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Warfare exposure in later life and cognitive function: The moderating role of social connectedness

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Abstract

This study examined the influence of warfare exposure on older adults' cognitive functioning and explored the protective role of social connectedness. The study used cross-sectional data from the Israeli component of the Survey of Health, Ageing and Retirement in Europe (SHARE-Israel) collected in 2015. We focused on a composite scale of social connectedness and on the exposure to war-related events during the 2014 Israel-Gaza conflict. Social connectedness and warfare exposure were used to predict three indicators of cognitive functioning. The results showed that warfare exposure was related to worse cognitive functioning, after controlling for socio-demographic and health covariates. However, social connectedness moderated this association. Persons who were highly connected did not suffer from worse cognitive functioning in recall (immediate and delayed) following warfare-related events and their fluency score increased. The results suggest that experiencing war-related events is associated with poorer cognitive functioning, but social connectedness moderates the strength of the negative association. These findings can inform intervention initiatives for adults exposed to warfare events, encouraging them to strengthen their social connections.

Keywords

social networks; trauma; missile attacks; cognition; older adults

1. Introduction

Social connectedness has been identified as a meaningful factor in coping with stressful events (Hobfoll et al. 2006). However, this role has seldom been examined in relation to cognition in old age, even though older adults are more at risk of low cognitive and social resources (Deary et al. 2009; Wrzus et al. 2013). Moreover, the risk of cognitive decline may be even greater following exposure to warfare in later life. Consequently, the current study examines the protective role of social connectedness in relation to cognitive functioning

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Conflict of interest

The authors declare that they have no conflict of interest.

among persons exposed to warfare in later life. It focuses on the number of warfare events to which participants were exposed.

Warfare exposure can have adverse effects on late life health (Solomon et al. 2014; Eşsizoğlu et al. 2017), but its influence on cognitive function is still under-explored. Evidence supporting such an effect shows that traumatic events in general, not necessarily those resulting from warfare, may be related to an increased risk of cognitive decline and Alzheimer's Disease (Burnes and Burnette 2013). Stressful events can lead to the secretion of cortisol, a hormone that affects brain regions associated with learning and memory (Lupien et al. 2007). Stress also instigates or accelerates neurological tissue damage, especially in older persons with fragile physiological protective systems (Burnes and Burnette 2013). However, stressful events do not always lead to worse cognitive functioning and some studies even suggest a positive effect of mild stress on cognition (Rosnick et al. 2007; Comijs et al. 2011).

The effects of warfare exposure on cognitive functioning are particularly relevant for older people, as they are at greater risk of cognitive decline (Hobfoll 2002; Deary et al. 2009). Moreover, there are indications that the negative effects of traumatic life events on cognitive functioning strengthen as people age (Shrira 2014). The first aim of the current study, therefore, is to understand the effects of warfare on cognitive functioning among older adults.

This study also aims to understand the role of social ties as possibly mitigating the impact of warfare exposure on cognitive functioning. The Conservation of Resources (COR) theory claims that social resources, including social connections and support, can protect against some of the negative consequences of adverse events (Hobfoll and Lilly 1993; Hobfoll et al. 2006). According to this perspective, the presence of intimate others in whom one can confide promotes coping with traumatic events by reducing the severity of threat perceptions and by increasing appraisals of one's coping abilities (Guay et al. 2006). Moreover, social connections can be mobilized to provide information, practical assistance and to provide a sense of belonging (Kwan and Walsh 2017). Such reduction of stress by close social ties can result in a smaller effect of adverse events on cognition. Moreover, frequent interactions with close others can act as a source of "mental stimulation" to help maintain one's cognitive functioning (Schwartz et al. 2018). Previous research shows that the availability of close supportive relationships may moderate reactions among civilians exposed to warfare and terror (Nandi et al. 2009; Regev and Slonim-nevo 2019), although it has not considered this buffering effect in relation to cognitive functioning.

Close ties are meaningful in old age, and might be especially needed following warfare exposure. According to the Socioemotional Selectivity Theory (Carstensen 2006), older individuals place a greater emphasis on their close social networks than younger people. Moreover, older adults might benefit to a larger degree from their social ties when coping with stressful events, compared to younger adults (Bolin and Klenow 1988). However, social networks may shrink as people get older due to life changes such as retirement and spousal loss (Wrzus et al. 2013). This can result in a lower availability of social resources in the face of warfare.

The present study aims to assess cognitive functioning following exposure to warfare during the 2014 Israel-Gaza conflict, and the role of social connectedness in relation to this association. We predict that older persons who were exposed to more warfare events during the conflict will display worse cognitive functioning following the conflict (hypothesis 1). We also hypothesize that this negative association will be moderated by social connectedness, such that warfare exposure will have a smaller association with cognitive functioning among adults who are more socially connected (hypothesis 2).

2. Methods

2.1. Participants and data collection

Data for the analysis were taken from the Israeli component of the Survey of Health Ageing and Retirement in Europe (SHARE-Israel), a national sample of community dwelling people aged 50 and above and their partners of any age (Börsch-Supan et al. 2013), collected between February 2015-August 2015. The design was based upon a probability sample of households within representative statistical areas delineated by geographical and socio-demographic criteria (Litwin and Sapir 2008). The data were collected via in-person interviews conducted by trained interviewers using a computer-assisted personal interview (CAPI), supplemented by a self-completion questionnaire. Informed consent was obtained from all participants prior to the interview. The SHARE-Israel survey received ethical approval from the Institutional Review Board (IRB) of the Hebrew University of Jerusalem. Uniquely included in the Israeli drop-off questionnaire was a measure of exposure to warfare during the 2014-Israel Gaza conflict that constitutes the focus of the present analysis. This wave of SHARE was also the first in Israel to include a measure of personal social networks.

The survey included 2,035 Israeli respondents, of which 1,810 (89%) filled the drop-off questionnaire. The analytic sample numbered 1,627 respondents and included those who completed the drop-off instrument, were aged 50 and above at the time of the interview, were interviewed about their social networks and did not report being diagnosed with Alzheimer's disease, dementia, or any other serious memory impairment. Attrition analysis revealed that respondents who completed the drop-off were more likely than those who did not ($p < .05$) to be younger and to have more years of education, better financial adequacy, less mobility limitations, and more depressive symptoms. They were also more socially connected and drank less excessively. Importantly, they did not differ in their scores on fluency and immediate recall, but they did have worse scores in delayed recall.

2.2. Measures

2.2.1. Cognitive functioning—The measures of cognitive functioning were a set of three tests that are sensitive to aging-related cognitive decline – immediate recall, delayed recall and fluency (Dewey and Prince 2005). *Immediate recall* is measured in SHARE using a modified version of Rey's Auditory Verbal Learning Test-RAVLT (Dal Bianco et al. 2013). The test examines how many of 10 words the respondent was able to recall immediately after the interviewer read the words (score range = 0–10). *Delayed recall* measures the respondent's ability to recall the same words later on, after other interview questions (score range = 0–10). The immediate and delayed recall tasks test short term verbal learning and

memory as well as information retention (Dal Bianco et al. 2013) and can be used as a measure of episodic memory (Cheke and Clayton 2013). The *fluency* probe measures how many distinct animals the respondent can name in a one-minute period. Six respondents whose scores fell more than 3 standard deviations above the mean group score (i.e., greater than 45) were given a score of 45. The test is considered a measure of executive functioning, but also includes other processes, such as semantic memory and processing speed (Clark et al. 2009; Haugrud et al. 2011).

2.2.2. Exposure to warfare—The sample is composed of community-dwelling older adults in Israel who were asked about exposure to warfare-related events during the 2014 Gaza-Israel military conflict (a.k.a. Operation Protective Edge). During the 51 days of the operation, between July 8th to August 26th 2014, the Hamas forces in Gaza fired approximately 4,600 mortars and rockets that reached most parts of Israel (Chorev 2014). Consequently, more than 70% of the Israeli population was living within rocket range (Hoffman et al. 2015).

Exposure to warfare events during the 2014 Israel-Gaza conflict was assessed through a list of twelve events or occurrences: being injured, death of a close other, injury of a close other, risk of physical injury to self \ close other, damage \ risk of damage to one's personal property, damage \ risk of damage to one's workplace, exposure to people who were injured, disruption of one's daily routine for a week or more, and being forced to leave one's home for a week or more. Respondents were asked to indicate whether they experienced each event during the conflict (score range = 0–12). We note that some of these events, such as moving away for a week, are stressful but not necessarily traumatic. However, during the 2014 conflict most of Israel's inhabitants were under missile threat. Therefore, even moving away may be considered as potentially traumatic if it took place due to missile threats (American Psychiatric Association 2013)

2.2.3. Social connectedness—Social networks were measured in SHARE using a name generating inventory. This instrument asks respondents to list up to seven persons with whom they discussed important matters in the preceding 12 months and then records additional information on the nature of the relations with each person named (Schwartz et al. 2017). The current study used a summary scale that aggregates several of the relationship characteristics, providing a single measure of social connectedness; (for information about the scale's development and use in other studies, see: Litwin and Levinson, 2017; Litwin and Stoeckel, 2016). The summary scale was comprised of four main characteristics - counts of: 1) persons cited, 2) persons with weekly or more frequent contact, 3) persons with very or extremely close emotional closeness, that is persons to whom participants reported feeling "very" or "extremely" close, and 4) different types of relationships within the network. The first three characteristics were scored as follows: 0 = 0, 1 = 1, 2 = 2/3, 3 = 4/5, and 4 = 6/7 persons cited. The fourth measure counted the number of different relationship categories [(a) spouse, (b) other family, (c) friends, and (d) other] in the network (0–4)]. These measures were summed to create a scale ranging of 0–16, which was then collapsed to create the final scale of 0–4 (the collapse was performed in the following manner: 0=0; 1–

4=1; 5–8=2; 9–12=3; 13–16=4) (Litwin and Stoeckel 2016). The alpha coefficient for the social networks scale in the present study was .92.

2.2.4. Covariates—Several socio-demographic and health covariates were controlled due to their associations with cognitive functioning and with the impact of traumatic events on health. Age was used as a continuous variable. Gender was coded as 1 (men) and 2 (women). Education was measured in years. Partner status differentiated between participants with a partner (married \ in a registered partnership) and those without a partner (never married \ divorced \ widowed). Financial adequacy was measured by asking participants the extent to which their household could make ends meet, with four response options ranging from 1 = *with great difficulty* to *4 = easily* (Litwin and Sapir 2009). Physical health was assessed using a count of mobility, arm function and fine motor limitations (range: 0–10, α =.88). Emotional health was assessed via the Euro-D scale for late-life depressive symptoms (Prince et al. 1999). The scale is composed of 12 *yes* or *no* questions about symptoms experienced in the past month (range: 0–12). A minimum of ten completed items was required for using the score, such that scores with 10–11 complete items were interpolated. Alcohol consumption was measured by asking respondents whether they consumed six or more units of alcohol on one occasion in the last three months (*yes / no*).

2.3. Statistical analysis

We first computed univariate descriptive statistics for the variables in the study, followed by Pearson correlations of trauma exposure with the three outcome variables of cognitive function. The p value was adjusted for the multiple correlations, which can increase the risk of a type I error, i.e., to erroneously conclude the presence of a significant correlation. Adjustment was performed using a Bonferroni correction, in which the threshold level of significance was divided by the number of comparisons (Curtin and Schulz 1998). Thus, a p value lower than 0.017 was deemed to indicate a significant correlation.

A series of hierarchical linear regression models was conducted to predict the three cognitive functioning indicators. All predictor variables were mean centered prior to entering the regression models. The first step in each model entered the study variables and the second step added the interaction between the warfare events and social connectedness. If an interaction effect reached significance we examined the simple slopes of the association between cognitive functioning and warfare exposure among respondents who had no social network members (social connectedness = 0) and those who were highly-connected (social connectedness = 4) (Figueiras et al. 1998). We checked for multicollinearity by computing the Variance Inflation Factor (VIF). In our analysis none of the VIF scores exceeded the value of 2, indicating no multicollinearity.

3. Results

Table 1 shows the descriptive statistics for the study variables. The current sample experienced one occurrence related to the 2014 Gaza-Israel conflict on average. The mean immediate recall score was 5 and the delayed recall score was 4. The average fluency indicator was 19.5. The average score on the social connectedness scale was 2. Mean age was 69, education averaged over 12 years, a slight majority was women and 75% had a

partner. Participants indicated that their household was able to make ends meet “Fairly easily” (3 out of 4), had 1.7 mobility limitations and reported 2.5 depressive symptoms. Five percent reported excessive consumption of alcohol in the previous three months.

Table 2 shows the bivariate Pearson correlations between warfare exposure and cognitive functioning. Persons who experienced more warfare-related events had a lower score in all three cognitive indicators – worse immediate recall, worse delayed recall and lower fluency scores. These results were deemed significant following a Bonferonni correction for multiple correlations.

Next, a series of ordinary least squares (OLS) regressions were performed to predict the three cognitive measures (Table 3). The first step in each model introduced the main study variables and the covariates. The results revealed that experiencing a higher number of warfare-related events was related to lower cognitive functioning in the three cognitive indicators, even after controlling for socio-demographic variable and health, supporting the study’s first hypothesis. Social connectedness was significantly related to better immediate recall, while it was not significantly related to delayed recall or to fluency. An examination of the covariates showed that persons with better cognitive functioning on all three cognitive indicators were younger, had more years of education, had less mobility limitations and less depressive symptoms. Those in better financial situation had higher scores in immediate recall.

The next step in each model added an interaction between social connectedness and warfare exposure. The interaction effects were significant in relation to all three cognitive outcomes. They indicated that social connectedness moderated the negative influence of trauma on cognitive functioning, such that persons who were exposed to more warfare-related events reported less negative cognitive implications if they were socially integrated. These findings supported the study’s second hypothesis.

Additional analyses were performed to investigate these interaction effects, as previously explained. The first analysis considered the effects on immediate recall. It showed that among persons not socially connected (social connectedness = 0), traumatic events were related to lower immediate recall (B = −0.26, $p < .001$), while for those high in social connectivity (social connectedness = 4) such events were not significantly related to immediate recall (B = 0.09, $p = .14$). The second analysis considered the effects on delayed recall. It showed that among persons not socially connected, traumatic events were related to lower delayed recall (B = −0.37, $p < .001$), while for those high in social connectivity such events were not related to delayed recall (B = 0.04, $p = .55$). The third analysis considered the effects on fluency. It showed that among persons not socially connected, traumatic events were related to lower fluency (B = −2.10, $p < .001$), while for those high in social connectivity such events were related to better fluency (B = 0.59, $p = .02$).

4. Discussion

The current study examined the association between warfare-related events and cognitive functioning in later life and the possible moderating role of social connectedness. It found

that exposure to more warfare events during the 2014 Israel-Gaza conflict was related to worse cognitive functioning in terms of immediate recall, delayed recall and fluency. However, social connectedness moderated this negative influence. Among persons who were highly socially connected, warfare exposure was not associated with poorer cognitive functioning. Moreover, highly connected persons showed a positive association between warfare-related events and fluency scores. On the other hand, among persons without close social connections, exposure to warfare events was related to poorer cognitive functioning. Thus, this study sheds light on cognitive functioning, social connections and warfare exposure in later life, an under-explored topic with meaningful implications for the older population.

The results underscored that exposure to warfare among older persons was related to worse cognitive functioning. These findings are particularly important as cognitive functioning is not often explored following exposure to warfare related events, despite the detrimental implications of poor cognitive functioning on everyday life (Singh-Manoux et al. 2012). Such effects following warfare can be particularly meaningful for older adults, who may already suffer from some degree of cognitive decline (Deary et al. 2009) and for whom exposure to warfare may enhance the risk of accelerated decline. Therefore, it is important to pay special attention to older adults following warfare events, as such events may have harmful implications for their cognitive state. In the future, researchers could differentiate between events that are less traumatic and more traumatic to better understand the effects of trauma on cognition.

Social connectedness was found to moderate the negative cognitive effects of warfare events in later life. Moreover, among socially connected individuals, warfare exposure was even related to better fluency scores, possibly suggesting that social connectedness can facilitate some degree of posttraumatic growth (Han et al. 2019). This is in line with the Conservation of Resources theory's identification of social connections as protective against the impact of adverse events (Hobfoll et al. 2006) and expands the theory to cognitive outcomes in late life. Social ties might reduce the stress caused by warfare exposure and help maintain mental stimulation following these adverse events. These results are particularly important for older individuals, as they may place greater value on their close ties compared to the younger populations, while being at greater risk of having less ties and of experiencing cognitive decline. These findings indicate that following warfare-exposure in late life, it is important to be embedded in resourceful social networks to reduce cognitive deterioration. Future research could delve deeper into this trend by identifying which specific aspects of social networks play a role in moderating the effect of warfare on cognition. For example, aspects such as contact frequency, practical support and emotional closeness might differ in their moderating effects.

Some limitations of the present study should be acknowledged. First, the cross-sectional nature of the data prohibits clear conclusions about causality. It might be the case that rather than networks buffering the effect of warfare exposure on cognitive functioning, it was having a stronger network that lessened one's exposure to dangerous events. This latter explanation is less plausible, however, insofar as risk of warfare exposure during the 2014 conflict was widespread across Israel (Chorev 2014). An additional limitation is the

measurement of cognitive functioning about one year following the traumatic events. A shorter time frame might have been able to detect stronger and more immediate implications of warfare on cognitive performance. However, the findings of worse cognitive function even a year after exposure to warfare can attest to the relatively long lasting consequences of such events.

Another limitation might be the measures of cognitive function employed. Although prior studies have validated these tests as an index of cognition (Green et al. 2011; Haugrud et al. 2011), more refined measures of cognitive function may have resulted in slightly different findings. We note that the current cognitive measures have been shown to be related to diagnosis of dementia and Alzheimer's disease (Henry et al. 2004; Green et al. 2011; Haugrud et al. 2011) and that they are sensitive to aging-related cognitive decline (Singh-Manoux et al. 2012). Finally, it should be noted that some respondents were not included in the final analysis due to not filling in the drop-off questionnaire, and they differed in several socio-demographic characters from those participants who were eventually included.

Despite these limitations, the current study nevertheless demonstrates the moderating role of the close social network against cognitive decline due to warfare-related events in older age. It also expands previous research on warfare exposure by showing its adverse effects on cognitive performance, an area of great significance for everyday functioning, especially in later life. Policy-makers and practitioners should be aware of these implications on cognitive function. Service agencies may need to actively reach out to the older population in times of warfare and offer help and support. Moreover, practitioners working with the older population in the context of warfare, including practitioners focused on cognitive rehabilitation, should encourage their patients to spend more time with close others and perhaps even implement interventions aimed at increasing social connections (Cherry et al. 2013; Czaja et al. 2018).

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Table 1

Descriptive characteristics of the study sample

Variable	M	SD	%	Range
Exposure to warfare events	0.98	1.65		0–12
Immediate recall	5.26	1.89		0–10
Delayed recall	3.98	2.08		0–10
Fluency	19.53	8.09		0–45
Social connectedness scale	2.05	1.01		0–4
Age	69.21	9.21		50–105
Gender (women)			57.8%	
Years of education	12.69	4.31		0–25
Partner status (has partner)			74.7%	
Financial adequacy	2.85	1.04		1–4
Mobility limitations	1.68	2.54		0–10
Depressive symptoms	2.54	2.4		0–12
Alcohol consumption			4.7%	

Note. $N = 1,627$.

Table 2

Pearson correlations of warfare exposure with cognitive functioning

	Correlation	p value
Immediate recall	−0.09	< 0.001
Delayed recall	−0.15	< 0.001
Fluency	−0.14	< 0.001

Table 3

Hierarchical linear regression models predicting immediate recall, delayed recall and fluency

	Immediate recall				Delayed recall				Fluency			
	B	**SE**	**β**	***p*-value**	**B**	**SE**	**β**	***p*-value**	**B**	**SE**	**β**	***p*-value**
Step 1 (main effects)												
Age	−0.05	0.01	−.24	<.001	−0.06	0.01	−.26	<.001	−0.18	0.02	−.20	<.001
Gender (women)	0.00	0.09	.01	.993	0.17	0.10	.04	.102	−0.45	0.39	−.03	.252
Years of education	0.08	0.01	.18	<.001	0.08	0.01	.17	<.001	0.45	0.05	.24	<.001
Partner status (has partner)	0.06	0.11	.01	.620	0.04	0.13	.01	.748	−0.35	0.47	−.02	.464
Financial adequacy	0.10	0.05	.05	.038	0.04	0.05	.02	.477	0.36	0.20	.05	.068
Mobility limitations	−0.06	0.02	−.07	.016	−0.07	0.03	−.08	.008	−0.41	0.10	−.13	<.001
Depressive symptoms	−0.20	0.02	−.25	<.001	−0.20	0.03	−.23	<.001	−0.88	0.10	−.26	<.001
Alcohol consumption	−0.11	0.21	−.01	.597	0.34	0.24	.04	.146	−0.62	0.88	−.02	.479
Exposure to warfare events	−0.06	0.03	−.06	.026	−0.14	0.03	−.11	<.001	−0.56	0.12	−.12	<.001
Social connectedness scale	0.10	0.05	.06	.024	−0.09	0.05	−.04	.093	−0.33	0.19	−.04	.088
R^2		0.291				0.286				0.350		
Step 2 (interaction)												
Warfare exposure X Social connectedness scale	0.09	0.03	.07	.004	0.10	0.03	.07	.002	0.68	0.13	.12	<.001
R^2		0.295				0.291				0.364		
N		1,277				1,277				1,278		