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Abstract

Background. Military personnel deployed to combat and peacekeeping missions are exposed to high rates of traumatic events. Accumulating evidence suggests an important association between deployment and the development of other mental health symptoms beyond post-traumatic stress disorder.

Methods. This study examined the prevalence of agoraphobia, anxiety, depression, and hostility symptoms in a cohort of Dutch ISAF veterans ($N = 978$) from pre-deployment up to 10 years after homecoming. The interaction of potential moderating factors with the change in mental health symptoms relative to pre-deployment was investigated at each time point.

Results. The probable prevalence of agoraphobia, anxiety, depression, and hostility symptoms significantly increased over time to respectively 6.5, 2.7, 3.5, and 6.2% at 10 years after deployment. Except for hostility symptoms, the probable prevalence at 10 years after deployment was the highest compared to all previous follow-up assessments. Importantly, less perceived social support after returning from deployment was found as a risk factor for all different mental health symptoms. Unit support was not associated with the development of mental health problems.

Conclusions. This study suggests a probable broad and long-term impact of deployment on the mental health of military service members. Due to the lack of a non-deployed control group, causal effects of deployment could not be demonstrated. Continued effort should nevertheless be made in the diagnosis and treatment of a wide range of mental health symptoms, even a decade after deployment. The findings also underscore the importance of social support after homecoming and its potential for the prevention of long-term mental health problems.

Introduction

Military deployment to combat and peacekeeping missions can offer individuals an opportunity to increase personal growth, to build skills, and to gain new perspectives of the world around them. Extensive military training prepares service members for handling all kinds of stressful situations that might be encountered during their mission. However, when witnessing people suffer, seeing a colleague killed, or being held at gunpoint, psychological scars may appear. 'After all, we are only ordinary men' (Pink 1973). Continued effort should therefore be put in identifying and addressing of mental health problems in deployed military personnel returning home.

With the recent involvement in the Balkan, Iraq, and Afghanistan wars, the society's concern regarding the mental health of military service members is growing. This concern is endorsed by several publications reporting on prevalence rates of a wide range of mental health disorders in returning military personnel. The largest amount of literature is almost exclusively focused on the development of post-traumatic stress disorder (PTSD) symptoms (e.g. Bonanno *et al.* 2012; Eekhout, Reijnen, Vermetten, & Geuze, 2016; Kamphuis, Delahajj, Duel, Geuze, & Vermetten, 2021; Palmer *et al.* 2019; Polusny *et al.* 2017; Ramchand, Rudavsky, Grant, Tanielian, & Jaycox, 2015). Although the amount of literature focusing on other types of mental health problems is less extensive, the relation with deployment-related stressors is well documented (e.g. Ciarleglio *et al.* 2018; Fear *et al.* 2010; Hoopsick *et al.* 2020; Reijnen, Rademaker, Vermetten, & Geuze, 2015; Thomas *et al.* 2010; Wells *et al.* 2010). For example, combat exposed US service members deployed to Iraq and Afghanistan were at increased risk for new depression onset compared to their non-deployed colleagues (Wells *et al.*, 2010). Another study in US service members returning from Iraq showed depression concerns in 4.7–10.3% of the active component soldiers (Milliken, Auchterlonie, & Hoge, 2007). More recently, a study in service members of the Australian

Defence Force deployed to Afghanistan found probable prevalence rates of 4.5% for anxiety, 4.6% for depression, and 7.9% for any mental disorder within 4-month post-deployment (Sheriff, Van Hooff, Malhi, Grace, & McFarlane, 2020). Except for anxiety, this was a significant increase compared to pre-deployment.

The direct effect of deployment on mental health symptoms is probably moderated by several factors. Besides often identified risk factors for stress-related disorders such as younger age, female gender, combat exposure, or previous traumatic experiences, social support may play an important role in military service member's mental health (Cai *et al.*, 2017; Han *et al.*, 2014; Luciano & McDevitt-Murphy, 2017; Nordmo, Hystad, Sanden, & Johnsen, 2020). Social support can be defined as the perceived availability of support, affection, and instrumental aid from significant social partners (LaRocca & Scogin, 2015). Having a perception of a good quality of social support, for example by experiencing a strong family support system, may lead to a sense of purpose and a more robust mental health during and following deployment (Nordmo *et al.*, 2020). In comparison, if service members perceive less support from family, friends, colleagues, or even society, contact moments may diminish or act as demanding stressors, and may initiate or excite the development of mental health symptoms after returning home (Nordmo *et al.*, 2020).

As a follow-up on our previous study (Reijnen *et al.*, 2015), in the current study we examined the prevalence of a high level of agoraphobia, anxiety, depression, and hostility symptoms in Dutch military personnel deployed to Afghanistan up to 10 years after deployment. Moreover, we assessed the role of different covariates on the development of these mental health symptoms after homecoming. This study addresses limitations of previous research by including a pre-deployment measurement allowing evaluation of mental health symptoms prior to deployment and five consecutive follow-up measurements during a long period of time. In our report on the development of PTSD in this cohort, we identified a higher prevalence of PTSD symptoms at 10-years post-deployment compared to all previous measurements up to 2-years after deployment (van der Wal, Vermetten, & Geuze, 2020). Also, in a previous report on the prevalence of other mental health symptoms, we identified increases in the prevalence of agoraphobia-, anxiety-, and depression symptoms up to 2-years post-deployment. The prevalence of hostility symptoms, on the other hand decreased after 6 months (Reijnen *et al.*, 2015). Based on these findings, we hypothesize that agoraphobia-, anxiety-, and depression, symptoms will be further increased at the 10-year follow-up measurement, while hostility symptoms will be further decreased.

Methods

Study population

The present study reports on findings from the PRISMO-study, a large prospective cohort study on the development of stress-related mental health symptoms in Dutch military personnel deployed to Afghanistan, which is described in detail elsewhere (van der Wal, Gorter, Reijnen, Geuze, & Vermetten, 2019). A total of 1007 study participants who were deployed for about 4 months to Afghanistan on behalf of the International Security Assistance Force (ISAF) between 2005 and 2008 were included in the study. Written informed consent was obtained from all subjects. Approximately 1 month prior to their deployment,

participants completed the baseline measurement at the army base. At approximately 1 and 6 months after returning home, the first two follow-up measurements were also completed at the army base. The 1-, 2-year, and 5-year follow-up assessment were completed at home, and the 10-year follow-up was conducted at the research facility of the Military Mental Healthcare. Except for the 5-year measurement which was completed online, all measurements consisted of paper-and-pencil questionnaires. In order to minimize dropout in the follow-up assessments, all participants were repeatedly contacted (up to five times) through email, mail and/or telephone, in order to remind them to complete the questionnaires. Still, response rates dropped to 843 respondents at 1 month, 773 at 6 months, 573 at 1 year, 566 at 2 years, 581 at 5 years, and 598 at 10 years. The current study used data from all measurement points, except from the 5-year measurement. At this measurement point, mental health symptoms were measured with a different assessment tool, and therefore not included in the present analyses. All procedures were approved by the Institutional Review Board of the University Medical Center Utrecht (Utrecht, The Netherlands).

Measures

Mental health symptoms

For all assessments, mental health symptoms were measured with the agoraphobia (seven items), anxiety (10 items), depression (16 items), and hostility (six items) subscales of the Dutch revised Symptom Checklist (SCL-90-R) (Derogatis, 1994). The agoraphobia subscale measures a disproportional reaction of fear in open spaces, public spaces, or other certain places where a person feels weak, is afraid not to be able to rely on a trusted other, or is afraid of losing control of his or her presence. The anxiety subscale measures increased arousal and more general symptoms such as nervousness, tension, as well as more specific symptoms such as panic attacks and restlessness. Also cognitive components of anxiety-like feelings of misfortune and anxious thoughts and imaginations are assessed. The depression subscale assesses depressed mood, inability to feel pleasure, decreased self-esteem, and thoughts of guilt, helplessness, death, and suicide. This subscale also includes physical symptoms like a loss of appetite, lack of energy, and loss of sexual interest. Finally, the hostility subscale measures thoughts, feelings, or behaviors characteristic for a negative state of mind of anger. The SCL-90 contains 90 items with responses measured on a Likert scale ranging from 1 (not at all) to 5 (very much). The SCL-90 has good internal consistency, discriminant validity, and concurrent validity (Carrozzino *et al.*, 2016; Holi, Sammallahti, & Aalberg, 1998; Schmitz *et al.*, 2000). A cut-off value of ≥ 11 was used for agoraphobia, ≥ 22 for anxiety, for ≥ 36 depression, and ≥ 11 for hostility. Cut-off values for all subscales were based on the 95th percentile scores of a sample from the general population as reported in the Dutch manual of the SCL-90-R (Arrindell & Ettema, 2003; Reijnen *et al.*, 2015). The receipt of psychological care was assessed by the item 'Have you ever received any care for psychological health complaints after your deployment?' at the 10-year follow-up measurement. We defined psychological care as any received care for psychological health complaints provided by a GP, social worker, psychologist, psychiatrist, or other mental health specialist. Due to the fact that we had no information on the timing, type, and length of the psychological care, this variable was not tested as a covariate in our analyses and only used as a descriptive.

Covariates

At baseline, participants provided information about their sex, age, educational level, rank, and the number of previous deployments. Potential traumatic experiences before the age of 18 were assessed using the Early Trauma Inventory Self Report-Short Form (ETISR-SF) (Bremner, Bolus, & Mayer, 2007). The ETISR-SF contains 27 items measured on a five-point frequency scale, and included four domains of childhood traumatic events: general trauma, physical-, emotional-, and sexual abuse. At the first measurement after deployment, information on the participant's role during the mission was collected and divided in three categories: inside the base, outside the base, and both inside and outside the base. Exposure to potentially traumatic and combat-related stressors during deployment was assessed with the Deployment Experience Scale (DES), a 19-item deployment stressors checklist (Reijnen et al., 2015). At the 1-year follow-up assessment, participants completed part F (support from other military personnel during deployment; 12 items) and part L (support from family and friends after deployment; 17 items) of the Deployment Risk and Resilience Inventory 1 (DRRI-1) (King, King, Vogt, Knight, & Samper, 2006), a collection of measures assessing deployment-related experiences of military veterans. Although the DRRI-1 was administered at the 1-year follow-up assessment, the questionnaire assessed the perceived support during deployment (part F) or the perceived support in the period directly after deployment (part L). Responses were measured on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Potential new deployments after the initial deployment were assessed at each follow-up assessment. All tested covariates were selected before analysis. We included the covariates that we, based on the existing literature, considered to be relevant for mental health in a military population, with special focus on stress-related mental health symptoms.

Statistical analysis

The change in agoraphobia, anxiety, depression, and hostility symptom levels at 1 month, 6 months, 1 year, 2 years, and 10 years after deployment, relative to the pre-deployment level, were assessed in four separate linear mixed-effects models with repeated measures. The time variable was recoded into five dummy variables (one dummy variable for each measurement after deployment), whereby pre-deployment served as the reference. All five dummy variables for time were included in the models. Continuous, longitudinal symptom scores were used as the outcome variable. The coefficients and associated *p* values of the dummy variables for time were reported. After running these four 'initial' mixed models, the interaction of the potential moderating factors (i.e. demographic factors, early trauma, deployment characteristics, social support; see covariates) with the change in mental health symptoms relative to pre-deployment was investigated at each time point. In each initial model, the covariate itself as well as the interaction terms between the covariate and all five dummy variables for time were now added as fixed effects. The different covariates were included separately in the initial mixed models. We did not use a multivariate approach due to model stability issues and correlation between some of the covariates. Coefficients and associated *p* values of the interaction terms were used as the effect size for the covariates, and only reported for time points with a significant change in symptoms relative to pre-deployment. Participants were excluded from

the analysis if they had no SCL-90-R assessment at any time point. A two-tailed *p* value of less than 0.05 was considered statistically significant.

Missing data analysis

Considering that in mixed model analysis the missing data are not assumed to be missing completely at random, and that the results obtained from a mixed model analysis with multiple imputation can be quite unstable (Twisk, De Boer, De Vente, & Heymans, 2013), no multiple imputation techniques were used prior to the mixed model analyses. Detailed information on missing data can be found in Table S2 in the Supplementary Material.

Results

At baseline, a total of 1007 participants were included in the PRISMO cohort. Twenty-nine of them had no valid SCL-90-R measurement at any of the time points including the pre-deployment measurement (referred to as participants without a SCL-90-R measurement) and were excluded from the analyses. A total of 978 participants with at least one valid SCL-90-R measurement at any of the time points (referred to as participants with a SCL-90-R measurement) were therefore included in the present analyses. The baseline characteristics are shown in Table 1. No significant differences in demographics were found between participants with and without a SCL-90-R measurement. Differences in demographics between responders and non-responders at the 10-year follow-up measurement can be found in Table S1 in the Supplementary Material. In short, participants that did not complete the 10-year follow-up measurement had a lower educational level and a lower rank, were more often previously deployed, had more often a role outside the military base, and experienced more deployment stressors. Mean agoraphobia, anxiety, depression, and hostility symptom levels and probable prevalence rates at each time point are shown in Fig. 1 and Table 2. A full tabulation of the results for the analyses are shown in the Supplementary Material. The interactions of covariates with the change in mental health symptoms are shown in Table 3. Reported patterns of comorbidity between the mental health symptoms at all time points are shown in Table S2 in the Supplementary Material. The percentage of military personnel that did not report any of the assessed mental health symptoms (i.e. that did not score above cut-off for agoraphobia, anxiety, depression, and hostility symptoms) was 92.5% at 1 month, 91.5% at 6 months, 90.7% at 1 year, 91.9% at 2 years, and 89.0% at 10 years post-deployment (Online Supplementary Table S3). 28.5% of the participants indicated to have received any psychological care for mental health symptoms. Of the participants that did report any of the assessed mental health symptoms at any of the time points (i.e. that did score above cut-off for agoraphobia, anxiety, depression, and/or hostility symptoms at any time point), 55% received any psychological care.

Agoraphobia

The percentage of participants scoring above cut-off on agoraphobia symptoms at 10 years after deployment was 6.5%. This was a much higher percentage compared to all earlier follow-up measurements, with a probable prevalence rates ranging from 1.6% at 6 months post-deployment to 3.8% at 1 year post-deployment. The mixed model analysis with only the time points included

Table 1. Demographics and other characteristics of participants in the cohort who were deployed, separated for participants included in the analyses and participants without any outcome value

	Participants with outcome values at one or more time points (<i>n</i> = 978) ^a	Participants without any outcome value (<i>n</i> = 29) ^a	<i>p</i> value
Sex			
Male	893 (91%)	28 (97%)	0.319
Female	85 (9%)	1 (3%)	
Age (years) ^b			
<21	136 (14%)	3 (13%)	0.841
≥21	840 (86%)	21 (88%)	
Educational level ^c			
Low	362 (40%)	4 (33%)	0.790
Moderate	435 (48%)	7 (58%)	
High	101 (11%)	1 (8%)	
Rank ^d			
Private	388 (40%)	6 (50%)	0.411
Corporal	199 (21%)	4 (33%)	
Non-commissioned officer	250 (26%)	1 (8%)	
Staff officer	131 (14%)	1 (8%)	
Previous deployment(s) ^e			
Yes	417 (47%)	3 (25%)	0.129
No	470 (53%)	9 (75%)	
Role during deployment ^f			
Inside the military base	244 (31%)	4 (36%)	0.564
Both inside and outside the military base	73 (9%)	0 (0%)	
Outside the military base	476 (60%)	7 (64%)	
Deployment year			
2005 or 2006	251 (26%)	10 (35%)	0.286
2007 or 2008	727 (74%)	19 (66%)	
New deployment(s) ^g			
Yes	285 (45%)	..	..
No	348 (55%)	..	..
DES (deployment stressors) total score ^h	4.51 (3.22)	..	..
DDRI-F (unit social support) total score ⁱ	45.39 (10.19)	..	..
DDRI-L (support after deployment) total score ^j	60.35 (9.07)	..	..
ETISR-SF (early trauma) total score ^k	3.49 (3.06)	..	..

DES, Deployment Experience Scale; DDRI-F, Deployment Risk and Resilience Inventory part F; DDRI-L, Deployment Risk and Resilience Inventory part L; ETISR-SF, Early Trauma Inventory Self Report-Short Form. Education (ISCED levels); Low = primary and lower secondary education; Moderate = upper secondary, post-secondary non-tertiary, and short-cycle tertiary education; High = bachelor, master, and doctoral education.

Note: data are *n* (%) or mean (s.d.). Differences in descriptive characteristics between participants with and without any outcome value were tested with a χ^2 -test (categorical). ^aSample sizes might not add up to total because of missing data in the descriptive variables; where there is missing data, the total is indicated. Totals for participants included in the analyses: ^b*n* = 976, ^c*n* = 898, ^d*n* = 968, ^e*n* = 887, ^f*n* = 793, ^g*n* = 633, ^h*n* = 706, ⁱ*n* = 335, ^j*n* = 333, ^k*n* = 888; totals for participants without any outcome value: ^b*n* = 24, ^c*n* = 12, ^d*n* = 12, ^e*n* = 12, ^f*n* = 11, ^g*n* = 0, ^h*n* = 0, ⁱ*n* = 0, ^j*n* = 0, ^k*n* = 0.

showed that, relative to pre-deployment, agoraphobia symptoms were increased at 1 month, 1 year, 2 years and 10 years after deployment (Online Supplementary Table S4).

Age was significantly related to a lower increase in agoraphobia symptoms at 10 years after deployment [$\beta = -0.026$; 95%

confidence interval (CI) -0.038 to -0.015], suggesting a higher increase in agoraphobia symptoms relative to pre-deployment for younger military personnel. Similar moderating effects were found for rank during deployment ($\beta = -0.598$; 95% CI -0.824 to -0.373), where the lower-ranking personnel had more

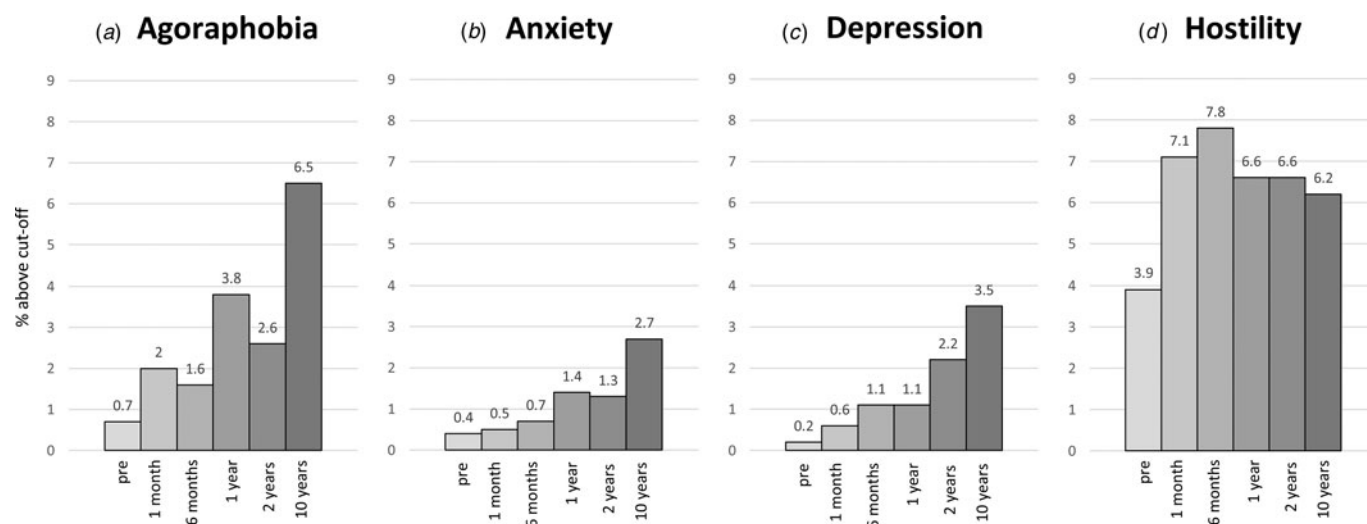


Fig. 1. Reported agoraphobia (a), anxiety (b), depression (c), and hostility (d) symptoms over time in Dutch ISAF veterans. Prevalence rates were based on the Symptom Checklist (SCL-90-R). Cut-off values for all subscales were based on the 95th percentile scores of a sample from the general population as reported in the respective questionnaire manual. Cut-off values: agoraphobia: ≥ 11 ; anxiety: ≥ 22 ; depression: ≥ 36 ; hostility: ≥ 11 .

increased agoraphobia symptoms at 10-year post-deployment compared to higher-ranking personnel. Also, military personnel with one or more previous deployments had a lower increase ($\beta = 0.286$; 95% CI 0.055–0.516) in symptoms at 10 years after deployment relative to pre-deployment. Military personnel with a role outside the base had more increased agoraphobia symptoms at 1 year ($\beta = 0.286$; 95% CI 0.010–0.562) and 10 years ($\beta = 0.665$; 95% CI 0.383–0.927) after deployment than the group that operated only inside the base. Moreover, a higher level of deployment stressors was related to a greater increase in agoraphobia symptoms at 1 month ($\beta = 0.044$; 95% CI 0.011–0.077), 1 year ($\beta = 0.077$; 95% CI 0.036–0.118), and 10 year ($\beta = 0.091$; 95% CI 0.052–0.131) post-deployment. Social support after deployment was associated with a lower increase in agoraphobia symptoms at 1 year ($\beta = -0.036$; 95% CI -0.054 to -0.018) and 10 years ($\beta = -0.054$; 95% CI -0.075 to -0.034) after deployment, suggesting a lower increase in agoraphobia symptoms for personnel that perceived more social support after a return.

Anxiety

Ten years after deployment, 2.7% of all participants scored above cut-off on anxiety symptoms. This was an increase compared to the probable prevalence rates on previous follow-up measurements, ranging from 0.5% (1-month post-deployment) to 1.3% (2 years post-deployment). The mixed model showed that anxiety symptoms were only significantly increased at 10-years after deployment relative to pre-deployment (Online Supplementary Table S5).

At 10 years post-deployment, age ($\beta = -0.045$; 95% CI -0.066 to -0.023) and rank ($\beta = -0.970$; 95% CI -1.378 to -0.563) were associated with a lower increase in anxiety symptoms, suggesting that younger and lower-ranking personnel had a higher increase in anxiety symptoms relative to pre-deployment. A role outside the base compared to a role inside the base was related to a larger increase in anxiety symptoms at 10 years after deployment ($\beta = 0.917$; 95% CI 0.428–1.407). Personnel that experienced a higher level of deployment stressors also had more increased

anxiety symptoms 10 years post-deployment relative to pre-deployment ($\beta = 0.163$; 95% CI 0.092–0.233). Furthermore, a higher level of social support after deployment was related to a lower increase in anxiety symptoms at 10 years after deployment ($\beta = -0.094$; 95% CI -0.131 to -0.057).

Depression

The prevalence of a high level of depression symptoms 10 years after deployment was 3.5%. This percentage was higher compared to previous follow-up measurements that ranged from 0.6% at 1-month post-deployment to 1.3% at 2 years post-deployment. The mixed model revealed that depression symptoms were only elevated at 1 year, 2 years, and 10 years relative to the level before deployment (Online Supplementary Table S6).

Age ($\beta = -0.086$; 95% CI -0.124 to -0.048) and rank ($\beta = -1.547$; 95% CI -2.271 to -0.822) were significantly related to a lower increase in depressive symptoms relative to pre-deployment at 10 years post-deployment, suggesting a higher increase in depression symptoms for younger and lower-ranking personnel. Having participated in one or more previous deployments was related to a higher increase in depression symptoms 10 years after deployment relative to pre-deployment ($\beta = 1.000$; 95% CI 0.257–1.744). A role outside the base compared to a role inside the base was also associated with a higher increase in depression symptoms at 10 years after deployment ($\beta = 1.041$; 95% CI 0.424–2.108). A higher level of deployment stressors was related to a greater increase in depression symptoms at 1 year ($\beta = 0.141$; 95% CI 0.010–0.272) and 10 years ($\beta = 0.211$; 95% CI 0.085–0.338) post-deployment relative to pre-deployment. Social support after deployment was associated with a lower increase in depression symptoms compared to pre-deployment at 1 year ($\beta = -0.227$; 95% CI -0.285 to -0.168), 2 years ($\beta = -0.152$; 95% CI -0.213 to -0.091), and 10 years ($\beta = -0.166$; 95% CI -0.232 to -0.100) after deployment, suggesting a lower increase in depression symptoms for personnel that perceived more social support after homecoming. Finally, reported childhood emotional abuse was related to a greater

Table 2. Reported agoraphobia, anxiety, depression, and hostility symptoms over time in Dutch ISAF veterans

	Total number of participants with available data	Above cut-off ^a	Mean SCL-90 subscore	Range SCL-90 subscore ^b
Agoraphobia				
Pre-deployment	829	6	7.19 (0.69)	7–16
1 month	807	16	7.32 (1.08)	7–19
6 months	731	12	7.30 (1.14)	7–23
1 year	558	21	7.41 (1.54)	7–28
2 years	544	14	7.40 (1.45)	7–24
10 years	600	39	7.77 (2.37)	7–30
Anxiety				
Pre-deployment	818	3	11.01 (1.78)	10–22
1 month	798	4	11.05 (2.16)	10–39
6 months	724	5	11.07 (2.29)	10–32
1 year	553	8	11.15 (2.77)	10–39
2 years	531	7	11.18 (2.64)	10–37
10 years	595	16	11.50 (3.81)	10–50
Depression				
Pre-deployment	823	2	17.97 (2.97)	16–38
1 month	800	5	18.28 (3.83)	16–50
6 months	729	8	18.33 (4.13)	16–46
1 year	552	8	19.08 (5.71)	16–64
2 years	544	12	19.25 (5.65)	16–63
10 years	595	21	19.30 (6.11)	16–60
Hostility				
Pre-deployment	828	32	6.96 (1.58)	6–22
1 month	808	57	7.29 (2.15)	6–21
6 months	732	57	7.21 (2.29)	6–24
1 year	558	37	7.21 (2.41)	6–29
2 years	547	36	7.26 (2.34)	6–27
10 years	598	37	7.07 (2.28)	6–26

Note: data are n or mean (s.d.). SCL-90 = Symptom Checklist-90.

^a Used cut-off values for subscales: agoraphobia: ≥ 11 ; anxiety: ≥ 22 ; depression: ≥ 36 ; hostility: ≥ 11 . ^b Minimum and maximum scores for subscales: agoraphobia: 7–35; anxiety: 10–50; depression: 16–80; hostility: 6–30.

increase in depression symptoms at 2 years after deployment compared to pre-deployment ($\beta = 0.623$; 95% CI 0.270–0.976), while childhood sexual abuse was related to a greater increase in depression symptoms at 1 year after deployment ($\beta = 1.131$; 95% CI 0.393–1.869).

Hostility

In total, 6.2% of all participants scored above cut-off for hostility symptoms at 10 years after deployment. This was a decrease compared to all previous follow-up assessments, ranging from 6.6% at 1 and 2-year follow-up to 7.8% at 6 months follow-up. The mixed model showed that hostility symptoms were increased at all follow-up assessments relative to the pre-deployment level (Online Supplementary Table S7).

For hostility symptoms, only three covariates were associated with the increase in symptoms after deployment.

Personnel that experienced a higher level of deployment stressors had a higher increase in hostility symptoms relative to pre-deployment at 1 month ($\beta = 0.090$; 95% CI 0.041–0.140), 6 months ($\beta = 0.083$; 95% CI 0.029–0.136), and 1 year ($\beta = 0.076$; 95% CI 0.015–0.138) post-deployment. Social support after deployment was related to a lower increase in hostility symptoms relative to pre-deployment at 1 month ($\beta = -0.053$; 95% CI -0.080 to -0.025), 6 months ($\beta = -0.069$; 95% CI -0.097 to -0.041), 1 year ($\beta = -0.090$; 95% CI -0.118 to -0.062), 2 years ($\beta = -0.043$; 95% CI -0.073 to -0.014), and 10 years ($\beta = -0.050$; 95% CI -0.082 to -0.019) after returning home, suggesting a lower increase in hostility symptoms in personnel that received more social support after homecoming. Childhood emotional abuse was associated with a higher increase in hostility symptoms at 1 month after deployment compared to pre-deployment ($\beta = 0.204$; 95% CI 0.059–0.349).

Table 3. Significant effect sizes of risk factors for an increase in psychological symptoms over time relative to pre-deployment

	Age	Education	Rank ^a	Previous deployment	Role during deployment ^b	Deployment experience	Social support	Unit support	Early general trauma	Early emotional abuse	Physical abuse	Early sexual abuse
Agoraphobia												
Δ 1 month	..	..	..	..	..	0.044*	..	..	..	..	..	..
Δ 1 year	..	..	..	..	0.286*	0.077**	-0.036***	..	..	..	..	..
Δ 2 years	..	..	..	..	..	..	..	..	..	..	..	..
Δ 10 years	-0.026***	..	-0.598***	0.286*	0.665**	0.091***	-0.054***	..	..	..	..	..
Anxiety												
Δ 10 years	-0.045***	..	-0.970***	..	0.917**	0.163***	-0.094***	..	..	..	..	..
Depression												
Δ 1 year	..	..	..	..	..	0.141*	-0.227***	..	..	..	..	1.131*
Δ 2 years	..	..	..	..	..	..	-0.152***	..	..	0.623*	..	..
Δ 10 years	-0.086***	..	1.547***	1.000*	1.041*	0.211*	-0.166***	..	..	..	..	..
Hostility												
Δ 1 month	..	..	..	..	..	0.090**	-0.053**	..	..	0.204*	..	..
Δ 6 months	..	..	..	..	..	0.083*	-0.069***	..	..	..	..	..
Δ 1 year	..	..	..	..	..	0.076*	-0.090***	..	..	..	..	..
Δ 2 years	..	..	..	..	..	..	-0.043*	..	..	..	..	..
Δ 10 years	..	..	..	..	..	..	-0.050*	..	..	..	..	..

Note: Δ indicates the significant difference in symptom score relative to pre-deployment status, when there was no significant difference in symptom score relative to pre-deployment at a time-point, no covariates were tested; effect sizes are β -values; .. indicates no significant effect size; * $p < 0.05$; ** $p < 0.001$; *** $p < 0.0001$.

^athe rank parameter indicates the difference between non-commissioned officer and staff officer ranks v. private and corporal ranks (reference category).

^bthe role during deployment parameter indicates the difference between the group with a role outside the military base v. the group with a role inside the military base (reference category).

Discussion

This paper suggests a long-term effect of deployment on the mental health of Dutch military personnel deployed to Afghanistan. Although the large majority of deployed service members showed low levels of mental health symptoms, the average levels of agoraphobia, anxiety, depression and hostility symptoms were still increased at 10 years after deployment compared to the pre-deployment level. The identified prevalence of a high level of anxiety (2.7%) and depression (3.5%) symptoms was quite low in comparison to a US sample of military personnel deployed to Iraq and Afghanistan in which a current prevalence of 36% was found for anxiety disorder and 25% for depression 7.5 years after deployment (Ciarleglio et al., 2018). However, these prevalence rates were based on diagnoses derived from clinical interviews. A one-to-one comparison with the prevalence rates based on a self-report measure as in the current study is therefore not possible. Except for hostility symptoms, the probable prevalence of all mental health problems at 10 years after deployment was the highest compared to all previous follow-up assessments in our sample. To our knowledge, this is the first study to report the prevalence of a wide range of mental health symptoms (beyond PTSD) in military personnel up to 10 years after deployment. The results have implications for current monitoring policies that usually include routine screenings that stop after 1 or 2 years.

For agoraphobia, anxiety, and depression symptoms, there was an increase in the percentage of the participants scoring above cut-off between 2 and 10 years post-deployment. This suggests a long-term deterioration in mental health symptoms in deployed personnel over time. Interestingly, a large study on ageing and the prevalence of mental health symptoms in a general population sample from the UK showed that the risk of developing a common mental disorder remained almost constant up to age 55 (Jokela, Batty, & Kivimäki, 2013). Also, the NEMESIS-2 study, a large Dutch nationally representative survey on the prevalence of mental health disorders, found a higher 12-month prevalence of mood disorders and anxiety disorder in the 18–24 age category compared to the 25–34 and 35–44 age categories (De Graaf, Ten Have, Van Gool, & Van Dorsselaer, 2012). It can therefore be suggested that the identified increase in mental health symptoms in the present study is related to deployment rather than a result of the ageing of the sample. However, as the cut-off values used to calculate the probable prevalence rates in our sample were based on the 95th percentile score of a representative sample from the general Dutch population (Arrindell & Ettema, 2003) (i.e. 5% of the general population scored above this cut-off value), it is important to note that although deployed military personnel reported high levels of agoraphobia, anxiety, and depression symptoms more frequently over time; as a group, they experience better mental health compared to the general population. Only the prevalence of a high level of agoraphobia symptoms at 10 years after deployment (6.5%) was higher compared to the prevalence in the general population. When studying a cohort of military personnel that is going to be deployed, you are dealing with a psychologically healthy population at baseline. Psychological testing before one is joining the army selects psychologically fit individuals, and extensive military training prepares service members for handling all kinds of stressful situations. Together with the observation that a substantial portion of the participants did not report high deployment stressors, it seems plausible that even after deployment our cohort

experiences better mental health compared to the general population. For hostility symptoms, the prevalence was higher in comparison to the general population at all measurements after deployment. To our surprise, this was not the case pre-deployment (3.9%). Military personnel in our sample thus experienced high levels of hostility less frequently before their deployment, even less frequently than individuals in the general population, but develop hostility rates after deployment that transcend the rates in the general population.

In our report on the development of PTSD symptoms that included a measurement at 5 years post-deployment, we found a higher probable PTSD prevalence at 5 years after deployment that significantly declined at 10 years after deployment (van der Wal et al., 2020). This subsequent increase in symptom level at 5 years post-deployment could well be the case for other mental health symptoms, suggesting a decline in symptoms after 5 years instead of a long-term symptom deterioration over time. Although no SCL-90-R measure was available at the 5-year assessment, participants completed an online version of the Brief Symptom Inventory (BSI) (Derogatis, 1993), the short version of the SCL-90-R which also includes a subscale for depression, anxiety, and hostility symptoms. When using the BSI, we found a prevalence of a high level of symptoms at 5 years after the deployment of 8.8% for anxiety, 4.8% for depression, and 14.9% for hostility (see Online Supplementary Figure S1), supporting the hypothesis of a prevalence peak at 5 years post-deployment that tapers off in the following years. However, it is important to emphasize that these prevalence rates are based on a different psychopathology assessment tool that was administered as an online questionnaire instead of a paper-and-pencil questionnaire.

Our study also identified several factors that moderated the relation between deployment and the development of mental health symptoms afterwards. Previously identified risk factors for mental health problems in deployed military personnel like younger age, lower rank, combat stress exposure, or childhood trauma (Eekhout et al., 2016; Sheriff et al., 2020; Stevelink et al., 2018; Zuromski et al., 2020) were also found relevant in the present study. Besides the level of combat stress exposure, the level of perceived social support after returning home was the only tested covariate that was identified as a risk factor for all different mental health symptoms on several points in time. Its relationship with the development of depression symptoms at 1, 2, and 10 years after deployment was especially prominent.

The importance of social support in the mental health of military service members has been widely described in the literature (e.g. Cai et al., 2017; Han et al., 2014; Moore et al., 2017; Nordmo et al., 2020; Vest, Cercone Heavey, Homish, & Homish, 2017), although with limited follow-up periods. It has been proposed that receiving social support can decrease the perception of a traumatic or stressful event. This will constrain the psychological difficulties following the event, and provides emotional resources that can lessen the burden of these experiences (Nordmo et al., 2020). For example, social support can improve coping strategies and thereby enables military personnel to express their feelings and thoughts which in turn can be conducive for processing a threatening event (Nordmo et al., 2020; Price, Gros, Strachan, Ruggiero, & Acierno, 2013). In addition, several physiological mechanisms or pathways have been proposed to explain the buffering effect of social support on stress responsiveness. For instance, positive social support is suggested to suppress glucocorticoid concentrations (Lob, Kirschbaum, & Steptoe, 2018) and cortisol levels (Heinrichs, Baumgartner,

Kirschbaum, & Ehlert, 2003), while negative social exchanges may instead increase the risk of HPA axis hyperactivity (Iob et al., 2018). Also, oxytocin is frequently named as an important underlying biological mechanism for the stress-protective effects of positive social support (Heinrichs et al., 2003; Matsushita, Latt, Koga, Nishiki, & Matsui, 2019; Ozbay et al., 2007). On the other hand, some research suggested that social support does not influence subsequent mental health symptoms. Instead, the perception of received social support might change in relation to the severity of mental health symptoms (Forbes et al., 2016; Moore et al., 2017). However, in the present study perceived social support after homecoming was measured 1 year after deployment, and was still found to be associated with the increase in agoraphobia, anxiety, depression, and hostility symptoms 10 years after deployment. As we showed that social support after deployment turned out to be an important factor even 10 years after deployment for a wide range of mental health symptoms, interventions that enhance social support may protect deployed personnel against post-deployment mental health problems. Continued effort should therefore be put in the assessment and monitoring of social support during family briefings and post-deployment screenings.

Besides social support from family and friends after deployment, unit cohesion, which includes emotional safety, bonding, and support between soldiers and with unit leaders (Choi et al., 2020), has received substantial attention in the literature (Anderson et al., 2019; Campbell-Sills et al., 2020; Pietrzak et al., 2010; Vest et al., 2017; Zang et al., 2017). These studies all show that service members who report high unit cohesion exhibit less mental health problems. It was therefore to our surprise that we did not find such a clear effect for unit support in our study. In fact, unit support was not significantly associated with any of the assessed mental health symptoms at any point in time. As previous research on unit cohesion was predominantly performed in US military personnel, the role of unit cohesion in mental health symptom development might be mission or unit-specific, or may be influenced by cultural factors in addition, the use of different questionnaires to measure unit cohesion across studies, and the fact that unit cohesion was assessed 1 year after deployment in the present study might also partly explain the found inconsistency in results.

The results of the current study must be interpreted in the context of its limitations. Most important, it is not known whether the reported increase in mental health symptoms is exclusively the result of deployment, as we did not examine prevalence rates of mental health symptoms in a non-deployed military cohort. Therefore, we can not rule out that this increase is a result of military life itself. Secondly, we used self-report measurements to obtain mental health symptom levels. The results might therefore be subject to the biases associated with the use of self-report assessments. Our prevalence rates were based on cut-off values on a questionnaire, which are more or less arbitrary. This approach excludes participants with a comparable level of symptoms as participants scoring just above the cut-off. Although we used the SCL-90-R, a validated and often used instrument to measure psychopathology, it may also have resulted in higher prevalence rates compared to clinician diagnoses (Engelhard et al., 2007; Frueh, Hamner, Cahill, Gold, & Hamlin, 2000). Moreover, the absence of an SCL-90-R measurement at 5 years after deployment might have left a high increase in symptom levels unnoted. Also, unit support and social support after deployment were exclusively assessed 1 year after deployment, increasing the risk for recall

bias. Furthermore, due to the explorative nature of the analyses, we did not adjust for multiple testing. The adjustment would render a few of the effects non-significant, and is a point of concern. Although inevitable in longitudinal studies, attrition is also a significant concern and the influence of non-response on the study findings cannot be ruled out. Finally, the variability in symptom scores in our cohort was relatively small. Therefore, we were not able to examine potentially heterogeneous trajectories of symptom development, which would be highly interesting and clinically relevant information. On the other hand, the present study possessed several strengths and addresses the limitations of previous research. For example, the pre-deployment measurement enabled us to determine whether symptom levels were significantly increased compared to pre-deployment. Furthermore, the five follow-up measurements over a period of 10 years following deployment offered a unique opportunity to assess the potential long-term impact of deployment on several mental health problems, and made differences in symptom progression over time noticeable for the various mental health symptoms.

In conclusion, the present study provides insights into the potential long-term impact of deployment by showing that the level of agoraphobia, anxiety, depression, and hostility symptoms was still increased at 10 years after returning home from deployment compared to pre-deployment. For agoraphobia, anxiety, and depression, the prevalence of a high level of symptoms at 10 years after deployment was even higher than the prevalence rates at all previous follow-up moments. However, prevalence rates of agoraphobia, anxiety, and hostility symptoms derived from a comparable questionnaire at 5-year follow-up suggest a prevalence peak at 5 years post-deployment that tapers off in the following year. Society should be aware of long-term increases in mental health problems in deployed service members, and monitoring policies must be adapted accordingly. Furthermore, this study underscores the importance of a high level of perceived social support from friends and family for more robust mental health in deployed personnel. Given that social support is potentially modifiable, it serves as a good candidate for intervention programs in deployed military personnel and their families that can target a wide range of mental health outcomes over a long period of time.

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