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# Genitourinary infections in Australian servicewomen

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## Abstract

**Background:** Genitourinary infections, including those associated with the urinary tract (urinary tract infection [UTI]) and vulvovaginal region, are common in women, affecting approximately one-third of biological females. A growing female military workforce necessitates consideration of their genitourinary health risks and needs to support and enhance their occupational health, safety, and performance.

**Method:** The pelvic health of active-duty servicewomen in the Australian Defense Force (ADF) was explored using an online cross-sectional survey. For the purposes of this study, only data related to genitourinary infections were extracted. The data were descriptively analysed to provide estimates of period prevalence rates. Risk factors and prevention and management strategies utilized were identified and described.

**Results:** Of the 491 servicewomen who provided survey responses, 41% (95% confidence interval [CI]: 37%–46%) reported experiencing at least one UTI and 32% (95% CI: 28%–36%) reported experiencing *regular* symptoms of vulvovaginal irritation during their last period of active-duty service. Service arm, length of service, and history of participation in field activities or deployment were not substantially associated with prevalence estimates. Medical assessment was the most common diagnostic strategy for UTI and antibiotics were the most common management strategy.

**Abbreviations:** 95% CI, 95% confidence interval; ADF, Australian Defense Force; NCO, Non-Commissioned Officer; UTI, urinary tract infection; VVI, vulvovaginal irritation; WO, Warrant Officer.

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**Conclusion:** Genitourinary infections are common in female ADF personnel and may impact on occupational health and performance. Therefore, organization-wide prevention and management approaches may be an important strategy for reducing the impact on personnel, their units and mission objectives, by reducing working days lost, utilization of health services and minimizing risks in more austere military environments.

**KEYWORDS**

management, military, urinary tract infection, vulvovaginal infection

## 1 | INTRODUCTION

In the general population, genitourinary infections are common and more prevalent in females than males.<sup>1</sup> Urinary tract infections (UTI) occur in over one-third of adult women,<sup>2,3</sup> and vulvovaginal infections, such as bacterial vaginosis, have an estimated prevalence of 23%–29%.<sup>4</sup> Increased susceptibility to genitourinary tract irritation and infection in females, when compared to males, is likely attributable to anatomical differences, such as the close proximity of the anus to the urethra and vulva, and short urethral length,<sup>5</sup> which make it easier for bacteria to infiltrate and multiply within these regions.

Consistent with general population statistics, genitourinary infections are common in female military personnel<sup>6</sup> and can impact on work performance and medical resource use.<sup>7,8</sup> Over a 14-year surveillance period (2000–2013), 30.4% of active duty female military personnel in the U.S. Armed Forces were reported to have had at least one UTI resulting in a medical encounter, compared with 3.5% of male personnel.<sup>8</sup> Recurrent UTIs were also more common in female personnel (12.5% females, 0.5% males),<sup>8</sup> with a history of UTI identified as a key risk factor for further diagnoses, particularly in deployed environments.<sup>9,10</sup> Moreover, in the U.S. Armed Forces UTIs were associated with a loss of 4981 work days/year and 2240 hospital bed days/year between 2000 and 2013.<sup>8</sup> Similarly, period prevalence of vulvovaginal infection whilst deployed was found to be 30.1% in a sample of active servicewomen in the U.S. Navy and Army.<sup>10</sup> An estimated incidence rate of 35.1 cases/1000 person-years was calculated for vulvovaginal infections during a 6-year surveillance period (2008–2013) of medical encounters in deployed U.S. servicewomen serving in Asia.<sup>11</sup> However, these rates of genitourinary infections may be underestimated given that many servicewomen self-manage or do not report genitourinary symptoms.<sup>9,10,12</sup>

Given the high prevalence of genitourinary infections in female military personnel, the ability to prevent and

manage symptoms and infections within occupational settings, particularly austere deployed settings, is important. Environmental (e.g., sanitation, climate), equipment (e.g., uniform fabric and design) and organizational (e.g., leadership, access to predeployment education) factors have all been identified to influence the behaviors servicewomen engage in to manage their genitourinary health, with the majority of studies focused on deployed settings.<sup>10,12–14</sup>

Whilst genitourinary infections have been shown to be common in servicewomen, most studies have been limited to the U.S. Armed Forces and as noted above, have strongly focused on the prevalence and experiences of servicewomen during deployment. Addressing the resulting gaps in knowledge, the aim of this study was to determine the prevalence, risk factors, and prevention and management approaches for genitourinary infections in women serving in the Australian Defense Force (ADF), being the Royal Australian Navy, Australian Army, and Royal Australian Air Force.

## 2 | METHOD

UTI and vulvovaginal irritation (VVI) were explored in this study as part of a large cross-sectional online survey exploring the pelvic health of female ADF personnel. An online survey was chosen because it was efficient and cost-effective to deliver to servicewomen regardless of where they were stationed or located on separating from the ADF. Ethics approvals for the study were received from the Human Research Ethics Committees of the Departments of Defense and Veterans' Affairs (099-19), Charles Sturt University (H19271), and Bond University (TCO1733).

Biological females (sex assigned at birth) aged 18 years and over who had actively served for at least 6 months in the ADF were eligible to participate in the survey. To promote safe and private access to information about the survey, as well as maintain respondent

anonymity and minimize risks of coercion to participate, a combination of print (ADF newspapers) and targeted social media advertisements (Facebook) were utilized for recruitment. Advertisements provided an online link to the participant information sheet on the survey landing page, with understanding and consent indicated by survey commencement. Survey data were collected between October 2019 and June 2020.

Due to the breadth of pelvic health issues to be explored within the study, the specific occupational context of the participants, and the research aims, a custom-made survey was developed by the research team (refer to O'Shea et al.,<sup>15</sup> for details regarding survey development). Whilst the full survey covered topics such as bladder and bowel health, reproductive health, pelvic pain and injury, as well as pelvic health risk factors, only the demographic data and findings related to UTI and VVI are reported here. In addition, data related to vulvovaginal symptoms, rather than infection, were collected in the survey as it has been reported that female military personnel can be reluctant to seek medical assessment, tend to self-manage symptoms, and may never have confirmation of vaginal infection.<sup>6,12</sup>

The descriptive analyses conducted to estimate and explore the survey response rate and demographic characteristics of respondents have been previously reported.<sup>15</sup> Data analysis for this report was focused primarily on determining measures of frequency and 95% confidence intervals (CI) for participant responses to relevant survey questions, descriptive analysis of reported symptoms and approaches to diagnosis and management of UTI.<sup>16</sup> Content analysis was utilized to explore text-based responses to questions regarding UTI and work performance.<sup>17</sup>

### 3 | RESULTS

A total of 491 out of 987 (49.7%) survey responses were available for the data analysis; the remaining 496 survey responses were incomplete and therefore removed. It was impossible to accurately determine the survey response rate, as there was no way of determining the proportion of the underlying population reached by survey advertising. Therefore, the representativeness of the cohort of servicewomen who participated in the survey was thoroughly explored against data available from the Australian Defense Census 2019<sup>18</sup> and Women in the ADF 2017–2018 report.<sup>19</sup> Respondents were found to be well matched to the underlying population, with full details regarding sample representativeness previously reported.<sup>15</sup> Additional demographic details of the survey cohort demonstrate that respondents had a wide range of

Service experience, were of varied ranks, and had actively participated in field and deployment opportunities (Table 1).

Within the survey 41% of respondents ( $n = 202/491$ , 95% CI: 37%–46%) reported having at least one UTI during their most recent period of active-duty service. Of those that had experienced a UTI, the majority ( $n = 166/202$ , 82%, 95% CI: 76%–87%) reported between 1 and 3

**TABLE 1** Demographic data for respondents, as an entire cohort and by current service status.<sup>15</sup>

Participant attributes	All respondents ( $n = 491$ )	Service status	
		Active duty ( $n = 299$ )	Veteran ( $n = 192$ )
Mean (range) age (years)	42 (19–78)	38 (19–63)	48 (20–78)
Service arm			
Navy	105 (22%)	62 (21%)	43 (22%)
Army	258 (53%)	144 (48%)	114 (59%)
Air Force	126 (26%)	91 (30%)	35 (18%)
Service years			
<10 years	191 (39%)	94 (31%)	97 (51%)
10–19 years	167 (34%)	112 (38%)	55 (29%)
>20 years	133 (27%)	93 (31%)	40 (21%)
Rank			
Commissioned officer	172 (35%)	138 (46%)	34 (18%)
NCO/WO <sup>a</sup>	167 (34%)	98 (33%)	69 (36%)
Other rank	142 (29%)	59 (20%)	83 (43%)
Cadet/trainee/recruit	10 (2%)	4 (1%)	6 (3%)
Participated in field activities	397 (81%)	241 (81%)	156 (81%)
Experienced deployment	342 (70%)	236 (79%)	106 (55%)
Other attributes (during service)			
Nulliparous	114 (23%)	78 (26%)	36 (19%)
Regular back/hip pain	315 (64%)	192 (64%)	123 (64%)
Overweight/obese	122 (25%)	79 (26%)	43 (22%)
Regular antibiotic use	59 (12%)	19 (6%)	40 (21%)
Smoker	61 (12%)	26 (9%)	35 (18%)

<sup>a</sup>NCO/WO: Non-commissioned officer/warrant officer.

UTI per year, and a smaller proportion reported more frequent episodes of UTI annually (4–12 episodes/year,  $n = 30$ , 15%, 95% CI: 11%–20%; >12 episodes/year,  $n = 6$ , 3%, 95% CI: 1%–6%). Symptoms of VVI such as itching, burning, discharge, dryness or odor were also *regularly* experienced by 32% ( $n = 157/491$ , 95% CI: 28%–36%) of respondents.

Figure 1 demonstrates the period prevalence rates of UTI and VVI in this cohort of Australian servicewomen during their most recent period of active-duty service, according to their Service arm, length of service, service and employment status, as well as whether they had previously participated in field activities and deployment. The figure demonstrates a similar pattern of prevalence of UTI and VVI across demographic categories.

Among female military personnel reporting UTI during their most recent period of military service, the majority ( $n = 169/200$ , 84.5%, 95% CI: 79%–89%) indicated that their first UTI occurred during service. Over 40% of women ( $n = 81/187$ , 95% CI: 36%–50%) reported that they experienced their first UTI over 20 years ago, 34% reported time since initial onset was less than 10 years, and 22% that initial onset occurred 10–19 years ago.

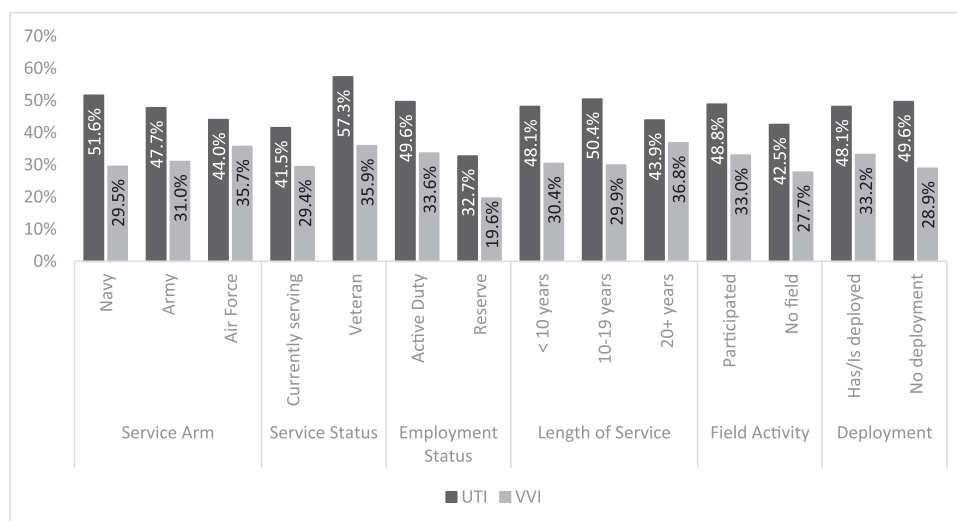
Nearly half the respondents who experienced UTIs during active-duty service also experienced regular vulvovaginal symptoms ( $n = 97/202$ , 48%, 95% CI: 41%–55%), compared with only 27% ( $n = 60/222$ , 95% CI: 21%–33%) of women who did not report UTIs. Respondents who smoked were more likely to report a history of UTI ( $n = 38/61$ , 62%, 95% CI: 50%–73%) than nonsmokers ( $n = 133/289$ , 46%, 95% CI: 40%–52%). Over two thirds of *regular* antibiotic users ( $n = 40/59$ , 68%, 95% CI: 55%–78%) had a history of UTI compared to non-*regular* antibiotic users ( $n = 162/365$ , 44%,

95% CI: 39%–50%), and one in two women ( $n = 160/314$ , 51%, 95% CI: 45%–56%) with *regular* back/hip pain reported a history of UTI compared with one-third of those without pain ( $n = 12/38$ , 32%, 95% CI: 19%–47%). No variations in UTI period prevalence rates were seen across categories of other variables such as age, weight status, menstrual pattern, and parity.

Regarding VVI, smokers were more likely to report symptoms ( $n = 33/61$ , 54%, 95% CI: 42%–66%) than nonsmokers ( $n = 110/290$ , 38%, 95% CI: 33%–44%), as were *regular* antibiotic users ( $n = 41/59$ , 70%, 95% CI: 57%–80%) when compared to those who were not ( $n = 116/432$ , 27%, 95% CI: 23%–31%). A substantial proportion of respondents with *regular* back/hip pain had experienced VVI ( $n = 137/315$ , 44%, 95% CI: 38%–49%), compared with only 11% ( $n = 20/176$ , 95% CI: 7%–17%) of those without or not reporting pain. Similar to UTI, respondent age, field activity, deployment history, and weight status were not observed to influence the period prevalence of *regular* VVI.

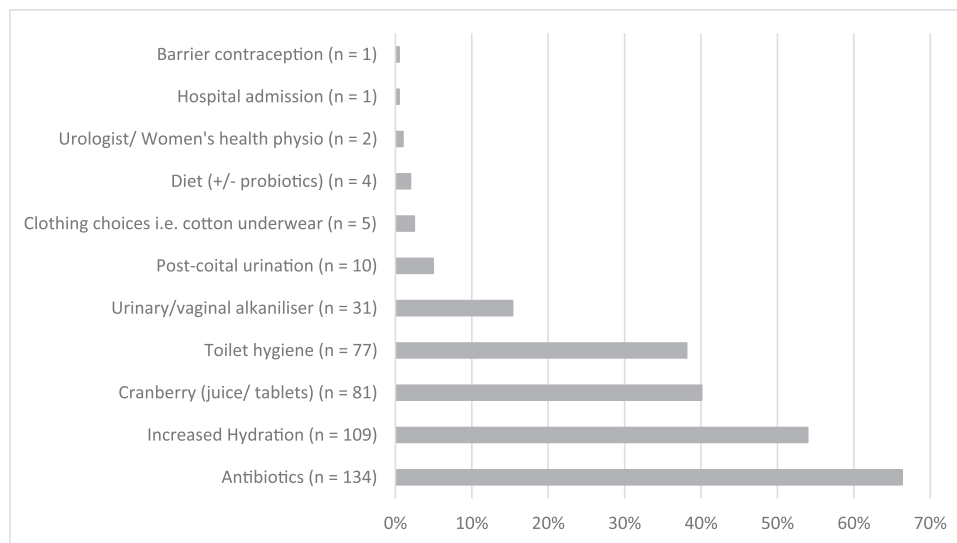
Medical assessment was the most commonly reported approach to diagnosis of UTI ( $n = 147/202$ , 73%), but self-testing kits were also used by a small number of women ( $n = 15/202$ , 7%). Antibiotics were the most common management strategy for UTI ( $n = 132/202$ , 65%), with Figure 2 showing all the UTI prevention and management strategies stated by respondents. Similar data for VVI were not available from the survey.

The influence of the ADF work environment and occupational roles on the ability of servicewomen to manage UTI was explored within the cohort. Small numbers of servicewomen reported that their work in the ADF had no impact on their ability to manage UTI



**FIGURE 1** Period-prevalence of UTI and VVI during most recent period of active-duty service (various demographic features). UTI, urinary tract infection; VVI, vulvovaginal irritation.





**FIGURE 2** UTI prevention and management strategies: listed percentages for servicewomen who reported UTI during active-duty service. UTI, urinary tract infection.

( $n = 27/202$ , 13.4%). Encouragement to take sick leave ( $n = 9$ , 4.5%), good self-management knowledge ( $n = 6$ , 3%), flexible work arrangements ( $n = 3$ , 1.5%), and good access to medical care ( $n = 3$ , 1.5%) facilitated the ability of some servicewomen to manage UTI at work. In contrast, reduced access to medical treatment ( $n = 37$ , 18.3%), toilets ( $n = 27$ , 13.4%), and sanitation ( $n = 20$ , 9.9%), particularly in the field or whilst deployed challenged servicewomen's ability to manage a UTI. A small number of servicewomen ( $n = 5$ , 2.5%) also highlighted reduced access to female bathroom facilities regardless of work environment. Other general barriers to UTI management at work included the demands of the occupational role (e.g., time/availability of other staff,  $n = 15$ , 7.4%), limited understanding within the workplace of female toileting needs ( $n = 6$ , 3%), stigma/speculation associated with UTI ( $n = 4$ , 2%), inability/discouragement to take sick leave ( $n = 4$ , 2%), uniform requirements (e.g., tight fitting, heavy fabrics,  $n = 4$ , 2%), attitude of getting on with duties despite symptoms ( $n = 3$ , 1.5%), inability to maintain hydration ( $n = 3$ , 1.5%), and associated work stress ( $n = 3$ , 1.5%). Similar data were not available from the survey regarding factors influencing management of VVI.

## 4 | DISCUSSION

This study is the first to explore the prevalence, possible risk factors, and impacts of genitourinary infections in a cohort of Australian servicewomen. The prevalence rates of UTI and VVI reported in this study are slightly higher than those reported for the general population<sup>3,4</sup> and by the U.S. Armed

Forces for UTI (41% ADF vs. 30.4% U.S. Armed Forces).<sup>8</sup> However, variations were expected due to differences in the methods and contexts of data collection in each of these studies. Compared with the self-reported data in this study, lower prevalence rates were found when medical encounter surveillance data was used in the U.S. military study,<sup>8</sup> which would be expected given that not all servicewomen will choose to seek or have had access to medical care in some contexts.<sup>6,9,10,14,20</sup> In addition, previous studies have also focused on prevalence in defined time periods, such as periods of deployment.<sup>21</sup> Regardless, the available evidence consistently highlights that genitourinary infections are common in servicewomen, affecting at least one-third during active-duty service, thus warranting consideration of prevention and management strategies. Furthermore, the requirement for ongoing care and management must be considered for these personnel on leaving the military and re-entering the community as veterans.

Other than being biologically female, the general risk factors previously identified in the literature for genitourinary infections include previous genitourinary infection, sexual intercourse, use of condoms/spermicide, compromised immune status, genetic predisposition, trauma, diabetes, and obesity.<sup>5,10</sup> Within military occupations, field and operational environments have been postulated to increase the risks for servicewomen.<sup>7,10,12,20,21</sup> The findings of this study support previous genitourinary tract infection as a risk factor for future infections. However, no relationship appeared to be evident between participation in field activities or history of deployment and genitourinary infection in this study, despite both being associated with more challenging environmental conditions. Similarly, surveillance data from the U.S. Armed Forces found rates

of UTI were 26%–55% higher in nondeployed women over a 6-year surveillance period.<sup>9</sup> These findings challenge the notion that genitourinary infections are only of concern for servicewomen when they participate in field exercises or are on operations, or that these military environments (being field and deployment) are the main risk factor for these infections in servicewomen.

However, the austere nature of field and deployed settings do represent challenging environments for servicewomen to maintain and manage their genitourinary health.<sup>10,12,20,21</sup> The ability to maintain hygiene with limited facilities and poor sanitation, harsh environmental conditions, high levels of physical and psychological stress, and organizational factors, such as access to medical services and predeployment education, have all been hypothesized to increase the risks of genitourinary infections during deployment for servicewomen.<sup>7,10,12,20,21</sup> The findings of this survey of ADF personnel corroborate the experiences of other servicewomen, that specific operational settings present additional challenges for maintaining and managing genitourinary health. Despite these challenges, previous genitourinary infection in nondeployed settings still appears to be a primary risk factor for infection during deployment, with over half the U.S. servicewomen diagnosed with a UTI while deployed (from 2008 to 2013) having had at least one medical encounter for UTI before deployment, and 29% having recurrent UTIs in the nondeployed setting.<sup>9</sup> These findings suggest that prevention and management of female genitourinary infections in the nondeployed setting may be an important strategy for minimizing the risks during more exigent military environments.

Australian servicewomen identified a range of factors affecting their ability to maintain and manage their genitourinary health at work. Organizational factors have the capacity to be both facilitators and barriers to genitourinary health management for servicewomen. Knowledge of female pelvic health needs, access to appropriate health services, as well as flexible work and leave arrangements were identified as being valued to support management of genitourinary health issues, whereas specific features of occupational roles, availability of covering staff, limited time and stigma were all reported to be barriers. Similar themes have been reported in studies of deployed female personnel in the U.S. Armed Forces, particularly features of organizational culture that may influence servicewomen's trust and their subsequent health care behaviors.<sup>12</sup>

Investing in organizational approaches for the prevention and effective management of genitourinary infections in servicewomen may help to reduce the burden of these conditions on women and military health services,<sup>22</sup> and enhance occupational readiness

and performance in a wide variety of military settings. A predeployment women's health education program was found to be well-accepted and effective at reducing diagnoses of genitourinary infections,<sup>22</sup> and self-diagnosis and management kits have been reported to be a discreet, efficient, and user-friendly option for diagnosis and early management of UTI in deployed settings.<sup>23</sup> Additional education and training of military medics,<sup>14</sup> commanding officers,<sup>21</sup> and servicewomen<sup>7</sup> regarding common female genitourinary health issues and management has also been recommended to promote a culture of understanding and access to timely and relevant support. Equitable access across the Defense organization and sustainable approaches to education, training, and resources also need to be considered and evaluated.<sup>22</sup> However, this study did not collect specific data on Australian servicewomen's knowledge of genitourinary health and their access to, or understanding of, available management options within the ADF.

A consistent, system-wide military health approach to the prevention and management of servicewomen's health issues, such as genitourinary health, may be beneficial within the ADF. Medical assessment processes regarding genitourinary health (i.e., urine testing) already exist to inform recruitment of female candidates,<sup>24</sup> suggesting that prior genitourinary health history is considered when determining medical fitness for service. However, in the experience of one of the authors (NG), no specific or standardized genitourinary health screening process is outlined at periodic, predeployment, or separation health assessments. Therefore, discussion about these issues is most likely to occur if they are disclosed by the member or happened to be identified in an audit of the medical file. Given the high prevalence of genitourinary symptoms in female personnel, and the threat these conditions may pose to occupational health and performance, if no standardized screening procedures exist, their inclusion in routine health assessments could be an initial starting point for prevention and management.

Smoking history, *regular* antibiotic use, and frequent back/hip pain were attributes of ADF servicewomen in this study associated with genitourinary infection. Smoking and *regular* antibiotic use may influence immune status and vulvovaginal flora, which in turn may increase susceptibility to infection.<sup>1,5</sup> A higher proportion of women who identified as veterans at the time of survey and who experienced genitourinary infections, also reported being smokers and *regular* antibiotic users during their last period of active-duty service. These findings are likely to demonstrate historical societal shifts in knowledge and behaviors around smoking<sup>25</sup> and antibiotic use,<sup>26,27</sup> but may also support a

relationship between these behaviors and risk of genitourinary infection.<sup>1,28</sup> However, findings related to smoking history and antibiotic use need to be interpreted with caution given the small number of survey respondents, the proportion of those respondents identifying as smokers and antibiotic users, and recall bias. In addition, *regular* antibiotic use may also be related to treatment for recurrent genitourinary infections.<sup>1</sup> Regular back/hip pain were common symptoms for female servicewomen during active-duty service.<sup>15</sup> It is unclear whether pain is a risk factor for genitourinary infection or whether it is a resultant symptom. Due to the broad scope of the pelvic health survey, the nature of these relationships cannot be determined, but warrant further investigation.

The current study provides useful insights into the prevalence, possible risk factors, and approaches to management of genitourinary infections in a cohort of Australian servicewomen. However, it is important to acknowledge the potential impact of cross-sectional survey design, use of self-reported symptom data, and recall bias on the findings.<sup>15</sup> The pelvic health survey was also broad and not focused specifically on genitourinary symptoms; therefore, limiting the ability to provide specific prevalence data related to single and recurrent episodes of genitourinary infection, more precise risk factor analysis, and greater exploration of VVI. The length and breadth of the survey may have further contributed to nonresponse bias, given data from a substantial number of incomplete surveys needed to be excluded. Finally, a nonprobability sampling approach may limit the generalizability of the findings to the broader population of Australian servicewomen, particularly as, based on estimates that there were 48 000 Australian servicewomen and female veterans at the time of the survey,<sup>18,29</sup> it was determined that approximately 1% of this underlying population participated in the survey.

## 5 | CONCLUSION

Genitourinary symptoms and infections are likely to be common in female ADF personnel, affecting over one-third of survey respondents in this study during active-duty service. These findings are consistent with data from the U.S. Armed Forces. Whilst Service arm, service status, and history of participation in field activities or deployment were not found to be associated with the prevalence of genitourinary symptoms in this cohort, a prior history of genitourinary infection is a notable risk factor. Therefore, to further optimize the occupational health and performance of ADF servicewomen and their retention, prevention and management of female genitourinary health issues in the nondeployed setting may be an important strategy, potentially reducing working days

lost and minimizing the risks when in more austere military environments.

## AUTHOR CONTRIBUTIONS

**Simone D. O'Shea:** responsible for research concept and design, survey development, data collection and analysis, and drafting and revising the manuscript. **Rod Pope:** contributed to research design, data interpretation and editing the manuscript. **Katharine Freire:** contributed to data analysis and editing the manuscript. **Robin Orr:** contributed to editing the manuscript. **Naomi Gallagher Maj:** responsible for reviewing pelvic health survey and manuscript for contextual relevance. All authors read and approved the final manuscript.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interests.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions. The dataset generated and analysed during the current study is not publicly available without permission from the ADF.

## ETHICS STATEMENT

Approvals for the study were received from the Human Research Ethics Committees of the Departments of Defense and Veterans' Affairs (099-19), Charles Sturt University (H19271), and Bond University (TCO1733).

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## REFERENCES

- Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol*. 2015;13(5):269-284. doi:10.1038/nrmicro3432
- Butler CC, Hawking MK, Quigley A, McNulty CA. Incidence, severity, help seeking, and management of uncomplicated urinary tract infection: a population-based survey. *Br J Gen Pract*. 2015;65(639):e702-e707. doi:10.3399/bjgp15x686965
- Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. *Ther Adv Urol*. 2019;11:175628721983217. doi:10.1177/1756287219832172
- Peebles K, Velloza J, Balkus JE, McClelland RS, Barnabas RV. High global burden and costs of bacterial vaginosis: a systematic review and meta-analysis. *Sex Transm Dis*. 2019;46(5):304-311. doi:10.1097/olq.0000000000000972
- Foxman B. Urinary tract infection syndromes. *Infect Dis Clin North Am*. 2014;28(1):1-13. doi:10.1016/j.idc.2013.09.003
- Kostas-Polston EA, Braun LA, Miedema J. Female warfighters' perceptions of urogenital health in operational settings. *J Am Assoc Nurse Pract*. 2020;32(11):729-737. doi:10.1097/JXX.0000000000000534
- Foster GA, Alviar A. Military women's health while deployed: feminine hygiene and health in austere environments. *Federal Practitioner*. 2013;30:9-13.
- Armed Forces Health Surveillance Center (AFHSC). Urinary tract infections, active component, U.S. Armed Forces, 2000-2013. *MSMR*. 2014;21(2):7-11.
- Armed Forces Health Surveillance Center (AFHSC). Urinary tract infections during deployment, active component, U.S. Armed Forces, 2008-2013. *MSMR*. 2014;21(3):2-5.
- Lowe NK, Ryan-Wenger NA. Military women's risk factors for and symptoms of genitourinary infections during deployment. *Mil Med*. 2003;168(7):569-574.
- Armed Forces Health Surveillance Center (AFHSC). Vaginal yeast infections while deployed in Southwest/Central Asia, active component females, U.S. Armed Forces, 2008-2013. *MSMR*. 2014;21(8):13-15.
- Wilson C, Nelson JP. Exploring the patterns, practices, and experiences of military women who managed genitourinary symptoms in deployed settings. *J Obstet Gynecol Neonatal Nurs*. 2012;41(2):293-302. doi:10.1111/j.1552-6909.2012.01347.x
- Steele N, Yoder LH. Military women's urinary patterns, practices, and complications in deployment settings. *Urol Nurs*. 2013;33(2):61-78. doi:10.7257/1053-816X.2013.33.2.61
- Wilson C, Corrigan R, Reese S, Almonte A, Simpson D, Wilson A. Military medics' insight into providing women's health care in deployed settings. *Mil Med*. 2016;181(11):e1608-e1614. doi:10.7205/MILMED-D-15-00480
- O'Shea SD, Pope R, Freire K, Orr R. Prevalence of lower urinary tract symptoms in a cohort of Australian servicewomen and female veterans. *Int Urogynecol J*. 2023;34(4):885-896. doi:10.1007/s00192-022-05254-x
- Rea LM, Parker RA. Designing and Conducting Survey Research: A Comprehensive Guide. 4th Edition ed: Jossey-Base, an imprint of Wiley; 2014.
- Drisko JW, Maschi T, Drisko J, Maschi T. 2 Basic Content Analysis. *Content Analysis*. Oxford University Press; 2015:21-56. doi:10.1093/acprof:oso/9780190215491.001.0001
- Department of Defence. *Defence Census 2019: public report*. 2020. ISBN: 978-1-925890-35-8. <https://www1.defence.gov.au/about/census>
- Defence People Group. *Women in the ADF report 2017 - 2018: A supplement to the Defence Annual Report 2017-2018*. 2019. Accessed October 2, 2019. <https://www.defence.gov.au/sites/default/files/2021-10/AR-2017-18.pdf>
- Doherty ME, Scannell-Desch E. Women's health and hygiene experiences during deployment to the Iraq and Afghanistan wars, 2003 through 2010. *J Midwifery Womens Health*. 2012;57(2):172-177. doi:10.1111/j.1542-2011.2011.00115.x
- Czerwinski BS, Wardell DW, Yoder LH, et al. Variations in feminine hygiene practices of military women in deployed and noncombat environments. *Mil Med*. 2001;166(2):152-158.
- Trego LL, Steele NM, Jordan P. Using the RE-AIM model of health promotion to implement a Military Women's Health Promotion Program for Austere settings. *Mil Med*. 2018;183:538-546. doi:10.1093/milmed/usx230
- Ryan-Wenger NA, Lowe NK. Evaluation of training methods required for military women's accurate use of a self-diagnosis and self-treatment kit for vaginal and urinary symptoms. *Mil Med*. 2015;180(5):559-564. doi:10.7205/MILMED-D-14-00324
- Defence Force Recruiting Medical Assessment Process. 2022. <https://www.defencejobs.gov.au/joining/how-to-join/recruitment-process>
- Australian Institute of Health and Welfare (AIHW). *National Drug Strategy Household Survey 2019*. Vol. Drug Statistics series no. 32. 2020. <https://www.aihw.gov.au/reports/illicit-use-of-drugs/national-drug-strategy-household-survey-2019/contents/summary>
- Glasziou P, Dartnell J, Biezen R, Morgan M, Manski-Nankervis JA. Antibiotic stewardship: a review of successful, evidence-based primary care strategies. *Aust J Gen Pract*. 2022;51(1/2):15-20.
- Hawkins O, Scott AM, Montgomery A, et al. Comparing public attitudes, knowledge, beliefs and behaviours towards antibiotics and antimicrobial resistance in Australia, United Kingdom, and Sweden (2010-2021): a systematic review, meta-analysis, and comparative policy analysis. *PLoS One*. 2022;17(1):e0261917. doi:10.1371/journal.pone.0261917
- Nelson TM, Borgogna JC, Michalek RD, et al. Cigarette smoking is associated with an altered vaginal tract metabolomic profile. *Sci Rep*. 2018;8(1):852. doi:10.1038/s41598-017-14943-3
- Australian Institute of Health and Welfare (AIHW). *National suicide monitoring of serving and ex-serving Australian Defence Force personnel: 2020 update*. 2020. <https://www.aihw.gov.au/reports/veterans/national-suicide-monitoring-adf-2020/report-editions>

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