Original Article

Quality of Life in Patients With Postural Tachycardia Syndrome

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• ***Objectives*: To quantify quality of life and identify demographic and clinical correlates of functioning in a well-characterized sample of patients with postural tachycardia syndrome (POTS).**

• ***Patients and Methods*: Prospective patients were those seen at the Mayo Clinic Autonomic Disorders Laboratory from September 2000 to June 2001. Neurologists made diagnoses of POTS according to established criteria. Patients completed a questionnaire packet that included measures of quality of life (36-Item Short-Form Health Survey [SF-36]) and symptom severity (Autonomic Symptom Profile). Additional clinical information was abstracted from medical records.**

• ***Results*: Ninety-four patients (89% female; mean age, 34.2 years) were enrolled in the study. Patients with POTS reported impairment across multiple domains on the SF-36. Physical functioning, role functioning, bodily pain, general health, vitality, and social functioning were all significantly impaired compared with a healthy population ($P<.01$ for all) and similar to that reported by patients with other chronic, disabling conditions. Hierarchical regression analyses revealed that symptom severity ($\beta = -.36$, $P<.001$) and disability status ($\beta = -.36$, $P<.001$) were independent predictors of SF-36 physical component scores, with the full model accounting for 54% of the variance ($P<.001$). None of the variables examined accounted for a significant amount of the variance in SF-36 mental component scores.**

• ***Conclusions*: Patients with POTS experience clear limitations across multiple domains of quality of life, including physical, social, and role functioning. Treatment should address the multiple and varied impairments experienced by these patients and may require a multidisciplinary approach. Future research must further delineate factors, both disease related and psychosocial, that predict functioning and adjustment in this population.**

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CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; GI = gastrointestinal; POTS = postural tachycardia syndrome; SF-36 = 36-Item Short-Form Health Survey

Postural tachycardia syndrome (POTS) is a clinical syndrome of orthostatic intolerance characterized by the development of excessive tachycardia and symptoms of cerebral hypoperfusion on standing.[1] Patients with POTS often present with complaints of chronic fatigue, exercise intolerance, dizziness, diminished concentration, tremulousness, nausea, and recurrent syncope. Simple activities, such as eating, showering, or low-intensity exercise, may profoundly exacerbate these symptoms, resulting in impairment of even the most rudimentary activities of daily living.[2] Although orthostatic intolerance is the hallmark of POTS, patients may experience other symptoms of autonomic dysfunction as well, including upper gastrointestinal (GI) tract symptoms, bowel and bladder dysfunction, and secretomotor dysfunction.[2,3] Mainly, POTS occurs in persons between the ages of 20 and 50 years, at a time when employment and physical activity are of primary importance.[2] Clinical observations suggest that POTS affects quality of life considerably; however, to our knowledge, no data have investigated this systematically.

Numerous studies[4-7] have demonstrated the adverse impact medical morbidity can have on health-related quality of life, a multidimensional construct involving domains such as physical, role, and social functioning; mood; and perceived health. The impact can be especially prominent in chronic conditions with no definitive treatment or cure. In patients with such conditions (eg, chronic pain), research has shown that multidisciplinary interventions are often needed to restore function and improve quality of life despite continuing symptoms.[8,9] Patients with POTS often remain symptomatic despite standard medical treatment[3] and likely experience significant limitations in function that may benefit from similar interventions. Before consideration of such interventions, objective data are needed to show the extent of functional limitation and impairment in quality of life experienced by patients with POTS.

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The purpose of this study was to evaluate the impact of POTS on functioning and quality of life. We were specifically interested in identifying the following: (1) the pattern of functional impairment in patients with POTS; (2) the degree of functional impairment in patients with POTS compared with the general population and with patients with other chronic medical conditions that can result in significant functional disability; and (3) demographic and clinical characteristics (eg, symptom severity, symptom duration, treatment status) that are associated with impairment in functioning. Such information is necessary for the development of interventions aimed at improving quality of life in this population.

PATIENTS AND METHODS

Study participants were recruited through the Mayo Clinic Autonomic Disorders Laboratory. All patients had a complete general medical and neurologic evaluation and a full autonomic reflex laboratory evaluation before participating in the study. Inclusion criteria were as follows: (1) men or women age 18 years or older; (2) sustained heart rate increment of 30 beats/min or greater within 5 minutes of head-up tilt; and (3) symptoms of orthostatic intolerance, including weakness, light-headedness, blurred vision, nausea, palpitations, and difficulty with concentration and thinking.

Exclusion criteria were as follows: (1) presence of another cause of autonomic failure; (2) presence of other organ systems failure or illness that can affect autonomic function or the patient's ability to cooperate, including dementia, pheochromocytoma, heart failure, hypertension, renal or hepatic disease, severe anemia, alcoholism, malignant neoplasms, hypothyroidism, sympathectomy, and cerebrovascular accidents; and (3) clinically significant coronary artery disease.

Prospective participants were either approached during regularly scheduled clinic appointments (n=59) or recruited by mail (n=226) from a database of POTS patients who had participated in prior research conducted through the Autonomic Disorders Laboratory. The clinic sample consisted of consecutive patients seen in the Autonomic Disorders Laboratory from September 2000 to June 2001. Fifty patients (85%) approached in the clinic and 63 patients (28%) recruited by mail agreed to participate in the study, resulting in a sample size of 113 and an overall response rate of 40%. Among the patients recruited by mail, responders were slightly older than nonresponders (mean age, 37.9 vs 34.4 years; P=.03) and more likely to be female than male (35% vs 10%; P=.009).

Procedure

Patients approached in the clinic signed an informed consent form and were given a questionnaire packet, including the measures described herein. Participants were given the option of either completing the packet in the clinic or returning it via mail in a stamped, addressed envelope. Patients who received the questionnaire packet through the mail were asked to sign the consent form and return it along with the completed questionnaire. The study protocol was approved by the Mayo Foundation Institutional Review Board. All data were collected between September 2000 and June 2001.

Measures

The 36-Item Short-Form Health Survey.—The 36-Item Short-Form Health Survey (SF-36) is a self-report questionnaire that has been used to assess quality of life in various medical populations.[10,11] The questionnaire contains 36 items that yield 8 category scales: physical functioning, role limitations caused by physical problems, bodily pain, general health, vitality, social functioning, role limitations caused by emotional problems, and mental health. Scale scores range from 0 to 100, with higher scores indicating better health. The 8 category scores can be aggregated into 2 summary scales, the physical component summary scale and the mental component summary scale. The 2 summary scores are calculated as t scores (based on general population norms), with a mean of 50 and an SD of 10. The SF-36 has demonstrated excellent psychometric properties in both patient and healthy control populations.[10,11] Extensive normative data are available for a healthy population stratified by age and sex and for a diverse range of patient populations, including those with diabetes, congestive heart failure (CHF), and chronic obstructive pulmonary disease (COPD).

Autonomic Symptom Profile.—The Autonomic Symptom Profile is a self-report instrument designed to provide an index of autonomic symptom severity.[12] It yields 1 total score that reflects overall severity of autonomic symptoms and 10 weighted subscale scores that assess severity of symptoms within the following domains: orthostatic intolerance, sexual failure (men only), bladder dysfunction, diarrhea, constipation, upper GI tract symptoms, secretomotor dysfunction, sleep dysfunction, vasomotor symptoms, and pupillomotor symptoms. The total score is calculated by summing the individual scales. Autonomic Symptom Profile scores have been shown to correlate with objective indices of autonomic function.[12]

Data Analysis

Because many of the Autonomic Symptom Profile scales and some of the SF-36 scales had skewed distributions, nonparametric methods were used to identify significant demographic and clinical (ie, symptom severity, symptom duration, treatment status) correlates of the SF-36

domains. Specifically, Mann-Whitney *U* tests were used for group comparisons, and Spearman ρ correlation coefficients were used to examine relationships between continuous variables. Separate hierarchical regression analyses were then conducted to investigate the independent contributions of demographic and clinical variables to the prediction of the SF-36 physical and mental component summary scales. Significant demographic correlates were entered into the equation first, followed by simultaneous entry of symptom duration, symptom severity, and treatment status. To reduce the number of predictors, the Autonomic Symptom Profile total score was used as an index of symptom severity rather than the individual subscale scores. In addition, variables with skewed distributions underwent transformations to normalize their distribution before being entered into the regression equation.

RESULTS

Sample Characteristics

Of the 113 questionnaires returned, 19 (17%) were excluded from analyses because the participants did not meet full inclusion criteria. An additional 25 participants had a heart rate increment of 30 beats/min or more but did not sustain a heart rate of at least 120 beats/min throughout the tilt. These participants were compared to the rest of the sample on all the variables of interest. Results of Mann-Whitney *U* tests revealed no significant differences on any of the study measures except for 1 scale of the Autonomic Symptom Profile (upper GI tract symptoms in the group with a sustained heart rate of <120 beats/min: mean, 6.1 vs 3.7; P=.03). Consequently, the 2 groups were combined for all analyses. This resulted in a final sample size of 94.

The sample was predominantly young (mean ± SD age, 34.2±10.1 years), white (n=93; 99%), and female (n=83; 89%). They were well educated, with 42 participants (45%) reporting a college or graduate education. Twenty-three participants (24%) identified their employment status as disabled or unable to work secondary to POTS (compared with employed, homemaker, student, retired, or unemployed for reasons other than POTS). On average, patients had been experiencing symptoms of autonomic dysfunction for several years (mean ± SD, 7.5±5.7 years), although this varied widely (range, 3 months to ≥20 years). Most of the sample (n=60; 64%) was taking some type of medication for their symptoms (eg, fludrocortisone, midodrine, β-blocker).

Demographic and clinical characteristics differed somewhat between patients recruited in the clinic and those recruited by mail. Specifically, patients recruited in the clinic were younger (mean age, 29.2 vs 37.4 years; P<.001), more likely to be single (51% vs 19%, P=.01), had been experiencing their symptoms for a shorter duration (mean, 9.4 vs 4.7 years; P<.001), and reported more severe symptoms of orthostatic intolerance (mean, 30.1 vs 25.7; P=.01) than those recruited via mail. The prevalence of disability did not differ significantly between patients recruited by mail and those recruited through the clinic (22% vs 33%; P=.08). Because of the demographic and clinical differences between patients recruited in the clinic and those recruited via mail, recruitment site was controlled for in the regression analyses.

Descriptors

Figure 1 presents patients' mean SF-36 category scores. For comparison purposes, we also present previously published mean SF-36 scores for a healthy sample of young women similar in age to our POTS sample,[10] a sample of patients with CHF,[10] and a sample of patients with COPD.[10] We chose CHF and COPD as comparison groups because, similar to POTS, they are chronic conditions that are marked by recurring symptoms and often result in significant disability. In addition, the SF-36 has extensive normative data on these 2 populations. As shown, patients with POTS reported impairment across multiple domains of functioning, with the most severe impairment reported in vitality and role limitations due to physical health. Physical functioning, role functioning, bodily pain, general health, vitality, and social functioning were all significantly impaired compared with a healthy population (P<.01 for all) and similar to that reported by patients with COPD and CHF. Scores on the psychological domains (ie, mental health and role limitations due to emotional problems) were similar across the 4 groups.

Table 1 presents participants' mean scores on the Autonomic Symptom Profile. For the purposes of this study, the sexual failure subscale (which was completed by men only) was excluded in the calculation of the total score, and men and women were combined because of the small number of men in the sample (n=10; 11%). As expected, patients reported the most severe symptoms in the area of orthostatic intolerance; however, they also reported experiencing several additional symptoms of autonomic dysfunction.

Demographic Correlates of Quality of Life

Disability status (disabled vs not) was the only demographic variable significantly related to quality of life. Patients who were disabled (ie, unable to work because of symptoms) reported significantly more impairment in physical function (mean, 27.3 vs 63.8; P<.001), role limitations caused by physical problems (mean, 4.2 vs 42.3; P<.001), bodily pain (mean, 43.7 vs 65.1; P<.001), general health (mean, 26.5 vs 54.9; P<.001), vitality (mean, 20.2 vs 41.5; P<.001), social functioning (mean, 32.8 vs 67.6;

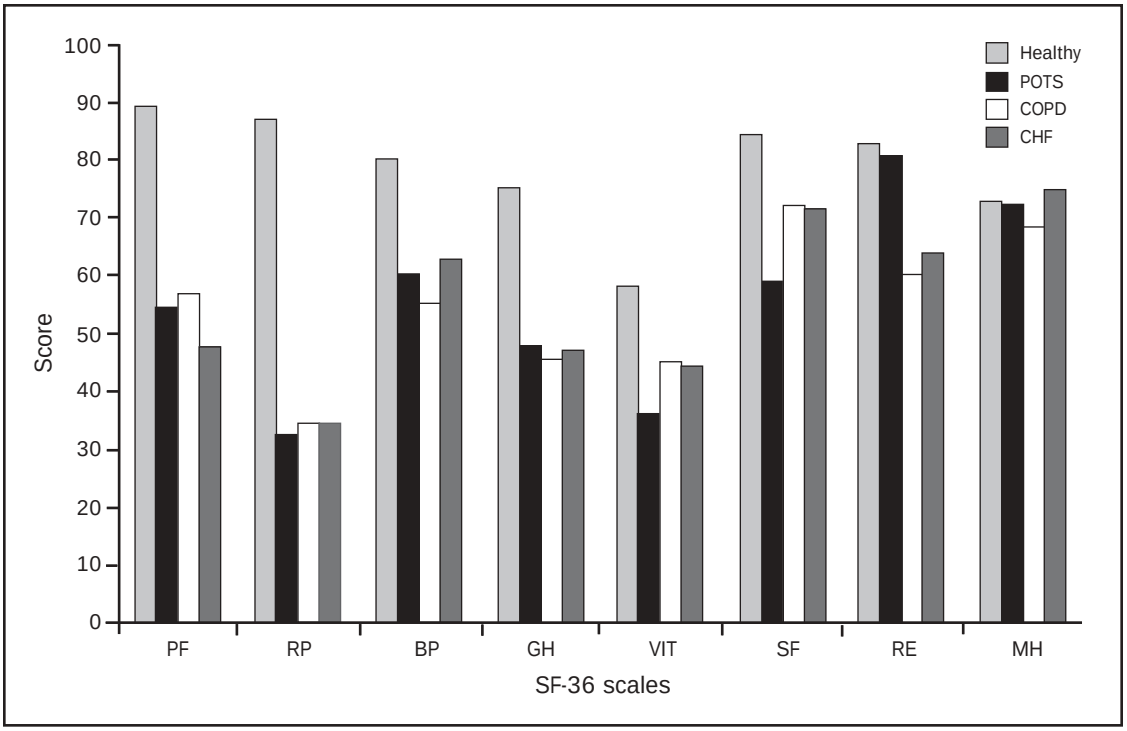

Figure 1. Mean scores on the 36-Item Short-Form Health Survey (SF-36) category scales for a young, healthy female population, patients with postural tachycardia syndrome (POTS), patients with congestive heart failure (CHF), and patients with chronic obstructive pulmonary disease (COPD). Healthy was defined as women 25 to 34 years of age in the general US population[10]; CHF, physician report of current CHF[10]; and COPD, lung disease diagnosed by a physician as COPD (like chronic bronchitis or emphysema) in past 6 months.[10] BP = bodily pain; GH = general health; MH = mental health; PF = physical function; RE = role limitations due to emotional problems; RP = role limitations due to physical health; SF = social function; VIT = vitality.

P<.001), role limitations caused by emotional problems (mean, 66.7 vs 84.8; *P*=.05), and the physical component summary scale of the SF-36 (mean, 22.8 vs 38.4; *P*<.001) compared with patients who were employed, homemakers, students, retired, or unemployed due to reasons other than POTS. Additional demographic variables examined included age, sex, marital status, and education, none of which was significantly related to any of the SF-36 domains (*P*>.05 for all).

Table 1. **Autonomic Symptom Profile Scores**

Scale	Mean ± SD score	Maximum possible score*
Orthostatic intolerance	27.4±8.2	40
Sexual failure (male)	3.3±5.8	30
Bladder dysfunction	3.0±3.7	20
Constipation	2.1±2.9	10
Diarrhea	4.0±5.8	20
Upper gastrointestinal tract symptoms	2.2±2.3	10
Pupillomotor symptoms	1.8±1.5	5
Secretomotor symptoms	6.7±3.6	20
Sleep dysfunction	1.8±2.2	15
Vasomotor symptoms	4.1±3.0	10
Total score†	55.6±19.8	160

*Higher scores indicate increased symptom severity.
†Excluding the sexual failure subscale.

Symptom Severity and Quality of Life

Table 2 presents the bivariate correlations (Spearman ρ) between the Autonomic Symptom Profile scales and the physical and mental component summary scales of the SF-36. Overall, the Autonomic Symptom Profile scales were more strongly correlated with the SF-36 physical component summary scale than the mental component summary scale, indicating that symptom severity is more strongly associated with physical and role functioning rather than psychological functioning. As expected, symptoms of orthostatic intolerance had the strongest correlation with the SF-36 physical component scale. However, most of the other symptom scales also were significantly correlated with the SF-36, suggesting that other symptoms of autonomic dysfunction (eg, upper GI tract symptoms, secreto-

motor dysfunction, pupillomotor symptoms) interfere with quality of life in patients with POTS.

Prediction of SF-36 Physical Component Summary Scale

Table 3 summarizes the results of a hierarchical regression analysis that predicted the SF-36 physical component summary scale. Because patients recruited in the clinic tended to differ on several variables from those recruited by mail, recruitment site was forced into the regression equation first. Disability status, the only significant demographic correlate of the SF-36 physical component scale, was entered on the second step, followed by simultaneous entry of symptom duration, treatment status, and symptom severity (Autonomic Symptom Profile total score). The final model was significant and accounted for 54% of the variance in SF-36 physical component summary scores ($P<.001$). After controlling for recruitment site, disability status and symptom severity were the only factors independently associated with impairment in physical function.

Prediction of SF-36 Mental Component Summary Scale

The model predicting the SF-36 mental component summary scale accounted only for 10% of the variance and was not statistically significant ($P=.12$). Symptom severity was the only variable that approached significance as an independent predictor ($P=.05$) of the SF-36 mental component summary scores.

DISCUSSION

To our knowledge, this study is the first to quantify the degree of functional impairment in patients with POTS. Patients reported clear limitations in several domains of functioning, particularly energy level and role functioning. In our sample, reported functioning was comparable to that of patients with COPD or CHF, 2 chronic, symptomatic conditions generally present in a much older patient population. The average patient with POTS is a young, highly educated, previously healthy woman[2] (mean age was 34 years in this sample), who should be facing many years of economic and social productivity. Approximately 25% of our sample was disabled and unable to work because of POTS. This figure is especially noteworthy given that younger age and more education are often associated with less disability among patients with chronic medical conditions.[13] Clearly, the potential economic burden of POTS is great, both in direct costs related to health care and in indirect costs related to disability. Successful treatment, at least for some patients with POTS, will likely have to address multiple limitations and may require a multidisciplinary approach.

Table 2. **Spearman ρ Correlations Between the 36-Item Short-Form Health Survey (SF-36) Summary Scales and the Autonomic Symptom Profile Scales**

Autonomic symptom profile scales	SF-36 summary scales	
	Physical component	Mental component
Orthostatic intolerance	–0.45*	–0.18
Vasomotor symptoms	–0.29*	–0.11
Secretomotor dysfunction	–0.39*	–0.04
Upper gastrointestinal tract symptoms	–0.28*	–0.21†
Diarrhea	–0.08	–0.17
Constipation	–0.27†	–0.03
Bladder dysfunction	–0.32*	–0.20
Pupillomotor symptoms	–0.33*	–0.22†
Sleep dysfunction	–0.27*	–0.22†
Total score	–0.49*	–0.27†

*$P<.01$.
†$P<.05$.

Functional Limitations

The degree and pattern of functional limitations reported by our sample are similar to, but less severe than, those reported by patients with chronic fatigue syndrome, a disorder with some similarities to POTS.[14,15] Fatigue is a prominent feature of POTS and may play an important role in patients' quality of life. In fact, vitality was one of the most impaired domains on the SF-36. Future research should look at fatigue more systematically because this may be a particularly important target for intervention in patients with POTS.

Not surprisingly, patients who reported more severe symptoms and those who were disabled or unable to work reported the greatest impairment in function. Both variables were strong, independent predictors of function, suggesting that the patients disabled by POTS are not simply those with the most severe symptoms. Identification of additional factors (eg, psychosocial) that may predict who will become disabled by POTS is an important direction for future research. Treatment status was not a significant predictor of function in this sample. This finding is in line with clinical reports that suggest that a subgroup of patients with POTS is refractory to standard medical treatment.[3] It also points to the importance of considering a biopsychosocial approach to the treatment of POTS. Research with other chronic conditions marked by functional disability, particularly chronic pain, has clearly shown that a multidisciplinary treatment approach is often needed to restore function and improve quality of life.[8,9] Future research needs to investigate whether similar interventions can improve function in patients with POTS.

Table 3. **Summary of Hierarchical Regression Analysis Predicting the 36-Item Short-Form Health Survey Physical Component Summary Scale**

Step	Variable(s) included	Total R^2 (%)	Significance of improvement in R^2	Regression coefficient for final model
1	Recruitment site	8.5	.007	.30*
2	Disability status	37.3	<.001	–.36†
3	Symptom duration, treatment status, and symptom severity	53.9	<.001	–.12 –.15 –.36†

*P<.01.
†P<.001.

Psychological Distress

Our sample, on average, reported little psychological distress on the SF-36, although the range of scores was large. The generally low level of distress is surprising because clinical observations suggest that these patients often experience marked anxiety, frustration, and depressed mood. It is also in contrast to findings in patients with recurrent syncope (another condition marked by orthostatic intolerance), in which psychosocial impairment tends to be greater than physical impairment.[16] The finding is consistent, however, with data from several other populations with chronic medical conditions, including rheumatoid arthritis, chronic fatigue, and diabetes mellitus, in which patients report considerable impairment in physical, social, and role functioning due to their medical condition, but describe comparably little psychological distress.[5,14,15] Kempen et al[6] explained this finding by suggesting that psychological distress may be more susceptible to adaptation through cognitive and behavioral strategies than the more physical domains of quality of life. Persons with chronic medical conditions may be able to learn coping strategies to manage their psychological distress but may be less able to affect their physical impairment.

It is also possible that the low level of distress reported in our sample reflects a measurement issue. The psychologically focused scales on the SF-36 (ie, role interference due to emotional problems and mental health) may be susceptible to a social desirability bias. When given the option, patients may prefer to say that they are experiencing interference in role functioning due to their physical health rather than to "emotional problems." The SF-36 also may not be sensitive or specific enough to detect more than gross impairment in psychological functioning. Using specific measures of anxiety, depression, and general psychological distress in future research with POTS patients would likely yield more information regarding this domain than that provided by the SF-36.

The clinical and demographic variables examined in this study did not significantly predict psychological functioning (as measured by the SF-36 mental component summary scale) in a multiple regression model. This finding suggests that factors other than demographic or clinical characteristics may be important in predicting psychological functioning in patients with POTS. Similar results have been found in patients with chronic fatigue syndrome in whom clinical signs and symptoms correlate poorly with psychological function on the SF-36.[14,15] Research with other medical populations (eg, chronic pain, cancer) has demonstrated that personality characteristics and coping strategies, such as neuroticism, optimism, and catastrophizing, are significantly associated with both physical and psychological functioning and are often stronger predictors of both than are clinical or disease indices.[17-19] Similar psychosocial factors likely play a role in predicting who develops psychological distress in response to living with POTS. Future research needs to investigate this possibility.

Study Limitations

Several limitations of this study deserve mention. First, the cross-sectional nature of the data obviously does not allow causal inferences. In addition, all data were self-reported, which raises the possibility that some of the significant associations are due to shared method variance. Prospective, longitudinal data are needed to examine the natural course of POTS and its impact on physical and psychosocial function over time. Future studies should also include more objective indices of disease severity, such as results of clinical autonomic function testing, and examine the effects of various interventions. It is also important to examine the impact of comorbid physical and psychiatric conditions (eg, migraine headache, chronic fatigue syndrome, fibromyalgia, anxiety disorders) that may occur in patients with POTS. The severe functional impairment in our sample might be accounted for, in part, by the presence

of comorbid conditions, as has been demonstrated in other populations.[13,20]

Sample selection is another primary limitation. All participants were seen at a large tertiary care center and may not represent the general population of patients with POTS. Because patients referred to a specialty medical center often represent the most severe cases, the current findings may not generalize broadly. Functional impairment is likely less severe in a community sample of patients with POTS. The poor response rate, primarily among those recruited by mail (30%), is also problematic. It is possible that only patients functioning very well or very poorly responded to the survey, resulting in a sample of "extremes." Future studies need to recruit patients with POTS from various settings together with control or comparison groups. This would allow for delineation of issues specific to POTS compared with medical illness in general.

CONCLUSIONS

This study is the first to our knowledge that systematically investigates quality of life in a well-characterized sample of patients with POTS. Results show that these patients experience significant limitations across several domains of quality of life, including physical, social, and role functioning. Health care practitioners must recognize the multiple impairments that often accompany POTS and address not only the physical aspects of the condition but also the social ones. More research is needed to determine factors, both disease related and psychosocial, that predict functioning and adjustment in this population and to develop multidisciplinary interventions aimed at improving quality of life. Such research is necessary for the optimal care of persons with this potentially disabling condition.

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