

## ONLINE FIRST

# Deployment and Mental Health Diagnoses Among Children of US Army Personnel

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**Objective:** To characterize the risk of mental health diagnoses among children of US military personnel associated with parental deployment in support of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF).

**Design:** Nonrandomized, retrospective cohort study (2003-2006).

**Setting:** Electronic medical record data for outpatient care.

**Participants:** Children (N=307 520) aged 5 to 17 years with at least 1 active-duty US Army parent.

**Main Exposure:** Number of months of parental deployment for OIF and OEF.

**Main Outcome Measures:** A mental health diagnosis was defined as having at least 1 mental health-related *International Classification of Diseases, Ninth Revision*, code out of 4 possible codes for a given outpatient medical visit. Diagnoses were further classified into 1 of 17 disorder categories.

**Results:** Overall, children with parental deployment represented an excess of 6579 mental health diagnoses during the 4-year period compared with children whose parents did not deploy. After the children's age, sex, and mental health history were adjusted for, excess mental health diagnoses associated with parental deployment were greatest for acute stress reaction/adjustment, depressive, and pediatric behavioral disorders and increased with total months of parental deployment. Boys and girls showed similar patterns within these same categories, with more diagnoses observed in older children within sex groups and in boys relative to girls within age groups.

**Conclusions:** A dose-response pattern between deployment of a parent for OIF and OEF and increased mental health diagnoses was observed in military children of all ages. Findings may be used to inform policy, prevention, and treatment efforts for military families facing substantial troop deployments.

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**R**ECENT OPERATIONS IN IRAQ and Afghanistan have involved frequent and extended deployment of US military personnel, prompting attention to the mental health needs of returning soldiers.<sup>1-3</sup> Major life events such as long-term parental absence are also traumatic for children,

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often predicting future emotional and behavioral functioning across ages.<sup>4,5</sup> Children fear a parent's death above any other event<sup>6</sup> and, in military families, view war as a threat to their caretakers' security and stability.<sup>7</sup> Even the possibility of war and a par-

ent's potential harm has been shown to be sufficient to induce psychological distress among children with military parents,<sup>8</sup> as has actual parental separation during military deployment.<sup>9</sup> After rank and child's age were adjusted for, deployment status during Operation Desert Storm (1990-1991) was associated with depression and negative affect in children with military parents.<sup>10</sup>

Research addressing military children during Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) is sparse, yet points to increased stress and behavioral problems associated with parental deployment.<sup>11-15</sup> Although some authors have suggested a higher baseline prevalence of mental health problems and maladaptive behaviors for

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children in military vs nonmilitary families owing to the stresses of military life (eg, frequent relocation, deployment),<sup>16</sup> others have found no differences.<sup>17</sup> The few existing studies focusing on the effects of parental deployment are limited by the use of self-reported data, small or highly selective samples, narrow age ranges, and cross-sectional designs or were conducted during peacetime. Therefore, the results may not generalize well to children of service members who are deployed in support of current operations. Furthermore, some articles report relative rather than absolute measures of effect, making it difficult to gauge the actual public health impact of deployment on the mental health of children in military families. To date, no studies (to our knowledge) have assessed whether more time spent deployed for personnel brings greater psychological morbidity for their children.

The US military often deploys its forces to areas of high volatility and instability. As troops face dynamic and evolving threats (eg, an increasingly sophisticated array of roadside explosive devices), the need to anticipate the psychological consequences for their children and to offer timely intervention becomes increasingly important. This study examined the association between operational deployment and mental health diagnoses among children of US Army active duty personnel. We hypothesized that the risk of mental health diagnoses would be greater among children whose military parent had spent more cumulative time deployed in support of OEF and OIF between 2003 and 2006. Also, relationships were expected to vary across specific categories of mental health disorders and by children's age and sex.

## METHODS

### STUDY POPULATION

We examined electronic medical record data for all outpatient primary and specialty care medical visits occurring between January 1, 2003, and December 31, 2006, among children of non-retired, active-duty US Army personnel who either (1) obtained outpatient medical care from a US military medical facility or (2) used military medical insurance at a nonmilitary facility. Because some mental health disorders may not be clinically relevant for certain age groups, children who had not attained an age at which a clinical diagnosis is usually made were excluded a priori from analysis. Specifically, we excluded all visits for children who were 4 years old or younger and for children whose mean age over the 4-year study period was younger than 5 years. Also, a maximum mean age of 17 years was established over the study period for several reasons: (1) children 18 years of age and older are more likely to receive medical care from sources outside the military health system; (2) exposure to deployment-related stressors is different and probably less for those who have moved out of their parents' home; and (3) this age group would be smaller in number owing in part to both reasons 1 and 2.

We excluded children of Reserve and National Guard personnel because their beneficiaries do not generally receive military medical benefits until the service member is called up to active duty. Furthermore, we included only children whose military sponsor had been in active duty service for at least 5 years as of January 1, 2007. This restriction, which was required to

exclude children of Army personnel who joined the military during the study period, included an additional year immediately before the study to establish a recent mental health history for each child.

### DATA SOURCES AND MEASURES

Outpatient medical data made up the Standard Ambulatory Data Record, a mandatory collection and reporting system for all outpatient visits at military medical facilities, and TRICARE Enrolled Dependent data, complete billing code information for medical care received outside a military medical treatment facility but reimbursed under the military's medical insurance system. Each service member's rank, deployment history for OIF or OEF from January 1, 2003, through December 31, 2006, and total time in service and active duty as of January 1, 2007, were derived from Defense Manpower Data Center records. All data were obtained from the Armed Forces Health Surveillance Center, Silver Spring, Maryland.

### MENTAL HEALTH DIAGNOSES

We defined a mental health diagnosis as at least 1 mental health-related *International Classification of Diseases, Ninth Revision*, code out of 4 possible codes for a given outpatient medical visit. Diagnoses were classified into 1 of 17 disorder categories chosen in a previous study of active-duty Army spouses<sup>18</sup>: alcohol use; anxiety; bipolar disorder; delirium, dementia, and other cognitive disorders; depression; dissociative disorder; pediatric behavioral disorder; personality disorder; psychotic disorder; sleep disorder; somatoform and factitious disorders; and 4 stress-related categories (acute stress reaction and adjustment disorder, neurotic disorder, posttraumatic stress disorder, and other stress disorders). To increase the specificity of a mental health diagnosis code for a current diagnosis, we decided a priori to exclude codes assigned during the study period denoting conditions in full or partial remission. We determined outpatient mental health history using these same 17 categories for diagnoses occurring between January 1, 2000, and December 31, 2002, and included remission codes.

### STATISTICAL ANALYSIS

Linear risk regression<sup>19</sup> models were used to obtain estimates of the adjusted risk difference attributable to 1 to 11 months or more than 11 months ( $\geq 12$  months) of parental deployment in support of OEF or OIF compared with no deployment for these operations during the study period. To assess potential nonindependence as a result of 307 520 children clustered within 166 345 families, we examined the robustness of model estimates using generalized estimating equations. Model building and testing were conducted to identify variables that confounded or modified this relationship. A change in estimate of 10% or greater indicated confounding.<sup>20</sup> The children's age, sex, and mental health history and the sponsoring military parent's rank and time in the military were examined as covariates. The presence of outpatient mental health diagnoses for up to 3 years before the study period was used to denote and control for mental health history. Given the size of the data set, statistical significance does not necessarily correspond to substantive importance. Therefore, confidence intervals rather than *P* values were used to determine which differences were most precise.<sup>21</sup> All data analyses were conducted using SAS software (Version 9.2; SAS Institute, Cary, North Carolina).

**Table. Mental Health Diagnoses in Children of US Army Personnel by Parental Deployment Status (2003-2006)**

Variable	Parent Deployed		Parent Not Deployed	
	Boys (n=98 466)	Girls (n=94 592)	Boys (n=57 885)	Girls (n=55 123)
No. (%) with parent deployed ≥12 mo	48 053 (48.8)	46 364 (49.0)	NA	NA
Age, No. (%), y				
5-8	38 969 (39.6)	37 149 (39.3)	18 648 (32.2)	17 581 (31.9)
9-12	31 895 (32.4)	30 389 (32.1)	18 353 (31.7)	17 406 (31.6)
13-17	27 602 (28.0)	27 054 (28.6)	20 884 (36.1)	20 136 (36.5)
Parent's rank, No. (%)				
Enlisted	76 592 (77.8)	67 538 (71.4)	43 037 (74.4)	41 237 (74.8)
Officer	21 874 (22.2)	27 054 (28.6)	14 848 (25.6)	13 886 (25.2)
Parent's time in active duty, mean (SD), y	14.1 (4.7)	14.0 (4.7)	15.6 (4.6)	15.6 (4.5)
Parent's time deployed, mean (SD), mo	11.4 (6.2)	11.4 (6.3)	NA	NA
Prevalence of diagnosis, No. (%)				
Alcohol use	278 (0.3)	213 (0.2)	181 (0.3)	123 (0.2)
Anxiety	2846 (2.9)	2534 (2.7)	1454 (2.5)	1371 (2.5)
Bipolar disorder	1491 (1.5)	967 (1.0)	656 (1.1)	490 (0.9)
Delirium, dementia, or other cognitive disorder	255 (0.3)	180 (0.2)	134 (0.2)	94 (0.2)
Depressive disorder	5722 (5.8)	5371 (5.7)	2915 (5.0)	3018 (5.5)
Dissociative disorder	17 (<0.1)	12 (<0.1)	7 (<0.1)	11 (<0.1)
Drug use	486 (0.5)	326 (0.3)	322 (0.6)	173 (0.3)
Impulse control disorder	592 (0.6)	284 (0.3)	295 (0.5)	139 (0.3)
Pediatric behavioral disorder	6886 (7.0)	3328 (3.5)	3108 (5.4)	1504 (2.7)
Personality disorder	330 (0.3)	304 (0.3)	166 (0.3)	174 (0.3)
Psychotic disorder	2276 (2.3)	1031 (1.1)	1142 (2.0)	541 (1.0)
Sleep disorder	2796 (2.8)	2120 (2.2)	1344 (2.3)	989 (1.8)
Somatoform or factitious disorder	563 (0.6)	709 (0.8)	329 (0.6)	395 (0.7)
Stress disorder				
Acute stress reaction or adjustment disorder	6882 (7.0)	5825 (6.2)	2945 (5.1)	2566 (4.7)
Neurotic disorder	498 (0.5)	517 (0.6)	245 (0.4)	290 (0.5)
Posttraumatic stress disorder	507 (0.5)	584 (0.6)	255 (0.4)	291 (0.5)
Other	495 (0.5)	389 (0.4)	240 (0.4)	149 (0.3)
Composite findings, No. (%)				
Any diagnosis	19 286 (19.6)	14 854 (15.7)	9421 (16.3)	7517 (13.6)
No diagnosis	79 180 (80.4)	79 738 (84.3)	48 464 (83.7)	47 606 (86.4)
<b>Total sample</b>	<b>98 446 (100)</b>	<b>94 592 (100)</b>	<b>57 885 (100)</b>	<b>55 123 (100)</b>

Abbreviation: NA, not applicable.

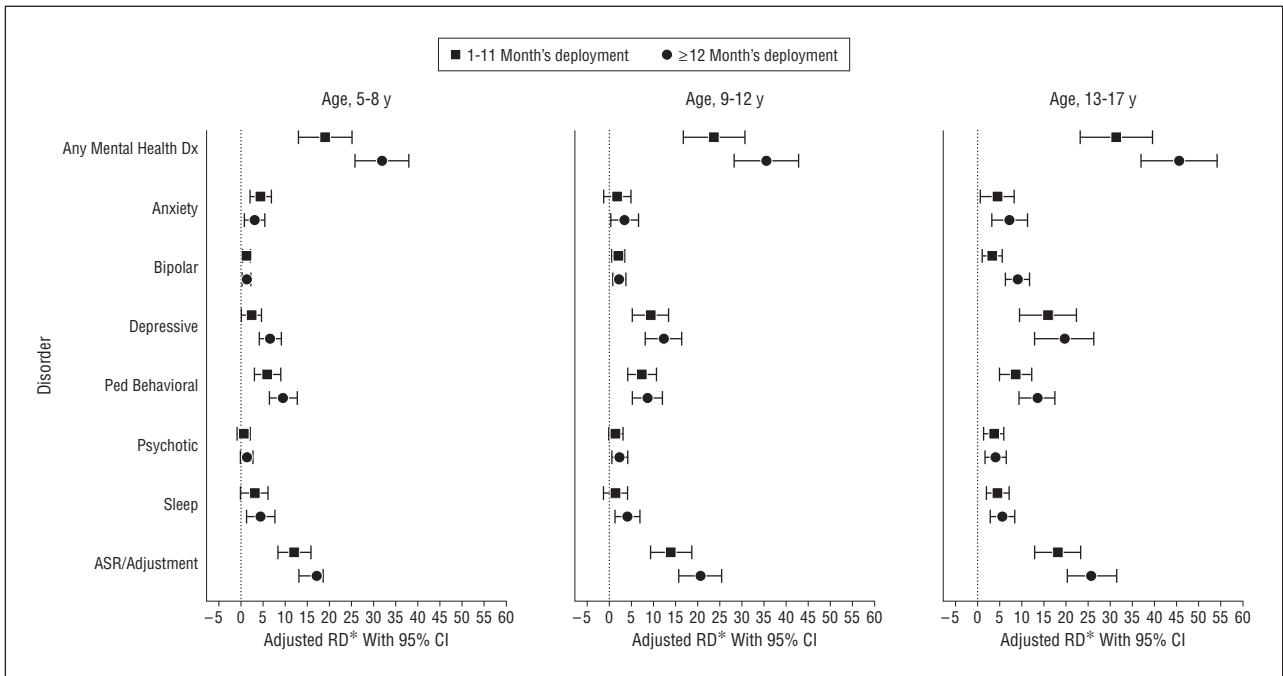
The institutional review boards (IRBs) of the Gillings School of Global Public Health at the University of North Carolina at Chapel Hill (IRB 04-2335) and the Uniformed Services University of the Health Sciences (IRB HU88LC) reviewed the study protocol and waived the requirement for informed consent.

## RESULTS

Data included 4 392 524 outpatient medical visits for 307 520 children of 166 345 active-duty US Army personnel. Of all children, 16.7% had at least 1 mental health diagnosis during the study period, most commonly for disorders of stress (5.9%), depression (5.6%), pediatric behavioral issues (4.8%), anxiety (2.7%), and sleep (2.4%). Military parents were deployed for a total of 11 months during the study period, on average, and in support of OIF only (50.9%), OEF only (6.1%), or both operations (5.6%). Remaining service members (37.4%) did not deploy for any operations. Most parents held an enlisted rank (paygrade) as opposed to officer, with slightly more time in service for nondeployed vs deployed service members (**Table**). Although children of deployed personnel outnumbered children of nondeployed personnel by al-

most 2 to 1 and were skewed toward the younger age groups, the proportion of boys and girls overall and in each age range was essentially equivalent within the respective deployment groups. The prevalence of mental health diagnoses among boys during the study period equaled or exceeded that among girls, with the exception of 3 categories (ie, somatoform or factitious disorders, neurotic stress disorder, and posttraumatic stress disorder) in which estimates among girls were slightly higher. Similarly, the prevalence of specific diagnoses among children whose parents were deployed between 2003 and 2006 met or exceeded the prevalence of those same conditions for children whose parents were not deployed (**Table**). Data on race or ethnicity were missing for most children (70.3%). As there was no evidence of confounding by race or ethnicity (eg, the mean months deployed was equivalent for all racial/ethnic groups), this category was excluded from further data analysis given the extent of missing data.

We decided a priori to treat age and sex as effect measure modifiers of the relationship between parental deployment and a child's mental health diagnosis. Reliable data for sex was missing for 1454 children (0.5%),



**Figure 1.** Adjusted number of mental health diagnoses attributable to parental deployment among girls, per 1000 deployed personnel (2003-2006). \*Adjusted for any mental health diagnosis (2000-2002). ASR/Adjustment indicates acute stress reaction or adjustment disorders; CI, confidence interval; DX, diagnosis; Ped Behavioral, pediatric behavioral disorder; and RD, risk difference. Note: The analyses did not compare deployed groups with each other. Rather, the reference group for both models tested was composed of girls within each age group whose parent(s) did not deploy during the same period.

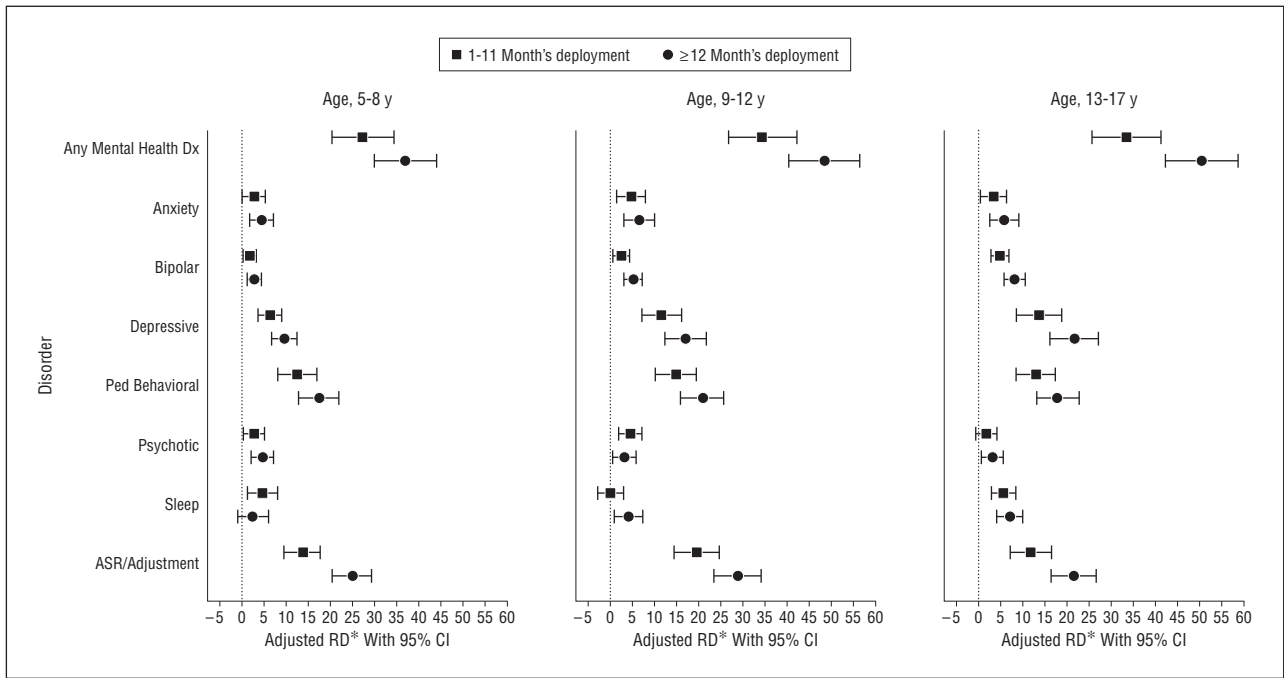
leaving an analysis sample of 306 066. Mental health history emerged as the only important confounder of the deployment–mental health diagnosis relationship and was included in all models. As generalized estimating equation and nongeneralized estimating equation confidence limits were similar and did not suggest an effect of clustering within families, all analyses were conducted using generalized linear models with maximum likelihood estimates of variance. Adjusted risk difference results are expressed as the number of excess cases of mental health diagnoses among children, attributable to 1 to 11 months or more than 11 months of parental deployment from 2003 to 2006, per 1000 deployed personnel, with children of nondeployed personnel as the reference group.

As 10 of the original 17 diagnostic categories were very rare (<1% prevalence overall) in the current study, model estimates for those diagnoses are not presented in detail. Adjusted estimates for the remaining categories are presented for girls and boys in **Figure 1** and **Figure 2**, respectively. Among girls, the number of excess cases per 1000 deployed personnel for any mental health diagnosis associated with parental deployment for 1 to 11 months was 19.0 (95% confidence interval [CI], 13.0-25.1) among 5- to 8-year-olds, 23.7 (95% CI, 16.7-30.7) among 9- to 12-year-olds, and 31.3 (95% CI, 23.1-39.6) among 13- to 17-year-olds. For girls with a parent deployed for more than 11 months, the number of excess cases per 1000 deployed personnel for any mental health diagnosis was 31.8 (95% CI, 25.6-38.0) among 5- to 8-year-olds, 35.5 (95% CI, 28.3-42.7) among 9- to 12-year-olds, and 45.5 (95% CI, 36.9-54.2) among 13- to 17-year-olds (Figure 1). Among boys, the number of excess cases per 1000 deployed personnel for any mental health diagnosis asso-

ciated with parental deployment for 1 to 11 months was 27.3 (95% CI, 20.3-34.3) among 5- to 8-year-olds, 34.4 (95% CI, 26.7-42.2) among 9- to 12-year-olds, and 33.4 (95% CI, 25.7-41.1) among 13- to 17-year-olds. For boys with a parent deployed for more than 11 months, the number of excess cases per 1000 deployed personnel for any mental health diagnosis was 36.9 (95% CI, 29.8-44.0) among 5- to 8-year-olds, 48.3 (95% CI, 40.3-56.3) among 9- to 12-year-olds, and 50.4 (95% CI, 42.2-58.6) among 13- to 17-year-olds (Figure 2). Among all children, the largest effects were observed for acute stress reaction and adjustment disorders, pediatric behavioral disorders, and depression and were larger among children whose parent(s) spent more vs less time deployed during the study period. Effects for boys tended to surpass those for girls in all categories, as did the effects for older children compared with younger children.

**COMMENT**

We conducted a large population-based investigation of the risk for mental health diagnoses among children in Army families relating to operations in Iraq and Afghanistan. In adjusted analyses, parental deployment was associated with an increased risk of a medical encounter yielding a mental health diagnosis code, in general, and for acute stress reaction and adjustment disorders, depressive disorders, and pediatric behavioral disorders, specifically, among children across age groups and sex. Furthermore, we observed a clear dose-response pattern such that children of parents who spent more time deployed between 2003 and 2006 fared worse than children whose parents were deployed for a shorter duration. Together,



**Figure 2.** Adjusted number of mental health diagnoses attributable to parental deployment among boys, per 1000 deployed personnel, 2003-2006. \*Adjusted for any mental health diagnosis (2000-2002). ASR/Adjustment indicates acute stress reaction or adjustment disorders; CI, confidence interval; DX, diagnosis; Ped Behavioral, pediatric behavioral disorder; and RD, risk difference. Note: The analyses did not compare deployed groups with each other. Rather, the reference group for both models tested was composed of boys within each age group whose parent(s) did not deploy during the same period.

these findings suggest that prolonged or multiple deployments of active-duty personnel may contribute to mental health problems among their children. Other authors have reported increased mental health symptoms and service use among children associated with parental deployment.<sup>12-15</sup> Our study improves on such works by including a broader age range, a longer follow-up period, and the measurement of mental health outcomes that quantify the public health significance of these issues.

This study has a number of strengths. Medical care for children of active-duty personnel and received through the military comes at little or no direct financial cost to parents, making cost an unlikely barrier to care seeking in this study. The inclusion of visits at which military medical insurance was used in the civilian medical system made it unlikely that we missed an appreciable amount of data on children who received their care outside a military medical facility. Furthermore, our cohort includes two-thirds of the approximately 470 000 children of active duty Army personnel during the study period<sup>22-25</sup> and likely an even greater proportion of those aged 5 to 17 years since we excluded children outside of this range.

Reliance on diagnostic codes to ascertain mental health status is not a perfectly sensitive or specific method of classification. Medical professionals may be reluctant to assign mental health diagnoses to children, resulting in underreporting of some outcomes. This underreporting likely occurred for all children but, if based on the belief that an individual was reacting to a stressful event (eg, parental deployment), may have introduced a differential misclassification bias. Our retrospective design precluded assessment of potential biases that warrant fur-

ther attention in future studies. Considering only clinical diagnosis as an outcome prevented assessment of sub-clinical conditions that may have stemmed from dealing with a parent's deployment but for which a child did not receive medical care. Similarly, a low prevalence of certain conditions prevented a detailed analysis of many deployment-related effects. Alternative data sources may more fully characterize the experiences of children in the wake of parental deployments.

Data on the mental health status, injury, or death of personnel during the study period were not included, nor was the mental health status of the child's primary caretaker during deployment, yet any of these factors could greatly affect a child's mental health. Although failure to include this information did not bias our study findings, the potential effects on children should be considered in the larger context of parental deployment. Children become attuned to the psychological state of their parents, and studies suggest that stress levels of parents and children are related.<sup>6</sup> If the children in our study developed psychological disorders through internalization of their caretakers' stress, this would only underscore the importance of comprehending the far-reaching effects of deployment on military families. Nonmilitary or nondeployed parents dealing with their own mental health problems may be more or less attuned to symptoms in themselves and in their children, affecting their willingness to seek professional help. Our previous finding of increased mental health problems among military wives of deployed personnel supports the need for additional research on this matter,<sup>18</sup> perhaps by studying parents and children concurrently or examining families rather than individuals. Medication may have been prescribed to treat the symp-

toms of a mental health problem without assigning a corresponding diagnostic code. Although we did not include prescription data, such occurrences would underestimate the true incidence of mental health problems in the study population and, as they are not expected to occur differentially by deployment status, are unlikely to have had an appreciable effect on our results. Finally, the lack of data on specific dates of eligibility for military medical care precluded ascertainment of mental health diagnoses if children became ineligible for care during the study period. Future work should include such information to determine whether there is any bias associated with differential emigration from the military health system.

Controlling for mental health history meant including only children of active-duty personnel with 5 or more years of service as of January 1, 2007. This restriction limits the generalizability of our findings, recognizing that children who are new to military life or parental deployment may have markedly different experiences from those described in our study. We also excluded very young children. Other authors have reported an association between parental deployment and increased behavioral symptoms in children younger than 5 years as reported by their caretakers.<sup>13</sup> We relied on diagnostic evidence of psychological distress. However, the complexity of diagnosis and assessment in young children and the current availability of various diagnostic manuals make reliable use of diagnostic codes difficult.<sup>26</sup> Approximately 7% of active-duty Army personnel are single parents, and 9% of all active-duty marriages are between dual-military partners,<sup>27</sup> with women more likely than men to be in dual-military marriages (38% vs 5%, respectively).<sup>28</sup> Our data likely include children from these families, yet we could not identify them for subgroup analysis. Considering these children is an important direction for future research, as their responses to the deployment of one or both parents may be unique.

Similar to findings among military spouses,<sup>18</sup> prolonged deployment appears to be taking a mental health toll on children. The results presented herein translate into 6579 mental health diagnoses among children of all ages that are attributable to parental deployment and in addition to what would have been expected had their parents not been deployed. Most active-duty Army personnel have children,<sup>27</sup> essentially all of whom will eventually receive care outside the military medical system. Therefore, the prevention and treatment of mental health problems associated with deployment have broad public health relevance. Installation-level support programs for families of deployed personnel represent a first step in addressing the mental health needs of children associated with current operations. Our findings support increasing targeted efforts, specifically on military installations deploying greater numbers of troops. Future studies should not only include but also target all service branches, as well as children of Guard and Reserve personnel, to determine whether mental health findings associated with deployment are similar.

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**Author Contributions:** Dr Mansfield had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Mansfield, Kaufman, and Engel. *Acquisition of data:* Mansfield. *Analysis and interpretation of data:* Mansfield, Kaufman, Engel, and Gaynes. *Drafting of the manuscript:* Mansfield and Kaufman. *Critical revision of the manuscript for important intellectual content:* Mansfield, Kaufman, Engel, and Gaynes. *Statistical analysis:* Mansfield and Kaufman. *Administrative, technical, and material support:* Mansfield, Engel, and Gaynes. *Study supervision:* Kaufman, Engel, and Gaynes.

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