Journal of Adolescent and Family Health

Volume 11 | Issue 1 Article 3

January 2020

Parental Deployment and Healthcare Utilization in Adolescents with Migraines and Other Somatic Symptoms

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Cover Page Footnote

Disclaimer: The views expressed in this abstract are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government. This research was supported in part by an appointment to the Postgraduate Research Participation Program at the Navy and Marine Corps Public Health Center administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and NMCPHC.

"Parental Deployment and Healthcare Utilization in Adolescents with Migraines and Other Somatic Symptoms"

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Abstract

Somatic symptoms in adolescents are associated with psychosocial stress. Parental military deployment can function as a stressor for adolescents. A retrospective cohort study was developed exploring relationships between health care utilization, a proxy for symptomatology, and sponsor deployment in adolescents with somatic symptoms. Data was obtained from the Military Health System Data Repository. Migraine headaches was the most common somatic symptom diagnosis. Parental deployment was overall associated with a 27% decrease in visits for somatic symptoms. For adolescents whose sponsor was female, deployment was associated with a 34% decrease in visits. This pattern is inconsistent with prior research on somatic symptoms and psychosocial stressors. Potential causes of this discrepancy are discussed in the context of military family life.

Keywords
Military Affiliated Adolescents
Somatic Symptoms
Deployment
Health Care Utilization

List of Abbreviations:

AD – Active Duty

CONUS – Continental United States

MDR – Military Health System Data Repository

MH – Mental Health

MHS – Military Health System

MTF – Military Treatment Facility

SS – Somatic Symptomatology

Introduction

Somatic symptoms comprise a heterogeneous group of symptoms often characterized by lack of specificity, fluctuating symptomatology, and strong associations with psychosocial stressors (Ibeziako & Bujoreanu, 2011). These symptoms impair quality of life for youth both during adolescence and potentially into adulthood (Bohman et al., 2012). Healthcare providers often struggle to understand these symptoms and provide effective support and treatment (Ibeziako & Bujoreanu, 2011). This is true despite the fact these patients often have a significantly greater use of healthcare resources, including clinic visits and diagnostic studies than age-matched peers (Barkmann, Braehler, Schulte-Markwort, & Richterich, 2011; Ibeziako & Bujoreanu, 2011). Furthermore, there are few studies that investigate associations between specific types of psychosocial stressors and somatic symptomatology in large samples of patients, such as among military-affiliated youth who experience the military deployment of a parent or guardian.

Theoretical Framework

An eclectic theoretical framework was useful for grounding our exploration of associations between family psychosocial stressors and somatic symptomatology. We drew primarily on Margaret Beale Spencer's Phenomenological Variant of Ecological Systems Theory (PVEST) for understanding complex reciprocal relationships between contextual stressors, resilience and the self (Spencer, 2006). We also draw on Family Systems Theory to help inform potential processes through which stressors, such as deployment, on one family member, may produce stressful impacts throughout the entire

family unit (Cox & Paley, 1997; Lerner, Lerner, von Eye, Bowers, & Lewin-Bizan, 2011; Paley, Lester, & Mogil, 2013). Furthermore, previous studies of somatic symptoms as well as military-affiliated youth and families have drawn on ecological and family systems perspectives (Beck, 2008; Palermo, Valrie, & Karlson, 2014; Paley et al., 2013). We felt it was important to further refine our theoretical framework with a biological understanding of the relationship between psychosocial stress and physiologic change. Multiple mechanisms have been proposed for these effects, with much emphasis placed the dynamic interplay of the autonomic nervous system as well as the cortisol stress response (Gianaros & Wager, 2015; Kyrou & Tsigos, 2009). Finally, we drew on Elizabeth Wilson's theoretical work in *Psychosomatic: Feminism and the neurological body* (Wilson, 2004) and *Gut feminism* (Wilson, 2015) to help think through the dialogic relationships between psychological and biological models of stress and physiological symptoms, as well as historically-situated social constructions of gender and power.

Somatic Symptomatology

Somatic symptoms may be divided into the subgroups of chronic pain syndromes and acquired dysautonomias (Barakat et al., 2012; Ibeziako & Bujoreanu, 2011; Stewart, 2012). Chronic pain syndromes include diagnoses such as fibromyalgia, reflex neurosympathetic dystrophy, chronic daily headaches, chronic migraines, amplified pain syndrome, chronic pelvic pain, and functional abdominal pain, among others (Barakat et al., 2012; Eccleston, Crombez, Scotford, Clinch, & Connell, 2004; Walker, Sherman, Bruehl, Garber, & Smith, 2012). Acquired dysautonomias must be differentiated from the potentially lethal congenital dysautonomias (Brunt & McKusick, 1970). The category of

acquired dysautonomias includes diagnoses such as Postural Orthostatic Tachycardia Syndrome, Irritable Bowel Syndrome, and Chronic Fatigue Syndrome. These diagnoses are rarely fatal and often appear during adolescence. (Barakat et al., 2012; Jarjour, 2013; Okamoto et al., 2012; Stabell et al., 2014). These patients report heterogeneous symptoms including fatigue, "brain fog," poor concentration, blurry vision, dizziness, shortness of breath, palpitations, tachycardia, pounding pulses, abdominal discomfort and pain, nausea, diarrhea, constipation, weakness, vital sign changes, and mottling of their extremities, among others (Barakat et al., 2012; Ibeziako & Bujoreanu, 2011). These physical symptoms may prevent school attendance, sports and activities, and lead to isolation with potential impacts on healthy development (Cerutti et al., 2017; Mulvaney, Lambert, Garber, & Walker, 2006). Many of these symptoms appear to decrease as the young person leaves adolescence and enters adulthood (Barakat et al., 2012; Ibeziako & Bujoreanu, 2011). The significant overlap between chronic pain syndromes and acquired dysautonomias has led some authors to propose a common etiology for these symptoms, despite the extreme diversity of possible symptoms (Barakat et al., 2012; Oaklander & Klein, 2013; Stewart, 2012).

Somatic symptoms are a prevalent finding in pediatric and adolescent populations. A recent study from Italy found that 33% of their participants reported one or more somatic symptoms within the previous 2 weeks (Cerutti et al., 2017). A representative study from Spain found that 20% of participants reported a somatic symptoms occurring weekly on at least one day per week (Romero-Acosta et al., 2013). Across multiple studies of somatic symptoms in children and adolescents there are also persistent significant gender differences in reporting symptoms, with a consistent female

predominance in symptoms (Barsky, Peekna, & Borus, 2001; Hetland, Torsheim, & Aarø, 2002). The higher female predominance of reported somatic symptoms appears to increase with age (Barsky et al., 2001; Hetland et al., 2002; Romero-Acosta et al., 2013). A recent study found significant gender differences in heart rate variability, a commonly used clinical marker of acquired dysautonomia, demonstrating the female predominance of somatic symptoms is measurable through physiologic parameters not only in subjective symptoms reporting (Walker et al., 2017). While the causes of the noted gender differences are unclear, the consistency of these differences and the increasing effect with age suggests a complex interaction between developmental, physiological, and sociocultural influences (Buchbinder, 2015; Hetland et al., 2002).

Psychosocial factors are quite salient in somatic symptomatology (Aro, Hänninen, & Paronen, 1989). These somatic symptoms appear to differ from the psychiatric diagnoses of somatization disorders, such as conversion disorder or factitious disorder, but do have some elements that overlap with these disorders, such as difficult to explain symptoms that do not fit typical patterns of known pathology (Ibeziako & Bujoreanu, 2011; Kinnunen, Laukkanen, & Kylmä, 2010). Also, patients with somatic symptoms and co-occurring mental illness appear to have more severe somatic symptoms and greater degree of disability from their symptoms (Kinnunen et al., 2010; Surís, Bélanger, Ambresin, Chabloz, & Michaud, 2011). Psychosocial stress is also associated with increased symptomatology in patients with somatic symptoms (Huurre, Rahkonen, Komulainen, & Aro, 2005; Surís et al., 2011; Villalonga-Olives et al., 2011). This may be related to alternations in the cortisol stress response (Essex et al., 2013; Niwa et al., 2013). Despite the uncertain etiology, psychological interventions appear effective in

ameliorating symptoms and distress in these patients, and are routinely recommended as important parts of holistic treatment plans (Bonvanie et al., 2017; Ibeziako & Bujoreanu, 2011). Since somatic symptoms appear linked to stress responses, understanding associations between stressful life situations and somatic symptoms is important for providers seeking to support these youth (Aro et al., 1989; Åslund, Starrin, & Nilsson, 2010; DeLongis, Folkman, & Lazarus, 1988; Egger, Costello, Erkanli, & Angold, 1999; Huurre et al., 2005).

Stress, Health, and Deployment in Military Affiliated Families

U.S. Military affiliated youth present a unique population for investigating the associations between stressful life events and somatic symptoms. In particular, military deployment may function as a potent psychosocial stressor for youth and families of active duty (AD) service members (Esposito-Smythers et al., 2011; Paley et al., 2013). The AD service member is often referred to as the "sponsor." While most of military dependent youth and families handle the stress of deployments without any appreciable difficulties, some experience the stress of deployment as overwhelming (Easterbrooks, Ginsburg, & Lerner, 2013; Esposito-Smythers et al., 2011; Paley et al., 2013; Park, 2011). Esposito -Smythers and colleagues propose dividing the stressors of deployment into three tiers each associated with a progressively higher potential for disrupting normal family and individual physical, mental and social well-being: 1 - the normal stressors of daily life, 2 - the added stressors of deployment that are easily coped with, 3 - "toxic stress" that overwhelms coping mechanisms and disrupts individual and family lives (Esposito-Smythers et al., 2011).

Military deployment is not a single entity, rather there are important differences in the types and length of deployments AD services members might experience (Pincus, House, Christenson, & Adler, 2001; Sheppard, Malatras, & Israel, 2010). This may include deployments to combat zones that last greater than a year, to brief deployments of three months or less in support of humanitarian operations. Each aspect of the deployment may provide its own unique stressors, from the anticipation of separation, to fears regarding possible injury and loss of life, to developments of new family routines and power arrangements, to the challenges of reintegrating the returning family member and developing new routines and relational interactions (Pincus et al., 2001; Sheppard et al., 2010). Furthermore, there are significant documented gender differences in the experience of military deployments for both the deploying sponsor and their families (Fox et al., 2016; Walsh, 2017; Welsh, Olson, Perkins, Travis, & Ormsby, 2015).

Previous research with military veterans has shown significant increases in health care utilization associated with post-traumatic stress disorder and somatic symptoms (Outcalt, Yu, Hoen, Pennington, & Krebs, 2014). Recent data from the National Health Interview Survey showed relationships between health care utilization and somatic symptoms in adults may be significantly mediated by psychological symptoms and social/environmental factors (Weissman, Russell, Beasley, Jay, & Malaspina, 2016). Similar to the adult data, for pediatric populations an association has been noted between somatic symptoms and an increase in health care utilization (Levy et al., 2004). Health care utilization serves as an accepted and widely utilized proxy for evaluating severity and changes in somatic symptomatology associated with psychosocial stress.

Very few studies have previously investigated associations between sponsor deployment and physical symptoms in their dependents. Most prior research has looked primarily at mental and behavioral health. For example, a study by Gorman et. al looked at a very large sample of 3-8 year-old military dependent children over a 2 year period, and showed an 11% increase in behavioral and mental health visits when the child's sponsor was deployed (Gorman, Eide, & Hisle-Gorman, 2010). Another prior study demonstrated a significant increase in healthcare utilization during sponsor deployment, particularly in accessing mental and behavioral health services (Larson et al., 2012). These studies support the idea that military deployment may function as a psychosocial stressor, and the impact of deployment may be measurable through exploring healthcare utilization. However, to our knowledge, how the stress of a military deployment might affect somatic symptoms in adolescents has not been investigated. It is plausible the stress associated with military deployment, transmitted through physiological mechanisms such as the stress-cortisol system, could translate into exacerbations of somatic symptoms in military affiliated youth.

Accordingly, we set out to retrospectively explore the relationship between exacerbations of somatic symptoms and military deployment in the adolescent dependents of AD personnel in the U.S. Military. In particular, we hypothesized that in adolescents 11-17 years-old diagnosed with somatic symptoms the sponsor's military deployment would be associated with an increased healthcare utilization as measured by increased number of visits for these symptoms. We hypothesized this association would be significantly moderated by the co-occurrence of mental health (MH) diagnosis, either the sponsor or patient being female, as well as by the age of the patient.

Methods

This is a retrospective cohort study, assessing the association between deployment and the number of medical outpatient visits for somatic symptoms among dependents of AD service members eligible for TRICARE benefits who were previously diagnosed with somatic symptoms before the start of the study. Data were obtained from the Military Health System (MHS) Data Repository (MDR), a data warehouse containing the most complete collection of data about healthcare provided to beneficiaries of the MHS, allowing users to capture, validate, and distribute comprehensive MHS data.

Data Collection

To capture the population previously diagnosed with somatic symptoms, we developed a cohort of adolescents who were born between 10/01/1985 and 10/01/1990 with AD parents from any service branch and had at least one medical outpatient visit for somatic symptoms during fiscal year (FY) 2002 (10/01/2001 – 09/30/2002) at any military treatment facility (MTF) or civilian medical facility in the continental United States (CONUS). This gives a participant age range of 11-17 years, inclusive. Adolescents who had two AD parents, whose parent had deployed for any amount of time prior to the start of the study (10/01/2002), or who had congenital abnormalities of the nervous system were excluded from the study. Congenital abnormalities were defined using ICD-9 codes 740.XX, 741.XX, or 742.XX. Adolescents who had a specific co-occurring mental health diagnosis between FY 2002 and FY 2003 were categorized as having a mental health diagnosis.

Somatic symptoms were defined using a group of ICD-9 codes with the goal of capturing somatic symptoms through both symptom codes as well as diagnosis codes. These groups were determined through consultation with clinicians as well members of the research team with extensive experience with the MDR. A particular challenge is that certain symptoms might be captured under a symptom-based ICD-9 code or they might be captured under diagnostic code for a specific diagnosis. For example, headaches might be captured under ICD-9 code 784.0, which is a code often used for general headache symptoms, or they might be captured under ICD-9 code 346.9, which is one of the possible codes for Migraine headaches. This dependence on provider coding creates a high level of variability (Sarrazin & Rosenthal, 2012; Weiskopf & Weng, 2013). Accordingly, the decision was made to use a breadth of codes while acknowledging the inherent decrease in specificity this entails.

The number of somatic symptoms visits for each adolescent was calculated at each change in sponsor deployment status (a sponsor classified as being deployed at the time of the adolescent's somatic symptoms visit instead of not deployed) for the duration of the study period (FY 2003-2007). Adolescents were followed until either their sponsor lost eligibility for TRICARE benefits for one month or more or until they were no longer a dependent child of an AD service member. Only deployments greater than 30 days were included in analysis.

Statistical Analysis

Chi-square tests and Wilcoxon rank sum tests were used to determine differences between the group of adolescents included and excluded from the analysis. Generalized

estimating equations (GEE) with negative binomial regression models were used to obtain estimates of the incidence rate ratio (IRR) of somatic symptoms medical visits per 90 days attributable to sponsor length of deployment (Hilbe, 2007; Liang & Zeger, 1986; Zeger & Liang, 1986). Since the average number of visits per day was low, a 90-day time interval was used to create a more clinically meaningful number of visits. Deployment status was considered an external time-dependent variable. Individuals and families were used as clustered variables. Covariates included child age, gender, and mental health status and sponsor age, gender and military rank. Interactions between child mental health status and deployment status were considered in the analysis. P values (p) of < 0.05 were considered statistically significant. Both adjusted rate ratios (ARRs) and unadjusted rate ratios (URRs) were used in this analysis. URRs are crude rates that do not consider the differences in distributions for all other characteristics in the model, while ARRs control for other characteristics in the model. The URRs, as well as the rates of appointments, can be used for evaluating interactions in between predictors while the ARRs take all other predictors into consideration. Analyses were conducted using SAS vs 9.4 (SAS Institute). Research data derived from an approved Naval Medical Center, Portsmouth, Virginia IRB, protocol number NMCP.2015.0054.

Results

The goal of this study was to retrospectively explore the relationship between exacerbations of somatic symptoms and military deployment in the adolescent dependents of AD personnel in the U.S. Military. A total of 4,981 dependent children age 12-17 on 10/1/2002, with AD sponsors, who received a somatic symptoms diagnosis

code prior to the start of the study (FY 2002) at a CONUS MTF or civilian medical outpatient facility were included in the analysis. The median child age was 14 and median sponsor age was 39; 44.2% of the children and 91.3% of the sponsors were male; 19.6% of the children had a mental health diagnosis; 29.0% of the sponsors were deployed at some point during the study (Table 1). The adolescents that were excluded from the analysis were statistically different from those included in terms of sponsor rank, sponsor gender, sponsor age, and service branch (Table 2). However, it is important to note the sample sizes in the included and excluded groups were vastly disproportionate and therefore statistical significance does not necessarily imply clinical significance. Among the children with mental health diagnoses, adjustment disorder, depressive disorders, and anxiety disorders were the most common diagnostic codes.

Table 1. Select Demographic Characteristics of the Study Population[a] and Their Military Parents, FY 2003 - FY 2007

	n	%
Total	4,981	
Median Adolescent Age (IQR)	14 (2.0)	
Adolescent Gender		
Male	2,202	44.2
Female	2,779	55.8
Sponsor Rank Group		
Junior Enlisted (E1 - E4)	127	2.5
Senior Enlisted (E5 - E9)	3,618	72.6
Junior Officer (O1 - O3)	198	4.0
Senior Officer (O4- O9, 10, 11)	842	16.9
Warrant Officer (W1 - W5)	139	2.8
Missing	57	1.1
Sponsor Gender		
Male	4,547	91.3
Female	377	7.6
Missing	57	1.1
Median Sponsor Age (IQR)	39 (6.0)	
Adolescent Mental Health Status		
Yes	974	19.6
No	4,007	80.4
Sponsor Service		
Army	2,028	40.7
Coast Guard	130	2.6
Air Force	1,351	27.1
Public Health Service	17	0.3
Marines	298	6.0
Navy	1,099	22.1
Foreign Navy	1	0.0
Missing	57	1.1

Health Analysis Department, Navy and Marine Corps Public Health Center.

Data Sources: Comprehensive Ambulatory Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.

[a] Study population consists of children who were born between 10/01/1985 and 10/01/1990, with active duty (AD) parents, who received an SS diagnosis code prior to the start of the study (during FY2002) at a direct care or purchased care outpatient facility in CONUS.

Abbreviations: IQR = Interquartile Range.

NOTE: Demographic information was captured at the start of the study period (10/01/2002).

Table 2. Select Demographic Characteristics and Differences Between the Study Cohort and the Excluded Group

	Cohort		Excluded [a]		P Value
	n	%	n	%	
Total	4,981		656		
Median Adolescent Age (IQR)	14 (2.0)		14 (2.0)		0.5
Adolescent Gender					
Male	2,202	44.2	266	40.5	0.08
Female	2,779	55.8	390	59.5	
Sponsor Rank Group					
Junior Enlisted (E1 - E4)	127	2.5	14	2.1	
Senior Enlisted (E5 - E9)	3,618	72.6	510	77.7	
Junior Officer (O1 - O3)	198	4.0	30	4.6	**0.02**
Senior Officer (O4- O9, 10, 11)	842	16.9	81	12.3	
Warrant Officer (W1 - W5)	139	2.8	13	2.0	
Missing	57	1.1	8	1.2	
Sponsor Gender					
Male	4,547	91.3	628	95.7	
Female	377	7.6	20	3.0	**<0.0001**
Missing	57	1.1	8	1.2	
Median Sponsor Age (IQR)	39 (6.0)		38.5 (5.0)		**<0.0001**
Adolescent Mental Health Status					
Yes	974	19.6	140	21.3	0.28
No	4,007	80.4	516	78.7	
Sponsor Service					
Army	2,028	40.7	126	19.2	
Coast Guard	130	2.6	1	0.2	
Air Force	1,351	27.1	280	42.7	
Public Health Service	17	0.3	0	0.0	**<0.0001**
Marines	298	6.0	13	2.0	
Navy	1,099	22.1	228	34.8	
Foreign Navy	1	0.0	0	0.0	
Missing	57	1.1	8	1.2	

Health Analysis Department, Navy and Marine Corps Public Health Center.

Data Sources: Comprehensive Ambulatory Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.

BOLD indicates the p-value is statistically significant at alpha = 0.05.

[a] There were two adolescents that had more than one AD parent. They were excluded from this comparison because it would be difficult to determine which parent's demographic information to use.

Abbreviations: IQR = Interquartile Range.

NOTE: Demographic information was captured at the start of the study period (10/01/2002).

There were 8,193,128 person-days with 8,168 somatic symptoms visits (1.0 visit per 1,000 days). Migraine headaches were the most common somatic symptom diagnostic code, present in 6,187 of the visits. See Table 5 for other somatic symptom diagnostic code frequencies. The IRR for a one day increase in length of deployment was 0.9995 (95% confidence interval (CI): 0.9990, 1.000 p=0.077). The IRRs for child gender, age and mental health status were 1.95 (95% CI: 1.68, 2.26, p<0.0001), 0.90 (95% CI: 0.88, 0.93, p<0.0001) and 1.82 (95% CI: 1.52, 2.17, p<0.0001) respectively. The IRRs for sponsor age and gender were 1.03 (95% CI: 1.02, 1.05, p<0.0001) and 0.66 (95% CI: 0.51, 0.85, p=0.0013). We considered sponsor rank; however, that variable was not significant in the final model. We also considered the number of deployments each sponsor had; however, that variable was collinear with cumulative length of deployment. Service branch was not a confounder and therefore excluded in the final model. Both adjusted rate ratios (ARRs) (Table 3) and unadjusted rate ratios (URRs) (Table 4) were reported in this analysis. In summary, sponsor deployment was overall associated with a decrease in number of visits for somatic symptoms. However, being a female adolescent, increasing sponsor age, the adolescent having a mental health diagnosis, and the deploying sponsor being male were associated with an increased rate of somatic symptoms visits. Finally, for patients whose deploying sponsor was female, deployment was associated with a significant decrease in number of visits for somatic symptoms (Table 5).

Table 3. Adjusted Rate Ratios for Predictors According to Parental Length of Deployment

Predictor	Rate Ratio (95% CI)	P Value	Interpretation
Cumulative Length of deployment	0.9995 (0.9990, 1.000)	0.077	The effect of the length of deployment on the number of visits to the doctor in 90 days is not significant and is not associated with a change in the number of doctor appointments [a]
Adolescent Gender	1.9486 (1.6823, 2.2569)	**<0.0001**	The effect of a patient being female (compared to male) is to increase the expected number of visits to the doctor in 90 days by 94.9% [a]
Adolescent Age (per year)	0.9037 (0.8775, 0.9329)	**<0.0001**	Each additional year in adolescent age is associated with an estimated 9.6% decrease in doctor appointments [a]
Sponsor Age (per year)	1.0337 (1.0199, 1.0477)	**<0.0001**	Each additional year in sponsor age is associated with an estimated 3.4% increase in doctor appointments [a]
Sponsor Gender	0.6609 (0.5130, 0.8513)	**0.0013**	The effect of a sponsor being female (compared to male) is to decrease the expected number of visits to the doctor in 90 days by 33.9% [a]
Adolescent Mental Health Status	1.8175 (1.5201, 2.1730)	**<0.0001**	The effect of a patient having a mental health diagnosis is to increase the expected number of visits to the doctor in 90 days by 81.8% [a]

Health Analysis Department, Navy and Marine Corps Public Health Center.

Data Sources: Comprehensive Ambulatory / Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.

Abbreviations: CI = Confidence Interval.

[a] Adjusted for all other variables in the model.

BOLD indicates the p-value is statistically significant at alpha = 0.05.

Table 4. Unadjusted Rate Ratios for Predictors According to Parental Length of Deployment

Predictor	Rate Ratio (95% CI)	P Value	Interpretation
Cumulative Length of Deployment	0.9992 (0.9987, 0.9998)	**0.0074**	As the cumulative length of deployment increases there is a slight but significant decrease on the number of visits to the doctor in 90 days
Adolescent Gender	1.9199 (1.6365, 2.2525)	**<0.0001**	The effect of a patient being female (compared to male) is to increase the expected number of visits to the doctor in 90 days by 92.0%
Adolescent Age (per year)	0.9597 (0.9278, 0.9927)	**0.0171**	Each additional year in adolescent age is associtated with an estimated 4.0% decrease in doctor appointments
Sponsor Age (per year)	0.6220 (0.4854, 0.7970)	**0.0002**	Each additional year in sponsor age is associated with an estimated 37.8% decrease in doctor appointments
Sponsor Gender	1.0164 (1.0019, 1.0311)	**0.0262**	The effect of sponsor being female (compared to male) is to increase the expected number of visits to the doctor in 90 days by 1.6%
Adolescent Mental Health Status	1.9325 (1.6074, 2.3232)	**<0.0001**	The effect of a patient having a mental health diagnosis is to increase the expected number of visits to the doctor in 90 days by 93.3%

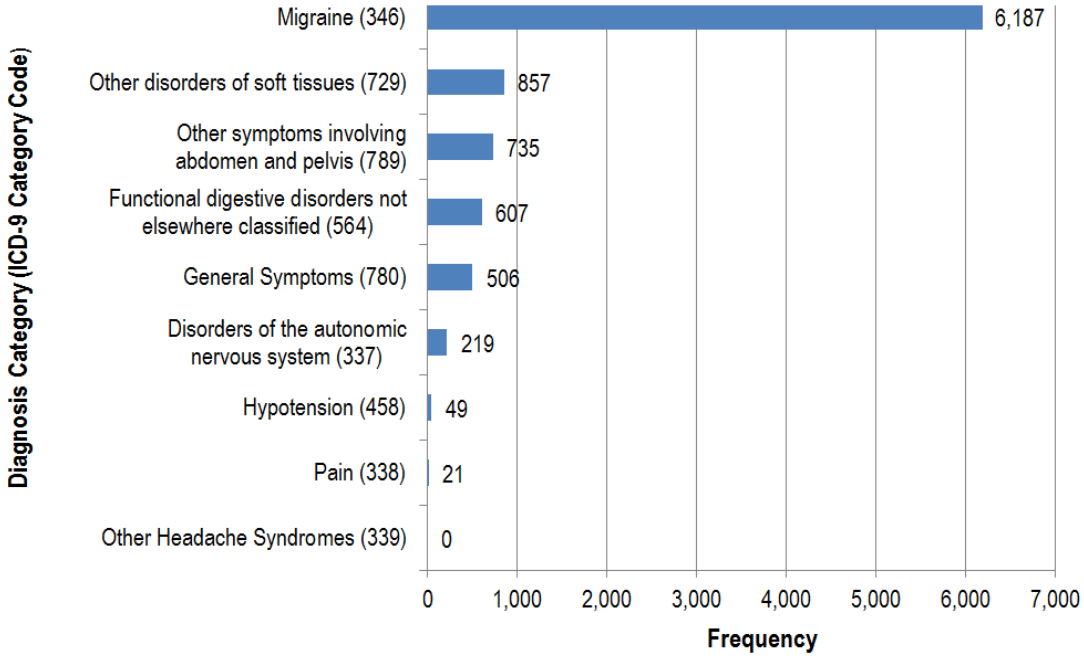
Health Analysis Department, Navy and Marine Corps Public Health Center.
Data Sources: Comprehensive Ambulatory / Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.
Abbreviations: CI = Confidence Interval.
BOLD indicates the p-value is statistically significant at alpha = 0.05.

Table 5. Adjusted Rate Ratio for Predictors According to Parent Deployment Status [a]

Predictor	Rate Ratio (95% CI)	P value	Interpretation
Ever deployed	0.7259 (0.6207, 0.8490)	**<0.0001**	The effect of ever being deployed (compared to never being deployed) is to decrease the number of appointments appointments by 27% [b]
Adolescent Gender	1.9860 (1.7314, 2.3020)	**<0.0001**	The effect of being female (compared to male) is to increase the number of appointments by 99% [b]
Adolescent Age (per year)	0.8837 (0.8545, 0.9139)	**<0.0001**	Each additional year in adolescent age is associated with an estimated 12% decrease in doctor appointments [b]
Sponsor Age (per year)	1.0307 (1.0144, 1.0421)	**<0.0001**	Each additional year in sponsor age is associated with an estimated 3% increase in doctor appointments [b]
Sponsor Gender	0.6554 (0.5034, 0.8533)	**0.0017**	The effect of sponsor being female (compared to male) is to decrease the number of appointments by 34% [b]
Adolescent Mental Health Status	1.8471 (1.5434, 2.2106)	**<0.0001**	The effect of a patient having a mental health diagnosis is to increase the number of appointments by 85% [b]

Data Sources: Comprehensive Ambulatory / Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.
Abbreviations: CI = Confidence Interval.
[a] Ever vs. never being deployed.
[b] Adjusted for all other variables in the model.
BOLD indicates the p-value is statistically significant at alpha = 0.05.

Table 6. Frequency[a] of Diagnosis Categories Documented During Adolescent SS Visits, FY 2003 - FY 2007



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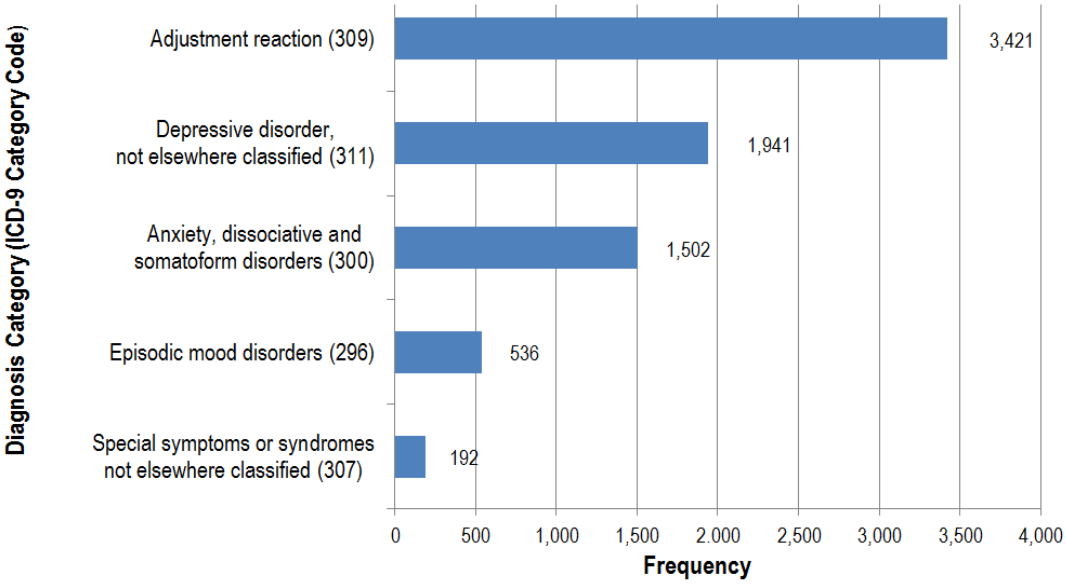
Data Sources: Comprehensive Amublatory Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.
[a] Frequency of each SS diagnosis code category documented during each SS visit. One visit can have multiple diagnosis categories documented.

Table 7. Frequency[a] of Diagnosis Categories Documented During Adolescent MH Visits, FY 2002 - FY 2003



Health Analysis Department, Navy and Marine Corps Public Health Center.
Data Sources: Comprehensive Ambulatory Professional Encounter Record (CAPER) and TRICARE Encounter Data Non-Institutional (TED-NI) tables, February 2016.
[a] Frequency of each mental health diagnosis code category documented during each mental health visit. One visit can have multiple diagnosis categories documented.

Discussion

To our knowledge, this is first study exploring the associations between sponsor deployment and health care utilization among adolescents with somatic symptoms. Contrary to our initial hypothesis, our data shows that among adolescents with somatic symptoms, sponsor deployment was associated with a decrease in number of medical visits. For adolescents whose military sponsor was female, the decrease in visits was particularly pronounced. For adolescents who were female or those who had a co-occurring mental health diagnosis there was a significant increase in the number of visits for somatic symptoms.

Migraine Headaches

Migraine headaches accounted for the vast majority of somatic symptomatology in this study (Table 6). This is unsurprising, as migraines are a common pain disorder, occurring in up to 10% of children and 18.5% of adults (Kathleen R Merikangas, 2013; Sillanpää & Saarinen, 2018). The high prevalence of migraines in our study population is also intriguing from a gender perspective, as it is well documented that migraines occur approximately 2-3x more frequently in women than in men (Vetvik & MacGregor, 2017). A comparison of two of the largest migraine databases demonstrated that women experience both high prevalence of migraine headaches as well as higher degrees of disability as compared to men (Lipton, Manack Adams, Buse, Fanning, & Reed, 2016). The increasing number of visits associated with increasing age of the patients is also consistent with previous data regarding the increasing prevalence of migraines with age across childhood, adolescence, and into adulthood (Sillanpää & Saarinen, 2018). It is

important to note that Migraine headaches are a particular medical diagnosis, with a particular set of diagnostic criteria ("Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition," 2018). However, the diagnostic criteria leave significant room for interpretation on the part of individual clinicians. This may create some uncertainty in our data regarding the specificity of the diagnostic category of Migraine headaches.

The low rate of other somatic diagnoses in our study sample is surprising. It is difficult to draw meaningful interpretations from the small number of patients with these symptoms. It is possible there were limitations in the coding at the time of provider documentation, or the codes used in our study did not adequately capture codes used by providers.

Mental Health Diagnoses

Among the mental health diagnoses the most common were adjustment disorder, depressive disorders, and anxiety disorders (Table 7). It was intriguing that anxiety disorders came in third, as these are the most common mental health diagnoses in adolescents, followed by depressive disorders (Kathleen Ries Merikangas et al., 2010). While our data is unable to tease this apart, it is possible the diagnosis of "adjustment disorder" masked symptoms that might have otherwise been classified as another mental health disorder, such as an anxiety disorder or mood disorder. It is also possible that adjustment symptoms were more prevalent in this population because of their somatic symptoms. The process of psychologically adjusting to living with chronic illness has

been well documented, including the possibility of psychological distress (de Ridder, Geenen, Kuijer, & van Middendorp, 2008).

The finding that the presence of a mental health disorder increased the number of somatic symptom visits by 85% is unsurprising, and is consistent with prior literature and our hypothesis regarding the moderating effect of mental health. The presence of mental health diagnoses and psychological distress are associated with worse somatic symptomatology, and psychological interventions are shown to effectively assist in ameliorating somatic symptoms (Bonvanie et al., 2017; Cerutti et al., 2017). Parent/guardian military deployment has also been associated with increased psychological distress in children and adolescents (Esposito-Smythers et al., 2011; Gorman et al., 2010). Drawing on Family Systems and Attachment theory, it is plausible the deployment of one parent creates a sense of fear of loss of the parental attachment figure for the child while simultaneously disrupting the normal arrangement of the family system. Both of these would create significant psychological distress for the child (Paley et al., 2013). Several authors have previously posited that the psychological distress from these types of disruptions could contribute to the development and exacerbation of somatic symptoms (Ciechanowski, Walker, Katon, & Russo, 2002; Palermo et al., 2014).

Military Deployment

Our data demonstrated a slight but significant decrease in visits for somatic symptoms with increasing cumulative length of deployment. As noted above this is inconsistent with our initial hypothesis. It is also inconsistent with prior data (Larson et al., 2012). Larson and colleagues demonstrated that during deployments in Operation

Iraqi Freedom and Operation Enduring Freedom, which correspond to the dates of our study as well, there was as significant increase in healthcare utilization, particularly for mental health and behavioral health visits as well as in prescriptions for anti-anxiety and anti-depressant medications (Larson et al., 2012). As noted earlier, the strong association between mental health diagnoses and exacerbations of somatic symptoms led us to postulate that deployment would be associated with more frequent visits for somatic symptoms. It is unclear why this was not the case.

It is plausible that caregivers for youth of deployed service members found it challenging to access care because of the stress of deployment. It is also possible adolescents may mask or hide some of their symptoms during parental deployments in an attempt to not add further stress onto the family system. This would be consistent with prior research on adolescents and deployment which suggests that some young people work hard to not add to the stress already experienced by the family during a deployment (Esposito-Smythers et al., 2011; Paley et al., 2013). Perhaps masking or not disclosing physical symptoms might be one strategy for reducing stress on the family system and preserving attachment relationships for young people with somatic symptoms.

Patient Age and Development

Our data suggest that as adolescents age, the frequency of visits for somatic symptoms significantly declines. Several possible explanations are plausible. First, it would be consistent with known trajectories of somatic symptoms such as dysautonomia that the symptoms might simply decline with age (Stewart, 2012). However, this would not be consistent with the fact Migraine Headaches were the predominant somatic

diagnosis in our study. As noted above, Migraine Headaches, increase with age across adolescence and into adulthood. Second, it is plausible that early in adolescence is when these symptoms are being diagnosed and management initiated, and that would necessitate more frequent visits to a clinician. Third, it is possible that as adolescents age they have learned coping strategies to deal with their symptoms, necessitating fewer visits. Finally, it remains plausible that older adolescents might work harder to reduce stress on the caregiver at home during deployments and cope with or mask their symptoms more effectively than younger adolescents.

Drawing on PVEST (Spencer, 2006), it is conceivable that younger adolescents are developing a sense of themselves in the face of the dual stressors, or risk factors, of somatic symptoms and parental deployment. However, it has been documented that a sponsor's military deployment can serve to develop resilience in young people (Easterbrooks et al., 2013; Saltzman et al., 2011). It is plausible that resilience developed in the context of military deployments might translate into resilience in managing somatic symptoms, potentially leading to fewer visits.

Sponsor Age

Increasing sponsor age was associated with decreased visits for somatic symptoms. We are unsure of the causes of this finding. It is plausible that sponsor age functions as a surrogate marker for socioeconomic status. We make this claim based on the rank system within the military, where increasing rank is required to remain in the military on active duty, and is associated with increasing salary. This is an intriguing possibility as a Swedish study found lower socioeconomic status during adolescence was

associated with an increased prevalence of somatic symptoms throughout life (Jonsson, San Sebastian, Strömsten, Hammarström, & Gustafsson, 2016). It is also possible that increasing sponsor age was related to increasing numbers of deployments, offering opportunities for developing resilience as noted above.

Gender

Patient Gender

It was unsurprising that female adolescents accounted for a greater number of subjects. The female predominance of somatic symptoms has been well documented (Barkmann et al., 2011; Bohman et al., 2012). The most common diagnosis in this study was migraines, which, as noted above, are associated with a strong female predominance as well as females experiencing greater levels of disability (Lipton et al., 2016; Sillanpää & Saarinen, 2018). As noted above, previous research suggests somatic symptoms show an age-related increase in symptoms that is particularly greater for females (Hetland et al., 2002; Romero-Acosta et al., 2013). It is notable that our data showed increases in visits associated with being female, but a decrease with age in contrast to that prior data.

The causal mechanisms underlying the gender discrepancy are not well documented, although it likely involves a complex interplay between neuroendocrine mechanisms and sociohistorical aspects of gender discrimination within our society (Wilson, 2004).

Joanna Kempner, in her ethnography *Not Tonight: Migraines and the politics of gender and health*, traces how migraine headaches are paradigmatic of a gendered approach to healthcare in the US that delegitimates pain and unexplained symptoms

particularly for women (Kempner, 2014; Sillanpää & Saarinen, 2018). She contends some women forgo seeking medical care because the medical establishment has not adequately engaged in working to ameliorate their migraine symptoms. Kempner explores how these contemporary experiences of women are rooted in a medical system that has attributed women's migraines to everything from wandering uteruses to personality defects to deficient coping with stress. All of these serve to create distrust of the medical system in women with migraines and can lead to women forgoing seeking care. Similarly, Maria Buchbinder conducted ethnographic research with pediatric and adolescent chronic pain patients (Buchbinder, 2015). She also documented how patients and their families sometimes avoided medical providers because they felt they were treated as if their symptoms were factitious. She found this was particularly true for female patients.

It is possible the female patients in our study presented for care during younger adolescence at higher rates, receiving diagnoses. However, if they experienced some of the elements described by Buchbined and Kempner, they may have subsequently avoided further interactions with the medical system.

Sponsor Gender

This study unexpectedly showed that if the military service member was female, the number of visits for somatic symptoms decreased by an additional 34%. Females account for only approximately 14.5% of all AD service members (Clever & Segal, 2013). Female service members are significantly less likely than their male counterparts to be married. If female service members have children, they are more likely to be single than their male counterparts. If they are married with children, female service members

are much more likely to be married to another AD service member than their male counterparts (Clever & Segal, 2013).

This pattern of gender differences suggests a possible explanation for the decreased number of visits found in this study. In the U.S., mothers are primarily responsible for bringing their children to medical visits (Mehta & Richards, 2002). For single female service members with children, deployment means their children are either under someone else's care for the duration of the deployment, whether that is a partner, extended family, or trusted caretaker. For married female service members, the burden of childcare falls to their spouse primarily. In these situations, it is the caregiver who is now responsible for bringing the child in for healthcare. It is plausible the combined stress of the deployment along with taking on roles typically managed by the deployed female service member leads to decreased number of medical visits. For adolescents who primarily receive care at military facilities, there may be the added challenge of accessing a secure military instillation for a caregiver who is not affiliated with the military.

Limitations and Future Directions

Any investigation of military deployment is fraught with multiple challenges. Deployment is not a singular event, but a series of stages, starting with pre-deployment training and work-up, the actual deployment, and reintegration. Discussions of deployment are complicated by the fact deployments differ dramatically between the various branches of the U.S. military and from unit to unit based up job and assignment – ranging in length from 6 weeks to greater than 12 months. Furthermore, the length of deployment also says little about the differing

character of the deployment – for example family members may experience a parent's 6-month deployment to a combat zone differently from a 6-month deployment on a humanitarian mission. It is impossible to derive this level of granularity regarding deployments from the data available in this study.

There are also limitations in grouping somatic symptomatology together in a single study. As noted earlier, these syndromes have significant overlap, and there are potentially some common causal pathways. However, there also may be important distinctions in how differing diagnoses are related to psychosocial stress.

This study is also a retrospective cohort study utilizing medical coding in an electronic medical database. There are inherent limitations to this methodology, such as uncertainty regarding the consistency or appropriateness of codes used by providers, and the inability to access other documented information from the clinical encounters.

In spite of these limitations, this is the first study we know of exploring the relationship between increased healthcare utilization and deployment, or to investigate the relationship between physical symptoms and deployment. Furthermore, this data suggests that providers caring for these youth should routinely have conversations with their parents about ensuring appropriate medical follow-up and symptom management as part of the family's planning for the deployment cycle. Furthermore, we recommend that prospective, longitudinal, mixed methods studies be conducted with military affiliated youth with somatic symptoms across their parent's deployment cycle to better elucidate the relationship between symptomatic exacerbation and deployments.

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