Incidence of Greater Trochanteric Pain Syndrome in Active Duty US Military Servicemembers

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abstract

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Although greater trochanteric pain syndrome is thought to be a common musculoskeletal disorder, little has been reported on the incidence rates of the disorder. The purpose of this study was to determine the incidence and demographic risk factors of greater trochanteric pain syndrome in a United States military population.

Multivariate Poisson regression analysis was used to estimate the rate of greater trochanteric pain syndrome per 1000 person-years, controlling for sex, race, age, rank, and branch of service. The overall unadjusted incidence rate of greater trochanteric pain syndrome was 2.03 per 1000 person-years. Women had a significantly increased adjusted incidence rate ratio for greater trochanteric pain syndrome of 5.03 (95% confidence interval [CI], 4.91-5.16). The adjusted incidence rate ratio for White servicemembers compared with Black servicemembers was 1.36 (95% CI, 1.32-1.40). The adjusted incidence rate ratio for the 40+ age group compared with the 25 to 29 age group was 2.81 (95% CI, 2.68-2.95). Compared with junior officers, junior and senior enlisted ranks had an increased adjusted incidence rate ratio of 1.94 (95% CI, 1.84-2.04) and 1.17 (95% CI, 1.12-1.23), respectively. Compared with the Navy, each branch of service had an increased adjusted incidence rate ratio, with the Army at 2.90 (95% CI, 2.80-3.01), the Marines at 1.96 (95% CI, 1.87-2.07), and the Air Force at 1.33 (95% CI, 1.27-1.38).

Female servicemembers had a five-fold greater incidence of greater trochanteric pain syndrome. Increasing age, enlisted rank groups, and service in the Army, Marines, or Air Force were also significant risk factors.

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Greater trochanteric pain syndrome (GTPS), was first described in the literature in the 1920s. It is thought to be a common musculoskeletal complaint, accounting for 10% to 20% of hip pain complaints presenting to primary care physicians. Greater trochanteric pain syndrome is primarily a clinical diagnosis. Current diagnostic criteria for GTPS include the first 2 plus 1 of the last 3 criteria: (1) lateral hip pain; (2) tenderness to deep palpation either directly over or posterior to the greater trochanter; (3) pain at the extremes of rotation, abduction, and adduction; (4) pain with resisted hip abduction; and (5) pseudoradicularity. Other diagnostic features are pain with lying on the affected side and relief of pain after a local injection of corticosteroid and anesthetic. Greater trochanteric pain syndrome can be a solitary syndrome but can also occur as a result of trauma or other common musculoskeletal conditions, such as degenerative arthritis of the hip, knee, or spine and iliobial band tightness or tendinitis.

The exact etiology of GTPS remains uncertain. Greater trochanteric pain syndrome has been attributed to a pathologic process within the bursa in the greater trochanteric region. Previously, 3 constant bursae were thought to be located around the greater trochanter, 1 associated with each of the gluteal tendons. It was thought to be primarily related to pathology located within the subgluteus maximus bursa or secondarily related to the bursae beneath the gluteus medius and gluteus minimus. However, a cadaveric study by Woodley et al investigated the morphology of the bursae around the greater trochanter and found an average of 6 small bursae, including at least 2 bursae associated with each gluteal tendon.

The term trochanteric bursitis has fallen out of favor because increasing evidence suggests that underlying pathology is not within the bursa but may result from other pathologic conditions. This entity lacks the major features of a primary bursitis, which include localized swelling and erythema related to an underlying bursal inflammation. Silva et al performed a prospective histologic analysis of bursal specimens from patients with and without symptoms of GTPS who underwent total hip arthroplasty. They demonstrated no findings consistent with acute or chronic inflammation in the GTPS group. Several authors have attributed this condition, now known as GTPS, to degenerative changes within the gluteal tendons. 

Greater trochanteric pain syndrome has often been considered an overuse syndrome, common in runners and dancers, and the associated pain is secondary to repetitive microtrauma around the hip. A recent study has reported tendinopathy or tears of the gluteal tendons as the etiology for GTPS pain. The gluteal tendons have been referred to as the rotator cuff of the hip, and comparisons have been drawn to GTPS and rotator cuff tears of the shoulder.

Due to the belief that GTPS more commonly afflicts active individuals, the current authors investigated GTPS in military servicemembers. Few data exist in the literature on the prevalence or incidence of this disorder in the United States, let alone among a high-demand population such as the military. This study used a database of active duty military personnel to determine the prevalence of GTPS based on age, sex, race, branch of service, and rank.

**MATERIALS AND METHODS**

The US Armed Forces represents a physically active population of male and female servicemembers with generally high occupational demands. These servicemembers participate in organized physical fitness training programs, and they must meet the standards of their individual service’s physical fitness test and height/weight requirements semi-annually. At the initial military entry examination, preexisting hip conditions are screened by history and physical examination. If concerns exist about a preexisting hip condition, radiographs and an orthopedic consultation are obtained. Findings of any preexisting physical abnormalities exclude those individuals from initial entry into active duty military service.

The military maintains large medical databases, making it an excellent population in which to study musculoskeletal disorders such as GTPS. One such database is the Defense Medical Epidemiology Database (DMED), which compiles International Classification of Diseases, Ninth Revision (ICD-9) coding information for every patient encounter in a military treatment facility. This database also maintains the total number of servicemembers on active duty each year and contains patient demographic and military-specific data.

The DMED is a frequently updated database able to track military servicemembers as they move throughout the world. The DMED also adjusts for servicemembers as they retire or re-enlist into the armed forces. It has been used previously to provide information on various musculoskeletal conditions.

The DMED provides 4 types of data: demographic features, inpatient hospitalizations, ambulatory visits, and reportable events. The outpatient data in the DMED is a combination of the standard ambulatory data records extracted from the Ambulatory Data System, from the Composite Health Care System used in military treatment facilities worldwide, and from outsourced (nonmilitary) outpatient health care facilities providing care to active duty servicemembers.

To determine the total number of patients with GTPS, the ambulatory DMED system was queried for the years 1998 to 2006 using the ICD-9 CM code 726.5. Ambulatory encounters were limited to a first occurrence to exclude repeat coding of the same initial diagnosis for all services during the study period. The results were then categorized by sex, race, age, rank, and branch of service.

Race data are routinely obtained from the Defense Manpower Data Center,
which compiles servicemembers’ self-report of race with the following options: White, Black, Hispanic, Alaskan Native/American Indian, Asian/Pacific Islander, and other. The DMED classifies these categories into 3 larger groups: White, Black, and other. Mixed-race individuals were classified according to self-report. Age categories used were <20, 20-24, 25-29, 30-34, 35-39, and 40+ years. Rank categories used were junior enlisted (E1-E4), senior enlisted (E5-E9), junior officers (O1-O3), and senior officers (O4-O9). Branch of service categories used were Army, Navy, Air Force, and Marines.

The DMED does not compile height or weight data on servicemembers, so this information was not available for analysis. The database was also queried for the total number of servicemembers on active duty during the study period, and the results were categorized by sex, race, age, rank, and branch of service. To estimate incidence, 1 exposure year was defined as 1 year that the servicemember was in the United States Armed Forces.

For incident GTPS, the outcome measure was the unadjusted incidence rate per 1000 person-years. We used multivariate Poisson regression to estimate the rate of GTPS per 1000 person-years by sex, race, age, rank, and branch of service (unadjusted rates). In addition, rate ratios for sex were computed, using men as the referent and controlling for differences in race, age, rank, and branch of service between men and women (adjusted rates). The aforementioned referent categories were chosen because they had the lowest unadjusted incidence rates. Rate ratios were also calculated for race, using Black as the referent; age, using 25-29 years as the referent; rank, using junior officers as the referent category; and branch of service, using the Navy as the referent category, all of which were adjusted for other covariates. All statistical analyses were performed using SAS version 9.1 software (SAS Institute Inc, Cary, North Carolina). This study was approved by the Institutional Review Board of William Beaumont Army Medical Center.

Older servicemembers had a higher incidence rate of GTPS compared with younger servicemembers. The highest unadjusted incidence rates were seen in the <20 and 40+ age groups, with incidence rates of 2.94 and 3.23 per 1000 person-years, respectively. After adjusting for the other variables, the 40+ age group had the highest adjusted rate of GTPS. The adjusted rate ratio for the 40+ age group compared with the 25-29 age group was 2.81 (95% CI, 2.68-2.95) (Table 2). The incidence rate for GTPS was 2.03 among Whites, 2.26 among Blacks, and 1.61 among others per 1000 person-years. Using Black as a referent category, the adjusted incidence rate ratio demonstrated for sex, race, age, rank, and branch of service (unadjusted rates). In addition, rate ratios for sex were computed, using men as the referent and controlling for differences in race, age, rank, and branch of service between men and women (adjusted rates). The aforementioned referent categories were chosen because they had the lowest unadjusted incidence rates. Rate ratios were also calculated for race, using Black as the referent; age, using 25-29 years as the referent; rank, using junior officers as the referent category; and branch of service, using the Navy as the referent category, all of which were adjusted for other covariates. All statistical analyses were performed using SAS version 9.1 software (SAS Institute Inc, Cary, North Carolina). This study was approved by the Institutional Review Board of William Beaumont Army Medical Center.

RESULTS

A total of 27,335 cases of GTPS were documented during the study period among an at-risk population of 13,443,221 person-years. The overall incidence rate of GTPS was 2.03 per 1000 person-years. The incidence rate of GTPS was 6.16 per 1000 person-years among women and 1.33 per 1000 person-years among men. When compared with men, women had a significantly increased adjusted incidence rate ratio for GTPS of 5.03 (95% confidence interval [CI], 4.91-5.16) (Table 1).

Table 1: Unadjusted and Adjusted Incidence Rates and Adjusted Incidence Rate Ratios of GTPS Among US Military Servicemembers, 1999-2006

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Cases</th>
<th>Person-years</th>
<th>Unadjusted IR</th>
<th>Adjusted IRR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15,276</td>
<td>11,487,365</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>12,059</td>
<td>1,955,856</td>
<td>6.16</td>
<td>5.03 (4.91-5.16)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>5984</td>
<td>2,651,536</td>
<td>2.26</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2152</td>
<td>1,335,892</td>
<td>1.61</td>
<td>0.70 (0.66-0.73)</td>
</tr>
<tr>
<td>White</td>
<td>19,199</td>
<td>9,455,793</td>
<td>2.03</td>
<td>1.36 (1.32-1.40)</td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1-E4</td>
<td>13,423</td>
<td>5,950,349</td>
<td>2.26</td>
<td>1.94 (1.84-2.04)</td>
</tr>
<tr>
<td>O1-O3</td>
<td>2060</td>
<td>1,299,749</td>
<td>1.58</td>
<td></td>
</tr>
<tr>
<td>E5-E9</td>
<td>9669</td>
<td>5,339,957</td>
<td>1.85</td>
<td>1.17 (1.12-1.23)</td>
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<tr>
<td>O4-O9</td>
<td>2183</td>
<td>853,114</td>
<td>2.56</td>
<td>0.97 (0.91-1.03)</td>
</tr>
<tr>
<td>Branch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Army</td>
<td>14,884</td>
<td>4,721,473</td>
<td>3.15</td>
<td>2.90 (2.80-3.01)</td>
</tr>
<tr>
<td>Navy</td>
<td>3895</td>
<td>3,583,270</td>
<td>1.09</td>
<td></td>
</tr>
<tr>
<td>Air Force</td>
<td>5773</td>
<td>3,456,080</td>
<td>1.67</td>
<td>1.33 (1.27-1.38)</td>
</tr>
<tr>
<td>Marines</td>
<td>2783</td>
<td>1,682,398</td>
<td>1.65</td>
<td>1.96 (1.87-2.07)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; GTPS, greater trochanteric pain syndrome; IR, incidence rate; IRR, incidence rate ratio.

- Adjusted for age, race, rank, and branch. Male is referent category.
- Adjusted for age, sex, rank, and branch. Black is referent category.
- Adjusted for age, sex, race, and branch, O1-O3 is referent category.
- Adjusted for age, sex, race, and rank. Navy is referent category.
stratified increased risks for Whites, with a rate of 1.36 (95% CI, 1.32-1.40) (Table 1).

The incidence rate for GTPS among the 4 rank groups was 2.26 for junior enlisted, 1.58 for junior officers, 1.85 for senior enlisted, and 2.56 for senior officers per 1000 person-years. When compared with junior officers as the referent category, junior and senior enlisted groups overall had significantly increased adjusted incidence rate ratios for GTPS, at 1.94 (95% CI, 1.84-2.04) and 1.17 (95% CI, 1.12-1.23), respectively (Table 1).

The incidence rate for GTPS among the 4 branches of service was 3.15 for the Army, 1.09 for the Navy, 1.67 for the Air Force, and 1.65 for the Marines per 1000 person-years. Each branch, when compared with the Navy as the referent category, had a significantly increased adjusted incidence rate ratio for GTPS, with the Army at 2.90 (95% CI, 2.80-3.01), the Air Force at 1.33 (95% CI, 1.27-1.38), and the Marines at 1.96 (95% CI, 1.87-2.07) (Table 1).

### Table 2

<table>
<thead>
<tr>
<th>Age Group, y</th>
<th>IR†</th>
<th>Adjusted IRR (95% CI)bc</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>2.94</td>
<td>1.18 (1.13-1.24)</td>
</tr>
<tr>
<td>20-24</td>
<td>1.77</td>
<td>0.81 (0.78-0.84)</td>
</tr>
<tr>
<td>25-29</td>
<td>1.67</td>
<td>N/A</td>
</tr>
<tr>
<td>30-35</td>
<td>1.70</td>
<td>1.26 (1.21-1.32)</td>
</tr>
<tr>
<td>35-39</td>
<td>2.15</td>
<td>1.82 (1.73-1.90)</td>
</tr>
<tr>
<td>40+</td>
<td>3.23</td>
<td>2.81 (2.68-2.95)</td>
</tr>
</tbody>
</table>

**Abbreviations:** CI, confidence interval; GTPS, greater trochanteric pain syndrome; IR, incidence rate; IRR, incidence rate ratio; N/A, not applicable.

†Incidence rate is per 1000 person-years.
bc25-29 age group is referent category.
*Adjusted for sex, race, rank, and branch.
*Referent category.

### Discussion

In this large-scale database study, female sex, White race, increased age, junior enlisted and senior enlisted rank groups, and military service in the Army, Marines, and Air Force were significant risk factors for the development of incident GTPS. Incidence rates were determined for this unique population of individuals who are all active duty US military servicemembers. Standard training for active duty military servicemembers includes multiple weekly aerobic and strength training sessions, daily physically demanding military occupational specialty training, overseas deployments, maintaining height and weight requirements, and passing a semi-annual service-specific physical fitness test. A servicemember’s inability to complete any of these requirements could result in medical or administrative discharge from the military.

Relatively little is known about the epidemiology of the common musculoskeletal condition GTPS. Previous studies of GTPS in adults have reported prevalence rates of 18% in a community-based sample of older adults at high risk for knee osteoarthritis, and from 20% to 35% in spine clinic patients presenting with low back pain. The incidence rate of GTPS in the current study population was 2.03 per 1000 person-years, with men at 1.33 and women at 6.17 per 1000 person-years. Lievens et al. reported an incidence rate of 1.8 per 1000 per year in a primary care setting with a mean patient age of 55 years, but the potential existed for a considerable amount of selection bias secondary to the 46% nonresponse rate to their questionnaire. The current study’s slightly higher overall incidence rate in a younger population is likely attributable to the increased physical and occupational demands experienced by military servicemembers.

The results in the current study found a significant increased risk in the development of GTPS in women compared with men, with an adjusted incidence rate ratio of 5.03 (95% CI, 4.91-5.16). Prior analyses of GTPS have consistently reported an increased prevalence in women, although to a lesser extent than the findings of this study. In a prevalence study of a population of adults aged 50 to 79 years who were at a high risk of developing or who had knee osteoarthritis, Segal et al. found that women had a significantly increased odds ratio of 3.37 (95% CI, 2.67-4.25) for developing GTPS compared with men. The study also reported that iliotibial band tenderness, knee osteoarthritis or knee pain, and low back pain were positively related to GTPS. The significant predisposition for women developing GTPS may relate to anatomical differences stemming from their wider pelvis, which alters the muscle biomechanics of the gluteal muscles and the iliotibial band in the area of the greater trochanter. Thus, women’s anatomical differences and individuals with knee or back pain may cause GTPS through compensatory movements during the gait cycle.

The current study’s data showed an increased risk of GTPS in White servicemembers compared with Black servicemembers. To the authors’ knowledge, this study is the first in the literature to specifically address race as a risk factor for GTPS. In the United States, a higher prevalence of obesity in Black compared with White adults has been seen in both the military and civilian population. Increased body weight and increased body mass index may be intrinsic risk factors for GTPS, although no association has previously been reported. The DMED does not compile height or weight data on servicemembers, so this information was not available for analysis.

As expected, this study demonstrated a statistically significant increased risk for the development of GTPS with increasing age. The adjusted rate ratio was 2.81 (95% CI, 2.68-2.95) for servicemembers in the 40+ age group compared with those in the 25-29 age group. Previous studies have found that the highest prevalence of GTPS...
occurs in the 40-60 age group.\textsuperscript{4,9,12,13,20} One possible explanation for the higher rate in patients older than 40 years is the correlation between GTPS and other comorbidities. Segal et al\textsuperscript{20} determined adjusted odds ratios of $3.47$ (95% CI, 2.72-4.42) and $1.74$ (95% CI, 1.32-2.28) for ipsilateral and contralateral knee osteoarthritis, respectively, as well as an adjusted odds ratio of 2.79 (95% CI, 2.22-3.50) for low back pain associated with GTPS. These musculoskeletal conditions are also more prevalent with increasing age.

In the current study, the adjusted rate ratio was 1.18 (95% CI, 1.13-1.24) for service members in the <20 age group compared with those in the 25-29 age group. In the military, the <20 age group comprises a group of military servicemembers who generally have increased their activity levels over a short period of time. Military basic and advanced individual training involves intense physical training and occupational demands that may result in GTPS and other overuse syndromes.

Several currently accepted mechanisms exist for the pathogenesis of GTPS. The first, which is the likely explanation for the increased incidence observed in the <20 age group, is repetitive microtrauma to the gluteal tendons. This is the predominant age group for servicemembers who are undergoing basic training and advanced individual training. During these courses, many of these military servicemembers have likely had a significant increase in their activity level. Lower-extremity overuse syndromes are common in this population, resulting from microtrauma to tendons that are not allowed adequate healing time in between training sessions.\textsuperscript{25,26} Regarding the 40+ age group, comparisons have been made to the gluteal tendons and the rotator cuff of the shoulder.\textsuperscript{13,15,17} Rotator cuff tears of the shoulder are described as having extrinsic or intrinsic causes. Extrinsic factors include repetitive impingement under the acromion, whereas intrinsic factors are defined by a degeneration-microtrauma model.\textsuperscript{27} The degeneration-microtrauma model likely explains GTPS pain because abnormalities around the greater trochanter, such as osteophytes or calcifications, are seen in 40% of patients.\textsuperscript{4} Changes within the gluteal tendons have been confirmed by several recent studies. Kingzett-Taylor et al\textsuperscript{13} reviewed magnetic resonance imaging studies of 250 patients reporting buttock, lateral hip, or groin pain and found that 14% had either tendinosis or tears of the gluteus medius or minimus muscles as the primary positive finding. Bird et al\textsuperscript{9} reported on a more refined subset of 24 women with GTPS and found that 83% had either a tear or tendinitis of the gluteus medius and that bursal distension was an uncommon finding.

In the current study, the junior and senior enlisted rank groups were at a significantly greater risk for developing GTPS when compared with the junior officer rank group. Compared with servicemembers in the Navy, a statistically significant increased risk for the development of GTPS existed for servicemembers in the Army, Marines, and Air Force. The high incidence of GTPS in these active populations is representative of the overuse model of GTPS. In this database, rank and branch of service act as a proxy for activity level. Therefore, these results emphasize the role of activity level, including occupational demands, in the development of GTPS.

Servicemembers in the junior enlisted rank group and those in the Army and Marines generally have an overall higher activity and occupational demand level than the referent groups. The lowest rank group, consisting of junior enlisted servicemembers, comprises the majority of combat and combat support units, maintains superior physical readiness through structured physical training programs, and is subject to the physical rigor of repeated combat deployments. Although their current duties may not be as physically demanding as the junior enlisted rank group’s, the senior enlisted rank group had a significantly increased adjusted incidence rate ratio compared with the junior officer rank group. This may be attributable to the cumulative physical activity that they encounter during the years of service required to reach their current rank level.

The greatest strength of this study was the large number of active duty servicemembers who were captured in the closed military health care system and annotated in the DMED database. This system allows for epidemiologic studies where the results can be used in comparison with populations of physically active individuals whose activity may be through sports or occupation.

The authors acknowledge the limitations inherent to any large database study. First, multiple physicians evaluated and coded the patient encounters, which may decrease the accuracy of the diagnosis of GTPS. Greater trochanteric pain syndrome is a common musculoskeletal condition that is often seen in general practice clinics; thus, the authors believe that familiarity with the presentation and diagnosis of GTPS is high. In addition, substantial interobserver reliability for the determination of trochanteric tenderness on physical examination has been reported.\textsuperscript{28} Second, because the data are based on patient-driven clinic visits, individuals with no symptoms may not seek medical care and thus would not be captured in a database study. Finally, the DMED cannot track individuals, so the authors were unable to report on the duration and severity of GTPS symptoms in military servicemembers or analyze risk factors in refractory cases.

**Conclusion**

The greatest risk factor for the development of GTPS identified in this study was female sex. Age older than 40 years is also a significant predisposing risk factor. These findings correlate with previous studies, although the incidence rates demonstrated in this study are more signifi-
greater, likely due to the increased activity levels of the study population. With the identification of demographic risk factors for GTPS, these data may be useful in identifying high-risk groups within general physically active populations to implement preventative measures. These preventative measures may include specific training programs emphasizing hip abductor stretching and strengthening.

**References**
