

# Association between medication adherence and health-related quality of life in patients with tic disorder: A cross-sectional survey

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## Abstract

A cross-sectional study was conducted in children with tic disorder (TD) in western China who were recruited at a pediatric neurology clinic. We used the Pediatric Quality of Life Inventory TM Version 4.0 Short Form Generic Core Scale (PedsQL 4.0) and the eight-item Morisky Medication Adherence Scale to assess the QOL and medication adherence, respectively. A multiple linear regression model was used to examine the factors affecting QOL. In total, 198 patients participated in the study, and the response rate was 93.4%. The mean age of the participants was  $7.73 \pm 2.60$  years, and 77.3% (153/198) of the participants were male. The mean overall score of the PedsQL 4.0 Generic Core Scales was  $82.25 \pm 11.68$ . The highest mean score was for physical functioning ( $92.49 \pm 12.85$ ), whereas the lowest mean score was for school functioning ( $67.93 \pm 22.09$ ). The mean scores for emotional functioning and social functioning were  $75.20 \pm 17.70$  and  $87.22 \pm 14.13$ , respectively. PedsQL scores were positively correlated with lower Yale Global Tic Severity Scale (YGTSS) scores, the absence of comorbidity, and higher adherence scores. The score of school functioning and emotional functioning is not high in children with TD in western China. In conclusion, as medication adherence is associated with quality of life, it is necessary to develop a multidisciplinary approach to improve medication adherence among children with TD.

**Keywords:** Tic disorder, quality of life, medication adherence, children, questionnaire

## INTRODUCTION

Tic disorders (TD) is one of common neuropsychiatric disorders in childhood, characterized by sudden, rapid, recurrent, nonrhythmic movements or vocalizations. It consists of the 'simple forms', that manifest as eye blinking, facial grimacing, and throat clearing; and 'complex forms', that manifest as body twisting, coprolalia (uttering socially inappropriate words, such as swearing) or echolalia (repeating the words or phrases of others).<sup>1</sup> According to the clinical characteristics and the duration of the disease, TD may be classified into three types: provisional tic disorder (PTD), chronic tic disorder (CTD), and Tourette syndrome (TS).<sup>2</sup> Previous meta-analysis have shown that the worldwide prevalence of PTD to be 2.99%, followed by CTD (1.61%), and TS

(0.77%).<sup>2</sup> In China, the combined prevalence of TD has been reported to be 6.1%. Previous meta-analysis showed that the prevalence of PTD, CTD, and TS to be 1.7, 1.2, and 0.3%, respectively.<sup>3</sup> Tics mostly begin before 18 years of age, typically between 4–8 years old, and the mean age at onset is around 6 years old. Tics increase in severity to a peak around 10–12 years old, and then gradually decrease and some remit in late adolescence and young adulthood.<sup>4-7</sup> Psychiatric comorbidities of TD are common.<sup>8-10</sup> About half of the children with TD and more than 80% of patients with TS suffer from at least one, and about 60% TS patients suffer from two or more psychopathological or behavioral comorbidities.<sup>4</sup> For example, attention deficit-hyperactivity disorder (ADHD), the most common co-morbidity, was reported in 30%–50%

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of the TS population.<sup>11</sup> Other comorbidities such as obsessive-compulsive disorder (OCD), phobias, anxiety, aggressive, and depression may also be seen.<sup>12-13</sup>

Health-related quality of life (HRQOL) measures how an individual's well-being may be affected over time by a disease, disability, or disorder.<sup>14</sup> With the improvement of social and economic level, HRQOL has been established as an important measure of clinical outcome as it also reflects the patient's own subjective perspective.<sup>15</sup>

To date, several studies have evaluated quality of life (QOL) in children with TD with or without comorbidities.<sup>16-18</sup> Evans *et al.* (2016)<sup>19</sup> conducted a systematic review of all published QOL studies in patients with TD to evaluate the effects of this disease on QOL in different age groups. A total of 21 studies were evaluated, including 14 and 7 studies performed in children and adults, respectively. The majority of studies focused on the impact of tic and comorbid behavioral problems on different QOL domains. Only two studies were conducted in China and thus, QOL data for patients with TD in China are lacking. Some studies<sup>20,21</sup> have explored the association of treatment adherence with QOL in children or adolescent with chronic disease, but these results showed conflicting results. In addition, no studies have assessed the association between medication adherence and QOL in children with TD. Thus, we decided to investigate the QOL in Chinese children with TD and examine the association between medication adherence and QOL.

## METHODS

### *Setting*

The study was carried out in West China Second Hospital of Sichuan University located the city of Chengdu, which is the capital city of Sichuan Province and one of the largest cities in China, with an estimated population of approximately 16 million spread over 11 local government districts. The hospital is the largest and most important referral center for the diagnosis and treatment of childhood diseases in western China, providing medical services for more than 2,000 pediatric patients daily.

### *Study design and sample selection*

The participants for this study were consecutively sampled from the pediatric neurology clinic of West China Second Hospital between January 2019 and May 2019. The physicians informed all

adolescents about the study. The inclusion criteria were: 1) Clinically confirmed TD diagnosis using the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5); 2) Age of less than 18 years; 3) Patients receiving pharmacological treatment, at least one pharmacological drug. There is no limit to the time of pharmacological treatment. When the patient sees a physician, the physician will inform the patient and guardian the knowledge related to TD, such as the cause, course, treatment method and prognosis, so as to enable them to better understand the disease and participate in the treatment.

The exclusion criteria were: 1) Cognitive impairment (Wechsler intelligence quotient < 70 points), 2) Other chronic diseases (i.e., congenital heart disease, diabetes) that could affect QOL, 3) Patients only received behavioral therapy, and 4) Lack of consent.

### *Data collection*

The questionnaire is designed based on expert opinions and published literature. A pre-test structured questionnaire was administered by a trained physician or pharmacist. Children >8 years old completed the questionnaire independently, whereas younger children completed the questionnaire with assistance from their guardian(s).

The questionnaire prepared by the investigators contained four aspects: (1) Basic characteristics (gender and age of participants), (2) Disease status (time of disease, type of visit, tic symptom, type of TD, family history, comorbidity, QOL, regular review). We obtained the information of co-morbidities from medical records and the results of patient survey. (3) Medication status (type of medication, quantity of medication, necessity beliefs, concerns beliefs); and (4) Family conditions (parents' marital status, caregiver, caregiver's age, education level, and medical expenses payment).

### *Instruments*

The study used the PedsQL 4.0 standard questionnaire to assess the QOL. Lu *et al.*<sup>22</sup> tested the reliability and validity of Chinese Version "Pediatric Quality of Life Inventory, and a total of 335 healthy children and 44 children with leukemia completed the Chinese version. The authors concluded that the Chinese Version PedsQL4.0 had an acceptable psychometric properties and can be used in health-related quality of life research for Chinese children. Xin

*et al.*<sup>23</sup> used the PedsQL4.0 to assess the QOL of children with ADHD, and found the ADHD children had significantly lower scores than that of the healthy children.

The questionnaire cover four domains and 23 items: (1) Physical functioning, (2) Emotional functioning, (3) Social functioning, and (4) School functioning.<sup>24</sup> Within the domains, all items were presented on a five-point response scale (0 = never a problem; 1 = almost never a problem; 2 = sometimes a problem; 3 = often a problem; 4 = almost always a problem), and all were reverse-scored and linearly transformed to a 0–100 scale. Higher scores indicate better QOL. Children more than 8 years completed the questionnaire personally, and questionnaires for children younger than eight years old were completed by their parents.

The study used the Morisky Medication Adherence Scale which had good reliability and validity to assess participants' medication adherence.<sup>25,26</sup> Higher scores indicated better adherence. For newly diagnosed patients, we conducted a telephone follow-up one week after the patient has taken the medicine to evaluate the medication adherence.

#### *Data analysis*

Data analysis was conducted in two parts. First, quantitative data were expressed as the mean  $\pm$  standard deviation. Second, we used a *t*-test in the case of normally distributed data to compare quantitative variables between groups, and the Mann–Whitney U test for non-normally distributed data. The relationships between qualitative variables were also evaluated using the chi-squared test and Fisher's exact test.

For univariate analysis, factors with univariate  $P \leq 0.10$  were included in the multiple linear regression model. Multivariate analysis was performed to examine the relative contribution of potential variables of QOL categorization using multiple linear regression. Data analysis was performed using SPSS version 22, and a *P* value of  $\leq 0.05$  was considered statistically significant.

The study was approved by the Office of Research Ethics Committees of West China Second Hospital. Written informed consent was obtained from all caregivers, and consent was also obtained from children aged  $>8$  years.

## RESULTS

### *Demographic characteristics of the patients*

Two hundred and twelve participants were included in the study, with 93.4% (198/212) patients (mean age:  $7.73 \pm 2.60$  years) completed the study. In the process of filling out the questionnaire, two participants were interrupted by the phone and refused to continue filling the questionnaire. As the information filled in two questionnaires was incomplete we decided to exclude them in the final analysis. Of the participants, 77.3% (153/198) were male, 16.2% (32/198) participants lived in rural areas, 83.8% (166/198) lived in suburbs and cities. Of the patients, 37.4% (74/198) were newly diagnosed (i.e., the patient comes to the clinic for the first time), 46.5% (92/198) were under review (i.e., follow up patient), and 16.2% (32/198) had recurrent symptoms (i.e., patient having typical waxing and waning course of TD).

Concerning tic symptoms, 55.6 (110/198), 5.6 (11/198) and 38.9% (77/198) of patients presented with motor tic symptoms, vocal tic symptoms, and both, respectively; 44.9 (89/198), 31.3 (62/198), and 23.7% (47/198) of patients were diagnosed with TTD, CTD, and TS, respectively. In total, 18.7% (37/198) had comorbidities; 89.2% (33/37) comorbidities were ADHD, 10.8% (4/37) were OCD.

There were six drug treatment regimens in the study patients as follows: tiapride ( $n=90$ ), the compound syrup of lysine inositol vitamin B12 ( $n=46$ ), clonidine adhesive patch+tiapride+ the compound syrup of lysine inositol vitamin B12 ( $n=41$ ), clonidine adhesive patch ( $n=14$ ), clonidine Adhesive patch+ tiapride+ haloperidol ( $n=5$ ), clonidine adhesive patch+tiapride+topiramate ( $n=2$ ).

### *QOL*

The mean score of the PedsQL was  $82.25 \pm 11.68$ . The highest mean score was for physical functioning ( $92.49 \pm 12.85$ ), whereas the lowest mean score was for school functioning ( $67.93 \pm 22.09$ ). The mean scores for emotional functioning and social functioning were  $75.20 \pm 17.70$  and  $87.22 \pm 14.13$ , respectively.

### *Factors associated with subjective QOL satisfaction (Tables 1–2)*

In univariate analysis, YGTSS scores, age, time of disease, type of TD, tic symptom, comorbidity, caregivers' education level, and adherence scores

**Table 1: Analysis of current quality of life and influencing factors**

Variable	Total QOL scores	Dimension 1		Dimension 2		Dimension 3		Dimension 4	
		Physical Functioning	Statistics value	Emotional Functioning	Statistics value	Social Functioning	Statistics value	School Functioning	Statistics value
Gender	81.68±12.45	91.57±13.65	t=-2.314 P=0.023	75.98±17.66	t=1.142 P=0.255	86.63±14.65	t=-1.081 P=0.281	66.60±24.24	t=-2.260 P=0.025
Time of disease	84.18±8.38	95.63±9.12	t=-2.275, P=0.024	72.56±17.76	t=-1.846, P=0.066	89.22±12.11	t=-1.520, P=0.130	72.44±11.31	t=-2.215, P=0.031
Age	t=-2.178, P=0.031	t=-0.538, P=0.591	t=-2.204, P=0.029	t=-1.877, P=0.062	t=-0.102, P=0.919	t=-1.768, P=0.079	t=-0.603, P=0.547	t=-1.768, P=0.079	t=-0.603, P=0.547
Necessity Beliefs	t=-0.458, P=0.647	t=1.128, P=0.261	t=-1.877, P=0.062	t=-1.877, P=0.062	t=-0.102, P=0.919	t=-0.603, P=0.547	t=-0.603, P=0.547	t=-0.603, P=0.547	t=-0.603, P=0.547
Concerns Beliefs	t=-1.327, P=0.186	t=0.255, P=0.799	t=-2.103, P=0.037	t=-2.103, P=0.037	t=-0.947, P=0.345	t=-1.184, P=0.238	t=-1.184, P=0.238	t=-1.184, P=0.238	t=-1.184, P=0.238
Adherence scores	t=1.920, P=0.056	t=1.157, P=0.248	t=1.192, P=0.235	t=1.192, P=0.235	t=2.131, P=0.034	t=1.256, P=0.211	t=1.256, P=0.211	t=1.256, P=0.211	t=1.256, P=0.211
Type of visiting	83.29±12.326	91.64±14.47	F=0.126 P=0.939	78.58±16.271	F=4.103 P=0.129	87.50±14.624	F=0.627 P=0.535	72.03±23.201	F=2.462 P=0.088
Type of TD	82.38±9.820	94.40±10.02	F=1.583 P=0.453	75.53±16.699	F=0.988 P=0.374	87.88±13.056	F=3.592 P=0.029	66.52±19.382	F=1.780 P=0.171
Tie symptom	79.45±14.654	91.31±15.55	F=2.569 P=0.079	72.19±22.430	F=2.064 P=0.130	84.69±16.011	F=3.525 P=0.031	62.50±25.590	F=2.182 P=0.116
Motor tic	83.29±10.514	93.45±11.96	F=1.031 P=0.359	76.64±16.78	F=2.064 P=0.130	88.95±12.60	F=3.525 P=0.031	68.00±17.36	F=2.182 P=0.116
Vocal tic	86.76±9.936	94.32±10.63	F=1.031 P=0.359	76.36±20.87	F=2.064 P=0.130	92.27±13.48	F=3.525 P=0.031	79.55±14.74	F=2.182 P=0.116
Both	80.12±13.144	90.87±14.27	F=1.031 P=0.359	72.99±18.50	F=2.064 P=0.130	84.03±15.73	F=3.525 P=0.031	66.17±27.96	F=2.182 P=0.116
TTD	84.56±11.82	94.01±12.84	F=1.228 P=0.295	77.81±16.58	F=2.064 P=0.130	89.55±14.10	F=3.525 P=0.031	71.18±23.50	F=2.182 P=0.116
CTD	81.54±11.456	91.73±13.34	F=1.228 P=0.295	74.19±18.95	F=2.064 P=0.130	87.18±12.60	F=3.525 P=0.031	66.94±20.23	F=2.182 P=0.116
TS	78.82±10.77	90.63±12.12	F=1.228 P=0.295	71.60±17.64	F=2.064 P=0.130	82.87±15.31	F=3.525 P=0.031	63.09±21.10	F=2.182 P=0.116
YGTSS score	t=-3.591, P=0.000	t=-1.375, P=0.171	t=-4.314, P=0.000	t=-4.314, P=0.000	t=-2.500, P=0.013	t=-2.338, P=0.020	t=-2.338, P=0.020	t=-2.338, P=0.020	t=-2.338, P=0.020
Family history	82.27±11.92	92.45±13.03	t=-0.154 P=0.877	75.59±17.95	t=0.938 P=0.349	86.93±14.37	t=-0.901 P=0.369	68.02±22.61	t=-0.171 P=0.865
Comorbidity	83.50±11.47	93.93±11.31	t=-0.039 P=0.970	71.58±15.01	t=1.160 P=0.248	90.00±11.55	t=-2.245 P=0.026	67.11±16.86	t=-0.865 P=0.400
Regular review	76.82±11.14	92.48±12.68	t=-0.039 P=0.970	75.90±17.06	t=1.160 P=0.248	88.29±13.71	t=-2.245 P=0.026	71.93±21.30	t=-0.865 P=0.400
Awareness of the disease	77.36±13.75	92.57±13.77	t=-1.503 P=0.135	72.16±20.23	t=0.882 P=0.379	82.57±15.17	t=-1.763 P=0.106	50.54±16.49	t=-1.695 P=0.092
Caregiver	82.56±11.50	91.67±15.95	t=-1.493 P=0.168	70.50±25.33	t=-0.611 P=0.556	78.00±21.76	t=-2.137 P=0.034	53.00±26.16	t=-2.215 P=0.028
Caregivers' age	73.37±19.64	92.55±12.68	t=-1.032 P=0.328	75.45±17.26	t=1.415 P=0.159	87.71±13.52	t=-0.040 P=0.968	68.72±21.65	t=-1.147 P=0.253
Caregivers' education level	82.53±11.64	85.00±24.02	t=0.441 P=0.660	75.75±17.57	t=2.746 P=0.007	87.21±14.05	t=-0.538 P=0.591	68.48±21.80	t=-0.412 P=0.681
Place of residence	79.28±12.05	92.68±12.80	t=0.716 P=0.475	76.17±17.53	t=-1.725 P=0.086	87.35±15.42	t=-1.481 P=0.140	62.26±24.94	t=-1.293 P=0.199
Total household income/year	82.59±11.59	90.20±13.72	t=-1.805 P=0.074	63.33±15.77	t=1.185 P=0.237	85.00±13.90	t=-0.667 P=0.505	65.94±20.06	t=-0.556 P=0.579
Medical expenses payment	77.97±12.23	89.77±15.16	t=-2.309 P=0.022	71.97±17.28	t=1.725 P=0.086	88.21±14.17	t=-0.857 P=0.393	64.67±24.86	t=-1.757 P=0.080
	79.40±12.53	93.70±11.53	t=2.794 P=0.007	76.64±17.75	t=1.185 P=0.237	88.21±14.17	t=-0.857 P=0.393	69.38±20.67	t=-0.556 P=0.579
	83.51±11.09	96.68±8.21	t=2.794 P=0.007	78.50±15.25	t=1.185 P=0.237	88.75±12.44	t=-0.857 P=0.393	65.94±20.06	t=-0.556 P=0.579
	84.34±9.93	91.69±13.43	t=0.402 P=0.688	74.55±18.10	t=0.830 P=0.408	86.93±14.45	t=-1.310 P=0.192	68.31±22.50	t=-0.458 P=0.647
	81.33±12.46	92.01±13.41	t=0.402 P=0.688	73.84±17.86	t=0.408 P=0.688	86.10±13.80	t=-1.757 P=0.080	66.99±27.23	t=-0.458 P=0.647
	82.78±11.21	92.77±12.55	t=0.197 P=0.844	76.00±17.62	t=1.310 P=0.192	87.88±14.33	t=-1.757 P=0.080	68.48±18.55	t=-0.496 P=0.621
	76.36±12.05	93.75±6.75	t=0.197 P=0.844	63.75±21.36	t=1.310 P=0.192	75.00±25.50	t=-1.757 P=0.080	62.50±18.48	t=-0.496 P=0.621
	82.37±11.67	92.47±12.95	t=0.197 P=0.844	75.44±17.60	t=1.310 P=0.192	87.47±13.80	t=-1.757 P=0.080	68.04±22.19	t=-0.496 P=0.621

**Table 2: Multiple Linear Regression of Subjective QOL Satisfaction**

Variable	Non-standardized coefficient	Standard error	Standard coefficient	t	Sig.
Constant	86.986	4.018		21.647	0.000
Age	-0.179	0.341	-0.040	-0.527	0.599
YGTSS score	-0.335	0.113	-0.251	-2.972	0.003
Time of disease	-0.216	0.817	-0.026	-0.265	0.792
Tic symptom	1.333	1.091	0.110	1.221	0.224
Type of TD	-1.791	1.486	-0.123	-1.205	0.230
Comorbidity	-4.672	2.092	-0.156	-2.233	0.027
Caregivers' education level	3.056	1.792	0.121	1.706	0.090
Adherence scores	0.827	0.284	0.198	2.914	0.004

were correlated with PedsQL scores. However, in multiple linear regression, PedsQL scores were only correlated with lower YGTSS scores ( $B = -0.335$ ; standard error = 0.113;  $P = 0.003$ ), the absence of comorbidity ( $B = -4.672$ ; standard error = 2.092;  $P = 0.027$ ), and higher adherence scores ( $B = 0.827$ ; standard error = 0.284;  $P = 0.004$ ).

*Factors associated with physical functioning (Table 3)*

In univariate analysis, gender, caregivers' education level, and place of residence were significantly correlated with physical functioning. However, multiple linear regression revealed that only caregivers' education level ( $B = 5.628$ ; standard error = 2.077;  $P = 0.007$ ) and place of residence ( $B = -7.990$ ; standard error = 2.577;  $P = 0.002$ ) were associated with physical functioning.

*Factors associated with emotional functioning (Table 4)*

Univariate analysis indicated that the YGTSS score, age, time of disease, necessity beliefs, concerns beliefs, caregivers' age, and caregivers' education level may be associated with emotional functioning, but multiple linear regression revealed that emotional functioning was significantly

correlated with lower YGTSS scores only ( $B = -0.495$ ; standard error = 0.141;  $P = 0.001$ ).

*Factors associated with social functioning (Table 5)*

Nine factors, namely the YGTSS score, age, adherence scores, tic symptoms, type of TD, comorbidity, awareness of the disease, and medical expenses payment, were associated with social functioning in univariate analysis. Multiple linear regression showed that only adherence scores ( $B = 0.936$ ; standard error = 0.350;  $P = 0.008$ ) was associated with social functioning.

*Factors associated with school functioning (Table 6)*

The YGTSS score, age, gender, time of disease, type of visit, comorbidity, regular review, and awareness of the disease were associated with school functioning in univariate analysis, but multiple linear regression indicated that only comorbidity ( $B = -17.791$ ; standard error = 4.095;  $P = 0.000$ ) was associated with school functioning.

**DISCUSSION**

To our knowledge, this was the first study to evaluate QOL in children and adolescents with

**Table 3: Multiple Linear Regression of Physical Functioning**

Variable	Non-standardized coefficient	Standard error	Standard coefficient	t	Sig.
Constant	94.459	2.297		41.131	0.000
Gender	3.693	2.146	0.121	1.721	0.087
Caregivers' education level	5.628	2.077	0.203	2.710	0.007
Place of residence	-7.990	2.577	-0.229	-3.100	0.002

**Table 4: Multiple Linear Regression of Emotional Functioning**

Variable	Non-standardized coefficient	Standard error	Standard coefficient	t	Sig.
Constant	106.366	10.725		9.917	0.000
YGTSS score	-0.495	0.141	-0.245	-3.501	0.001
Age	-0.502	0.526	-0.074	-0.955	0.341
Time of disease	-0.306	0.964	-0.024	-0.318	0.751
Necessity Beliefs	-2.238	3.127	-0.053	-0.716	0.475
Concerns Beliefs	-2.478	2.462	-0.075	-1.007	0.315
Caregivers' age	-8.762	4.745	-0.131	-1.847	0.066
Caregivers' education level	1.834	2.859	0.048	0.642	0.522

TD, and investigate the association of adherence to prescribed medication with QOL of the patients. We included 198 children and found that the mean overall score of the PedsQL 4.0 was  $82.25 \pm 11.68$ , which was lower than that in normal children with the score of  $83.7 \pm 12.00$ . The scores for the physical functioning and social functioning domains were relatively high, whereas those for school functioning ( $67.93 \pm 22.09$  VS  $83.5 \pm 13.6$  in normal children) and emotional functioning ( $75.20 \pm 17.70$  VS  $77.3 \pm 20.6$  in normal children) were relatively low.<sup>23</sup> This study suggest that more attention should be given to school functioning and emotional functioning for children with TD.

Regarding the factors influencing QOL, multivariate analysis showed that adherence scores were significantly correlated with QOL and social functioning. Moreover, caregivers' education level and the place of residence were significantly associated with physical functioning, and these were novel findings in this study. The reasons for these findings may be as follows: (1) Patients with good adherence to medication will

experience better effectiveness of pharmacological treatment and thus, their scores of QOL and social functioning were higher.<sup>27,28</sup> (2) Caregivers who completed high school or higher may have higher health literacy and more awareness of the disease, which could lead to better physical functioning of the children than observed for patients whose caregivers' education levels were low.<sup>29,30</sup> (3) Rural environments were closer to nature and have more open space. Thus, the physical functioning of patients in rural areas may be better than that of patients in urban areas, in which environmental pollution and restricted space for movement can be serious concerns, and the children have less opportunities to participate in physical activities.

We also found that YGTSS scores were correlated with QOL and emotional functioning; and QOL and school functioning was affected by comorbidity of the patients. These results were similar to those published previously.<sup>31-33</sup>

As for implications of this study on clinical practice, first, it is necessary to focus on the QOL of patients. QOL assessment should be considered

**Table 5: Multiple Linear Regression of Social Functioning**

Variable	Non-standardized coefficient	Standard error	Standard coefficient	t	Sig.
Constant	73.725	9.358		7.878	0.000
YGTSS score	-0.143	0.142	-0.089	-1.008	0.315
Age	-0.545	0.397	-0.101	-1.375	0.171
Adherence scores	0.936	0.350	0.185	2.676	0.008
Tic symptom	-0.525	1.343	-0.036	-0.391	0.696
Type of TD	-2.220	1.419	-0.126	-1.564	0.119
Comorbidity	-2.635	2.667	-0.073	-0.988	0.324
Awareness of the disease	8.874	4.584	0.138	1.936	0.054
Medical expenses payment	13.082	6.982	0.131	1.874	0.063

**Table 6: Multiple Linear Regression of School Functioning**

Variable	Non-standardized coefficient	Standard error	Standard coefficient	t	Sig.
Constant	66.077	9.663		6.838	0.000
YGTSS score	-0.102	0.177	-0.040	-0.574	0.566
Age	-0.346	0.618	-0.041	-0.560	0.576
Gender	1.862	3.593	0.035	0.518	0.605
Time of disease	-1.500	1.193	-0.095	-1.257	0.210
Type of visiting	-3.522	2.225	-0.112	-1.583	0.115
Comorbidity	-17.791	4.095	-0.315	-4.345	0.000
Regular review	11.857	6.297	0.128	1.883	0.061
Awareness of the disease	7.621	7.049	0.076	1.081	0.281

in routine clinical evaluation, especially for patients with severe symptoms or comorbidities. Second, the influence of various factors on QOL is complex, and medication adherence is an important factor. Therefore, greater attention should be given to medication adherence to improve QOL. This include the need to address the practicalities of adherence (e.g., ability to use the medication as advised) and the perceptions that influence motivation to adherence. It is necessary to develop a multidisciplinary approach to improve medication adherence for children with TD. Nurses or clinical pharmacists may be suitable personnel for ensuring adherence among parents and children, but further studies is needed to demonstrate the efficacy of this approach.<sup>34</sup> Third, the QOL of patients was also affected by family and environmental factors, such as caregivers' education level and place of residence. Thus, it is necessary to provide relevant health education to patients' families and improve their understanding of the disease. We should also try to create a relaxed living environment for children to reduce the negative impact of the disease on their QOL. Fourth, adherence is not the only driver of treatment response, especially when a child does not experience much benefit from the treatment and thus over time might become discouraged and de-motivated to comply with their treatment. Thus, we should also pay attention to other factors such as treatment effects, comorbidities and prognosis.

There were several limitations in this study. First, the cross-sectional design of this study makes it is impossible to clarify the direction of causality for the observed association between medication adherence and QOL. Also this study did not consider the changing trend of medication

adherence in the disease cycle. Therefore, further research with prospective designs is needed to confirm whether higher medication adherence contributes to higher QOL. Second, all patients were recruited from a university hospital, and this may compromise the representativeness of the study subject. However, our hospital is the largest in western China. Thus, the study results still contribute to greater understanding of this important clinical problem. Third, the relatively small sample size limits the statistical power of the analysis. Therefore, prospective studies with larger samples are needed.

In conclusion, school functioning and emotional functioning is impaired among children with TD in western China. Medication adherence and quality of life are associated. Therefore, it is necessary to develop a multidisciplinary approach to improve medication adherence among children with TDs.

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#### DISCLOSURE

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