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1 **Associations between paternal PTSD or depression, adolescent mental health, and family**
2 **functioning: A cross-sectional study of UK military families**

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4 Alice Wickersham (corresponding author)

5 CAMHS Digital Lab, Department of Child and Adolescent Psychiatry, King's College London,

6 London, United Kingdom

7 alice.wickersham@kcl.ac.uk

8

9 Daniel Leightley

10 King's Centre for Military Health Research, King's College London, London, United Kingdom

11 daniel.leightley@kcl.ac.uk

12

13 Benjamin Baig

14 Department of Child and Adolescent Psychiatry, King's College London, London, United

15 Kingdom

16 South London and Maudsley NHS Foundation Trust, London, United Kingdom

17 benjamin.baig@kcl.ac.uk

18

19 Melanie Chesnokov

20 Square Health Ltd

21 melanie.chesnokov@squarehealth.com

22

23

24 Alan Stein

25 Department of Psychiatry, University of Oxford, Oxford, United Kingdom

26 alan.stein@psych.ox.ac.uk

27

28 Paul Ramchandani

29 Faculty of Education, PEDAL Research Centre, University of Cambridge, Cambridge, UK

30 pr441@cam.ac.uk

31

32 Johnny Downs

33 CAMHS Digital Lab, Department of Child and Adolescent Psychiatry, King's College London,

34 London, United Kingdom

35 johnny.downs@kcl.ac.uk

36

37 Nathan Parnell

38 Tavistock and Portman NHS Foundation Trust, London, United Kingdom

39 King's Centre for Military Health Research, King's College London, London, United Kingdom

40 nparnell@tavi-port.nhs.uk

41

42 Kristy Rye

43 King's Centre for Military Health Research, King's College London, London, United Kingdom

44 kristy.rye@sabp.nhs.uk

45

46

47 Anna Verey

48 King's Centre for Military Health Research, King's College London, London, United Kingdom

49 anna.l.verey@kcl.ac.uk

50

51 Nicola T Fear

52 King's Centre for Military Health Research, King's College London, London, United Kingdom

53 nicola.t.fear@kcl.ac.uk

54

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70 For the purposes of open access, the authors have applied a Creative Commons Attribution (CC
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72 **Data sharing statement**

73 The data cannot be made publicly available, but can be accessed with permissions from King's
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78

79

80 ABSTRACT

81 **Background:** Relationships between paternal mental health, adolescent mental health, and
82 family functioning have received limited attention in UK military populations. The aim of this
83 secondary data analysis was to investigate whether post-traumatic stress disorder (PTSD) or
84 depression in military fathers was associated with mental health disorders in adolescent offspring
85 and impaired family functioning.

86 **Methods:** In total, n=105 serving and ex-serving members of the UK Armed Forces, and n=137
87 of their adolescent offspring (aged 11 to 17 years), were included in this analysis. Data were
88 collected online and via home visits, using validated questionnaires to assess mental health and
89 family functioning.

90 **Results:** Families where fathers had probable PTSD or depression experienced more impaired
91 general family functioning compared to families where the father did not have these conditions
92 (unadjusted $b=0.21$, 95% CI=0.07 to 0.35, $p=0.003$), and particularly on the communication
93 subscale of the Family Assessment Device. Probable paternal PTSD or depression was also
94 associated with increased likelihood of adolescent mental health disorders (unadjusted OR=2.30,
95 95% CI=1.10 to 4.81, $p=0.027$), particularly internalising disorders such as depression or anxiety
96 (unadjusted OR=2.21, 95% CI=1.04 to 4.71, $p=0.040$). The direction and strength of these
97 associations did not substantially change after adjusting for sociodemographic and military
98 covariates.

99 **Conclusions:** This study found evidence for associations between probable paternal PTSD or
100 depression, poorer adolescent mental health, and poorer family functioning in military families.
101 This highlights the importance of supporting the wellbeing of both military fathers and their

102 adolescent offspring, and of supporting the whole family when parents are known to be
103 struggling with their mental health.

104

105 **Keywords:** Military; Paternal; PTSD; Depression; Adolescent; Family

106 INTRODUCTION

107 Among United Kingdom (UK) service personnel, an estimated 21.9% meet criteria for a
108 common mental disorder, and 6.2% for post-traumatic stress disorder (PTSD) (1). Mental health
109 problems in military parents could pose challenges to their families and offspring, who already
110 experience a range of stressors as a result of military service, such as regular relocation and
111 separation from parents (2).

112 In particular, mental health problems in service personnel have been associated with impaired
113 structural, organisational, and transactional dynamics of family life (termed ‘family functioning’)
114 (3-6), problems readjusting to family life after returning from deployment (7), and marital or
115 relationship problems (3, 6, 8). As well as impacting family life in general, mental health
116 problems in service personnel have been shown to impact on their interactions with their
117 offspring, specifically problems with parenting (3, 6, 8), parent-child bonding (4), and perceived
118 relationship quality with offspring (9).

119 Mental health difficulties in parents are also thought to be associated with mental health
120 difficulties in offspring. Research in this area has often focused on maternal mental health, but
121 one review found that paternal mental health can also play an important role (10). It particularly
122 highlighted an association between paternal depression and adolescent anxiety, depression and
123 internalising problems, while evidence for other paternal mental health disorders such as PTSD
124 was less conclusive (10).

125 Investigations in United States, Australian and Kuwaiti military populations have also shown a
126 relationship between paternal and offspring mental health (11-13). This relationship has received
127 less attention in UK military families to date. One study conducted in UK military families found

128 paternal PTSD to be associated with hyperactivity among their offspring, but not with other
129 social and emotional problems (14). Understanding these relationships further is important, since
130 mental health problems during adolescence can, in turn, have a marked impact on outcomes such
131 as lower educational attainment (15) and unemployment (16).

132 To improve our understanding of these associations in UK military families, we aimed to
133 investigate whether families whose military fathers meet criteria for probable PTSD or
134 depression are at increased risk of (i) impaired family functioning, and (ii) adolescent mental
135 health disorders.

136 **METHODS**

137 **Design, setting and procedures**

138 Reporting follows STROBE guidelines for cross-sectional studies (Supplementary Table 1) (17).
139 This was a secondary, exploratory analysis of the Service Parents' & Adolescents' Challenges &
140 Experiences study (SPACE study), a study designed to explore the effects of paternal PTSD on
141 adolescent offspring. Participants for this cross-sectional study were drawn from the [PLACE
142 NAME REDACTED FOR MANUSCRIPT BLINDING] Health and Wellbeing cohort of UK
143 Armed Forces service personnel and the Children and Military Fathers with PTSD study (14, 18,
144 19). Fathers were invited to participate in the SPACE study if they had at least one child aged 11
145 to 17 years. Data collection ran from January 2016 to January 2017. Fathers were initially
146 invited, followed by mothers, long-term partners, and adolescent offspring (where consent was
147 given by the father to contact them). Adolescents either provided consent or assent depending on
148 age and geographical location, and, where possible, consent was sought from both biological

149 parents. Where this was not possible, consent was sought from the parent with parental
150 responsibility for the participating adolescent.

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

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

158 **Paternal depression and PTSD**

159 Paternal depression was measured using the 9-item Patient Health Questionnaire depression
160 scale (PHQ-9) (20, 21). The PHQ-9 was completed during the home visit. This self-report
161 questionnaire contains nine items, and asks participants about their experience of mental health
162 symptoms over the previous two weeks using a Likert scale of 0 (not at all) to 3 (nearly every
163 day). The responses are then summed to provide a total score (possible range 0 to 27). Cut-off
164 scores of 5, 10, 15 and 20 have been proposed as indicators of mild, moderate, moderately
165 severe, and severe depression respectively (20). Therefore in this study, a score of 5 or higher
166 was used to indicate any level of paternal depression. The PHQ-9 has been shown to have good
167 psychometric properties and has previously been used in military populations (22, 23). In our
168 sample, there were no missing data items on the PHQ-9, and internal consistency was excellent,
169 Cronbach's $\alpha = 0.90$.

170 Paternal PTSD was assessed using the self-report National Center for PTSD Checklist (PCL-5)
171 (24). The PCL-5 was completed during the home visit. It comprises twenty items asking
172 respondents to rate how much they were bothered by a series of problems over the previous
173 month on a scale of 0 (not at all) to 4 (extremely). The responses are then summed to provide a
174 total score (possible range 0 to 80). A total score of 33 or higher was taken to indicate probable
175 PTSD, based on previous evaluations of the PCL-5 in military populations (25). The PCL-5 was
176 used in preference to the PCL-M (military version) as the questions are not restricted to military-
177 related trauma. The PCL-5 has also been validated for use in military populations (25). In our
178 sample, one father was missing a single data item on the PCL-5, which was imputed with a zero.
179 Following this, internal consistency was excellent on the PCL-5, Cronbach's $\alpha = 0.95$.

180 For statistical analyses, a composite variable of depression and PTSD was generated. This binary
181 variable indicated the presence of probable depression or PTSD, versus no depression or PTSD.

182 **Family functioning**

183 Family functioning was assessed using the self-report McMaster Family Assessment Device
184 (FAD) (26). The FAD was completed during the home visit, but non-resident mothers who were
185 not present during the home visit could complete the FAD online. Each family member rated
186 how well 60 items (some of which are reverse scored) described their family on a Likert scale
187 (strongly agree, agree, disagree, strongly disagree). After reverse scoring, missing items were
188 imputed with a score of one if three or fewer items were missing (if more items were missing,
189 imputation was not carried out). Across all 314 FAD questionnaires which were completed as
190 part of this study by fathers, mothers and adolescents, 11 (3.5%) were missing a single FAD
191 item, and eight (2.6%) were missing two FAD items; these items were therefore imputed with a

192 one. A further three (1.0%) had 11 or more missing FAD items which were therefore left as
193 missing.

194 FAD subscales were then scored for each individual by taking the mean average across items
195 capturing general family functioning (12 items), problem solving (six items), communication
196 (nine items), roles (11 items), affective responsiveness (six items), affective involvement (seven
197 items), and behaviour control (nine items). Finally, we took mean average scores on the resulting
198 subscales across all available informants for each family. Higher scores indicate more
199 problematic family functioning, and can be further interpreted using cut-off scores recommended
200 by Miller et al. (27), where subscale scores meeting or exceeding the subscale cut-off value can
201 be considered indicative of unhealthy functioning in that area. Among the families included in
202 our analysis, the number of family members who completed the FAD ranged between two and
203 five (median = 3, interquartile range = 2 to 3). The FAD has been shown to have good
204 psychometric properties, and the general family functioning scale has previously been used in
205 military populations (27, 28). Following imputation of missing items, and across all family
206 members, internal consistency was modest to excellent for each subscale, ranging from
207 Cronbach's $\alpha = 0.67$ (behaviour control) to Cronbach's $\alpha = 0.88$ (general family functioning).

208 **Adolescent mental health disorders**

209 Adolescents' emotional and behavioural well-being was assessed using the Development &
210 Well-Being Assessment (DAWBA), a structured diagnostic assessment covering all major
211 mental health diagnoses in the 2010 edition of ICD-10 (29, 30). The DAWBA was completed
212 online by participating fathers, mothers, step-mothers and adolescents. A clinician then reviewed
213 responses in combination with computer-generated probability scores to decide likely diagnoses
214 for each adolescent (part of the clinician's role in this process is deciding how to balance

215 information from multiple sources which might sometimes be conflicting). The DAWBA has
216 been shown to have good validity and inter-rater reliability (30, 31). Three binary variables were
217 generated, one indicating whether or not adolescents met criteria for any ICD-10 mental health
218 disorder, and two composite variables indicating whether or not adolescents met criteria for an
219 internalising disorder, and for a neurodevelopmental, externalising or other mental health
220 disorder (see Supplementary Table 2 for groupings).

221 **Covariates**

222 Sociodemographic and military factors were also considered. Adolescent age and gender were
223 collected as part of the current study. Paternal engagement type (Regular/Reserve) and service
224 (Army/Royal Air Force/Naval Services) were collected from Phase 1 of the [PLACE NAME
225 REDACTED FOR MANUSCRIPT BLINDING] Health and Wellbeing cohort (32). Paternal age,
226 relationship status (in a relationship/single), serving status (serving/ex-service), rank
227 (commissioned officer/other) and deployment status (Iraq or Afghanistan/neither) were collected
228 from Phase 3 of the [PLACE NAME REDACTED FOR MANUSCRIPT BLINDING] Health
229 and Wellbeing cohort (33), and supplemented from KIDS if missing from Phase 3.

230 **Statistical analyses**

231 Linear regression analyses were conducted to examine the associations between probable
232 paternal PTSD or depression and each family functioning subscale. Logistic regression analyses
233 were conducted to examine the association between probable paternal PTSD or depression and
234 adolescent mental health disorders, accounting for clustering within families using cluster-robust
235 standard errors (this was not necessary for analyses of family functioning, as only one FAD score

236 per family was used) (34). Models were adjusted for sociodemographic covariates, then
237 additionally for military covariates.

238 In a set of sensitivity analyses, we repeated these analyses twice with PTSD and depression
239 considered separately and as continuous total scores in separate regressions. PTSD scores were
240 scaled so that the resulting regression coefficients represent a 15 point difference on the PCL-5,
241 and depression scores were scaled so that the resulting regression coefficients represent a 5 point
242 difference on the PHQ-9, these having been proposed as clinically meaningful differences in
243 previous literature (35, 36). We also stratified our main analysis of adolescent mental health
244 disorders by adolescent gender, although it should be noted that the cell sizes for stratified
245 analyses were small.

246 Complete case analyses were conducted. Statistical significance was defined as $p < 0.05$. Analyses
247 were conducted using Stata version 18.0.

248 **RESULTS**

249 **Descriptive statistics**

250 In total, $n=105$ fathers and their $n=137$ adolescents had complete data available for analysis
251 (Supplementary Figure 1, Supplementary Table 3). The characteristics of included fathers are
252 summarised in Table 1. Of the $n=105$ included fathers, the majority served as regulars ($n=88$,
253 83.8%), in ranks other than commissioned officers ($n=71$, 67.6%), and in the Army ($n=67$,
254 63.8%). Most were in a relationship ($n=96$, 91.4%). Over a third of fathers met criteria for either
255 probable PTSD or depression ($n=41$, 39.1%). All fathers who met criteria for probable PTSD
256 also met criteria for any depression.

257 On average, the included families scored in the healthy range for all family functioning subscales
258 (Table 2), and scores on the subscales were very highly correlated (Supplementary Table 4).
259 Characteristics of the n=137 included adolescents are summarised in Table 3. Over a third of
260 included adolescents met criteria for a mental health disorder (n=51, 37.3%).

261 [Table 1]

262 [Table 2]

263 [Table 3]

264 **Associations between probable paternal PTSD or depression and family functioning**

265 There was evidence that probable paternal PTSD or depression was associated with worse
266 general family functioning (b=0.21, 95% CI=0.07 to 0.35, p=0.003). This association remained
267 after adjusting for sociodemographic characteristics and military factors (Table 4). However, the
268 average general family functioning score among families where the father met criteria for
269 probable PTSD or depression still did not meet the cut-off for unhealthy functioning.

270 Analyses of the remaining family functioning subscales indicated that probable paternal PTSD or
271 depression was associated with worse scores on problem solving (b=0.15, 95% CI=0.03 to 0.26,
272 p=0.017), communication (b=0.16, 95% CI=0.05 to 0.28, p=0.007), roles (b=0.13, 95% CI=0.03
273 to 0.24, p=0.012), and affective responsiveness (b=0.15, 95% CI=0.00 to 0.31, p=0.048)
274 subscales. These associations remained after adjusting for sociodemographic characteristics and
275 military factors. However, of these, the average score among families where the father met
276 criteria for probable PTSD or depression only met or exceeded the cut-off for unhealthy
277 functioning on the communication subscale. Using this cut-off, 58.5% of families where the

278 father met criteria for probable PTSD or depression had unhealthy communication (compared to
279 32.8% in the comparison group).

280 [Table 4]

281 Our sensitivity analyses considering paternal PTSD and depression separately as continuous total
282 scores showed further evidence for both PTSD and depression symptoms being significantly
283 associated with worse general family functioning, including after adjustment for
284 sociodemographic and military covariates (Table 5). Depression scores were likewise
285 significantly associated with worse family functioning on all remaining subscales, whereas
286 following adjustment for sociodemographic and military covariates, PTSD scores were only
287 significantly associated with worse scores on communication, roles, and affective responsiveness
288 subscales.

289 [Table 5]

290 **Associations between probable paternal PTSD or depression and adolescent mental health** 291 **disorders**

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

296 A similar pattern of results emerged when focusing our analysis on adolescent internalising
297 disorders. Probable paternal PTSD or depression was associated with adolescent internalising
298 disorders (OR=2.21, 95% CI=1.04 to 4.71, p=0.040), and while this association was no longer
299 statistically significant after adjusting for sociodemographic characteristics and military factors,

300 the strength and direction of the association remained similar. However, evidence for an
301 association between probable paternal PTSD or depression and adolescent neurodevelopmental,
302 externalising or other mental health disorder was weaker.

303 Stratifying by adolescent gender suggested that the association between probable paternal PTSD
304 or depression and any adolescent mental health disorder was stronger among adolescent boys
305 (OR=3.23, 95% CI=1.18 to 8.85, p=0.023) than among adolescent girls (OR=1.58, 95% CI=0.52
306 to 4.82, p=0.425). However, it should be noted that sample sizes following stratification were
307 small (Supplementary Table 5).

308 Our sensitivity analyses considering paternal PTSD and depression separately as continuous total
309 scores suggested that higher paternal depression scores were associated with increased odds for
310 mental health disorders in adolescent offspring, particularly internalising disorders. Odds ratios
311 remained similar, but no longer statistically significant, after adjusting for sociodemographic and
312 military covariates. Furthermore, neither the unadjusted nor adjusted associations between
313 paternal PTSD scores and adolescent mental health were statistically significant (Table 6).

314 [Table 6]

315 **DISCUSSION**

316 The aims of this study were to investigate whether UK military families whose fathers met
317 criteria for probable PTSD or depression are at increased risk of impaired family functioning and
318 of adolescent mental health disorders. We found strong evidence for an association between
319 probable paternal PTSD or depression and impaired family functioning, particularly on the
320 communication subscale of the Family Assessment Device. There was also some evidence for an

321 association between probable paternal PTSD or depression and adolescent mental health
322 disorder, particularly internalising disorders, and particularly among adolescent boys.

323 Our finding that probable paternal PTSD or depression is associated with family functioning is
324 consistent with previous military studies which have investigated similar associations (3-6). For
325 our probable paternal PTSD or depression exposure, and for our continuous PTSD score
326 exposure, we found negative and statistically significant associations with all family functioning
327 subscales other than affective involvement and behavioural control; two previous studies which
328 used the FAD found paternal PTSD to be significantly associated with all subscales other than
329 roles and behaviour control (4, 5). Our finding that paternal PTSD or depression was particularly
330 associated with communication is of interest. During depressive episodes, individuals often
331 experience reduced energy, activity, and capacity for interest and enjoyment (29). Taken
332 together, these symptoms might reduce paternal engagement in family behaviours which are
333 captured by the communication subscale. This possibility would benefit from further research.

334 Our findings are somewhat consistent with previous studies which have demonstrated
335 associations between paternal mental health and offspring mental health in military families (11-
336 13). We found some evidence for associations between probable paternal PTSD or depression
337 and adolescent mental health disorders, but these associations were no longer statistically
338 significant after adjusting for sociodemographic and military covariates (although the magnitude
339 of odds ratios remained similar). Our sensitivity analyses suggested that these associations were
340 perhaps being driven by paternal depression symptoms in our sample, rather than by PTSD
341 symptoms, but larger studies would be needed to confirm this with improved statistical power.
342 Our findings stratifying by adolescent gender are especially likely to be underpowered, but

343 tentatively suggest stronger associations for adolescent boys – this would also need to be
344 investigated in further studies.

345 Possible mechanisms in the relationship between paternal and offspring mental wellbeing have
346 been explored, with reviews implicating genetic processes, parenting, and the home environment
347 in the transmission of risk (37, 38). Maternal mental health has also been proposed as a factor on
348 the pathway between paternal and adolescent mental health (37), and could therefore be
349 investigated in future studies. Military families may additionally experience a range of stressors
350 which could increase risk for mental health disorders, like relocation and parental physical
351 trauma, as well as protective factors, such as strong community connections which could foster
352 parental resiliency and positive family functioning in military families (39). With family
353 functioning potentially playing a role in the relationship between paternal and adolescent mental
354 health, these relationships warrant further study in a military population.

355 **Strengths and limitations**

356 To our knowledge, this is the first UK-based study to examine the association between paternal
357 and adolescent mental health in military families using a robust clinical measure to gather
358 diagnostic data from multiple informants on adolescent mental health. This ensured that the
359 adolescent mental health data used is both reliable and clinically relevant (30).

360 Our sample size had a number of implications for our study. First, to increase statistical power,
361 our main analysis focused on a composite of ‘probable’ PTSD and ‘any’ depression, largely
362 because cell sizes were not sufficient to examine probable PTSD separately. However, our
363 supplementary analyses using continuous measures of PTSD and depression add more detailed
364 findings for each separate set of symptoms. Second, caution is warranted in adjusting for large

365 numbers of covariates where sample sizes are small. However, we equally found it important to
366 adjust for sociodemographic and military covariates which could play an important role in family
367 functioning and adolescent mental health. Finally, small sample sizes can limit the external
368 generalisability of findings. Nonetheless, our sample originated from a representative, random
369 cohort of the UK military (18, 19).

370 We relied on fathers providing consent to contact and recruit mothers and adolescents.
371 Therefore, recruitment may have selected for intact or well-functioning families. The extent of
372 contact between participating fathers and adolescents was also unknown, so it is possible that
373 fathers and adolescents who lived separately with other spouses or children completed the FAD
374 with different family units in mind. However, given that the FAD was collected during home
375 visits at which the father and adolescent were both present, it remains likely that they took their
376 shared family environment into consideration. Importantly, we used family functioning data
377 from multiple informants to increase validity (40), and took an average across these informants
378 to ensure that the perspective of each family member was given equal weight in analysis. Family
379 functioning scores sometimes vary between family members (41), so future studies might further
380 investigate whether paternal mental health is associated with family functioning as perceived by
381 different family members.

382 **Conclusion**

383 In summary, we found evidence to suggest that probable paternal PTSD or depression is
384 associated with adolescent mental health disorders in military families, particularly internalising
385 disorders, and particularly among boys. Probable paternal PTSD or depression was also
386 associated with worse family functioning, particularly on the communication subscale. The
387 prevalence of mental health disorders in the UK military is generally low (1), but this study

388 highlights the continued importance of supporting service personnel with their mental health, and
389 of extending that support to families and adolescent offspring.

390 **REFERENCES**

- 391 1. Stevelink SAM, Jones M, Hull L, Pernet D, MacCrimmon S, Goodwin L, et al. Mental health
392 outcomes at the end of the British involvement in the Iraq and Afghanistan conflicts: a cohort study. *The*
393 *British Journal of Psychiatry*. 2018;213(6):690-7.
- 394 2. Gribble R, Fear NT. Living separately during the week: Influences on family functioning, health,
395 and well-being of UK naval families. *Journal of Military, Veteran and Family Health*. 2022;8(2):82-93.
- 396 3. Blow AJ, Gorman L, Ganoczy D, Kees M, Kashy DA, Valenstein M, et al. Hazardous drinking and
397 family functioning in National Guard veterans and spouses postdeployment. *Journal of Family*
398 *Psychology*. 2013;27(2):303.
- 399 4. Boricevic Marsanic V, Aukst Margetic B, Jukic V, Matko V, Grgic V. Self-reported emotional and
400 behavioral symptoms, parent-adolescent bonding and family functioning in clinically referred adolescent
401 offspring of Croatian PTSD war veterans. *European Child & Adolescent Psychiatry*. 2014;23(5):295-306.
- 402 5. Davidson AC, Mellor DJ. The adjustment of children of Australian Vietnam veterans: is there
403 evidence for the transgenerational transmission of the effects of war-related trauma? *Australian and*
404 *New Zealand Journal of Psychiatry*. 2001;35(3):345-51.
- 405 6. Jordan BK, Marmar CR, Fairbank JA, Schlenger WE, Kulka RA, Hough RL, et al. Problems in
406 families of male Vietnam veterans with posttraumatic stress disorder. *Journal of Consulting and Clinical*
407 *Psychology*. 1992;60(6):916-26.
- 408 7. Sayers SL, Farrow VA, Ross J, Oslin DW. Family problems among recently returned military
409 veterans referred for a mental health evaluation. *The Journal of Clinical Psychiatry*. 2009;70(2):163-70.
- 410 8. Mustillo S, Xu M, MACDERMID WADSWORTH S. Traumatic combat exposure and parenting
411 among national guard fathers: an application of the ecological model. *Fathering: A Journal of Theory,*
412 *Research & Practice about Men as Fathers*. 2014;12(3).
- 413 9. Ruscio AM, Weathers FW, King LA, King DW. Male war-zone veterans' perceived relationships
414 with their children: The importance of emotional numbing. *Journal of Traumatic Stress: Official*
415 *Publication of The International Society for Traumatic Stress Studies*. 2002;15(5):351-7.
- 416 10. Wickersham A, Leightley D, Archer M, Fear NT. The association between paternal
417 psychopathology and adolescent depression and anxiety: A systematic review. *Journal of Adolescence*.
418 2020;79:232-46.
- 419 11. Al-Turkait FA, Ohaeri JU. Psychopathological status, behavior problems, and family adjustment
420 of Kuwaiti children whose fathers were involved in the first gulf war. *Child and Adolescent Psychiatry*
421 *and Mental Health*. 2008;2(1):12.
- 422 12. Lester P, Peterson K, Reeves J, Knauss L, Glover D, Mogil C, et al. The long war and parental
423 combat deployment: Effects on military children and at-home spouses. *Journal of the American*
424 *Academy of Child & Adolescent Psychiatry*. 2010;49(4):310-20.

- 425 13. O'Toole BI, Burton MJ, Rothwell A, Outram S, Dadds M, Catts SV. Intergenerational transmission
426 of post-traumatic stress disorder in Australian Vietnam veterans' families. *Acta Psychiatrica*
427 *Scandinavica*. 2017;135(5):363-72.
- 428 14. Fear NT, Reed RV, Rowe S, Burdett H, Pernet D, Mahar A, et al. Impact of paternal deployment
429 to the conflicts in Iraq and Afghanistan and paternal post-traumatic stress disorder on the children of
430 military fathers. *The British Journal of Psychiatry*. 2018;212(6):347-55.
- 431 15. Wickersham A, Sugg HVR, Epstein S, Stewart R, Ford T, Downs J. Systematic Review and Meta-
432 analysis: The Association Between Child and Adolescent Depression and Later Educational Attainment.
433 *Journal of the American Academy of Child & Adolescent Psychiatry*. 2021;60(1):105-18.
- 434 16. Clayborne ZM, Varin M, Colman I. Systematic review and meta-analysis: adolescent depression
435 and long-term psychosocial outcomes. *Journal of the American Academy of Child & Adolescent*
436 *Psychiatry*. 2019;58(1):72-9.
- 437 17. Vandembroucke JP, Elm Ev, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening
438 the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and elaboration. *Annals*
439 *of Internal Medicine*. 2007;147(8):W-163-W-94.
- 440 18. Fear NT, Jones M, Murphy D, Hull L, Iversen AC, Coker B, et al. What are the consequences of
441 deployment to Iraq and Afghanistan on the mental health of the UK armed forces? A cohort study. *The*
442 *Lancet*. 2010;375(9728):1783-97.
- 443 19. Hotopf M, Hull L, Fear NT, Browne T, Horn O, Iversen A, et al. The health of UK military
444 personnel who deployed to the 2003 Iraq war: a cohort study. *The Lancet*. 2006;367(9524):1731-41.
- 445 20. Kroenke K, Spitzer RL, Williams JBW. The PHQ-9: Validity of a Brief Depression Severity Measure.
446 *Journal of General Internal Medicine*. 2001;16(9):606-13.
- 447 21. Spitzer RL, Kroenke K, Williams JW, and the Patient Health Questionnaire Primary Care Study G.
448 Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. *JAMA*.
449 1999;282(18):1737-44.
- 450 22. Iversen AC, van Staden L, Hughes JH, Browne T, Hull L, Hall J, et al. The prevalence of common
451 mental disorders and PTSD in the UK military: using data from a clinical interview-based study. *BMC*
452 *Psychiatry*. 2009;9(1):68.
- 453 23. Stevelink SA, Jones N, Jones M, Dyball D, Khera CK, Pernet D, et al. Do serving and ex-serving
454 personnel of the UK armed forces seek help for perceived stress, emotional or mental health problems?
455 *European Journal of Psychotraumatology*. 2019;10(1):1556552.
- 456 24. Blevins C, Weathers F, Davis M, Witte T, Domino J. The Posttraumatic Stress Disorder Checklist
457 for DSM-5 (PCL-5): Development and Initial Psychometric Evaluation. *Journal of Traumatic Stress*.
458 2015;28(6):489-98.
- 459 25. Bovin MJ, Marx BP, Weathers FW, Gallagher MW, Rodriguez P, Schnurr PP, et al. Psychometric
460 properties of the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition
461 (PCL-5) in veterans. *Psychological Assessment*. 2016;28(11):1379-91.

- 462 26. Epstein Nathan B, Baldwin Lawrence M, Bishop Duane S. THE McMASTER FAMILY ASSESSMENT
463 DEVICE*. *Journal of Marital and Family Therapy*. 1983;9(2):171-80.
- 464 27. Miller IW, Epstein NB, Bishop DS, Keitner GI. The McMaster Family Assessment Device:
465 Reliability and validity. *Journal of Marital and Family Therapy*. 1985;11(4):345-56.
- 466 28. Lester P, Saltzman WR, Woodward K, Glover D, Leskin GA, Bursch B, et al. Evaluation of a family-
467 centered prevention intervention for military children and families facing wartime deployments.
468 *American Journal of Public Health*. 2012;102 Suppl 1:S48-54.
- 469 29. World Health Organization. International classification of diseases and related health problems,
470 10th revision. Geneva: World Health Organization; 1992.
- 471 30. Goodman R, Ford T, Richards H, Gatward R, Meltzer H. The Development and Well-Being
472 Assessment: description and initial validation of an integrated assessment of child and adolescent
473 psychopathology. *Journal of Child Psychology and Psychiatry*. 2000;41(5):645-55.
- 474 31. Ford T, Goodman R, Meltzer H. The British Child and Adolescent Mental Health Survey 1999: The
475 Prevalence of DSM-IV Disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*.
476 2003;42(10):1203-11.
- 477 32. Redacted. [PLACEHOLDER CITATION 1, REDACTED FOR MANUSCRIPT BLINDING]. n.d.
- 478 33. Redacted. [PLACEHOLDER CITATION 2, REDACTED FOR MANUSCRIPT BLINDING]. n.d.
- 479 34. StataCorp. 20.22 Obtaining robust variance estimates. In: StataCorp, editor. *Stata: Release 18*
480 *Statistical Software*. College Station, TX: StataCorp LLC; 2023.
- 481 35. Kroenke K. Enhancing the clinical utility of depression screening. *Canadian Medical Association*
482 *Journal*. 2012;184(3):281-2.
- 483 36. Marx BP, Lee DJ, Norman SB, Bovin MJ, Sloan DM, Weathers FW, et al. Reliable and clinically
484 significant change in the clinician-administered PTSD Scale for DSM-5 and PTSD Checklist for DSM-5
485 among male veterans. *Psychological Assessment*. 2022;34(2):197.
- 486 37. Ramchandani P, Psychogiou L. Paternal psychiatric disorders and children's psychosocial
487 development. *The Lancet*. 2009;374(9690):646-53.
- 488 38. Stein A, Pearson RM, Goodman SH, Rapa E, Rahman A, McCallum M, et al. Effects of perinatal
489 mental disorders on the fetus and child. *The Lancet*. 2014;384(9956):1800-19.
- 490 39. O'Neal CW, Mallette JK, Mancini JA. The Importance of Parents' Community Connections for
491 Adolescent Well-being: An Examination of Military Families. *American Journal of Community*
492 *Psychology*. 2018;61(1-2):204-17.
- 493 40. Georgiades K, Boyle MH, Jenkins JM, Sanford M, Lipman E. A multilevel analysis of whole family
494 functioning using the McMaster Family Assessment Device. *Journal of Family Psychology*.
495 2008;22(3):344.

- 496 41. Akister J, Stevenson-Hinde J. Identifying families at risk: Exploring the potential of the McMaster
497 Family Assessment Device. *Journal of Family Therapy*. 1991;13(4):411-21.
498

499 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		
<i>Single</i>	9	8.6%
<i>In a relationship</i>	96	91.4%
Serving status		
<i>Serving</i>	55	52.4%
<i>Ex-Service</i>	50	47.6%
Engagement type		
<i>Regular</i>	88	83.8%
<i>Reserve</i>	17	16.2%
Service		
<i>Army</i>	67	63.8%
<i>Royal Air Force</i>	23	21.9%
<i>Naval Services</i>	15	14.3%
Rank		
<i>Commissioned Officer</i>	34	32.4%
<i>Other ranks</i>	71	67.6%
Deployment status		
<i>Iraq or Afghanistan</i>	77	73.3%
<i>Neither</i>	28	26.7%
Mental health – categorical variables		
<i>Probable PTSD</i>	11	10.5%
<i>Any depression</i>	41	39.1%
<i>Probable PTSD or depression</i>	41	39.1%
Mental health – continuous variables		
<i>PTSD score, median and interquartile range</i>	12 (5-21)	
<i>Depression score, median and interquartile range</i>	3 (1-7)	

501 *Table 2: Descriptive statistics of family functioning (n=105) (higher scores indicate worse*
 502 *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
Problem solving (2.2)	1.98	1.92-2.04
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

503

504 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		
<i>Male</i>	75	54.7%
<i>Female</i>	62	45.3%
Mental health		
<i>Any mental health disorder</i>	51	37.2%
<i>Internalising disorder</i>	37	27.0%
<i>Neurodevelopmental, externalising or other mental health disorder</i>	23	16.8%

505

506 *Table 4: Associations between probable paternal PTSD or depression, family functioning, and*
 507 *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 b¹ (95% CI)	p	Adjusted b² (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 OR¹ (95% CI)	p	Adjusted OR² (95% CI)	p
Any mental health disorder								
<i>No</i>	62 (69.7%)	24 (50.0%)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	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
Internalising disorder								
<i>No</i>	70 (78.7%)	30 (62.5%)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	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, externalising or other mental health disorder								
<i>No</i>	77 (86.5%)	37 (77.1%)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	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

508 Abbreviations: b=unstandardised regression coefficient, OR=Odds Ratio, CI=Confidence
 509 Interval

510 ¹ Adjusted for sociodemographic characteristics (paternal age, paternal relationship status,
 511 adolescent age, adolescent gender)

512 ² Adjusted for sociodemographic characteristics (paternal age, paternal relationship status,
 513 adolescent age, adolescent gender) and for military factors (serving status, engagement type,
 514 service, rank, deployment status)

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

Exposure: paternal PTSD score	Unadjusted b (95% CI)	P	Adjusted b¹ (95% CI)	P	Adjusted b² (95% CI)	P
General family functioning	0.12 (0.05 to 0.19)	0.001	0.12 (0.06 to 0.19)	<0.001	0.13 (0.05 to 0.21)	0.002
Problem solving	0.07 (0.00 to 0.13)	0.037	0.07 (0.01 to 0.13)	0.024	0.07 (-0.00 to 0.14)	0.056
Communication	0.07 (0.01 to 0.13)	0.027	0.07 (0.01 to 0.13)	0.016	0.07 (0.00 to 0.14)	0.048
Roles	0.06 (0.01 to 0.12)	0.018	0.07 (0.02 to 0.12)	0.011	0.07 (0.00 to 0.13)	0.040
Affective responsiveness	0.10 (0.02 to 0.17)	0.013	0.10 (0.03 to 0.17)	0.004	0.09 (0.01 to 0.17)	0.038
Affective involvement	0.06 (-0.01 to 0.13)	0.092	0.07 (0.00 to 0.13)	0.047	0.07 (-0.01 to 0.15)	0.090
Behaviour control	0.06 (0.01 to 0.12)	0.016	0.07 (0.02 to 0.12)	0.010	0.05 (-0.01 to 0.11)	0.083
Exposure: paternal depression score	Unadjusted b (95% CI)	P	Adjusted b¹ (95% CI)	P	Adjusted b² (95% CI)	P
General family functioning	0.13 (0.07 to 0.19)	<0.001	0.14 (0.08 to 0.20)	<0.001	0.14 (0.08 to 0.21)	<0.001
Problem solving	0.08 (0.02 to 0.13)	0.005	0.08 (0.03 to 0.14)	0.003	0.08 (0.02 to 0.14)	0.007
Communication	0.09 (0.03 to 0.14)	0.002	0.09 (0.04 to 0.14)	0.001	0.09 (0.04 to 0.15)	0.002
Roles	0.08 (0.03 to 0.12)	0.002	0.08 (0.03 to 0.13)	0.001	0.08 (0.03 to 0.13)	0.002
Affective responsiveness	0.09 (0.02 to 0.16)	0.010	0.10 (0.04 to 0.17)	0.001	0.09 (0.02 to 0.16)	0.016
Affective involvement	0.07 (0.00 to 0.13)	0.038	0.08 (0.02 to 0.14)	0.007	0.08 (0.02 to 0.15)	0.015
Behaviour control	0.07 (0.03 to 0.12)	0.003	0.08 (0.03 to 0.12)	0.001	0.07 (0.02 to 0.12)	0.008

517 Abbreviations: b=unstandardised regression coefficient, CI=Confidence Interval

518 Note: PTSD score has been scaled to represent a 15 point change on the PCL-5, and depression
 519 score has been scaled to represent a 5 point change on the PHQ-9.

520 ¹ Adjusted for sociodemographic characteristics (paternal age, paternal relationship status,
 521 adolescent age, adolescent gender)

522 ² Adjusted for sociodemographic characteristics (paternal age, paternal relationship status,
 523 adolescent age, adolescent gender) and for military factors (serving status, engagement type,
 524 service, rank, deployment status)

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

Exposure: paternal PTSD score	Mean paternal PTSD score (SD)	Unadjusted OR (95% CI)	p	Adjusted OR ¹ (95% CI)	p	Adjusted OR ² (95% CI)	p
Any mental health disorder							
<i>No</i>	12.8 (12.5)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	16.8 (17.0)	1.32 (0.92 to 1.91)	0.136	1.29 (0.86 to 1.92)	0.219	1.07 (0.70 to 1.65)	0.755
Internalising disorder							
<i>No</i>	13.7 (14.0)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	15.9 (15.7)	1.16 (0.86 to 1.58)	0.337	1.15 (0.78 to 1.71)	0.474	0.98 (0.65 to 1.48)	0.922
Neurodevelopmental, externalising or other mental health disorder							
<i>No</i>	13.3 (12.7)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	19.2 (20.8)	1.43 (0.91 to 2.27)	0.125	1.40 (0.89 to 2.21)	0.149	1.36 (0.80 to 2.33)	0.256
Exposure: paternal depression score	Mean paternal depression score (SD)	Unadjusted OR (95% CI)	p	Adjusted OR ¹ (95% CI)	p	Adjusted OR ² (95% CI)	p
Any mental health disorder							
<i>No</i>	3.93 (4.43)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	5.82 (5.80)	1.45 (1.01 to 2.08)	0.046	1.41 (0.95 to 2.09)	0.086	1.26 (0.84 to 1.90)	0.264
Internalising disorder							
<i>No</i>	4.13 (4.75)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	6.00 (5.62)	1.41 (1.03 to 1.91)	0.031	1.43 (0.95 to 2.15)	0.082	1.33 (0.87 to 2.04)	0.191
Neurodevelopmental, externalising or other mental health disorder							
<i>No</i>	4.32 (4.68)	Reference	-	Reference	-	Reference	-
<i>Yes</i>	6.17 (6.47)	1.37 (0.86 to 2.18)	0.184	1.31 (0.83 to 2.08)	0.240	1.24 (0.75 to 2.04)	0.406

527 Abbreviations: OR=Odds Ratio, CI=Confidence Interval, SD=Standard Deviation.

528 Note: PTSD score has been scaled to represent a 15 point change on the PCL-5, and depression
 529 score has been scaled to represent a 5 point change on the PHQ-9.

530 ¹ Adjusted for sociodemographic characteristics (paternal age, paternal relationship status,
 531 adolescent age, adolescent gender)

532 ² Adjusted for sociodemographic characteristics (paternal age, paternal relationship status,
 533 adolescent age, adolescent gender) and for military factors (serving status, engagement type,
 534 service, rank, deployment status)