

# **The Health and Well-being of Military Drone Operators and Intelligence Analysts: A Systematic Review**

Cherie Armour, Ph.D.

Jana Ross, MSc

[Both authors are affiliated with the](#) Psychology Research Institute, Ulster University,  
Cromore Rd, Coleraine, Northern Ireland, BT52 1SA, United Kingdom

Corresponding author:

Cherie Armour, Psychology Research Institute, Ulster University, Cromore Rd, Coleraine,  
Northern Ireland, BT52 1SA, United Kingdom, [armour.cherie@gmail.com](mailto:armour.cherie@gmail.com), Tel: (0044)  
02870123374

**\*\*\*Confidential draft – revised and resubmitted to Military Psychology\*\*\***

### **Abstract**

Objectives: The aim of this study was to systematically review the existing research on the health and well-being of military drone operators and intelligence analysts in order to provide an overview of research and identify gaps in this area. Methods: Six literature databases and two databases containing unclassified military reports were searched for relevant papers produced between January 1996 to May 2016. The search criteria were broad to allow for the identification of all relevant studies on the topic. Results: Fifteen studies met the inclusion criteria; all of which were conducted in the U.S. with the U.S. Air Force personnel. The main sources of occupational stress reported by participants across the studies were operational. The rates of mental health diagnoses, including PTSD, were low, but levels of psychological distress were higher in drone and intelligence operators than in comparison groups. Fatigue emerged as a significant concern. Conclusions: It is important that future studies examine a variety of mental and physical health outcomes. The health and well-being of drone operators and intelligence analysts should be studied not just in the U.S., but also in other countries that are using drones for military purposes.

Keywords: Systematic review, Military, Drone, Unmanned aerial vehicles, Health

## **Introduction**

Unmanned aerial vehicles (UAVs), commonly referred to as drones or remotely piloted aircraft (RPA) have a long history in the military (Keane & Carr, 2003). The first Air Force drone was used for tactical reconnaissance during the Vietnam War (U.S. Air Force, 2005), however, the use of drones has only proliferated recently, when their effectiveness, enabled by advancements in technology, was verified in the conflicts in Iraq, Afghanistan, and Kosovo (Bone & Bolkom, 2003). Indeed, it was not until 2002 when the first drone was modified to deliver lethal payloads (Gertler, 2012). According to the U.S. Department of Defence, drones are powered aerial vehicles that use aerodynamic forces to provide lift, they either fly autonomously, or are piloted remotely; they are expendable or recoverable and are used for surveillance or direct combat in which case they carry a lethal payload (Bone & Bolkom, 2003). Drones represent an important source of military intelligence and with their ability to target enemy combatants from a great distance they provide critical support to ground troop operations. The two main advantages of drones over manned aircraft are their cheaper procurement and operation and the elimination of the risk to a pilot's life (Bone & Bolkom, 2003; Gertler, 2012). Indeed, drone operators are considered to be "deployed in garrison" as they are usually based at a ground control station within their nation's borders and thus participate in the combat or surveillance mission from a significant distance through computer monitors. In a technical report on U.S. Unmanned aerial systems prepared for the U.S. Congress, Gertler (2012) reported that between the years of 2002 and 2010, the number of UAVs in the Department of Defence's inventory increased from 167 to almost 7,500, highlighting the increased popularity of this modern warfare technology. It is estimated that over 30 countries are now in possession of drones (Cole, 2012), with more countries being added to the list every year (Cole, 2015).

## SR of military drone operators

The drone ground crew consists of a small number of people and can vary depending on the type of drone and the type of mission (Asaro, 2013). In recent years, the MQ-1 Predator and MQ-9 Reaper have garnered the most media attention and have been very popular with the military (U.S. Air Force, 2005) due to their ability to carry out surveillance, reconnaissance, target acquisition, precision strike and force protection operations (Gertler, 2012). The predator/reaper ground crew normally consists of 1) the pilot who controls the aircraft, 2) the sensor operator who operates the cameras, radars, and sensors to gather intelligence, but who is also responsible for targeting and missile guidance, and 3) the mission intelligence coordinator who communicates and relays important information to and from other intelligence analysts and those in command (Chappelle, McDonald, & King, 2010).

Given the need to provide 24/7 combat support and surveillance, the work of drone operators requires long hours of heightened vigilance as well as exposure to high-definition combat-related imagery. Anecdotal reports have suggested two major sources of stress in drone operators that are not present in manned aircraft pilots (Singer, 2009). First, being deployed in garrison, drone operators can be said to “commute to battlefield” every day, having to juggle their military duties with their personal and domestic lives. Second, through surveillance of enemies in high definition videos over extended periods of time, drone operators become familiar with the daily routines of their potential targets and are required to survey the targets after attacking them to ensure that the destruction was completed (Singer, 2009). In contrast, the manned aircraft pilots rarely know their enemies and after firing the missiles, they do not linger behind to survey the aftermath of the attack. Hence, even though the drone operators are physically remote from their targets, they can be said to be very close to them psychologically (Fitzsimmons & Sangha, 2010).

More rigorous research in the area of mental health and well-being of military drone operators is, however, needed. A plethora of research has been conducted on the effects of exposure to combat on mental health in deployed personnel (e.g., Bray et al., 2010; Karstoft, Armour, Elklit, & Solomon, 2013; Karstoft, Armour, Elklit, & Solomon, 2015; Seal, Bertenthal, Miner, Sen, & Marmar, 2007), suggesting that the rates of behavioural and mental health problems in this population are high. It has also been found that media exposure to traumatic images can lead to elevations in posttraumatic stress disorder (PTSD; Silver et al., 2013). Indeed, the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013) recognizes exposure to traumatic events through electronic media as a qualifying trauma for PTSD as long as the exposure is work-related; as is the case for drone crews. Considering the ability of the MQ-1 Predator and MQ-9 Reaper to drop hellfire missiles and destroy enemy combatants as well as their ability to gather high-definition visual imagery of the attack, it is possible that the drone crew members would suffer from elevated rates of PTSD and other trauma-related symptomatology. As mentioned above, studies examining the psychological problems in drone operators and intelligence exploitation operators, who frequently analyse the data gathered by these drones, have started to emerge.

The current study aimed to both systematically review the existing literature on this topic in order to provide a comprehensive summary of the research and to identify gaps in the literature in order to direct future research. To the best of our knowledge, this is the first systematic review of the mental health and well-being of drone operators and intelligence exploitation personnel.

### **Method**

Given the scarcity of studies in this area, which is a likely result of the restricted access to the population of interest, the inclusion criteria were broad; all empirical studies

## SR of military drone operators

relevant to the topic were included if they examined the physical or mental health of the military drone operators, including the pilots, sensor operators, and mission intelligence coordinators. Studies examining the health and well-being of imagery analysts and other intelligence exploitation operators involved in analysing the real-time imagery from the war zone were also included as their work directly impacts on the decision-making of the drone operators regarding the elimination of enemy combatants (Prince et al., 2015). Additionally, to be included, studies had to be peer-reviewed journal articles, official technical reports, or conference papers produced between January 1996 and 14<sup>th</sup> May 2016 when the literature search was conducted. Since the drones were only adapted to deliver payloads in 2002 (Gertler, 2012), we decided to review the literature from the last 20 years. Studies assessing situational stress in drone operators under experimental conditions were excluded.

In the first step, the following six literature databases were searched: Embase, Pilots, PsycInfo, Pubmed, Scopus and Web of Science (Core collection). Wherever possible, we searched keywords, titles and abstracts for words and phrases relevant to and representing: 1) drones, UAVs, imagery analysts, AND 2) military, air force, navy, combat, war, AND 3) health, well-being, illness, PTSD, anxiety. A number of synonyms and related concepts were included for each one of the three categories. The initial search returned 534 hits. After removing the duplicates ( $n = 154$ ), 380 references were left for the review of titles and abstracts. Of these, 365 did not meet the inclusion criteria and/or the aims of the review and were removed. The full texts of the remaining 15 articles were retrieved and reviewed in full. Eight of these met the inclusion criteria and 7 were removed.

At the second step, we hand searched the reference lists of the relevant papers and identified a further 5 articles that met the inclusion criteria. No additional articles were identified from the reference lists of the 5 new papers. At the third step, we searched the technical reports in the database of the Defense Technical Information Center on the U.S.

## SR of military drone operators

Department of Defense website using the terms 'health' AND 'drone'. There were 667 technical reports from January 1996 onwards available on the website. Disregarding the duplicate items, one of these reports met the inclusion criteria. Hand searching of UK technical reports available since 2009 on the Defence Science and Technology Laboratory website (funded by the UK Ministry of Defence) did not identify any relevant papers. At this stage, one additional paper that did not come up through the searches was highlighted to us by colleagues and included. Altogether, 15 articles were included in the review. Wherever a journal article was based on a technical report, the journal article was selected over the technical report for inclusion. Table 1 lists the included articles which from herein will be referred to by numbers. Due to the heterogeneous nature of the studies, a narrative synthesis was preferred over a meta-analysis.

\*\*\*Please insert Table 1 here\*\*\*

## Results

All 15 studies were cross-sectional and conducted in the U.S., sampling U.S. Air Force (USAF) personnel. The majority were conducted specifically with the predator/reaper drone operators (1, 2, 3, 4, 6, 7, 9, 13, 14, 15), one was conducted with RPA pilots in general (8) and four were conducted with intelligence exploitation operators (5, 10, 11, 12). A number of studies included comparison groups of non-combatant airmen, non-missile-deploying Global Hawk operators, manned aircraft pilots and maintenance personnel, RPA maintenance personnel or non-intelligence support personnel (See Table 1). One study (13) utilized external reference groups from previously conducted studies. A few studies were based on the results of a survey administered to the same sample of drone operators (1, 2, 3, 7) and two were follow-up studies designed to specifically assess the impact of the changes in shift work schedule (14, 15) and changes in mental health (3, 4) over time, although both were cross-sectional in design.

SR of military drone operators

### ***Sources of occupational stress (6 studies)***

Four studies (3, 4, 6, 9) examined self-reported sources of occupational stress in predator/reaper operators and two studies (10, 11) examined these in the intelligence exploitation operators. The most frequently reported occupational stressors are listed in Table 2. Interestingly, the top sources of occupational stress in the two groups were operational rather than combat-related.

\*\*\*Please insert Table 2 here\*\*\*

### ***Indirect trauma exposure (1 study)***

One study (10), conducted with intelligence exploitation operators, examined indirect trauma exposure in their participants. Assessed with the Vicarious Combat Exposure Scale, 12.9% of the intelligence exploitation group reported high combat exposure, compared to 2.2% of the non-intelligence support group. Moderate exposure was reported by 39% of intelligence operators and 20% of non-intelligence support personnel. Overall, the intelligence exploitation group scored significantly higher.

### ***Any mental health diagnoses (1 study)***

One study (8) investigated the incidence rates of mental health diagnoses according to the ninth edition of the International Classification of Diseases (ICD-9) and mental health counselling problems, such as suicidal ideation, relationship problems and others, in a sample of RPA pilots (including attack, generalist, reconnaissance, and special operations pilots). Retrospective examination of the electronic health care records revealed that 8.2% of the RPA pilots, compared to 6.0% of the manned aircraft pilots had at least one mental health outcome since the start of their RPA career (or the start of last deployment for manned aircraft pilots). This difference was not significant. The most common mental health outcomes in both groups were adjustment disorders, depressive disorders, relationship

## SR of military drone operators

problems, and life circumstances requiring counselling. Interestingly, the authors reported that the two groups of pilots had the lowest incidence rates for any mental health outcome in the whole USAF.

### ***PTSD (6 studies)***

Six studies examined the symptoms of PTSD, all using the PTSD Checklist-Military version (PCL-M). Two of these (1, 3) used the same sample of participants and will therefore be considered as one (1/3). Two samples (1/3, 4) consisted of predator/reaper operators. One study (1/3) was a replication of another (4) to examine changes in PTSD symptoms in this population over a period of two years, although the number of participants was different across the two studies. The earlier study compared levels of PTSD in predator/reaper operators with those in the non-combatant airmen and found that predator/reaper operators were significantly more likely to score above the clinical cut-off for PTSD than the latter group (5% vs. 2%). This was especially true for individuals who were enlisted, under the age of 25, working swing or night shifts, and working over 50 hours per week with time on station for less than 24 months. The later study (1/3) utilized a larger sample and found that 1.6% of predator/reaper operators scored above the clinical cut-off for probable PTSD. Significant risk factors for clinical levels of PTSD in this study included working over 50 hours per week with time on station of more than 24 months.

Three studies (10, 11, 12) were conducted with intelligence exploitation operators. In the first study (10), the intelligence operators were no more or less likely to score above the cut-off for clinical levels of PTSD than the non-intelligence support personnel or non-combatant airmen (1.6% vs. 2.9% vs. 2.3%). However, in the later study (11) utilizing a larger sample, intelligence operators were significantly more likely than the non-intelligence support personnel to score above the clinical cut-off (2.5% vs. 2.1%). The only significant risk factor for PTSD among the intelligence exploitation operators in this later study was time

## SR of military drone operators

on station for over 24 months. In a sample of imagery analysts (12), 2.0% of participants scored above the clinical cut-off on PCL-M. Based on the DSM-IV diagnostic algorithm, 4.2% had probable PTSD. Significant risk factors for elevated levels of PTSD in this participant group were shift work, rotating shift schedule, and working over 50 hours per week.

### ***Occupational burnout (4 studies)***

Four studies (2, 6, 9, 10) used the Maslach Burnout Inventory-General Survey (MBI-GSs) to examine levels of occupational burnout. MBI-GS measures three facets of occupational burnout: emotional exhaustion (i.e., fatigue), cynicism (i.e., indifference and negative work attitude), and professional efficacy (i.e., sense of accomplishment in one's occupation). Three studies (2, 6, 9) used samples consisting of predator/reaper operators with one study (2) comparing occupational burnout across three different major commands (Air Combat command, Air Force Special Operations command, Air National Guard) and another study (9) comparing occupational burnout across active duty and reserve predator/reaper operators. Across the six samples from the three studies between 14% - 33% of participants scored above the clinical cut-off for emotional exhaustion, 7% - 17% scored above the clinical cut-off for cynicism and 0% - 6% scored below the clinical cut-off for professional efficacy.

One study (6) compared the levels of occupational burnout in predator/reaper operators, Global Hawk operators and non-combatant airmen. Predator/reaper operators scored significantly lower on emotional exhaustion than Global Hawk operators but significantly higher than non-combatant airmen. On cynicism, they scored significantly lower than both the Global Hawk operators and the non-combatant airmen. On professional efficacy, they scored significantly higher than the non-combatant airmen. In the Global Hawk

## SR of military drone operators

operators (6), 33% had clinical levels of emotional exhaustion, 20.8% scored above the cut-off for cynicism and 4.6% scored below the cut-off for professional efficacy.

Two predator/reaper operator studies (2, 6) examined the risk factors for the three components of occupational burnout. The examined risk factors differed across the two studies, making it difficult to draw any definitive conclusions. Nevertheless, the risk factors for clinical levels of emotional exhaustion included working swing/night shifts, working over 50 hours per week, serving in the current position for over 24 months (2), high levels of stress, poor quality and quantity of sleep, working in a supervisory position, perceiving job duties as very/extremely difficult, and perceiving shift work as having a moderate/large impact on one's occupational stress (6). Interestingly, one study (2) found the officer status to be a significant risk factor, whereas the other one (6) found the enlisted status to be a significant risk factor. Significant risk factors for high levels of cynicism were age group 26-30, working in the current position for over 24 months (2), high levels of stress, poor sleep quality and quantity, and perceiving shift work as having a moderate/large impact on one's occupational stress (6). As before, officer status was a significant risk factor for high levels of cynicism in one study (2), whereas the enlisted status was a significant risk factor in the other study (5). Low professional efficacy was predicted only by the officer status (2).

One study (10) examined occupational burnout in intelligence exploitation operators and found that 26.6% scored above the clinical cut-off for emotional exhaustion, 20.8% scored above the cut-off for cynicism and 5.9% scored below the cut-off for professional efficacy. The intelligence exploitation operators scored significantly higher than the non-exploitation support personnel and non-combatant airmen on emotional exhaustion and cynicism, but no significant differences were found in professional efficacy. In the intelligence exploitation group, significant risk factors for high emotional exhaustion included working swing/night shifts, working over 50 hours per week, inadequate sleep and

SR of military drone operators

high levels of vicarious combat exposure. Significant risk factors for high levels of cynicism included working night shifts.

### ***Fatigue (3 studies)***

Three studies (13, 14, 15) examined fatigue in predator/reaper operators, using a number of standardized measures including the Fatigue Scale, Fatigue Assessment Scale, Checklist Individual Strength Concentration Subscale, the World Health Organization Quality of Life Assessment Energy and Fatigue Subscale, and the Maslach Burnout Inventory Emotional Exhaustion Subscale. One study (14) additionally utilized the Epworth Sleepiness Scale. In one study (13) the predator crew members scored significantly higher on four out of five fatigue measures than an external reference group of Airborne warning and control system (AWACS) aircrew. This reference group was selected with the aim of reducing potential confounding based on differences in crew composition (e.g., operations tempo, mission type and duration). Moreover, 53.6% of predator crew members and 6.8% of the reference group met the DSM-IV (APA, 1994) criteria for shift work sleep disorder (SWSD). The likelihood of meeting the criteria for SWSD was not affected by type of shift or shift rotation schedule. Moreover, the levels of fatigue in predator crew members were similar and not significantly different across all shift patterns and shift rotation schedules.

In another study (15), levels of fatigue were found to be significantly higher in predator crew members and maintenance personnel than the manned aircraft crew members and maintenance personnel. In a replication of this study (14), conducted a year later and after a modification of the shift work schedule was introduced, it was found that the modified shifts had no effect on the levels of fatigue in predator/reaper operators, who scored higher on all fatigue measures than the AWACS reference group. It was also found that the fatigue levels were positively associated with the number of months involved in shift work, inadequate time for life activities and poor sleep quality. Of note, 40% of predator/reaper

## SR of military drone operators

operators reported that they were moderately or highly likely to fall asleep whilst on duty and 51.5% scored above the cut-off of 10 on the Epworth Sleepiness Scale, a measure of daytime sleepiness (14).

### ***Psychological distress (4 studies)***

Four studies (3, 4, 10, 11) examined psychological distress using the Outcome Questionnaire 45.2. Two of these utilized samples of predator/reaper operators (3, 4). In the earlier study (4), 20% of predator/reaper operators and 11% of non-combatant airmen scored above the clinical cut-off of 63 for psychological distress. Two years later in a replication of this study utilizing a larger sample (3), only 11% of predator/reaper operators scored above the cut-off (reference group was not used). There was only one consistent risk factor for high psychological distress across both studies: working over 50 hours a week. Other significant risk factors included being under 25 years old (4), working swing/night shifts and working in the current position for over 24 months (3).

Two other studies (10, 11) examined psychological distress in intelligence exploitation personnel. Between 14.4% - 16.1% scored above the clinical cut-off for psychological distress and they were significantly more likely to score above the cut-off than the comparison groups of non-exploitation support personnel or non-combatant airmen (10, 11). Intelligence exploitation operators scored significantly higher than the other two comparison groups on all subscales of the OQ-45.2, including the Symptom distress subscale, the Interpersonal relationship subscale, and the Social role subscale (10). One common significant risk factor of high psychological distress across the two studies was being single. Other significant risk factors included female sex, enlisted (as opposed to officer) status, working over 50 hours a week (11), working swing/night shifts, and inadequate sleep (10).

### ***Health-related behaviours and Healthcare utilization (2 studies)***

## SR of military drone operators

Two studies examined health-related behaviours, such as physical exercise, alcohol and tobacco consumption, emerging medical conditions and healthcare utilization, one in predator/reaper operators (7) and one in intelligence exploitation operators (5). Among the predator/reaper operators (7), 56.4% reported that they get between 5-6 hours of sleep prior to work and 4% reported getting only 4 or less hours of sleep. Daily exercising was reported by 6.3% of the sample and 14.1% reported that they exercise 5-6 times a week. A proportion (4.9%) reported elevated frequency and quantity of alcohol consumption that could be considered 'excessive drinking', and 18.8% reported using tobacco products. Of note, 13.5% and 8.2% of participants reported increased use of alcohol and tobacco respectively since beginning their predator/reaper duties. Moreover, 14.9% of participants reported increased utilization of medical services since beginning their duties and 9.3% and 12% reported increased use of prescription and over the counter medication respectively. Of note, a proportion of the predator/reaper operators reported a decrease in their utilization of medical services, primarily due to the distance from such services, the difficulty of scheduling appointments around their shifts, and manning demands (7).

Among the intelligence exploitation operators (5), 57.9% reported that they get on average between 5-6 hours of sleep prior to their shift and 7.5% reported only getting up to 4 hours of sleep. These proportions were similar to those reported by the support personnel (56% and 6.3% respectively). A proportion of 5.3% of intelligence operators reported that they exercised daily and 12.5% exercised 5-6 times a week. These proportions were significantly lower than those reported by the comparison group of non-exploitation support personnel (9.4% and 17.5% respectively). Excessive drinking was reported by 6.2% of intelligence operators and 3.8% of support personnel. A proportion of 17.1% of intelligence operators as compared to 8.1% of support personnel reported increase in their use of alcohol since the start of their duty. Increased use of tobacco products was reported by 6.6% of

## SR of military drone operators

intelligence operators and 5.2% of support personnel. Increased medical services utilization was reported by 21.5% of intelligence operators and 21.3% of support personnel. An increase in the use of prescription and over the counter medication was reported by 16.4% and 17.8% of intelligence operators respectively (17.5% and 10.5% of support personnel).

## **Discussion**

This systematic review analyzed 15 studies to provide an overview of the health-related research with military drone operators and intelligence analysts. The most frequently studied health-related outcomes were the self-reported sources of occupational stress and PTSD, followed by general psychological distress, occupational burnout and fatigue. Interestingly, all 15 studies were conducted in the U.S. with the USAF personnel, even though other countries are known to possess drones and to have used them for combat (Kmietowicz, 2012). Indeed, the first UK drone strike happened in June 2008 (Kmietowicz, 2012), but the mental health and well-being of UK drone operators is yet to be investigated. It is possible that there are differences in how the U.S. and UK drone operators work and by conducting cross-cultural research in this area, it may be possible to identify the major factors contributing to the physical and mental health problems reported by this population.

The search criteria utilized in our review were broad, yet we only identified 15 relevant studies. One reason for the limited number of studies could be the restricted access to this population. Indeed, drone operators are not allowed to discuss the details of their work with anyone who does not have security clearances. For this reason, the U.S. studies with this population are usually conducted only on the request of the Air Force leadership and the only researchers allowed access to drone operators are employed by the military (Asaro, 2013).

Nevertheless, the limited research has revealed some interesting findings. Across all the studies that examined self-reported sources of occupational stress, working long hours

## SR of military drone operators

together with low manning emerged as the most critical factors across both the predator/reaper and intelligence exploitation operators. This finding is consistent with the reports on the increasing popularity of using drones over manned aircraft (Gertler, 2012), and the requirement for drone operators that currently grows at a pace faster than the USAF's ability to train future operators (Hoagland, 2013). Other self-reported sources of stress were all operational in nature, rather than combat-related. However, it should be pointed out that in all of these studies, occupational stressors were assessed by an open-ended question and participants' attention was not directed towards potential combat-related stressors in any way. It is possible that in the military culture which encourages toughness and independence, participants will not willingly disclose any information that might make them look weak and unfit for service, even anonymously. Indeed, Prince et al. (2012) found that in a sample of intelligence exploitation operators, high levels of vicarious trauma exposure were significantly associated with high levels of psychological distress, emotional exhaustion and cynicism, yet the trauma exposure was not reported by participants as one of the top sources of occupational stress.

It is interesting to note that many of the occupational stressors commonly reported by drone and intelligence exploitation operators are also reported by individuals in the civilian peace keeping positions, such as police officers (Bonnar, 2000). In police officers, organisational stressors have often been found to have more pronounced negative effects on their mental well-being than those concerning dangerous situations, such as tackling offenders (Gershon, Barocas, Canton, Li, & Vlahov, 2009; Violanti et al., 2016). Although limited in number, the existing studies with drone and intelligence exploitation operators seem to suggest that the same is true in this occupational group. More rigorous research which directly addresses combat-related stressors is, however, needed to support this conclusion. Possible underreporting of mental health problems is evident in the finding that RPA pilots, along with

## SR of military drone operators

the manned aircraft pilots, had the lowest incidence rates of mental health problems and diagnoses in the whole of USAF (8). A mental health diagnosis has dire consequences for military pilots who could lose their job as a result of being diagnosed. Underreporting of mental health problems could also be a result of the concerns about stigma. Indeed, Hoge et al. (2004) found disproportionately higher rates of perceived stigma in those members of the U.S. infantry units who were most in need of help. Considering the need for close collaboration among the drone crew members, it is possible that the concerns about stigma are even higher in this occupational group. However, the reason for low rates of diagnoses could also be the rigorous training programmes and the stringent physical, psychological, and behavioural requirements that are part of the selection process (Davis, Johnson, Stepanek, & Fogarty, 2008). The RPA pilots as well as the manned aircraft pilots may therefore be less vulnerable or better prepared for the stressful demands of their work, although more research is needed to corroborate this assumption.

Analysis of studies examining PTSD in drone and intelligence exploitation operators revealed that the rates of PTSD (1.6% - 5%) in this population are at the low range of those found in the deployed military personnel. For example, in a review of combat-related PTSD, Richardson, Frueh and Acierno (2010) reported the point prevalence in US combat veterans since the Vietnam War to be between 2% - 17%. Among the veterans from the most recent conflicts in Iraq and Afghanistan, the point prevalence was 4% - 17.1%. It is possible that the nature of the drone operator work is associated with a lessened risk of developing PTSD compared to that in other combatants, because the bodily integrity of drone operators is not endangered whilst on duty. The most consistent risk factor for clinical levels of PTSD across the studies was working long hours (over 50 hours/week). As suggested by Chappelle, Goodman, Reardon and Thompson (2014), the length of time of exposure to combat-related imagery may increase the risk of PTSD.

## SR of military drone operators

Studies examining occupational burnout consistently reported high levels of emotional exhaustion (prevalence: 14% - 33%) and cynicism (7% - 20.8%) in a small group of drone operators, but consistently low levels of perceived professional efficacy (0% - 6%). This finding suggests that despite being emotionally exhausted with a sense of indifference towards what they are doing, the majority of drone and intelligence exploitation operators believe that their work has value and they are making a significant contribution in their role at work. Consequently, a large majority of all participants would not meet the full criteria for occupational burnout. However, the results show that fatigue, including daytime sleepiness, the likelihood of falling asleep whilst on duty, and shift work sleep disorder, are a serious problem for a significant proportion of drone operators and intelligence analysts. In line with this, sleep disturbance has been reported as the most frequently endorsed PTSD symptom in predator/reaper operators (1). Considering the high operational tempo, long hours, and shift work due to the need to sustain 24/7 operations, this is hardly surprising. This problem, however, needs addressed since fatigue can lead to degradation of performance and has been identified as one of the major factors contributing to RPA mishaps and safety incidents (Tvaryanas & Thompson, 2008). Considering the nature of this work, it is imperative that the number of mishaps is kept to a minimum as it can lead to loss of human life, loss of a multimillion dollar aircraft, and threat to national security and foreign relations (Ouma, Chappelle, & Salinas, 2011).

Studies examining general psychological distress have revealed this to be slightly higher in drone and intelligence exploitation operators than in the comparison groups, suggesting that this problem might be related to the nature of this work or the conditions in which the operators work. Indeed, the most common significant risk factor for high psychological distress was working over 50 hours a week. Moreover, in a replication of an earlier study (Chappelle et al., 2012), Chappelle and colleagues reported that the rates of

## SR of military drone operators

psychological distress decreased from 20% to 11% in a sample of predator/reaper operators (Chappelle, McDonald, Prince, Goodman, Ray-Sannerud, & Thompson, 2014b). It is possible that this improvement resulted from the changes implemented by the USAF that addressed operational stressors and increased access to healthcare. These results highlight the need for further replications as well as original studies in this area, as they show that it is possible to improve the health and well-being and thereby possibly also the work efficiency of military drone operators and intelligence analysts. However, effective changes cannot be implemented unless the leadership and management are aware of the problem. It is therefore of paramount importance that the UK and other countries utilizing drones conduct research in this area.

Another important consideration for the air force leadership and management is to provide and support access to health care among all members of their task force. Increased access to medical care was reported by a significant proportion of drone and intelligence exploitation operators, however, there were also reports of decreased utilization of health care services (7), primarily due to the difficulties of scheduling daytime appointments around one's shifts. Employing specially trained mental health professionals who understand the nature of the drone and intelligence operators' work as well as the nature of their working environment may help to tackle this problem and may also reduce the mental health stigma in this population.

Considering the low rates of mental health outcomes, such as PTSD, it is important that future studies examine alternative mental health outcomes that may be troubling the drone operators, such as depression, but also inter-personal problems or the physical health-related problems, that have only been addressed in two studies so far (5, 7). It is highly likely that a stressful sedentary job along with inadequate sleep and physical exercise in drone and intelligence operators (5, 7) might lead to poor physical health outcomes. Indeed, sedentary behaviour has been found to be a significant risk factor for all-cause mortality, diabetes,

## SR of military drone operators

cardiovascular disease, metabolic syndrome and others (De Rezende, Lopes, Rey-López, Matsudi, & Luiz, 2014). Future research could also address the effects of mismatch between the expected and actual length of assignment, as this has been found to negatively impact mental health in deployed military personnel (Buckman et al., 2011). Such investigation would be especially relevant to those drone operators, whose assignment to the position was initially temporary, but became more long-term as the demand for drone operators increased (Chappelle, Salinas, & McDonald, 2011). Additionally, one of the limitations of the existing research is its focus on the individual, rather than the crew working together as a team.

Examination of the drone operators' mental health and wellbeing using multi-level modelling could therefore provide further insights into our understanding of the problems faced by this occupational group. It is also important that all future studies employ methodologies that maximize self-disclosure and are designed to be anonymous and confidential so as to overcome the reluctance of the military personnel to participate and self-disclose any mental or physical health problems. Aside from this, further replications of the existing studies are needed, especially with regard to the various risk factors for the mental health outcomes.

The current review was limited by the fact that we were only able to search for studies conducted in English. It is possible that other countries have assessed the well-being of their drone operators, but did not publish the studies in peer-reviewed English-language journals. Indeed, a number of the included studies were only published as technical reports and have therefore not undergone the rigorous process of peer review. However, considering the limited research in this area, we believe that this review will nevertheless provide a valuable overview of the existing research and may both prompt and inform future studies in this area.

In conclusion, the current study is the first systematic review of research on the health and well-being of military drone operators and intelligence analysts. Across the studies, it was found that the main sources of occupational stress in this population are operational in

## SR of military drone operators

nature, rather than combat-related. The rates of mental health diagnoses, including PTSD, are low, but fatigue emerged as a significant problem. All the included studies were U.S. based even though other countries are known to have used drones in recent years. Further research conducted in UK, Israel, and other countries using drones for military purposes is needed and these future studies should consider examining other mental health outcomes, as well as problems associated with physical health in this population.

## References

References marked by an \* were included in the review.

American Psychiatric Association (1994). Diagnostic and statistical manual of mental disorders (4th ed). Washington, DC: American Psychiatric Association.

American Psychiatric Association (2013). Diagnostic and statistical manual of mental disorders (5th ed). Washington, DC: American Psychiatric Association 2013.

Asaro, P.M. (2013). The labor of surveillance and bureaucratized killing: New subjectivities of military drone operators. *Social Semiotics*, 23(2), 196-224.

doi:10.1080/10350330.2013.777591.

Bone, E., & Bolkcom, C. (2003). Unmanned aerial vehicles: Background and issues for congress. Congressional research service report, Library of Congress Washington DC, 25 April 2003.

<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA467807> (accessed May 2016).

Bonnar, A. J. (2000). Stress at work: The beliefs and experiences of police superintendents. *International Journal of Police Science and Management*, 2(4), 285-302. doi: 10.1177/146135570000200402

Bray, R. M., Pemberton, M. R., Lane, M.E., Hourani, L. L., Mattiko, M. J., & Babeu, L. A. Substance use and mental health trends among US military active duty personnel: Key findings from the 2008 DoD Health Behavior Survey. *Military Medicine*, 175(6), 390-399.

Buckman, J. E. J., Sundin, J., Greene T, Fear, N. T., Dandeker, C., Greenberg, N., & Wessely, S. (2011). The impact of deployment length on the health and well-being of

## SR of military drone operators

military personnel: a systematic review of the literature. *Occupational and Environmental Medicine*, 68, 69-76. doi:10.1136/oem.2009.054692.

\*Chappelle, W., Goodman, T., Reardon, L., & Thompson, W. (2014). An analysis of post-traumatic stress symptoms in United States Air Force drone operators. *Journal of Anxiety Disorders*, 28, 480-487. doi:[10.1016/j.janxdis.2014.05.003](https://doi.org/10.1016/j.janxdis.2014.05.003).

Chappelle, W., McDonald, K., & King, R. E. (2010). Psychological attributes critical to the performance of MQ-1 Predator and MQ-9 Reaper U.S. Air Force sensor operators. Technical Report, USAF School of Aerospace Medicine, Brooks City-Base, Texas, 25 June 2010.  
<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA525910> (accessed May 2016).

\*Chappelle, W., McDonald, K., Prince, L., Goodman, T., Ray-Sannerud, B. N., & Thompson, W. (2014a). Assessment of occupational burnout in United States Air Force Predator/Reaper “drone” operators. *Military Psychology*, 26(5-6):376-385. doi:[10.1037/mil0000046](https://doi.org/10.1037/mil0000046).

\*Chappelle, W. L., McDonald, K. D., Prince, L., Goodman, T., Ray-Sannerud, B. N., Thompson, W. (2014b). Symptoms of psychological distress and post-traumatic stress disorder in United States Air Force “drone” operators. *Military Medicine*, 179(8S), 63-70. doi:10.7205/MILMED-D-13-00501.

\*Chappelle, W., McDonald, K., Thompson, B., & Swearingen, J. (2012). Prevalence of high emotional distress, symptoms of post-traumatic stress disorder in U. S. Air Force active duty remotely piloted aircraft operators (2010 USAFSAM survey results). Technical report, USAF School of Aerospace Medicine, Brooks City-Base, Texas, December 2012.

SR of military drone operators

<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA577055> (accessed May 2016).

\*Chappelle, W., Prince, L., Goodman, T., Thompson, W., Cowper, S., & Ray-Sannerud, B. (2014c). Occupational health screening of the virtual warrior: Distributed common ground system intelligence operators compared with non-combatant support personnel. Technical report, USAF School of Aerospace Medicine, Brooks City-Base, Texas, February 2014.

<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA604765> (accessed September 2016).

\*Chappelle, W., Salinas, A., & McDonald, K. (2011). Psychological health screening of USAF remotely piloted aircraft (RPA) operators and supporting units. Paper presented at the Symposium on Mental Health and Well-Being Across the Military Spectrum, Bergen, Norway, 12 April 2011. <http://www.dtic.mil/dtic/tr/fulltext/u2/a582856.pdf> (accessed May 2016).

\*Chappelle, W., Swearingen, J., Goodman, T., Cowper, S., Prince, L., & Thompson, W. (2014). Occupational health screenings of US Air Force remotely piloted aircraft (Drone) operators. Technical report, USAF School of Aerospace Medicine, Brooks City-Base, Texas, April 2014.

<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA608598> (accessed May 2016).

Cole, C. (2012). Is drone proliferation about to explode? Drone wars UK, 25 May 2012.

<https://dronewars.net/2012/05/25/is-drone-proliferation-about-to-explode/> (accessed June 2016).

## SR of military drone operators

- Cole, C. (2015). Drone proliferation in light of increased targeted killing. *Drone wars UK*, 25 September 2015. <https://dronewars.net/2015/09/25/drone-proliferation-in-light-of-increased-targeted-killing/> (accessed June 2016).
- Davis, J., Johnson, R., Stepanek J, & Fogarty, J. A. (2008). *Fundamentals of aerospace medicine* (4th ed). Philadelphia: Lippincott Williams & Wilkins.
- De Rezende, L. F. M., Lopes, M. R., Rey-López, J. P., Matsudo, V. K. R., & Luiz, O. D. C. (2014). Sedentary behavior and health outcomes: An overview of systematic reviews. *PloS One*, 9(8), e105620. doi:[10.1371/journal.pone.0105620](https://doi.org/10.1371/journal.pone.0105620).
- Fitzsimmons, S., & Sangha, K. (2010). Killing in high definition: Combat stress among operators of remotely piloted aircraft. *Technology*, 12, 289-292.
- Gershon, R. R. M., Barocas, B., Li, X., & Vlahov, D. (2009). Mental, physical, and behavioural outcomes associated with perceived work stress in police officers. *Criminal Justice and Behavior*, 36(3), 275-289. doi:10.1177/0093854808330015
- Gertler, J. (2012). US unmanned aerial systems. Congressional research service report, Library of Congress Washington DC, 3 January 2012. <http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA566235> (accessed May 2016).
- Hoagland, B. T. (2013). Manning the next unmanned Air Force: Developing RPA pilots of the future. Policy paper, Brookings Institution, Washington DC, 6 August 2013. <http://www.brookings.edu/research/papers/2013/08/06-air-force-drone-pilot-development-hoagland> (accessed May 2016).
- Karstoft, K. I., Armour, C., Elklit A, & Solomon, Z. (2013). Long term trajectories of PTSD in veterans: the role of social resources. *Journal of Clinical Psychiatry*, 74(12), e1163-e1168. doi:10.4088/JCP.13.m08482

## SR of military drone operators

- Karstoft K. I., Armour C., Elklit A., & Solomon, Z. (2015). The role of locus of control and coping style in predicting longitudinal PTSD-trajectories after combat exposure. *Journal of Anxiety Disorders*, 32, 89-94. doi:10.1016/j.janxdis.2015.03.007.
- Keane, J. F., & Carr, S. S. (2013). A brief history of early unmanned aircraft. *Johns Hopkins APL Technical Digest*, 32(3), 558-571.
- Kmietowicz, Z. (2012). Use of drones is a war crime and must be stopped, says charity. *BMJ*, 345, e6820. doi:10.1136/bmj.e6820.
- \*Otto, J. L., & Webber, B.J. (2013). Mental health diagnoses and counseling among pilots of remotely piloted aircraft in the United States Air Force. *MSMR*, 20(3), 3-8.
- \*Ouma, J. A., Chappelle, W. L., & Salinas, A. (2011). Facets of occupational burnout among US Air Force active duty and National Guard/Reserve MQ-1 Predator and MQ-9 Reaper operators. Technical report, USAF School of Aerospace Medicine, Brooks City-Base, Texas, June 2011.  
<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA548103> (accessed June 2016).
- \*Prince, L., Chappelle, W., McDonald, K., & Goodman, T. (2012). Main sources of occupational stress and symptoms of burnout, clinical distress, and post-traumatic stress among Distributed Common Ground System intelligence exploitation operators (2011 USAFSAM survey results). Technical report, USAF School of Aerospace Medicine, Brooks City-Base, Texas, September 2012.  
<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA571309> (accessed May, 2016).
- \*Prince, L., Chappelle, W.L., McDonald, K.D., Goodman, T., Cowper, S., & Thompson, W. (2015). Reassessment of psychological distress and post-traumatic stress disorder in

## SR of military drone operators

United States Air Force distributed common ground system operators. *Military Medicine*, 180(3S), 171-178. doi:10.7205/MILMED-D-14-00397.

\*Reardon, L., Chappelle, W., Goodman, T., Cowper, S., Prince, L., & Thompson, W. (2016). Prevalence of posttraumatic stress symptoms in United States Air Force Intelligence, Surveillance, and Reconnaissance agency imagery analysts. *Psychological Trauma: Theory, Research, Practice, and Policy*, 88(1), 55-62. doi:10.1037/tra0000046.

Richardson, L. K., Frueh, B. C., & Acierno, R. (2010). Prevalence estimates of combat-related PTSD: a critical review. *Australian and New Zealand Journal of Psychiatry*, 44, 4-19. doi:10.3109/00048670903393597.

Seal, K.H., Bertenthal, D., Miner, C. R. Sen, S., & Marmar, C. (2007). Bringing the war back home: Mental health disorders among 103 788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs Facilities. *Archives of Internal Medicine*, 167(5), 476-482. doi: 10.1001/archinte.167.5.476.

Silver, R. C., Holman, E. A., Andersen, J. P., Poulin, M., McIntosh, D. N., & Gil-Rivas, V. (2013). Mental- and physical-health effects of acute exposure to media images of the September 11, 2001, attacks and the Iraq War. *Psychological Science*, 24(9), 1623-1634. doi: 10.1177/0956797612460406

Singer, P. W. (2009). *Wired for war: The robotics revolution and conflict in the twenty-first century*. New York: Penguin Press.

\*Thompson, W. T., Lopez, N., Hickey, P., DaLuz, C., Caldwell, J. L., & Tvaryanas, A. P. (2006). Effects of shift work and sustained operations: Operator performance in remotely piloted aircraft (OP-REPAIR). Technical Report, Air Force Research Laboratory, Brooks City-Base, Texas, January 2006.

<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA443145> (accessed June 2016).

## SR of military drone operators

\*Tvaryanas, A. P., & MacPherson, G.D. (2009). Fatigue in pilots of remotely piloted aircraft before and after shift work adjustment. *Aviation, Space, Environmental Medicine*, 80(5), 454-461. doi:[10.3357/ASEM.2455.2009](https://doi.org/10.3357/ASEM.2455.2009).

\*Tvaryanas, A. P., & Thompson, W. T. (2006). Fatigue in military aviation shift workers: Survey results for selected occupational groups. *Aviation, Space, and Environmental Medicine*, 77(11), 1166-1170.

Tvaryanas, A. P., & Thompson, W.T. (2008). Recurrent error pathways in HFACS data: analysis of 95 mishaps with remotely piloted aircraft. *Aviation, Space, and Environmental Medicine*, 79(5), 525-532. doi:[10.3357/ASEM.2002.2008](https://doi.org/10.3357/ASEM.2002.2008).

U.S. Air Force (2005). The U.S. Air Force remotely piloted aircraft and unmanned aerial vehicle strategic vision.

<http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1000&context=usafresearch>  
[h](#) (accessed May 2016).

Violanti, J. M., Andrew, M. E., Mnatsakanova, A., Hartley, T. A., Fekedulegn, D., & Burchfiel, C. M. (2016). Correlates of hopelessness in the high suicide risk police occupation. *Police Practice and Research*, 17(5), 408-419. doi:  
[10.1080/15614263.2015.1015125](https://doi.org/10.1080/15614263.2015.1015125)

## SR of military drone operators

Table 1. Summary of included studies

Study	Study sample	Comparison sample	Demographics	Outcomes
1. Chappelle, Goodman et al. (2014)	1,084 USAF predator/reaper operators	n/a	88.2% males, 11.4% females, <1% missing; 36.4% single, 63.2% married, <1% missing	PTSD (PCL-M)
2. Chappelle, McDonald et al. (2014a)	1,094 USAF predator/reaper operators	n/a	88.2% males, 11.4% females; 36.4% single, 63.3% married	Occupational burnout (MBI-GS)
3. Chappelle, McDonald et al. (2014b)	1,094 USAF predator/reaper operators	n/a	88% males, 12% females, <1% missing; 36% single, 63% married	Sources of occupational stress; Psychological distress (OQ-45.2); PTSD (PCL-M)
4. Chappelle et al. (2012)	670 USAF predator/reaper operators (pilots, sensor operators, mission intelligence coordinators),	751 non-combatant non-RPA airmen	Predator/reaper operators: 80.4% males, 19.6% females; 45.2% single, 54.9% married  Non-combatant non-RPA airmen: 86.9% males, 13.1% females; 46.6% single, 53.4% married	Sources of occupational stress; Psychological distress (OQ-45.2); PTSD (PCL-M)
5. Chappelle et al. (2014c)	1,091 DCGS exploitation operators	447 support (non-exploitation) personnel	DCGS exploitation operators: 70.8% males, 29.2% females; 42.9% single, 57.1% married  Support (non-exploitation) personnel: 82.7% males, 17.4% females; 44.4% single, 55.6% married	Sleep; Physical exercise health behaviours; Alcohol, tobacco, and caffeine use; Medical conditions created or made worse by current unit assignment; Medical, mental support, and alternative healthcare utilization; Prescription and over-the-counter medication utilization

## SR of military drone operators

6. Chappelle et al. (2011)	600 USAF predator/reaper operators (pilots, sensor operators, mission intelligence coordinators)	264 Global Hawk operators who do not engage in weapon deploying missions (pilots, sensor operators, image analysts); 600 non-combatant airmen supporting RPA units	<p>Predator/reaper operators: 84.8% males, 14.5% females, &lt;1% missing; 38% single, 62% married</p> <p>Global Hawk operators: 74.6% males, 24.2% females, 1.1% missing; 48.3% single, 51.7% married</p> <p>Non-combatant airmen: 89% males, 10.7% females, &lt;1% missing; 48.5% single, 51.5% married</p>	Sources of occupational stress; Occupational burnout (MBI-GS)
7. Chappelle, Swearingen et al. (2014)	1,094 USAF predator/reaper operators (pilots, sensor operators, mission intelligence coordinators)	n/a	88.5% males, 11.5% females; 36.5% single, 63.5% married	Sleep; Physical exercise health behaviours; Alcohol, tobacco, and caffeine use; Medical conditions created or made worse by current unit assignment; Medical, mental support, and alternative healthcare utilization; Prescription and over-the-counter medication utilization
8. Otto & Webber (2013)	709 USAF RPA pilots	5,256 manned aircraft pilots	<p>RPA pilots: 94.6% males, 5.4% females; 74.2% married, 21.4% single, 4.4% other</p> <p>Manned aircraft pilots: 97.3% males, 2.7% females; 26.1% single, 71.4% married, 2.5% other</p>	Mental health diagnoses (ICD-9)

## SR of military drone operators

9. Ouma et al. (2011)	296 USAF active duty predator/reaper pilots and sensor operators	130 USAF National guard and Reserve predator/reaper pilots and sensor operators	<p>Active duty pilots and operators: 90.8% males, 9.2% females; 38.7% single, 61.3% married</p> <p>National guard and Reserve pilots and operators: 94.6% males, 5.4% females; 25.2% single, 74.8% married</p>	Sources of occupational stress; Occupational burnout (MBI-GS)
10. Prince et al. (2012)	411 USAF DCGS intelligence exploitation operators	152 DCGS (non-exploitation) personnel; 200 non-combatant support and logistics airmen	<p>DCGS intelligence exploitation operators: 67.4% males, 31.4% females, 1.2% missing; 31.6% single, 60.7% married</p> <p>DCGS (non-exploitation) personnel: 77.6% males, 22.4% females; 34.2% single, 55.9% married</p> <p>Non-combatant support and logistics airmen: 76.5% males, 21.5% females; 26.7% single, 66.6% married</p>	Sources of occupational stress; Occupational burnout (MBI-GS); Psychological distress (OQ-45.2); PTSD (PCL-M); Vicarious trauma exposure (VCES)
11. Prince et al. (2015)	1,091 USAF DCGS intelligence exploitation operators	447 USAF DCGS non-intelligence support personnel	<p>DCGS intelligence exploitation operators: 69.5% males, 28.6% females, 1.9% missing; 42.9% single, 57.1% married</p> <p>DCGS non-intelligence support personnel: 81% males, 17% females, 2% missing; 44.3% single; 55.5% married</p>	Sources of occupational stress; Psychological distress (OQ-45.2); PTSD (PCL-M)
12. Reardon et al. (2016)	498 USAF imagery analysts	n/a	74.1% males, 25.9% females; 38.8% single, 61.2% married	PTSD (PCL-M)

## SR of military drone operators

13. Thompson et al. (2006)	28 USAF predator operators (pilots, sensor operators, intelligence personnel)	External reference group of Airborne warning and control system (AWACS) aircrew	82.1% males*	Fatigue (FAS, FS, CIS-CON, EF-WHOQOL, MBI-EE)
14. Tvaryanas & MacPherson (2009)	66 USAF predator/reaper pilots and sensor operators	USAF predator/reaper pilots and sensor operators surveyed in 2005; External reference group of Airborne warning and control system (AWACS) aircrew	92.4% males*	Fatigue (FS, CIS-CON, FAS, EF-WHOQOL, MBI-EE, ESS)
15. Tvaryanas & Thompson (2006)	31 USAF predator operators (pilots, sensor operators)	26 predator maintenance personnel; 54 manned aircraft crew members; 61 manned aircraft maintenance personnel	81% males*	Fatigue (FS, CIS-CON, FAS, EF-WHOQOL, MBI-EE); Quantity and quality of sleep

---

*Note.* CFS = CIS-CON = Checklist Individual Strength Concentration Subscale; DCGS = Distributed common ground system; EF-WHOQOL = World Health Organization Quality of Life Assessment Energy and Fatigue Subscale; ESS = Epworth Sleepiness Scale; FAS = Fatigue assessment scale; FS = Fatigue Scale; ICD-9 = International Classification of Diseases, ninth revision; MBI-EE = Maslach Burnout Inventory Emotional Exhaustion Subscale; MBI-GS = Maslach Burnout Inventory-General Survey; OQ-45.2 = Outcome Questionnaire 45.2; PCL-M = PTSD Checklist Military Version; PTSD = Posttraumatic stress disorder; RPA = Remotely piloted aircraft; USAF = United States Air Force; VCES = Vicarious Combat Exposure Scale. Please note that all percentages are rounded. \* Indicates studies where number of females and those not disclosing gender were not reported.

## SR of military drone operators

*Table 2. Most frequently reported sources of occupational stress*

<b>Source of occupational stress</b>	<b>Study no.</b>
Long hours	3, 4, 6, 9, 10, 11
Low unit manning	3, 4, 6, 10, 11
Shift work	3, 6, 9, 11
Ergonomic design of the ground control station	4, 6, 9
Inefficiencies in computer-based input and command procedures	6, 9
Geographical location	6, 9
Sustaining heightened vigilance	4, 6
Deployed-in-garrison status	4, 10
Juggling the demands of personal and domestic life with military operations	6, 9
Career progression concerns	6, 9
Job training and professional development	11
Assignment concerns (e.g., perceived involuntary nature of assignment)	9
Extra duties/administrative tasks	3
Operational leadership and communication	11
Organizational management	11