ORIGINAL ARTICLE

# Employment retention after moderate-severe traumatic brain injury (TBI) in the British Army 1989–98

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*Occup Environ Med* 2004;**61**:414–418. doi: 10.1136/oem.2003.007336

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Accepted 14 October 2003

**Aims:** To examine retention in employment of subjects with moderate-severe traumatic brain injury (TBI) in the British Army.
**Methods:** Comparative groups study of retention in Army employment after TBI using 564 TBI, 368 lower limb fracture, and 25 575 healthy subjects. Kaplan-Meier survival analysis was used to examine, stratifying for age, continuation in Army employment for six years after TBI.
**Results:** Subjects in the younger groups (mean ages 23 years and 27 years respectively) with either TBI or lower limb fracture remained in employment longer than healthy peers (median time for TBI, 3.91 years, lower limb fracture, 4.39 years, and healthy, 1.74 years). This trend changed through age stratification and for older subjects the reverse pattern was seen. In group 4 (mean age 41 years), median retention time for TBI was 3.33 years, for lower limb fracture, 3.75 years, healthy 5.55 years. Older subjects also showed a marked drop out rate at one year after injury; 32.7% of those with TBI in group 3 (mean age 31 years) had left Army employment at the end of year one compared with 19% in age group 1 (mean age 23 years).
**Conclusions:** Younger soldiers with either TBI or lower limb fracture are retained in Army employment longer than their healthy peers. This may be due to sheltered employment, the availability of ongoing support, or transience of the healthy population. Since these results were drawn from incidence data on moderate and severe TBI it may be that those who serve on after TBI will do so with some degree of disability which affects occupational performance. There may be a significant unmet rehabilitation need for this group which is the focus of ongoing research.

Occupational outcome after traumatic brain injury (TBI) has been systematically studied in the civilian population. It is considered an important index of outcome, although in the literature return to work rates vary from 10% to 80%.[1–3] Besides severity of injury, studies have shown a variety of other factors to be of prognostic value. These include a range of pre-injury traits such as educational level and personality as well as post-injury impairments, activity limitation, and participation issues.[4–8] After TBI it is frequently social and behavioural disabilities that persist and contribute to social morbidity.[9–15] These impact on employment in terms of gaining and sustaining work after injury.[7 16–18] Many brain injured persons return to employment after injury, but it is often in a less demanding role. Success rates are higher for return to work in manual and clerical roles than in management or leadership posts.[7 19]

There have been no studies into the occupational outcome of TBI in the British Armed Forces. However, a study of the incidence of TBI in the Armed Forces has recently been carried out since it was felt that the incidence of TBI in the Armed Forces may be higher than in the civilian population.[20] Consequently, this may be a significant problem, operationally, for the Forces in terms of persisting morbidity and the effect this may have on operational performance. The study showed that the rates of moderate and severe injury are rising. However, a significant proportion of these individuals returned to military employment. Operational performance is of importance to the Armed Forces since individuals are not only required to undertake a variety of roles found in civilian occupations, but also to carry out duties in hostile and combat situations.

The aim of this study was to examine occupational outcome in the Army in terms of retention in employment after TBI. The hypothesis was that TBI would reduce the length of employment in the Army.

## METHODS

This was a retrospective cohort study of continued employment in the British Army after injury. Data were obtained from the Defence Analytical Services Agency (DASA) and consisted of a list of 8193 Service personnel who had sustained a TBI according to the International Classification of Disease 9th and 10th revision (ICD 9, ICD 10) between 1989 and 1998. Data were captured from Ministry of Defence Medical Forms Fmed7 (outpatient record) and Fmed14 (inpatient record), which were completed on admission of individuals to medical centres or hospitals and returned to DASA. The completed database contained names and Service numbers for all subjects included by this process. For the analysis of retention in employment post-TBI a closed cohort of all recorded Army TBI subjects injured in 1994 was selected (564 subjects, 18 female). Army subjects were studied because of the difficulties of obtaining data from all three Armed Forces; the data were, however, felt to be appropriate since the Army is the largest of the three. The year 1994 was chosen to allow for a six year follow up period to elapse. Two further subject databases were provided by DASA: all recorded Army personnel who sustained a lower limb fracture in 1994 (368 subjects, 18 female), and all healthy Army subjects (25 575, 1348 female). Subjects were deemed healthy if, up to 1994, there had been no record of injury prior to that point. The only information held by DASA on this group of subjects were entry medical documents (Fmed1 or Fmed2). This group contained subjects who had

**Abbreviations:** DASA, Defence Analytical Services Agency; PES, Physical Efficiency Standards; TBI, traumatic brain injury

## Main messages

- Older Service personnel who return do not remain in military employment for as long as their healthy peers.
- Younger soldiers who return to work after brain injury remain in military employment longer than their healthy peers.
- A number of those who return to work after sustaining brain injury continue in employment with varying types and degree of ongoing disability.
- There is likely to be an unmet management and/or rehabilitation need.

## Policy implications

- There is a requirement for occupational screening and/or assessment for younger people prior to returning to work after TBI.
- Ongoing support and rehabilitation services within the workplace are necessary for those returning to work after TBI to ensure productive employment outcome.

no significant co-morbidity associated with being unable to carry out their roles. If this had been the case, an Fmed7 or Fmed14 would have been completed and forwarded to DASA, thus excluding these subjects from the healthy group. All subjects in the three groups had served for at least one year prior to 1994 excluding basic training, and were fully fit prior to 1994. These criteria were to minimise confounding the outcome by existing injuries. TBI subjects were selected if they had associated ICD codes for TBI in the absence of other injury codes. This was also the case for those with lower limb fracture. For each subject, DASA provided annual Physical Efficiency Standards (PES) ratings annually post-1994. These ratings denote fitness for employment. Absence of codes was used to indicate that a subject had left military employment. PES ratings are not conducted by means of an annual test although all soldiers receive an annual PES rating. Twenty two years is the maximum career length for soldiers, although personnel may leave at any time prior to this. On joining the Army, soldiers undergo a medical examination and are graded as fully fit for all duties. The medical examination is repeated at ages 30 years, 35 years, 40 years, and every three years after the age of 40. The PES score is to inform the employer of a soldier's physical capabilities which denotes what type of work he/she can do. At any time, if injury or illness causes incapacitation, the medical grade is lowered and employability changed, that is, the PES score alters. Therefore, soldiers are annually graded fully fit until an injury or illness that changes their medical grade occurs. Thus, absence of PES codes can only denote that a soldier has left the Service. It is unusual for errors to occur with this as on termination of Service, salary ceases. In addition, all alterations in medical grading are sent to DASA as is termination of employment for whatever reason, including death. Consequently it is felt to be a robust method of data capture.

In order to examine retention in employment, Kaplan-Meier survival analysis was performed, stratifying for age. Age was split into the following groups: 16–24 years, 25–28 years, 29–33 years, 34 years and above. These were chosen to reflect different career stages in the Army. For soldiers who serve for 22 years, the career promotional progression roughly follows these age bands with more seniority and managerial responsibility acquired at each stage. From the point of injury (within the year 1994) subjects were followed up for six years. Subjects who died at the time of injury were included in this study. Individual data were censored at the time of death of if they were still in the Army after the six year follow up point. The log rank test was used to compare differences in survival between the groups, adjusting for age.

## RESULTS

Retention in Army employment (expressed as survival) is presented in fig 1 and summarised in table 1. Highly significant differences were detected between groups ($p < 0.001$). In terms of continuing Army employment, the most significant differences between healthy and injured subjects were in the youngest and oldest age groups.

In age group 1, the youngest group (mean age 23 years), healthy subjects left the Army earlier than subjects in either of the two injury groups. The median survival time was 1.74 years for healthy subjects, 3.91 years for subjects with TBI, and 4.93 years for those with lower limb fractures (table 1).

In age group 4, the oldest (mean age 41 years), healthy subjects served for the longest period of the three groups; median survival time 5.55 years. This compared with a median survival time of 3.75 years for those with lower limb fracture and 3.33 years for those with TBI (table 1).

The greatest proportion of numbers of TBI subjects leaving employment were noted in the cohorts in age groups 3 and 4 (mean ages 31 years and 41 years respectively) (see fig 1). In age group 3 the proportion of subjects with TBI who had left by the end of year 1 was 0.33 (compared with 0.19 of the lower limb fracture group and 0.14 of the healthy group), while in age group 4 the proportion was 0.31 (compared with 0.15 in the lower limb fracture group and 0.2 in the healthy group).

The TBI cohort in age group 4 (mean age 41 years) show the lowest pattern of employment retention with a proportion of 0.69 continuing to serve beyond one year, compared with proportions of 0.85 in the fracture group, 0.8 in the healthy group, and a proportion of 0.19 still in employment at year 6, compared with proportions of 0.26 in the fracture group and 0.48 of the healthy subjects.

## DISCUSSION

This is the first study of employment outcome of moderate-severe TBI in the British Armed Forces and has yielded surprising results in that younger injured soldiers who return to Army employment after TBI continue in the Service for longer than their healthy peers, showing that, for this group, length of employment after TBI is not reduced. However, for older people the reverse is seen.

The principle limitations of this study lie in the accuracy of the original data obtained from DASA in that these are only compiled on Service personnel who were admitted to hospitals or medical centre wards and is not, therefore, inclusive of all TBI in the Armed Forces. Those with milder injuries, for whom no inpatient management is required, are not included in the data capture and we have no estimate of the failure of case capture from the method used here. Moreover, there is anecdotal evidence of incomplete data capture at both a clinical level in terms of accurate diagnosis of TBI and medical statistics compilation level in that not all records of TBI reach the medical statistics compilers. The data presented here probably represent more accurately the employment retention outcomes of military subjects with moderate or severe TBI. If mild TBI had been comprehensively included in

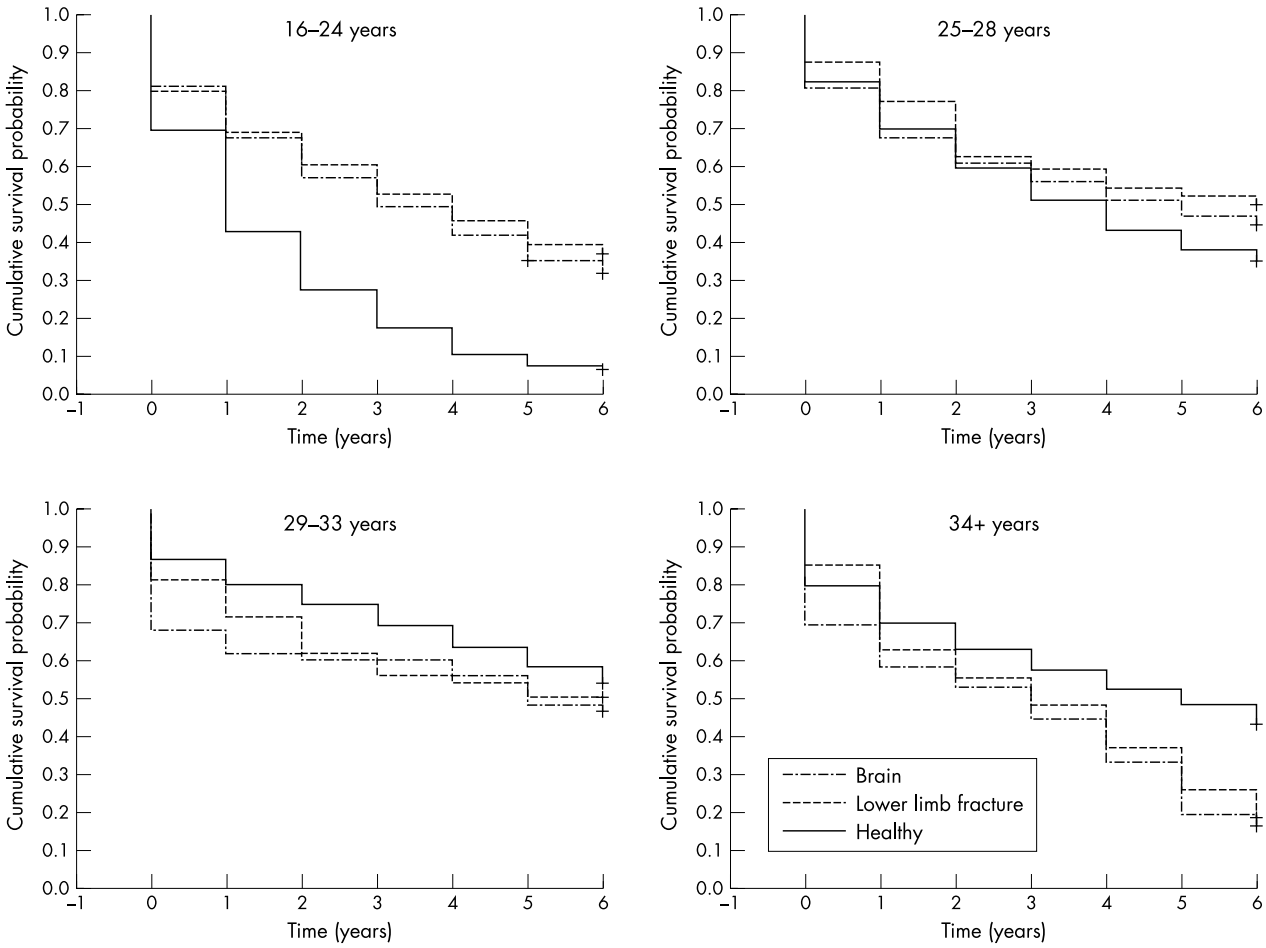


**Figure 1** Survival plots for injury groups stratified by age.

the data collation, the employment retention survival analysis would have been more representative of the spectrum of severity of TBI. However, it could reasonably be anticipated that those with mild TBI would have an increased likelihood of returning to work post-injury and therefore the overall employment retention trends would not have been vastly different from those presented here. Length of service of individuals is a potential confounder since younger soldiers serving a minimum term may be more typical of the type of person to sustain TBI. Those who serve a full term of 22 years may be more career orientated in terms of gaining seniority and/or may be in more technical professions within the Army. Similarly, trade (type of employment) could confound the findings since TBI will have varying effects on employment performance in different roles. No data were collected on this for this study. In addition, severity of injury may have affected the results. While all subjects were hospitalised, suggesting a degree of

**Table 1** Mean survival in employment times by injury group and stratified by age

| | | Survival in employment | Survival in employment at year 1 | | Survival in employment at year 6 | |
|---|---|---|---|---|---|---|
| **Group** | **Age** | **Median*** | **Proportion** | **SE** | **Proportion** | **SE** |
| TBI | 16–24 | 3.91 | 0.8102 | 0.0209 | 0.3508 | 0.0254 |
| Lower limb fracture | | 4.93 | 0.7960 | 0.0284 | 0.3930 | 0.0345 |
| Healthy | | 1.74 | 0.6986 | 0.0057 | 0.0747 | 0.0033 |
| TBI | 25–28 | 5.3 | 0.8049 | 0.0357 | 0.4715 | 0.0450 |
| Lower limb fracture | | 6.0+ | 0.8750 | 0.0353 | 0.5227 | 0.0532 |
| Healthy | | 4.16 | 0.8224 | 0.0047 | 0.3804 | 0.0060 |
| TBI | 29–33 | 5.75 | 0.6731 | 0.0651 | 0.4808 | 0.0693 |
| Lower limb fracture | | 6.0+ | 0.8077 | 0.0547 | 0.5000 | 0.0693 |
| Healthy | | 6.0+ | 0.8623 | 0.0045 | 0.5806 | 0.0065 |
| TBI | 34+ | 3.33 | 0.6944 | 0.0768 | 0.1944 | 00660 |
| Lower limb fracture | | 3.75 | 0.8519 | 0.0684 | 0.2593 | 0.0843 |
| Healthy | | 5.55 | 0.7976 | 0.0049 | 0.4801 | 0.0061 |

*Significant difference between groups ($p<0.001$, log rank test).

severity, ICD diagnostic codes varied from intracranial injury to concussion. It is acknowledged that ICD coding is a subjective procedure and often inaccurate. This was not analysed here. The principle of strength of this study is in the strong and robust design. This was a large population based prospective analysis with robust data capture. There is good evidence to suggest, for example, that PES codes were accurately allocated. In addition, left censorship bias was avoided by including those who had died at the point of injury.

The results of this study suggest that younger soldiers with either moderate-severe TBI or lower limb fracture serve longer in Army employment than do those who are healthy. Most Service personnel join up between the ages of 17 and 19 years of age and stay for approximately four years, so it is perhaps not surprising to see a steady drop out of employment in the healthy group, although in the youngest age group the median survival in employment for healthy subjects was just 1.7 years. This appears to be an accurate calculation since the PES ratings are robust and allocated to all serving personnel. However, this drop off is not reflected in either injured group. TBI incidence data[20] which reflect moderate and severe injury suggest that, while some personnel either die or are medically discharged, a significant proportion continue in Service employment. Prevalence of disability in this group is unclear but it is likely that, with the level of injury described, a proportion of those who serve on will do so with some degree of disability. This explanation would mean that after injury an active decision is taken to remain in the Army on the part of the subject or Service. Further research is ongoing to determine the capacity in which these injured personnel serve on and to examine the number that do so medically downgraded. Continued employment in a medically downgraded capacity would indicate ongoing difficulties and there is likely to be a significant unmet rehabilitation or management need for this group. As age increases a greater fall is seen in the injured cohorts, particularly for those with TBI. This fall could be due to subjects in these groups being older and in employment positions of responsibility. Army personnel in their mid 20s will by this time often be in Junior Non-Commissioned Officer ranks or Junior Officer positions which carry leadership and managerial responsibilities. It is well documented in the literature that those with TBI do less well in managerial positions due to increased demands on communication, cognitive, and executive skills.[21–23] It is deficits in these skills that tend to persist after TBI, precluding success in vocational roles that rely on these skills being intact.[24–26] Thus the fall off seen could correspond to an increase in medical discharge rates for those in these positions and ranks. The very significant fall off in the TBI group at one year, in the older cohorts, appears to support this theory since this could either be indicative of medical or administrative discharge after moderate or severe injury without the subject returning to work, or discharge from the Army after a period back at work during which time the subject was unable to perform to the standards required. The lower limb fracture group does not show this effect in any of the age groups, suggesting that vocational failure due to the difficulties mentioned may be exclusive to those with TBI. The plateau in the TBI survival curve in group 3 (mean age 31 years) may be explained by protected employment status. Once individuals are in their 30s they are likely to be in Senior Non-Commissioned Officer (SNCO) positions or Senior Officers and may have been in the Army for up to 15 years. Employers may take the decision to keep some senior personnel on in supported, downgraded roles until their retirement dates. Most SNCOs retire from the Army after 22 years, usually in their mid 40s. Consequently, in the oldest age group (mean age 41 years) some of the fall off observed for subjects will be due to their run out date occurring. Thereafter, the curve is representative of those (particularly Senior Officers in their late 40s) being protected in their jobs. Generally, there is an element of sheltered employment in the Army. If a job exists that a soldier with an injury can do, or can undertake in a downgraded capacity, they may be retained in employment provided they can perform to the standard required. If not, they are medically discharged from the Service.

It is possible from the results of this study to suggest some cautious parallels with the civilian population. In the civilian population it is frequently young males with risk taking lifestyles who are at the greatest risk of sustaining TBI.[27] This personality type is strongly represented in the make-up of the Army. However, the Army is a selective population and without further research conducted on civilians, wider generalisations cannot be upheld.

In conclusion, it seems that young soldiers are being retained in employment with possible ongoing difficulties, while older soldiers with TBI are being lost to the Service. Both probably have unmet vocational rehabilitation needs. We plan to conduct further research into these issues and to also evaluate the unmet requirement for rehabilitation, support, and education.

## ACKNOWLEDGEMENTS

We thank Dr Chris Martin (neuroepidemiologist) and Dr Clive Osmond (statistician), MRC Applied Epidemiology Unit, Southampton General Hospital, for their help and advice with this study.

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# ECHO

## Low job control and myocardial infarction risk

Please visit the *Occupational and Environmental Medicine* website [www.occenvmed.com] for a link to the full text of this article.

Many studies have shown an association between low job control and increased risk of myocardial infarction. Some have emphasised the importance of the combination of high psychological demand and low control (job strain) but in other studies only low control and not job strain, has seemed the important factor. Researchers in Lithuania have again found low job control to be more important than job strain and to be operative throughout all occupational categories.

They performed a case-control study with 203 cases and 287 controls. Cases were men aged 25–64 years who had survived a first myocardial infarction between 1 October 2000 and 30 September 2002. Controls were men without evidence of coronary disease matched with cases for age and living in the same 12 districts of the city of Kaunas. Cases and controls were interviewed at their local hospitals by doctors who used a standardised questionnaire. Psychosocial job demands and job control were assessed using the scoring system of the Swedish version of the Karasek demand-control questionnaire. Median scores for job demands and job control were 11 and 14 respectively and scores above and below these levels were classified as high and low. Occupations were categorised according to the International Standard Classification of Occupations, (10 categories, 0–9).

The risk of myocardial infarction was greatest in occupational categories 1 (legislators, senior officials, and managers) and 8 (plant and machine operators and assemblers) who had a 93% and a 58% increase in risk compared with the lowest risk group (category 7, craft and related trades workers). Adjustment for conventional coronary risk factors did not change these findings. Scores for job demands and job strain (ratio of job demands to job control) were similar in cases and controls. Low scores for job control, however, were associated with a more than two fold increase in risk of myocardial infarction and the effect was similar (odds ratios (ORs) 2.23–2.78) throughout all occupational categories.

In prosperous western countries high risk of coronary disease is related to high job strain and low social position. In a transitional country of the former Soviet bloc low job control seems more important than job strain and operates throughout the social scale and through all occupational categories.

▲ *Journal of Epidemiology and Community Health* 2004;**58**:131–135.