



Parental PTSD, health behaviors and successful aging among offspring of Holocaust survivors

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ABSTRACT

Unhealthy behaviors and physical morbidity are more common among trauma survivors, especially those who suffer from posttraumatic stress disorder (PTSD). This study looked at the underexplored relationships between parental PTSD, unhealthy behaviors and aging of trauma survivors' offspring. Dyads of parents (mean age = 82.42) and offspring (mean age = 55.48) reported PTSD symptoms, health behaviors and completed indices of successful aging. Dyads were divided into three groups: Holocaust survivors (HS) with probable PTSD ($n = 28$ dyads), HS without PTSD ($n = 86$ dyads) and comparison parents without PTSD ($n = 73$ dyads). Relative to the other groups, HS parents with probable PTSD and their offspring reported more unhealthy behaviors. Serial mediation models showed that the effect of parental PTSD on offspring successful aging was mediated by both parental and offspring unhealthy behaviors. Findings remained significant after controlling for background characteristics and offspring PTSD. This study provides preliminary evidence that PTSD is related to unhealthy behaviors across generations in HS families. Possible mechanisms for such intergenerational effect and its clinical implication are discussed.

1. Introduction

Myriad studies have identified traumatic exposure and especially posttraumatic stress disorder (PTSD) as risk factors for unhealthy behaviors including smoking, alcohol abuse and low frequency of physical activity (Rheingold et al., 2004). These behaviors comprise an important path to increased physical morbidity seen among traumatized individuals (Schnurr, 2017). As engagement in health behaviors tend to continue across generations (e.g., Pugliese and Tinsley, 2007), it is possible that parental trauma exposure and PTSD not only relate to parental behavior, but also linger on to associate with health behaviors and physical status of offspring. This latter possibility is underexplored. To address this issue, the current study assessed health behaviors and indices of successful aging among Holocaust survivors (HS) and their adult offspring.

1.1. Health behaviors and successful aging of trauma survivors

Exposure to traumatic events, and especially PTSD, increase the risk for a variety of health-risk behaviors such as substance abuse (Rheingold et al., 2004). PTSD is also related to less preventive health behaviors (e.g., physical activity, diet and regular utilization of medical care), although this relationship is less consistent across studies

(Lee and Park, 2018). Traumatized individuals may turn to substance use with the attempt to rapidly minimize discomfort linked with trauma-related losses, PTSD symptoms and related negative emotions (Rheingold et al., 2004). Decreased preventive health behaviors among traumatized victims associate with dampened motivation for proactive measures, low self-efficacy, and foreshortened future orientation (Lee and Park, 2018).

Relatedly, theoretical models and empirical works suggest that unhealthy behaviors mediate the effect of trauma exposure and PTSD on various markers of aging among survivors (Schnurr, 2017). Utilizing an extensive outlook at the aging of trauma survivors, scholars began to assess the relationship of behaviors with multiple indices of health usually clustered under the concept of successful aging (e.g., Pietrzak et al., 2014; Bodner et al., 2018).

Successful aging was originally described as the combination between freedom from disease and disability and active engagement with life (Rowe and Kahn, 1987). Criticized for depicting an extraordinary or exceptional aging, rather than successful aging (Martin et al., 2015), scholars recently suggested to move from the prior dichotomous operationalization (i.e., either successful or unsuccessful aging) to a continuous one, as individuals experience limitations in one functional domain may perform relatively well in other domains (Kok et al., 2017). Not surprisingly, substance abuse history is among the factors

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related to less successful aging among trauma survivors (Pietrzak et al., 2014). The current study followed this broad-scope view and assessed the link between health behaviors and successful aging from an inter-generational perspective.

1.2. Parents' and offspring health behaviors

There is a fairly large and consistent literature demonstrating moderate resemblance between parents' and offspring health behaviors. For example, parental alcohol consumption is positively associated with drinking in offspring (Rossow et al., 2016). Similarly, parents' smoking is related to their children's smoking (Leonardi-Bee et al., 2011), and parental modeling behavior, as well as parental support for physical activity, are associated with offspring physical activity (Pugliese and Tinsley, 2007). The correlation between parents' health behaviors and their offspring behaviors can extend for decades (e.g., Hemmingsson et al., 2017).

The link between parents' and offspring health behaviors can reflect the latter tendency to emulate parental behaviors (Bandura, 1986). This link can also result from parents engaging in unhealthy behaviors being more lenient towards children's risky behaviors, or being unable to fulfil their responsibilities and take adequate care of their offspring. Poor parenting accompanying parental negative health behaviors could also associate with mental health and later health-risk behaviors among offspring (Reczek et al., 2017).

Despite the abovementioned findings, the intergenerational association of unhealthy behaviors among trauma survivors and their family members is underexplored. As this study focuses on HS and their offspring, the next section will briefly review the health behaviors and aging in these groups.

1.3. Health behaviors and successful aging among Holocaust survivors and offspring

Most of the literature suggests that the behaviors and health of HS and their offspring are not an inevitable consequence of exposure per se, but rather, relate to an unresolved attempt to cope with the trauma mainly manifested by parental PTSD (Yehuda et al., 2008; Shrira et al., 2017). Accordingly, large-scale studies on community-dwelling individuals did not find HS (Shmotkin et al., 2003) or their offspring (Levav et al., 2007; Shrira et al., 2011) to differ from comparisons in health behaviors. However, other studies with samples coping with stress, or with samples characterized by significant clinical features, did allude to the possibility of higher rates of unhealthy behaviors among HS and offspring. For example, Kimron and Cohen (2012) showed that HS used more emotional-focused coping (including alcohol use) when being hospitalized. Emotional-focused coping further explained the greater psychological distress seen among HS relative to other hospitalized older adults. In another sample characterized with an extraordinarily high rates of parental PTSD (77.0%), Yehuda et al. (2008) found a slightly higher frequency of substance abuse disorder among offspring of HS relative to comparisons, yet they did not find parental PTSD (as reported by offspring themselves) to be related to an increased risk of such disorder.

With regard to successful aging and its indices, there is evidence that physical morbidity is higher among HS who suffer from PTSD (Brodsky et al., 2004), and burgeoning evidence suggests that their offspring also manifest less successful aging (Shrira et al., 2017) and perceive their aging in less favourable terms (Shrira, 2016). Therefore, the current study will separate HS to those with and without probable PTSD, with an attempt to point at unhealthy behaviors as one possible factor associating with less successful aging in families of HS with PTSD.

1.4. The current study hypotheses

The study compared health behaviors and indices of successful aging among HS and comparison parent-offspring dyads. The first hypothesis was that relative to the other dyads (comparison and HS without PTSD), HS with probable PTSD and their offspring would report more unhealthy behaviors. Offspring of HS with probable PTSD will also show less successful aging relative to their counterparts. The second hypothesis maintained that the relationship between parental PTSD and offspring successful aging would be mediated by parents' health behaviors and the health behaviors of the offspring themselves.

2. Method

2.1. Participants

A convenience sample included 374 community-dwelling participants, who consisted 187 dyads of parents and adult offspring. All parents were Jewish of European origin born before 1945. Offspring were born after 1945 and had two parents who were alive during World War II. HS and their offspring included 114 dyads, and comparison parents without a Holocaust background and their offspring included 73 dyads. Holocaust background was determined by parents' presence under Nazi or pro-Nazi occupation or domination during World War II.

Dyads were next divided according to probable parental PTSD (for more details see the Measures section). There were 28 Holocaust dyads with a parent suffering from probable PTSD, 86 Holocaust dyads with a parent without PTSD, and 73 comparison dyads (all of them with parents without PTSD).

Table 1 presents the background characteristics of the study groups. HS without PTSD were older than comparison parents. HS with probable PTSD had lower education level and rated their economic status as lower than both other groups. The groups did not significantly differ in parental gender and marital status. The offspring groups did not significantly differ in any of the background characteristics.

Holocaust-related experiences (e.g., being in concentration camp, work camp, ghetto, hiding, living with partisans, having been exposed to hunger, extreme weather conditions and extreme physical abuse) were documented among HS. Compared to survivors without PTSD, a significantly greater number of survivors with probable PTSD were exposed to physical abuse during the Holocaust (25.0% vs. 9.3%, $\chi^2[1] = 4.55, p = .03$). Significantly more survivors without PTSD reported to have been in hiding than survivors with probable PTSD (54.7% vs. 17.9%, $\chi^2[1] = 11.52, p = .001$).

2.2. Measures

2.2.1. Background characteristics

Background characteristics were completed by all respondents and included age, gender, education and marital status. Education was rated on a scale from 'no formal education' (1), to 'academic degree' (6). Self-rated economic status was rated on a scale from 'not good at all' (1) to 'very good' (5).

2.2.2. PTSD symptoms

PTSD symptoms were rated by all respondents with the PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013). This questionnaire is a 20-item measure of PTSD symptoms as appearing in the DSM-5 (APA, 2013). HS were instructed to refer to their experiences during the Holocaust whereas comparison parents were instructed to refer to the most traumatic event that had happened to them. Most comparison parents referred to a sudden death of a close person (27.3%), or to a life-threatening illness or disability that happened to a close person (16.7%). Others referred to being diagnosed with a life-threatening illness (7.6%), participating in war or combat (6.1%), surviving a severe accident (6.1%), being injured in war or terrorist act (4.5%), being

Table 1
Background characteristics of the study groups.

	Holocaust survivors with probable PTSD dyads	Holocaust survivors without PTSD dyads	Comparison dyads	Comparison tests
<i>n</i>	28	86	73	
<i>Parents</i>				
Mean age (<i>SD</i>)	82.82 ^{a,b} (5.38)	83.56 ^a (5.61)	80.91 ^b (5.34)	$F(2,184) = 4.71, p = .01, \eta^2 = 0.04$ $\chi^2(2) = 0.51, p = .77$
Gender (%)				
Woman	64.3	61.6	67.1	
Man	35.7	38.4	32.9	
Education (%)				$\chi^2(4) = 36.30, p < .0001, \phi_c = 0.31$
Below high-school	71.4	40.7	13.9	
Full high-school	17.9	27.9	26.4	
Above high-school	10.7	31.4	59.7	
Marital status (%)				$\chi^2(8) = 6.53, p = .58$
Married	42.9	54.7	57.5	
Widowed	53.6	36.0	35.6	
Divorced	0.0	5.8	2.7	
Single	3.6	1.2	1.4	
Partner	0.0	2.3	2.7	
Mean self-rated economic status (<i>SD</i>)	3.03 (0.74) ^a	3.52 (0.78) ^b	3.73 (0.80) ^b	$F(2,181) = 8.00, p < .0001, \eta^2 = 0.08$
<i>Offspring</i>				
Mean age (<i>SD</i>)	56.00 (6.11)	56.37 (6.16)	54.23 (5.45)	$F(2,184) = 2.73, p = .07$ $\chi^2(2) = 2.27, p = .32$
Gender (%)				
Woman	75.0	59.3	64.4	
Man	25.0	40.7	35.6	
Education (%)				$\chi^2(4) = 1.04, p = .90$
Below high-school	3.6	1.2	2.7	
Full high-school	25.0	22.1	20.5	
Above high-school	71.4	76.7	76.7	
Marital status (%)				$\chi^2(8) = 5.33, p = .72$
Married	82.1	80.5	83.3	
Widowed	0.0	0.0	2.8	
Divorced	14.3	14.6	8.3	
Single	0.0	2.4	2.8	
Partner	3.6	2.4	2.8	
Mean self-rated economic status (<i>SD</i>)	3.67 (0.77)	3.83 (0.85)	3.89 (0.87)	$F(2,183) = 0.62, p = .53$

Note. Means that do not share letters significantly differ from each other in a post hoc Bonferroni test.

physically attacked (3.0%), or undergoing other life-threatening events (e.g., natural disaster, experiencing abuse etc., 28.7%).

Offspring were instructed to refer to the most traumatic event that had happened to them. Close to a third of the offspring (29.1%) referred to the sudden loss of a loved one, 13.6% referred to a life-threatening event that occurred to a loved one, 11.2% referred to exposure to warfare, and 10.7% referred to a serious accident. Another third (34.4%) referred to exposure to other life-threatening events, such as physical assault, and physical or sexual abuse.

For each symptom participants were asked to choose their response on a 5-point Likert scale from 1 (*not at all bothered*) to 5 (*extremely bothered*) when referring to the last month. The PTSD symptom score was the sum of ratings. Higher scores indicated higher levels of PTSD symptoms. Cronbach's α coefficient for this sample was 0.91 for parents and 0.93 for offspring. The Hebrew version of the scale was previously used (Shrira et al., 2017). Probable PTSD for both parents and offspring was determined by a cut-off score of 33 or higher (cf. Bovin et al., 2016).

2.2.3. Health-risk behaviors

Health-risk behaviors were rated by all respondents with items adapted from the Survey of Health, Ageing and Retirement in Europe (SHARE; e.g., Shrira et al., 2011). Smoking was assessed by asking the respondents whether they smoke. The item was scored 0 (*Never smoked*), 1 (*Smoked in the past*), and 2 (*Currently smoking*). Alcohol consumption was assessed by asking the respondents how often have they drunk any alcoholic beverages, such as beer, cider, wine, spirits or cocktails during the last six months. The item was scored 0 (*Less than once a month*), 1 (*On a weekly basis but not every day*), and 2 (*Almost*

every day or every day). Lack of physical activity was assessed by asking the respondents how often do they engage in vigorous physical activity, such as sports, heavy housework, or a job that involves physical labor. The item was scored 0 (*Almost every day*), 1 (*On a weekly basis, but not every day*), and 2 (*Less than once a month, or not at all*). Following prior works that used overall health behavior score and documented the combined detrimental effect of multiple risky lifestyle behaviors (Loef and Walach, 2012), the sum of items was computed to reflect overall unhealthy behaviors score, with higher scores reflecting higher risk to health.

2.2.4. Successful aging

Offspring completed several indices of successful aging including chronic medical conditions, disability, somatic symptoms and a global assessment of health (self-rated health).

Chronic medical conditions were assessed by a sum of 11 listed illnesses that participants reported to have been diagnosed with by a physician. The illnesses consisted of heart disease, high blood pressure, high cholesterol, stroke or cerebral vascular disease, diabetes or high blood sugar, chronic lung disease, such as chronic bronchitis or emphysema, asthma, arthritis (including osteoarthritis or rheumatism), osteoporosis, cancer or malignant tumor and Parkinson disease.

Disability was measured by asking respondents to rate difficulties in performing five functional activities (adapted from Nagi, 1976) including stooping, kneeling, or crouching, reaching or extending arms above shoulder level, pulling or pushing heavy objects, lifting or carrying heavy weights and picking up a small coin from a table. Each activity was rated on a scale from 1 (*not difficult to perform at all*) to 4 (*extremely difficult to perform*). The final score was based on the average

of answers. Higher scores reflect higher disability. Cronbach's α was 0.70. Previous studies have used the Hebrew version of this measure (e.g., Shrira, 2016).

Somatic symptoms were assessed using the somatization subscale derived from the 18-item Brief Symptom Inventory (BSI-18; Derogates, 2001). I computed the mean of six items rated on a scale ranging from 0 (*not at all*) to 4 (*very much*) with a Cronbach's α of 0.80. Previous studies have used the Hebrew version of this measure (e.g., Shrira et al., 2017).

Self-rated health was rated on a scale from 1 (*very good*) to 5 (*not good at all*) (Benyamini et al., 2003).

In order to compute the overall successful aging score, the four scores were standardized (medical conditions, disability, somatic symptoms and self-rated health), and then the standardized scores were averaged. Subsequently, the averaged standardized score was multiplied by -1 , so that high scores will reflect greater successful aging (cf. Shrira et al., 2017; Bodner et al., 2018).

2.3. Procedure

Undergraduate student research assistants were instructed to recruit eligible participants available in their surroundings. The research assistants were instructed how to approach the interviewees and respond to potential difficulties. From January 2017 until April 2018, research assistants requested participants to take part in a study, which aimed to examine how families cope with difficult life events. Participants read and signed an informed consent form, which also noted that the questionnaire included queries regarding aging, death, various difficult life events and the Holocaust. Following that, participants, mostly offspring, accessed an online questionnaire via a link sent to them. The research assistants interviewed participants, mostly parents, who could not complete the online questionnaire themselves. Participants were interviewed in their homes or other places convenient to them. The study received approval by an ethic review committee in Bar-Ilan University.

2.4. Data analysis

Group differences in health-risk behaviors and successful aging were assessed with a series of univariate analyses of variance (ANOVA) and covariance (ANCOVA). As parental education level and subjective economic status significantly differed between the parent groups, these variables were controlled for in the analyses involving parents. As parental PTSD is related to offspring PTSD (Yehuda et al., 2008), the latter was adjusted for in analyses involving offspring. Probable PTSD was evident in 8.8% of the offspring.

The PROCESS macro (Hayes, 2013) was applied to test the hypotheses regarding the mediation effects. The multi-categorical independent variable (study groups) was coded into two dummy

indicator variables, D_1 and D_2 , denoting Holocaust exposure without PTSD and with probable PTSD, respectively, and leaving the comparisons as the reference group. To predict offspring successful aging I used parents' unhealthy behaviors and offspring unhealthy behaviors as two mediators, M_1 and M_2 , respectively. Possible mediation paths were assessed in a serial mediation analysis using a bias-corrected bootstrap with 5000 resamples. The serial mediation analysis controlled for all the abovementioned covariates (i.e., parents' age, education level, subjective economic status, and offspring probable PTSD).

3. Results

3.1. Group differences in unhealthy behaviors and successful aging

Among parents, there was a significant group difference in unhealthy behaviors ($F[2,184] = 6.82, p = .001, \eta^2 = .07$). Post-hoc Bonferroni tests showed that HS with probable PTSD had a higher unhealthy behaviors score ($M = 2.75, SD = 1.71$) than each of the two other parent groups ($M = 1.94, SD = 1.24$, and $M = 1.67, SD = 1.21$, for HS without PTSD and comparison parents). The group difference in unhealthy behaviors remained significant after adjusting for covariates ($F[2,180] = 5.79, p = .004, \eta^2_p = .06$).

Among offspring, there was also a significant group difference in unhealthy behaviors ($F[2,183] = 11.97, p < .0001, \eta^2 = .11$). Post-hoc Bonferroni tests showed that offspring of HS with probable PTSD had a higher unhealthy behaviors score ($M = 2.67, SD = 1.44$) than each of the two other offspring groups ($M = 1.59, SD = 1.24$, and $M = 1.31, SD = 1.19$, for offspring of HS without PTSD and comparison offspring, respectively). The group difference in unhealthy behaviors remained significant after adjusting for offspring PTSD ($F[2,166] = 9.80, p < .0001, \eta^2_p = .10$).

The offspring groups further differed in successful aging ($F[2,184] = 6.46, p = .002, \eta^2 = .06$). Post-hoc Bonferroni tests showed that offspring of HS with probable PTSD had a lower successful aging score ($M = -0.41, SD = 0.97$) than each of the two other offspring groups ($M = -0.01, SD = 0.73$, and $M = 0.17, SD = 0.60$, for offspring of HS without PTSD and comparison offspring, respectively). The group difference remained significant after adjusting for offspring PTSD ($F[2,166] = 3.89, p = .022, \eta^2_p = .04$), but then offspring of HS with probable PTSD differed from comparison offspring only.

3.2. Serial mediation analysis predicting offspring successful aging

Table 2 presents the findings from the serial mediation analyses (adjusted for covariates). When performing serial mediation analysis predicting successful aging among offspring, parental PTSD (D_2) predicted lower successful aging score among offspring (Y). As the other dummy variable (D_1) was not significant, the group difference reflected lower successful aging among offspring of HS with probable PTSD

Table 2

Estimated unstandardized coefficients (coeff.) for the effect of study group (D_1 and D_2) on offspring successful aging (Y), mediated by parents' unhealthy behaviors (M_1) and offspring unhealthy behaviors (M_2).

	Outcome Parents' unhealthy behaviors (M_1)		Offspring unhealthy behaviors (M_2)		Offspring successful aging (Y)			
	Coeff.	<i>p</i>	Coeff.	<i>p</i>	Mediated Coeff.	<i>p</i>	Unmediated Coeff.	<i>p</i>
Predictors								
Holocaust survivors without PTSD (D_1)	0.10	.635	0.21	.288	-0.09	.425	-0.12	.290
Holocaust survivors with probable PTSD (D_2)	1.02	.0009	0.95	.001	-0.23	.162	-0.40	.012
Parents unhealthy behaviors (M_1)	—	—	0.22	.001	-0.01	.684	—	—
Offspring unhealthy behaviors (M_2)	—	—	—	—	-0.12	.004	—	—
R^2	0.14		0.23		0.26		0.21	
$F(df)$	4.58 (6,162)		6.98 (7,161)		7.01 (8,160)		7.43 (6,162)	
<i>p</i>	.0003		<.0001		<.0001		<.0001	

Note. Analyses controlled for parent's age, education level, self-rated economic status, and offspring PTSD symptom level.

relative to comparisons only. Moreover, parental PTSD (D_2) predicted more unhealthy behaviors among parents (M_1). When both study group (D_1 and D_2) and parents' behaviors (M_1) were included as predictors of offspring unhealthy behaviors (M_2), both parental PTSD (D_2) and parents' unhealthy behaviors predicted more unhealthy behaviors among offspring (M_2). Finally, when study group (D_1 and D_2) alongside both mediators – parents' behaviors (M_1) and offspring behaviors (M_2) – were included as predictors of offspring successful aging (Y), only offspring unhealthy behaviors (M_2) significantly predicted less successful aging (Y).

The bootstrap analyses estimating the indirect effects of study group on offspring successful aging found two significant indirect effects. One indirect effect connected parental PTSD to less successful aging among offspring through more unhealthy behaviors among offspring (indirect effect = -0.12 , 95%LLCI = -0.25 , 95%ULCI = -0.02). A second indirect effect connected parental PTSD to increased unhealthy behavior score among parents that were related to more unhealthy behaviors among offspring, which were finally related to less successful aging among offspring (indirect effect = -0.03 , 95%LLCI = -0.08 , 95%ULCI = -0.002).

Fig. 1 presents the indirect effects connecting parental PTSD to offspring successful aging.

3.3. Supplementary analyses

In the total sample, 13.4% of parent-offspring dyads were father-son dyads, 22.5% were father-daughter dyads, 23.0% were mother-son dyads, and 41.2% were mother-daughter dyads. The ratio of the dyad types did not significantly differ across the three study groups, $\chi^2(6) = 3.07, p = .79$. Nevertheless, a series of ANOVAs assessed the effect of dyad type on the main study variables. The dyad types did not significantly differ in unhealthy behaviors among parents ($F[3,183] = 0.15, p = .92$) or offspring ($F[3,182] = 1.14, p = .33$), nor in successful aging among offspring ($F[3,183] = 1.57, p = .19$).

4. Discussion

Corroborating the study hypotheses, HS suffering from probable PTSD as well as their offspring reported more unhealthy behaviors than HS without PTSD or comparison parents and their offspring. Moreover, the relationship between parental PTSD and offspring less successful aging was mediated by parental unhealthy behaviors and offspring unhealthy behaviors. I now move on to discuss these findings in detail.

The current findings extend previous findings regarding more

unhealthy behaviors among trauma survivors with PTSD (Benyamini and Solomon, 2005; Del Gaizo et al., 2011) further showing that unhealthy behaviors can be common among offspring of survivors with PTSD-offspring who were not exposed to their ancestral trauma.

Posttraumatic HS may engage in unhealthy behaviors in order to decrease distress related to PTSD symptoms and other negative emotions. For example, substance abuse can serve as self-medication against hypervigilance, sleep disturbances, nightmares, dysphoria and guilt (Rheingold et al., 2004). Low frequency of preventive health behaviors among traumatized survivors may mark reduced motivation, and low sense of self-efficacy (Lee and Park, 2018). It was further proposed that physical activity is avoided by traumatized individuals because bodily arousal during physical activity can remind the survivors of body's response during trauma or PTSD-related hypervigilance (Lee and Park, 2018).

Unhealthy behaviors among offspring of HS who suffer from probable PTSD can be associated with several processes. First, it is possible that offspring emulated parental behaviors (Bandura, 1986). Second, HS who engaged in unhealthy behaviors may have been more lenient towards offspring risky behaviors, or even used to encourage such behaviors. Third, it is possible that conflict-saturated and agitated familial environment mediated the effect of parental PTSD and parental health behaviors on offspring behavior. Indeed, prior works showed that offspring exposed to such an environment at home developed substance use disorder decades later (Schiff et al., 2014). It is known that in some families of HS, there was more strain, and offspring frequently reported symbiotic relationships with their parents (Scharf, 2007; Scharf and Maysel, 2011). It is probable that such burdening familial dynamics were more salient in homes of posttraumatic HS, ultimately linked to more unhealthy behaviors in offspring.

Potential biological pathways related to unhealthy behaviors should also be considered. In this context, recent evidence suggests that epigenetic processes may explain the connection between parental PTSD with unhealthy behaviors and aging of offspring. Epigenetic processes refer to environmentally sensitive change that can alter gene expression by processes such as DNA methylation, among others. Although epigenetic processes are sensitive to environmental perturbation, they generate long-lasting signatures despite a shift in the environment originally responsible for initiating alteration (Zhang and Meaney, 2010). Animal studies show that parental stress associates with offspring behavior and health through epigenetic programming (Szyf, 2015). Yehuda and Lehrner (2018) provide additional evidence for the linkage between parental PTSD and epigenetic change in human offspring. For example, they review findings for lower levels of DNA

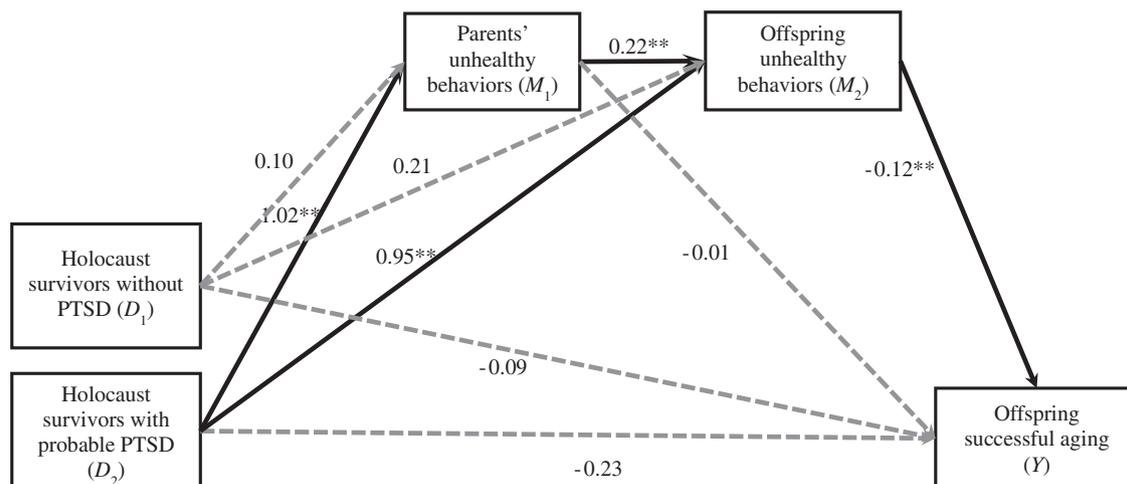


Fig. 1. Parents' and offspring unhealthy behaviors mediate the relationship between parental PTSD and offspring successful aging (controlled for parental age, education and economic status and offspring PTSD). Values refer to estimated unstandardized coefficients from the first three regression equations presented in Table 2. ** $p < .01$.

methylation (resulting in higher level of RNA expression) in the NR3C1 gene contributing to HPA-axis dysfunction among offspring of HS, who reported that both their parents suffered from PTSD. It may be assumed that the abovementioned, as well as other epigenetic markers (Kellermann, 2018), associate with biological dysregulation in offspring, which further relate to unhealthy behaviors and less successful aging.

The current findings also reinforce the notion that many detrimental effects of the Holocaust are not necessarily related to exposure per se (cf. Shrira et al., 2010). Although traumatic exposure can be related to unhealthy behaviors even after controlling for PTSD (Del Gaizo et al., 2011), the current findings add to prior ones, noting that the general exposure to the Holocaust is not related to such behaviors among HS (Shmotkin et al., 2003) or offspring (Shrira et al., 2011). Indeed, significant resilience was documented among many HS, who transferred messages of fortitude and impressive coping abilities to younger generations (cf. O'Rourke et al., 2015).

It seems that other negative long-term effects of the Holocaust are mostly concomitant to parental PTSD or offspring secondary traumatization (Kellermann, 2009; Danieli et al., 2017). In this context, prior works shown that parental PTSD (Shrira et al., 2017) or high secondary traumatization among the offspring (Shrira, 2016) are related to less successful aging among offspring of HS, whereas the aging of offspring of survivors without PTSD or offspring with low secondary traumatization is generally similar to the aging of comparisons. It should be added that the current study found an association between parental PTSD and physical abuse during the Holocaust, and therefore, it is possible that PTSD mediates the relationship between specific types of exposure to behavior and health among HS.

The current findings should be viewed in light of the study limitations. First, the findings came from a convenience sample, which was probably biased toward high-educated persons. Nevertheless, in contrast to many prior works, the current study did not specifically select participants from organizations related to the Holocaust, and the study was presented to participants as a general investigation relating to difficult or traumatic life events. This is of high importance, as studies that target participants from Holocaust-related organizations or gatherings are biased to produce larger effects of the Holocaust (Shmotkin and Lomranz, 1998) and its intergenerational transmission (van IJzendoorn et al., 2003). Second, the relatively small number of posttraumatic parents did not enable comparison of paternal and maternal PTSD. Previous studies suggest that exposure to the Holocaust may have stronger association with health among women survivors (Carmel et al., 2017), and that maternal PTSD has a stronger relationship with offspring health (Yehuda et al., 2008). Third, health behaviors and successful aging were based on self-reports. Moreover, other health behaviors (e.g., drug use, sedentary time, quality of diet, sleep duration, medical adherence) were not assessed, and it was unknown at which life period unhealthy behaviors began to develop. Future studies should include psychiatric assessment of parental PTSD, comprehensive measures of health behaviors and biological indices of health.

Although preliminary, the current findings have important clinical implications. The findings suggest that unhealthy behaviors should be assessed among offspring of HS, especially among those whose parents suffer from PTSD. Screening of offspring patients should cover cigarette use, alcohol consumption, drug use, exercise and eating habits. In cases where unhealthy behaviors are identified, practitioners should provide information about related health risks and initiate treatment to interrupt negative health behaviors.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2018.11.060](https://doi.org/10.1016/j.psychres.2018.11.060).

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