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ORIGINAL COMMUNICATION

Quality of life in young people with Tourette syndrome: a controlled study

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Abstract Quality of life (QoL) may be adversely affected by Tourette syndrome (TS). Although the core symptoms of this complex neurodevelopmental disorder are tics, patients often present with an array of behavioural difficulties, such as co-morbid obsessive compulsive disorder (OCD) or attention deficit hyperactivity disorder (ADHD). In this study we investigated whether young people with TS exhibited poorer QoL in comparison to healthy individuals and an epilepsy control group. We also analysed whether greater tic severity or co-morbid OCD and\or ADHD led to greater differences in perceived QoL. The Youth Quality of Life Instrument-Research Version (Edwards et al. in J Adolesc 25:275–286, 2002) was used to assess QoL and a range of clinical scales were administered to assess anxiety, depression and other behavioural symptoms. TS was associated with significant differences in aspects of QoL related to home and social activities, involving peer and family interactions. Patients with more severe tics reported a greater negative impact on QoL. Patients with TS and no associated diagnoses (pure TS) presented with lower QoL scores in the environment domain, poorer perceived QoL in general, and depressive features. Co-morbid OCD appeared to exert a greater impact on self and relationship QoL domains. The presence of both OCD and ADHD as co-morbidities led to more widespread problems. In conclusion, TS can be associated with poorer perceived QoL. Although social aspects of QoL may be more vulnerable to TS in general, co-morbid conditions make an important contribution in determining which aspects of QoL are most affected in the individual.

Keywords Tourette syndrome · Tics · Epilepsy · Quality of life

Introduction

Tourette Syndrome (TS) is a neurodevelopmental disorder characterized by multiple motor and one or more phonic tics which last longer than a year [1]. The majority of patients have co-morbid conditions such as attention-deficit hyperactivity disorder (ADHD) and obsessive-compulsive disorder (OCD) [2, 3]. Since preliminary research showed that up to 88% of patients consider that having tics affects their life [4], considerable attention has been devoted to the investigation of quality of life (QoL) in this population. Perceived QoL can determine the subjective experience of living with a health condition, affect planning for the future, and potentially affect acceptance of and adherence

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to treatment. TS can be associated with a range of functional impairments in performing routine and age-appropriate tasks across many domains [5], and understanding these difficulties can enable both the prioritization of treatment and the development of new interventions.

Recent studies have offered insight into the QoL of young people with TS. Storch et al. [6] reported that children with tics experience lower health-related QoL than healthy controls (HCs) in all areas (school, social, emotional) except physical functioning. Similarly, Cutler et al. [7] investigated QoL in a UK sample of 57 young people with TS (aged 8–17; mean 11.4 years). QoL was significantly worse than the normative sample across all domains, but particularly poor within emotional and school domains. Some of TS patients' difficulties at school are likely to be related to learning and the difficulties with concentration and memory that are commonly reported by clinical samples [8]. However, other problems at school may be related to social factors. Packer et al. [9] studied QoL in TS patients (aged 6–17; mean 11 years) using feedback from 69 parents/guardians. In relation to peer relationships, 48% of respondents said tics had a moderate to significant impact and 31% said tics had a mild impact. In the same survey, 29% of the young people with TS were teased a bit, 10% were teased a lot, 18% were rejected a bit, and 10% were rejected a lot, because of their tics. Another study found that more than 40% of patients with TS have problems with dating and keeping friends [10].

Factors which can affect the QoL of young people with TS include tic severity and the presence of co-morbid conditions. Storch et al. [6] reported that tic severity was inversely associated with health-related QoL, and Elstner et al. [8] reported that motor tics (in 78% of TS respondents) and/or vocal tics (in 35% of TS respondents) can lead to pain and problems with activities of daily living. Another study [7] showed that tic severity was a significant independent predictor of QoL, although ratings of symptom severity contributed to only 47% of the variance in QoL scores. This study also indicated that symptoms associated with ADHD and OCD influenced QoL scores. In a study of 56 young people with TS (aged 5–17; mean 10 years) Bernard et al. [11] found that both OCD and ADHD ratings were related to QoL, but motor and phonic tic ratings were not. Another study reported that about 70% of the problems experienced by patients with TS were due to non-tic-related impairment, namely as a result of OCD and/or ADHD symptoms [6].

Most studies of QoL in TS have relied on proxy-based methods (e.g. [8]), which may lead to a less accurate representation of perceived QoL. Storch et al. [6] assessed health-related QoL in 59 children and adolescents with either TS or tic disorder using the Pediatric Quality of Life inventory (PedsQL) and the PedsQL-Parent Proxy. Strong positive correlations were apparent between the QoL scores provided by parents and children aged 8–11 years. However, correlations were weaker for older children (aged 12–17 years) and their parents. Parent reports may therefore not always give an accurate representation of the perspective of older children.

Another possible limitation of studies of QoL in TS can be the failure to include a separate clinical control group, which would allow the identification of specific aspects of QoL affected by TS in comparison to other clinical conditions. Elstner et al. [8] did include a clinical control group when they investigated QoL in adults (aged 16–54; mean 28 years) with TS using the SF-36 and QoL assessment schedules. Patients with TS had lower QoL scores than both HCs and patients with intractable epilepsy. However, patients with TS exhibited higher scores than patients with epilepsy for the SF-36 subscales of role limitation due to physical problems and social functioning. Of note, many of the patients in this sample had anxiety and/or depression (70% anxiety and 20% depression) which affected QoL scores broadly.

In the current study, we investigated whether young people with TS report differences in QoL in comparison to HCs and patients with benign idiopathic epilepsy. One advantage was the use of a self report QoL measure not previously administered to the TS population (the Youth Quality of Life Instrument—Research version [12, 13]). This multidimensional measure included items related to social aspects of QoL, which previous studies have indicated may be particularly important in TS [7–10], and contained both subjective and more objective items. The inclusion of a clinical control group allowed the investigation of which aspects of QoL may be more specifically vulnerable to TS in comparison to other clinical conditions. A further advantage of this study was that the influence of tic severity and co-morbid conditions on QoL was analysed using patient subgroups, which allowed a greater focus on the differences in QoL between subgroups of individuals with TS and controls. We hypothesized that young people with TS would report lower total QoL scores than HCs, but that for some aspects of QoL, the ratings given by individuals with TS and epilepsy controls (ECs) may be similar, due to the social stigma related to having a clinical condition. We further hypothesised that patients with more severe tics, or co-morbid OCD or ADHD, would show the greatest differences in QoL in comparison to both control groups.

Methods

Participants

Participants comprised a total of 202 young people (138 male, 64 female), aged 10–17 years (mean 12.91, SD 1.86) of varying socio-economic status. These participants formed three groups: 50 young people with TS (44 males; mean age 13.26 years; SD 2.32); 50 epilepsy controls (ECs), who were young people with benign idiopathic epilepsy from a similar source (26 males; mean age 12.16 years; SD 1.39 years), and 102 neurologically intact healthy controls (HCs) with no diagnosed clinical condition (68 males; mean age 13.11 years; SD 1.71 years) who were recruited from local schools.

The diagnoses of TS and other clinical conditions were made in accordance with DSM IV-TR criteria by a child neurologist with extensive experience (RR). All TS patients were initially assessed using a semi-structured interview: the National Hospital Interview Schedule for Gilles de la Tourette Syndrome [14]. All ECs were diagnosed with epilepsy according to the International League Against Epilepsy criteria. They were all taking medication for the condition (38 = valproic acid, 6 = topiramate, 4 = ethosuximide, 1 = lamotrigine and 1 = phenobarbital). Thirty of the young people with TS were taking medication for tics or symptoms of co-morbid OCD or ADHD. Fifteen patients with TS were taking Pimozide (6 + fluoxetine, 1 + clonidine, 1 + fluoxetine + clonidine), 7 were taking aripiprazole (1 + fluoxetine), 6 were taking risperidone (1 + fluoxetine) and 2 were taking sulpiride. No patients were included in the study who showed evidence of severe neurological or physical impairment.

Procedure

The study received approval from a local ethical committee and all participants gave written informed consent. After basic demographical data were collected, measures were administered to assess QoL and the nature and severity of TS and other behavioural symptoms.

Patients with TS, ECs and HCs completed the Youth Quality of Life Instrument-Research Version (YQOL-R) and four clinical scales. These were the Multidimensional Anxiety Scale for Children (MASC), Child Depression Inventory (CDI), Conner's ADHD/DSMV-IV Scale (CADS) and the Child Behavior Checklist (CBCL). The MASC and CDI were used to assess anxiety and depression, the CADS provided an indication of symptoms related to ADHD and the CBCL was used to assess a range of emotional and behavioural difficulties. Two additional measures were used with young people with TS. Tic severity scores were obtained through the use of the Yale Global Tic Severity Rating Scale (YGTSS) and the presence of symptoms relating to OCD was assessed using the Children's Yale-Brown Obsessive Compulsive Scale (Y-BOCS).

Measures

Youth quality of life instrument-research version [12, 13]

The YQOL-R is a self-reporting instrument designed to encompass QoL ratings across a range of important areas of young peoples' lives as previously defined by adolescents themselves, parents, teachers, and health care providers. The scale contains two types of items that may be broadly classified as subjective or objective. The "perceptual" items are things known only to the adolescent him/herself (e.g. I feel that life is worthwhile); while the "contextual" items are potentially verifiable (e.g. during the past month, how often did you spend time with a friend having a good time outside of school?)

The 41 "perceptual items" create scores for the following four domains: sense of self, social relationships, environment and general QoL. The *self* domain (14 items) provides a perspective on the adolescent's sense of who they are (e.g. "I feel good about myself"). The *relationships* domain (14 items) assesses both family and peer relationships (e.g. "I am happy with the friends I have"). The *environment* domain includes ten items such as "I feel my life is full of interesting things to do" and the *general* QoL domain contains three broader evaluative items (e.g. "I enjoy life"). All items were scored on an 11 point scale from 0 (not at all) to 10 (completely/a great deal).

The 15 "contextual items" are used as individual indicators (Table 1). These are important for assessing objective factors that may impact the youth's perception of their QoL. For all items other than the reverse scored items D4, D6, D7, D8, D9 and D10, low scores indicate a low QoL.

Multidimensional anxiety scale for children [15]

The MASC is a validated and widely used tool which assesses anxiety disorders in children and adolescents. It contains three sub-scales (physical, harm and social) which are combined to generate a total score.

Children's depression inventory [16]

The CDI is a self-rated instrument which can enable the diagnosis of major depressive or dysthymic disorder in children and adolescents. The CDI has been extensively validated and is designed for children and adolescents aged 7–17.

Children's Yale-brown obsessive-compulsive scale [17]

The YBOCS is a reliable instrument used to assess the severity of obsessive-compulsive symptoms in children. The clinician

Table 1 Contextual QoL items from the Youth Quality of Life Instrument–Research version [12]

Number	Item	Reverse Scored?
D1	How often did you have a conversation with an adult about something that is important to you?	N
D2	How often did you help someone who needed it?	N
D3	How often have your parents or guardians let you make your own decisions about what time you go to bed?	N
D4	How often has your behavior caused problems with your family?	Y
D5	How often did you spend time with a friend having a good time outside of school?	N
D6	How often have you had serious emotional or mental health problems that you felt you needed help with?	Y
D7	How often did you feel that you could not shake off the blues, even with help from your family and friends?	Y
D8	How often have any of your family members had serious arguments with one another?	Y
D9	How often did you miss out on an activity that you wanted to do because of any physical or emotional problems you have?	Y
D10	How often have people your age made you feel unwelcome because of how you look?	Y
D11	How often have you been in a good mood?	N
D12	How often have you had enough food and a safe place to live?	N
D13	How many days did you work around the (your) house, such as cleaning, cooking, laundry, or caring for a pet?	N
D14	How many days did you have dinner with a parent, guardian, or other adult in your family?	N
D15	How many days were you at home without an adult for at least three hours?	N

All items are scored on a five point scale: 0 (never), 1 (almost never), 2 (sometimes), 3 (fairly often), 4 (very often)

initially notes the presence of obsessions and compulsions based on observation, and child and parent report relating to recent weeks, before rating their severity in terms of number, frequency, intensity, resistance and interference. The total score provides an indication of the impairment that obsessive compulsive symptoms cause for the patient.

Conners' ADHD/DSM-IV scale [18]

The CADS is a self- and proxy-rated (parent, teacher) scale used to ascertain a diagnosis of ADHD which can enable the discrimination between the subtypes predominantly inattentive, predominantly hyperactive-impulsive, and combined attention-deficit/hyperactivity disorder. It has been extensively validated and is designed for ages 12–17.

Child behavior checklist [19]

The CBCL is a widely used parent-rated scale assessing the frequency and intensity of behavioral and emotional problems exhibited by the child over the preceding 6 months. It consists of eight syndrome scales (withdrawn, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior and aggressive behaviour) and two composite scales (externalizing and internalizing problems). It has excellent psychometric properties and construct validity [19].

Yale global tic severity scale [20]

The YGTSS is a reliable [20] clinician rated interview. The clinician initially notes the presence of tics based on child and parent report relating to recent weeks and behavioral observation. The severity of motor and phonic tics is then rated in terms of number, frequency, intensity, complexity and interference.

Data analysis

The first part of analysis compared the QoL scores given by patients with TS to HCs and then to ECs. Possible differences between total QoL scores, scores for the four QoL domains, and scores for each contextual item (D1–D15) were investigated. Individuals with TS were also compared to the other two groups for mean ratings on clinical measures and for subscale scores, where appropriate.

The second part of analysis investigated whether patients with TS who had more severe tics or co-morbid OCD or ADHD exhibited greater differences from the control groups on the measures administered. The whole TS group was split in two ways. The first was according to YGTSS score, which generated two subgroups of patients with either milder or more severe tics. The second was dependent on the presence of co-morbidities, which generated four subgroups. For each split, the subgroups were independently compared to HCs and ECs for scores on the scales administered.

Results

Non-parametric Mann Whitney *U* tests (MWU) were used for statistical analyses, as data were not normally distributed.

Overall group comparisons for QoL measure and clinical scales

Table 2 shows the mean and standard deviation of scores on all QoL and clinical measures for young people with TS, HCs and ECs.

Young people with TS versus healthy controls

There were no significant differences between patients with TS and HCs for total or domain QoL scores. However, significant differences were found for a number of QoL contextual items, all indicating reduced QoL in TS. Patients with TS scored significantly lower than controls on item D1 (MWU = 2,041, $p = 0.046$), suggesting they had conversations with adults about something that was important to them less often; on item D5 (MWU = 1,944, $p = 0.014$), indicating they spent less time having a good time with a friend outside of school; on item D12 (MWU = 2,078.5, $p = 0.007$), showing that they felt they had enough food and a safe place to live less often; and on item D13 (MWU = 2,014, $p = 0.030$), indicating they spent less time working around their home. Patients with TS scored significantly higher than controls on item D6 (MWU = 1,836, $p = 0.001$), suggesting they felt they had serious emotional or mental health problems more often than HCs; on item D8 (MWU = 2,038, $p = 0.032$), indicating that their family members may argue more frequently; and on item D9

Table 2 Mean and SD for statistically different scores on the QoL and clinical measures for the three groups

Measure	Mean (SD)		
	Healthy controls	Patients with Tourette syndrome	Patients with epilepsy
CDI	8.73 (8.69)	8.72 (7.74)	8.02 (5.45)
CADS	3.13 (2.25)	21.85 (15.30)	9.48 (8.31)
MASC			
Total	33.26 (17.38)	39.78 (16.50)	38.16 (14.94)
Physical	7.95 (5.53)	10.98 (5.92)	9.58 (7.29)
Harm	11.13 (5.85)	13.44 (5.33)	11.34 (5.48)
Social anxiety	8.88 (6.75)	9.28 (6.21)	10.28 (5.94)
CBCL			
Total	10.83 (7.89)	36.12 (23.26)	22.84 (17.45)
Internalising	4.69 (3.35)	11.90 (9.04)	8.72 (6.81)
Externalising	1.97 (1.78)	13.12 (8.71)	7.3 (7.45)
QOL perceptual			
Total	320.00 (47.74)	307.12 (59.99)	311.62 (52.18)
Self	101.21 (20.04)	93.66 (25.98)	93.78 (19.99)
Relationships	114.72 (22.00)	102.58 (33.03)	110.86 (25.30)
Environment	83.24 (11.47)	80.9 (16.41)	82.24 (13.71)
General	25.70 (5.88)	25.86 (6.55)	26.52 (5.91)
QOL contextual			
D1	2.03 (1.20)	1.60 (1.25)	2.26 (1.41)
D2	2.01 (1.01)	1.84 (1.31)	2.12 (1.15)
D3	2.49 (1.38)	2.28 (1.51)	2.04 (1.56)
D4	1.57 (1.21)	1.34 (1.14)	1.18 (1.49)
D5	2.77 (1.29)	2.08 (1.63)	2.30 (1.50)
D6	0.56 (1.02)	1.28 (1.44)	0.70 (1.13)
D7	1.15 (1.23)	1.17 (1.14)	0.90 (1.25)
D8	0.82 (1.07)	1.16 (1.08)	1.18 (1.35)
D9	0.53 (0.95)	0.94 (1.15)	0.70 (0.98)
D10	0.62 (1.09)	0.68 (1.00)	0.80 (0.97)
D11	3.13 (0.82)	2.92 (1.18)	2.84 (1.30)
D12	3.68 (1.00)	3.36 (1.12)	3.50 (0.91)
D13	2.23 (1.59)	1.60 (1.62)	2.06 (1.58)
D14	3.88 (0.49)	3.7 (0.79)	3.60 (0.81)
D15	1.72 (1.52)	1.6 (1.54)	1.18 (1.48)

(MWU = 1,982.5, $p = 0.010$), showing that they more frequently thought that they missed out on activities because of physical or emotional problems.

Patients with TS also scored significantly differently compared to HCs on many clinical scales. They had significantly higher scores on the CADS (MWU = 221, $p < 0.001$), indicating more ADHD related symptoms. Patients with TS also scored more highly than controls on the MASC scale overall (MWU = 1,974, $p = 0.024$), the MASC physical subscale (MWU = 1,817, $p = 0.004$) and the MASC harm subscale (MWU = 1,913, $p = 0.012$), indicating increased anxiety in TS, particularly as expressed in relation to the experience of physical symptoms and in coping behaviour. Patients with TS also had higher scores on the CBCL scale overall (MWU = 735.5, $p < 0.001$), and on both the CBCL internalising (MWU = 1,181, $p < 0.001$) and externalising subscales (MWU = 331.5, $p \leq 0.001$), suggesting that TS is associated with a range of emotional and behavioural difficulties.

Young people with TS versus epilepsy controls

No significant differences were apparent between patients with TS and ECs for QoL perceptual items. However, there were differences for contextual items. Patients with TS had significantly lower scores for item D12 (MWU = 2,179, $p = 0.029$), suggesting that they felt they had enough food and a safe place to live less often. Patients with TS also scored significantly more highly than ECs on item D4 (MWU = 2,024.5, $p = 0.032$), suggesting that patients with TS more often felt that their behaviour led to problems for their family; on item D9 (MWU = 2,105, $p = 0.041$) suggesting that they missed out on activities due to physical and emotional problems more often than ECs; and on items D14 (MWU = 2,132.5, $p = 0.012$) and D15 (MWU = 3,294.5, $p = 0.031$), which could indicate patients with TS spend less time with their families or are more independent than ECs.

Young people with TS also scored differently compared to ECs on clinical scales. They had higher scores on the CADS (MWU = 491.5, $p < 0.001$), indicating a higher prevalence of ADHD related symptoms. TS was also associated with significantly greater scores in the CBCL overall (MWU = 781, $p = 0.002$) and on the externalising subscale (MWU = 710, $p < 0.001$), indicating that patients with TS exhibit more externalising emotional and behavioural problems that ECs.

Tic severity

For the TS group, tic severity scores ranged from 10 to 46 on the YGTSS. As QoL may be more adversely affected in those patients with TS who have worse tic symptoms, patients were split into two groups with scores above or below the median YGTSS score of 30 before being compared to the HCs and ECs for scores on all measures (Table 3). Out of the 49 TS patients with YGTSS scores available, 4 had a score of 30 and were therefore excluded from analysis. The marked severity group (scores above 30) contained 24 patients (age: mean 13.24, SD 2.32 years; co-morbidities: 2 TS only, 7 TS + ADHD, 8 TS + OCD, 7 TS + OCD + ADHD) and the mild severity group (scores below 30) contained 21 patients (age: mean 13.5, SD 2.28; co-morbidities: 8 TS only, 4 TS + OCD, 6 TS + ADHD, 3 TS + OCD + ADHD).

Table 3 Mean and SD for statistically different scores for QoL and clinical measures for the tic severity subgroups

Measure	Mean (SD)	
	Patients with TS and mild tics	Patients with TS and marked tics
CADS	17.30 (11.34)	27.08 (17.65)
MASC		
Total	35.19 (12.97)	42.54 (18.67)
Physical	9.67 (5.52)	11.17 (5.64)
CBCL		
Total	32.75 (23.60)	39.88 (23.95)
Internalising	10.45 (9.48)	13 (8.34)
Externalising	13.05 (9.43)	14 (8.72)
QOL perceptual: relationships	110.80 (24.05)	96 (37.32)
QOL contextual		
D1	1.90 (1.18)	1.42 (1.31)
D2	1.52 (0.98)	2.08 (1.53)
D5	1.91 (1.50)	2.21 (1.74)
D6	0.86 (1.06)	1.79 (1.7)
D8	1.05 (0.86)	1.38 (1.27)
D9	0.90 (1.09)	0.96 (1.12)
D12	3.86 (0.36)	3.04 (1.30)
D13	1.57 (1.47)	1.46 (1.59)
D14	3.86 (0.65)	3.58 (0.94)
D15	1.10 (1.22)	2 (1.62)

Mild tic severity

Patients with milder TS had significantly lower scores than controls for contextual items D2 (MWU = 754, $p = 0.033$) and D5 (MWU = 677.5, $p = 0.006$), perhaps suggesting patients with milder tics exhibit reduced social interaction compared to HCs.

The milder tic severity group also differed significantly from HCs for clinical measures by exhibiting higher scores on the CADS (MWU = 195.5, $p < 0.001$), higher CBCL total scores (MWU = 402.5, $p < 0.001$) and higher internalising (MWU = 610.5, $p = 0.004$) and externalising (MWU = 136.5, $p < 0.001$) subscale scores. Patients with mild tics, therefore, exhibit more symptoms of ADHD and internalising and externalising behavioural difficulties than HCs.

Similar findings were apparent when patients with mild tics were compared to ECs. These latter two groups differed significantly for contextual item D2 (MWU = 356, $p = 0.025$), with patients with TS exhibiting lower scores for this item.

Patients with milder tic severity also exhibited higher scores than ECs for the CADS (MWU = 267.5, $p = 0.002$) and for the CBCL externalising (MWU = 302, $p = 0.009$) subscale.

Marked tic severity

The group of TS patients with greater tic severity exhibited significantly lower scores than controls for the QoL relationships domain (MWU = 801, $p = 0.009$). They also exhibited lower scores than controls for contextual items D1 (MWU = 896, $p = 0.038$), D12 (MWU = 831, $p < 0.001$), D13 (MWU = 910.5, $p = 0.044$) and D14 (MWU = 1,018, $p = 0.035$), and higher scores than controls on items D6 (MWU = 719.5, $p < 0.001$), D8 (MWU = 893.5, $p = 0.027$) and D9 (MWU = 926.5, $p = 0.028$). Overall, these differences indicate that more severe TS may decrease social interaction and involvement in home and leisure activities, and could be associated with insecurity relating to basic needs and the home environment.

Young people with marked tic severity scored differently to HCs on the CADS (MWU = 25.5, $p < 0.001$), MASC overall (MWU = 876, $p = 0.031$) and MASC physical subscale (MWU = 836.5, $p = 0.016$), and for the CBCL overall (MWU = 344, $p < 0.001$) and the internalising (MWU = 440.5, $p < 0.001$) and externalising (MWU = 176, $p < 0.001$) subscales. Unlike patients with milder tics, patients with more severe tics experience anxiety difficulties when compared to HCs (especially physically related anxiety symptoms) as well as more symptoms of ADHD and emotional and behavioural problems.

Patients with more severe tics also scored significantly lower in the QoL relationships domain (MWU = 429.5, $p = 0.049$) when compared to ECs, indicating that social or relationship difficulties may be more closely linked to having severe tics than other clinical disorders. TS patients with higher YGTSS scores also scored significantly differently to ECs for some contextual items. Patients with TS exhibited lower scores for item D1 (MWU = 395.5, $p = 0.015$), but higher scores than ECs for items D6 (MWU = 377, $p = 0.004$) and D15 (MWU = 416.5, $p = 0.026$). More severe TS may therefore be associated with less supportive communication and perhaps less adult supervision than epilepsy, even though patients with severe tics feel that they experience more emotional difficulties than ECs.

Young people with TS and marked tic severity also scored significantly higher than ECs on the CADS (MWU = 183.5, $p < 0.001$) and had significantly higher CBCL total (MWU = 335.5, $p = 0.002$), internalising (MWU = 403.5, $p = 0.023$) and externalising (MWU = 341, $p = 0.003$) scores, indicating more evidence of symptoms of ADHD and varying emotional and behavioural difficulties in the former group.

Co-morbid conditions

QoL may be more affected in individuals with TS who suffer with other co-morbid conditions such as OCD and ADHD, or both. The TS group ($n = 50$) was therefore split into four subgroups based on the presence of co-morbid conditions, so that they could be separately compared to HCs and ECs (Table 4). The subgroups were as follows: TS only ($n = 11$; age: mean 13.73, SD 2.41 years; YGTSS score: mean 24.36, SD 7.24); TS plus OCD (TS + OCD: $n = 13$; age: mean 13.77, 2.62 years; YGTSS score: mean 31.92, SD 6.44); TS plus ADHD (TS + ADHD: $n = 15$; age: mean 12.4, SD 1.84 years; YGTSS score: mean 31.14, SD 7.88); TS plus OCD and ADHD (TS + OCD + ADHD: $n = 11$; age: mean 13.36, SD 12.42 years; YGTSS score: mean 33.64, SD 6.36).

Young people with pure TS

Young people with pure TS exhibited significantly lower QoL scores than HCs for the environmental (MWU = 336, $p = 0.029$) and general (MWU = 317, $p = 0.016$) domains. They also scored significantly lower than HCs for contextual item D1 (MWU = 243.5, $p = 0.001$), suggesting that they communicated less with adults about important personal issues; and for item D5 (MWU = 362, $p = 0.045$), indicating that involvement in social activities may be negatively affected by TS.

For clinical scales, patients with TS scored significantly higher than HCs only on the CADS (MWU = 165, $p < 0.001$), the CDI (MWU = 357.5, $p = 0.048$), and on the externalising subscale of the CBCL (MWU = 163, $p < 0.001$). Therefore, young people with TS without co-morbidities experience more symptoms related to ADHD and depression and externalising behavioural problems than HCs.

In comparison to ECs, young people with TS had significantly lower scores for contextual item D1 (MWU = 117, $p = 0.002$), indicating that they may communicate less with adults.

Pure TS may be more likely to be associated with depression and social anxiety problems than epilepsy, as young people with pure TS exhibited significantly higher scores than ECs for the CDI (MWU = 151.5, $p = 0.020$)

Table 4 Mean and SD for significantly different scores for QoL and clinical measures for the co-morbidity subgroups

Task/measure	Mean (SD)			
	Group 1: TS only	Group 2: TS + OCD	Group 3: TS + ADHD	Group 4: TS + OCD + ADHD
CDI	4.18 (4.60)	12.54 (10.08)	6.40 (4.22)	11.91 (8.03)
CADS	10.90 (6.76)	16.92 (13.28)	25.64 (12.99)	32.82 (18)
MASC TOT	30.36 (7.72)	41 (15.21)	37.87 (13.53)	50.36 (22.62)
MASC PHY	8.27 (4.05)	10.54 (5.87)	10.53 (5.01)	14.82 (7.33)
MASC HAR	11.64 (3.29)	13.31 (6.42)	13.80 (5.56)	14.91 (5.45)
MASC SOC	5.55 (3.86)	10.31 (4.19)	8.60 (5.85)	12.73 (8.64)
CBCL TOT	16.90 (12.62)	38.92 (18.43)	36.73 (21.38)	49.45 (28.82)
CBCL INT	5 (4.88)	14.54 (10.27)	11.40 (6.07)	15.73 (10.92)
CBCL EXT	6.30 (4.99)	13.15 (8.60)	14.20 (7.46)	17.82 (10.13)
QOL TOT	335.91 (52.61)	287.08 (67.50)	324.13 (48.42)	278.82 (58.03)
QOL SELF	105.73 (18.63)	85.23 (28.03)	99.47 (27.04)	83.64 (24.09)
QOL RELAT	120.73 (25.06)	88.31 (40.77)	15.60 (13.91)	83.55 (34.23)
QOL ENV	88.36 (17.08)	75.85 (17.75)	85.13 (12.61)	73.64 (15.73)
QOL GEN	28.64 (2.62)	22.62 (10.08)	27.07 (4.46)	25.27 (5.35)
D1	0.82 (0.87)	1.92 (1.19)	1.80 (1.15)	1.73 (1.56)
D5	1.82 (1.60)	2.46 (1.66)	2.20 (1.52)	1.73 (1.85)
D6	0.45 (1.04)	1.85 (1.63)	0.93 (1.16)	1.91 (1.51)
D7	1.09 (1.30)	1.15 (1.21)	0.80 (0.86)	1.64 (1.21)
D10	0.55 (0.69)	0.38 (0.51)	0.60 (0.99)	1.27 (1.49)
D12	3.55 (0.93)	2.85 (1.63)	3.67 (0.62)	3.36 (1.03)
D13	1.36 (1.50)	2.31 (1.60)	1.27 (1.58)	1.45 (1.75)
D14	3.91 (0.30)	3.62 (1.12)	3.87 (0.35)	3.36 (1.03)

and the social anxiety subscale of the MASC (MWU = 151, $p = 0.020$).

Young people with TS and OCD

Patients with TS + OCD scored significantly lower than HCs for both the self (MWU = 418, $p = 0.030$) and relationships (MWU = 410, $p = 0.025$) domains. TS + OCD was associated with significantly higher scores than HCs for contextual item D6 (MWU = 352, $p = 0.001$) and significantly lower scores than controls for item D12 (MWU = 486.5, $p = 0.014$). Young people with TS + OCD were more likely to feel they had a significant mental health problem and felt secure about food and their home less often than HCs.

Patients with TS + OCD exhibited significantly higher scores than HCs for the CADS (MWU = 53, $p < 0.001$), and for CBCL total (MWU = 146.5, $p < 0.001$), internalising (MWU = 235.5, $p < 0.001$) and externalising (MWU = 85.5, $p < 0.001$) subscale scores. TS + OCD therefore appears to be associated with more signs of ADHD and emotional and behavioural difficulties.

Young people with TS + OCD exhibited significantly higher scores than ECs for contextual item D6 (MWU = 187.5, $p = 0.009$), indicating they felt they had a significant emotional or mental health problem more often than ECs.

As when compared to HCs, patients with TS + OCD also exhibited significantly higher scores than ECs for the CADS (MWU = 170.5, $p = 0.008$), and the CBCL in total (MWU = 157.5, $p = 0.004$) and for the internalising (MWU = 205, $p = 0.040$) and externalising (MWU = 185, $p = 0.019$) subscales of this measure.

Young people with TS and ADHD

Patients with TS + ADHD scored significantly lower than HCs for contextual item D13 (MWU = 512, $p = 0.033$). This finding suggests that young people with TS + ADHD may spend less time engaging in household tasks than HCs. No other significant differences in QoL were apparent.

Young people with TS + ADHD exhibited significantly higher scores than controls for the CADS (MWU = 3, $p < 0.001$), the MASC harm subscale (MWU = 514, $p = 0.040$), and CBCL total (MWU = 148, $p < 0.001$) and internalising (MWU = 186.5, $p < 0.001$) and externalising (MWU = 56, $p < 0.001$) subscales.

There were differences for scores only on the clinical measures between ECs and patients with TS + ADHD. Patients with TS + ADHD exhibited significantly higher scores than ECs for the CADS (MWU = 83.5, $p < 0.001$) and for CBCL total (MWU = 193.5, $p = 0.005$) and the internalising (MWU = 230, $p = 0.023$) and externalising (MWU = 161, $p = 0.001$) subscales.

Young people with TS, OCD and ADHD

Patients with TS + OCD + ADHD exhibited significantly lower total QoL score than HCs (MWU = 307, $p = 0.014$) and significantly lower scores within the QoL self (MWU = 314.5, $p = 0.017$), relationships (MWU = 234, $p = 0.002$) and environment (MWU = 344.5, $p = 0.036$) domains. Significant differences were also evident for contextual items. Patients with TS + OCD + ADHD scored higher than controls for items D6 (MWU = 270.5, $p = 0.001$) and D10 (MWU = 387.5, $p = 0.047$), but lower for item D14 (MWU = 400.5, $p = 0.010$). These findings indicate that young people with TS + OCD + ADHD feel they experience greater mental health problems, may experience social difficulties because of their symptoms and are perhaps less likely to spend time socialising with adults in the family at home.

Patients with TS + OCD + ADHD scored significantly more highly than HCs on a number of clinical measures. These were the CADS (MWU = 0, $p < 0.001$), MASC total score (MWU = 304, $p = 0.013$) and MASC physical (MWU = 264.5, $p = 0.004$) and harm (MWU = 352.5, $p = 0.043$) subscale scores, and for the CBCL (MWU = 112, $p < 0.001$) and internalising (MWU = 246, $p = 0.002$) and externalising (MWU = 27, $p < 0.001$) subscale scores for this measure.

Patients with TS + OCD + ADHD exhibited significantly lower scores than ECs for the QoL relationships domain (MWU = 138, $p = 0.010$). They also scored significantly more highly than ECs for contextual items D6 (MWU = 148, $p = 0.007$) and D7 (MWU = 170.5, $p = 0.035$), suggesting they are more likely to feel they have a serious mental health problem and feel lower in mood more often than ECs.

Patients with TS and both co-morbidities also exhibited higher scores than ECs for the CADS (MWU = 43.5, $p < 0.001$), the MASC physical subscale (MWU = 152.5, $p = 0.021$) and for CBCL total (MWU = 122.5, $p = 0.004$) and externalising subscale (MWU = 96, $p = 0.001$) scores.

Discussion

We performed a controlled study to explore the clinical correlates of QoL in a young population with TS. Scores for contextual items showed that in comparison to HCs, young people with TS engaged less in home and social activities, communicated less with adults in their family, felt more insecure about home and witnessed more family arguments. These findings suggest that TS could be associated with family stress and mild social withdrawal. However, this reduction in social activities was not accompanied by evidence of social anxiety, although MASC total scores were higher in TS.

Patients with TS showed more insecurities about home than ECs. They also appeared more independent than ECs (spending less time without adults) which may suggest that the parents of young people with TS are less protective. Alternatively, parenting young people with TS may be more difficult, as these individuals exhibited more emotional and behavioural difficulties than ECs, and felt that their behaviour caused more problems for their family.

Scores were lower for the QoL relationships domain for young people with severe tics in comparison to both control groups, indicating that this area of QoL may be specifically vulnerable in TS. Even young people with TS who had milder tics report evidence of reduced social interaction in comparison to HCs and ECs. Comparisons to HCs indicated that more severe tics were associated with signs of insecurity and may have a widespread negative influence on social activities within and outside the home. In comparison to ECs, patients with severe tics may have less discussion with or supervision from their parents or other caregivers. Perhaps the parents of ECs maintain a parenting style that means their children are less independent, or changes in parent–child interaction occur due to the greater behavioural problems and family stress associated with having severe tics. Whatever the case, these differences in QoL are likely to have been influenced by other clinical symptoms in addition to tic severity. Both groups of TS patients exhibited higher scores than controls on particular clinical scales, and the group of patients with more severe tics contained more young people with co-morbid conditions such as OCD and/or ADHD.

A key finding of this study is that even patients TS who had no co-morbidities (pure TS) evaluated some aspects of QoL more negatively than controls. They also reported more depressive symptoms than both HCs and ECs. As young people with pure TS reported worse QoL for the general and environmental domains than did HCs, the items for these domains could be more sensitive to depression. Lower scores in the QoL environment domain could suggest that young people with pure TS feel less secure about, or do not feel that they make the most out of their surroundings. Scores for contextual items also suggested some social aspects of QoL can be affected by pure TS.

There were fewer QoL differences for pure TS compared to epilepsy. However, one finding which could be linked to the social difficulties exhibited by some patients with TS is that individuals with pure TS had higher MASC social anxiety scores than ECs. As scores on clinical measures showed that pure TS may still be associated with more symptoms related to ADHD, depression and other behavioural or emotional difficulties, it is again possible that such clinical symptoms (and perhaps subthreshold symptoms of OCD or ADHD), could have influenced perceived QoL in this group.

Young people with TS + OCD gave significantly lower ratings than HCs for the QoL domains of self and relationships, which could indicate that having co-morbid OCD has a greater negative impact on these domains of QoL than having TS. On the other hand, it was rather surprising that young people with TS + ADHD showed very few differences in perceived QoL in comparison to HCs and ECs. Contextual items yielded one quantitative difference, in that TS + ADHD was associated with patients engaging in fewer household duties. We should be cautious in concluding that ADHD is not associated with problems that affect QoL due to severity of the behavioural problems shown by some patients and the results of other studies suggesting ADHD may be linked to poor QoL [6, 11]. Like the findings for young people with TS and OCD, the scores given by patients with TS and co-morbid ADHD may partly reflect symptoms of this co-morbid disorder. That is, in contrast to young people with OCD who may attend more to and ruminate about any difficulties they have, those with ADHD may demonstrate less focus on or insight into any difficulties related to QoL. Despite the potential merits of self-reporting instruments, they may therefore be less reliable than proxy-based measures in certain patient groups, and should be used in addition to objective clinician ratings.

Young people with TS + OCD + ADHD scored significantly lower on all QoL domains in comparison to HCs. Having both co-morbid disorders therefore contributes to widespread negative effects on QoL, as suggested by previous studies [6, 11]. This could be seen as the additive effect of having multiple co-morbidities. For instance, pure TS was associated with lower scores for the environment and general domains, whereas patients with TS + OCD had lower scores for self and relationships domains. When compared to ECs, patients with TS + OCD + ADHD showed poorer perceived QoL only for the relationships domain, thus showing that more complex cases of TS are more likely to negatively affect social aspects of QoL than epilepsy.

Many of our findings are in agreement with other studies which have highlighted that aspects of QoL involving social interaction and relationships can be vulnerable to TS. For example, Stokes et al. [21] found that the peers of young people with TS rate them to be significantly more withdrawn, aggressive, and less popular than their classmates. Another study found that 29% of patients with TS reported difficulties in the social domain of QoL, such as difficulties with social life and relationships due to self-consciousness and the stigma related to having TS [8].

Limitations associated with the current study include the size of the sample, and generalisability of the findings, given that all cases were recruited from a tertiary referral centre. One difficulty with assessing QoL in young people is that their QoL is a moving target due to the fact that they are constantly developing. A more specific limitation of QoL research in TS is that these young people are likely to face unique challenges and impacts on QoL for which specific tools of investigation are currently unavailable, and many QoL instruments may not be sufficiently sensitive to areas that are specific to TS. A disease-specific instrument is now available for adults with TS [22], and the adaptation of this instrument for children and adolescents with TS may enable greater insight into how this condition can affect their QoL.

In conclusion, young people with TS, including those with pure TS, report more distress and impairment in aspects of QoL than do HCs. These difficulties tend to be more apparent in areas of social life and relationships, are greater for individuals with severe tics or co-morbid OCD+/− ADHD, and can be more prominent in TS than in disorders such as epilepsy. The families of young people with TS also appear to experience considerable practical difficulties and psychosocial stress. Difficulties at home may lead to feelings of stress and insecurity that further exacerbate patients’ tics, emotional and behavioural problems. Further research is needed in order to develop much needed methods of support for these young people and their families.

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References

1. American Psychiatric Association (2000) Diagnostic and statistical manual of mental disorders (4th edn: text revision; DSM-IV-TR). American Psychiatric Association, Washington DC
2. Robertson MM (2000) Tourette syndrome, associated conditions and the complexities of treatment. Brain 123:425–462
3. Cavanna AE, Servo S, Monaco F, Robertson MM (2009) The behavioral spectrum of Gilles de la Tourette syndrome. J Neuropsychiatry Clin Neurosci 21:13–23
4. Erenberg G, Cruse RP, Rothner DA (1987) The natural history of Tourette’s syndrome: a follow-up study. Ann Neurol 22:383–385
5. Piacentini J, Bergman RL, Keller M, McCracken JT (2003) Functional impairment in children and adolescents with obsessive-compulsive disorder. J Child Adolesc Psychopharm 13(Suppl.1):S61–S69

6. Storch EA, Merlo LJ, Lack C, Milsom VA, Geffken GR, Goodman WK, Murphy TK (2007) Quality of life in youth with Tourette's syndrome and chronic tic disorder. J Clin Child Adolesc Psychol 36:217–227
7. Cutler D, Murphy T, Gilmour J, Heyman I (2009) The quality of life of young people with Tourette syndrome. Child 35:496–504
8. Elstner K, Selai CE, Trimble MR, Robertson MM (2001) Quality of life (QoL) of patients with Gilles de la Tourette syndrome. Acta Psychiatrica Scand 103:52–59
9. Packer LE (2005) Tic-related school problems: impact of functioning, accommodations and interventions. Behav Mod 29:876–899
10. Champion LM, Fulton WA, Shady GA (1988) Tourette syndrome and social functioning in a Canadian population. Neurosci Biobehav Rev 12:255–257
11. Bernard BA, Stebbins GT, Siegel S, Schultz TM, Hays C, Morrissey MJ, Leurgans S, Goetz CG (2009) Determinants of Quality of Life in Children with Tourette syndrome. Mov Disord 24:1070–1073
12. Edwards TC, Hueber CE, Connell FA, Patrick DL (2002) Adolescent quality of life, part I: conceptual and measurement model. J Adolesc 25:275–286
13. Patrick DL, Edwards TC, Topolski T (2002) Adolescent quality of life part II: initial validation of a new instrument. J Adolesc 25:287–300
14. Robertson MM, Eapen V (1996) The National Hospital Interview Schedule for the assessment of Gilles de la Tourette syndrome and related behaviours. Int J Methods Psychiatry Res 6:203–226
15. March JS, Parker JDA, Sullivan K, Stallings P, Conners CK (1997) The Multidimensional Anxiety Scales for Children (MASC): Factor structure, reliability and validity. J Am Acad Child Adolesc Psychiatry 36:544–552
16. Kovacs M (1992) Children's Depression Inventory (CDI). Multihealth Systems, Inc., New York
17. Scahill L, Riddle MA, McSwiggin-Harden M, Ort SI, King RA, Goodman WK, Cicchetti D, Leckman JF (1997) Children's Yale-Brown Obsessive Compulsive Scale: reliability and validity. J Am Acad Child Adolesc Psychiatry 36:844–852
18. Conners CK (1973) Rating scales for use in drug studies with children. Psychopharmacology Bulletin: Pharmacotherapy with children. Government Printing Office, Washington, DC
19. Achenbach T, Edelbrock C (1983) Manual for the child behavior checklist and revised child behavior profile. University of Vermont Department of Psychiatry, Burlington
20. Leckman JF, Riddle MA, Hardin MT, Ort SI, Swartz KL, Stevenson J, Cohen D (1989) The Yale Global Tic Severity Scale: initial testing of a clinician rated scale of tic severity. J Am Acad Child Adolesc Psychiatry 28:566–577
21. Stokes A, Bawden HN, Bachman JE, Booley JM, Campfield PR (1991) Peer problems in Tourette's disorder. Pediatrics 87:936–942
22. Cavanna AE, Schrag A, Morley D, Orth M, Robertson MM, Joyce E, Critchley HD, Selai C (2008) The Gilles de la Tourette syndrome-quality of life scale (GTS-QOL): development and validation. Neurology 71:1410–1416