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# A Comparison of Work Health and Safety Incidents and Injuries in Part-Time and Full-Time Australian Army Personnel

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***Context:*** Part-time personnel are an integral part of the Australian Army. With operational deployments increasing, it is essential that medical teams identify the patterns of injuries sustained by part-time personnel in order to mitigate the risks of injury and optimize deployability.

***Objective:*** To compare the patterns of reported work health and safety incidents and injuries in part-time and full-time Australian Army personnel.

***Design:*** Retrospective cohort study.

***Setting:*** The Australian Army.

***Patients or Other Participants:*** Australian Army Reserve and Australian regular Army populations, July 1, 2012, through June 30, 2014.

***Main Outcome Measure(s):*** Proportions of reported work health and safety incidents that resulted in injuries among Army Reserve and regular Army personnel and specifically the (a) body locations affected by incidents, (b) nature of resulting injuries, (c) injury mechanisms, and (d) activities being performed when the incidents occurred.

***Results:*** Over 2 years, 15 065 work health and safety incidents and 11 263 injuries were reported in Army Reserve and regular Army populations combined. In the Army Reserve population, 85% of reported incidents were classified as involving minor personal injuries; 4% involved a serious personal injury. In the regular Army population, 68% of reported incidents involved a minor personal injury; 5% involved a serious personal injury. Substantially lower proportions of Army reservist incidents involved sports, whereas substantially higher proportions were associated with combat training, manual handling, and patrolling when compared with regular Army incidents.

***Conclusions:*** Army reservists had a higher proportion of injuries from Army work-related activities than did regular Army soldiers. Proportions of incidents arising from combat tasks and manual handling were higher in the Army Reserve. Understanding the sources of injuries will allow the medical teams to implement injury-mitigation strategies.

***Key Words:*** injuries, military, military reserves, defense

**Key Points**

- A higher proportion of work health and safety incidents arose from combat training, manual handling, and patrolling in the Army Reserves than in the regular Army.
- These activities require regular training and careful risk management to ensure adequate conditioning and prevention of injuries.
- For these activities, commanders, safety officers, conditioning coaches, and medical teams must work together to ensure that training is optimized and other sources of risk are well managed in Army Reserve personnel.

Work health and safety incidents are of great concern to the Australian Army. These incidents include both injuries and dangerous occurrences that did not cause injuries. Injuries interrupt participation in active-duty service and also affect the readiness and productivity of the Australian Defence Force.[1] The Australian Army comprises both part-time and full-time personnel; work health and safety incidents and resulting injuries affect both populations.[1,2] Unlike full-time soldiers, part-time soldiers (ie, reservists) typically have primary employment outside the military and only become full-time soldiers when called upon to participate in training exercises and local or international military operations.[3] Active service of this nature is becoming more common, and these part-time personnel are no longer considered to be backup personnel but rather integral to the successful functioning of the full-time forces.[4] It is important that the medical teams, which include athletic trainers, physical therapists, and other allied health practitioners, working with these populations understand how mechanisms of injury and injury rates in reservists differ from those in full-time, regular soldiers in order to properly care for this challenging population.

Part-time soldiers now contribute to approximately 10% of Australian[4] and United Kingdom forces.[5] In the United States, reservists make up approximately 50% of personnel fighting current conflicts.[6] Strategically, the Australian Defence Force *Defence White Paper*[1] has acknowledged the importance of integrating Australian Army Reserve and Australian regular Army personnel under the government-approved plan BEERSHEBA. For this reason, the ability of Army Reserve personnel to effectively work and keep pace

with their regular Army peers without experiencing excessive numbers of work health and safety incidents or injuries is vital.[1] Preliminary research conducted by the Australian Department of Defence in 2000[2] suggested that part-time Defence Force personnel were 3 times more likely to report injuries that had occurred during physical and military training than were full-time personnel. Detailed data specific to Army Reserve personnel were not available in that report, but a trend similar to that in full-time personnel is expected. No researchers have compared injury rates in full-time and part-time Australian Defence Force personnel in detail.

Army Reserve personnel constitute a challenging population for the medical teams who are responsible for their injury management. Multiple factors may contribute to injury and safety incidents: (1) the requirement to complete the same physical fitness assessments and participate in the same field exercises as their regular Army peers at a commensurate level[1,3]; (2) deployment in the same combat operations and in the same roles as regular Army personnel[1]; (3) the need to balance other occupations and work demands; (4) being responsible for their own individualized training sessions, with on-the-job physical training at a lower level than that for full-time personnel[3,7,8]; and (5) having less contact with Army physical training instructors and clinicians than full-time personnel and, as a result, less monitoring and management of their injury risks both as individuals and as a population.

Reservists participate in shorter, intermittent bouts of active service and do not typically have the opportunity for the same amount of chronic military physical conditioning as regular Army personnel. Previous research[9] indicates a strong link between the level of physical conditioning and injury risk. Differences in levels of specific conditioning and the requirement to perform tasks at the same level as full-time personnel are likely to increase rates of work health and safety incidents and injuries among Army Reserve personnel when they undertake military duties. Part-time Army personnel often have their injuries managed by clinicians who are external to the military organization and therefore less familiar with the particular military context and current demands than the embedded medical teams. Also, part-time personnel generally have less contact with Army physical training instructors. In the Australian Army, all members of the medical teams play important roles in collaborating with safety officers to monitor, detect, and manage the sources of risk associated with emerging injury trends and clusters and informing training design to prevent injuries.[10,11] These important risk-management activities are frequently lacking for Army Reserve personnel, and this gap is likely to further increase their rates of work health and safety incidents.

Internationally, investigators comparing part-time and full-time army populations have focused on differences in training regimes and their effects,[3] as well as on the ability to complete common military tasks.[8] In contrast, research[10,11] in this field within the Australian Army has remained largely focused on full-time personnel and how to reduce their injury rates. Given the preliminary evidence of increased injury rates in Reserve personnel provided by the Defence Health Status Report[2] and recent increases in Army Reserve deployment requirements, it is imperative that we examine the patterns of reported work health and safety incidents and resulting injuries among part-time Army personnel. Once we understand these patterns, strategies can be developed to prevent and manage the associated risks, improve soldier training, and help medical teams to better serve this population.

**Table 1. Australian Army Reserve and Regular Army Soldier Population Sizes, 2012–2014**

| Years | Army Reserve | Regular Army | Total Army |
|---|---|---|---|
| 2012–2013 | 14 867 | 28 955 | 43 822 |
| 2013–2014 | 15 200 | 29 847 | 45 047 |
| Mean | 15 034 | 29 401 | 44 435 |

The aims of our research project were therefore to (a) determine the proportions of reported work health and safety incidents that resulted in injuries in the Army Reserve and regular Army populations within the period of interest and (b) quantify and compare the key factors involved in work health and safety incidents between Army Reserve and regular Army populations.

## METHODS

A retrospective cohort study was conducted to ascertain and compare the work health and safety incident profiles of Army Reserve and regular Army personnel based on incident and personnel data obtained for these populations from July 1, 2012, through June 30, 2014. Work health and safety incident and injury data were sourced from the Australian Department of Defence Workplace Health, Safety, Compensation Analysis and Reporting (WHSCAR) database, which contains the records of incidents and injuries sustained by Army personnel. The WHSCAR database is designed to capture all reports submitted in the notification and reporting of workplace health and safety incidents occurring within the Department of Defence.[12] A qualified WHSCAR database operator extracted the data from the database in order to maintain record privacy and ensure optimal data retrieval. The WHSCAR dataset provided to the researchers included Service (Army) to which the affected person belonged, service type (part time or full time), type of occurrence, date of incident, incident status, incident severity, nature of resulting injury, body site affected by resulting injury, mechanism of resulting injury, activity at the time of the incident (including specific event: eg, field exercise, if applicable), incident description, and duty status at the time of the incident. The mean population sizes of Army Reserve and regular Army personnel across the study period were sourced from published Department of Defence records (Table 1).[13,14]

Work health and safety incident and injury records extracted from the WHSCAR database were included in the study data set if they related to (a) Australian Army Reserve or Australian regular Army personnel, (b) an incident or injury that occurred while the person was on duty, and (c) an incident or injury that occurred between July 1, 2012, and June 30, 2014, inclusive. Records were excluded if they (a) related to personnel from Australian military services other than the Australian Army, (b) related to personnel from a foreign defense service on secondment, or (c) contained missing or incomplete data.

All work health and safety incident and injury records were grouped according to the service type (Army Reserve or regular Army) and formed the primary basis for

**Table 2. Australian Army Reserve and Regular Army Soldiers' Reported Injuries by Year[a]**

| Years | Injuries | Army Reserve | Regular Army | Total Army |
|---|---|---|---|---|
| 2012–2013 | No. | 708 | 4775 | 5483 |
| | Within year, % | 13 | 87 | 100 |
| 2013–2014 | No. | 726 | 5054 | 5780 |
| | Within year, % | 13 | 87 | 100 |
| Total 2012–2014 | No. | 1434 | 9829 | 11 263 |
| | Within year, % | 13 | 87 | 100 |

[a] Note: Percentages rounded to the nearest whole number.

**Table 3. Australian Army Reserve and Regular Army Soldiers' Body Locations Affected by Reported Workplace Health and Safety Incidents, %**

| Body Location | Army Reserve | Regular Army | Total Army |
|---|---|---|---|
| Lower limb | 36.50 | 30.80 | 31.40 |
| Trunk and pelvis | 23.40 | 21.20 | 21.40 |
| Upper limb | 14.60 | 9.50 | 10.00 |
| Systemic | 10.60 | 22.80 | 21.50 |
| Head | 8.30 | 7.80 | 7.90 |
| Other | 6.60 | 7.90 | 7.80 |
| Total | 100.00 | 100.00 | 100.00 |

comparative analyses. The primary outcome measure was the proportion of reported work health and safety incidents that resulted in injuries in the Army Reserve and regular Army populations. Secondary outcome measures were proportional representations of specific (a) body locations affected by incidents, (b) natures of resulting injuries, (c) injury mechanisms, and (d) activities being performed at the times the incidents occurred. Each outcome measure was calculated as the percentage of the work health and safety incidents that included a particular response option.

The Australian Defence Human Research Ethics Committee and the Bond University Human Research Ethics Committee granted approval for this study. Departmental authorization for the project was obtained in parallel with the process for obtaining Australian Defence Human Research Ethics Committee approval.

### Data Analysis

The WHSCAR database operator provided us with raw, nonidentifiable data in an Excel (Microsoft Corporation, Redmond, WA) spreadsheet. The data were then manually cleaned to ensure that only the records consistent with the inclusion and exclusion criteria were retained. In addition, each line of data was reviewed and compared with other lines of data to ensure identification and removal of duplicate entries (ie, the same record entered twice). Each data record was further verified, corrected, or made more precise by manual comparison of the allocated Type of Occurrence Classification System classifications with the free-text narrative data from the same record. When discrepancies were identified, precedence was given to the free-text narratives, and the classification was adjusted accordingly, as narratives provided by incident reporters are considered more detailed and accurate than data entered by a third party using a finite coding system.[15] The resulting, often more precise Type of Occurrence Classification System codes were used in the subsequent data analysis.

Data were entered into SPSS software (version 21.0; IBM Corporation, Armonk, NY) for statistical analysis. Descriptive analyses were used to examine and describe the data and to calculate the primary and secondary outcome measures (described earlier) for Army Reserve and regular Army populations in each year of the period of interest.

For the purposes of our study, *work health and safety incidents* were defined as all incidents recorded in the WHSCAR database for the population and period of interest: (a) minor personal injuries, (b) serious personal injuries or illnesses, (c) dangerous occurrences, (d) fatalities, (e) incidents involving exposure to a hazardous substance or material, and (f) near misses. Our definition of *injury* consisted of only the minor personal injuries and serious personal injuries or illnesses resulting from the types of incidents reported in the WHSCAR database.[12]

## RESULTS

In total, 15 065 work health and safety incidents were reported (7633 in 2012–2013, 7432 in 2013–2014). Among these, 11 263 injuries (consisting of minor personal injuries and serious personal injuries and illnesses) were reported across the 2-year study period. The numbers of injuries reported in Army Reserve and regular Army populations in each year of the study period are detailed in Table 2. Given that the population figures for the Army Reserve and regular Army (Table 1) were relatively stable year to year, the values presented in Table 2 indicate that the reported injury-incidence rates were relatively stable in the Army Reserve and in regular Army populations year to year.

Because the frequencies of reported work health and safety incidents and the underlying Army Reserve and regular Army population sizes were each relatively stable across the 2 study years, we pooled work health and safety incident data across the full study period. It is important to note that some reported work health and safety incidents (exposure to a chemical substance, for example) did not result in a reported injury, and this fact is reflected in the findings that follow.

In the Army Reserve population, 85% of reported incidents involved minor personal injuries, and 4% involved a serious personal injury or illness. In the regular Army population, 68% of reported incidents involved a minor personal injury and 5% involved a serious personal injury or illness. In both the Army Reserve and regular Army populations, we calculated a rate of 1 fatality per 1000 reported work health and safety incidents. The remaining incidents in the Army Reserve and regular Army populations did not involve an injury but rather constituted dangerous occurrences, exposures to hazards, or near misses.

The proportions of reported work health and safety incidents in the Army Reserve, regular Army, and total army populations that involved specific reported body locations are presented in Table 3. The raw data relating to reported body locations were separated into 36 body location categories, and these were grouped to form the 7 overarching categories listed in Table 3. Many of the work health and safety incidents for which *other* is the affected body location were events such as near misses, dangerous occurrences, and exposures in which no injury was

**Table 4. Australian Army Reserve and Regular Army Soldiers' Nature of Injuries Resulting From Reported Workplace Health and Safety Incidents, %**

| Nature of Injury | Army Reserve | Regular Army | Total Army |
|---|---|---|---|
| Harm to unspecified soft tissues | 42.9 | 32.3 | 33.5 |
| Harm to muscles and tendons | 14.2 | 11.2 | 11.5 |
| Disease or chronic condition | 7.0 | 4.3 | 4.6 |
| Harm to joints and ligaments | 4.9 | 7.5 | 7.2 |
| Laceration or open wound (not amputation) | 4.7 | 3.9 | 4.0 |
| Burns | 2.6 | 1.0 | 1.2 |
| Harm to bones | 2.5 | 5.0 | 4.7 |
| Poisoning and toxic effects of substances | 2.3 | 0.9 | 1.0 |
| Superficial injury | 2.3 | 0.8 | 0.9 |
| Foreign body on external eye or in ear or nose or respiratory, digestive, or reproductive tract | 1.9 | 0.9 | 0.9 |
| Heat stress/heat stroke | 1.9 | 1.7 | 1.7 |
| Deafness | 0.8 | 2.0 | 1.9 |
| Intracranial injury | 0.8 | 1.2 | 1.2 |
| Harm to mental health | 0.4 | 1.1 | 1.0 |
| Other specified injury | 1.5 | 1.5 | 1.6 |
| No known injury resulted from incident | 9.3 | 24.7 | 23.1 |
| Total | 100.0 | 100.0 | 100.0 |

sustained and so no specific body location could be reported.

The proportions of reported work health and safety incidents in Army Reserve, regular Army, and total army populations that involved an injury of a particular nature are presented in Table 4. The raw data relating to the natures of injuries sustained in reported work health and safety incidents were assigned to 117 nature-of-injury categories, and these were grouped to form the 17 overarching categories listed in Table 4.

The proportions of reported work health and safety incidents in the Army Reserve, regular Army, and total army populations that involved particular mechanisms of injury are presented in Table 5. The raw data relating to the mechanisms of injuries sustained from reported work health and safety incidents were categorized into 41 mechanisms of injury. Of these categories, those representing mechanisms of injury that were associated with more than 1% of work health and safety incidents in either the Army Reserve or regular Army populations are listed in Table 5; the many mechanisms of injury that were associated with less than 1% of work health and safety incidents in both populations are grouped in the *other* category.

The proportions of reported work health and safety incidents in Army Reserve, regular Army, and total army populations that occurred during particular activities are presented in Table 6. The raw data relating to the activities during which reported work health and safety incidents occurred were divided into 72 activity categories. Of these categories, those representing activities that were associated with more than 1% of work health and safety incidents in either the Army Reserve or regular Army populations are listed in Table 6; the many activities that were associated with less than 1% of work health and safety incidents in both populations are grouped in the *other* category.

**Table 5. Australian Army Reserve and Regular Army Soldiers' Mechanisms of Injuries Resulting From Reported Workplace Health and Safety Incidents, %**

| Mechanism of Injury | Army Reserve | Regular Army | Total Army |
|---|---|---|---|
| Muscular stress while lifting, carrying, or donning equipment | 34.8 | 31.6 | 31.9 |
| Fall | 20.2 | 14.9 | 15.5 |
| Contact with moving or stationary object | 12.1 | 10.3 | 10.4 |
| Chemical substance | 5.5 | 18.1 | 16.8 |
| Vehicle accident | 3.0 | 3.3 | 3.3 |
| Insect and spider bites and stings | 2.3 | 0.5 | 0.6 |
| Contact with, or exposure to, biological factors of unknown origin | 2.1 | 2.3 | 2.3 |
| Contact with hot objects | 1.9 | 0.4 | 0.5 |
| Exposure to environmental heat | 1.9 | 1.6 | 1.7 |
| Rubbing and chafing | 1.1 | 0.5 | 0.6 |
| Long-term exposure to sounds | 0.2 | 1.6 | 1.4 |
| Other and multiple mechanisms of injury | 13.8 | 13.8 | 13.8 |
| Unspecified mechanisms of injury | 1.1 | 1.1 | 1.2 |
| Total | 100.0 | 100.0 | 100.0 |

## DISCUSSION

The aims of our research were to (a) determine the proportions of reported work health and safety incidents within the period of interest that resulted in injuries in the Army Reserve and regular Army populations and (b) quantify and compare key factors involved in work health and safety incidents between the Army Reserve and regular Army populations. Such information can be used by commanders, medical teams (which include athletic trainers, physical therapists, and rehabilitation strength and conditioning coaches), other clinicians, and safety personnel to identify key injury risks and their sources and to inform injury risk-management approaches[10,11] for either population or both populations, depending on the needs this information reveals, but the focus of this paper is Army Reserve personnel.

In the Army Reserve population, 85% of reported incidents were classified as involving minor personal

**Table 6. Australian Army Reserve and Regular Army Soldiers' Activities During Which Reported Workplace Health and Safety Incidents Occurred, %**

| Activity | Army Reserve | Regular Army | Total Army |
|---|---|---|---|
| Combat training | 23.6 | 12.0 | 13.3 |
| Physical training | 20.2 | 24.6 | 24.1 |
| Manual or materials handling | 8.5 | 4.7 | 5.1 |
| Patrolling | 6.0 | 1.8 | 2.2 |
| Marching | 5.7 | 4.0 | 4.2 |
| Weapon handling total | 5.5 | 3.8 | 4.0 |
| Walking | 5.1 | 2.9 | 3.1 |
| Driving | 2.8 | 2.1 | 2.1 |
| Sports total | 2.5 | 8.9 | 8.2 |
| Passenger in vehicle | 2.3 | 1.0 | 1.1 |
| Sleeping | 1.5 | 0.3 | 0.4 |
| Boarding or alighting from a vehicle | 1.3 | 0.6 | 0.6 |
| Office work total | 1.1 | 1.0 | 1.0 |
| Vehicle maintenance | 0.9 | 1.6 | 1.5 |
| Operational | 0.9 | 18.8 | 16.9 |
| Other | 7.4 | 8.5 | 8.4 |
| Unknown | 4.7 | 3.4 | 3.8 |
| Total | 100.0 | 100.0 | 100.0 |

injuries, with a further 4% involving a serious personal injury or illness. In the regular Army, a slightly lower proportion (68%) of reported incidents involved a minor personal injury, whereas a similar 5% involved a serious personal injury or illness.

The key features of work health and safety incidents were similar between the populations when we considered the top 5 categories for (a) body location, (b) nature of injury, (c) and mechanism of injury. Although similarities were evident, some differences were observed between Army Reserve and regular Army populations in the activities being undertaken at the times the work health and safety incidents occurred.

For both Army Reserve and regular Army personnel, the lower limbs were the leading body location affected; the proportion of reported incidents involving the lower limbs was slightly higher in the former population. This finding was not unexpected given that the lower limbs were the leading body location of injury in military personnel[16,17] and have been the body location affected in more than 80% of reported injuries in military personnel.[16] It is of note that the proportion of work health and safety incidents that involved lower limb injuries across the Army as a whole in this study (31.4%) is strikingly similar to the proportion reported in the Australian Defence Health Status report in 2000[2] for the whole of the Australian Defence Force (31.5%), suggesting little variation in the distribution of injuries across body sites over the last 15 years.

Apart from a high proportion of systemic injuries in the regular Army (22.8%), the next most commonly injured body location for both groups was the trunk (Army Reserve = 23.4%, regular Army = 21.2%), followed by the upper limbs (Army Reserve = 14.6%, regular Army = 9.5%). This result differs from that in the Australian Defence Health Status report in 2000,[2] which indicated that the upper limbs were the next most commonly reported body location of injury in the Australian Defence Force as a whole (21.7%), followed by the trunk (14.8%). One potential reason for this increase in the proportion of trunk injuries may be the increased use of body armor and the increased carriage of heavy loads. Wearing body armor increases the physical demands of performing a given task,[18] and as such, the association with back injuries in military populations is not unexpected.[19] This hypothesis is supported by research[20,21] showing the lower limbs followed by the trunk to be the leading body locations of injury during or after load-carriage events.

Soft tissue structures were the most commonly reported injured structures for both the Army Reserve and regular Army. These injuries accounted for a higher proportion of total injuries in the Army Reserve when compared with the regular Army (Table 4). The most common mechanism of injury for both populations was muscular stress while lifting, carrying, or donning equipment, followed by falling. Again the proportion of reported work health and safety incidents that injuries with this mechanism constituted in Army Reserve personnel was slightly higher than in regular Army personnel (55% and 46.5% of reported work health and safety incidents, respectively). Although other occupational factors may exist, such as the nature of corps requirements (eg, lifting artillery shells), 1 common task that both populations are exposed to, regardless of corps, is load carriage.

Muscular stress from lifting, carrying, and donning equipment and falling were the leading mechanisms of injury within this population while handling heavy loads.[20] The association between load carriage and injuries that occur while lifting, carrying, and donning equipment is clear, but a direct link between load carriage and an increased risk of falling may be less apparent. Previous authors[22,23] have found that the number of participants able to successfully negotiate individual obstacles decreased as the load weight carried increased. In 1 study, loads of 9.1 kg led to 42% of participants (10 of 24) making contact with a 30-cm obstacle while stepping over it.[23] For soldiers carrying loads of more than 40 kg,[24,25] their risk of tripping and falling while performing tasks was increased considerably. Given their requirements to carry loads commensurate with their full-time counterparts,[3] the reduced amount of chronic conditioning for Army Reserve personnel[3,7,8] may have led to their higher proportion of fall mechanisms in injuries arising from work health and safety incidents.

Although the value was slightly lower in the Army Reserve population, both groups had similar percentages of injuries attributed to physical training. Physical training and sport have previously been identified as leading causes of injury in military populations,[2] yet this finding was unexpected as lower levels of fitness (which have been identified as more common in other part-time tactical populations)[26] have been associated with an increased risk of injury.[9] As such, a higher percentage of physical training injuries in Army Reserve soldiers was expected. A notable difference did exist in the lower percentage of sport injuries among Army Reserve personnel than regular Army personnel (2.5% versus 8.9%, respectively). These lower percentages of reported sport-related work health and safety incidents are understandable given that Army Reserve personnel may be less exposed to sport while on duty.

Combat tasks and manual handling were other activities for which differences between the populations existed. In the Army Reserve population, combat tasks, which include both combat training and patrolling, represented more than twice the work health and safety incidents (29.6%) as in the regular Army population (13.8%). Manual handling, which can also be associated with combat tasks (picking up and carrying combat stores, wounded personnel, etc) also accounted for a substantially higher proportion of work health and safety incidents in Army Reserve than in regular Army personnel. A potential reason for this difference may be training variations between the populations: Reserve training is predominantly performed outside of military duties.[3] As a result, with less exposure to combat and supervised physical training, Army Reserve personnel can be at a higher risk of injury when they must perform these combat tasks at levels required of regular Army personnel. Furthermore, the reduced exposure alone may result in an increased injury risk to Army Reserve personnel when restarting these combat tasks.[27]

In our study, Army Reserve personnel reported a higher percentage of injuries associated with manual-handling activities than did regular Army personnel (8.5% versus 4.7%, respectively). Military personnel are often required to manually handle heavy materials.[8] Williams and Evans,[8] when profiling the manual handling of heavy loads in the British Army, observed no differences in manual-handling

ability between Reserve soldiers and regular Army soldiers. Based on this finding, we expected to see similar proportions of reported manual-handling incidents among Army Reserve and regular Army personnel, but this was not the case. Although the observed differences in the current study may be artefact reflecting data limitations, it is again possible that Army Reserve personnel struggle to achieve the chronic load-carriage conditioning achieved by regular Army personnel. As with combat-related tasks, this may account for the observed increases in their proportions of work health and safety incidents and injuries that arise from manual handling.

A key limitation of this research was the reliance on retrospective data capture via a formal reporting system. This limitation means that more minor injuries (blistering, mild ankle sprains, etc) may have gone unreported. Similarly, actual injuries occurring in the workplace may be underreported.

When the body locations, natures of injury, and mechanisms and activities associated with reported injuries are considered collectively, an interesting pattern emerges. Although their rankings of body locations of injuries were consistent, in some instances, Army Reserve personnel reported a higher percentage of injuries to the lower limbs than did regular Army personnel; soft tissues, muscles, and tendons were the most common structures affected. These injuries occurred more frequently during combat training, with muscular stress while lifting, carrying, or donning equipment and falling being the most common mechanisms. When the reduced chronic conditioning, training time, and military-style training undertaken by Army Reserve personnel are considered, these differences are understandable.

These findings provide valuable guidance for commanders, athletic trainers, physical therapists, strength and conditioning coaches, and safety personnel as they seek to identify key injury risks and their sources and to manage injury risks in Army Reserve personnel. The results suggest that priorities for injury risk management in Army Reserve personnel should be combat training, manual handling, and patrolling and particularly the mechanisms of injury involving lifting, carrying, and donning equipment and falling. Based on the patterns of injury we identified and existing knowledge of injury causes, activities, and mechanisms, optimization of physical preparedness to undertake these tasks without injury is likely to be 1 important element of any injury risk-management approach for Army Reserve personnel. However, it will also be important to examine the potential contributions of task and environmental design,[10,11] especially when the tasks are for training purposes, because task and environmental designs can likely be controlled and optimally developed to match training stage and trainee skill levels to a much greater extent than in operational contexts.

We recognize that it would be optimal for Army Reserve personnel to be exposed to the same conditioning practices as full-time personnel, yet the nature of part-time service limits this potential. Our research showed little difference between full-time and Reserve personnel in proportions of injuries sustained during physical training but notable differences in proportions of injuries sustained during combat training, manual handling, and patrolling.

One potential reason for these differences may be a lack of specificity of the physical training undertaken by Reserve personnel. For example, Reserve personnel may run or train in a gymnasium, doing resistance training or group exercises, and as such, have a good level of general fitness. However, it is less likely that they would engage in combat-oriented fitness that involves load carriage and the manual handling (lifting and carrying) of heavy loads. The importance of this specific conditioning cannot be underestimated. Based on previous literature,[28] load-carriage conditioning for military personnel should occur on a weekly basis. With the potential for Reserve personnel to attend military exercises only monthly or even yearly, this conditioning would need to be conducted outside of formal military training.

Given that the wearing of actual combat loads in public places without broad-based forewarning of the general public regarding the purpose of the military exercise would not be acceptable, the athletic trainer, physical therapist, or strength and conditioning coach could steer sessions toward those that involve alternative, less publicly alarming forms of load carriage, such as orienteering, rogaining, and hiking. Similarly, emphasis should not only be placed on lifting loads but also on carrying them: for example, a farmer's carry could be incorporated into a session. Finally, the overall training would still need to include elements of metabolic (aerobic) fitness and muscular strength, power, and endurance, not only for injury prevention but also for optimal task performance.[29,30]

If physical-training sessions are to be integrated and include both full-time and part-time personnel, the athletic trainer, physical therapist, strength and conditioning coach, and other key advisors would need to recognize that, although both groups may present with similar levels of fitness during general physical training activities, the Reserve personnel may be less conditioned for combat-oriented training. To facilitate training in light of this conditioning difference, Reserve personnel initially may need to carry lighter loads than full-time personnel during a combat conditioning session and be provided with a more gradual increase in load to account for the potential lack of chronic combat-oriented conditioning.

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