CHAPTER 4

Stress Reactivity and Trauma:
Deviant in Holocaust Survivors, but not in their Daughters

Ayala Fridman, Marian J. Bakermans-Kranenburg, Abraham Sagi-Schwartz, Marinus H. van IJzendoorn

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Abstract

The long-term effects of the Holocaust trauma in survivors and their offspring might have affected their neurobiological system. Here we explore the influence of childhood exposure to the traumatic stress, at least characterized by loss of both parents during the Holocaust, on cortisol reactivity of the survivors and their daughters more than 60 years later. Holocaust survivors and comparison participants living in Israel were carefully matched to form a case-control study design with two generations, including four groups: 32 elderly female Holocaust survivors and their 47 adult daughters, and 33 elderly women in the comparison group, and their 32 adult daughters (total $N = 174$). The Trier Social Stress Test was used and saliva samples were taken to measure cortisol levels. Holocaust child survivors showed elevated levels of cortisol secretion immediately before the onset of the stress procedure, followed by a strong decline of cortisol levels. In contrast, comparison participants showed the expected increase of cortisol levels in response to induced stress. Adult offspring of Holocaust survivors, however, did not display different cortisol reactivity compared to that of their matched controls. The Holocaust seems to be imprinted in the neurobiological system of the survivors, but not of their offspring.
Introduction

Extended exposure to extreme stress in the early stages of life is believed to have long-term physical and psychological effects (Landau & Litwin, 2000). The Holocaust has become the prime example of an unprecedented genocidal trauma, and was a source of severe stress for the child survivors. In the current study we explore the influence of early childhood exposure to the traumatic stress of the Holocaust, associated with loss of both parents during childhood, on the neurobiological functioning of the survivors and their daughters more than 60 years later.

In a recent meta-analysis involving 12,746 participants from 71 samples, Holocaust survivors were compared to their counterparts on physical health, psychological well-being, posttraumatic stress symptoms, psychopathological symptomatology, cognitive functioning, and stress-related physiology (Barel, Van IJzendoorn, Sagi-Schwartz, & Bakermans-Kranenburg, in press). In select and non-select samples (i.e., drawn from population-wide demographic information) Holocaust survivors displayed substantially more posttraumatic stress symptoms than comparisons. However, in studies with non-select samples they also displayed good adaptation in physical health, cognitive functioning, and stress regulation, suggesting remarkable resilience.

The survivors' adaptability might be the reason for the unexpected absence of posttraumatic symptomatology among the second generation. In a meta-analytic study on 32 samples with 4,418 children of Holocaust survivors (second generation) there was no evidence for secondary traumatization in studies with adequate designs (non-select recruitment) and in non-clinical samples (Van IJzendoorn, Bakermans-Kranenburg & Sagi-Schwartz, 2003). The possibility that the effects of the trauma might skip the second generation and then be detected in the third generation ("tertiary traumatization") was examined in another meta-analysis of 13 non-clinical samples of third generation participants (N = 1012). Again, there was no evidence for intergenerational transmission of the first generation's trauma to the third generation offspring (Sagi-Schwartz, Van IJzendoorn, & Bakermans-Kranenburg, 2008).

It is possible, though, that the effects of the traumatic experiences might be detectable in the offspring only under very stressful life circumstances. In fact, vulnerability of such kind was found when young adult offspring of Holocaust survivors showed greater vulnerability to develop combat reactions, even three years after their military service during the 1982 Lebanon war (Solomon, Kotler, & Mikulincer, 1988). Apparently the stress associated with being actively involved in the war increased to such a degree that the challenge was less bearable for those soldiers who were second generation to the Holocaust. Vulnerability of the second
generation to extremely stressful life events was also found in a study examining psychological distress among offspring of Holocaust survivors and comparisons with breast cancer. It was found that, although the two groups were similar in respect to their medical condition, second generation Holocaust survivors were significantly more psychologically distressed than the comparison group (Baider et al., 2000).

Thus the long-term second generation effects of the Holocaust might be latent and residing ‘under the skin’ in the neurobiological system, and “remnants” of the traumatic experiences may be detected only under stressful circumstances. Stress regulation, as indexed by the HPA-axis functioning and its end-product cortisol, is a candidate for such latent long-term effects of (primary or secondary) traumatization. The hypothalamic-pituitary-adrenal (HPA) axis is the major physiological stress response system. It is a central regulatory and control system that connects the central nervous system (CNS) with the endocrine system (Chrousos & Gold, 1992; Kudileka, Hellhammer, & Kirrschbaum, 2007), and it is associated with the diurnal rhythm of the cortisol hormone production, which serves both the promotion of sleep-wake cycles and the monitoring of stress responses (Dozier et al., 2006). Diurnal cortisol patterns normally show a peak about 30 min post wake-up, and then decrease rapidly within the next one to two hours. Cortisol levels then decrease more slowly throughout the rest of the day to the nadir at bedtime (Dozier et al., 2006; Gunnar, Morison, Chisholm, & Schuder, 2001). In addition to this diurnal pattern higher secretion of cortisol is temporarily found in response to acute psychological stressors, both in animals (e.g., Shepard, Barron, & Myers, 2000) and in humans (Dickerson & Kemeny, 2004; Otte et al., 2005).

Moreover, the development of HPA axis is modified by early environmental factors (Liu et al., 1997; Meaney et al., 1991; Tarullo & Gunnar, 2006). Children in institutional or foster care, for example, are more likely to show atypical patterns of daily cortisol production than children who did not experience institutional or foster care (Dobrova-Krol, Van Ijzendoorn, Bakermans-Kranenburg, Cyr, & Juffer, 2008; Dozier et al., 2006). Such dysregulation has been observed even more than six years after adoption (Gunnar et al., 2001). Neurobiological consequences of trauma during childhood have also been documented by Yehuda and her colleagues among adult Holocaust survivors (e.g., Yehuda, Bierer, Andrew, Schmeidler, & Seckel, 2009; Yehuda, Golier, & Kaufman, 2005; Yehuda, Halligan, Grossman, Golier, & Wong, 2002) and their adult offspring (e.g., Yehuda, Halligan, & Bierer, 2002; Yehuda et al., 2000). Holocaust survivors with PTSD showed lower basal cortisol rhythm than non-Holocaust comparisons also diagnosed with PTSD, whereas no differences were found between Holocaust survivors without PTSD and subjects who did not experience the Holocaust (Yehuda, Golier, & Kaufman,
In our recent study, Holocaust survivors showed elevated levels of daily saliva cortisol secretion when compared to matched comparisons, whereas presence or absence of dissociative symptomatology in the first generation seemed to differentiate cortisol production among offspring (Van IJzendoorn, Fridman, Bakermans-Kranenburg, & Sagi-Schwartz, submitted).

Most research on HPA activity in adults who were exposed to childhood trauma in general, and to the Holocaust atrocities in particular, has focused on basal levels rather than stress reactivity. In a recent study (Van der Hal-Van Raalte, Bakermans-Kranenburg, & Van IJzendoorn, 2008) cortisol secretion under stress was tested among 133 child survivors of the Holocaust. Male subjects who were born during persecution (between 1941 and 1944) and male subjects who suffered from functional impairment related to PTSD showed elevated cortisol levels in reaction to a stressful interview (Van der Hal-Van Raalte et al., 2008). However, no comparison group was included in that study and the results thus call for further examination of Holocaust survivors’ reactivity to stress with a standardized stressor and a more controlled design including a comparison group.

In the current study, Holocaust survivors and their adult daughters were carefully matched to comparisons that did not experience the Holocaust, along with their daughters. A standardized psychological stressor, the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993), was used. We hypothesized that Holocaust survivors as well as their offspring would show elevated levels of cortisol reactivity to stress as compared to matched participants.

**Method**

**Participants**

Participants were recruited via the Population Registry administration by the Israeli Ministry of Interior (Sagi-Schwartz et al., 2003). Two groups were compared: First generation females with Holocaust experiences in their childhood and their Israeli-born daughters (second generation), and a matched comparison group of first generation females born in Europe and immigrated with their parents to Israel just before the onset of World War II along with their Israeli-born daughters (second generation).

For the purpose of this study, we contacted the 106 first-generation participants and 104 second-generation participants who took part in the original sample. However, by the time of data collection, 10 first-generation participants (9.3%) had passed away, and for reasons of health and personal problems another 17 individuals were not able to participate. Of 79 eligible first-generation
participants 65 (82.3%) agreed to take part in the study (32 Holocaust survivors, and 33 comparison participants). The age of the first-generation participants ranged from 71 to 84 years ($M = 76.98, SD = 2.99$). Among the second-generation women attrition was lower. Of the 104 original second-generation participants, eight women (7.7%) were unable to participate, mainly because they no longer lived in Israel. Of the remaining, 79 (82.29%) agreed to take part (47 daughters of Holocaust survivors group, and 32 daughters of comparison respondents). The age of the second-generation participants ranged from 38 to 59 years ($M = 47.46, SD = 4.41$).

**Procedure**

Two preliminary steps preceded data collection: the study was approved by the ethics committee of University of Leiden, the Netherlands, and participants signed a written informed consent. Data was collected at the participants’ homes at their convenience. First and second generation participants were visited on separate occasions. After a brief introduction, the participants provided the baseline salivary sample. The research assistant introduced the **Trier Social Stress Test** (TSST, Kirschbaum et al., 1993), a validated procedure to provoke physiological stress responses (Dickerson & Kemeny, 2002; McRae et al., 2006). A more detailed description of the TSST can be found below. After the TSST and a recovery period participants completed some questionnaires. For all participants a research assistant was available throughout the entire meeting for clarifications and support, and after the meeting by phone any time as necessary.

**Measures**

**Physical Health.** Physical health status was assessed by a questionnaire developed by Herczeg Institute on Aging (Tel Aviv University). This questionnaire is widely used for socio-demographic research in Israel, and was used in previous Holocaust studies (e.g., Van der Hal-Van Raalte, Bakermans-Kranenburg, & Van IJzendoorn, 2008). Subjects were asked to rate their health using a 5-point Likert scale ranging from 1 = *very unhealthy* to 5 = *very healthy*. Also, they were asked to indicate which of 19 listed health problems were applicable to them, and to report whether they used medication. Participants could supplement more health conditions whenever they felt it was in place, resulting in an overall list of 40 problems. In the current sample, the total number of reported health problems ranged from 0 (no health problems) to 15 for first generation, and from 0 to 8 for second generation. The correlation between the two health measures was $r = .54 (p < .01)$ for the first generation, and $r = .37 (p < .01)$ for the second generation.

**Satisfaction With Life** (SWL) scale is a 5-item questionnaire designed to assess satisfaction with life as a whole (Pavot & Diener, 1993). Using 7-point Likert scales,
participants were asked to rate their level of agreement with statements on a scale of 1 ("strongly disagree") to 7 ("strongly agree"). The score on the overall scale is the sum of all 5 items with higher scores representing more satisfaction with life. Cronbach's alpha reliability coefficients were .65 and .84 for the first and second generation respectively. The Hebrew version has been used in various studies in Israel (e.g. Cohen & Shmotkin, 2007).

**Trier Social Stress Test (TSST)**. The TSST (Kirschbaum et al., 1993) is a procedure that includes both social-evaluative threat (speaking in the presence of an audience) and lack of control (an arithmetic task that is impossible to complete within the time constraints). The combination of the public speaking and impossible arithmetic task has indeed been shown to be an effective psychosocial stressor (Buske-Kirschbaum et al., 1997), which elicits stronger physiological responses than other types of stressors (Dickerson & Kemeny, 2002). For the speaking task, second generation participants were asked to assume a role of a job applicant who was invited for a personal interview and to persuade the selection committee that she is the best candidate for the position. Because a job was inappropriate for the elderly group, first generation participants' public speaking task was to persuade the university experts that their grandchild would deserve a scholarship. All other instructions were identical for both generations. Participants were told that after a short preparation period they should introduce themselves in free speech to the video camera that was placed in the room and that the video cassette would be seen by the University of Haifa experts who were trained to assess both verbal and non-verbal behavior. Following these instructions, participants were given five minutes to prepare for their talk, however they were not allowed to use written notes. After five minutes they were asked to sit in front of the camera and give their speech. Whenever the participant finished her speech in less than five minutes, the research assistant responded in a standardized way: "You still have some time left. Please continue!" If the participant still finished the talk before the allotted time was over, the research assistant became quiet for 20 sec and then asked some standard questions such as "why do you think you/ your grandchild is the best candidate for this job/ scholarship?".

After the five-minute speech a mathematical task was introduced. Participants were asked to serially subtract the number 13 from 2083 as fast and accurately as possible, and they were told that their results would be delivered to university experts. In order to increase stress, a metronome was turned on with 40 beats per min, and every minute the research assistant made a comment, regardless of the participant’s performance (e.g., "Please be more accurate"; "Please try to be more focused"). On every failure the participant was asked to start all over again. After three failures, participants were given the option to start from 1022, instead of 2083. The task was stopped after five minutes, and the research assistant
debriefed the participants that no video analysis would in fact be preformed and that the comments were standard regardless of their performance. For the purpose of relaxation and recovery after the TSST participants watched 25 minutes of the nature movie: "Flying Birds".

Cortisol levels. Participants’ cortisol secretion under stress was measured three times following the stressful procedure: 20, 30 and 40 minutes after the onset of the TSST, respectively. Participants were not allowed to eat or drink anything but water until all saliva samples were collected. Mean cortisol sampling times for the first generation participants were 12:50 PM ($SD = 3:29$; baseline), 13:14 PM ($SD = 3:29$), 13:25 ($SD = 3:28$), and 13:35 PM ($SD = 3:28$). Mean cortisol sampling times for the second generation participants were 13:53 PM ($SD = 4:18$; baseline), 14:16 PM ($SD = 4:18$), 14:28 PM ($SD = 4:19$), and 14:36 PM ($SD = 4:18$). Since time of baseline sample varied, it was used as covariate in the analyses. Samples were stored at -18°C until being assayed by the Research Center for Psychobiology at the University of Trier.

Statistical Analyses

Cortisol measures were inspected for outliers, which were defined as values larger than 3.29 standard deviations above or below the mean (Tabachnick & Fidell, 2007). No outliers were detected for first and second generation participants. Because the distributions of cortisol values were positively skewed, log10 transformations were used for analysis, as is commonly done (Gunnar et al., 2001). Only participants with all four cortisol samples were included in the analysis, with 38 first generation participants (19 Holocaust survivors and 19 comparisons), and 64 second generation participants (36 daughters of Holocaust survivors and 28 daughters of comparisons). Cortisol reactivity to stress was analyzed using multivariate analyses of variance with repeated measures (the participants’ cortisol levels at four time points), with group (Holocaust survivors versus comparisons) as between-subject factor, and time of baseline sample as covariate.

Results

First generation. Table 1 presents the background variables and the transformed cortisol levels for first generation participants. For obvious reasons Holocaust survivors had significantly fewer years of education than the comparison group, $t (36) = -5.13, p < .01$, and they also reported more dissatisfaction with their life than their comparisons, $t (36) = 2.45, p = .02$. No differences were found for physical illness or medication between the two groups.
Table 1. Background Variables and Cortisol Values at Baseline and after Stress for the First Generation

<table>
<thead>
<tr>
<th></th>
<th>Holocaust (n = 19)</th>
<th>Comparison (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>age</td>
<td>77.26</td>
<td>3.60</td>
</tr>
<tr>
<td>years of education</td>
<td>4.47**</td>
<td>2.63</td>
</tr>
<tr>
<td>number of children</td>
<td>3.21</td>
<td>0.63</td>
</tr>
<tr>
<td>family status: married / widowed</td>
<td>12 / 6¹</td>
<td></td>
</tr>
<tr>
<td>perceived health</td>
<td>3.32</td>
<td>1.06</td>
</tr>
<tr>
<td>number of health problems</td>
<td>6.26</td>
<td>2.98</td>
</tr>
<tr>
<td>medication use</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>satisfaction with life (SWL)</td>
<td>23.32*</td>
<td>5.24</td>
</tr>
<tr>
<td>cortisol time 1 (baseline)²</td>
<td>0.57</td>
<td>0.37</td>
</tr>
<tr>
<td>cortisol time 2 (post stress 1)</td>
<td>0.48</td>
<td>0.29</td>
</tr>
<tr>
<td>cortisol time 3 (post stress 2)</td>
<td>0.48</td>
<td>0.36</td>
</tr>
<tr>
<td>cortisol time 4 (post stress 3)</td>
<td>0.46</td>
<td>0.26</td>
</tr>
</tbody>
</table>

* p < .05, ** p < .01

Note. ¹n = 1 separated, family status was not significantly different, p = .58.
²Cortisol values log_{10} transformed

A 2 (Holocaust versus comparisons) x 4 (time of sampling) repeated measure ANCOVA with baseline time of sampling as covariate was conducted. As expected, time of baseline sampling had a significant effect on cortisol levels $F(1, 35) = 13.21, p < .01$, with earlier assessments leading to higher cortisol production. The only significant interaction of time by group was found for the a priori contrast between the baseline and the first post-stress cortisol levels, $F(1, 35) = 4.10, p < .05$. Specifically, Holocaust survivors showed highly elevated cortisol levels just before the TSST possibly reflecting anticipatory stress, and they showed a strong decline of cortisol levels 20 minutes after the onset of the TSST, whereas comparisons subjects showed the expected increase of cortisol levels as a response to the stress condition. Figure 1 displays the stress reactivity curves for the two first
generation groups. The third and fourth cortisol assessments did not reflect the
differential influence of the stressor anymore.

Second generation. The background variables for the second generation
participants and log-transformed cortisol data are presented in Table 2. No
differences were found between the two groups on the background variables.

Figure 1. Cortisol Levels at Baseline and after Stress (nmol/l, log 10 transformed)
of First Generation Holocaust survivors and Comparisons, Controlled for
Baseline Time of Sampling.
Table 2. Background Variables and Cortisol Values at Baseline and after Stress for the Second Generation

<table>
<thead>
<tr>
<th></th>
<th>Holocaust (n = 36)</th>
<th>Comparison (n = 28)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>age</td>
<td>46.81</td>
<td>4.39</td>
</tr>
<tr>
<td>years of education</td>
<td>10.64</td>
<td>2.32</td>
</tr>
<tr>
<td>number of children</td>
<td>3.31</td>
<td>1.35</td>
</tr>
<tr>
<td>family status: married / divorced</td>
<td>34 / 1¹</td>
<td></td>
</tr>
<tr>
<td>perceived health</td>
<td>4.23</td>
<td>0.81</td>
</tr>
<tr>
<td>number of health problems</td>
<td>1.19</td>
<td>1.45</td>
</tr>
<tr>
<td>medication use²</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>satisfaction with life (SWL)</td>
<td>26.58</td>
<td>5.28</td>
</tr>
<tr>
<td>cortisol time 1 (base line)³</td>
<td>0.42</td>
<td>0.33</td>
</tr>
<tr>
<td>cortisol time 2 (post stress 1)</td>
<td>0.37</td>
<td>0.41</td>
</tr>
<tr>
<td>cortisol time 3 (post stress 2)</td>
<td>0.38</td>
<td>0.35</td>
</tr>
<tr>
<td>cortisol time 4 (post stress 3)</td>
<td>0.37</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Note. ¹n = 1 single. Family status was not significantly different, p = .37. ²Medication use was not significantly different, p = .36. ³Cortisol values log_{10} transformed

A repeated measure ANCOVA, with time of baseline as a covariate was used to test contrasts between 4 time points using 2 (Holocaust versus comparisons) x 4 (time of sampling) design. Time of baseline assessment was found to have a significant effect on cortisol levels $F(1, 61) = 40.36, p < .01$, with assessments earlier in the day associated with higher cortisol levels. Daughters of Holocaust survivors and daughters of comparisons showed similar declines in cortisol secretion at all time points, $F(1, 61) = 1.12, p = .29$. Figure 2 displays the stress reactivity curves for the two second generation groups.
Cortisol reactivity to stress did not show secondary traumatization effects. Furthermore, no significant correlations between cortisol reactivity to stress were found between first and second generation participants (Table 3).

Table 3. Cortisol Reactivity between Generations

<table>
<thead>
<tr>
<th>Cortisol time (post stress)</th>
<th>Holocaust survivors and their daughters</th>
<th>n</th>
<th>Comparisons and their daughters</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>cortisol time 1 (baseline)</td>
<td>.01</td>
<td>19</td>
<td>-.21</td>
<td>17</td>
</tr>
<tr>
<td>cortisol time 2 (post stress 1)</td>
<td>.06</td>
<td>21</td>
<td>-.38</td>
<td>16</td>
</tr>
<tr>
<td>cortisol time 3 (post stress 2)</td>
<td>-.26</td>
<td>22</td>
<td>-.36</td>
<td>16</td>
</tr>
<tr>
<td>cortisol time 4 (post stress 3)</td>
<td>-.21</td>
<td>22</td>
<td>-.30</td>
<td>17</td>
</tr>
</tbody>
</table>

* $p < .05$
Discussion

We found that Holocaust child survivors immigrating to Israel as orphans after the Holocaust, showed elevated levels of cortisol secretion immediately before the onset of the stress procedure, followed by a strong decline of cortisol levels 20 minutes after the onset of the stress procedure. Comparison subjects immigrating with their parents to the pre-state of Israel before the onset of the Holocaust, hence considered as having no Holocaust background, showed the expected increase of cortisol levels in response to induced stress. At the same time, adult offspring of Holocaust survivors did not display different cortisol reactivity in response to stress compared to that of their matched controls.

The initial elevated level of cortisol that was found among Holocaust survivors before the onset of the induced stress is consistent with elevated diurnal cortisol levels in the same sample of Holocaust survivors (Van IJzendoorn et al., submitted). Alterations in cortisol secretion among Holocaust survivors was also found by Yehuda and her colleagues in a host of studies with matched comparisons (Yehuda, Halligan, Grossman, Golier, & Wong, 2002; Yehuda, Golier, & Kaufman, 2005; Yehuda, Morris, Labinsky, Zemelman, & Schneider, 2007). However, in the studies conducted by the Yehuda group, Holocaust survivors diagnosed with PTSD showed lower levels of daily cortisol secretion. Importantly, participants in Yehuda et al.'s studies were living in the USA, whereas in our study survivors and comparisons are living in Israel, with enduring exposure to stressful life events ever since their immigration. Such chronic stress on top of the traumatic childhood events during World War II might explain the differences in the daily cortisol pattern in Israeli Holocaust survivors as compared to their US counterparts.

Elevated cortisol prior to the induced stress procedure might also be explained by survivors' increased alertness to stress when expecting a research session about the Holocaust. Israeli Holocaust survivors were found to perceive life events as more stressful than did their Israeli comparisons, even though in practice they did not experience more stressful events (Fridman et al., in press). It should be noted that child survivors often suffered a myriad of losses, not only of both parents and other love ones, but for many of them also of their basic sense of security and sense of justice (Durst, 2003). The ongoing struggle for survival forced them to be constantly alert and to try to adapt fast to new circumstances (Dasberg, 2001). Thus, coping behaviors, perceptions, and expectations that were adaptive during the years of extreme stress may be continually applied to even minor stress situations, resulting in maladaptive outcomes (Kahana, Harel, & Rosner, 1988) such as posttraumatic symptomatology (see Barel et al., in press, for a review) and a hyperactivated HPA axis in expectation of a (mild) stressor.
In the short run, such a stress response might promote survival: within seconds of a stressful encounter, the neurobiological stress coping systems become active, including the HPA-axis, and cortisol levels start to increase. However, if activated repeatedly, an overactive HPA axis may exert detrimental effects on one's health, with cardiovascular and metabolic consequences, and chronic immune suppression (Denson, Spanovic, & Miller, 2009; Johnson, Kamilaris, Chrousos, & Gold, 1992). In fact, elevated physical health problems have been documented among Holocaust survivors (e.g., Antonovsky, Maoz, Dowty, & Wijsenbeek, 1971; Landau & Litwin, 2000); in particular cancer morbidity (Keinan-Boker, Vin-Raviv, Lipshitz, Linn, & Barchana, 2009), which might be related to a dysregulated HPA-axis functioning.

In the second generation, the absence of differences in reactivity to stress between adult offspring of Holocaust survivors and their comparisons correspond to meta-analytic findings. Although survivors display posttraumatic symptomatology, there is no evidence of intergenerational transmission of the trauma to their offspring in unbiased samples (Van IJzendoorn et al., 2003) which is also the case in the present study. However, in daily cortisol secretion studies, 24 hours urinary cortisol was lower among adult offspring of Holocaust survivors, associated with parental PTSD (Yehuda, Halligan, & Bierer, 2002; Yehuda, Halligan, & Grossman, 2001; Yehuda et al., 2000). Our recent basal salivary cortisol study also demonstrated that parental higher dissociation was associated with lower level of cortisol production in second generation offspring of survivors (Van IJzendoorn et al., submitted). Similarly, second generation participants did display greater vulnerability for major stressful events such as suffering from a life-threatening illness (Baider et al., 2000) or developing enduring markers of combat reactions when actively involved in combat missions (Solomon et al., 1988). It is possible that the stressful procedure in the current study was indeed sufficiently stressful for both second generation groups to generate increases in their cortisol levels in response to the procedure regardless of Holocaust background. And yet, it might not have been perceived as life-threatening and therefore “hidden” vulnerability might not have emerged as well.

Our study was limited to female survivors and their female offspring, and replication in a male or mixed-gender sample is needed, since gender differences in the pattern of cortisol rise and decline in reaction to challenge have been documented (Kirschbaum & Hellhammer, 1994; Otte et al., 2005; Shalev et al., 2009; Van der Hal-Van Raalte et al., 2008). Also, a larger sample would increase the power of the statistical analyses, perhaps uncovering more subtle differences in the second generation. Yet it should be noted that the power for the current research design was sufficient to detect moderately strong effects. In future studies on the neurobiological effects of genocides, genetic strengths and vulnerabilities should
also be taken into account. It is possible that baseline and response levels of cortisol are partly genetically determined (Kirschbaum, Wust, Faig, & Hellhammer, 1992).

Taken together, Holocaust survivors showed elevated levels of cortisol secretion prior to the stress procedure, and they showed a strong decline of cortisol levels after the onset of the stressor. Comparison participants, however, showed the expected increase of cortisol levels in response to the stressor. Daughters of Holocaust survivors did not display different cortisol reactivity in response to stress when compared to offspring of matched controls, and no intergenerational transmission of the cortisol reactivity to stress was found. The Holocaust, and by implication genocides in general, seem to leave their marks on survivors' behavior and physiology many years after the end of the traumatic events.
References


