study, the authors proposed that the pessimism of health workers in regard to their patients' ability to change may have served as a barrier in the relationship between health care providers and patients. We speculated that the same mechanism might play a role in the relationship between doctors and nonadherent patients. The present study showed a higher nonadherence rate to TB treatment among smokers than nonsmokers. In addition, the results of previous studies suggest that a higher level of education and a lower level of pessimism would also be beneficial in lowering the non adherence rate in this high-risk group.

Admission to the local bureau of TB control for family screening was associated with adherence in the present study. We speculate that when family members visited the local bureau together, patients might have received social support from family and/or doctors and health workers, which may have helped them to overcome their fear of disease. Moreover, admission for screening might also be an indicator of responsibility, in this case for patients and their families and their successful completion of treatment.

In contrast to the study that reported a lack of association between the site of disease and adherence to TB treatment (5), a strong association between the site of disease and adherence was found in the present study. The highest adherence rate was observed in patients with pleurisy (81.3%) followed by those with pulmonary TB (65.0%), while the lowest adherence rate was observed in patients with extrarespiratory TB (45.5%). We assumed that this result may have been due to one of several factors, such as the use of invasive procedures to diagnose TB pleurisy, or the requirement for hospitalization to perform diagnostic and therapeutic procedures. We have also speculated that predominant symptoms such as cough and especially chest pain and dsypnea may have led patients to be more adherent to treatment in the pleurisy group. The higher adherence rates in pleurisy patients were not surprising, since the patients were predominantly new cases (31/32) in this group.

In a few studies a negative correlation between cough and adherence to treatment was shown, whereas in others no association was reported (1,10). In the present study, higher adherence rates were observed in patients with cough. We have speculated that cough, which is one of the main symptoms of this particular disease, alarms patients, making them think they are sick and causing them to be more adherent to treatment. Secondly, the finding that a significant number of patients with exrarespiratory TB were nonadherent may have been due to the lack of clear respiratory symptoms. Symptoms experienced by the patients can be regarded as internal reminders and hence as 'cues to action' (33).

Fear of the disease leads to patients presenting late for treatment. In general, patients tend not to accept the diagnosis. Many only present when they 'spit blood'. Most of the adherent patients reported hemoptysis as an initial symptom (3,34). Even though most of our patients did not have hemoptysis, they were more adherent to treatment. Since most of patients with hemoptysis and cavity were among the "previously treated cases" in the present study, the higher nonadherence rates in both groups was reasonable. Cavity formation in the lung appears to be related to hemoptysis. Our results were compatible with another study, in which it was shown that adherence was poor in patients who had persistent cavitation and lung destruction. The authors of that study proposed that irregular use or interruption of drug therapy leads to incomplete healing of TB infections, which subsequently causes permanent parenchymal damage, as seen on chest radiography (35). Although there was no such case in our study, a common reaction leading to nonadherence is disbelief among TB patients (3).

Persons who have failed previously at taking anti-TB medications either for treatment of disease or preventive therapy are at high risk (18,36). The Centers for Disease Control and Prevention reported that in 1991, 5.4% of newly reported cases of TB were recurrent cases. It is likely that most of these recurrences were due to the failure of patients to take their medications (22). This is compatible with our study.

During and after the aforementioned earthquakes, there was absolutely no time to care for chronic patients, and thus patients requiring long-term follow-up for their treatment, such as those with TB, were vulnerable. In addition, the loss

of medical charts and the failure by patients to keep details of their prescribed medications hindered attempts to properly treat these patients, and the suspension of traffic networks prevented them from visiting the hospital. Even though the trend did not reach the level of statistical significance, the treatment adherence rates for patients who initiated anti-TB therapy before the earthquake were higher than those of patients who initiated treatment immediately after the earthquake. We can state that TB is an important health problem under such circumstances.

Adherence to anti-TB medications is multidimensional, involving an interplay between sociodemographic variables and patient characteristics. We need to ask why patients are not able to comply with treatment to TB and eliminate all other possibilities before concluding that the patient is willfully refusing treatment. High risk patients may be identified and interventions tailored to promote adherence.

Better education of medical staff and health-care workers, use of directly-observed treatment, and regular surveillance of treatment outcome will be necessary to improve the results.

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