Paternal PTSD or depression, adolescent mental health, and family functioning: A study of UK military families

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ABSTRACT

Introduction: Adolescent mental health and family functioning have received limited attention in UK military families. This study investigated their association with posttraumatic stress disorder (PTSD) and depression in military fathers. **Methods:** In total, 105 serving and ex-serving members of the UK Armed Forces, and 137 of their adolescent offspring (ages 11 to 17 years), were included in this cross-sectional secondary data analysis. Data were collected online and at home using validated questionnaires. **Results:** Probable PTSD or depression was associated with more impaired general family functioning (unadjusted b = 0.21; 95% CI, 0.07-0.35; $p = 0.003$) and increased likelihood of adolescent mental health disorders (unadjusted OR = 2.30; 95% CI, 1.10-4.81; $p = 0.027$). The direction and strength of these associations did not substantially change after adjusting for covariates. **Discussion:** This highlights the importance of supporting the well-being of military families, especially when parents have mental health problems.

Key words: adolescent, depression, family, family functioning, father, mental health, military, paternal, posttraumatic stress disorder, PTSD, UK Armed Forces, Veteran

RÉSUMÉ

Introduction : La santé mentale des adolescents et le fonctionnement familial ont reçu peu d'attention dans les familles de Forces armées du Royaume-Uni. Cette étude a examiné leur association avec le trouble de stress post-traumatique (TSPT) et la dépression chez les pères militaires. **Méthodologie :** Au total, 105 membres en service ou libérés des Forces armées du Royaume-Uni et 137 de leurs enfants adolescent(e)s (de 11 à 17 ans) ont été inclus(e) dans cette analyse de données secondaires transversales. Les données ont été recueillies en ligne et à la maison à l'aide de questionnaires validés. **Résultats :** Un TSPT ou une dépression probable était associé à une plus grande perturbation du fonctionnement familial général (b non corrigé = 0,21; IC à 95 %, 0,07 à 0,35; $p = 0,003$) et à une probabilité accrue de troubles de santé mentale chez les adolescent(e)s (RC non corrigé = 2,30; IC à 95 %, 1,10 à 4,81; $p = 0,027$). L'orientation et la force de ces associations n'ont pas tellement changé après correction pour tenir compte des covariables. **Discussion :** Ces constats font ressortir l'importance de soutenir le bien-être des familles de militaires, particulièrement lorsque les parents éprouvent des problèmes de santé mentale.

Mots clés : adolescent, dépression, famille, fonctionnement familial, Forces armées du Royaume-Uni, militaire, paternel, père, santé mentale, trouble de stress post-traumatique, TSPT, vétéran(e)

LAY SUMMARY

Limited research has explored the relationships between paternal mental health, adolescent offspring mental health, and family functioning in United Kingdom military populations. The authors investigated this in a study of 105 serving and ex-serving members of the United Kingdom Armed Forces, with adolescent offspring ages 11 to 17 years. It was found military fathers with symptoms of PTSD or depression had more family difficulties, particularly around communication. Their adolescent offspring were also more likely to meet criteria for mental health disorders. These findings demonstrate the importance of supporting military fathers and their families with mental health and well-being.

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INTRODUCTION

Among United Kingdom service personnel, an estimated 21.9% meet criteria for a common mental disorder, and 6.2% for posttraumatic stress disorder (PTSD).[1] Mental health problems in military parents could pose challenges to their families and offspring, who already experience a range of stressors as a result of military service, such as regular relocation and separation from parents.[2] In particular, mental health problems in service personnel have been associated with impaired structural, organizational, and transactional dynamics of family life (termed family functioning),[3-6] problems readjusting to family life after returning from deployment,[7] and marital or relationship problems.[3,6,8] As well as impacting family life in general, mental health problems in service personnel were shown to impact interactions with their offspring, specifically problems with parenting,[3,6,8] parent-child bonding,[4] and perceived relationship quality with offspring.[9]

Mental health difficulties in parents are also thought to be associated with mental health difficulties in offspring. Research in this area has often focused on maternal mental health, but one review found paternal mental health can also play an important role.[10] It particularly highlighted an association between paternal depression and adolescent anxiety, depression, and internalizing problems, while evidence for other paternal mental health disorders such as PTSD was less conclusive.[10] Investigations in U.S., Australian, and Kuwaiti military populations showed a relationship between paternal and offspring mental health.[11-13] To date, this relationship has received less attention in UK military families. One study conducted in UK military families found paternal PTSD was associated with hyperactivity among offspring, but not with other social and emotional problems.[14] Further understanding these relationships is important, since mental health problems during adolescence can, in turn, have a marked impact on outcomes such as lower educational attainment[15] and unemployment.[16]

To improve understanding of these associations in UK military families, the authors aimed to investigate whether families whose military fathers met criteria for probable PTSD or depression were at increased risk of 1) impaired family functioning and 2) adolescent mental health disorders.

METHODS

Design, setting, and procedures

Reporting follows STROBE guidelines for cross-sectional studies (Appendix Table A1).[17] This was a secondary, exploratory analysis of the Service Parents' & Adolescents' Challenges & Experiences study (SPACE study), a study designed to explore the effects of paternal PTSD on adolescent offspring. Participants for this cross-sectional study were drawn from the King's Centre for Military Health Research (KCMHR) Health and Wellbeing cohort of UK Armed Forces service personnel and the Children and Military Fathers with PTSD study (KIDS study).[14,18,19] Fathers were invited to participate in the SPACE study if they had at least one child ages 11 to 17 years. Data collection ran from January 2016 to January 2017. Fathers were initially invited, followed by mothers, long-term partners, and adolescent offspring (where consent was given by the father to contact them). Adolescents either provided consent or assent depending on age and geographical location, and, where possible, consent was sought from both biological parents. Where this was not possible, consent was sought from the parent with parental responsibility for the participating adolescent.

Questionnaire data were collected online and by two research assistants during a home visit with the father, his adolescent offspring, and their biological mother or stepmother if she resided with the father. As a thank you for their time, adolescents were offered shopping vouchers worth £20. Parents were offered shopping vouchers worth £30, reflecting the greater time commitment.

This study received ethical approval from the United Kingdom Ministry of Defence Research Ethics Committee (654/MODREC/15), the King's College Hospital local Research Ethics Committee, and the United States of America Human Protection Research Office (A-17980).

Paternal depression and PTSD

Paternal depression was measured using the 9-item Patient Health Questionnaire depression scale (PHQ-9).[20,21] The PHQ-9 was completed during the home visit. This self-report questionnaire contains nine items and asks participants about their experience of mental health symptoms over the previous two weeks using a Likert scale of 0 (not at all) to 3 (nearly every day). Responses are then summed to provide a total score (possible range 0 to 27). Cut-off scores of 5, 10, 15, and 20 have been proposed as indicators of mild, moderate, moderately severe, and severe depression, respectively.[20] Therefore, in this study, a score of 5 or higher was used to indicate any level of paternal depression. The PHQ-9 has been shown to have good psychometric properties and was previously used

in military populations.[22,23] In this sample, there were no missing data items on the PHQ-9, and internal consistency was excellent, Cronbach's $\alpha = 0.90$.

Paternal PTSD was assessed using the self-report National Center for PTSD Checklist (PCL-5).[24] The PCL-5 was completed during the home visit. It comprises 20 items asking respondents to rate how much they were bothered by a series of problems over the previous month on a scale of 0 (not at all) to 4 (extremely). Responses are then summed to provide a total score (possible range 0 to 80). A total score of 33 or higher was taken to indicate probable PTSD, based on previous evaluations of the PCL-5 in military populations.[25] The PCL-5 was used in preference to the PCL-M (military version), as the questions are not restricted to military-related trauma. The PCL-5 was validated for use in military populations.[25] In this sample, one father was missing a single data item on the PCL-5, which was imputed with a 0. Following this, internal consistency was excellent on the PCL-5, Cronbach's $\alpha = 0.95$. For statistical analyses, a composite variable of depression and PTSD was generated. This binary variable indicated the presence of probable depression or PTSD versus no depression or PTSD.

Family functioning

Family functioning was assessed using the self-report McMaster Family Assessment Device (FAD).[26] The FAD was completed during the home visit, but non-resident mothers who were not present during the home visit could complete the FAD online. Each family member rated how well 60 items (some of which were reverse scored) described their family on a Likert scale (strongly agree, agree, disagree, strongly disagree). After reverse scoring, missing items were imputed with a score of 1 if three or fewer items were missing (if more items were missing, imputation was not carried out). Across all 314 FAD questionnaires completed by fathers, mothers, and adolescents as part of this study, 11 (3.5%) were missing a single FAD item, and 8 (2.6%) were missing 2 FAD items; these items were therefore imputed with a 1. A further 3 (1.0%) had 11 or more missing FAD items, which were therefore left as missing.

FAD sub-scales were then scored for everyone by taking the mean average across items capturing general family functioning (12 items), problem solving (6 items), communication (9 items), roles (11 items), affective responsiveness (6 items), affective involvement (7 items), and behaviour control (9 items). Finally, mean average scores were taken on the resulting sub-scales across all available informants for each family. Higher scores indicated more problematic family functioning and could be further interpreted using cut-off scores recommended by Miller et al.,[27] where sub-scale scores meeting or exceeding the sub-scale cut-off value can be considered indicative of unhealthy functioning in that area. Among the families included in this analysis, the number of family members who completed the FAD ranged between 2 and 5 (median = 3, interquartile range = 2 to 3). The FAD was shown to have good psychometric properties, and the general family functioning scale was previously used in military populations.[27,28] Following imputation of missing items, and across all family members, internal consistency was modest to excellent for each sub-scale, ranging from Cronbach's $\alpha = 0.67$ (behaviour control) to Cronbach's $\alpha = 0.88$ (general family functioning).

Adolescent mental health disorders

Adolescents' emotional and behavioural well-being was assessed using the Development & Well-Being Assessment (DAWBA), a structured diagnostic assessment covering all major mental health diagnoses in the 2010 edition of the *International Classification of Diseases*, 10th Edition (*ICD*-10).[29,30] The DAWBA was completed online by participating fathers, mothers, stepmothers, and adolescents. A clinician then reviewed responses in combination with computer-generated probability scores to decide likely diagnoses for each adolescent (part of the clinician's role in this process was deciding how to balance information from multiple sources that might sometimes conflict). The DAWBA has been shown to have good validity and inter-rater reliability.[30,31] Three binary variables were generated, one indicating whether adolescents met criteria for any *ICD*-10 mental health disorder and two composite variables indicating whether adolescents met criteria for an internalizing disorder and for a neurodevelopmental, externalizing, or other mental health disorder (see Appendix Table A2 for groupings).

Covariates

Socio-demographic and military factors were also considered. Adolescent age and gender were collected as part of this current study. Paternal engagement type (Regular/reserve) and service (army/Royal Air Force/naval services) were collected from Phase 1 of the KCMHR Health and Wellbeing cohort.[19] Paternal age, relationship status (in a relationship/single), serving

status (serving/ex-serving), rank (commissioned officer/other), and deployment status (Iraq or Afghanistan/neither) were collected from Phase 3 of the KCMHR Health and Wellbeing cohort,[1] and supplemented from the KIDS study if missing from Phase 3.

Statistical analyses

Linear regression analyses were conducted to examine the associations between probable paternal PTSD or depression and each family functioning sub-scale. Logistic regression analyses were conducted to examine the association between probable paternal PTSD or depression and adolescent mental health disorders, accounting for clustering within families using cluster-robust standard errors (this was unnecessary for analyses of family functioning, as only one FAD score per family was used).[32] Models were adjusted for socio-demographic covariates, then additionally for military covariates. In a set of sensitivity analyses, the authors repeated these analyses twice with PTSD and depression considered separately and as continuous total scores in separate regressions. PTSD scores were scaled so the resulting regression coefficients represented a 15-point difference on the PCL-5, and depression scores were scaled so the resulting regression coefficients represented a 5-point difference on the PHQ-9, these having been proposed as clinically meaningful differences in previous literature.[33,34] The authors also stratified the main analysis of adolescent mental health disorders by adolescent gender, although it should be noted the cell sizes for stratified analyses were small. Complete case analyses were conducted. Statistical significance was defined as $p < 0.05$. Analyses were conducted using Stata, version 18.0 (StataCorp, College Station, TX).

Table 1. Characteristics of fathers included in the study (n = 105)

Characteristic	Frequency	%
Age (years), mean and 95% confidence interval		44.5 (43.3-45.6)
Relationship status		
Single	9	8.6%
In a relationship	96	91.4%
Serving status		
Serving	55	52.4%
Ex-service	50	47.6%
Engagement type		
Regular	88	83.8%
Reserve	17	16.2%
Service		
Army	67	63.8%
Royal Air Force	23	21.9%
Naval services	15	14.3%
Rank		
Commissioned officer	34	32.4%
Other ranks	71	67.6%
Deployment status		
Iraq or Afghanistan	77	73.3%
Neither	28	26.7%
Mental health — categorical variables		
Probable PTSD	11	10.5%
Any depression	41	39.1%
Probable PTSD or depression	41	39.1%
Mental health — continuous variables		
PTSD score, median and interquartile range	12 (5-21)	
Depression score, median and interquartile range	3 (1-7)	

RESULTS

Descriptive statistics

In total, n = 105 fathers, and their n = 137 adolescent children had complete data available for analysis (Appendix Figure A1, Appendix Table A3). The characteristics of included fathers are summarized in Table 1. Of the 105 included fathers, the majority served as Regular personnel (n = 88, 83.8%), in ranks other than commissioned officers (n = 71, 67.6%), and in the army (n = 67, 63.8%). Most were in a relationship (n = 96, 91.4%). Over one-third of fathers met criteria for either probable PTSD or depression (n = 41, 39.1%). All fathers who met criteria for probable PTSD also met criteria for any depression.

On average, the included families scored in the healthy range for all family functioning sub-scales (Table 2), and scores on the sub-scales were very highly correlated (Appendix Table A4). Characteristics of the n = 137 included adolescents are summarized in Table 3. Over one-third of included adolescents met criteria for a mental health disorder (n = 51, 37.3%).

Associations between probable paternal PTSD or depression and family functioning

There was evidence probable paternal PTSD or depression was associated with worse general family functioning (b = 0.21; 95% CI, 0.07-0.35; $p = 0.003$). This association remained after adjusting for socio-demographic characteristics and military factors (Table 4). However, the average general family functioning score in families where the father met criteria for probable

PTSD or depression still did not meet the cut-off for unhealthy functioning.

Analyses of the remaining family functioning sub-scales indicated probable paternal PTSD or depression was associated with worse scores on problem-solving (b = 0.15; 95% CI, 0.03-0.26; $p = 0.017$), communication (b = 0.16; 95% CI, 0.05-0.28; $p = 0.007$), roles (b = 0.13; 95% CI, 0.03-0.24, $p = 0.012$), and affective responsiveness (b = 0.15; 95% CI, 0.00- 0.31, $p = 0.048$) sub-scales. These associations remained after adjusting for socio-demographic characteristics and military factors. However, of these, the average score among families in which the father met criteria for probable PTSD or depression only met or exceeded the cut-off for unhealthy functioning on the communication sub-scale. Using this cut-off, 58.5% of families in which the father met criteria for probable PTSD or depression had unhealthy communication (compared to 32.8% in the comparison group).

Sensitivity analyses considering paternal PTSD and depression separately as continuous total scores showed further evidence for both PTSD and depression symptoms being significantly associated with worse general family functioning, including after adjustment for socio-demographic and military covariates (Table 5). Depression scores were likewise significantly associated with worse family functioning on all remaining sub-scales, whereas following adjustment for socio-demographic and military covariates, PTSD scores were only significantly associated with worse scores on communication, roles, and affective responsiveness sub-scales.

Associations between probable paternal PTSD or depression and adolescent mental health disorders

Probable paternal PTSD or depression was associated with adolescents meeting criteria for any mental health disorder (OR = 2.30; 95% CI, 1.10-4.81; $p = 0.027$) (Table 4). Although this association was no longer statistically significant after adjusting for socio-demographic characteristics and military factors, the direction and strength of the association remained similar.

A similar pattern of results emerged when focusing analysis on adolescent internalizing disorders. Probable paternal PTSD or depression was associated with adolescent internalizing disorders (OR = 2.21; 95% CI, 1.04-4.71; $p = 0.040$), and while this association was no longer statistically significant after adjusting for socio-demographic characteristics and military factors, the strength and direction of the association remained similar. However, evidence for an association between probable paternal PTSD or depression and adolescent neurodevelopmental, externalizing, or other mental health disorder was weaker.

Stratifying by adolescent gender suggested the association between probable paternal PTSD or depression and any adolescent mental health disorder was stronger among adolescent boys (OR = 3.23; 95% CI, 1.18-8.85; $p = 0.023$) than among adolescent girls (OR = 1.58; 95% CI, 0.52-4.82; $p = 0.425$). However, it should be noted sample sizes following stratification were small (Appendix Table A5).

Sensitivity analyses considering paternal PTSD and depression separately as continuous total scores suggested higher paternal depression scores were associated with increased odds for mental health disorders in adolescent offspring, particularly internalizing disorders. Odds ratios remained similar, but no longer statistically significant, after adjusting for socio-demographic and military covariates. Furthermore, neither the unadjusted nor adjusted associations between paternal PTSD scores and adolescent mental health were statistically significant (Table 6).

Table 2. Descriptive statistics of family functioning (n = 105) (higher scores indicate worse family functioning)

Family functioning (FAD) (cut-off scores for unhealthy functioning in parentheses)	Mean	95% CI
General family functioning (2.0)	1.84	1.77-1.91
Communication (2.2)	2.13	2.07-2.18
Roles (2.3)	2.14	2.09-2.19
Affective responsiveness (2.2)	2.06	1.98-2.13
Affective involvement (2.1)	2.04	1.97-2.11
Behaviour control (1.9)	1.74	1.69-1.79

FAD = Family Assessment Device.

Table 3. Characteristics of adolescents included in the study (n = 137)

Characteristic	Frequency	%
Age (years), mean and 95% confidence interval		13.9 (13.6-14.2)
Gender		
Male	75	54.7%
Female	62	45.3%
Mental health		
Any mental health disorder	51	37.2%
Internalizing disorder	37	27.0%
Neurodevelopmental, externalizing, or other mental health disorder	23	16.8%

DISCUSSION

The aims of this study were to investigate whether UK military families whose fathers met criteria for probable PTSD or depression were at increased risk of impaired family functioning and of adolescent mental health disorders. Strong evidence was found for an association between probable paternal PTSD or depression and impaired family functioning, particularly on the communication sub-scale of the FAD. There was also some evidence for an association between probable paternal PTSD or depression and adolescent mental health disorders, particularly internalizing disorders and particularly among adolescent boys.

Finding that probable paternal PTSD or depression was associated with family functioning is consistent with previous military studies that investigated similar associations.[3-6] For the probable paternal PTSD or depression exposure, and for the continuous PTSD score exposure, negative and statistically significant associations were found with all family functioning sub-scales other than affective involvement or behavioural control. Two previous studies that used the FAD found paternal PTSD to be significantly associated with all sub-scales other than roles and behaviour control.[4,5] The finding that paternal PTSD or depression was particularly associated with communication is of interest.

Table 4. Associations between probable paternal PTSD or depression, family functioning, and adolescent mental health disorders

Family functioning outcome (cut-off scores for unhealthy functioning in parentheses) (n = 105)	No paternal PTSD or depression, mean (95% CI)	Probable paternal PTSD or depression, mean (95% CI)	Unadjusted b (95% CI)	*p*	Adjusted b* (95% CI)	*p*	Adjusted b† (95% CI)	*p*
General family functioning (2.0)	1.75 (1.67-1.84)	1.96 (1.85-2.08)	0.21 (0.07-0.35)	0.003	0.24 (0.11-0.37)	<0.001	0.22 (0.09-0.35)	0.002
Problem solving (2.2)	1.92 (1.85-2.00)	2.07 (1.97-2.16)	0.15 (0.03-0.26)	0.017	0.15 (0.04-0.27)	0.011	0.14 (0.02-0.27)	0.023
Communication (2.2)	2.06 (1.99-2.14)	2.22 (2.13-2.31)	0.16 (0.05-0.28)	0.007	0.17 (0.06-0.28)	0.003	0.16 (0.04-0.28)	0.008
Roles (2.3)	2.09 (2.03–2.14)	2.22 (2.13-2.31)	0.13 (0.03–0.24)	0.012	0.14 (0.04-0.25)	0.006	0.13 (0.02-0.24)	0.017
Affective responsiveness (2.2)	2.00 (1.91-2.09)	2.15 (2.02-2.28)	0.15 (0.00-0.31)	0.048	0.18 (0.04-0.32)	0.012	0.15 (0.00-0.29)	0.047
Affective involvement (2.1)	2.00 (1.91-2.09)	2.10 (1.99-2.21)	0.10 (-0.04-0.24)	0.153	0.14 (0.01-0.27)	0.035	0.13 (-0.01-0.27)	0.065
Behaviour control (1.9)	1.70 (1.65-1.76)	1.80 (1.70–1.90)	0.09 (-0.01-0.20)	0.074	0.11 (0.00-0.21)	0.042	0.08 (-0.02-0.18)	0.136
Adolescent mental health outcome (n = 137)	**No paternal PTSD or depression, n (%)**	**Probable paternal PTSD or depression, n (%)**	**Unadjusted OR (95% CI)**	***p***	**Adjusted OR* (95% CI)**	***p***	**Adjusted OR† (95% CI)**	***p***
Any mental health disorder								
No	62 (69.7%)	24 (50.0%)	Reference	—	Reference	—	Reference	—
Yes	27 (30.3%)	24 (50.0%)	2.30 (1.10-4.81)	0.027	2.13 (0.97-4.67)	0.059	1.81 (0.79-4.14)	0.157
Internalizing disorder								
No	70 (78.7%)	30 (62.5%)	Reference	—	Reference	—	Reference	—
Yes	19 (21.4%)	18 (37.5%)	2.21 (1.04-4.71)	0.040	2.24 (0.96-5.24)	0.063	1.98 (0.81-4.84)	0.135
Neurodevelopmental, externalizing, or other mental health disorder								
No	77 (86.5%)	37 (77.1%)	Reference	—	Reference	—	Reference	—
Yes	12 (13.5%)	11 (22.9%)	1.91 (0.75-4.85)	0.175	1.65 (0.62-4.42)	0.315	1.47 (0.51-4.24)	0.472

b = unstandardized regression coefficient; OR = odds ratio; CI = confidence interval.
* Adjusted for socio-demographic characteristics (paternal age, paternal relationship status, adolescent age, adolescent gender).
† Adjusted for socio-demographic characteristics (paternal age, paternal relationship status, adolescent age, adolescent gender) and for military factors (serving status, engagement type, service, rank, deployment status).

During depressive episodes, individuals often experience reduced energy, activity, and capacity for interest and enjoyment.[29] Taken together, these symptoms might reduce paternal engagement in family behaviours that are captured by the communication sub-scale. This possibility would benefit from further research.

These findings are somewhat consistent with previous studies that demonstrated associations between paternal mental health and offspring mental health in military families.[11-13] Some evidence was found for associations between probable paternal PTSD or depression and adolescent mental health disorders, but these associations were no longer statistically significant after adjusting for socio-demographic and military covariates (although the magnitude of odds ratios remained similar). Sensitivity analyses suggested these associations were perhaps driven by paternal depression symptoms in the sample, rather than by PTSD symptoms, but larger studies would be needed to confirm this with improved statistical power. Findings stratifying by adolescent gender are especially likely to be underpowered, but tentatively suggest stronger associations for adolescent boys; this would also need to be investigated in further studies.

Possible mechanisms in the relationship between paternal and offspring mental well-being were explored, with reviews implicating genetic processes, parenting, and the home environment in the transmission of risk.[35,36] Maternal mental health was also proposed as a factor on the pathway between paternal and adolescent

Table 5. Associations between paternal PTSD score, paternal depression score, and family functioning, n = 105

Exposure: paternal PTSD score	Unadjusted b (95% CI)	*p*	Adjusted b* (95% CI)	*p*	Adjusted b† (95% CI)	*p*
General family functioning	0.12 (0.05 to 0.19)	0.001	0.12 (0.06-0.19)	<0.001	0.13 (0.05-0.21)	0.002
Problem solving	0.07 (0.00-0.13)	0.037	0.07 (0.01-0.13)	0.024	0.07 (-0.00 to 0.14)	0.056
Communication	0.07 (0.01-0.13)	0.027	0.07 (0.01-0.13)	0.016	0.07 (0.00-0.14)	0.048
Roles	0.06 (0.01-0.12)	0.018	0.07 (0.02-0.12)	0.011	0.07 (0.00-0.13)	0.040
Affective responsiveness	0.10 (0.02-0.17)	0.013	0.10 (0.03-0.17)	0.004	0.09 (0.01-0.17)	0.038
Affective involvement	0.06 (-0.01 to 0.13)	0.092	0.07 (0.00-0.13)	0.047	0.07 (-0.01 to 0.15)	0.090
Behaviour control	0.06 (0.01-0.12)	0.016	0.07 (0.02-0.12)	0.010	0.05 (-0.01 to 0.11)	0.083
Exposure: paternal depression score	**Unadjusted b (95% CI)**	***p***	**Adjusted b* (95% CI)**	***p***	**Adjusted b† (95% CI)**	***p***
General family functioning	0.13 (0.07-0.19)	<0.001	0.14 (0.08-0.20)	<0.001	0.14 (0.08-0.21)	<0.001
Problem solving	0.08 (0.02-0.13)	0.005	0.08 (0.03-0.14)	0.003	0.08 (0.02-0.14)	0.007
Communication	0.09 (0.03-0.14)	0.002	0.09 (0.04-0.14)	0.001	0.09 (0.04-0.15)	0.002
Roles	0.08 (0.03-0.12)	0.002	0.08 (0.03-0.13)	0.001	0.08 (0.03-0.13)	0.002
Affective responsiveness	0.09 (0.02-0.16)	0.010	0.10 (0.04-0.17)	0.001	0.09 (0.02-0.16)	0.016
Affective involvement	0.07 (0.00-0.13)	0.038	0.08 (0.02-0.14)	0.007	0.08 (0.02-0.15)	0.015
Behaviour control	0.07 (0.03-0.12)	0.003	0.08 (0.03-0.12)	0.001	0.07 (0.02-0.12)	0.008

PTSD = posttraumatic stress disorder; b = unstandardized regression coefficient; CI = confidence interval.
Note: PTSD score has been scaled to represent a 15-point change on the PCL-5, and depression score has been scaled to represent a 5-point change on the PHQ-9.
* Adjusted for socio-demographic characteristics (paternal age, paternal relationship status, adolescent age, adolescent gender).
† Adjusted for socio-demographic characteristics (paternal age, paternal relationship status, adolescent age, adolescent gender) and for military factors (serving status, engagement type, service, rank, deployment status).

mental health[35] and could therefore be investigated in future studies. Military families may additionally experience a range of stressors that could increase risk for mental health disorders, like relocation and parental physical trauma, as well as protective factors, such as strong community connections, which could foster parental resiliency and positive family functioning in military families.[37] With family functioning potentially playing a role in the relationship between paternal and adolescent mental health, these relationships warrant further study in a military population.

Strengths and limitations

To the authors' knowledge, this is the first UK-based study to examine the association between paternal and adolescent mental health in military families using a robust clinical measure to gather diagnostic data from multiple informants on adolescent mental health. This ensured the adolescent mental health data used was both reliable and clinically relevant.[30]

The sample size had several implications for this study. First, to increase statistical power, the main analysis focused on a composite of "probable" PTSD and "any" depression, largely because cell sizes were not sufficient to examine probable PTSD separately. However, supplementary analyses using continuous measures of PTSD and depression added more detailed findings for each separate set of symptoms. Second, caution is warranted in adjusting for large numbers of covariates where sample sizes are small. However, the authors equally found it important to adjust for socio-demographic and military covariates that could play an important role in family functioning and adolescent mental health. Finally, small sample sizes can limit the external generalizability of findings. Nonetheless, the sample originated from a representative, random cohort of the UK military.[18,19]

The authors relied on fathers providing consent to contact and recruit mothers and adolescents. Therefore, recruitment may have selected for intact or well-

Table 6. Associations between paternal PTSD score, paternal depression score, and adolescent mental health, n = 137

Exposure: paternal PTSD score	Mean paternal PTSD score (SD)	Unadjusted OR (95% CI)	*p*	Adjusted OR* (95% CI)	*p*	Adjusted OR† (95% CI)	*p*
Any mental health disorder							
No	12.8 (12.5)	Reference	—	Reference	—	Reference	—
Yes	16.8 (17.0)	1.32 (0.92-1.91)	0.136	1.29 (0.86-1.92)	0.219	1.07 (0.70-1.65)	0.755
Internalizing disorder							
No	13.7 (14.0)	Reference	—	Reference	—	Reference	—
Yes	15.9 (15.7)	1.16 (0.86-1.58)	0.337	1.15 (0.78-1.71)	0.474	0.98 (0.65-1.48)	0.922
Neurodevelopmental, externalizing, or other mental health disorder							
No	13.3 (12.7)	Reference	—	Reference	—	Reference	—
Yes	19.2 (20.8)	1.43 (0.91-2.27)	0.125	1.40 (0.89-2.21)	0.149	1.36 (0.80-2.33)	0.256
Exposure: paternal depression score	**Mean paternal depression score (SD)**	**Unadjusted OR (95% CI)**	***p***	**Adjusted OR* (95% CI)**	***p***	**Adjusted OR† (95% CI)**	***p***
Any mental health disorder							
No	3.93 (4.43)	Reference	—	Reference	—	Reference	—
Yes	5.82 (5.80)	1.45 (1.01-2.08)	0.046	1.41 (0.95-2.09)	0.086	1.26 (0.84-1.90)	0.264
Internalizing disorder							
No	4.13 (4.75)	Reference	—	Reference	—	Reference	—
Yes	6.00 (5.62)	1.41 (1.03-1.91)	0.031	1.43 (0.95-2.15)	0.082	1.33 (0.87-2.04)	0.191
Neurodevelopmental, externalizing, or other mental health disorder							
No	4.32 (4.68)	Reference	—	Reference	—	Reference	—
Yes	6.17 (6.47)	1.37 (0.86-2.18)	0.184	1.31 (0.83-2.08)	0.240	1.24 (0.75-2.04)	0.406

OR = odds ratio; CI = confidence interval; SD = standard deviation.
Note: PTSD score has been scaled to represent a 15-point change on the PCL-5, and depression score has been scaled to represent a 5-point change on the PHQ-9.
* Adjusted for socio-demographic characteristics (paternal age, paternal relationship status, adolescent age, adolescent gender).
† Adjusted for socio-demographic characteristics (paternal age, paternal relationship status, adolescent age, adolescent gender) and for military factors (serving status, engagement type, service, rank, deployment status).

functioning families. The extent of contact between participating fathers and adolescents was also unknown, so it is possible fathers and adolescents who lived separately with other spouses or children completed the FAD with different family units in mind. However, given the FAD was collected during home visits at which the father and adolescent were both present, it remains likely they took the shared family environment into consideration. Importantly, family functioning data from multiple informants was used to increase validity,[38] and the authors took an average across these informants to ensure the perspective of each family member was given equal weight in analysis. Family functioning scores sometimes vary between family members,[39] so future studies might further investigate whether paternal mental health is associated with family functioning as perceived by different family members.

Conclusion

Evidence was found to suggest probable paternal PTSD or depression is associated with adolescent mental health disorders in military families, particularly internalizing disorders and particularly among boys. Probable paternal PTSD or depression was also associated with worse family functioning, particularly on the communication sub-scale. The prevalence of mental health disorders in the UK military is generally low,[1] but this study highlights the continued importance of supporting service personnel with mental health and of extending that support to families and adolescent offspring.

AUTHOR INFORMATION

Alice Wickersham, PhD, is Academic Lead for Clinical and Population Analytics in the CAMHS Digital Lab, King's College London. Her research interests are in using epidemiological methods and data linkage to investigate issues affecting children, adolescents, and young people, particularly intersections between mental health, education, and criminal justice. Previously, Wickersham worked as a research assistant at the King's Centre for Military Health Research.

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COMPETING INTERESTS

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Supervision: D Leightley and NT Fear

Funding Acquisition: NT Fear

ETHICS APPROVAL

The study protocol was approved by an ethics committee and the ethics certificate information is available from the authors upon request.

INFORMED CONSENT

N/A

REGISTRY AND REGISTRATION NO. OF THE STUDY/TRIAL

N/A

ANIMAL STUDIES

N/A

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PEER REVIEW

This manuscript has been peer reviewed.

DATA AVAILABILITY

The data cannot be made publicly available but can be accessed with permissions from King's Centre for Military Health Research, King's College London, United Kingdom, via Professor NT Fear.

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APPENDIX

Table A1. STROBE statement—Checklist of items that should be included in reports of cross-sectional studies

	Item no	Recommendation	Page
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract.	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found.	1-2
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported.	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses.	4
Methods			
Study design	4	Present key elements of study design early in the paper.	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	4-5
Participants	6	(a) Give the eligibility criteria and the sources and methods of selection of participants.	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	5-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	5-8
Bias	9	Describe any efforts to address potential sources of bias.	N/A
Study size	10	Explain how the study size was arrived at.	Supplementary Figure 1
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why.	5-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding.	8-9
		(b) Describe any methods used to examine sub-groups and interactions.	8-9
		(c) Explain how missing data were addressed.	8-9
		(d) If applicable, describe analytical methods taking account of sampling strategy.	N/A
		(e) Describe any sensitivity analyses.	8-9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completed follow-up, and analyzed.	Supplementary Figure 1
		(b) Give reasons for non-participation at each stage.	Supplementary Figure 1
		(c) Consider use of a flow diagram.	Supplementary Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders	9-10 (Note: we have not stratified characteristics by exposure group due to potentially disclosive cell sizes.)
		(b) Indicate number of participants with missing data for each variable of interest.	Supplementary Table 3
Outcome data	15*	Report numbers of outcome events or summary measures.	10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included.	10-12
		(b) Report category boundaries when continuous variables were categorized.	5-7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.	N/A
Other analyses	17	Report other analyses done—e.g., analyses of sub-groups and interactions, and sensitivity analyses.	10-12

Table A1. (Continued)

	Item no	Recommendation	Page
Discussion			
Key results	18	Summarize key results with reference to study objectives.	12-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	15-16
Generalizability	21	Discuss the generalizability (external validity) of the study results.	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based.	Title page

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at https://www.plosmedicine.org, Annals of Internal Medicine at https://www.annals.org, and Epidemiology at httpa://www.epidem.com). Information on the STROBE Initiative is available at https://www.strobe-statement.org.
* Give information separately for exposed and unexposed groups.

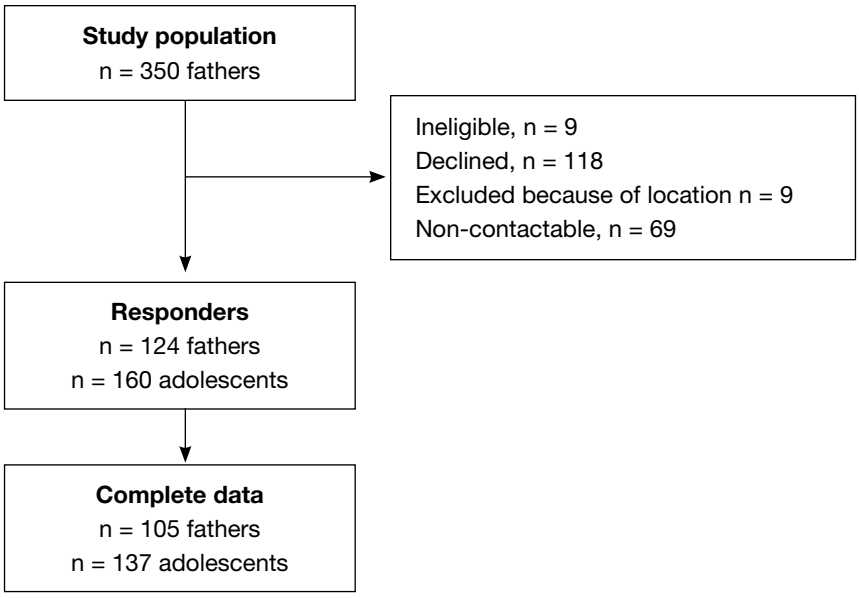

Figure A1. Study flow diagram

Table A2. Groupings for internalizing disorders and neurodevelopmental, externalizing, or other mental health disorders

Internalizing disorders	Neurodevelopmental, externalizing, or other mental health disorders
Depressive episode	Hyperactivity
Other depression	Hyperkinesis
Undifferentiated anxiety/depression	Other hyperactivity
Separation anxiety	Conduct/oppositional
Specific phobia	Oppositional defiant
Social phobia	Conduct disorder confined to family
Panic disorder	Unsocialized conduct disorder
Agoraphobia	Socialized conduct disorder
Obsessive compulsive disorder	Pervasive developmental disorder/autism
Generalized anxiety disorder	Tic disorder
Other anxiety	Eating disorder
	Any other disorder

Note: Only disorders that at least one adolescent met criteria for are listed. All "internalizing disorders" are categorized as mood disorders (F30-F39), neurotic, stress-related, and somatoform disorders (F40-F48), or emotional disorders with onset specific to childhood (F93) in ICD-10, while all "neurodevelopmental, externalizing, or other mental health disorders" are categorized elsewhere in ICD-10.

Table A3. Missing data summary

Variable	n missing (%)
Family functioning	18/124 fathers (14.5%)
Paternal depression or PTSD	19/124 fathers (15.3%)
Adolescent mental health	1/160 adolescents (0.6%)

Table A4. Pairwise correlation coefficients between McMaster Family Assessment Device scales (*p* values in parentheses)

	1	2	3	4	5	6	7
General family functioning	1.00	-	-	-	-	-	-
Problem solving	0.84	1.00	-	-	-	-	-
Communication	0.79	0.79	1.00	-	-	-	-
Roles	0.71	0.67	0.68	1.00	-	-	-
Affective responsiveness	0.83	0.80	0.73	0.55	1.00	-	-
Affective involvement	0.73	0.60	0.55	0.61	0.64	1.00	-
Behaviour control	0.62	0.64	0.57	0.66	0.55	0.49	1.00

Note: n = 105. All reported correlations were $p < 0.001$.

Table A5. Associations between paternal PTSD or depression and adolescent mental health disorders, stratified by adolescent gender

Adolescent mental health outcome	No paternal PTSD or depression, n (%)	Probable paternal PTSD or depression, n (%)	Unadjusted OR (95% CI)	*p*	Adjusted OR* (95% CI)	*p*	Adjusted OR† (95% CI)	*p*
Adolescent females (n = 62)								
Any mental health disorder								
No	26 (63.4%)	11 (52.4%)	Reference	—	Reference	—	Reference	—
Yes	15 (36.6%)	10 (47.6%)	1.58 (0.52-4.82)	0.425	1.22 (0.35-4.24)	0.753	1.12 (0.31-4.05)	0.858
Adolescent males (n = 75)								
Any mental health disorder								
No	36 (75.0%)	13 (48.2%)	Reference	—	Reference	—	Reference	—
Yes	12 (25.0%)	14 (51.9%)	3.23 (1.18-8.85)	0.023	3.68 (1.27-10.64)	0.016	2.73 (0.81-9.27)	0.106

PTSD = posttraumatic stress disorder; OR = odds ratio; CI = confidence interval.
* Adjusted for socio-demographic characteristics (paternal age, adolescent age) (paternal relationship status was excluded from these stratifications because of empty cells).
† Adjusted for socio-demographic characteristics (paternal age, adolescent age) and for military factors (serving status, engagement type, service, rank, deployment status).