Which category of lifetime adversity accelerates physical impairment among Israeli older adults?

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Abstract Preliminary evidence suggests that exposure to lifetime cumulative adversity is related to faster increase in physical impairment with time, especially when depressive symptoms are present. Nevertheless, it is still unclear whether different adversity categories accelerate impairment. The current study capitalized on the unique accounts of adversity available in the Israeli component of the Survey of Health, Ageing and Retirement in Europe (SHARE-Israel) by focusing on different categories of adversity, while accounting for their interaction with depressive symptoms in predicting trajectories of physical impairment (i.e., chronic medical conditions and disability). Data of 1665 participants (mean age = 63.08, SD = 10.04 at Wave 1) were drawn from the first three waves of SHARE-Israel. Respondents reported exposure to bereavement (e.g., experiencing the death of a spouse), war and terrorism (e.g., being wounded in terrorist attack), and victimization (e.g., being a victim of abuse or assault).

Other measures assessed depressive symptoms, chronic medical conditions, and disability. Growth-curve models showed that bereavement and exposure to war and terrorism were related to specific measures of physical impairment. Moreover, three-way interactions showed that clinical level of depressive symptoms coupled with exposure to either bereavement or war and terrorism predicted a faster increase in chronic medical conditions and disability. The findings offer a differentiated outlook on the effect of adversity on age-related increase in physical impairment. Practitioners should consider that older adults previously exposed to bereavement, war and terrorism are at risk for a hastened physical decline, especially when they suffer from depressive symptoms.

Keywords Lifetime adversity · Depressive symptoms · Chronic medical conditions · Disability · SHARE-Israel · Growth-curve models

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Introduction

A host of studies has indicated that exposure to a wide spectrum of potentially traumatic events accumulated across life, hereby referred to as cumulative adversity, significantly increases psychosocial problems among older adults (for review, see Palgi et al. 2015). However, research on the effects of cumulative adversity on physical health outcomes is more limited (Krause et al. 2004; Shrira et al. 2011a). Moreover, fewer studies have examined within-person changes in the attempt to delineate the effect of cumulative adversity on the aging process over time. Recently, Shrira and Litwin (2014) showed that cumulative adversity is related not only to physical impairment at one point in time, but also to a general steeper increase in

impairment over time, which indicated an accelerated process of physical decline with age. However, as the index of cumulative adversity contains diverse categories of adversity, it is still unknown whether specific categories are related to the acceleration of physical impairment with age. Therefore, the current study aimed to look at different categories of adversity, and to examine whether they are related to trajectories of physical impairment. In the attempt to capture the combined effect of exposure and mental distress, the study also assessed how different adversity categories interact with depressive symptoms.

Exposure to different kinds of adversity is related to an earlier onset of physical impairment (Keyes et al. 2013; Scott et al. 2013). More specifically, accelerated age-related health decline may follow adversity when the normal aging process interacts with long-lasting metabolic, inflammatory, or cardiovascular reactions to stress, which create an allostatic load on the body (McEwen 2002), thus possibly inducing early formation of disease and frailty in late life (Miller et al. 2011). Posttraumatic distress and depressive symptoms, as well as an unhealthy lifestyle, may intervene in this process (Lapp et al. 2011).

Seeking to differentiate between categories of adversity, this study examines three main categories of adversity: bereavement (e.g., spousal and parental), war and terrorism, and victimization (e.g., physical or sexual assault). Next, we briefly review the literature on each of these categories and its unique effect on physical health.

The experience of bereavement has been largely found to take its toll on physical systems. In this context, losing a spouse is the most investigated event. This event, rated as the life transition requiring the most readjustment (Stroebe et al. 2007), is associated with higher levels of physical problems and mortality risk (Moon et al. 2011). Parental bereavement is also followed by increased physical impairment and mortality, as found in an Israeli national sample of older adults (Cohen-Mansfield et al. 2013). Also, parental and grandparental bereavement were associated with a steeper cognitive decline with time (Comijs et al. 2011).

The effects of war and terrorism on late-life physical health were investigated as well. War veterans suffering from mental distress had a premature appearance of illnesses and higher mortality risk, even decades after exposure (Bramsen et al. 2007; Solomon et al. 2014). Compared to nonveterans, veterans also showed a steeper increase in physical problems across time, even when they had better health around retirement age (Wilmoth et al. 2010). The association between exposure to terrorism and physical functioning was mainly examined in the general population, rather than specifically among older adults. For example, Gelkopf et al. (2012) found more visits to a general practitioner and more use of medications for

physical ailments among Israeli civilians continuously exposed to terrorism relative to those with no exposure. Even indirect exposure to terrorism through the media was related to higher physical symptoms and greater use of health care utilization (Holman and Silver 2011).

Finally, victimization, and especially exposure to physical and sexual assault, increased morbidity among adults (Felitti et al. 1998) and older adults (Sachs-Ericsson et al. 2014). Similarly to bereavement-related events, sexual assault was also related to a greater decline in cognitive abilities with time (Petkus et al. 2012). Concomitant to the abovementioned increased morbidity and to this cognitive decline, one may expect to see a stronger physical decline among victimized older adults.

To conclude, the three adversity categories reviewed above were found to be associated with subsequent onset of physical impairment (Keyes et al. 2013; Scott et al. 2013). However, most studies, with the exception of those focusing on exposure to war (e.g., Wilmoth et al. 2010), examined physical health at one time point (either concurrently with, or following, reports of adversity). Therefore, it remains to be assessed which adversity category is related to within-subject trajectories of accelerated physical impairment. This is of importance to gerontological perspectives on aging processes that emerge across time.

It should be noted that the effect of adversity on physical health has been generally found to be moderate (Keyes et al. 2013; Krause et al. 2004; Scott et al. 2013; Shrira et al. 2011a). This suggests that the majority of older adults successfully cope with adverse events and maintain resilience. Nevertheless, some people may be mentally more susceptible to the effect of adversity than others are. In this regard, current evidence shows that levels of mental distress may moderate the effect of adversity on physical health. Using data from the first four waves of the Survey of Health, Ageing and Retirement in Europe (SHARE; excluding the Israeli component), Shrira and Litwin (2014) found a stronger relationship between lifetime adversity and time-related decline in functional status among older adults with a clinical level of depressive symptoms. Therefore, one of the aims of the present study was to provide a more differentiated outlook, by assessing whether depressive symptoms moderated the effect of *categories* of adversity on physical impairment.

In sum, the current study aimed (1) to examine whether different categories of adversity predict time-related trajectories of physical impairment and (2) to investigate what happens in each category when exposure is combined with depressive symptoms. In order to address these two related aims, the study used data from the first three waves of the Israeli component of SHARE (Litwin and Sapir 2008), which included a detailed account of lifetime adversity. Based on the above literature, we first hypothesize that

exposure to each of the adversity categories is related to accelerated increase in physical impairment with time. Second, we hypothesize that the effect of adversity on physical impairment is especially strong when coupled with high level of depressive symptoms.

Methods

Participants and procedure

Data were drawn from the first three waves of the Israeli component of SHARE (SHARE-Israel), which presents a national sample of Israelis aged 50 or older and their spouses regardless of age. Respondents were interviewed during 2005–2006 (Wave 1; W1), and re-interviewed during 2009–2010 (Wave 2; W2) and during 2013 (Wave 3; W3). The design was based upon a probability sample of households within 150 representative statistical areas delineated by geographical and sociodemographic criteria. The total sample at W1 included 2598 noninstitutionalized adults in 1771 households. The data were collected by a comprehensive computer-assisted personal interview, which lasted about 90 min, and a supplementary paper Drop-Off questionnaire, which was returned later. Informed consent had been obtained from all respondents prior to the interview. SHARE-Israel received ethical approval by the Institutional Review Board of the Hebrew University of Jerusalem (for more on SHARE-Israel, see Litwin and Sapir 2008).

As the queries regarding cumulative adversity were included in the Drop-Off questionnaire administered at W1, the sample addressed in this study is limited to the 1665 respondents who completed this questionnaire at W1 and participated in at least one of the next two waves. Among the W1 Drop-Off respondents, 1248 were interviewed in W2 (i.e., 74.9 % with two data points) and 848 were interviewed again in W3 (i.e., 50.9 % with three data points). The mean W1 age was 63.08 (SD = 10.04), 56.3 % were women, 81.6 % were Jews, and 18.4 % Israeli-born Arabs. Five and a half percent of the respondents had a preprimary education, 20.1 % had primary education, 43.7 % had secondary education, and 30.6 % had post-secondary or tertiary education. As for marital status, 80.9 % were married, 5.0 % divorced, 1.7 % never married, and 12.4 % were widowed. Finally, median gross household income adjusted for purchasing power parity (in Euros) was 16,114 (SD = 27,329).

An initial analysis comparing between respondents who completed the Drop-Off questionnaire and those who did not complete it, did not find significant differences in gender, education, and gross household income. However, Drop-Off respondents included a higher proportion of younger (below

60), Jewish, and married respondents (Cramer's Φ ranged .05 to .15). When comparing the groups on W1 variables, there were no significant differences in medical conditions and disability. However, Drop-Off respondents had lower scores in depressive symptoms ($\eta^2 = .008$). Still, as can be seen, this group difference had a small effect size.

An additional attrition analysis comparing Drop-Off respondents who participated only at W1 to Drop-Off respondents who participated in more than one wave failed to find significant differences in gender and education. However, Drop-Off respondents who participated in more than one wave had a higher gross household income (Cohen's $d = -.23$), and included a higher proportion of younger respondents, married and Arab-Israeli respondents (Cramer's Φ ranged .06 to .07). When comparing these groups on W1 variables, those who participated in more than one wave also had lower scores in medical conditions, disability, and depressive symptoms (η^2 ranged from .005 to .01). Nevertheless, these group differences had a small effect size as well.

Measures

The main measures included lifetime cumulative adversity and depressive symptoms at W1 and the outcome measures of physical impairment across the three waves.

Lifetime adversity was assessed by the Potentially Traumatic Events Inventory. Based on Breslau et al.'s (1998) survey of lifetime traumatic events and pilot versions administered to older Israelis (more details in Keinan et al. 2012), this inventory was adapted especially for the Drop-Off questionnaire in SHARE-Israel (Shmotkin and Litwin 2009). The final inventory consisted of 17 difficult life events, which included bereavement-related events (e.g., experiencing the death of a spouse), war- and terrorism-related events (e.g., being wounded in war), victimizations (e.g., being the victim of a crime), and other life hardships and health vulnerabilities (e.g., being at a risk of death due to illness or accident). Specific adverse events were attributed to distinctive categories based on thematic analysis conducted on the Potentially Traumatic Events Inventory itself, as well as on previous major surveys of lifetime adversity (Breslau et al. 1998; Kessler et al. 1995; Norris 1992). Some of these events go beyond those that meet the DSM-5 (American Psychiatric Association 2013) definition of traumatic events. This approach is in congruity with a growing literature suggesting that the type of events causing posttraumatic symptoms is broader than what the current diagnostic criteria indicate (Robinson and Larson 2010). Respondents were asked to check whether each of the 17 events had ever happened to them. As our outcome measures reflected physical impairment, the life hardships and health vulnerabilities category was

omitted, leaving 12 events in three categories. In order to calculate adversity in each category, respondents were divided into those experiencing at least one event in each category and those who did not. This truncation was done as the number of events in each category differed between two and six, and these different distributions could have affected results.

Depressive symptoms at W1 were assessed by the European Depression scale (Euro-D; Prince et al. 1999). This scale contains 12 items that specify recent depressive symptoms (e.g., “In the last month, have you felt sad or depressed?”), scored as a sum of “no” (0) and “yes” (1, indicating the presence of a symptom) encoded answers. Five items were phrased in positive terms (e.g., “do you keep up your interests?”). In the present analysis, a minimum of completion of 10 items was required for scoring a sum, with scores of 10–11 items being interpolated. Kuder–Richardson’s ρ for the Euro-D in the current study was .75.

Chronic medical conditions were assessed in each of the three waves by a sum of listed chronic conditions and illnesses that participants reported to have been diagnosed by a physician. These consisted of heart disease (e.g., myocardial infarction, coronary thrombosis, or any other heart problem including congestive heart failure), stroke or cerebral vascular disease, diabetes or high blood sugar, chronic lung disease such as chronic bronchitis or emphysema, cancer or malignant tumor (including leukemia or lymphoma, but excluding minor skin cancers), Parkinson disease, and hip fracture or femoral fracture (the possible range was 0–7; cf. Shrira et al. 2011b).

Disability was measured in each of the three waves by counting difficulties in basic and instrumental activities of daily living (adapted from Katz et al. 1970, and Lawton and Brody 1969). Difficulties in basic activities (ADL) included difficulties in dressing, crossing a small room, bathing, getting in or out of bed, eating, and toileting. Difficulties in instrumental activities of daily living (IADL) included trouble with using a map, preparing meals, daily shopping, using the telephone, taking medications, doing housework, and handling personal finances. Difficulties were rated with a dichotomized answer (not having difficulties/having difficulties), and ADL and IADL scores reflected the sum of difficulties (with ranges of 0–6 and 0–7, respectively). Internal reliability for ADL, measured by Kuder–Richardson’s ρ , was .82, .90, and .93 at W1, W2, and W3, respectively. Internal reliability for IADL according to Kuder–Richardson’s ρ was .60, .83, and .89 at W1, W2, and W3, respectively.

In our models, we controlled for background characteristics and major health behaviors, as these variables generally affect physical health. Background characteristics included age, gender, ethnicity (Jews vs. Arabs), and marital

status. Education was classified into one of seven categories according to the International Standard Classification of Educational Degrees (ISCED-97, United Nations Educational, Scientific and Cultural Organization 1997): (0) preprimary education, (1) primary education, (2) lower secondary education, (3) upper secondary education, (4) post-secondary education, (5) first tertiary education, and (6) second-stage tertiary education. Gross household income was indicated by the annual household income adjusted for purchasing power parity (in Euros). Health behaviors included smoking and alcohol consumption. Smoking was assessed by asking the participants if they smoked at the present time (noted at baseline). The item was scored as 0 (*no*) or 1 (*yes*). Alcohol consumption was assessed by asking the participants to rate how often they drank alcoholic beverages in the past 6 months on a scale ranging from 1 (not at all in the last 6 months) to 7 (almost every day).

Data analyses

The outcome measures were standardized to a T metric ($M = 50$ and $SD = 10$ at W1), with the baseline sample serving as the reference. This transformation ensured a common metric across variables while maintaining the psychometric properties of the scores and the longitudinal changes in means and variances. This method also facilitated interpretation of relative changes. All predictors were centered.

To test whether adversity, depressive symptoms, and their interaction moderated change in physical impairment, we fitted nine separate growth-curve models (Peugh and Enders 2005) for each of the three categories of adversity and each of the three physical impairment outcomes (chronic medical conditions, ADL, and IADL), with years since study entry as the time variable (Model 1). Depressive symptoms were dichotomized at the optimal Euro-D cut-off point for predicting a diagnosis of depression in semi-structured clinical interviews, 0–3 symptoms versus 4 symptoms or above (Prince et al. 1999).

The Level 1 (within-person level) model was parameterized as

$$\text{Physical impairment}_{it} = \beta_{0i} + \beta_{1i}(\text{Time}_{it}) + e_{it}. \quad (1)$$

In this model, physical impairment for person i at time t , $\text{Physical impairment}_{it}$, is a function of (a) an intercept parameter for person i (across the t times for which the person provided data), β_{0i} ; (b) a slope parameter that captures the rate of time-related change for person i , $\beta_{1i}(-\text{Time}_{it})$; and (c) the within-individual random error, e_{it} . The Level 2 (between-person level) model was parameterized as

$$\begin{aligned} \beta_{0i} = & \gamma_{00} + \gamma_{01}(\text{Adversity}_i) + \gamma_{02}(\text{Depression}_i) \\ & + \gamma_{03}(\text{Adversity}_i \times \text{Depression}_i) + u_{0i} \end{aligned} \quad (2)$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{Adversity}_i) + \gamma_{12}(\text{Depression}_i) + \gamma_{13}(\text{Adversity}_i \times \text{Depression}_i) + u_{1i}. \quad (3)$$

In this model, γ_{00} represents the intercept of physical impairment for a person with average adversity and average depression level (i.e., adversity and depression level equal to the sample mean); γ_{01} represents the effect of adversity on the initial level of physical impairment for person i ; γ_{02} represents the effect of clinical level of depressive symptoms on the initial level of physical impairment for person i ; γ_{03} represents the effect of the interaction between adversity and clinical level of depressive symptoms on the initial level of physical impairment for person i ; and u_{0i} represents the error of β_{0i} . In addition, γ_{10} represents the slope of time-related change in physical impairment for a person of average adversity and depression level, γ_{11} represents the effect of adversity on the covariance of time and physical impairment, γ_{12} represents the effect of depression level on the covariance of time and physical impairment, and u_{1i} represents the error of β_{1i} .

Substituting Eqs. 2 and 3 back into Eq. 1, we have the following:

$$\begin{aligned} \text{Physical impairment}_{it} = & \gamma_{00} + \gamma_{01}(\text{Adversity}_i) \\ & + \gamma_{02}(\text{Depression}_i) + \gamma_{03}(\text{Adversity}_i \times \text{Depression}_i) \\ & + \gamma_{10}(\text{Time}_{it}) + \gamma_{11}(\text{Adversity}_i \times \text{Time}_{it}) \\ & + \gamma_{12}(\text{Depression}_i \times \text{Time}_{it}) + \gamma_{13}(\text{Adversity}_i \\ & \times \text{Depression}_i \times \text{Time}_{it}) + u_{0i} + u_{1i} \times \text{Time}_{it} + e_{it}. \end{aligned} \quad (4)$$

where the first eight terms are the fixed effects that capture the average model. The last three terms are again the same random effects mentioned above. All models were also tested with covariates including baseline age, gender, ethnicity, baseline education, baseline gross household income, and baseline smoking and alcohol consumption. Covariates were added to control for the intercept term. The models were examined with SPSS 20. Incomplete data were treated as missing at random (Little and Rubin 1987).

Results

Descriptive statistics and preliminary analyses

Table 1 presents the descriptive statistics for the background characteristics and study variables. The physical impairment measures showed an increase across waves indicating that chronic medical conditions and disability increased with time.

Table 2 presents the frequencies for each of the categories of adversity and for the 12 specific adverse events included in these categories. Exposure to war and terrorism

was the most frequent, while victimization was reported by the least number of respondents. Approximately half of the sample ($n = 799$, 48.0 %) did not report exposure to any of the categories of adversity. Exposure to one or two categories was reported by 553 (33.2 %) and 270 (16.2 %) participants, respectively, while exposure to three categories was quite rare ($n = 43$, 2.6 %).

We should note that the 1665 respondents who completed the lifetime adversity items at W1 and the physical impairment measures in at least one of the waves provided 3761 observations across time. Of these, 873 (23.2 %) and 2544 (67.6 %) were longitudinal observations across two waves and three waves, respectively. The average number of observations per individual was 2.58 ($SD = 0.65$).

Preliminary intraclass correlation (the proportion of the between-individual variance to the sum of the between- and within-individual variances) for chronic medical conditions, ADL, and IADL was 0.56, 0.47, and 0.46, respectively, suggesting that there was between 44 and 54 % within-person variance in functional status over time.

Growth-curve models

In a preliminary model predicting chronic medical conditions using time alone (not shown), the intercept was 50.32 ($p < 0.0001$) and the slope was 0.365 ($p < 0.0001$). The annual increase in chronic medical conditions was equivalent to 0.36 T score units across all respondents. In the complete model with covariates (Table 3), chronic medical conditions increased with time, and the clinical level of depressive symptoms was also related to more conditions. From the three categories of adversity, only exposure to war and terrorism was significantly related to chronic medical conditions. The two-way interaction between time and adversity and the two-way interaction between adversity and clinical level of depressive symptoms were not significant for all adversity categories. Moreover, the two-way interaction between time and clinical level of depressive symptoms was not significant. However, for two categories of adversity, the three-way interactions between time, adversity, and clinical level of depressive symptoms were significant.

These three-way interactions were probed using Preacher et al.'s (2006) procedure. It revealed that those who were not exposed to bereavement and had a sub-clinical level of depressive symptoms had the smallest increase in chronic medical conditions with time (an increase of 0.36 T score units per year), whereas those who were exposed to bereavement and had a clinical level of depressive symptoms had the largest increase in chronic medical conditions with time (an increase of 0.95 T score units per year). Figure 1a presents this three-way interaction.

Table 1 Descriptive statistics for the participants across the study waves

Variable	W1: <i>n</i> = 1665	W2: <i>n</i> = 1248	W3: <i>n</i> = 848
Mean age (SD)	63.08 (10.04)	66.47 (9.66)	69.79 (9.16)
No. (%) women	938 (56.3)	714 (57.2)	550 (59.7)
No. (%) Arab-Israelis	297 (17.8)	246 (19.7)	114 (12.4)
Mean education (SD) ^a	2.95 (1.69)	–	–
Median gross household income in Euro (SD)	16,114 (27,329)	–	–
No. (%) smoking	276 (16.6)	–	–
No. (%) drank alcohol in the last six months	501 (30.1)	–	–
Depressive symptoms (SD)	2.79 (2.52)	–	–
Mean chronic medical conditions (SD)	0.49 (0.74)	0.55 (0.77)	0.62 (0.87)
Mean ADL (SD)	0.26 (0.93)	0.32 (1.12)	0.44 (1.35)
Mean IADL (SD)	0.49 (1.14)	0.91 (1.63)	0.91 (1.80)

W1 data collection: 2004–2006; W2 data collection: 2009–2010; W3 data collection: 2013. Only respondents who completed the adversity items at W1 were included

ADL difficulty in activities of daily living, IADL difficulty in instrumental activities of daily living

^a Recorded by one of the seven education levels according to the International Standard Classification of Educational Degrees (ISCED-97; UNESCO, 1997): (0) preprimary education, (1) primary education, (2) lower secondary education, (3) upper secondary education, (4) post-secondary education, (5) first tertiary education, and (6) second-stage tertiary education

Table 2 Exposure to categories of adversity and specific adverse events

	<i>N</i>	%
<i>Bereavement</i>	370	22.2
Experienced the death of a spouse	238	14.3
Experienced the death of a child or grandchild	172	10.4
<i>War and terrorism</i>	544	32.7
Lost a loved one in a war or in military service	338	20.4
Witnessed the serious injury or the death of someone in war or military action	268	16.2
Experienced the injury or the death of a loved one in a terrorist act	132	7.9
Was wounded in war or military action	98	5.9
Witnessed a terrorist act in which she/he was not harmed personally	91	5.5
Was wounded in a terrorist act (an attack by terrorists against civilians)	23	1.4
<i>Victimization</i>	308	18.5
Was the victim of crime (such as robbery or fraud)	159	9.6
Witnessed an accident or violent act in which someone was seriously injured or killed	150	9.0
Was the victim of violence or abuse	53	3.2
Experienced sexual assault (rape or harassment)	36	2.2

N = 1665

A similar trend was found for exposure to war and terrorism. Those who were not exposed and had a sub-clinical level of depressive symptoms had the smallest increase in chronic medical conditions, while those who were exposed to bereavement and had a clinical level of depressive symptoms had the largest increase (0.38 vs. 0.95 *T* score units per year, respectively). Figure 1b presents this three-way interaction. The Δ pseudo- R^2 (Snijders and Bosker 1999) showed that the bereavement and war–terrorism models explained 21.2 and 21.4 % of the variance in chronic medical conditions, respectively.

In a preliminary model predicting disability using time alone (not shown), the intercept was 50.34 ($p < 0.0001$) and the slope was 0.356 ($p < 0.0001$) for ADL, while the intercept was 50.43 ($p < 0.0001$) and the slope was 0.615 ($p < 0.0001$) for IADL. Therefore, the annual increase in ADL and IADL was equivalent to 0.36 and 0.62 *T* score units across all respondents, respectively. In the complete model with covariates (Table 3), ADL and IADL increased with time and were higher among those with clinical level of depressive symptoms. Bereavement as well as war and terrorism was related to disability, as respondents exposed

Table 3 Growth-curve models for physical impairment

Fixed effect estimates	Chronic medical conditions				ADL				IADL			
	Bereavement		War and terrorism		Victimization		Bereavement		War and terrorism		Victimization	
	Bereavement	War and terrorism	Bereavement	War and terrorism	Bereavement	War and terrorism	Bereavement	War and terrorism	Bereavement	War and terrorism	Bereavement	War and terrorism
Intercept	50.12***	50.172***	50.168***	50.145***	50.00***	50.118***	50.039***	50.189***	50.039***	50.189***	50.159***	50.189***
Time	0.367***	0.383***	0.378***	0.367***	0.354***	0.358***	0.603***	0.622***	0.603***	0.622***	0.612***	0.612***
Adversity	0.293	0.948*	0.619	0.883	1.310*	0.071	1.930***	0.818*	1.930***	0.818*	-0.260	-0.260
Depression	3.621***	3.727***	3.648***	4.769***	4.411***	4.676***	4.898***	5.337***	4.898***	5.337***	5.238***	5.238***
Adversity × depression	1.767	-0.111	0.798	1.472	5.406***	1.832	5.705***	2.030*	5.705***	2.030*	1.975*	1.975*
Time × Adversity	-0.004	0.021	-0.016	0.144	0.366**	0.027	0.550***	0.205*	0.550***	0.205*	-0.078	-0.078
Time × depression	0.106	0.135	0.118	0.271*	0.205	0.247*	0.263*	0.362***	0.263*	0.362***	0.330***	0.330***
Time × adversity × depression	0.496*	0.423*	0.166	0.415	0.384	0.378	0.553*	0.594**	0.553*	0.594**	0.399	0.399
AIC	26,286.12	26,284.36	26,269.43	26,262.57	26,225.25	26,247.61	25,712.44	25,773.46	25,712.44	25,773.46	25,763.16	25,763.16
BIC	26,404.28	26,402.51	26,387.57	26,380.75	26,343.42	26,365.77	25,830.61	25,891.63	25,830.61	25,891.63	25,881.32	25,881.32

N = 1665 respondents who provided 3761 observations. Unstandardized estimates and standard errors are presented. Effects are controlled for baseline age, gender, ethnicity, baseline education, baseline gross household income as well as baseline smoking and alcohol consumption

ADL difficulties in basic activities of daily living, IADL difficulties in instrumental activities of daily living, AIC Akaike's information criterion, BIC Schwarz's Bayesian criterion

* $p < .05$, ** $p < .01$, *** $p < .001$

to bereavement reported higher difficulties in ADL and IADL, and respondents exposed to war and terrorism reported higher difficulties in IADL. Exposure to bereavement was also related to a steeper time-related increase in both ADL and IADL difficulties, as indicated by the significant Bereavement*Time interactions. Exposure to war and terrorism was related to a steeper time-related increase in IADL alone, as indicated by the significant War and terrorism*Time interaction. While there were no significant three-way interactions between time, adversity, and depression level for ADL, both bereavement and war–terrorism showed three-way interactions between time, adversity, and clinical level of depressive symptoms.

Probing these interactions using Preacher et al.'s (2006) method showed similar trends to the interactions found for chronic medical conditions. While respondents who were not exposed to bereavement and had a sub-clinical level of depressive symptoms showed the smallest increase in IADL difficulties, those who were exposed to bereavement and had a clinical level of depressive symptoms showed the largest increase (0.60 vs. 1.96 *T* score units per year, respectively). Figure 1c presents this three-way interaction. Respondents who were not exposed to war and terrorism and had a sub-clinical level of depressive symptoms had the smallest increase (0.62 *T* score units per year), while those who were exposed to war and terrorism and had a clinical level of depressive symptoms had the steepest slope of increase of IADL difficulties (1.77 *T* score units per year). Figure 1d presents this three-way interaction. The Δ pseudo- R^2 showed that the bereavement and war–terrorism models each explained 28.9 % of the variance in IADL difficulties.

As we performed three separate analyses for each of the outcome measures, we corrected our significant values according to the false discovery rate method (Benjamini and Hochberg 1995). After this correction, the two-way interactions between bereavement and time remained significant ($p = .03$ and $.0003$ for ADL and IADL, respectively). The two-way interaction between war and terrorism and time predicting IADL became non-significant ($p = .12$). All three-way interactions remained significant ($p = .03$ and $.05$ for bereavement and war and terrorism predicting medical conditions, respectively; $p = .03$ and $.02$ for bereavement and war and terrorism predicting IADL, respectively).

Supplementary analyses

In a series of supplementary analyses, we assessed whether specific bereavement and war and terrorism events were related to an accelerated increase in physical impairment with time, especially when a high level of depressive symptoms was evident. As some events had low frequency

Fig. 1 Three-way interaction between time, adversity, and depressive symptom level on physical impairment. **a–b** Medical conditions and **c–d** difficulties in instrumental activities of daily living

of occurrence, we chose events with relatively high occurrence ($n \sim 100$). These events included experiencing the death of a spouse or the death of a child or a grandchild,

losing a loved one in a war, witnessing the serious injury or death of someone in war, experiencing the injury or death of a loved one in a terrorist act, and being wounded in war.

Only three events significantly interacted with time, or with time and depressive symptoms, in predicting physical impairment. Experiencing the death of a spouse was related to a steeper increase in ADL ($p = .047$) and IADL ($p = .0001$) with time. It also predicted a steeper increase in chronic medical conditions when depressive symptom level was high ($p = .028$). Experiencing the death of a child or a grandchild was related to a steeper increase in IADL with time ($p = .018$), and predicted a steeper increase in both ADL and IADL when depressive symptom level was high ($p = .001$ and $.021$, respectively). Finally, losing a loved one in a war was related to a steeper increase in IADL with time ($p = .018$), and predicted a steeper increase in both medical conditions and IADL when depressive symptom level was high ($p = .027$ and $.004$, respectively). These effects are presented in detail in Supplementary Table 1.

As bereavement and war–terrorism may not have been inclusive categories, we assessed their potential response overlap. Respondents who reported experiencing the death of a spouse were also more likely to report losing a loved one in war ($\chi^2 = 12.17$, $p < .0001$). However, the death of a child or a grandchild was unrelated to losing a loved one in war ($\chi^2 = 0.17$, $p = .68$). Due to the weak relationship between bereavement and losing a loved one in war, we could not remove the possibility of an overlap between these events. Still, when we re-assessed the effects of losing a loved one in war after controlling for the death of a spouse, all effects remained the same (with the same significant levels).

Discussion

This study examined within-subject trajectories of physical impairment in later life as a function of exposure to categories of adversity and depressive symptoms. We found that after controlling for background characteristics and health behaviors, individuals exposed to bereavement showed greater disability than their unexposed counterparts did, while those exposed to war and terrorism reported a greater number of chronic medical conditions and disability than their unexposed counterparts. Moreover, individuals exposed to bereavement-related adversity or to war and terrorism showed a steeper time-related increase in disability compared to their unexposed counterparts. Finally, both exposure to bereavement and exposure to war and terrorism predicted a more rapid increase in chronic medical conditions and disability, especially when exposure was coupled with a clinical level of depressive symptoms. We now move on to review these findings in more detail.

First, bereavement was generally related to higher disability, and predicted a faster increase in disability even after controlling for age, other socio-demographics, and depression level. The effects of bereavement were generally evident for both death of a spouse and death of a child or grandchild. It is possible that bereavement produces an earlier frailty via unfavorable coping strategies such as emotional suppression (Stroebe et al. 2007). However, the three-way interaction showed that bereavement is most detrimental to both chronic medical conditions and disability among older adults with a clinical level of depressive symptoms. These symptoms may have captured aspects of unresolved grief and posttraumatic distress, which in turn affect bodily systems, such as the hypothalamic–pituitary–adrenal and immune systems, rendering an early onset of frailty (Li et al. 2003; Stroebe et al. 2007).

Second, exposure to war and terrorism was related to a greater number of medical conditions and disability, even after controlling for background characteristics and depression level. The interaction with time was more limited, as exposure to war and terrorism was related to a quicker increase in difficulties in IADL alone. This interaction became non-significant after adjusting for multiple analyses. However, once again, a more rapid increase in physical impairment was most evident among those with clinical level of depressive symptoms, suggesting that exposure to war and terrorism catalyzes faster deterioration in health due to long-term effect of mental distress on bodily systems (Bramsen et al. 2007; Solomon et al. 2014). Non-adaptive coping mechanisms related to depression following exposure to war and terrorism (Bleich et al. 2005) may exacerbate physical morbidity and disability via their effect on physical systems. Physical injuries caused by war or terrorist attacks cannot be ruled out as possible mechanisms for acceleration of physical decline (Bramsen et al. 2007), yet they are not likely to explain the entire effect. Indeed, supplementary analyses showed that the effects of war and terrorism were especially due to experiencing the death of a loved one in war and not due to direct injury.

It is noteworthy that exposure to victimization was not related to chronic medical conditions or disability, nor was it related to the pace of physical deterioration. These null findings stand against previous evidence showing increased cognitive and physical impairment among older adults exposed to sexual assault (Petkus et al. 2012; Sachs-Ericsson et al. 2014). These findings also disaccord with evidence that older adults, who had been exposed to sexual assault in childhood, had shortened telomeres—DNA–protein complexes that serve as an important marker of cellular aging (Lin et al. 2012). Because of the contradiction with previous findings, the current null findings should

be interpreted cautiously. It should also be noted that reports of direct exposure to physical and sexual assault were relatively infrequent in our sample, and therefore the power to detect the effect of assault was lower compared to other studies.

Viewed together, our findings correspond with the assumptions that adversity shapes physical health in old age and may lead to a hastened aging process. Moreover, the fact that the negative effects of adversity were aggravated among those with clinical level of depressive symptoms accords with previous findings. The moderating role of depressive symptoms was previously found by Shrira and Litwin (2014), who used the European sample of SHARE. Studies that used other samples showed that the effects of lifetime adversity on mental health were exacerbated among people high in neuroticism (Kendler et al. 2004) and among those with a previous history of depression (Kessler and Magee, 1994; Maciejewski et al., 2000). Together, these findings highlight the possible interaction between adversity and one's ability (or impaired ability) to mobilize resources and human agency (e.g., Ferraro and Shippee 2009).

Although the current findings offer new insights, they should be considered in light of the study limitations and strengths. First, the lifetime adversity questionnaire did not include detailed description of each event. Therefore, some events had to be collapsed together, some events had a potential overlap (that was controlled for), and certain characteristics, such as repeated exposure to the same events and length of exposure, were not documented. Still, the broad-scoped view that the present survey took on lifetime adversity allowed for a relatively differentiated analysis compared to other large-scale studies (e.g., Shrira and Litwin 2014). Second, the present study did not address posttraumatic distress, which is often considered a relevant outcome in studies of lifetime adversity. Still, there was an advantage in using depressive symptoms in this study because of their applicability to large community populations as well as their sensitivity to both clinical and sub-clinical conditions (Blazer and Hybels 2005). Third, we used self-report measures of physical impairment, and future studies should examine accelerated decline using objective measures as well. Fourth, we could not rule out possible reciprocal influences between adversity and physical health. Adversity may indeed increase the risk for physical deterioration, but physical morbidity and disability can elicit or exacerbate certain stressful events and difficulties. Moreover, certain predispositions, such as early social circumstances, genetic liability, aspects of personality, or access to social support, may render people prone to both adversity and physical impairment. Therefore, future studies should delineate the possible causal paths between adversity and physical health.

The current study also has several strengths worthy of note. The study longitudinally examined a large heterogeneous sample drawn in a national survey. Moreover, although retrospective reports of lifetime adversity may show inconsistency across time (Ayalon 2015), this was partially mitigated by looking at fairly objective and major events, which are usually remembered well (Hardt and Rutter 2004).

To conclude, the current findings extend previous findings regarding the effect of lifetime adversity on older adults' trajectories of physical health (Shrira and Litwin 2014) by showing that specific exposure to bereavement-related events and exposure to war and terrorism are related to a more rapid rate of physical decline, especially when combined with a clinical level of depressive symptoms. Prevention and intervention programs should focus on targeting older adults in these high-risk groups, especially given their greater likelihood of experiencing a hastened process of physical decline.

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