ORIGINAL RESEARCH

Comparison of In-Person vs. Video Directly Observed Therapy (VDOT) on Stigma Levels in Tuberculosis Patients

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Introduction: **To investigate the effect of video directly observed therapy (VDOT) on stigma levels in tuberculosis (TB) patients.**

Methods: **Thirty TB patients (36.5%) receiving directly observed therapy (DOT) and 52 receiving VDOT (63.4%) between 15.08.2021 and 15.10.2021 in Samsun, Turkey, were included in this study (n = 82). All the participants completed the Stigma Scale in Patients with Tuberculosis (SSTB), and their demographic and disease characteristics were investigated.**

Results: **The mean age of the participants was 50.0 ± 17.8 years, 64 were married (78.8%), and 38 were women (46.3%) in the study group. Sixty patients had pulmonary TB (73.1%), and duration of disease was less than 6 months in 64 (82.9) patients. The mean SSTB score was 84.2 ± 12.3, the DOT group exhibiting higher SSTB scores then the VDOT group (t = 2.524, P = *.006*). The VDOT group had lower mean SSTB subdimension mean scores (perceived stigma, self-perception internalized stigma, and family/friend relations) (P < *.05*). Linear regression models identified VDOT and male gender as independent factors for increased total SSTB scores (P < *.05*). VDOT was also identified as an independent factor for total SSTB subdimension scores in the linear regression models (P < *.05*).**

Conclusion: **Our results confirm that TB patients who receive VDOT has less stigmata compared with homecare DOT. (J Am Board Fam Med 2022;35:951–960.)**

Keywords: **Directly Observed Therapy, Linear Models, Stigmatization, Telemedicine, Tuberculosis**

Introduction

Approximately 1.5 million people worldwide died from tuberculosis (TB) in 2020. TB is the 13th leading cause of death and the second main infectious killer after COVID-19 (and more fatal than HIV/AIDS).[1] TB is a curable and preventable disease requiring strict treatment lasting 6 to 9 months (median, 8.4 months).[2] The World Health Organization recommends directly observed therapy (DOT) as the cornerstone of TB treatment.[3] In this strategy, the TB patient has to swallow each dose of medication in front of a health care professional on a daily basis. Seven-day therapeutic regimens are therefore generally administered, using DOT 5 days per week and self-administered treatment at weekends. DOT is executed using 2 main approaches. Clinical DOT involves the TB patient being asked (or obliged) to travel to a clinic and receive medication, while field DOT (or homecare DOT) involves medical personnel visiting the patient's home or place of work for that purpose.[4] Both methods were designed to monitor drug side-effects and to increase TB patients' compliance with medication. Poorly treated TB patients, or those with poor compliance, represent a public health risk, which increases the costs attendant on the disease, leading to ongoing transmission, disease progression, and development of drug-resistant strains.[5] Multi-drug resistance is a major problem for TB patients, because these require more drugs and experience more side-effects while receiving less effective treatment compared with patients with other conditions.[6] Although DOT has many public

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health benefits, it entails high costs and personal requirements. There is little doubt that clinical DOT adversely affects the quality of life of TB patients with its impact on the economic and social spheres.[7] One of the problems faced by TB patients who undergo DOT is the risk of stigmatization. This can be defined as antipathy toward patient groups with diseases such as epilepsy, AIDS, leprosy, tuberculosis, and schizophrenia. It results in numerous problems, such as exclusion from society, decreased self-esteem, reduced employment opportunities, and loss of social status because of prejudice.[8] Several studies have identified the contagious nature of TB and ignorance regarding the transmission of the disease as the main reasons for stigmatization.[9] There are several aspects of stigmatization in TB. In addition to the negative and discriminatory external social pressure to which patients may be exposed, they may also have negative self-perception. The stigmatized individual often internalizes this sense of lack of value and adopts a set of self-regarding attitudes toward his visible characteristics, including shame, disgust, and guilt.[10] These patients may also conceal their medical condition by withdrawing from interpersonal relationships and social life.[11] Paradoxically, DOT can trigger the opposite of what it actually intends by increasing stigmatization of patients by delaying diagnosis, treatment, and compliance.[12] Stigmatization also increases the cost of treatment by causing the disease to spread in the community, delaying the healing process, and facilitating multi-drug resistance.[13]

However, innovations in electronics and smartphone technology have now made an alternative to the DOT available. Video directly observed therapy (VDOT) involves the use of a videophone or other video/computer equipment to remotely observe tuberculosis (TB) patients taking their medications.[14] This can be done in real time (synchronous), or else patients can record themselves taking their medication and forward this to their health-care professionals (asynchronous).[15] The method is promising as a flexible and less invasive option for helping ensure that TB patients complete their treatment successfully. VDOT is a new approach in the treatment of TB, and many aspects of it have not been studied in any depth. One of the main advantages of VDOT may be its effect on stigma, a subject which has not been investigated to date.

The aim of this study was to investigate the effects of VDOT and DOT on stigmatization levels in TB patients.

Methods

Study Design

The research was designed as an analytic, single-center, cross-sectional study. Eighty-five patients with active TB diagnosed at the Samsun Central Tuberculosis Dispensary, Turkey, between 15 August 2021 and 15 October 2021 were recruited as the study group. TB patients older than 18, receiving antituberculosis medication at least for 2 months before the start of the study period, without missing data, and with no known psychiatric or cognitive disorder were included in the research.

TB is a notifiable disease with very strict treatment regulations in Turkey. Under normal circumstances, patients mostly receive clinical directly observed therapy (DOT) in the health institutions to which they are legally affiliated. However, due to the general curfews imposed under the COVID-19 pandemic, newly diagnosed active TB patients were unable to apply directly to a health institution for DOT and were obliged to take their medicines at home. Two options were offered to these patients for the treatment to be initiated. The first option was to send daily video recordings of themselves taking their medications to the relevant authorities (either their family physician or a TB dispensary). The second option was taking their medication at home on a daily basis under supervision and direct observation by a mobile team consisting of family physicians. Fifty-two patients forwarded video recordings to the relevant authorities. These constituted the asynchronous VDOT group (63.4%). The video recordings sent by these patients were collected, checked, and saved on different servers. Those TB patients who reported being unable to send recordings in this manner due to technical (lack of a smartphone, internet problems, etc.) or social problems were visited by mobile units at their homes on a daily basis and took their medications under direct supervision were enrolled as the home-care DOT group (n = 30).

Three patients who were initially enrolled in the VDOT group and subsequently transferred to the DOT group due to failing to send their recordings were excluded from the research. The remaining 82 TB patients were enrolled as the final study group (96.2%).

Face-to-face interviews were conducted with TB patients who had been receiving antituberculosis

treatments for at least 2 months after choosing between either VDOT or DOT. The participants in both groups were evaluated in terms of socio-demographic characteristics (age, gender, marital status, income level, etc.), cigarette, alcohol or substance abuse, and TB status. The Stigma Scale in Patients with Tuberculosis (SSTB) was applied to both groups. We also put 5 statements on a 5-point Likert scale to the members of the VDOT group concerning their views about VDOT (1 = fully disagree, 5 = fully agree). We also asked this group to rate VDOT on a 10-point scale (between 1 and 10, 1= If you are completely unsatisfied with VDOT, 10= If you are completely satisfied with VDOT). All the data were collected at face-to-face interviews with a single interviewer in the participants' homes following receipt of written consent. No participants refused to participate in the study.

Stigma Scale in Patients With Tuberculosis (SSTB)

Havva Sert developed the SSTB in 2010.[16] It consists of 33 4-point Likert-type statements (1 = strongly agree, 2= agree, 3 = disagree, 4 = strongly disagree) aiming to measure the stigma levels of patients with TB. The highest possible score is 132, and the lowest 33. There is no cutoff point. Higher scores are regarded as indicating greater exposure to stigma. The SSTB has 4 subdimensions; perceived stigma, internalized stigma, self-perception, and family/friends' relationships.

The perceived stigma subdimension measures the stigma felt by the patient from society, while internalized stigma are the negative stereotypes perceived by the individual concerning himself. These patients can develop negative feelings such as worthlessness and shame toward their own existence and thus withdraw themselves from society. Self-perception concerns the TB patient's objective perception of TB. Finally, the family/friends' relationship subdimension measures stigma affecting these social relationships.

The α-Cronbach value for the SSTB was 0.91, while the subdimension values varied between 0.83 and 0.90.

Statistical Analyses

All the variables were uploaded onto Statistical Package for Social Sciences, (SSPS, Version 22) software. A P value <0.05 was regarded as statistically significant. Sociodemographic and disease-specific categorical variables were analyzed using the χ^2 test, and others with Independent Sample *t* test.

Total SSTB and the 4 subdimensions scores were adopted as independent variables. Since SSTB does not determine a cutoff value for TB stigma we were unable to construct binary logistic regression models for the VDOT and DOT groups. The homogeneity tests revealed that all 5 continuous variables were distributed normally ($P < .05$). SSTB total scores and scores for the other 4 subdimensions were modeled in the linear regression equation. Explanatory/predictor variables in the model were identified as membership of the VDOT group, gender, and age. However, since VDOT and gender are categorical variables, these were included in the regression model as dummy (dichotomous) variables. It is acceptable for categorical variables to be included as dummy variables in regression models.[17] Autocorrelation (multicollinearity) analysis was performed between predictors in the regression analysis. The variance inflation factor (VIF) values obtained were very close to 1. It was therefore decided that there was no autocorrelation between the predictors.[18]

Results

Demographic Variables

Eighty-two TB patients (VDOT = 52, DOT = 30) were included in the study. The demographic features of the study population and a comparison of these variables between the 2 groups (VDOT and DOT) are shown in Table 1. Most of the participants were men (53.6%), married (78%), and living in a nuclear family (80.4%). There was no gender difference in terms of family type, educational status, marital status, monthly income, or possession of social security ($P > .05$) in the main study group. However, the rate of unemployment was higher among women (n = 32, 39%) than in men (n = 6, 7.3%) (x^2=10.613, $P < .001$).

The VDOT group was app. 8 years younger than DOT group, and there was a statistically significant difference in terms of marital status, educational level, social insurance ratio and family type between the 2 groups ($P < .05$). No difference was determined between the mean ages of men and women participants in the VDOT ($t = 0.073$, $P = .942$) and DOT ($t = 0.66$, $P = .511$) groups.

Table 1. The Sociodemographic Features of the Participants and Comparison of Them Between VDOT and DOT Groups

	Main Study Population (N = 82)	VDOT (n = 52)	DOT (n = 30)	P Value
Age (years, mean)	53.21 ± 12.7	47.03 ± 18.8	55.2 ± 14.8	P = .04
Gender				
Male	44 (53.6%)	26 (50%)	18 (60%)	P = .260
Female	38 (39.0%)	26 (50%)	12 (40%)	
Marital Status				
Married	64 (78.0%)	36 (69.2%)	28 (93.3%)	P = .037
Single	16 (18.1%)	14 (26.9%)	2 (6.7%)	
Widowed/Divorced	2 (2.2%)	2 (3.8%)	0 (0%)	
Educational Status				
Literate	22 (26.8%)	16 (30.8%)	6 (20.0%)	P = .005
Primary school	34 (41.4%)	26 (50.0%)	8 (26.7%)	
High school	10 (12.1%)	2 (3.8%)	8 (26.7%)	
University	16 (19.5%)	8 (15.4%)	8 (26.7%)	
Family Type				
Nucleus	66 (80.4%)	38 (73.1%)	28 (93.3%)	P = .017
Extended	12 (14.6%)	12 (23.1%)	0	
Broken	4 (4.8%)	2 (3.8%)	2 (6.7%)	
Income**				
<Minimum Wage	25 (30.4%)	19 (42.3%)	6 (20%)	P = .072
Minimum Wage	14 (17.0%)	7 (3.8%)	7 (0%)	
>Minimum Wage	43 (52.4%)	26 (53.8%)	17 (80%)	
Employment				
Yes	28 (34.1%)	14 (26.9%)	14 (46.7%)	P = .058
No	54 (65.8%)	38 (73.1)	16 (53.9%)	
Social Insurance				
Yes	64 (78.0%)	36 (69.2%)	28 (93.3%)	P = .009
No	18 (22.05)	16 (30.8%)	2 (6.7%)	
Smoking Status				
Smoker	22 (26.8%)	12 (23.1%)	10 (33.3%)	P = .561
Non-smoker	38 (46.3%)	26 (50.0%)	12 (40.0%)	
Ex-smoker	22 (26.85)	14 (26.9%)	8 (26.7)	
Alcohol Status (drinking regularly)				
Yes	6 (7.3%)	4 (7.7%)	2 (6.7%)	P = .617
No	76 (92.6%)	48 (92.3%)	28 (93.3%)	

Abbreviations: VDOT, video observed therapy; DOT, directly observed therapy.
**$US 400.00 per month.

Tuberculosis Disease Characteristic Variables

A comparison of TB disease characteristics in the main group and a comparison of these between the 2 groups (VDOT and DOT) are shown in Table 2. The majority of cases in both groups were newly diagnosed, had pulmonary TB, and had been diagnosed less than 6 months previously (80.6% of VDOT and 86.7% of DOT). The most common accompanying diseases were cardiovascular diseases (30.8% of VDOT and 40% of DOT). Viral hepatitis B was the most common accompanying infectious disease (n = 3 VDOT, n = 2 DOT). There were no HIV cases in either group.

Mean Total SSTB and Subdimension Scores

The mean total SSTB and subdimension scores in the main study group and comparison of these between the 2 groups (VDOT and DOT) are given in Table 3. There was no significant gender difference in terms of mean total SSTB and subdimension scores in the main study group ($P > .05$). No significant association was observed between family

Table 2. The Disease Features of the Study Group and Comparison of Them Between VDOT and DOT Groups

Variable	Main Study Population (N = 82)	VDOT (n = 52)	DOT (n = 30)	P Value
Disease Status				
Newly Diagnosed	76 (92.6)	48 (92.3%)	28 (93.3%)	P = .210
Recurrence	6 (7.3)	4 (7.6%)	2 (6.7%)	
TB location				
Lung	60 (73.1)	36 (69.2%)	24 (73.3%)	P = .487
Other than lung	22 (26.8)	16 (30.8%)	6 (26.7%)	
TB duration (months)				
0 to 2	32 (39.0)	18 (34.6%)	14 (46.7%)	P = .556
3 to 6	36 (43.9)	24 (46.2%)	12 (40.0%)	
6 to 12	12 (14.6)	8 (15.4%)	4 (13.3%)	
>12	2 (2.4)	2 (3.8%)	0 (0%)	
Any other TB patients among 1st/2nd degree relatives?				
Yes	24 (29.2)	18 (34.6%)	6 (20.0%)	P = .124
No	58 (70.7)	34 (65.4%)	24 (80%)	
Chronic disease (Yes)				
Diabetes Mellitus	22 (26.8%)	12 (23.1%)	10 (33.3%)	P = .225
Cardiovascular Disease	28 (34.1%)	16 (30.8%)	12 (40.0%)	P = .271
GIS	9 (10.9%)	6 (11.5%)	3 (10%)	P = .374
Rheumatic diseases	16 (19.5%)	8 (15.4%)	8 (26.7%)	P = .170
Infectious Diseases	8 (9.7%)	5 (9.6%)	3 (10%)	P = .125

Abbreviations: VDOT, video observed therapy; DOT, directly observed therapy; TB, tuberculosis; GIS, Geographic Information Systems.

type, monthly income, educational status, marital status, employment, or possession of social security and total SSTB and subdimension scores. Positive weak correlation was determined between age and family/friends' stigma scores ($r = 0.222$, $P = .045$).

Mean total SSTB and all 4 subdimension scores were higher in the DOT group than in the VDOT group ($P < .05$). Women had higher total SSTB scores (86.03 ± 13.8 vs 77.34 ± 12.04, $t = 2.414$, $P = .020$), perceived stigma subdimension scores, and internalized stigma subdimension scores (19.0 ± 2.2 vs 17.3 ± 2.9 $t = 2.328$, $P = .024$) compared with men in the VDOT group. Comparison of total and subdimension scores between the genders in the DOT group revealed that only internalized stigma scores were significantly higher among men than in women (24.2 ± 2.1 vs 21.5 ± 3.6, respectively, $t = 2.620$, $P = .014$).

The Relationship between Sociodemographic and Disease Variables and SSTB Scores in the VDOT and DOT Groups

Main Study Population

No statistically significant association was found between onset of the disease, location of TBC, having a relative with TBC, and smoking status among the patients and mean total SSTB and

Table 3. The Mean SSTB and Subdimension Scores in the Main Study Group and Comparison of Them Between VDOT and DOT Groups

Variable	Main Study Population (N = 82)	VDOT (n = 52)	DOT (n = 32)	P Value
Total SSTB score	88.21 ± 12.8	81.69 ± 13.58	88.69 ± 8.4	0.06
Perceived stigma	36.1 ± 3.7	33.3 ± 6.05	36.13 ± 3.2	0.008
Internalized stigma	23.7 ± 2.2	18.15 ± 2.7	23.13 ± 3.1	<0.001
Self-perception	22.0 ± 2.5	16.5 ± 2.8	22.0 ± 2.5	<0.001
Family/friends relationship	18.1 ± 2.3		12.5 ± 3.3	<0.001

Abbreviations: VDOT, video observed therapy; DOT, directly observed therapy; SSTB, stigmata scale in patients with tuberculosis.

subdimension scores ($P > .05$) in the main study sample. However, individuals' education to university levels had lower total STSB scores ($F = 2.057$, $P = .015$, 86.7 ± 12.4 vs 74.6 ± 10.8), perceived stigma ($F = 2.057$, $P = .015$, 34.8 ± 3.5 vs $30.7 \pm$) and relations between family ($F = 1.987$, $P = .028$, 18.1 ± 2.4 vs 15.3 ± 3.2) scores than those who were merely literate. The group with the highest monthly income registered lower scores for perceived stigma ($F = 3.774$, $P < .001$, 47.0 ± 7.0 vs 32.2 ± 3.6), self-perception ($F = 5.478$, $P = .0041$, 21.0 ± 0.0 vs 16.6 ± 2.3) and family/friends' relationships ($F = 6.887$, $P = .004$, 21.5 ± 3.5 vs 12.3 ± 2.4) compared with the lowest income group.

DOT Group

No statistically significant differences were observed in mean total SSTB, perceived stigmata, self-perception, family/friends' relationships, and mean SSTB scores in terms of gender, marital status, education status, family type, monthly income level, or employment status. However, the participants in the DOT group who possessed social security registered lower mean total STSB ($t = 2587$, $P = .016$, 82.2 ± 9.1 vs 99.5 ± 7.7), perceived stigma ($t = 3110$, $P = .007$, 37.7 ± 3.6 vs 40.5 ± 2.1), and internalized stigma ($t = 2587$, $P = .007$, 18.7 ± 2.4 vs 23.5 ± 3.5) scores.

VDOT Group

Patients with higher education had lower mean total STSB ($F = 5014$ $P = .04$, 71.8 ± 15.7 vs 86.3 ± 13.1) and self-perception ($F = 4.102$, $P < .001$, 47.0 ± 7.0 vs 31.7 ± 3.7) scores. The group with the highest income scored lower on the perceived stigma ($F = 6201$, $P < .001$, 14.2 ± 4.3 vs 18.1 ± 2.4), self-perception ($F = 3.784$, $P = .034$, 21.0 ± 0.0 vs 16.0 ± 2.2), and family/friends' relationships ($F = 8.657$, $P = .002$, 21.5 ± 3.5 vs 11.2 ± 2.0) subdimensions compared with the lowest income group.

Views concerning VDOT

The VDOT group replied to the 5 statements using a 5-point Likert scale, the mean scores for all 5 being higher than 4. These statements were "I spent less time with VDOT (4.46 ± 1.2)", "VDOT is economical (4.47 ± 0.8)", "VDOT is practical (4.28 ± 0.9)", "VDOT does not affect my daily routine (4.25 ± 1.1)," and "I recommend VDOT (4.12 ± 1.3)". They also awarded VDOT a mean 9.41 ± 2.5 points on a 10-point scale (1 = very unsatisfactory, 10 = very satisfactory).

The Linear Regression Models for SSTB and Its Sub-Dimensions

The linear regression model investigating the relationship between total SSTB scores and VDOT, age, and gender is shown in Table 4. Age did not emerge as an independent risk factor for total SSTB scores. In this model, men and TB patients undergoing VDOT had less stigma compared with other participants ($P < .05$). The model had a R^2 value of 0.132, indicating that 13% of the model could be explained by these 2 independent risk factors.

The linear regression model investigating the relationship between perceived stigma subdimension scores and VDOT, age, and gender is presented in Table 5. According to this model, men and TB patients with VDOT had less perceived stigma than other participants. This model had an R^2 value of 0.167, indicating that 16% of the model could be explained by these 2 independent risk factors.

The linear regression model investigating the relationship between internalized stigma scores and VDOT, age, and gender is shown in Table 6. According to this model, only TB patients treated with VDOT experienced less stigma than the other participants. This model had an R^2 value of 0.411, indicating that 41% of the model could be explained by this independent risk factor.

Table 4. The Linear Regression Model Predicting Variables Affecting Total SSTB Scores

Predictor Variable	B (95% CI)	t	P Value	R	R^2	F (p)
Age	−0.087 (−0.237/0.062)	−1.162	0.249	0.364	0.132	3.962 (0.011)
Male gender	−5.263 (−10.473/−0.052)		0.048			
VDOT*	−8.186 (−13.720/−2.652)	−2.295	0.004			

Abbreviations: SSTB, Stigmata Scale in Patients with Tuberculosis; CI, confidence interval; VDOT, video observed therapy.

Table 5. The Linear Regression Model Predicting Variables Affecting SSTB Perceived Stigma Scores

Predictor Variable	B (95% CI)	t	P Value	R	R^2	F (p)
Age	−0.074 (−0.137/0.011)	−2.337	0.022	0.408	0.167	5.195 (0.003)
Male gender	−5.263 (−10.473/−0.052)	−2.011	0.048			
VDOT*	−8.186 (−13.720/−2.652)	−2.295	0.004			

Abbreviations: SSTB, Stigmata Scale in Patients with Tuberculosis; CI, confidence interval; VDOT, video observed therapy.

The linear regression model investigating the relationship between self-perception of stigma scores and VDOT, age, and gender is presented in Table 7. Only VDOT emerged as an independent risk factor for perception of stigma, while age and gender had no effect. This model had an R^2 value of 0.494, indicating that 49% of the model could be explained by this independent risk factor.

Finally, the linear regression model investigating the relationship between perception of stigma scores and VDOT, age, and gender is given in Table 8. VDOT again emerged as an independent risk factor for perception of stigma, while age and gender had no effect. This model had an R^2 value of 0459, showing that 45% of the model could be explained by this independent risk factor.

Discussion

Various studies have investigated the reasons for stigma, its characteristics, and its effect on the diagnosis and treatment of TB. However, to the best of our knowledge, this is the first study to examine stigma levels in TB patients undergoing VDOT and DOT.[9,19,20] Total stigma levels in the VDOT group were significantly lower than those in the DOT group. The VDOT group also exhibited lower stigma on all subdimensions (perceived, self-perception, internalization, and family/friends' stigma). It is particularly striking that these results were obtained when comparing homecare DOT patients with VDOT patients. Patients undergoing clinical DOT spend a considerable amount of time on their treatment and are at a greater risk of stigma when attending a health care institution compared with homecare DOT patients. In particular, clinical DOT patients have to visit a health center during working hours 5 days a week. If these patients are working or studying, they have to request the requisite leave from their work or school to comply with this regimen. This means admitting their medical condition to their superiors, bosses, teachers, or colleagues, in contravention of the universal patient right to "diagnostic confidentiality."[21] In the present study, home-based DOT was performed by mobile family physicians. Dick & Schoeman[22] explained that the presence of a health professional for the provision of home-based DOT, marks an individual out as infected, which may further increase their stigmatization. Our results might therefore have been more dramatic if our control group had consisted of all clinical instead of homecare DOT patients.

TB patients are known to perceive themselves as at risk of a number of stigma-related social and economic outcomes. Men are more concerned with the impact of TB stigma in the economic dimension, including fear of unemployment and reduced income.[23] Our results were in line with these findings, as male VDOT patients had significantly lower total stigma and perceived stigma subdimension scores. Other studies have reported that

Table 6. The Linear Regression Model Predicting Variables Affecting SSTB Internalized Stigma Subdimension Scores

Predictor Variable	B (95% CI)	t	P Value	R	R^2	F (p)
Age	−0.032 (−0.068/0.005)	−1.734	0.087	0.664	0.441	20.488 (<0.001)
Male gender	−0.133 (−1.401/−1.134)	−0.209	0.835			
VDOT*	−7.818 (−6.633/−3.941)	−8.456	<0.001			

Abbreviations: SSTB, Stigmata Scale in Patients with Tuberculosis; CI, confidence interval; VDOT, video observed therapy.

Table 7. The Linear Regression Model Predicting Variables Affecting SSTB Self-Perception Stigma Subdimension Scores

Predictor Variable	B (95% CI)	t	P Value	R	R^2	F (p)
Age	−0.003 (−0.032/0.038)	−1.186	0.853	0.703	0.494	3.962 (0.011)
Male gender	−0.551 (−1.774/−0.672)	−0.897	0.373			
VDOT*	−5.518 (−6.817/−4.219)	−8.456	<0.001			

Abbreviations: SSTB, Stigmata Scale in Patients with Tuberculosis; CI, confidence interval; VDOT, video observed therapy.

economic factors also affect women TB patients. However, women tend to be more concerned than men that TB-related stigma will adversely affect their marriages.[24] Since most of our participants were married, this may have had an effect on our findings. One of the main concerns regarding VDOT is that TB patient will require technological hardware and software and a proper internet connection. A significant proportion of TB patients, worldwide, suffer from severe poverty or homelessness. Such individuals may be unable to access these items because they simply lack the necessary economic resources. VDOT may also be challenging in the context of vulnerable populations. There was no statistically significant difference between economic income between the VDOT and DOT patients in the present study. However, the home-based DOT group consisted of TB patients with any kind of technical problem (such as lack of cell phones or proper internet connections) making VDOT impossible. In addition, older people may find it difficult to keep pace with telemedicine applications as these become more sophisticated and are upgraded on a daily basis. However, it is very likely that every smartphone owner will be capable of taking a self-video and sending it on. Very basic training and knowledge can help patients to perform VDOT. Our results confirm that that age is not an important factor for stigma levels in terms of VDOT. Another concern with VDOT is patient confidentiality, since the transmission of data through the internet is vulnerable to cyber piracy. Basic encryption software at the least will be needed in the future to protect not only TB patients' data but also all kinds of patient health information.

Limitations

Our study has a number of limitations. We aimed to compare stigma status among TB patients after receipt of VDOT and DOT. The randomization in this study was largely determined by the participants, who selected their own form of based on their own resources and individual characteristics at the beginning of treatment. A comparison of the sociodemographic and disease features of the 2 groups revealed several factors that may impact on stigma. For instance, the VDOT group was younger than the DOT group, and differences between the groups were also observed in some other socioeconomic factors (marital and educational status, family type, monthly income etc.). All these factors may have affected our results.

Had it been possible to apply SSTB pretests to our participants immediately after diagnosis, these would have constituted baseline data for comparison with post-test SSTB using the different treatment methods. This would thus have yielded stronger scientific evidence. However, these pretests could not be applied for a number of technical, legal, and ethical reasons. However, considering

Table 8. The Linear Regression Model Predicting Variables Affecting SSTB Family/Friend's Stigma Subdimension Scores

Predictor Variable	B (95% CI)	t	P Value	R	R^2	F (p)
Age	−0.017 (−0.032/0.038)	0.866	0.853	0.678	0.459	22.072 (<0.001)
Male gender	−0.601 (−1.949/0.748)	−0.887	0.373			
VDOT*	−5.530 (−6.963/−4.098)	−7.687	<0.001			

Abbreviations: SSTB, Stigmata Scale in Patients with Tuberculosis; CI, confidence interval; VDOT, video observed therapy.

that 93% of the cases included in our study were diagnosed for the first time, it is highly probable that these patients had no TB-related stigma at the time of diagnosis. Special emphasis was placed on isolation between the VDOT and DOT groups in the study design. Patients who initially preferred be in the VDOT group at the beginning of treatment, but who subsequently transferred to the DOT group for various reasons (such as being unable to take the video recordings of themselves taking their medication regularly) were excluded from the study. In addition, no TB patients transferred to the VDOT group from the DOT group during the study period. The number of cases in the present study might also be capable of criticism compared with previous multi-center studies of stigma and VDOT. However, almost all officially notified TB cases registered in our province during the 3-month study period were included in the sample (participation rate= 96.3%).

Several scales in the literature have been used to measure level of stigma in TB patients. Many studies use a qualitative approach, while Macq et al.[25] and Van Rie et al[26] designed quantitative scales. However, none of these scales has been studied in terms of validity and safety in Turkey. The stigma scale developed by Sert designed for Turkish culture was therefore employed in this research.[16] This scale allowed us to perform a quantitative measurement of stigma and its subdimensions.

The practicality, applicability, and cost-effectiveness of VDOT have been investigated in several studies.[27–29] These have revealed that VDOT is an effective follow-up and treatment option for TB, and is also very cost-effective. Another positive outcome is that VDOT is more patient-friendly.[30] For example, it can be more flexible in terms of timing and allows greater freedom for the patient, saving both time and travel expenses.[31] Likewise, the members of the VDOT group in this study evaluated the method as very satisfactory. They also reported spending less time on the procedure, found it highly practical and economical, and would highly recommend it to others. Our results confirmed that patients who received VDOT experienced less total patient stigma compared with those who received DOT. Further research investigating improving compliance with treatment and quality of life among patients receiving VDOT is now needed.

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References

1. Fact sheet. Tuberculosis [Internet]. WHO Newsroom; 2021 (cited 12 October 2021). Available from: https://www.who.int/news-room/fact-sheets/detail/tuberculosis.
2. Nahid P, Dorman SE, Alipanah N, et al. Official American Thoracic Society/Centers for Disease Control and Prevention/Infectious Diseases Society of America clinical practice guidelines: treatment of drug-susceptible tuberculosis. Clin Infect Dis 2016;63:e147–e195.
3. Global tuberculosis control: a short update to the 2009 report [Internet]. World Health Organization; (accessed 27 July 2018). Available from: http://www.who.int/iris/handle/10665/44241.
4. Hopewell PC, Pai M, Maher D, et al. International standards for tuberculosis care. Lancet Infect Dis 2006 Nov;6(11):710–25.
5. Gandhi NR, Nunn P, Dheda K, et al. Multidrug-resistant and extensively drug-resistant tuberculosis: a threat to global control of tuberculosis. The Lancet 2010;375:1830–43.
6. Migliori GB, Sotgiu G, Gandhi NR, et al. Drug resistance beyond extensively drug-resistant tuberculosis: individual patient data meta-analysis. Eur Respir J 2013;42:169–79.
7. Pope DS, Chaisson RE. TB treatment: as simple as DOT? Int J Tuberc Lung Dis 2003;7:611–5. PMID:12870680
8. Link B, Phelan J. Conceptualizing stigma. Annu Rev Sociol 2001;27:363–85.
9. Courtwright A, Turner AB. Tuberculosis and stigmatization: Pathways and interventions. Public Health Rep 2010;125:34–42.
10. Goffman E. Stigma: notes on the management of spoiled identity. Anchor Books; 1963.
11. Dodor EA, Neal K, Kelly S. An exploration of the causes of tuberculosis stigma in an urban district in Ghana. Int J Tuberc Lung Dis 2008;12:1048–54.
12. Ngamvithayapong J, Yanai H, Winkvist A, et al. Feasibility of home-based and health centre-based DOT: perspectives of TB care providers and clients in an HIV-endemic area of Thailand. Int J Tuberc Lung Dis 2001;5:741–5. PMID:11495265.
13. Kamble BD, Singh SK, Jethani S, et al. Social stigma among tuberculosis patients attending DOTS centers in Delhi. J Fam Med Prim Care 2020;9:4223.
14. DeMaio J, Schwartz L, Cooley P, et al. The application of telemedicine technology to a directly observed therapy program for tuberculosis: a pilot project. Clin Infect Dis 2001;33:2082–4.
15. Garfein RS, Collins K, Muñoz F, et al. Feasibility of tuberculosis treatment monitoring

by video directly observed therapy: a binational pilot study. Int J Tuberc Lung Dis 2015;19: 1057–64.
16. Sert H. Evaluating stigmata in tuberculosis patients. Marmara University Health Sciences Institute, Unpublished Doctoral Thesis, Istanbul, 2010. S32.
17. Keith TZ. Multiple regression and beyond, an introduction to multiple regression and structural equation modeling. Routledge; 2019.
18. Demaris A. Regression with social data, modeling continuous and limited response variables. John Wiley & Sons; 2004.
19. Kelly P. Isolation and stigma: The experience of patients with active tuberculosis. J Community Health Nurs 1999;16:233–41.
20. Suleiman MM, Sahal N, Sodemann M, et al. Tuberculosis stigma in Gezira State, Sudan: a case-control study. Int J Tuberc Lung Dis 2013;17:388–93.
21. Jaramillo E. Tuberculosis and stigma: Predictors of prejudice against people with tuberculosis. J Health Psychol 1999;4:71–9.
22. Dick J, Schoeman JH. Tuberculosis in the community: 2. The perceptions of members of a tuberculosis health team towards a voluntary health worker programme. Tuber Lung Dis 1996;77:380–3.
23. Atre SR, Kudale AM, Morankar SN, et al . Cultural concepts of tuberculosis and gender among the general population without tuberculosis in rural Maharashtra, India. Trop Med Int Health 2004;9:1228–38.
24. Zhang T, Liu X, Bromley H, Tang S. Perceptions of tuberculosis and health seeking behaviour in rural Inner Mongolia, China. Health Policy 2007; 81:155–65.
25. Macq J, Solis A, Martinez G. Assessing the stigma of tuberculosis. Psychol Health Med 2006;11: 346–52.
26. Van Rie A, Sengupta S, Pungrassami P, et al. Measuring stigma associated with tuberculosis and HIV/AIDS in southern Thailand: exploratory and confirmatory factor analyses of two new scales. Trop Med Int Health 2008;13:21–30.
27. Beeler Asay GR, Lam CK, Stewart B, et al. Cost of tuberculosis therapy directly observed on video for health departments and patients in New York City; San Farncisko, California; and Rhode Island (2017–2018). Am J Public Health 2020;110:1696–703.
28. Lam CK, Fluegge K, Macaraig M, Burzynski J. Cost savings associated with video directly observed therapy for treatment of tuberculosis. Int J Tuberc Lung Dis 2019;23:1149–54.
29. Gassanov MA, Feldman LJ, Sebastian A, et al . The use of videophone for directly observed therapy for the treatment of tuberculosis. Can J Public Health 2013;104:e272.
30. Story A, Aldridge RW, Smith CM, et al. Smart phone enabled video-observed versus directly observed treatment for tuberculosis: a multicentre, analyst-blinded, randomised, controlled superiority trial. The Lancet 2019;393:1216–24.
31. Mirsaeisi M. Video directly observed therapy for treatment of tuberculosis is patient-oriented and friendly. Eur Respir J 2015;46:869–71.