War-Related Exposure and Psychological Distress As Predictors of Health and Sleep: A Longitudinal Study of Kuwaiti Children

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Objectives: To determine whether exposure to war-related trauma during childhood predicted posttraumatic stress, self-reported health, sleep, and obesity in adulthood, and whether psychological distress mediated the relationships. **Methods:** We assessed 151 Kuwaiti boys and girls aged 9 to 12 years in 1993 to determine their level of exposure to war-related trauma during the Iraqi occupation and Gulf war, health complaints, and psychological distress. In 2003, 120 (79%) of the initial participants reported on their posttraumatic stress, general health, body mass index (BMI), and sleep quality. We tested a structural model where exposure to war-related trauma predicted psychological distress and health complaints 2 years after the war, and posttraumatic stress, self-reported health, BMI, and sleep quality and duration 10 years later, controlling for intermediary life events. We also tested effects of exposure to war-related trauma on self-reported health and sleep factors mediated by psychological distress. **Results:** Results indicated a direct effect of exposure on poor sleep quality and BMI. Exposure also predicted poor sleep quality through its association with concurrent posttraumatic stress. The effect of exposure on self-reported health was mediated by health complaints and psychological distress, which included symptoms of depression, anxiety, and posttraumatic stress. **Conclusion:** Exposure to war-related events during childhood is associated with posttraumatic stress, poor sleep quality, high BMI, and poor self-reported health in adulthood. **Key words:** war-related trauma, health related, posttraumatic stress, children.

BMI = body mass index; **PTSD** = posttraumatic stress disorder; **PTSDS** = Posttraumatic Stress Disorder Symptom Scale; **RCMAS** = Revised Children's Manifest Anxiety Scale; **CSI** = crisis structured interview; **RMSEA** = root mean squared error of approximation; **SRMR** = standardized root mean squared residual; **OR** = odds ratio.

INTRODUCTION

Little research has been done to examine how war-related trauma exposures during childhood, such as witnessing the killing of a parent, might affect health and whether health problems track into adulthood. This is not surprising because historically, war has been characterized by combat involving adults. However, modern versions of war no longer differentiate between combatants and civilians and, as a result, millions of children are affected. In fact, in the past two decades, 45% of war casualties have been children (1). The most common form of trauma during war is exposure to violence. War traumas are consistent with the exposure criteria for posttraumatic stress disorder (PTSD) first specified in the Diagnostic and Statistical Manual-III-R, including "serious threat or harm" to family members or friends, "seeing another person who has recently been, or is being, seriously injured or killed," or "learning about a serious threat or harm to a close friend or relative" (2). Media exposure, a common aspect of modern wars, can also be traumatic for children. Although opportunities to study children in war are sadly increasing, the circumstances of war present obvious difficulties for gathering data and for tracking those affected into adulthood.

In a review of studies of children who witnessed torture or other terrorist experiences, somatic complaints were one of the more commonly reported symptoms (3). A previous study of 233 Kuwaiti children reported 46% had more frequent health complaints after the Gulf war than before, and children's level of exposure to the war predicted health complaints after the war (4). Exposure to school violence has also been shown to increase somatic complaints in children 6 and 14 months after exposure (5). Absent from this literature are longitudinal studies that span into adulthood, when manifestation of diseases are more likely to occur. However, the hypothesis that war-related traumatic exposures in childhood affect adult health is reasonable, given the extensive retrospective evidence showing robust associations between other types of childhood trauma, specifically physical and sexual abuse, and overall general health (6), as well as specific health problems including obesity (7) and heart disease (8).

In the adult literature, exposure to war-related traumatic events by both combatants and civilians has been linked to poor health. When combat veterans have been compared with noncombat veterans of the same era or civilians, the results show increased health problems for the combat veterans (9). Studies of civilians exposed to civil war in Lebanon and Croatia (10,11) have shown associations between exposure and coronary abnormalities. In a study of refugees from the Cambodian war, extent of exposure to the war predicted negative health outcomes even after 10 years (12). These results are consistent with studies of other traumatic experiences including natural and manmade disasters (13), sexual and physical abuse (14–16), and community violence (17). Although the evidence is mostly based on self-report, some studies examine health utilization, morbidity, and mortality (10,11,18).

Friedman and Schnurr (19) argue that trauma exerts an indirect effect on health via posttraumatic stress symptoms that lead to PTSD, and PTSD has been associated with dysregulation of multiple systems in childhood and adolescence (20). Several factors may lead to an inadequate termination of a stress response, and the failure to contain the biological alterations initiated by trauma may have long-term adverse consequences (21). PTSD may be a component of the mediating mechanism responsible for long-lasting health effects of trauma exposure in childhood.

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Received for publication October 7, 2008; revision received March 27, 2009.

Supported by Grants from the Kuwait Foundation for the Advancement of Science and the Kuwait Society for the Advancement of Arab Children, Kuwait; and from the National Institutes of Mental Health, USA, Grant MH70878.

DOI: 10.1097/PSY.0b013e3181ae6aee

0033-3174/09/7107-0776

Self-rated health has been shown to correlate with medical diagnosis and to predict mortality (22) and is particularly important when studying young samples. Comparison of young Vietnam veterans with noncombat veterans showed no difference on physical manifestation of disease, whereas differing on self-report (23). Many chronic illnesses including hypertension, heart disease, and cancer are not diagnosed until later in life, but their risk factors (i.e., obesity, hyperlipidemia, inflammation, and poor sleep) are detectable much earlier. When studying the health consequences of war exposure in young samples, measures of risk factors for disease, in addition to reports of disease must be considered.

With escalating conflicts around the world that expose large numbers of children to war-related events, it becomes important to understand the health implications of such exposure. The Iraqi invasion of Kuwait in 1990–1991 leading to the Gulf war presents a relatively well-controlled event where the exposure was limited in duration and not confounded with additional socioeconomic factors. Once the war ended, educational and public health institutions were operational in a short time. Citizens received financial support from the government and returned to their preinvasion socioeconomic positions. Thus, the Gulf war presented a unique opportunity to examine war exposures of limited duration where health factors were not additionally compromised by postwar social decline or lack of access to health care.

We assessed Kuwaiti children with varying levels of exposure to war-related traumatic events to determine whether the exposure could have health consequences in adulthood. Because the participants were young adults (19–22-year old) when the health data were collected, we did not anticipate observing evidence of major illness. However, we were interested in the extent to which the exposure predicted risk factors, including obesity, poor sleep, health complaints, and self-rated health. The research questions addressed were 1) to what extent does exposure to war-related trauma in childhood predict indicators of health in adulthood? 2) Does psychological distress including posttraumatic stress symptoms mediate the relation between exposure and health outcomes?

METHOD

Participants

Participants were 151 preadolescent Kuwaiti citizens aged between 9 and 12 years enrolled in school. Participants were recruited through the Martyr's Office, the National Committee for Missing and Prisoners of War, the Association for Defending War Victims, or the local schools. The organizations that provided the information for the recruitment were government-sponsored organizations created after the Gulf war to track victims. Using these four different sources allowed us to identify children with varying levels of exposure to war-related events because of the experiences of their fathers. Each source of participants provided a list of names from which an initial stratified random sample of 20 boys and 20 girls was selected. Because nine families did not consent to participate, the sample included 20 boys and 20 girls whose fathers had been killed; 19 boys and 20 girls whose fathers were missing at the time of assessments; 15 boys and 17 girls whose fathers had been arrested but later returned home; and a control group of 20 boys and 20 girls whose fathers and family members were neither killed, missing, or arrested. Participants were middle or upper class with free access to education and health care. All participants lived within or near extended families and those whose fathers were killed or missing received government aid for housing. Thus, poverty was not confounded with exposure in this sample.

In 2003, a second wave of data were collected on n = 120 of the original participants when they were young adults between the ages of 19 and 23 years. Of the original sample, 120 (79.5%) agreed to participate in the follow-up study: 2 had died, 10 could not be located, 9 were studying abroad, and 10 did not wish to participate. Eleven participants reported receiving mental health treatment after the war.

Procedures

Families were initially contacted in 1993 by phone and asked to participate in a study designed to assess psychological consequences of the Gulf war. Those who agreed were asked if their children could be contacted through their schools. Once approval was obtained from the parents and the Ministry of Education, school principals were contacted and informed about the purpose of the study. An initial appointment was made for testing the children and parents at the schools by a psychologist. All scales were administered by interview in Arabic.

In 2003, contact with the initial study participants was made by the second author or a research assistant. Families were called to determine the current address and telephone number of each participant. At the 2003 follow-up, participants were consented and interviewed either in the offices of the Kuwait Society for the Advancement of Arab Children or at their home. The second author or one of two psychologists administered all measures by interview.

Instruments

Psychometric instruments were translated into Arabic by two professionals and back translated by a third person before the initial data collection in 1993. Persons involved in the translation made recommendations about the need to reword items for clarity and cultural appropriateness. One item was deleted (i.e., a lie scale item from the Revised Children's Manifest Anxiety Scale (RCMAS)) because it was deemed culturally offensive. All translated measures were pilot tested and their internal consistency reliabilities assessed and reported later. Means, standard deviations, and ranges are provided in Table 1.

TABLE 1. Means and Standard Deviations for Measures of Exposure, Psychological Distress, and Health-Related Outcomes

	M	SD	Range
Measures from 1993 (n = 151)			
Exposure	7.0	2.6	1–14
Posttraumatic stress	12.4	9.6	0–46
Depression	8.7	5.0	0–24
Anxiety	9.5	5.9	0–25
Health complaints	11.6	2.5	8–18
Measures from 2003 (n = 120)			
Health rating 1	4.7	1.1	1–6
Health rating 2	4.3	1.4	1–5
Health symptoms	8.5	5.0	0–25
Sleep latency (min)	31.8	32.5	2–180
Sleep efficiency	0.89	0.18	0.14–1
Sleep duration (h)	7.2	2.2	1–13
Sleep disturbances	18.7	5.0	10–34
Poor sleep quality	2.0	0.8	1–4
Daytime dysfunction	6.2	2.0	3–11
Body mass index	25.6	5.0	17–47
Posttraumatic stress	16.9	11.4	0–46
Number of stressful events	2.2	1.5	0–7

M = mean; SD = standard deviation.

Measures From 1993

War-Related Exposure

The crisis structured interview (CSI) was developed to assess the children's level of exposure to trauma and violence during the Gulf crisis (4). The items ask what happened to them, their parents, brothers or sisters, other relatives, friends, and acquaintances (e.g., was your father killed by the Iraqis?). Items also ask whether the participant witnessed violence in real life, television, or pictures. Sixteen items, with yes/no response options, were summed to yield a total score with higher scores reflecting increased level of exposure to war-related trauma, which included both witnessing and victimization. The reliability of the CSI was 0.67.

Psychosocial Measures

The Posttraumatic Stress Disorder Symptom Scale (PTSDS) was adapted from the Davidson Self-Rating Post Traumatic Stress Disorder Scale (24). The PTSDS consists of 17 items rated on a 5-point scale (0 = none; 1 = once only; 2 = 2–3 times; 3 = 4–6 times; and 4 = everyday). The PTSDS items refer to the three major symptom categories for the diagnosis of PTSD taken from the Diagnostic and Statistical Manual-III-R criteria (2). The three symptom categories are intrusive re-experiencing of the event, avoidance of reminders of the event and/or general psychic numbing, and increased general arousal. Instructions were given to respond to the items in terms of events that occurred during the Gulf crisis. Reliability of the translated PTSDS was 0.80.

The Children's Depression Inventory is a 27-item self-report instrument (25) designed to measure symptoms of depression in children and adolescents. Each item consists of three statements graded in severity and assigned scores of 0, 1, or 2, with higher scores indicative of more depression. Reliability of the translated version was 0.78.

The RCMAS (26) is a 37-item self-report measure designed to assess the level and nature of anxiety in children and adolescents. The responses are yes/no, indicating whether a feeling or action is or is not descriptive of the individual. The total score had reliability of 0.86.

Health-Related complaints

In this 8-item scale, participants indicated on a 3-point scale (0 = no occurrence; 1 = sometimes; 2 = very often) the extent to which they experienced common symptoms in childhood such as headaches, colds, stomachaches, etc., during the last 6 months.

Measures From 2003

Life Events Between 1993 and 2003

An 11-item measure of stressful life events was developed based on the Life Events Checklist (27). This list of life events were not war-related but asked participants to indicate the occurrence of major life events that reflect personal loss (e.g., death of a family member) or extended separations from family members (e.g., separation and divorce, serious illness), as well as events that could be perceived as stressful (e.g., breakup with friend/spouse). Participants were asked to indicate whether any of these events occurred between 1993 and 2003.

Health Measures

The Pittsburgh Sleep Quality Index (28) is a self-report measure of sleep quality, duration, and disturbances covering a 1-month period. It consists of 19 items with varying response options, including usual bed time, usual getting up time, usual amount of time to fall asleep, actual hours of sleep per night, frequency of sleep medications taken, ratings of quality of sleep, sleep disturbances, and daytime dysfunction associated with sleep problems. Items were combined to yield seven component scores: sleep quality, sleep duration, sleep latency, sleep efficiency, sleep disturbances, use of medications, and daytime dysfunction. Psychometric information in support of the measure is available (28). We also conducted our own psychometric evaluation (see Results).

General health was assessed with four items. In the first item, participants rated their general health using a six-point response option from 1 = very poor to 6 = excellent. In the second item, participants rated the extent to which their health interfered with daily activities on a 5-point scale with 1 = my health significantly interferes with my life and 5 = I think I am in very good health and rarely get sick and miss work or other daily activities. In the third item, 12 common symptoms, such as headaches, stomachaches, allergies, sore throats etc., were each rated with respect to their frequency during the last month using a scale of 1 = very frequently to 4 = not at all. These ratings were summed across symptoms to yield a total symptom frequency score. The fourth item asked whether the participant had been told by a physician they had any of the following: heart disease, hypertension, diabetes, high cholesterol, cancer, or asthma. Each of these four items was treated as a separate indicator of health. Body mass index (BMI) was calculated from self-reports of height (m) and weight (kg) using the formula weight over height squared. The PTSDS described earlier was also administered in 2003.

Analyses

Preliminary Analyses

All variables were checked for outliers and normality, but only sleep efficiency had to be log transformed. Participants who returned for assessment in 2003 (n = 120) were compared with those who did not (n = 31) on exposure, psychological distress, and health complaints using t tests. Means and standard deviations were obtained on all continuous variables. Boys and girls were compared on all continuous measures using t tests. Percentages were calculated for categories of responses to better characterize the sample.

Logistic Regression

One of the health outcomes of interest was a categorical variable asking whether participants had been diagnosed by a physician as having a chronic health condition (heart disease, hypertension, diabetes, high cholesterol, cancer, or asthma). Because asthma is a common chronic illness in children, it was excluded from this analysis. Cancer was also excluded because only one participant reported having the diagnosis. The other diagnoses were combined into one variable because there were not enough cases to treat each one separately. This variable coded as 0 or 1 was initially regressed on exposure using binary logistic regression.

Measurement Model

Before testing our prediction model using structural equation modeling, we tested a measurement model of sleep based on the Pittsburgh Sleep Quality Index subscales (we excluded use of sleep medication as 95% of the sample did not take medications). We then added a factor of psychological distress with the three indicators measured in 1993 (PTSDS, Children's Depression Inventory, and RCMAS) and a factor of general health in 2003 using the first three items from the general health measure (the two general health ratings and the common symptoms item). This was done to reduce the number of measures while improving reliability. These factors were then incorporated into the structural model.

Structural Model

The structural model tested is depicted in Figure 1 with rectangles indicating observed variables and ovals indicating the latent variables derived from the measurement model. The observed variables that define the latent variables, as well as the residuals, have been omitted to simplify the figure. Estimated parameters of primary interest were the path coefficients assessing direct effects. Indirect effects were also tested to assess mediation hypotheses. These effects were estimated using full information maximum likelihood assuming missing data were missing at random and tested using the z distribution at the 0.05 level of significance.

The model posited that exposure to war-related trauma would predict health complaints and psychological distress in 1993 and posttraumatic stress, self-reported health, poor sleep quality, sleep duration, and BMI in 2003. This hypothesis of primary interest derives from the adult literature on the health effects of war exposure. War-related trauma exposure was our key predictor. The experience of the fathers, coded with three dummy vectors (killed, missing, or arrested versus control), was specified to influence level of exposure by design. The long-term health effects of war-related trauma exposure have been hypothesized to operate through posttraumatic stress (19).

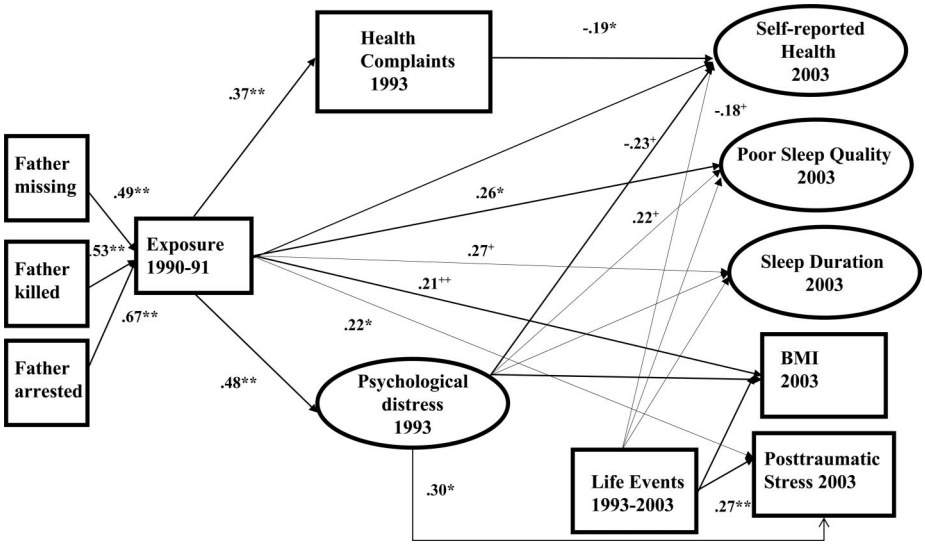

Figure 1. Structural model of exposure to war-related trauma in childhood predicting posttraumatic stress, self-rated health, sleep quality and duration, and BMI in adulthood. Significant paths are shown with standardized coefficients $^{**}p < .001$, $^{*}p < .05$, $^{++}p < .08$, $^{+}p < .10$.

To test this mediation hypothesis, we specified an indirect effect of exposure on self-reported health, BMI, poor sleep quality, and sleep duration in 2003 via psychological distress reported in 1993. Because self-reported health complaints may track over time, we also specified an indirect effect of exposure on self-reported health in 2003 via health complaints in 1993. To control for events that may have occurred during the 10-year interval between assessments, the measure of stressful life events between 1993 and 2003 was specified as a control variable, predicting self-reported health and BMI as well as poor sleep quality and duration in 2003. Finally, we respecified the model (figure not shown) to include posttraumatic stress in 2003 as an additional mediator of the link between war-related trauma exposure and the sleep and health variables. Although posttraumatic stress was measured concurrently with the health and sleep factors, weakening the case for mediation, this analysis allowed us to control for lingering posttraumatic stress symptoms with ongoing consequences for health and sleep.

RESULTS

Means, standard deviations, and observed ranges are reported in Table 1. The sample is not broken down by gender because there were no significant gender differences on any of the continuous measures ($p > .10$). Because there are no normative data on the translated measures of psychological distress in this study, it is difficult to interpret the means in an absolute sense. However, the standard deviations show variability in distress in 1993. Reported posttraumatic stress symptoms were higher in 2003 than in 1993 (t (119) = 4.09, $p < .001$). By 2003, participants generally see themselves as healthy young adults. On the basis of the sample means, they rate their health as good to very good. Seventy-two percent said they were in very good health and rarely get sick and miss work or other daily activities. However, 15% had been diagnosed by a physician with at least one health condition: 4.5% with diabetes, 9% with hypertension, 3.6% with heart disease, 6.3% with high cholesterol, 13.3% with asthma, and only one participant reported having cancer. And, although on average they were normal in weight, 30% could be classified as overweight and 18% as obese based on their BMI.

With respect to sleep, the mean would indicate that participants take half an hour to fall asleep and get about 7 hours of sleep. Their mean rating of sleep quality was very good. The majority did not take any sleep medication during the last month (95%). However, 27% rated their sleep quality during the last month as fairly bad or very bad; 21% could not go to sleep within 30 minutes three or more times per week; 29% reported waking up in the middle of the night three or more times per week; and for 46.7%, sleep difficulties interfered with daily function to a moderate to extreme extent during the last month. Thus, although overall this is a healthy sample, getting quality sleep, there is a sizable subgroup beginning to experience health problems.

Comparisons Between Returners and Nonreturners

Participants who returned for follow-up in 2003 ($n = 120$) were comparable with those who did not return ($n = 31$) on level of exposure to war-related trauma t (149) = −0.34, $p = .73$; posttraumatic stress symptoms t (149) = 0.41, $p = .68$; depression t (149) = −0.43, $p = .67$; anxiety t (149) = 0.56, $p = .58$; and health complaints t (149) = 1.39, $p = .17$. The group distribution for the participants who returned in 2003 was 33 from Group 1, 29 from Group 2, 23 from Group 3, and 35 from Group 4. The proportion of returning participants was comparable across the groups (χ^2 (3) = 3.56, $p = .31$). Thus, it seems that the reasons for nonparticipation in 2003 are not systematically related to the war-related variables in this study.

Logistic Regression

The logistic model of exposure as predictor of the odds of having a medical diagnosis revealed significant effects for exposure to war-related trauma (χ^2 (1) = 7.21, $p = .007$). An increase in 1 SD unit (2.57) on the CSI was associated with 2.27 (95% confidence interval, 1.21–4.24) higher odds of

reporting a diagnosis. We repeated the analysis excluding high cholesterol (not a disease) from the diagnosis and the odds ratio (OR) decreased only marginally to 2.11.

Measurement Model

The latent variable model specified sleep duration and sleep efficiency as indicators of a sleep duration factor, and poor sleep quality, time to fall asleep, sleep disturbances, and sleep daytime dysfunction as indicators of a poor sleep quality factor. The model had good fit to the data (χ^2 (8) = 6.46, p = .60; root mean squared error of approximation (RMSEA) = 0.0001; standardized root mean squared residual (SRMR) = 0.028). All standardized loadings were 0.50 or higher. The two variables were significantly correlated at −0.36. The factor variances indicated significant individual differences in poor sleep quality but a restricted range in sleep duration.

Two additional latent variables were added to this two-factor model: one defined by the three measures of psychological distress assessed in 1993 and one defined by the first three general health items. With minor modifications, this combined measurement model also yielded good fit to the data (χ^2 (45) = 52.61, p = .20; RMSEA = 0.033; SRMR = 0.054). Standardized loadings were greater than 0.5 for all indicators except the second general health item that focused on how their health interfered with daily activities (loading = 0.41). The unique variance in this item correlated with that of the sleep daytime dysfunction from the poor sleep quality factor.

The poor sleep quality factor correlated significantly with the psychological distress factor (0.36) and the health factor (−0.82); but the sleep duration factor did not correlate with either one (0.001 and 0.05). Psychological distress was significantly and inversely correlated with health (−0.36).

Structural Model

The model incorporating the measurement aspects presented previously fit the data well (χ^2 (138) = 150.81, p = .22; RMSEA = 0.025; SRMR = 0.064). Unstandardized path coefficients, standard errors, and z values are presented in Table 2. We also report the standardized coefficients for significant paths in Figure 1. The results indicate the degree to which subjects were exposed to war-related trauma significantly predicted health complaints and psychological distress of preadolescents in 1993, 2 years after the war ended. Health complaints and psychological distress were significantly correlated (r = .35, $p < .01$) beyond their shared variance explained by war-related trauma. Having their fathers killed, missing, or arrested increased participants' exposure to war-related events relative to control participants by about three to four additional exposures.

In the longitudinal aspect of the model, health complaints and to some extent psychological distress in 1993 significantly predicted self-rated health in 2003. Although exposure did not have a significant direct effect on 2003 self-rated health, the total indirect effect mediated by 1993 health complaints and psychological distress was statistically significant (z = −2.55, $p < .01$) explaining approximately 17% of the variance in 2003 self-rated health.

Exposure to war-related trauma significantly predicted 15% of the variance in 2003 poor sleep quality and 6% of the variance in BMI, but only showed a trend with respect to sleep duration, explaining 4% of its variance. Psychological distress in 1993 did not seem to mediate these effects because the indirect effects were not significant ($p > .10$). Exposure to war-related trauma had a significant direct effect on posttraumatic stress in 2003, as well as an indirect effect via earlier psychological distress (z = 2.64, $p < .01$).

TABLE 2. Unstandardized Path Coefficients, Standard Errors, and z Values for Direct and Indirect Effects

	Coefficient	SE	z
Direct path			
Father missing to exposure	2.88	0.48	6.02**
Father killed to exposure	3.10	0.47	6.58**
Father arrested to exposure	4.21	0.50	8.42**
Exposure to health complaints	0.357	0.074	4.81**
Exposure to psychological distress	0.743	0.133	5.58**
Exposure to self-reported health	0.001	0.034	0.04
Exposure to poor sleep quality	0.026	0.013	2.06*
Exposure to sleep duration	0.156	0.088	1.78††
Exposure to BMI	0.74	0.361	2.04*
Exposure to posttraumatic stress	0.947	0.421	2.25*
Health complaints to self-reported health	−0.056	0.026	−2.11*
Psychological distress to self-reported health	−0.044	0.026	−1.68†
Psychological distress to poor sleep quality	0.015	0.009	1.63
Psychological distress to sleep duration	−0.054	0.062	−0.88
Psychological distress to posttraumatic stress	0.848	0.288	2.94**
Life events to self-reported health	−0.091	0.053	−1.72†
Life events to poor sleep quality	0.030	0.020	1.51
Life events to sleep duration	0.035	0.129	0.27
Life events to BMI	−0.735	0.524	−1.40
Life events to posttraumatic stress	2.05	0.63	3.26**
Indirect paths			
Exposure to self-reported health via health complaints and psychological distress	−0.052	0.021	−2.55**
Exposure to poor sleep quality via psychological distress	0.011	0.007	1.57
Exposure to sleep duration via psychological distress	−0.040	0.046	−0.88
Exposure to BMI via psychological distress	0.078	0.181	0.43
Exposure to posttraumatic stress via psychological distress	0.630	0.239	2.64**

*$p < .05$.
**$p < .001$.
†$p < .10$.
††$p < .08$.
SE = standard errors.

Life events that occurred between the two waves of data collection did not significantly predict the sleep factors or BMI, marginally predicted self-rated health, but predicted posttraumatic stress in 2003.

When we controlled for posttraumatic stress in 2003 by specifying direct paths from it to self-reported health, poor sleep quality, sleep duration, and BMI, the fit of the model was not altered, and the results remained the same with two exceptions. Because posttraumatic stress was significantly associated with self-reported health ($z = -3.29$, $p < .01$) and with poor sleep quality ($z = 4.76$, $p < .01$) but not sleep duration or BMI, the direct effect of war-related trauma on poor sleep quality disappeared to be replaced by an indirect effect via posttraumatic stress ($z = 2.85$, $p < .01$). The previously reported indirect effect from exposure to self-rated health was strengthened ($z = -3.23$, $p < .01$).

DISCUSSION

This study showed that, in a sample of Kuwaiti preadolescents during the Gulf war of 1990, exposure to war-related trauma was associated with greater odds of a reported diagnosis of heart disease, hypertension, diabetes, or high cholesterol. The magnitude of the OR observed in this sample is comparable with those reported in studies of childhood abuse and neglect and a variety of diseases in US adults. Goodwin and Stein (16) reported significant increased risk of a range of adult diseases as a function of childhood physical and sexual abuse and neglect. With respect to diabetes, heart disease, and hypertension, their model adjusted for age and demographic characteristics had OR in the 1.6 to 4.1 range. Dong et al. (15) found that the OR of ischemic heart disease increased in the range of 1.3 to 1.7 with different types of adverse childhood experiences. Although childhood abuse and neglect are direct chronic stressors, the exposures in our sample were either direct or indirect and time limited. However, the increased risk of self-reported cardiometabolic disease was present despite a more time-limited stressor. Our data were limited in that the diagnosis was based on a self-report. Also, we did not have information on the time of diagnosis, so it is plausible some may have been made before the exposure. This possibility is unlikely as the diseases included are not common in childhood and the children were 7 to 10 years during the Gulf war.

The prevalence of disease in our sample is higher than that of samples similar in age from the United States with respect to diabetes (US 0.8% versus 4.5%) and hypertension (5.2% versus 9%). The rates are comparable with prevalence rates estimated from other samples in Kuwait for individuals aged 19 to 24 years for diabetes, 4.6% for women, and 5.1% for men but higher for hypertension (ours 9% versus other samples 0.8%; (29)). Prevalence of hypertension in Kuwaiti children aged 9 to 13 years has been estimated at an alarming 12% and has been associated with increases in the rate of obesity (30). Local publications in Kuwait (31) document dietary changes with an infusion of fast foods and other changes such as a more sedentary life-style after the war. Health outcomes clearly have multiple causes that operate at multiple levels, including the individual, the family, and the society. Multilevel models are needed to capture these influences. Our data indicate that early trauma at the individual level is important to consider in any model of adult disease and is particularly relevant for future studies of cardiovascular disease in Kuwait.

The longitudinal effects of war-related trauma on self-rated health were mediated by both psychological distress and health complaints in preadolescence and concurrent posttraumatic stress symptoms. These results are consistent with the hypothesis that posttraumatic stress is a mediator of the effects of war on health (32). Indeed numerous studies implicate PTSD resulting from war involvement in the development of health problems (33,34). Although our participants were not diagnosed for PTSD, one of our measures of psychological distress included symptoms of posttraumatic stress. Bremner (35) has described the overlap among symptoms of depression, anxiety, and PTSD, all sharing common alterations in brain structure and function in acute and chronic responses to trauma. The latent variable incorporated in our model and labeled "psychological distress" included depression and anxiety as well as posttraumatic stress symptoms. Exposure was a potent predictor of psychological distress. Exposure also predicted posttraumatic stress symptoms in 2003. We should note that these data were collected before the start of the Iraq war and Kuwait was a point of entry of troops into Iraq. Thus, at the time of assessment in 2003, participants were exposed to reminders of their earlier exposure including military checkpoints and media coverage. Our data support the notion that traumatic reminders activate symptoms (36) as we noted higher levels of posttraumatic stress symptoms reported in 2003.

Psychological distress was significantly correlated with health complaints in 1993 and predicted self-rated health 10 years later. Several pathways have been proposed to explain the links between PTSD and health, including the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis, and the variety of disease outcomes implicated would suggest the involvement of multiple systems. Although these data do not allow us to examine these pathways, they indicate that studies of these mechanisms might profit from the inclusion of youth in their samples. Furthermore, the association between health complaints in 1993 and self-rated health in 2003 show these complaints track into adulthood, underscoring the importance of accounting for health problems in youth when studying adult health.

The results also suggest that sleep difficulties reported may stem in part from exposure to war-related trauma. Sleep difficulties are a component of PTSD and physiological systems involved in hyperarousal are implicated in research in both trauma and sleep (37). Our data were mixed with respect to the role of psychological factors linking exposure to sleep problems because the mediation hypothesis was not supported for psychological distress in 1993 but was supported for posttraumatic stress symptoms in 2003. Perhaps the hyperarousal mechanism is explanatory for sleep problems closer in time to the exposure, and the reminders of the trauma served to

activate this mechanism. But sleep also has behavioral determinants that include use of stimulants, maintenance of sleep patterns, and other health behaviors (38). Research on insomnia has demonstrated that behavioral interventions that "decondition" poor sleep habits can be very successful (39). One approach emphasizes the importance of stimulus control as a mechanism to explain sleep difficulties and also provides an intervention that may be useful with young adults. Improving the quality of sleep in individuals exposed to war-related trauma is important because of the reported associations with health, including hypertension (40) and depression (41).

Results also indicated a direct effect of exposure on BMI not mediated by psychological distress. To our knowledge, our data are the first to show that war-related exposure in childhood is associated with greater BMI in early adulthood. Studies of adolescents have shown that obesity is partly explained by life-style factors, primarily diet and exercise (42). Unfortunately, these life-style variables were not included, thus, we cannot directly test whether they may mediate the effect of exposure on BMI. But life-style factors shown to influence obesity in other samples may be targeted in attempts to reduce obesity in young persons exposed to war-related trauma.

Other factors that could potentially confound the exposure hypothesis should be considered. For many participants, the loss of their father could have been associated with other lingering stressors not captured by the life events measure. In a previous analysis on a subset of this sample, we (43) showed the participants whose fathers were arrested but returned had the most negative psychological profile. Thus, we cannot rule out other psychosocial unmeasured consequences. This is true of any study of this kind because wars produce multiple consequences that are not possible to exhaustively assess. We can, however, rule out socioeconomic factors that typically follow war. As mentioned previously, Kuwait is an oil-rich country and had an unusually fast recovery from the Gulf war. In particular, health care is both free and accessible to all citizens. Another competing hypothesis is that participants were exposed to gases from the burning of oil fields. But this environmental stressor was not specific to participants with higher levels of war exposure rather it represented a more general or widespread stressor at the population level likely to have affected all participants in the study.

In sum, our data suggest that young adults exposed to war-related trauma as children may already detect health alterations resulting from exposure to traumatic events. These alterations include increased BMI and sleep difficulties and are reflected in their self-rated health. These findings have clinical implications involving both assessment and intervention. With respect to assessment, our data suggest that it is important to check health indicators after war exposure not only in war participants but also civilians, including children. Interventions designed to reduce the health effects of war exposure should focus on the reduction of psychological distress, improvement of sleep habits and patterns, and change in life-style factors that contribute to obesity. Clinicians working with war-exposed children should pay attention to health interventions that have proven successful in these areas.

These results illustrate that the effects of war-related exposure in childhood, even when time limited, have repercussions into adulthood. As this sample matures into adulthood, the emerging sleep problems and obesity may place the individuals at risk for a variety of diseases including diabetes and cardiovascular disease. Sleep has been associated with increased risk of cardiovascular disease, and BMI is an established risk factor for diabetes, hypertension, cancer, and heart disease. Given the increased exposure to war-related trauma in children throughout the world in current times, we can anticipate incidence rates for a variety of diseases to also increase. The toll of war is much broader than the fatalities, injuries, and destruction of property, as the effects of exposure have psychological and behavioral consequences and more subtle repercussions that have long-lasting effects on the health of those exposed.

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