

# Association of the World War II Finnish Evacuation of Children With Psychiatric Hospitalization in the Next Generation

Torsten Santavirta, PhD; Nina Santavirta, PhD; Stephen E. Gilman, ScD

**IMPORTANCE** Although there is evidence that adverse childhood experiences are associated with worse mental health in adulthood, scarce evidence is available regarding an emerging concern that the next generation might also be affected.

**OBJECTIVE** To compare the risk of psychiatric hospitalization in cousins whose parents were vs were not exposed to the Finnish evacuation policy that involved a mean 2-year stay with a Swedish foster family.

**DESIGN, SETTING, AND PARTICIPANTS** This multigenerational, population-based cohort study of Finnish individuals and their siblings born between January 1, 1933, and December 31, 1944, analyzed the association of evacuee status as a child during World War II in the first generation with the risk of psychiatric hospitalization among offspring in the second generation. Evacuee status during World War II was determined using the Finnish National Archive's registry of participants in the Finnish evacuation. Data on evacuee status were linked to the psychiatric diagnoses in the Finnish Hospital Discharge Register from January 1, 1971, through December 31, 2012, for offspring (n = 93 391) born between January 1, 1950, and December 31, 2010. Sex-specific Cox proportional hazards regression models were used to estimate hazard ratios for risk of psychiatric hospitalization during the follow-up period. Because offspring of evacuees and their nonevacuated siblings are cousins, the Cox proportional hazards regression models included fixed effects to adjust for confounding factors in families. Data analysis was performed from June 15, 2016, to August 26, 2017.

**EXPOSURES** Parental participation in the evacuation during World War II (coded 1 for parents who were evacuated and placed in foster care and 0 for those not evacuated).

**MAIN OUTCOMES AND MEASURES** Offspring's initial admission to the hospital for a psychiatric disorder, obtained from the Finnish Hospital Discharge Register from January 1, 1971, through December 31, 2012.

**RESULTS** Of the 93 391 study persons, 45 955 (49.2%) were women and 47 436 (50.8) were men; mean (SD) age in 2012 among survivors was 45.4 (6.58) years. Female offspring of mothers evacuated to Sweden during childhood had an elevated risk of psychiatric hospitalization (hazard ratio for any type of psychiatric disorder: 2.04 [95% CI, 1.04-4.01]; hazard ratio for mood disorder: 4.68 [95% CI, 1.92-11.42]). There was no excess risk of being hospitalized for a psychiatric disorder among women whose fathers were exposed to the Finnish evacuation policy during World War II or among men whose mothers or fathers were exposed.

**CONCLUSIONS AND RELEVANCE** In a prior follow-up study of the Finnish evacuees, girls evacuated to Swedish foster families during World War II were more likely to be hospitalized for a psychiatric disorder—in particular, a mood disorder—in adulthood than their nonevacuated sisters. The present study found that the offspring of these individuals were also at risk for mental health problems that required hospitalization and suggests that early-life adversities, including war-related exposures, may be associated with mental health disorders that persist across generations.

JAMA Psychiatry. doi:10.1001/jamapsychiatry.2017.3511  
Published online November 29, 2017.

← Editorial

+ Supplemental content

**Author Affiliations:** Institute for Housing and Urban Research, Uppsala University and Swedish Institute for Social Research, Stockholm University, Uppsala, Sweden (T. Santavirta); Department of Education, Faculty of Educational Sciences, University of Helsinki, Helsinki, Finland (N. Santavirta); Health Behavior Branch, Division of Intramural Population Health Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland (Gilman); Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland (Gilman).

**Corresponding Author:** Torsten Santavirta, PhD, Institute for Housing and Urban Research, Uppsala University and Swedish Institute for Social Research, Stockholm University, PO Box 256, 751 05 Uppsala, Sweden (torsten.santavirta@ibf.uu.se).

Early childhood adversity has a substantial influence on health, partly because it leads to deficits in children's mental and physical development.<sup>1-4</sup> In addition, early childhood adversity has lasting influences on health in middle and older adulthood because children exposed to adversity have higher risks of adult mental health problems, chronic disease, and dysregulation of physiologic pathways, such as inflammation that increases risk for cardiovascular-related conditions.<sup>5-8</sup>

One of the major sources of adversity experienced by children globally arises from armed conflict.<sup>9-12</sup> Children exposed to armed conflict have elevated risks of mental health disorders, including depression, posttraumatic stress disorder, and alcohol use disorders, and have shorter life expectancy.<sup>13-16</sup>

Given the scope of armed conflict and the evidence that early childhood adversity has associations with mental health that are only partly mitigated by later intervention,<sup>17,18</sup> there is an emerging concern that these associations might persist into the next generation.<sup>19-21</sup> Exposure to armed conflict during childhood could have an enduring association with psychological development that results in adverse parenting styles in adulthood,<sup>22,23</sup> selection into adverse adult environments, epigenetic changes that are transmitted to the next generation,<sup>24</sup> and, for women, alterations in pregnancy and consequently fetal development.<sup>25,26</sup> However, evidence of such intergenerational associations, particularly in population-based studies, is limited. Scharf<sup>23</sup> reported that the degree of exposure to holocaust survivors in the family was associated with worse psychosocial functioning, and Muhtz et al<sup>27</sup> documented that offspring who reported being most burdened by their parents' refugee history had higher scores on a scale of mental symptoms. However, these were small studies that did not have comparison groups of unexposed parents.

In a previous report<sup>28</sup> on the outcomes of Finnish children evacuated to Swedish foster families during World War II, girls (but not boys) evacuated to Sweden during the war were more than twice as likely to be hospitalized for a mood disorder during adulthood than their nonevacuated siblings, supporting the aforementioned evidence of the long-term association of war exposure with mental health. To address the concern about the intergenerational association of war exposures with mental health, we investigated whether offspring of the Finnish evacuees were more likely to be hospitalized for a mental disorder than offspring of nonevacuees. Offspring of evacuated and nonevacuated siblings are cousins; we therefore leverage the biological relationships between study participants to mitigate the confounding influences of shared family vulnerability to poor mental health using a fixed-effects design.<sup>29,30</sup>

## Methods

This is a multigenerational, population-based cohort study of Finnish individuals born from January 1, 1933, through December 31, 1944, and their offspring born from January 1, 1950, through December 31, 2010, and for whom hospital-

### Key Points

**Question** What is the association of parental exposure to unaccompanied evacuation as a result of the Finnish evacuation policy during World War II with psychiatric risk in the next generation?

**Findings** In this population-based cohort study, female (but not male) offspring of mothers placed in Swedish foster families during World War II had a significantly higher risk of hospitalization attributable to mood disorders than their female cousins.

**Meaning** A childhood exposure that increased the risk of psychiatric illness in adulthood was also associated with increased risk of psychiatric illness in the next generation, indicating that the psychiatric consequences of early adversity that are known to persist into adulthood may be transmitted intergenerationally.

ization data were available from January 1, 1971, through December 31, 2012. To investigate the intergenerational association of the Finnish evacuation policy during World War II with psychiatric hospitalization, we conducted analyses in which we associated evacuee status as a child during World War II in the first generation with the risk of psychiatric hospitalization among offspring in the second generation. Data analysis was performed from June 15, 2016 to August 26, 2017. The study was approved by the Data Protection Board of Statistics Finland and the ethical committee of the National Institute of Health and Welfare, Finland. According to Finnish law and the National Board of Health, informed consent is not necessary in deidentified, register-based research.

We selected all 71 788 participants from the World War II generations born from January 1, 1933, through December 31, 1944, who were included in a 10% follow-up sample of households from the 1950 Finnish census linked by Statistics Finland to individual social security numbers (issued in the late 1960s). We included in the analytic sample only participants who had at least 1 sibling also born between 1933 and 1944, thus eliminating 19 738 singletons. After further excluding those who had attrited from the sample before the issuing of social security numbers because of death or emigration (n = 4037) and those with a missing family identifier (n = 1136), our analytic sample of participants who experienced World War II events as children consisted of 46 877 individuals.

Statistics Finland then identified the offspring of our analytic sample, resulting in 93 391 individuals born between 1950 and 2010. We could not ascertain offspring who had died or emigrated before 1970. Of the 93 391 second-generation participants, 2992 were offspring of parents who as children had been evacuated from Finland to Sweden during World War II, and 90 399 were offspring of parents who remained in Finland throughout World War II (eFigure 1 in the Supplement). Parental evacuation status was determined by comparing their first and last names and exact birth date with the Finnish National Archives registry of participants in the Finnish evacuation policy, which covers the entire population of child evacuees.

## Measures

Our main outcome of interest was initial admission to the hospital for a psychiatric disorder between 1971 and 2012 based on the Finnish Hospital Discharge Register (HDR). The register contains information on the date of admission, discharge, and diagnoses for all inpatient stays. We used primary and subsidiary diagnosis codes from the eighth, ninth, and 10th revisions of the *International Classification of Diseases (ICD)* and deaths (*ICD* codes provided in the eTable in the Supplement). We investigated admissions for any psychiatric disorder and substance use, psychotic, mood, and anxiety disorders. The HDR has satisfactory to high validity, with positive predictive values for common diagnoses ranging from 75% to 98%.<sup>28</sup> Dates of death were obtained from the death cause registry administered by Statistics Finland.

The family sociodemographic characteristics of participants' households during World War II were obtained from the 1950 census by using the family identifier available in the 1950 census follow-up sample. The 1950 census contains questions surveying prewar conditions of families; we used family socioeconomic status based on grandfather's occupation and county of residence on September 1, 1939. Educational level of grandparents was defined by whether the grandfather or the grandmother had continued his or her education beyond primary school. Family size before the war was based on the number of children in the family as of 1940. Psychopathologic findings in the first generation were derived from the HDR during 1971 to 2011 using the same *ICD* codes as for the offspring generation. To address chronicity of psychopathologic findings in the first generation, we constructed a measure that differentiated between parents hospitalized once and parents hospitalized 2 or more times.

## Statistical Analysis

We fitted Cox proportional hazards regression models with delayed entry with estimated hazard ratios (HRs) for psychiatric hospitalization during the follow-up period and corresponding 95% CIs. The risk set included person-time beginning on January 1, 1971, until the date of the first hospital admission for psychiatric disorders for cases or until being censored for noncases (which occurred at death or the end of the follow-up period [December 31, 2012], when the oldest participants were aged 52 years).

The primary exposure in the analyses was parental participation in the evacuation policy during World War II (coded 1 for parents who were evacuated and placed in foster care and 0 for parents not evacuated). On the basis of previous results<sup>28</sup> of higher risk of psychiatric disorders among female evacuees but not males, we differentiated risks of psychiatric hospitalization between offspring of fathers and mothers who had been evacuated during the war.

We analyzed associations between parental exposure to evacuation during World War II and offspring psychiatric hospitalizations using conventional cohort analyses and using models that hold the baseline hazard constant among cousins while allowing it to differ between those who were not cousins. The within-cousin analyses adjust for all (measured and unmeasured) factors shared by cousins and thus circumvent potential confounding that arises from selection into the evacuation policy

based on family background. Throughout the analyses, we adjusted variance estimates to account for nonindependence between family members. The within-cousin fixed-effects analysis is an extension of sibling comparisons in adult outcomes reported in a previous study<sup>28</sup> analyzing only the sample of wartime cohorts ( $n = 46\,877$ ). The fixed-effects design applied adjusts for the component of family background shared by cousins and likely accounts for fewer potential confounders than the sibling design does. Nevertheless, based on the literature on intergenerational transmission of socioeconomic status, we know that, for example, family income is correlated among genetically close relatives. Although the degree of similarities in the family environment is greater for siblings than first cousins, there is evidence of substantial correlations in labor market outcomes and educational outcomes for first cousins.<sup>31,32</sup>

One potential explanation for an association between evacuation during World War II and offspring psychiatric disorder is that former evacuees themselves were more likely to develop psychiatric disorders (as demonstrated previously), which is an established risk factor for offspring psychiatric disorder.<sup>33</sup> Accordingly, we extended the Cox proportional hazards regression models to control for parental psychiatric hospitalization. We analyzed parental hospitalization as a time-varying covariate coded as the cumulative number of hospitalizations (0, 1, or  $\geq 2$ ) recorded in the HDR as of each person-year in the risk set. All analyses were performed using Stata software, version 14 (StataCorp).

## Results

Of the 93 391 study persons, 45 955 (49.2%) were women and 47 436 (50.8) were men; mean (SD) age in 2012 among survivors was 45.4 (6.58) years. **Table 1** presents the characteristics of participants by evacuation status and sex. A total of 2992 participants' parents (3.3%) were evacuated to Sweden during World War II. A total of 7495 participants (3614 male) were hospitalized for psychiatric disorders during the follow-up period. A total of 55 516 (59.4%) of the sample was born between 1961 and 1970 (see eFigure 2 in the Supplement for the age distribution of the sample at the time of censoring).

**Table 2** documents baseline covariates of the exposed participants and the unexposed participants. Of note, the parents of the exposed came from larger families and more frequently spoke Swedish as their native language.

**Table 3** reports HRs for female participants hospitalized for psychiatric disorders by exposure status of either parent from the cohort analyses by adjusting for measured characteristics of the parental families (evacuated father: HR, 0.86 [95% CI, 0.63-1.19]; evacuated mother: HR, 1.35 [95% CI, 1.00-1.81]) and from the within-cousin analyses by adjusting for all measured and unmeasured family characteristics of the parental families (evacuated father: HR, 1.04 [95% CI, 0.62-1.75]; evacuated mother: HR, 2.04; [95% CI, 1.04-4.01]). All baseline covariates reported in Table 2 were entered into the models as categorical variables except for number of children in the family as of 1940, which was continuous. In the within-cousin analysis, having a mother who was evacuated during child-

Table 1. Sample Size and Frequencies of Disorders by Sex and Parental Evacuee Status

Variable	Children of Nonevacuees With at Least 1 Episode			Children of Evacuees With at Least 1 Episode		
	All (n = 90 399)	Male (n = 45 932)	Female (n = 44 467)	All (n = 2992)	Male (n = 1504)	Female (n = 1488)
Type of diagnosis, No.						
Any disorder	7495	3614	3881	271	134	137
Mood disorders	2877	1389	1488	118	52	66
Substance abuse	2948	1571	1377	109	60	49
Psychotic disorders	1759	854	905	51	27	24
Anxiety disorders	2432	1201	1231	92	41	51
Cohort, No. (%)						
1951-1960	15 258 (16.9)	7742 (16.8)	7516 (16.9)	791 (26.4)	390 (25.9)	401 (26.9)
1961-1970	53 766 (59.5)	27 449 (59.8)	26 317 (59.2)	1750 (58.5)	888 (59.0)	862 (57.9)
1971-1980	18 352 (20.3)	9226 (20.1)	9126 (20.5)	398 (13.3)	197 (13.1)	201 (13.5)
1981 and later	3022 (3.3)	1515 (3.3)	1507 (3.4)	53 (1.8)	29 (2.0)	24 (1.6)

Table 2. Sample Characteristics by Sex and Parental Evacuee Status<sup>a</sup>

Characteristic	Nonevacuee Parents		Evacuee Parents	
	Male (n = 45 932)	Female (n = 44 467)	Male (n = 1504)	Female (n = 1488)
Educational level of grandparents <sup>b</sup>				
Primary school or less	42 788 (93.2)	41 431 (93.2)	1395 (92.8)	1363 (91.6)
Beyond primary school	3144 (6.8)	3036 (6.8)	109 (7.2)	125 (8.4)
Native language				
Finnish	43 640 (95.0)	42 298 (95.1)	1358 (90.3)	1319 (88.6)
Swedish	2292 (5.0)	2169 (4.9)	146 (9.7)	169 (11.4)
No. of children in parental family in 1940, mean (SD)	1.96 (1.81)	1.97 (1.81)	2.71 (1.50)	2.60 (1.46)
Socioeconomic status of grandparents in 1939 <sup>c</sup>				
Entrepreneur	14 305 (31.1)	13 768 (31.0)	200 (13.3)	194 (13.0)
White-collar worker	4306 (9.4)	4098 (9.1)	173 (11.4)	159 (10.7)
Blue-collar worker	13 042 (28.4)	12 617 (28.4)	645 (42.9)	630 (42.3)
Homemaker	3994 (8.7)	4001 (9.0)	52 (3.5)	61 (4.1)
Unemployed	10 285 (22.4)	9983 (22.5)	434 (28.9)	444 (29.8)

<sup>a</sup> Data are presented as number (percentage) of study participants unless otherwise indicated. All family background characteristics refer to parents' childhood socioeconomic background before World War II (eg, educational level referring to grandparents' educational level).

<sup>b</sup> Highest educational level of grandmother or grandfather.

<sup>c</sup> Occupation based on grandfather's occupation in 1939; if missing, replaced by grandmother's education.

hood was associated with a higher risk of psychiatric hospitalization (HR, 2.04; 95% CI, 1.04-4.01). This association appears to be driven by an elevated risk of being admitted to the hospital for mood disorders for women whose mothers were evacuated during childhood compared with their cousins whose mothers remained with their families throughout the war (HR, 4.68; 95% CI, 1.92-11.42). This result, combined with our previously reported elevated risk of admission to the hospital for the mothers who were evacuated as children, suggests intergenerational persistence for women in the psychiatric consequences of participation in the Finnish evacuation induced by the adverse events during World War II.<sup>28</sup>

Results of models identifying any offspring psychiatric disorder and offspring mood disorder when controlling for parental psychiatric hospitalization are presented in Table 4. The HRs for maternal evacuation were largely unchanged after adjusting for maternal psychiatric hospitalization. In the within-cousin analyses that adjusted for parental hospitalization, offspring of parents evacuated to Sweden during World War II were more likely to be hospitalized for any psychiatric disorder (HR, 2.00; 95% CI, 1.03-3.91) or for a mood disorder (HR, 4.29; 95% CI, 1.72-

10.71). Consistent with the established parent-offspring transmission of psychopathologic conditions, parental hospitalization was associated with the offspring's risk of hospitalization for any psychiatric disorder and for a mood disorder, with the greatest association for offspring whose parents were hospitalized more than once (HR for any disorder, 2.29 [95% CI, 1.47-3.56]; HR for mood disorder, 4.69 [95% CI, 2.85-8.64]).

Among male participants (Table 5), no association was found between parental evacuation during World War II and offspring risk of psychiatric hospitalization. This result is in line with a previously reported finding<sup>28</sup> of no increased risk of psychiatric hospitalization for men who were evacuated.

## Discussion

This study investigated the intergenerational consequences of psychiatric hospitalizations of the Finnish policy of evacuating unaccompanied children to foster care in Sweden during World War II. We conducted analyses in which we associated evacuee status as a child during World War II in the first gen-

**Table 3. Risk of Psychiatric Hospitalization Among Women (1971-2012) With Evacuee Parents During World War II<sup>a</sup>**

	Hazard Ratio (95% CI)			
	Evacuated Father		Evacuated Mother	
	Cohort	Within Cousin	Cohort	Within Cousin
<b>Mental Disorder</b>				
Any disorder	0.86 (0.63-1.19)	1.04 (0.62-1.75)	1.35 (1.00-1.81)	2.04 (1.04-4.01)
Substance abuse	1.26 (0.76-2.10)	0.99 (0.40-2.45)	1.43 (0.84-2.42)	1.46 (0.43-4.92)
Psychotic	0.79 (0.42-1.48)	0.55 (0.19-1.55)	1.24 (0.72-2.14)	0.91 (0.26-3.19)
Mood	0.99 (0.64-1.53)	0.95 (0.46-1.95)	1.66 (1.13-2.45)	4.68 (1.92-11.42)
Anxiety	0.77 (0.45-1.33)	1.07 (0.44-2.49)	1.42 (0.88-2.31)	1.24 (0.47-3.32)

<sup>a</sup> Women born between 1951 and 2012. Data for evacuated fathers are for 22 702 observations, of which 807 were exposed, and for evacuated mothers are for 23 253 observations, of which 681 were exposed. Associations by parental sex were derived from one model by including parental sex and an interaction between parental sex and evacuee status. Other predetermined variables included in the cohort analyses were the background variables summarized in Table 2 and parental county of birth (all predetermined

variables cancel out in the within-cousin analyses). Dummies for parental birth cohort (1933-1944) and parental birth order were included in all models. Within-cousin models stratify the Cox proportional hazards regression with respect to parental family (ie, holding the baseline hazard constant for children to siblings in the parental birth cohorts). All SEs are cluster adjusted to account for serial correlation within families.

**Table 4. Risk of Psychiatric Hospitalization Among Women by Maternal Evacuee Status During World War II Adjusting for Maternal Psychiatric Disorders<sup>a</sup>**

Variable	Hazard Ratio (95% CI)			
	Models Without Maternal Psychiatric Hospitalization		Models With Maternal Psychiatric Hospitalization	
	Cohort Analysis	Within Cousin	Cohort Analysis	Within Cousin
<b>Any Disorder</b>				
Exposure				
Maternal evacuation	1.35 (1.00-1.81)	2.04 (1.04-4.01)	1.32 (0.99-1.77)	2.00 (1.03-3.91)
Mediation				
Mother hospitalized once	NA	NA	1.66 (1.22-2.26)	1.22 (0.77-1.94)
Mother hospitalized ≥2 times	NA	NA	2.59 (2.05-3.28)	2.29 (1.47-3.56)
<b>Mood Disorder</b>				
Exposure				
Maternal evacuation	1.66 (1.13-2.45)	4.68 (1.92-11.42)	1.58 (1.07-2.33)	4.29 (1.72-10.71)
Mediation				
Mother hospitalized once	NA	NA	3.08 (2.29-4.13)	2.56 (1.47-4.45)
Mother hospitalized ≥2 times	NA	NA	3.74 (2.89-4.84)	4.69 (2.85-8.64)

Abbreviation: NA, not applicable.

<sup>a</sup> The first 2 columns replicate the results of Table 3. The last 2 columns report models that include maternal hospitalization in otherwise identical models to those in Table 3.

eration with the risk of psychiatric hospitalization among exposed and unexposed offspring in the second generation. A previous study<sup>28</sup> found that the families who adhered to the Finnish evacuation policy were a sociodemographically selected group of families. We therefore adjusted for family background by controlling for cousin fixed effects in our model.

The results suggest that there are differences in risk of psychiatric hospitalizations among offspring of the generation who were children during World War II. We observed a significantly elevated risk of psychiatric hospitalizations for mood disorders for female offspring whose mothers had been evacuated to foster care during childhood compared with their female cousins whose mothers had remained with their biological parents throughout the war. Because mood disorders account for up to 45% of all psychiatric hospitalizations, psychiatric hospitalization for any disorder (all diagnoses included) was also increased among female offspring of evacuated mothers. The elevated risk of offspring disorders among females did not appear to be accounted for by maternal psy-

chopathologic findings. For male offspring, no significant intergenerational associations were found.

The finding of a multigenerational persistence of associations between unaccompanied evacuation and psychiatric hospitalizations for mood disorders among female offspring of exposed mothers is important for multiple reasons. First, this result contributes to evidence that suggests persistence in psychiatric harms of childhood trauma that reaches across generations.<sup>19</sup> Second, results point to sex-specific patterns in this intergenerational persistence; we did not find an increased risk of psychiatric hospitalizations for mood disorders among male offspring of exposed mothers.

**Strengths and Limitations**

This study used high-quality, population-based data on a 10% sample of followed-up individuals born from January 1, 1933, through December 31, 1944, drawn from the 1950 Finnish Census of Population and their offspring born from January 1, 1950, through December 31, 2010.<sup>28</sup> We leveraged the data further by

Table 5. Risk of Psychiatric Hospitalization Among Men (1971-2012) With Severe Mental Disorders With Evacuee Parents During World War II<sup>a</sup>

Mental Disorder	Hazard Ratio (95% CI)			
	Evacuated Father		Evacuated Mother	
	Cohort	Within Cousin	Cohort	Within Cousin
Any disorder	1.04 (0.83-1.31)	0.81 (0.54-1.21)	0.97 (0.75-1.25)	0.87 (0.55-1.37)
Substance abuse	1.02 (0.73-1.40)	1.03 (0.55-1.91)	0.74 (0.51-1.06)	0.72 (0.34-1.52)
Psychotic	1.14 (0.70-1.84)	0.63 (0.25-1.55)	1.13 (0.70-1.83)	2.23 (0.70-7.05)
Mood	0.99 (0.67-1.46)	0.82 (0.34-1.77)	1.21 (0.84-1.75)	1.35 (0.65-2.80)
Anxiety	1.05 (0.71-1.55)	0.68 (0.36-1.31)	1.34 (0.89-2.02)	1.22 (0.53-2.81)

<sup>a</sup> Men born between 1951 and 2012. Data for evacuated fathers are for 23 571 observations, of which 811 were exposed, and for evacuated mothers are 23 865 observations, of which 693 were exposed. Associations by parental sex were derived from one model by including parental sex and an interaction between parental sex and evacuee status. Other predetermined variables included in the cohort analyses were the background variables summarized in Table 2 and parental county of birth (all predetermined variables cancel out in

the within-cousin analyses). Dummies for parental birth cohort (1933-1944) and parental birth order were included in all models. Within-cousin models stratify the Cox proportional hazards regression with respect to parental family (ie, holding the baseline hazard constant for children to siblings within the parental birth cohorts). All SEs are cluster adjusted to account for serial correlation within families.

linking offspring to the child evacuee generation. One of the unique features of these data are that many families evacuated only some of their children to Sweden for reasons mainly pertaining to the way the guidelines of the policy were formulated,<sup>28</sup> giving rise to sibling pairs discordant for exposure. In the intergenerational analysis of the psychiatric harms of exposure persisting in the offspring, the discordance provided a within-cousin comparison for the offspring generation. Within the context of unaccompanied evacuation, it is unusual to have access to information on background characteristics, exposure, and outcomes for comparisons pertaining to the base population and particularly for unexposed siblings.

This study has, however, certain limitations. First, the within-cousin design does not adjust for nonshared childhood experiences, and cousins would typically have fewer background characteristics in common than siblings. Thus, residual confounding bias cannot be ruled out, particularly by factors that might have differentially selected children in a family for the evacuation program. Second, approximately 10% of the population of the relevant war cohorts in the 1950 census was not included in the study sample at the start of follow-up in 1971 because of death- and migration-related attrition. Thus, the results and conclusions about intergenerational persistence of childhood exposure to unaccompanied evacuation are valid only for the population that was alive and residing in Finland at the beginning of the follow-up period in January 1, 1971. However, the attrited sample differs from the study sample only marginally with respect to evacuation status, sex, and native language.<sup>34</sup> Third, part of the association may be attributable to assortative mating, although an earlier study<sup>35</sup> on marital traits of the evacuees did not find an association between evacuation and the likelihood of getting married. Fourth, the analyses that control for parental psychiatric hospitalization do not fully account for all parental psychopathologic conditions given that only severe disorders receive hospital care. Thus, this study does not fully address the possibility that parental psychopathologic conditions explain the observed association between the evacuation and offspring psychopathologic findings. Furthermore, comparisons of HRs across Cox proportional hazards regression models with and without parental psychopathologic conditions cannot be interpreted causally.<sup>36</sup>

## Conclusions

The findings of this multigenerational cohort study extending a prior study<sup>28</sup> that assessed the psychiatric outcomes of the child evacuees contribute to the increasing evidence in global health that child refugees may experience health consequences that persist long after reunification. This study is, to our knowledge, the first multigenerational study on the intergenerational persistence of wartime trauma that had a non-exposed comparison group and used a fixed-effect design to adjust for potential confounding factors within the shared family background.

Whether these findings generalize to contemporary refugee contexts, many of which do not involve the type of government oversight and monitoring that was in place during the Finnish evacuation policy, is unknown. In addition, the mean duration that children were with Swedish families was 2 years, lasting up to 5 years. In contrast, in some contemporary contexts, duration of refugee status is longer (in some instances persisting across generations). One might therefore expect the intergenerational consequences of war-related experiences during childhood to be even stronger today, although this expectation should be investigated in contemporary settings, particularly in light of the global crisis of childhood displacement.<sup>37</sup> There are 2 additional questions that warrant further study based on our findings. First, to what extent do the intergenerational consequences of war-related exposures depend on the age and duration of exposure? Second, to identify potential intervention targets to reduce intergenerational consequences, what mechanisms account for the observed intergenerational effects? Parental psychopathologic conditions did not explain the findings in our study, but this result only pertained to disorders in hospitalized parents; thus, future work is needed in this respect. We also speculated that mechanisms could include influences on family processes, including parenting and physiologic (including epigenetic) pathways, many of which have been observed among children exposed to other forms of disadvantage<sup>5,38,39</sup> and many of which can be directly targeted by evidence-based interventions reported to improve outcomes of displaced individuals.<sup>40</sup>

## ARTICLE INFORMATION

**Accepted for Publication:** September 26, 2017.

**Published Online:** November 29, 2017.  
doi:10.1001/jamapsychiatry.2017.3511

**Open Access:** This article is published under the [JN-OA license](#) and is free to read on the day of publication.

**Author Contributions:** Dr T. Santavirta 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:* All authors.

*Acquisition, analysis, or interpretation of data:* All authors.

*Drafting of the manuscript:* All authors.

*Critical revision of the manuscript for important intellectual content:* All authors.

*Statistical analysis:* T. Santavirta, Gilman.

*Obtained funding:* N. Santavirta.

*Administrative, technical, or material support:* T. Santavirta.

*Study supervision:* T. Santavirta, N. Santavirta

**Conflict of Interest Disclosures:** None reported.

**Funding/Support:** This study was funded by the Intramural Research Program of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (Dr Gilman), Signe and Ane Gyllenberg Foundation (Dr N. Santavirta), and Wilhelm and Else Stockmann Foundation (Dr N. Santavirta).

**Role of the Funder/Sponsor:** The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and the decision to submit the manuscript for publication.

## REFERENCES

- Chin-Lun Hung G, Hahn J, Alamiri B, et al. Socioeconomic disadvantage and neural development from infancy through early childhood. *Int J Epidemiol.* 2015;44(6):1889-1899.
- Sheridan MA, Fox NA, Zeanah CH, McLaughlin KA, Nelson CA III. Variation in neural development as a result of exposure to institutionalization early in childhood. *Proc Natl Acad Sci U S A.* 2012;109(32):12927-12932.
- McLaughlin KA, Sheridan MA, Tibu F, Fox NA, Zeanah CH, Nelson CA III. Causal effects of the early caregiving environment on development of stress response systems in children. *Proc Natl Acad Sci U S A.* 2015;112(18):5637-5642.
- Loman MM, Wiik KL, Frenn KA, Pollak SD, Gunnar MR. Postinstitutionalized children's development. *J Dev Behav Pediatr.* 2009;30(5):426-434.
- Slopen N, Loucks EB, Appleton AA, et al. Early origins of inflammation. *Psychoneuroendocrinology.* 2015;51:403-413.
- Gilman SE, Kawachi I, Fitzmaurice GM, Buka L. Socio-economic status, family disruption and residential stability in childhood. *Psychol Med.* 2003;33(8):1341-1355.
- Gilman SE, Ni MY, Dunn EC, et al. Contributions of the social environment to first-onset and recurrent mania. *Mol Psychiatry.* 2015;20(3):329-336.
- Hanson MA, Cooper C, Aihie Sayer A, Eendebak RJ, Clough GF, Beard JR. Developmental aspects of a life course approach to healthy ageing. *J Physiol.* 2016;594(8):2147-2160.
- Slone M, Mann S. Effects of war, terrorism and armed conflict on young children. *Child Psychiatry Hum Dev.* 2016;47(6):950-965.
- Belsky J. War, trauma and children's development: observations from a modern evolutionary perspective. *Int J Behav Dev.* 2008;32(4):260-271.
- Betancourt TS, Brennan RT, Rubin-Smith J, Fitzmaurice GM, Gilman SE. Sierra Leone's former child soldiers. *J Am Acad Child Adolesc Psychiatry.* 2010;49(6):606-615.
- Betancourt TS, Khan KT. The mental health of children affected by armed conflict. *Int Rev Psychiatry.* 2008;20(3):317-328.
- Bramsen I, Deeg DJ, van der Ploeg E, Fransman S. Wartime stressors and mental health symptoms as predictors of late-life mortality in World War II survivors. *J Affect Disord.* 2007;103(1-3):121-129.
- Thabet AA, Karim K, Vostanis P. Trauma exposure in pre-school children in a war zone. *Br J Psychiatry.* 2006;188:154-158.
- Tol WA, Komproe IH, Jordans MJ, et al. Outcomes and moderators of a preventive school-based mental health intervention for children affected by war in Sri Lanka. *World Psychiatry.* 2012;11(2):114-122.
- Keyes KM, Shmulewitz D, Greenstein E, et al. Exposure to the Lebanon War of 2006 and effects on alcohol use disorders. *Drug Alcohol Depend.* 2014;134:296-303.
- Pesonen AK, Räikkönen K. The lifespan consequences of early life stress. *Physiol Behav.* 2012;106(5):722-727.
- Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics.* 2012;129(1):e232-e246.
- Betancourt TS. The intergenerational effect of war. *JAMA Psychiatry.* 2015;72(3):199-200.
- Galler J, Rabinowitz DG. The intergenerational effects of early adversity. *Prog Mol Biol Transl Sci.* 2014;128:177-198.
- Devakumar D, Birch M, Osrin D, Sondorp E, Wells JC. The intergenerational effects of war on the health of children. *BMC Med.* 2014;12:57.
- Palosaari E, Punamäki RL, Qouta S, Diab M. Intergenerational effects of war trauma among Palestinian families mediated via psychological maltreatment. *Child Abuse Negl.* 2013;37(11):955-968.
- Scharf M. Long-term effects of trauma. *Dev Psychopathol.* 2007;19(2):603-622.
- Yehuda R, Daskalakis NP, Bierer LM, et al. Holocaust exposure induced intergenerational effects on FKBP5 methylation. *Biol Psychiatry.* 2016;80(5):372-380.
- Neuwald MF, Agranonik M, Portella AK, et al; MAVAN Study Team. Transgenerational effects of maternal care interact with fetal growth and influence attention skills at 18 months of age. *Early Hum Dev.* 2014;90(5):241-246.
- Gilman SE, Hornig M, Ghassabian A, et al. Socioeconomic disadvantage, gestational immune activity, and neurodevelopment in early childhood. *Proc Natl Acad Sci U S A.* 2017;114(26):6728-6733.
- Muhtz C, Wittekind C, Godemann K, et al. Mental health in offspring of traumatized refugees with and without post-traumatic stress disorder. *Stress Health.* 2016;32(4):367-373.
- Santavirta T, Santavirta N, Betancourt TS, Gilman SE. Long term mental health outcomes of Finnish children evacuated to Swedish families during the second world war and their non-evacuated siblings. *BMJ.* 2015;350:g7753.
- D'Onofrio BM, Lahey BB, Turkheimer E, Lichtenstein P. Critical need for family-based, quasi-experimental designs in integrating genetic and social science research. *Am J Public Health.* 2013;103(suppl 1):S46-S55.
- Gilman SE, Loucks EB. Invited commentary: does the childhood environment influence the association between every x and every y in adulthood? *Am J Epidemiol.* 2012;176(8):684-688.
- Jaeger MM. The extended family and children's educational success. *Am Sociol Rev.* 2012;77:903-922.
- Hällsten M. Inequality across three and four generations in egalitarian Sweden. *Res Soc Stratification Mobility.* 2014;35:19-33.
- Weissman MM, Wickramaratne P, Nomura Y, et al. Families at high and low risk for depression. *Arch Gen Psychiatry.* 2005;62(1):29-36.
- Santavirta T. Unaccompanied evacuation and adult mortality: evaluating the Finnish policy of evacuating children to foster care during World War II. *Am J Public Health.* 2014;104(9):1759-1765.
- Santavirta T, Myrskylä M. Reproductive behavior following evacuation to foster care during World War II. *Demogr Res.* 2015;33:1-30.
- Lange T, Hansen JV. Direct and indirect effects in a survival context. *Epidemiology.* 2011;22(4):575-581.
- UNICEF. *A Child Is a Child: Protecting Children on the Move From Violence, Abuse and Exploitation.* New York, NY: Division of Data, Research, and Policy, UNICEF; May 2017.
- Loucks EB, Huang YT, Agha G, et al. Epigenetic mediators between childhood socioeconomic disadvantage and mid-life body mass index. *Psychosom Med.* 2016;78(9):1053-1065.
- Non AL, Román JC, Gross CL, et al. Early childhood social disadvantage is associated with poor health behaviours in adulthood. *Ann Hum Biol.* 2016;43(2):144-153.
- Annan J, Sim A, Puffer ES, Salhi C, Betancourt TS. Improving mental health outcomes of Burmese migrant and displaced children in Thailand [published online November 17, 2016]. *Prev Sci.*