

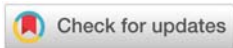
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**Research Article**

# Pain is a Prevalent Symptom of Adolescents at Diagnosis with Postural Orthostatic Tachycardia Syndrome

**Abstract**

Pain is often endorsed by patients with postural orthostatic tachycardia syndrome (POTS). A retrospective chart analysis of adolescents diagnosed with PTS from January 2014-December 2015 at the pediatric cardiology clinic at Children's National Health System were reviewed. 93% of the subjects reported pain at the time of diagnosis, with 46% of the sample reporting more than one site of pain. Since chronic pain syndromes and POTS are associated by similar symptom burden and often develop after illness or injury, both may be a product of pathology stemming from neuroinflammation and neuralplasticity that results in central sensitization and autonomic nervous system dysfunction.

**Introduction**

Chronic pain is a considerable health concern for pediatric patients. The International Association for the Study of Pain (IASP) has defined chronic pain as discomfort lasting longer than 3 months [1]. Research has shown that the occurrence of chronic pain in the general population of children ranges from 15-38%, with greater than 5% having severe debilitating pain [2-4]. Young patients with pain experience a decreased quality of life as evidenced by higher rates of anxiety and depression, frequent school absences, and withdrawal from previously enjoyed activities [5]. Children with chronic pain syndromes are also more likely to continue with pain and associated mental health co-morbidities into adulthood leading to high rates of disability [5].

The link between POTS, the symptom of pain, and chronic pain syndromes has been discussed in many recent studies and reviews [6-8]. Chronic pain syndromes that are often related to a diagnosis of POTS are headache and migraine, functional abdominal pain syndromes, and fibromyalgia [6-8]. Other symptoms of chronic pain that may not specifically be associated with a chronic pain syndrome have also been detailed in patients with POTS, which include widespread body, joint, chest, and bladder pain [9-11]. Although many of these studies discuss pain as a symptom frequently endorsed by those with POTS, there has yet to be a study that discusses the prevalence of pain at the time of diagnoses in children or adolescents with the syndrome.

POTS was first recognized in adolescents in 1999, and is frequently diagnosed in children within 1-3 years of a growth spurt and/or immediately following an injury, surgery, or illness [12,13]. The child and adolescent are particularly vulnerable to changes in the autonomic nervous system resulting from injury or illness, especially at a time of rapid development due to neural plasticity and inappropriate neuro-cognitive reprogramming following these events [14]. Similarly to disorders of central sensitization, such as fibromyalgia syndrome, POTS often occurs after a viral illness [8,15], which may suggest a neuroinflammatory process that triggers both chronic pain and disorders of the autonomic nervous system such as POTS.

The evaluation and diagnosis of POTS is established using the head up tilt test. This is accomplished by the patient being strapped to a bed while being monitored for various vital signs (heart rate, blood pressure and respiratory rate), symptoms, and a continuous electrocardiogram (ECG). The bed is then tilted at 70 degrees with measurements taken at 1-minute intervals [10,12]. The adult patient with POTS is diagnosed when there is a change in heart rate of >30 beats per minute with standing for 10 minutes following a period of recumbence on the table, or a heart rate that is consistently greater than 120 beats per minute subsequent to this interval [12]. For adolescents, a change of 30 beats per minute may be "normal" and a diagnosis of POTS is made with a heart rate change of >40 beats per minute with orthostasis [11,13].

## Patients and Methods

Following IRB approval, subject charts were identified from the pediatric cardiology clinic at Children's National Health System. Charts were captured based on the patient having had tilt-table testing within a 2-year period (January 2014–December 2015), and having received a diagnosis of POTS. The diagnosis of POTS was determined based on established criteria [10–13] a change in heart rate of greater than 40 beats per minute for adolescents of age 16 years or less, 30 beats per minute for adolescents at age 17 years and greater, or a sustained heart rate of greater than 120 beats per minute after standing for a 10 minute interval. All patient charts identified that met these standards were utilized for the chart review. Each patient had other disorders associated with orthostatic intolerance ruled out via laboratory testing that included basic metabolic panel, complete blood count, ferritin, cortisol, and thyroid studies. The clinic also has each patient fill out a symptom questionnaire at diagnosis and each subsequent visit. The questionnaire has an area for the patient to circle whether they have pain in form of headache, abdominal pain, musculoskeletal pain, or chest pain, and to delineate its frequency. Data pertaining to age, race, and presence of pain were extracted from the charts without documenting patient identifiable data. Analysis was completed utilizing SPSS Statistics (version 22) with the objective of describing the sample in terms of age, race, gender, the presence pain, and site/s of pain experienced.

## Results

As seen in Table 1, the sample size comprised of 76 adolescents and young adults diagnosed with PTS via tilt table test, with an age range of 11–20, and a mean age of 15.6 years and standard deviation of 1.98. The majority of the sample was female (n=56, 74%). Race or ethnicity of the sample was 87% Caucasian (n=66), 8% African American (n=6), 1.3% Asian (n=1) and 4% other (n=3). A vast majority of the sample identified as having pain (93%, n=68). The most prevalent type of pain was headache (67%, n=51), followed by abdominal (55%, n=41), musculoskeletal (46%, n=35), and chest (24%, n=18). Many of the subjects identified as having more than one type of chronic pain (46%, n=45).

## Discussion

Research has shown that patients with a diagnosis of POTS

are 80% female, with a large majority identifying as Caucasian, and a usual age of diagnosis between 15–50 years [9,13]. An analysis of the sample for this study demonstrates very similar patient demographics. Although there are a few small studies and review articles that discuss pain as a symptom associated with POTS, this is the first study to detail the symptom of pain, including pain site, and number of pain sites identified in adolescents at the time of diagnosis. The term “somatic hypervigilance” has been applied in describing patients with POTS, which makes reference to the identification and preoccupation with the multiple symptoms associated with the disease [10]. Ojha and Colleagues [9], discussed chronic pain as a co-morbidity in children with the syndrome, which included headache, and abdominal pain. Our study also examined type of pain site, as well as the quantity of types experienced by individuals in the sample. With 93% of the sample of adolescents with postural orthostatic tachycardia syndrome endorsing pain at diagnosis, and 45% of the sample identifying more than one type of pain site, pain likely represents a symptom that is an element of the disease pathophysiology. A link may be made through a neuroinflammatory process triggered by either illness or trauma that leads to both central sensitization and autonomic nervous system dysfunction [8,15].

It has already been established that headache and migraine are associated with POTS. A recent study demonstrated that 53% of adolescent subjects with headache met criteria for the syndrome through tilt-table testing [6]. It was not surprising that our sample identified headache as the most prevalent type of chronic pain encountered. Functional abdominal pain has also been associated with POTS [7,9]. Abdominal pain was the second highest frequency, with 55% of the adolescents in our sample describing this symptom. There is not a full understanding of why there is such high frequency of headache and abdominal pain among children with POTS; however, it does speak to the need for a multidisciplinary approach to treatment for those diagnosed with autonomic disorders.

This study was limited by being a retrospective chart review and having a sample from one geographic area in the Mid-Atlantic Region of the East Coast. A prospective and larger multi-center study to include both pediatric and adult subjects with POTS throughout the United States, or potentially internationally would give a more generalizable interpretation of the occurrence of pain in patients with POTS at the time of diagnosis. This larger study should include more information on the nature and severity of pain in patients with POTS.

## Conclusion

Pain is prevalent symptom at diagnosis in adolescents with POTS, and may represent a symptom that is related to the underlying disease pathophysiology. POTS may be a product of a pathological progression leading to the syndrome, such as the neuroinflammation and neuralplasticity stemming from illness or trauma that results in central sensitization and autonomic nervous system dysfunction. More research needs to be done in order to ascertain the pathophysiological link for the many symptoms endorsed by patients with POTS. This knowledge could be helpful in discovering better treatments

**Table 1:** Study Population.

Sample	Age	Race	Gender	Chronic Pain	Pain Type
N=76	Range: 11-20 years Mean: 15.6 years SD: 1.98	Cauc: 66, 87% AA: 6, 8% Asian: 1, 1.3% Other: 3, 4%	Male: 20, 26% Fem: 56, 74%	Yes: 68, 93% No: 8, 7%	HA: n=51, 67% Abd: n=41, 55% Musk: n=35, 46% Chest: n=18, 24% Multiple: n=45, 46%

Cauc: Caucasian, AA: African American, HA: Headache, ABD: Abdominal, Musk: Musculoskeletal.

that may be effective in reducing the symptom burden, and increase functionality in patients diagnosed with POTS and other forms of dysautonomia.

## Ethical Standards

This study met the ethical standards of the Children's National Health System institutional review board.

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