Journal of Hand Surgery Global Online 2 (2020) 349–353

Contents lists available at ScienceDirect

Journal of Hand Surgery Global Online

journal homepage: www.JHSGO.org

Original Research

Epidemiology of Symptomatic Dorsal Wrist Ganglia in Active Duty Military and Civilian Populations

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A R T I C L E I N F O

Article history:
Received for publication January 23, 2019
Accepted in revised form August 4, 2020
Available online September 18, 2020

Key words:
Dorsal wrist ganglia
Epidemiology
Hand mass

Purpose: The epidemiology of dorsal wrist ganglia (DWG) has been poorly studied. The purpose of this study was to determine the epidemiology of DWG in the US military and civilian populations. We hypothesized that military service would be associated with an increased risk for developing a DWG.
Methods: The US Department of Defense Management Analysis and Reporting Tool, a database of health care encounters by military personnel and dependents, was queried for encounters with an International Classification of Diseases, Ninth Revision diagnosis of 727.41 (ganglion of a joint) or 727.43 (ganglion, unspecified location) between 2009 and 2014. There is no specific code for DWG, so a random sample of 1,000 patients was selected from both the military and civilian cohorts. These 2,000 electronic medical records were examined to identify patients with a DWG. This estimate was used to determine the unadjusted incidence of DWG with a 95% confidence interval and a 5% margin of error in the entire military and civilian dependent population. Adjusted incidence rates and incidence rate ratios (IRR) were determined using Poisson regression, controlling for demographic covariates.
Results: The incidence of DWG in the military population is 14.25/10,000 person-years compared with 7.01/10,000 person-years in the civilian population. Female sex was a significant risk factor in both the military (IRR, 2.59) and civilian populations (IRR, 2.26). Younger age group (age 25–34 years) was a significant risk factor for DWG compared with an older age group (age 45–64 years) in both the military (IRR, 1.74) and civilian populations (IRR, 2.56). Senior rank (both officer and enlisted) was a significant risk factor for DWG compared with junior rank (IRR, 1.95).
Conclusions: The incidence of DWG was higher in the military compared with the civilian population. There is a higher incidence of a DWG in females and in the senior ranks (both officer and enlisted).
Type of study/level of evidence: Prognostic III.

Dorsal wrist ganglia (DWG) are common and patients with this condition often report pain, decreased range of motion, and even anxiety about potential malignancy.[1–3] Although it is the most common hand mass, the epidemiology and distribution of wrist ganglia have not been well-described. Most citations are based on the extrapolation of small cohorts or small sample populations.[4,5]

The purposes of this study were to define the incidence of DWG in the US military and civilian populations using a large database and to determine whether demographic associations such as age, sex, and military service influence the development of the condition. We hypothesized that the rate of DWG would be higher in the active duty military population.

Declaration of interests: No benefits in any form have been received or will be received by the authors related directly or indirectly to the subject of this article.

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https://doi.org/10.1016/j.jhsg.2020.08.001
2589-5141/

Materials and Methods

Data source

The US Department of Defense Management Analysis and Reporting Tool (M2) maintains comprehensive records of all health care encounters paid for by the Military Health System. These records include International Classification of Diseases, Ninth Revision (ICD-9) coding diagnoses specific to each patient encounter occurring in outpatient and inpatient care for active duty military members and their civilian dependents. The Department of Defense's electronic health records are maintained on the Armed Forces Health Longitudinal Technology Application, which that captures outpatient visits within the Department of Defense. These military health systems were used in previous studies to determine the epidemiology of a variety of musculoskeletal conditions.[6,7]

Study sample

After we obtained institutional review board approval, we used M2 to identify military patients and civilian patients with first-time ICD-9 diagnosis codes of 727.41 (ganglion of joint) or 727.43 (ganglion, unspecified) from January 1, 2009 to December 31, 2014. The number of patients who met these inclusion criteria was too large to complete a full chart review. Therefore, 1,000 patients from the military cohort and 1,000 patients from the civilian cohort were randomly selected using a random number generator in Excel (Microsoft Corp, Redman, WA). The exact location of ganglions from the sample populations was determined through thorough chart review of the Armed Forces Health Longitudinal Technology Application (electronic medical record). The number of patients with DWG was identified from the random samples; then, the proportions were extrapolated back to the original populations to estimate the incidence of DWG in the military and civilian populations. This step was necessary because of the nonspecific ganglion diagnosis. The number of patients at risk during the study period in the military and civilian populations was determined from population counts collected from M2, expressed in person-years and grouped by relevant variables such as sex, age group (18–24, 25–34, 35–44, and 45–64 years), and military versus civilian status. Additional military-specific variables determined at the time of initial diagnosis include military rank (officer or enlisted) and military experience, grouped as senior military members (senior enlisted members, ranks E5–E9; and senior officers, ranks O4–O9) and junior military members (junior enlisted members, ranks E1–E4; and junior officers members, ranks O1–O3), as well as the branch of service (Army, Navy, Marine Corps, and Air Force). Although military rank is not a direct measure of time in service, it is assumed that higher-ranking individuals have spent more time in the military owing to the time-sensitive career milestones required to achieve increasing ranks.

To compare the military population most accurately with the civilian population, retirees (any person with military experience at all for the purpose of these methods) and foreign military personnel were excluded from the military group. Similarly, age extremes that are not well-represented in the military population (patients aged less than 18 years or patients aged greater than 65 years) were excluded from the civilian group.

Statistical analysis

The incidence of DWG was calculated by extrapolating the proportion of DWG identified in the randomly sampled cohorts with the total active duty and civilian patient populations. Unadjusted incidence and 95% confidence intervals (CIs) of DWG for each variable were determined. Multivariate Poisson regression was used to determine the adjusted incidence rate of DWG per 10,000 person-years and adjusted incidence rate ratios (IRR) while adjusting for covariates. Statistical significance was established at $P = .05$.

Results

Incidence

In the military population, there were 10,002,176 person-years at risk from January 1, 2009 to December 31, 2014. A total of 25,222 military cases of ganglia with relevant ICD-9 codes were documented during the study period. A group of 1,000 patients was then randomly selected and their charts were reviewed. Dorsal ganglia were identified in 565 military patients from the random sample of 1,000. This percentage was then extrapolated to the original population to estimate the incidence. Therefore, the estimated number of dorsal ganglia in the military population was 14,250 and the unadjusted incidence rate of DWG in the active duty military population was 14.25/10,000 person-years (95% CI, 14.01–14.48).

In the civilian population, 20,018,355 person-years were at risk during the study period. Excluding age-extreme patients, the adjusted civilian population at risk was 10,027,762 person-years. A total of 21,378 civilian cases of ganglia with relevant ICD-9 codes were documented in the initial population at risk. From this group of identified civilian patients, 1,000 persons were again randomly sampled. In this random sample, we identified 411 civilian patients with DWG. We excluded DWG patients aged less than 18 years and greater than 65 years, which left 329 DWG patients in the civilian group. The estimated number of DWG in the population was 7,033 and the estimated unadjusted incidence rate of DWG in the civilian population aged 18 to 64 years was 7.01/10,000 person-years (95% CI, 6.85–7.12).

Demographic variables

Table 1 lists demographic variables of the extrapolated number of ganglia. In the military group, the estimated unadjusted incidence rate for male patients was 11.48/10,000 person-years (95% CI, 11.26–11.71) compared with 29.63/10,000 person-years for female patients (95% CI, 28.77–30.51). In the civilian group, the estimated unadjusted incidence rate for male patients was 3.89/10,000 person-years (95% CI, 3.60–4.21) compared with 7.63/10,000 person-years for female patients (95% CI, 7.44–7.82).

We determined the effect of demographic variables using a Poisson regression for both the military and civilian populations while adjusting for age and sex. Female sex was significant in both the military (IRR, 2.59; 95% CI, 2.05–3.27; $P < .001$) and civilian populations (IRR, 2.26; 95% CI, 2.08–2.45; $P < .001$). Younger age (25–34 years) was a significant risk factor for DWG compared with older age (45-64) in both the military (IRR, 1.74; 95% CI, 1.59–1.91; $P < .001$) and civilian populations (IRR, 2.56; 95% CI, 2.40–2.73; $P < .001$). The adjusted incidence rates for age and sex are depicted in Figure 1.

Military-specific variables

The effect of active duty military status was evaluated using a Poisson regression analysis while adjusting for age and sex. The adjusted incidence rate ratio for the active duty population was 3.18 (95% CI, 2.38–4.25; $P < .001$) compared with that for the civilians.

Military-specific variables were evaluated using Poisson regression adjusting for age, sex, branch of service, military

Table 1
Demographics of Extrapolated Military and Civilian Populations

	Military	Civilian
Population at risk, person-years	10,002,176	20,018,355
Population at risk (age extremes removed), person-years		10,027,762
Patients with ICD-9 codes 727.42 and 727.43	25,222	21,378
Dorsal ganglia	14,250	7,033
Male	9,736	641
Female	4,514	6,392
Age, y		
18–24	4,666	1,860
25–34	6,255	2,501
35–44	2,774	1,304
45–64	555	1,368

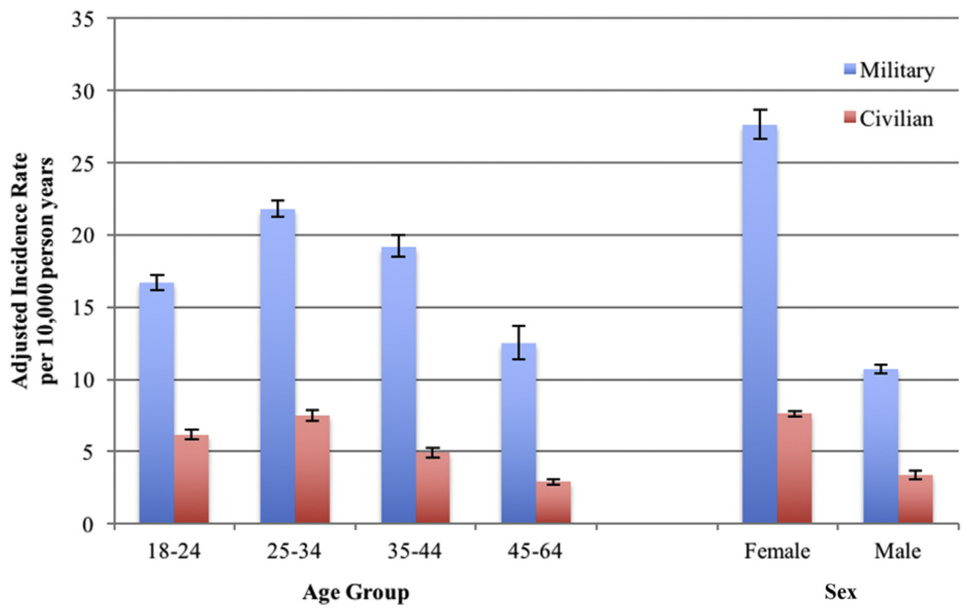

Figure 1. Adjusted incidence rates and 95% CIs in the military and civilian populations by age group and sex, adjusted by sex and age.

experience, and rank. Figure 2 shows the effect of military branch of service; the adjusted incidence rate was highest in the Army at 18.18/10,000 person-years (95% CI, 15.09–21.89). Military experience had a significant effect on the incidence of DWG. The senior military members had twice the risk for DWG compared with junior military members (IRR, 1.95; 95% CI, 1.53–2.49; $P < .001$).

Discussion

This epidemiologic study determined the incidence of DWG in both military and civilian populations using a large database. It provides a comprehensive description of the true incidence of DWG in both the military and civilian populations. We confirmed our hypotheses that DWG are more frequent in the military population (14.25/10,000 person-years) compared with the civilian population (7.01/10,000 person-years). The risk for DWG is significantly greater in the military population compared with the civilian population (IRR, 3.18) and in senior military members (officer and enlisted ranks) compared with junior military members (IRR, 1.95). As expected, our study was consistent with previous published results, showing an increased risk for DWG in women in both military (IRR, 2.59) and civilian (IRR, 2.26) populations.

Despite the common occurrence of DWG, there is a surprising lack of data with regard to the epidemiology of the condition. Janzon and Niechajev[8] reported the incidence of wrist ganglia over 1 year in a Swedish population of 250,000. Their table shows an incidence of DWG of 5.08/10,000 person-years. This is lower than the incidence of both the civilian and military populations in our study, likely because they included only operative patients.

Our study is consistent with previous studies with regard to age and sex distribution. McEvedy[9] and Janzon and Niechajev[8] both showed that the incidence of DWG was highest in patients aged 20 to 30 years. Similarly, the average age of patients in most contemporary studies on ganglia is the early thirties.[10–12] Female sex continues to be a risk for the development of DWG. Angelides and Wallace[13] reported that over 75% of 500 patients treated operatively with dorsal wrist ganglion excision were female. This is consistent with previous studies addressing surgical outcomes and risk factors, which showed a 2:1 female predominance.[3,12,14–16]

The underlying etiology of wrist ganglia is not well-understood and is often debated.[9,13] Previous studies described DWG as cysts or tumors; however, the pathology does not support these claims, because they do not arise from a single cell and are not contained by epithelial cells.[9,13,17] Increased ligamentous and soft tissue laxity has also been described as a possible cause on the basis of increased Beighton scores in patients presenting with ganglia compared with age- and sex-matched controls.[12] Although increased ligamentous laxity may be a notable risk factor for developing a cyst, a possible

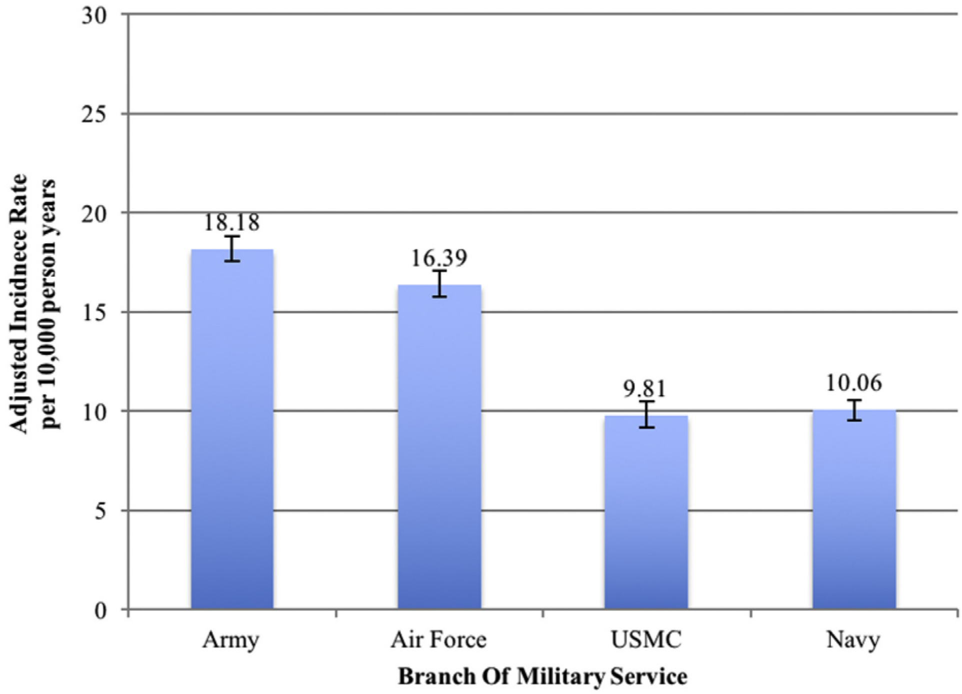

Figure 2. Adjusted incidence rates in the military population by branch of military service adjusted for age, sex, military rank, and military experience. *Statistically significant difference compared with the Navy. USMC, US Marine Corps.

etiology seems to be that of cumulative microtrauma or chronic repetitive motions. Repetitive stresses on the wrist result in a capsular rent, creating a one-way valve for fluid, resulting in a mass in the soft tissues.[13] Increased ligamentous and soft tissue laxity potentially accelerates the effects of repetitive microtrauma that lead to a cyst. This may account for the disproportionally higher incidence of DWG in military females compared with males, given the increased prevalence of ligamentous laxity in females.[18,19]

The theory of cumulative microtrauma is supported by authors who report a higher incidence of DWG in patients who experience repeated stresses to the wrist.[14,20,21] Requirements of active duty service necessitate a semiannual physical fitness test that varies slightly among military service branches. In addition, the everyday physical requirements of service members, such as weapons handling and group exercise, also are likely to put additional stress on the wrist joint. Unique findings of this study are the increased risk for dorsal ganglia in the active duty population compared with the civilian population and the increased incidence in senior military members (both officer and enlisted). Our seemingly contradictory finding of increased risk in younger military members, both male and female, yet also senior ranking military members, is not contradictory. It is important to acknowledge the considerable overlap in the group aged 25–34 years and in those with senior military rank, because most people are promoted to this level after around 10 years of service. According to this perspective, if one enters the military at age 18 after graduating from high school, eligibility for retirement would be at the young age of 38 years.

Our study demonstrated a significant difference in the risk for DWG with regard to the branch of military service when controlling for other factors such as age, sex, career progression, and officer status. Although all members of the military have the same level and access to health care coverage, certain military branches may have different levels of use as a reflection of the culture of the specific service. It is plausible that if there is a significant difference in use across the services, it could have affected the incidence rates of DWG in the different branches of military service. Given the large number of person-years covered in the study, the authors believe this is unlikely to have had a major effect on the incidence of DWG. However, additional studies on health care use across the services would help to define this concern further. The lowest rate of DWG in the Marine Corps may exist because their semiannual fitness test differs from those of the other services, requiring pull-ups instead of push-ups. As a result, Marines may be less likely to perform push-ups routinely, which subjects the wrists to much greater strain than the tested pull-ups, possibly contributing to the lowered risk for the development of DWG that we observed.

A strengths of this study was its access to a large sample size from a comprehensive and geographically diverse database. This allowed us to define the exact patient population at risk during the study period and gave us the ability to extrapolate the incidence of DWG from a captured population. However, there are also inherent weaknesses and biases associated with any retrospective database analysis publication. Estimation of the incidence is based only on patients who were evaluated by a health care provider. As such, we are unable to capture data on patients who did not seek treatment. However, by using patients' first encounter with a relevant ICD-9 code, both surgically and nonsurgically treated ganglia were included in the incidence calculations. This differs from other studies that included only operative cases.[22] Moreover, we were unable to determine whether military patients were more or less likely to seek medical evaluation for the DWG compared with civilian patients. However, given the large number of person-years at risk during the study period, we think this is unlikely to have a notable effect on the incidence of DWG, because every individual (military or civilian) has a different threshold for seeking medical evaluation. Furthermore, we are unable to determine ganglia incidence as a direct measure of exposure to repetitive microtrauma. We assume that senior ranking military members have spent a longer time on active duty than junior ranking military members; thus, they would have had more exposure to repetitive microtrauma. We were also unable to account for exposure to occupational repetitive microtrauma in the civilian cohort.

In addition, the demographics of the dependent civilian patient population are not the same as those of true civilian populations, because the dependent population tends to be younger, with more women and a different distribution of racial groups. As such, we believed that patients aged less than 18 years or greater than 65 years should be removed from the civilian group for better comparison with the military population (age 18–65 years). However, this was not completed until after patients were sampled. There were no military patients outside this age range. Although in our opinion this allowed for the most accurate comparison, it is an additional limitation of the study**.** Despite this increased female population in the dependent civilian group, the military still had a higher incidence of DWG. Finally, despite the difference in the civilian population compared with the true civilian population, we think that this is the best current estimate of the incidence available, because previous studies did not compare using the scale of person-years at risk.

Dorsal wrist ganglia are a common presenting diagnosis in military and civilian populations. This study provides epidemiology data based on a large diverse population compared with previous studies of smaller cohorts or Level V evidence. We demonstrated an increased incidence of DWG in female populations and senior military members (both officer and enlisted). Further prospective studies are necessary to evaluate the true exposure-related risk for developing DWG through repetitive microtrauma.

Acknowledgments

The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Army, Department of Defense, or the US Government.

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