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Cognitive ability and risk of post-traumatic stress disorder after military deployment: an observational cohort study

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Background
Studies of the association between pre-deployment cognitive ability and post-deployment post-traumatic stress disorder (PTSD) have shown mixed results.

Aims
To study the influence of pre-deployment cognitive ability on PTSD symptoms 6–8 months post-deployment in a large population while controlling for pre-deployment education and deployment-related variables.

Method
Study linking prospective pre-deployment conscription board data with post-deployment self-reported data in 9695 Danish Army personnel deployed to different war zones in 1997–2013. The association between pre-deployment cognitive ability and post-deployment PTSD was investigated using repeated-measure logistic regression models. Two models with cognitive ability score as the main exposure variable were created (model 1 and model 2). Model 1 was only adjusted for pre-deployment variables, while model 2 was adjusted for both pre-deployment and deployment-related variables.

Results
When including only variables recorded pre-deployment (cognitive ability score and educational level) and gender (model 1), all variables predicted post-deployment PTSD. When deployment-related variables were added (model 2), this was no longer the case for cognitive ability score. However, when educational level was removed from the model adjusted for deployment-related variables, the association between cognitive ability and post-deployment PTSD became significant.

Conclusions
Pre-deployment lower cognitive ability did not predict post-deployment PTSD independently of educational level after adjustment for deployment-related variables.

Declaration of interest
None.

Military personnel deployed to conflict and war zones are exposed to potentially traumatic events and are at risk for post-traumatic stress disorder (PTSD).[1] Recent research indicates that PTSD may be a highly prevalent disorder among service men and women returning from military deployments, with prevalence estimates as high as 14–16%.[2–4] PTSD is associated with individual suffering, considerable cost for the society and risk of separation from the military.[5] Consequently, there have been calls for the implementation of screening programmes to detect and exclude psychologically vulnerable service members with a higher risk of developing PTSD and other mental problems after deployment.[6] One approach to achieving this goal is through pre-deployment mental health screening. A study of 1885 British military personnel found that administration of a mental health questionnaire before deployment to Iraq was of very little value in identifying soldiers at risk of PTSD and other psychological problems on return from deployment.[7] This result indicates that mental health screening before deployment has a low predictive value when used as a separate measure. A possible better approach is to supplement screening measures with early identification of individual, social and trauma-related and deployment-related risk or protective factors for PTSD. Thereby, a risk profile for a soldier returning from deployment could be generated and used as a tool in assessing the need for intervention.

A recent meta-analysis of risk factors for PTSD among military personnel identified 18 significant risk factors for PTSD among deployed military personnel and veterans, including pre-deployment factors such as female gender, low education, non-officer rank and prior exposure to trauma and adverse life events.[8] However, the meta-analysis did not include information on cognitive ability which other studies have identified as a possible risk factor for PTSD.

Thus, in an earlier meta-analysis by Brewin *et al*[9] which among other studies included six studies on cognitive ability and PTSD, low cognitive ability was a risk factor for post-deployment PTSD with a weighted effect size of 0.18 (Pearson's *r*). Similarly, lack of education was a risk factor (*r*=0.10). Later studies of Vietnam War veterans examining the association between cognitive ability evaluated at entry in the military and the risk of developing PTSD have shown mixed results. Kremen *et al*[10] found that higher cognitive ability evaluated by the Armed Forces Qualification test (AFQT) significantly reduced the subsequent risk of post-deployment PTSD after controlling for age, education at entry in the military, parental education and combat exposure; odds ratio (OR) for the highest AFQT quartile versus the lowest was 0.52, 95% confidence interval (CI) 0.37–0.73. Another Vietnam War veteran study showed that higher pre-deployment scores on cognitive tests were significantly protective against development of post-deployment PTSD, but the association disappeared after adjusting for combat exposure.[11] In a recent study of 428 Danish soldiers deployed to Afghanistan, an inverse association was found between cognitive ability evaluated with the standard conscription board test and high level of PTSD symptoms 2.5 years post-deployment after adjustment for PTSD symptoms at baseline, pre-deployment traumatic life events, education at entry in the military and combat exposure.[12] Hence, it seems that pre-deployment low cognitive ability may be a risk factor for PTSD independent of educational level, that is, low cognitive ability seems to be associated with

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PTSD, and the association remains after controlling for educational level. However, the mixed results call for further studies with larger populations and adjustment for other potential risk factors and confounders.

As administration of a test of cognitive ability is part of the conscription or recruitment procedures in several countries,[10] including Denmark,[13] and educational level of conscripts is easy to ascertain by self-report, it is of interest to evaluate the potential usefulness of an objective test measure of cognitive ability in combination with other accessible pre-deployment factors in identification of vulnerable individuals. Therefore, the aim of this study was to assess (1) whether low cognitive ability at conscription was associated with PTSD after deployment independent of educational level, (2) the effect on this association of risk and protective factors during and immediately after deployment and (3) the performance of cognitive ability at conscription in young adulthood as a test of post-deployment PTSD.

Method

Study design and population

This was an observational cohort study linking pre-deployment conscription board registry data recorded prospectively with post-deployment self-report data. The study population consisted of Danish Army military personnel deployed to different war zones including the former Yugoslavia, Iraq and Afghanistan between 1997 and 2013.

Data sources

The study included data from several sources collected pre-deployment and post-deployment. Information on cognitive ability was gathered before deployment at the conscription board examination where the conscripts' mental health and physical health are evaluated. The evaluation includes a test of cognitive ability called Børge Prien's Prøve (BPP; Børge Prien's test[13]) and measurements of height and weight. The test result and measurements as well as self-reported data including educational level are recorded by the conscription board. Conscription board data were available from two sources; the Danish Conscription Database (DCD) and the conscription registry in the Danish Defence Personnel Organisation (DPO). DCD is a cohort with conscription board examination variables from nearly all Danish men born between 1939 and 1959 and examined from 1957 through 1984 (n=728 160).[14] The Department for Conscription and Recruitment in the DPO has recorded key data from conscription board examinations since 1995 (n=681 498). Relevant conscription board data from 1985 through 1994 were not available.

Since 1998, deployed Danish Army military personnel have been invited to complete the Psychological Reactions following International Missions (PRIM) questionnaire with information on their mission experience and psychological well-being 6–8 months after return from deployments. The PRIM questionnaire includes questions on demographics, military rank, perceived social support during and after deployment, perceived war-zone stress during deployment and psychological symptoms in the most recent 3 months in the following domains: PTSD, depression, arousal, dissociation, social relations, aggression, avoidance, sleeping problems and somatic symptoms. The response rate for the PRIM questionnaire is approximately 65%, resulting in self-reported data of deployment-related psychological consequences from about 20 000 deployments of nearly 14 000 Danish Army military personnel in the period 1997–2013. The results from the completed questionnaire have been digitised and stored in the PRIM database maintained by the Danish Veteran Centre.

The study population was created by merging the above mentioned data sources. A limiting prerequisite for establishing the study population was complete data on the variables BPP total score and educational level at the conscription board examination. The study was approved by the Danish Data Protection Agency. As the study was based solely on registry and questionnaire data, no approval from the Committee on Health Research Ethics was needed.

Pre-deployment exposure variables

The main pre-deployment exposure variable of interest was the total score of the BPP test of cognitive ability. BPP consists of four subtests each with about 20 items (78 in total), designed to assess logical, verbal, numerical and spatial reasoning. The test is timed (45 min in total), and the total score is the number of correct answers to the 78 questions. A score of at least 28 correct answers is a prerequisite for military service.[15] The BPP has been shown to have satisfactory reliability and validity.[15] In our study population, the BPP test score has been converted by linear transformation to a score with a mean of 100 and a standard deviation of 15 to obtain a more familiar metric. This transformed score is referred to as the *cognitive ability score*.

Other variables recorded prospectively were gender and educational level at conscription. The latter variable was coded in two categories: (1) low and middle level education comprising primary school, secondary school (unfinished) or vocational training and (2) high-level education comprising secondary school (completed) or higher education.

Deployment-related variables

The deployment-related variables were obtained from the PRIM-database. The following variables were registered: age at deployment, marital status, military rank during deployment, perceived social support during and after deployment, perceived war-zone stress and deployment region. Social support before and after deployment was calculated by the sum of five items each with a 1 to 4 Likert response format (1=completely correct, 2=almost correct, 3=correct to some extent, 4=not correct), and dichotomised by the median in the categories 'high social support' and 'medium-low social support'. The five items covering social support were as follows: (1) in your group you showed interest in each other during deployment; (2) in your group you talked about unpleasant events experienced during deployment; (3) you were supported and encouraged by your closest superior during deployment; (4) you experienced substantial support from family/friends after homecoming; (5) you could share your worries and problems with family and friends after homecoming. Cronbach's alpha for the social support scale was calculated. Perceived war-zone stress during deployment was measured by the danger/injury exposure score (range 10–40) developed by the Danish military.[12,16] The score was composed by the following items: during the deployment, did you experience (1) being threatened with a weapon, (2) being shot at, (3) being in areas with road-side bombs or mines, (4) passing areas with combat activities, (5) aggressive behaviour from the locals, (6) witnessing distress among the locals, (7) seeing wounded people, (8) seeing dead people, (9) being witness to assaults on civilians, and (10) insufficient reinforcement or relief? The response format was as follows: 1 = never, 2 = seldom, 3 = fairly often and 4 = almost daily.

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Cronbach's alpha for the score was calculated. Perceived war-zone stress score was categorised by tertiles in three groups: low (score between 10 and 13), medium (score between 14 and 19) and high (score of 20 or above).

Outcome variables

From the completed PRIM questionnaire, it was possible to construct a scale of the level of PTSD symptoms. The scale assesses symptoms in the past 3 months based on the DSM-IV criteria for PTSD and contains 12 questions in a Likert response format ranging from 1 (never) to 4 (very frequent). The total score for post-traumatic stress was the sum of all 12 questions. Higher scores indicated more symptoms (range 12–60). This scale of PTSD (PRIM-PTSD) has been validated against the PTSD checklist, civilian version (PCL-C),[17] by analysing between-measure correlations and the factor structure of PRIM-PTSD. By the application of receiver operating characteristics (ROC) curve analysis with a PCL-C cut-off score 44 as the criterion variable, the PRIM-PTSD was demonstrated to be useful as a dichotomous measure of low/high PTSD symptomatology.[18] The findings of the ROC curve analysis indicated that the dichotomous PRIM-PTSD could be used with two cut-offs: possible PTSD (cut-off score 24.5) and probable PTSD (cut-off score 29.5). Possible PTSD could detect cases with a high symptomatology with reasonable specificity (0.93) and perfect sensitivity (1.00), whereas probable PTSD had a higher specificity (0.98) and lower but acceptable sensitivity (0.71).[18]

Statistical analysis

For study participants with multiple deployments, outcome data were correlated, and consequently, data were analysed with multilevel logistic regression models allowing for repeated measures. The explained variance of all models was evaluated using McFadden's pseudo *R*-squared statistic.[19] Cognitive ability was expected to correlate moderately or even strongly with educational level because educational attainment could represent essential aspects of cognitive ability and could thereby have a moderating influence on the association between cognitive ability and the outcome.[20] For interpretative purposes, the following analysis strategy was applied. For both outcomes (possible PTSD and probable PTSD), two models with cognitive ability score as the main exposure variable were created. First, one model (model 1) with adjustment for only prospectively recorded variables (gender and educational level at conscription) was analysed. Second, a more general model (model 2) adjusted for both prospectively recorded variables and the deployment-related variables (age at time of deployment, marital status, military rank, social support during and after deployment, perceived war-zone stress and deployment region) was analysed. Finally, to assess how the cognitive ability score was associated with post-deployment PTSD without an eventual moderating effect of educational level, a version of model 2 without inclusion of educational level was analysed. During model development, tests of interactions of cognitive ability score with educational level, military rank and perceived war-zone stress, respectively, were conducted. To evaluate to what extent cognitive ability score could contribute to the prevention of post-deployment PTSD, we examined the performance of the score as a test for post-deployment PTSD by conducting ROC curve analysis for both outcomes. As the test variable, we used the *inverse* of the cognitive ability score, because increase in the score decreases the risk of post-deployment PTSD.

The results of the statistical analysis are presented in the tables as OR with 95% CI. The nominal statistical significance level was 0.05. Analyses were performed in STATA 12 (Stata Corporation, College Station, Texas; www.stata.com).

Results

The study population totalled 9695 participants, of which 9072 participants came from the DPO data and 623 participants from the DCD. The total number of deployments for the study population was 13 204, resulting in an average of 1.4 deployments per participant.

The average age at time of conscription was 19.6 years (s.d.=1.52 years). The cognitive ability score in the total population and by pre-deployment and deployment-related variables including possible and probable PTSD is presented in Table 1. The average cognitive ability scores differed by birth cohort, but only substantially for the small subcohort born 1961–70 while the variance was smaller for the more recent subcohorts. There were also notable differences in mean cognitive ability score between levels of education, levels of military rank and levels of post-deployment PTSD symptoms. The percentages indicating possible PTSD and probable PTSD were 8.1% and 2.6%, respectively. Cognitive ability score and educational level at the time of conscription were moderately correlated (r=0.46). Cronbach's alpha for the social support scale was 0.71, and for the perceived war-zone stress score it was 0.82.

Table 2 shows the OR of cognitive ability score and the other variables associated with possible PTSD and probable PTSD, respectively. Interaction terms were not significant in any of the models. The pattern of results from the analyses described below was similar for both outcomes, possible PTSD and probable PTSD. In the model including only variables known at the time of conscription (cognitive ability score and educational level) and gender, all variables were significantly associated with the outcome (model 1). In the model including mutual adjustment for deployment-related variables, the association between cognitive ability score and outcome was attenuated and no longer significant but the association between educational level and outcome remained (model 2). When removing educational level from model 2, the association between cognitive ability score and outcome became significant: for possible PTSD, the OR for the cognitive ability score was now 0.94 (95% CI 0.89–0.98), and for probable PTSD, the corresponding OR was 0.92 (95% CI 0.86–0.99), that is, the odds for probable PTSD is reduced by 8% for every half standard deviation (7.5) increase in the cognitive ability score (data not shown).

We performed ROC curve analysis for both outcomes, possible PTSD and probable PTSD (Fig. 1). As the test variable, we used the inverse of the cognitive ability score (CAS), because increase in CAS decreases risk of post-deployment PTSD. For possible PTSD, the area under the ROC curve (AUC) was 0.55. The cut-off point nearest to the point (0, 1) in the coordinate system had sensitivity 53.2% and specifity 53.4%. The positive predictive value (PPV) of this point was 9.1% and the negative predictive value (NPV) was 93.0%. Similarly, for probable PTSD, the AUC was 0.56. The cut-off point nearest to the point (0,1) had sensitivity 54.7% and specifity 53.1%. The PPV of this point was 3.0% and the NPV was 98.0%. Hence, for both outcomes, the AUC was below 0.60, showing that the test performance of CAS was very poor. The PPV for possible PTSD was a little better than for probable PTSD owing to the higher prevalence of the former.

Discussion

In this study, we examined whether low cognitive ability at conscription was associated with possible PTSD and probable PTSD after military deployment independent of educational level, and we investigated the effect of adjustment with deployment-related factors. We used prospectively collected pre-deployment data recorded during the conscription procedure and questionnaire data on risk

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Table 1 Cognitive ability score by total population, pre-deployment factors, deployment-related factors and level of post-deployment PTSD symptoms in 9695 Danish Army military personnel.

Cognitive ability score[a] by variables recorded at conscription (pre-deployment factors)	*n*[b]	Mean (s.d.)
Total population[a]	9695	100.6 (14.9)
Gender		
Male	9181	100.3 (14.9)
Female	514	102.6 (14.5)
Level of education at time of conscription		
Low or middle level	5756	95.6 (14.1)
High level	3938	107.7 (13.0)
Cognitive ability score[a] by variables recorded at deployment (deployment-related factors)	***n*[c]**	**Mean (s.d.)**
Age at deployment		
<25 years	7120	100.2 (14.5)
25–29 years	3735	99.5 (14.9)
30–39 years	1439	101.6 (15.4)
40–49 years	341	98.7 (19.2)
≥50 years	569	96.9 (17.9)
Military rank during deployment		
Private	8606	97.2 (14.9)
Non-commissioned officer, commissioned officer or civilian	4598	105.3 (13.6)
Marital status		
Married/partner	7776	99.7 (15.2)
Single	5428	100.4 (14.7)
Low-medium	7841	100.1 (15.2)
High	5363	99.9 (14.8)
Deployment region		
The Balkans	6521	99.9 (15.1)
Afghanistan	4487	100.1 (14.9)
Iraq	1958	100.2 (15.0)
Other	238	99.2 (16.0)
Perceived war-zone stress score		
Low (10–13)	3981	100.4 (15.4)
Medium (14–19)	5844	100.3 (14.9)
High (≥20)	3379	99.0 (14.7)
Possible PTSD (PRIM-PTSD cut-off 24.5)		
Score <24.5	11 922	100.3 (15.0)
Score ≥24.5	1053	97.6 (14.9)
Probable PTSD (PRIM-PTSD cut-off 29.5)		
Score <29.5	12 635	100.1 (15.0)
Score ≥29.5	340	96.7 (15.1)

a. BPP linear transformed to a scale with mean 100 and standard deviation 15.
b. Number of unique persons in the study.
c. The numbers in this part of the table are larger than the actual number of persons in the study because a person can have returned questionnaires from several deployments.

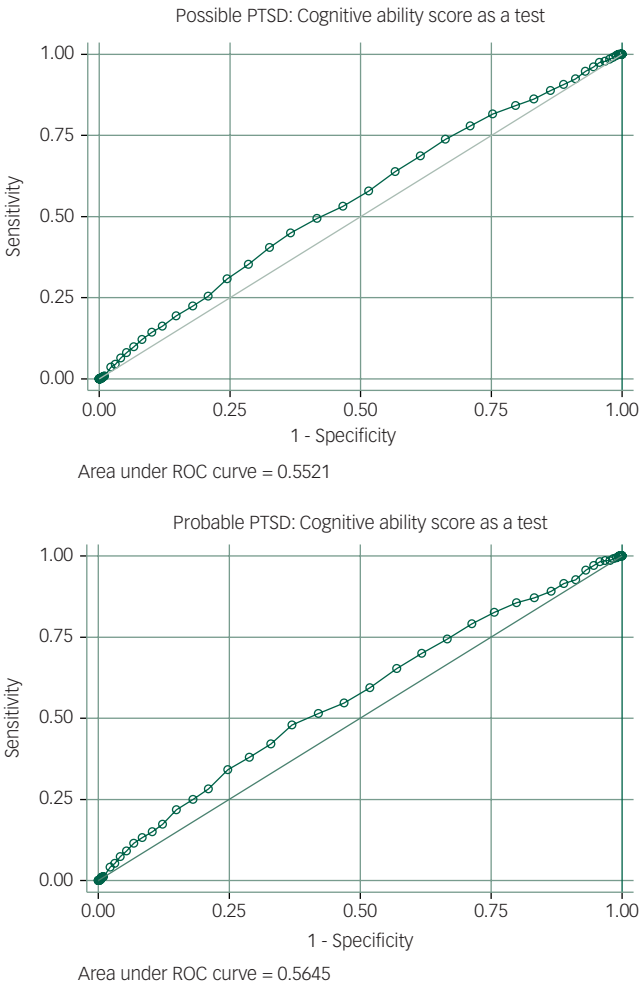

Fig. 1 Receiver operating characteristic (ROC) curve analysis for possible and probable post-traumatic stress disorder (PTSD).

factors and psychological reactions collected 6–8 months after deployment. When including only variables recorded pre-deployment (cognitive ability score and educational level) and gender, all variables predicted post-deployment PTSD. When deployment-related variables were added, this was no longer the case for cognitive ability score. However, when educational level was removed from the model adjusted for deployment-related variables, the association between cognitive ability and post-deployment PTSD became significant.

Studies in background populations have found low intelligence to be a general risk factor for a wide range of mental disorders later in life. [21,22] Cognitive models propose that PTSD develops when persons exposed to trauma have inadequate cognitive resources to manage their trauma memories and to engage in adaptive cognitive strategies to cope with the traumatic experience, that is, low cognitive ability may reflect mental vulnerability and contribute to the risk of developing PTSD.[23] Education and cognitive ability share common aspects, but are not perfectly correlated.[20] Educational attainment is associated with many life outcomes, including income, occupation and many health and lifestyle variables.[20] Different educational levels indirectly influence economic resources, social status, social networks and health behaviour, and low educational level has been shown to be an independent risk factor for post-deployment PTSD.[8] When factors recorded during deployment like military rank, social support and perceived war-zone stress were considered, the association found between cognitive ability at conscription and post-deployment PTSD became non-significant, whereas the association between the latter and educational level persisted. Therefore, an interpretation of our results is that military service members with a higher educational level may use better coping methods in relation to trauma exposure independently of their cognitive ability, because they have access to more resources

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Table 2 Association between outcomes possible PTSD and probable PTSD and cognitive ability score in Danish Army military personnel evaluated in two multilevel logistic regression models per outcome

	Outcome[a]			
	Possible PTSD		Probable PTSD	
	Model 1[b]	Model 2[c]	Model 1[b]	Model 2[c]
Independent variables	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Cognitive ability score[d]	0.90 (0.85–0.94)	0.97 (0.92–1.02)	0.89 (0.82–0.96)	0.97 (0.90–1.05)
Level of education at time of conscription				
Low or middle level	1	1	1	1
High level	0.73 (0.59–0.90)	0.64 (0.51–0.80)	0.63 (0.44–0.89)	0.54 (0.39–0.76)
Gender				
Male	1	1	1	1
Female	4.14 (2.86–5.99)	6.19 (4.23–9.05)	3.69 (2.11–6.44)	5.38 (3.15–9.21)
Age at deployment		1.00 (0.98–1.01)		1.01 (0.99–1.04)
Marital status at deployment				
Married or cohabitant		1		1
Single		1.08 (0.90–1.30)		1.11 (0.83–1.47)
Military rank at deployment				
Private		1		1
Non-commissioned officer, commissioned officer or civilian		0.45 (0.35–0.58)		0.49 (0.33–0.71)
Social support during deployment and after homecoming				
Low-medium		1		1
High		0.72 (0.60–0.86)		0.62 (0.47–0.83)
Perceived war-zone stress score[e]		1.25 (1.22–1.29)		1.28 (1.23–1.33)
Deployment country or region				
The Balkans		1		1
Afghanistan		1.65 (1.30–2.10)		1.34 (0.92–1.95)
Iraq		1.05 (0.80–1.39)		0.67 (0.42–1.06)
Other		0.82 (0.37–1.85)		1.21 (0.38–3.91)

OR, Odds ratio; CI, confidence interval. Possible PTSD: cut-off score 24.5 on PRIM-PTSD scale, used for screening. Probable PTSD: cut-off score 29.5 on PRIM-PTSD scale, used to identify suspected clinical cases.
a. Outcome recorded 6–8 months post-deployment.
b. Model 1: Adjustment for gender and level of education at time of conscript board examination.
c. Model 2: Model 1 with additional adjustment for deployment-related variables: age at deployment, marital status, military rank, social support during and after deployment, danger/injury score (perceived war-zone stress during deployment) and deployment country/region.
d. OR for cognitive ability score increased by half standard deviation (7.5) is shown.
e. OR for perceived war-zone stress score increased by one unit is shown.

as mentioned above, thereby reducing the risk of post-deployment PTSD. Not including educational level in the deployment-factors adjusted models had the effect of reappearance of a significant association with cognitive ability. As a consequence, the effect of early cognitive ability on post-deployment PTSD may be difficult to assess without taking educational attainment in consideration. In this study, we could not demonstrate an independent predictive role of cognitive ability for PTSD when including deployment-related factors.

The conclusions from a recent smaller study of Danish soldiers in Afghanistan measuring PTSD symptoms 2.5 years after deployment suggest that lower cognitive ability contributes independently to the increased risk of PTSD in the context of the hardships during military deployment.[12] This finding could not be corroborated by our results; an explanation of this disagreement could be that our study was based on a measurement of PTSD symptoms earlier post-deployment (6–8 months). However, late onset of PTSD symptoms has been shown to occur.[24] A recent study investigating the longitudinal development of PTSD symptoms up to 5 years post-deployment found a complex pattern with short-term increase in average post-traumatic stress symptoms within 6 months from homecoming, followed first by a decrease and later by a new increase within 5 years after return from deployment.[25] This indicates that associations of PTSD symptoms with pre-deployment factors could depend on time of measurement of the symptoms. Other studies have used different time points for measurement of PTSD symptoms including measurement many years post-deployment, and some studies use lifetime PTSD (not current PTSD) as the endpoint. This should be taken into consideration when comparing the effect of cognitive ability on the risk of developing PTSD symptoms found in this study with the results of other studies.[9–11]

In our models including only prospectively recorded variables, lower cognitive ability was significantly associated with PTSD, indicating the possible application of BPP in a screening procedure. In general, the prevention of post-deployment PTSD and other mental disorders by screening methods has proven difficult.[26,27] Although lower cognitive ability in some studies has been shown to be an independent risk factor for post-deployment PTSD,[9,10,12]

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our results indicate that tests such as the BPP are of little value in the prevention of PTSD symptoms after deployment to war zones, that is, the ROC curve analysis showed that the test performance of cognitive ability score was very poor in our study population. Thus, cognitive ability seems to be a factor among other mental traits and early life conditions including traumatic events,[8,9] which together with deployment-related factors potentially could contribute to the risk of developing PTSD at some time after deployment. Another recent study among a cohort of Danish soldiers deployed to Afghanistan indicates that more reliable early risk assessment of PTSD can be obtained by using the interplay of all available information on demographics, pre-deployment psychological characteristics including cognitive ability, trauma-related factors and early symptomatology, suggesting a promising direction for future research.[28]

Strengths and limitations

Compared with previous studies, the present study population was larger and spanned multiple deployments to different war zones during a period of 15 years. Further, the data included other relevant pre-deployment and deployment-related covariates and provided the opportunity for an in-depth investigation of the associations between prospectively assessed cognitive ability and PTSD. The study has several potential limitations. By design, it was a cross-sectional study based on a combination of prospectively recorded registry and self-report data obtained from questionnaires. The registry data are considered more reliable than the self-reported questionnaire data. The simultaneous recording of effect measures and risk information by questionnaires could lead to biased interdependency between the variables, and the data could be subject to recall bias. Consequently, the PRIM-PTSD measure may have limitations and should not be used as a way to diagnose individuals. However, based on tests of reliability, construct validity, factor structure and identification of cut-off scores against PCL, it is considered a valid measure of PTSD-symptomatology in Danish soldiers following deployment.[18] The prevalence of the outcome probable PTSD was quite low in our study which should be taken in consideration when assessing the results. The response rate for the questionnaire data was approximately 65% leaving open the possibility of response bias. However, we find the response rate acceptable because we analyse only within-cohort associations while not trying to make claims about, for example, the frequency of PTSD across cohorts. Another possible limitation is the 10-year period of missing conscription board data (1985–1994). This missing data reduced the power of the study, but it is not likely to reflect systematic selection or bias. Except from information on cognitive ability and education, we did not have data on other pre-deployment variables which could be risk factors for the development of post-deployment PTSD, that is, socio-economic factors, lifestyle, adverse life events in childhood and early trauma. However, with the exception of adverse life events, these factors contribute little to the total risk.[8] As the previous study of Danish soldiers deployed to Afghanistan[12] did not find that earlier traumatic events confounded the association between cognitive ability and PTSD symptoms, the scarcity of other pre-deployment variables may not be an important limitation.

Implications

This study contributes to the theoretical understanding of the development of PTSD symptoms in a military setting by examining the significance of cognitive ability for the risk of post-deployment PTSD accounting for pre-deployment educational level and deployment-related stressors in a large military population. It is possible that the results can be extended to other occupations where traumatic events are common, for example, police officer, fireman and prison officer, but this should be investigated in future research. Our results indicate that tests of cognitive ability are relevant as a part of the evaluation of the mental and physical health of recruits. However, the minimum score used to determine eligibility should be chosen with care. Cognitive ability test scores seem not to be associated with the risk of developing post-traumatic stress symptoms independently of educational level when deployment-related risk factors are considered. Thus, the result of such tests cannot justify rejecting otherwise able applicants from the military and possibly other occupations with a stressing psychological working environment. Rather than relying solely on tests to identify vulnerable individuals, comprehensive assessment of the whole person is important as well as early appropriate management of psychiatric and psychological problems that arise during training or as a result of traumatic events during service.

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