Title page

Title: Adverse events over the life course and later-life wellbeing and depressive symptoms in older people

Authors: Sol Richardson[1]*, Ewan Carr[1,2], Gopalakrishnan Netuveli[1,3], Amanda Sacker[1]

*Corresponding author, **Email:** sol.richardson@cantab.net; **Telephone:** 0044 (0)20 35596440

[1]Research Department of Epidemiology and Public Health, International Centre for Life Course Studies in Society and Health, University College London, 1-19 Torrington Place, London WC1E 6BT, United Kingdom.

[2]Department of Biostatistics and Health Informatics, Institute of Psychiatry, Psychology & Neuroscience, King's College London, 16 De Crespigny Park, London SE5 8AF, United Kingdom.

[3]Institute for Health and Human Development, University of East London, London E15 4LZ, United Kingdom.

Abstract

Objectives: Exposures to adverse events are associated with impaired later-life psychological health. While these associations depend on the type of event, the manner in which associations for different event types depend on when they occur within the life course has received less attention. We investigated associations between counts of adverse events over the life course, and wellbeing and mental health outcomes in older people, according to their timing (age of occurrence), orientation (self or other) and, both their timing and orientation.

Design: Linear and logistic random-effects models for repeated observations.

Setting: England, 2002–2015.

Participants: 4,208 respondents aged >50 years with 22,146 observations across Waves 1–7 of the English Longitudinal Study of Ageing.

Measurements: Cumulative adversity was measured by counts of 16 types of events occurring within four age ranges over the life course using retrospective life history data. These were categorized into other- (experienced through harms to others) and self-oriented events. Outcomes included CASP-12 (control, autonomy, self-realisation and pleasure), the eight-item Centre of Epidemiological Studies Depression Scale, and self-appraised subjective life satisfaction.

Results: Additional adverse events were associated with lower CASP-12 and life satisfaction scores, and higher odds of probable depressive caseness. In childhood, other-oriented events had a larger negative association with later-life wellbeing than self-oriented events; the converse was found for events occurring in adulthood.

Conclusions: Events occurring at all life course stages were independently associated with both later-life wellbeing and depression in a cumulative fashion. Certain age ranges may represent sensitive periods for specific event types.

Running title

Life events and later-life wellbeing and depression

Introduction

Adverse life events

Although no standard definition of an adverse life event exists, various descriptions have been offered. "Adverse", "traumatic" or "negative" life events represent sudden, dramatic experiences (Suh et al., 1996) that have the potential to significantly alter one's social world (Wheaton, 1994). They are typically unexpected, rather than universal, age-graded transitions (Rutter, 1996), and require a significant change in an individual's life pattern and adaptive or coping behaviour (Holmes and Rahe, 1967). Elsewhere they are referred to as "potentially traumatic events" due to their associations with post-traumatic stress disorder (PTSD). These are variously defined as events entailing any actual or perceived threat to the life or physical safety of the individual, their loved ones or those around them (American Psychiatric Association, 1994), or to individuals' physical or psychological wellbeing (Australian Psychological Society, 2019).

Earlier studies observed that individuals with depression and other conditions are more likely to have experiences of adverse life events than those without (Brown et al., 1973; Brown and Harris, 1978; Paykel, 1978). These studies typically found associations between events and onset of conditions occurred over relatively short timespans (i.e. less than one year) (Suh et al., 1996; Brown et al., 1973). Later work, however, has highlighted the potential for major events to represent "turning points" which cause lasting shifts in individuals' developmental and life trajectories (Rutter, 1996), and investigated associations between specific adverse life events individually and later-life mental health outcomes. For example, abuse and interpersonal loss in childhood have been associated with various mental health conditions over the life course including mood disorders and anxiety (Green et al., 2010). Childhood sexual abuse in particular has been shown to predict depression and lower wellbeing in adulthood (Kamiya et al., 2016).

Timing of adverse events

According to Elder's principles of life course theory (Elder, 1998), the developmental impact of specific life events may be contingent on when they occur in a person's life (Rutter, 1996). Although some studies have found that more recent events are of greater importance (Suh et al., 1996), associations between adverse events and mental health outcomes have been shown to persist for long periods after their occurrence, including from childhood to later life (Green et al., 2010; Kessler and Magee, 1993).

Self- and other-orientation of adverse events

Another principle of life course theory is that of "linked lives", in which consequences of stressors or adverse events are shared through social relationships (most notably parent-child relationships) (Elder, 1998). Adverse events may be experienced directly by individuals or indirectly through knowledge of experiences of other people. In contrast with previous editions, the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV) offered a wider definition of traumatic events to make a distinction between events which involve an injury or threat to the physical or psychological integrity of either the self or of others (American Psychiatric Association, 1994). Some studies have considered this distinction (Breslau et al., 1999; Shmotkin and Litwin, 2009; Green et al., 2010; Palgi et al., 2012; Ogle et al., 2014). This concept is similar to that of "egocentric" and "non-egocentric" stress proposed by Aldwin (1990) within the context of families. Parallels have also been drawn between mental health outcomes following experiences of other-oriented adverse events and phenomena such as "compassion fatigue" and "vicarious" or "secondary" traumatisation. These terms describe symptoms of exhaustion, hypervigilance and avoidance experienced by professionals working with, and family members of, people with PTSD (Baird and Kracen, 2006).

5

The only studies to disaggregate counts of events according to self- or other-orientation found associations between experiences of other-oriented adversity in early-life and positive later-life mental health outcomes and between self-oriented events in adulthood and adverse mental health outcomes (Shmotkin and Litwin, 2009; Shrira et al., 2012).

Life course models of risk: timing and accumulation of exposures

Different models have been proposed to describe associations between potentially harmful exposures over the life course and later-life functioning, wellbeing or mental health. Latency factors, or "programming effects", exert lasting influences throughout the subsequent life course. A critical period represents a limited window in which a given exposure can impair subsequent development and later-life outcomes (Ben-Shlomo and Kuh, 2002), whereas events in a sensitive period have a more pronounced effect than the same exposure in a different period. Timing of these periods, which need not only occur in childhood (Krause, Shaw and Cairney, 2004), depends on both the exposure and outcome of interest (Cohen et al, 2010).

The accumulation-of-risk model, based on the concept of "insult accumulation" (Riley, 1989), conceives the association between such exposures and later-life outcomes as a lifelong dose-response relationship (Cohen et al., 2010). Damage accrues over the life course as the number, duration, and severity of exposures to adversity increases, and as compensatory systems lose efficacy over time (Kuh et al., 2003). Various studies have highlighted additive accumulation of exposure to adverse events as important for later-life wellbeing and mental health (Turner and Lloyd, 1995; Krause, 2004; Kessler et al., 2010).

Objectives and hypotheses

As greater numbers of people in developed economies approach later life, the determinants of their mental health and wellbeing will assume ever greater importance. The aim of this study was to investigate how different types of adverse events, and their timing, influence how they may affect later life wellbeing and mental health. Its specific objectives were to investigate associations between counts of adverse events over the life course and wellbeing and mental health outcomes in older people, and to assess the extent to which these associations depended on: (i) their timing (age of occurrence), (ii) their orientation (self or other) and (iii) both their timing and orientation.

Based on previous studies, we hypothesized that cumulative experiences of adverse events over the life course would be associated with lower wellbeing and higher odds of depression in later life. Second, we hypothesized that adverse events occurring at all ages would be associated with negative outcomes, with more recent events (at later ages) potentially showing a stronger association. Finally, we hypothesized that both self- and other-oriented events would be associated with lower wellbeing and higher odds of depression. With regards to both orientation and timing, the results of Shrira et al (2012) would suggest that exposures to other-oriented adverse events, particularly in early life, are associated with higher wellbeing and positive mental health outcomes in older people while self-oriented events in adulthood are associated with lower wellbeing and worse mental health outcomes.

Methods

Analytic sample

Data were drawn from Waves 1–7 (2002/2003–2014/2015) of the English Longitudinal Study of Ageing (ELSA), a nationally-representative sample of older people (aged 50 and over) living in private households in England (Steptoe et al., 2013). Ethical approval for ELSA data collection was granted by the London Multicentre Research Ethics Committee (MREC/01/2/91), informed consent was

7

obtained from all participants, and all observations were anonymised. No specific approval was required for this study as it was based on secondary data analysis.

We restricted our analysis to respondents who participated in the Life History Module in Wave 3 (2006–2007), who were 50–90 years at any wave, had provided complete information on age of occurrence of all adverse events investigated and had no missing covariate data in at least one wave.

Wellbeing and mental health outcomes

Outcomes included two measures of wellbeing (CASP-12 and life satisfaction) and one of mental health (depressive symptomatology). The CASP-12 (control, autonomy, self-realisation and pleasure) scale (see Appendix A1, published as supplementary material online attached to the electronic version of this paper), available in ELSA Waves 1–7, was developed for individuals in later life and provides a global assessment of multiple domains encompassing hedonic and eudemonic aspects of wellbeing (Hyde et al., 2003).

Probable depression was measured using the eight-item Centre of Epidemiological Studies Depression Scale (CES-D), a screening test for depression and depressive disorder based on the number of depressive symptoms. It has been shown to be a reliable, validated tool with high internal consistency, acceptable test-retest stability, high generalisability across population subgroups, excellent concurrent validity by clinical and self-report criteria, and substantial evidence of construct validity (Radloff, 1977). Scores were calculated by summing the number of self-reported symptoms occurring within the past week (range: 0–8) (see Appendix A2). A score of three or more was used to define probable depressive caseness (Turvey et al., 1999), as recommended in previous studies (Courtin et al., 2015; White et al., 2016). CES-D measures were available from Waves 1–7 of ELSA and were expressed as binary outcomes (probable caseness/non-caseness).

Self-appraisals of subjective life satisfaction were assessed in Waves 2–7 and operationalized using a seven-point Likert scale with higher values indicating higher life satisfaction (see Appendix A3).

8

Adverse life events

Retrospective information on types of adverse events experienced and their age of first occurrence was collected in the Wave 3 Life History Module. This module comprised the Life History Interview, which included questions on relationships and family, housing, mobility and work history, and the Life History Self-Completion Questionnaire, which covered quality of parental care during childhood and adverse life events. Sixteen types of adverse event were identified (based on Breslau et al., 1998). Two (maternal separation and parental divorce) were drawn from the interview while all other items were assessed in the self-completion questionnaire. Six items were specific to childhood (ages 0–15 years) while the remaining 10 could occur at any age (0–49 years). Events were categorized according to whether they were self- or other-oriented using the same approach as in previous work (Shmotkin and Litwin, 2009; Shrira et al., 2012). All events occurred before the first wave in which a respondent was included in ELSA and had full information on at least one of the three outcomes investigated. From these 16 event items, two count variables for exposure to self- and other-oriented events were derived by summing the number of event types in which the primary harm was to the self and in which the primary harm was to another individual respectively. Both variables had ranges of 0–8.

Covariates

Covariates were conceptualized as potential confounders for relationships between life course events and later-life outcomes. We operationalized physical frailty based on accumulation of deficits using items relating to medically-diagnosed conditions, medical symptoms, functional activities and activities in daily living (Searle, Mitnitski et al., 2008) (see Appendix A4). The resulting scale included 36 items and was scaled as a continuous variable from 0 to 1. Models were further adjusted for gender, current self-reported labour market status (retired/in paid

9

employment/unemployed/permanently sick or disabled/looking after the home or other), housing tenure (outright ownership/ownership with mortgage/renting or other), participation in social activities within the previous month (yes/no) (see Appendix A5), birth outside the United Kingdom (yes/no), partnership status (in a marriage or other partnership/non-partnered), household wealth, and gross household income. Respondents were categorized by quintile of equivalized non-pension household net wealth. Household income was transformed taking the natural logarithm to reduce this skewness and normalize its distribution (Office for National Statistics, 2016) and was equivalized to account for differences in household size by dividing by the square root of the number of household members. Financial variables were inflation-adjusted using annual consumer price index inflation terms for all consumer items, obtained from the OECD Prices and Purchasing Power Parities database (Organisation for Economic Co-operation and Development, 2019), and expressed in 2011 £. Please see Richardon et al. (2018) for further details on specification of these variables in ELSA.

Occupational position was measured using the five-category National Statistics Socio-economic Classification (NS-SEC) groupings (Office for National Statistics, 2000) based on respondents' current occupation or last-known occupation if no longer in employment. A final sixth category was included for respondents who had never worked. All covariates except for birth abroad and occupational position were taken at the time of interview for each observation.

Descriptive analysis

We calculated summary statistics, including means, standard deviations (SD), skewness, and internal consistency (Cronbach's α) as appropriate, for each of the three outcome variables for respondents in Wave 3 with complete data adverse events and control variables.

We then estimated weighted proportions of respondents in the ELSA Wave 3 Life History module with complete information on adverse events and age of occurrence who had experienced each adverse event type by age 16 and by age 50 years. We then plotted the weighted cumulative

proportions of respondents who had experienced each event by age. Cross-sectional probability weights were used to ensure representativeness of the English population (Steptoe et al., 2013).

Statistical analysis

Continuous outcomes (CASP-12 and life satisfaction) were analyzed with linear random-effects models to reflect the repeated measures of individuals across waves. Logistic random-effects models were fitted for the binary outcome (CES-D). All models were fully-adjusted for all covariates listed above, and analyses were performed using Stata 14 (StataCorp, 2015) (for more information on model specification and selection of model covariates, and discussion of potential mediation of the primary associations tested by model covariates, see Appendix A6). Variance inflation factors were calculated to test for multicollinearity between model covariates (see Appendix A7).

Models were fitted corresponding to different assessments of adverse events, operationalised as count variables. First, the association between the total number of events and each outcome measure was tested (Model A). Four fully-adjusted models (Models B–E) were fitted for each outcome with adverse events disaggregated according to their timing (within different age ranges representing different life course stages: see Galobardes et al., 2006; Galobardes et al., 2007) and orientation (self or other). Models were specified with the following mutually-adjusted exposure measures:

- Model A: Total adverse events at all ages (0–49 years)

- Model B (events by age of occurrence): Adverse events in early childhood (0–5 years), adverse events in childhood late childhood (6–15 years), adverse events in early adulthood (16–30 years) and adverse events in late adulthood (31–49 years)

- Model C (events by orientation): Self-oriented events at all ages (0–49 years) and other-oriented events at all ages (0–49 years)

- Model D (events by age of occurrence and orientation): Self-oriented events in childhood (0–15 years), self-oriented events in adulthood (16–49 years), other-oriented events in childhood (0–15 years), and other-oriented events in adulthood (16–49 years)

- Model E (events by age of occurrence and orientation): Self-oriented events in early childhood (0–5 years), late childhood (6–15 years), early adulthood (16–30 years), and late adulthood (31–49 years), and other-oriented events in early childhood (0–5 years), late childhood (6–15 years), early adulthood (16–30 years) and late adulthood (31–49 years).

We considered whether experiences of adverse events influenced trajectories of wellbeing from age 50 to 90 and operationalised latent growth curve models within a multilevel framework for each of the three outcomes, with age fitted as a random effect and interacted with counts of total adverse events experienced (0–49 years).

Sensitivity analyses

We conducted three sensitivity analyses (see Appendices A8, A9 and A10). First, we tested the association between total adverse events experienced (0–49 years) and depression outcomes when the latter was operationalized as a count of symptoms (as opposed to a dichotomous variable). Second, we attempted to provide evidence against potential reverse causation between depressive caseness and reporting of adverse events in the same wave (Ross, 1989; Shrira et al., 2012), for example, due to potential overreporting of adverse events among those with depressive symptoms, by restricting the analysis of depression caseness outcomes to respondents who were not identified as having depressive caseness in Wave 3 and using data from Waves 1–2 and 4–7 only. Third, we tested the association between adverse events experienced (disaggregated by age of occurrence and orientation) and the number of waves in which respondents were identified as having depressive caseness (Waves 1–7).

12

Results

Analytic sample

A total of 9,771 respondents participated in ELSA Wave 3, of which 9,208 were aged 50–90 years. Of these, 7,445 participated in both the Wave 3 Life History Interview and returned the self-completion questionnaire, and 4,521 provided complete data on all 16 events and the age of occurrence. Our analysis included data from 4,208 unique individuals with at least one observation with no missing covariate information over Waves 1–7 (see Figure S1, published as supplementary material online attached to the electronic version of this paper).

Separate analytic samples were identified for each outcome measure after dropping observations with missing outcome values. The analytic sample for CASP-12 outcomes included 4,176 unique individuals with 20,176 observations over Waves 1–7. Samples for depressive caseness and life satisfaction outcomes included 4,208 respondents with 22,039 observations over Waves 1–7 and 4,152 respondents with 17,948 observations over Waves 2–7 respectively.

Descriptive analysis

Summary statistics for CASP-12, probable depressive caseness and life satisfaction were calculated for Wave 3 respondents with complete data on adverse events and covariates (sample n=3,159, 3,450 and 3,243 respectively). The mean CASP-12 score on a range of 12–48 was 38.04 (SD: 5.56). The distribution of CASP-12 scores was relatively symmetrical with a slight negative skew (skewness: -0.71). Internal consistency of the 12 scale items was good (Cronbach's α: 0.842). Prevalence of depressive caseness was 18.14% (95% CI: 16.86–19.43%) of the Wave 3 sample. Internal consistency of the eight-item CES-D scale, with scores representing number of symptoms present, was also good (Cronbach's α: 0.801). Mean subjective life satisfaction on a range of 1–7 was 5.36 (SD: 1.36, skewness: -1.32).

13

The characteristics of the analytic sample, both for Wave 3 respondents without missing data on adverse events or for covariates, and for all observations over Waves 1–7 without missing event or covariate data, are shown in Table S1, published as supplementary material online attached to the electronic version of this paper. Wave 3 respondents experienced a mean of 1.65 events from ages 0–49 years, with a mean of 0.65 self-oriented and 0.99 other-oriented events. Sample characteristics were similar for Wave 3 responses and observations in Waves 1–7, although respondents' mean frailty scores were lower and household income were higher for the latter (reflecting higher likelihood of repeat follow-up for respondents with these characteristics).

Table 1 presents the weighted proportion of respondents who experienced each specific adverse event by age 16 and by age 50 years. Of 4,521 respondents with complete data on adverse events, 3,449 had experienced one or more of the 16 events assessed (weighted proportion: 75.9%). Before age 16, the most commonly-experienced self- and other-oriented events were "separation from mother for 6 months or more" (13.1%) and "having parents who argued or fought very often" (13.9%). By age 50, the most common self- and other-oriented events were having a life-threatening illness or accident (15.7%) and having to provide long-term care to a disabled or impaired relative or friend (90.6%). Figure 1 and Figure S2 show the weighted cumulative proportions of respondents with full information on adverse events who experienced specific adverse events by age.

Statistical analysis

Table 2 shows the results of adjusted models for the association between total adverse events and CASP-12 and depressive caseness outcomes (Model A). Unemployment, female gender and not being in a partnership were associated with lower CASP-12 scores and higher odds of probable depressive caseness while engagement in social activities and higher household income, household net worth and occupational position were associated with positive outcomes across both measures. Age was associated with lower CASP-12 scores but lower odds of depressive caseness.

14

Table 3 shows the associations between total adverse events, and for events disaggregated by age and orientation (Models A–E), and CASP-12 outcomes. Total counts of cumulative adverse events over the life course (0–49 years) were associated with a decrease in scores by -0.49 (95% CI: -0.58, -0.41, p<0.001) for each additional adverse event experienced (Model A). Adverse events occurring in all age ranges, and total self- and other- oriented events, were also associated with lower CASP-12 scores (Models B and C). When self- and other-oriented events were further disaggregated by age of occurrence (Model D), both self- and other-oriented events in adulthood (16–49 years) were associated with lower CASP-12 scores with effect sizes of -0.71 (95% CI: -0.92, -0.49, p<0.001) and -0.50 (95% CI: -0.68, -0.31, p<0.001) respectively. In childhood (0–15 years), other-oriented events were found to significantly predict lower CASP-12 scores in later life (-0.63, 95% CI: 0.82, -0.44, p<0.001) while self-oriented events did not (-0.10, 95% CI: -0.32, 0.11, p=0.354).

Table 4 shows results for depressive caseness outcomes. Total counts of adverse events were associated with higher odds of probable depressive caseness (OR: 1.19, 95% CI: 1.14, 1.25, p<0.001) (Model A). The same was found for events occurring in all age ranges, and total self- and other-oriented events (Models B and C). Self-oriented events in adulthood were strongly associated with higher odds of depressive caseness (OR: 1.33, 95% CI: 1.18, 1.50, p<0.001). While we found a significant association between-other-oriented events and depression outcomes (OR: 1.27, 95% CI: 1.14, 1.40, p<0.001) no significant association was found for self-oriented events (OR: 1.07, 95% CI: 0.95, 1.21, p=0.261) (Model D). While other-oriented events in both early childhood (0–5 years) and late childhood (6–15 years) were both strongly associated with lower wellbeing and higher odds of depressive caseness, no significant association was found for self-oriented events in early and late childhood (Model E).

Results for life satisfaction were similar to those for CASP-12 (see Table S2 and Table S3). In general, the results for all three outcomes showed two gradients in effect sizes with self-oriented events having larger negative associations with later-life wellbeing when they occurred later in the life course and the effect of other-oriented events diminishing with age.

15

Interaction effects obtained from latent growth curve models indicated that there was no statistically significant difference in trajectories of any of the three outcomes investigated by total adverse events (0–49 years).

Sensitivity analyses

The results of the sensitivity analyses confirm the positive and significant association between overall numbers of adverse life events (0–49 years) and counts of CES-D depressive symptoms (Appendix A8). We also found that the association between adverse events and depressive caseness remained even after excluding respondents identified with depressive caseness in Wave 3 (Appendix A9). Finally, we found a positive and significant association between experiences of adverse events and the number of waves in which an individual was identified with depressive caseness (Appendix A10).

Discussion

This study expands the evidence base on the role of experiences of different types of adverse events, and their timing, in predicting the later-life effects of trauma. Its results support the case for intensification of efforts to prevent trauma and for exposure to adverse events at all points in the life course to be considered an issue of public health concern (Magruder et al., 2016).

The results of the descriptive analysis, based on a representative sample of the English population, highlight the widespread prevalence of experiences of adverse events, both in terms of overall exposure and exposure to specific events, together with the ages at which risk of experiencing specific events is greatest.

Consistent with expectations, we found greater cumulative exposure to adverse events over the life course to be associated with significantly lower wellbeing and increased odds of depressive caseness

16

after age 50 (Model A). These same associations were found for overall exposure to adverse events occurring in all age ranges tested (Model B), but, in contrast with our initial hypothesis, adverse events occurring later in the life course (closer to the date of interview) were not more strongly associated with negative wellbeing and depressive symptoms compared with earlier events. While both self- and other-oriented events occurring across all life course stages were associated with negative wellbeing and mental health outcomes as hypothesized (Model C), other-oriented events in childhood were strongly associated with later-life wellbeing and depressive symptoms in older people while no significant association was found for self-oriented events (Models D and E). Both self- and other-oriented events in adulthood were significantly associated with negative wellbeing and depression outcomes.

Our results for adverse events by their orientation and timing differ from those of Shrira et al (2012) and Shmotkin and Litwin (2009), who found that other-oriented events, particularly those occurring in childhood, were associated with higher CASP-12 wellbeing in later life. The authors hypothesized that their finding was due to experiences of other-oriented events earlier in the life course providing opportunities for posttraumatic growth (Weiss, 2004), development of empathy and a sense of commitment or responsibility to others who are victims of severe adverse events. This, in turn, is hypothesized to positively influence identity development, capacity for adaptation and maintenance of positive wellbeing and mental health. One explanation for this divergence in findings may be that their Israeli population samples are not comparable with that of the present study; prevalence of depression is substantially higher in SHARE-Israel and other Israeli population surveys than in comparable European populations (Shmotkin, 2003). Another may be that specific events occurring at particular ages may assume different meanings, and implications for wellbeing and mental health over the life course, within different social or cultural contexts (Elder, 1998; Turner and Schieman, 2008); previous work has shown that cognitive appraisals of stressfulness of specific events can differ between cultural or ethnic groups (Pine et al., 1985; Brown et al., 2018).

17

Counts of adverse events by age of occurrence and orientation were mutually-adjusted, demonstrating that the association between childhood (particularly other-oriented) events and negative later-life outcomes not only persisted for a long period following their occurrence but were also independent of subsequent adverse events. Associations between experiences of adverse events and negative wellbeing and depressive symptoms were also independent of individual-level variables, including socioeconomic position, physical frailty and social participation.

Our results also provide insight into how models of risk drawn from life course research may relate to individuals' experiences of adverse events and later-life outcomes. The accumulation-of-risk model provides the best description of the associations between exposure to adverse events over the life course and later-life wellbeing and depressive symptoms found in this study. Childhood, may represent a sensitive period in which other-oriented events exert a greater influence on wellbeing and mental health outcomes later in the life course, as suggested by the negative association between other-oriented events in childhood and later-life wellbeing and depressive symptoms independent of subsequent events. This sensitive period may arise as a result of other-oriented events taking a specific form and social meaning when they occur in childhood (Alwin, 2012) resulting in differential wellbeing and mental health effects as a result of their timing (Kuh et al., 2003).

Strengths and limitations

The degree to which our results may be generalizable to contexts other than England, or to other age cohorts, is uncertain. For example, Lacey et al (2012) found that the association between parental separation and psychological distress diminished in a younger cohort when compared with an older one. The sensitive nature of some questionnaire items may have led to their underreporting. Recall bias may also have occurred; particularly for events further chronologically removed from the date of interview (Green et al., 2010; Hardt and Rutter, 2004). The extent to

18

which reports of adverse events were influenced by repression of potentially distressing memories is also unknown. Although the issue of false memories of adverse events has previously been raised (Loftus, 1993), this is considered unlikely to represent a serious issue in retrospective studies (Hardt and Rutter, 2004). The retrospective nature of the life histories entails that no data are available from the time events occurred to validate retrospective self-reports.

Other studies raise concerns of inconsistencies in reporting of potentially traumatic events over time and whether all events are reported with equal reliability (Turner and Lloyd, 1995; Hepp et al., 2006). One reason may be that recollections of past states or events are influenced by aspects of current circumstances, including mental health status (Ross, 1989). Individuals use autobiographical memory to explain or justify their current state. Although contrasts between past and present states may be exaggerated when change is expected to have occurred, attitudes towards past events and their reporting may be correlated with current circumstances when an individual assumes or expects their state has remained stable over time. This "endowment effect" is likely to be stronger for more recent events as they are perceived as more closely related to the individual's present state (Shrira et al., 2012). This bias is more likely to have influenced reporting of more recent events and strengthened apparent associations between adverse events and negative wellbeing and depressive symptoms, but may have been mitigated by the collection of information on life events via the separate self-completion questionnaire. The finding of a positive and significant association between number of events experienced and depressive caseness even after excluding those identified with depressive caseness during the survey wave in which adverse events were reported provides some evidence against the influence of such bias on our results (see Appendix A9).

Potential social desirability bias was also likely reduced by the absence of an interviewer for most event items. Although consistency in reporting of events could not be investigated as retrospective reports of events were recorded in one wave, use of a life grid for collection of information on all events included in the ELSA Wave 3 Life History Interview may have aided participants' recall (Blane, 1996).

19

Exposure to adverse events may not be fully exogenous to the individual. Personality traits, such as openness to experience and neuroticism, may predict both adverse events and later-life wellbeing and mental health outcomes (Ogle et al., 2014; Phillips et al., 2015). Parental mental illness may also predict both childhood adversity and mental illness through genetic pathways (Green et al., 2010). Related to this is the concept of dependent events, which, rather than having a direct causal relationship, may be related to the development of the mental health problem itself (Brown et al., 1973) or arise from the individual's own behaviour (Bebbington, 1993).

Brown and colleagues make a distinction between acute stressors (life events) and chronic stressors (major difficulties); both of which are associated with onset of depression (Brown and Harris, 1978; Brown et al., 1987). This distinction is ambiguous for some of the event items in this study, particularly for certain other-oriented events in childhood. Mental health conditions are multifactorial in origin, and the relationship between individual events and mental health outcomes may be influenced by interactions with various factors (Paykel, 1978), including "matching" circumstances or ongoing difficulties surrounding events (Brown et al., 1897), which this study may not have considered. Our measure of adverse events was based on their first occurrence and did not account for repeat occurrences. Unlike in other studies (Brown et al., 1987; Ogle et al., 2014), respondents were not invited to rate their severity.

The study's strengths include coverage of a wide range of events occurring at all stages of the life course, its use of a large sample of unique individual respondents with event data, rich covariate data and its representativeness of the English population (although this may have been weakened by ELSA's exclusion of individuals living in institutions such as care homes or prisons). Use of multiple waves of data from the ELSA survey with observations over a period of 13 years maximized sample size. The interpretation of the results is strengthened by the fact the study employed three different outcome measures and found similar associations for each. CASP-12 overcomes weaknesses of more commonly-used unidimensional wellbeing measures by assessing multiple domains of wellbeing (Hyde et al., 2003; Vanhoutte, 2014).

20

Conclusion

Poor mental health is strongly influenced by a range of social and economic determinants, including exposure to adverse life events such as violence, child abuse and neglect (World Health Organization, 2013), and consideration of the effects of such events on both mental and physical functioning (Felitti et al., 1998) merits inclusion the global public health agenda (Magruder et al., 2016).

Identification of sensitive periods for specific types of life events in terms of their potential impact on later-life wellbeing and mental health outcomes may also guide attempts to provide timely treatment interventions to prevent or mitigate their effects (World Health Organization, 2013; Qi et al., 2016).

Further work could consider the role of culture as a moderator impact of adverse events on wellbeing and mental health (Krause, 2004). Future studies could also adopt a resources of resistance" perspective by attempting to identify resources which individuals may draw upon to mitigate potential negative impacts of adversity on later-life functioning, and inform design of specific "trauma-informed" interventions tailored to individuals' patterns of exposure to adversity over the life course (Magruder et al., 2016).

Description of authors 'roles

SR conceived the study, designed and conducted the quantitative analysis and drafted the manuscript. EC, GN and AS contributed substantively to the design and interpretation of the analysis and revised the manuscript for intellectual content. All authors had access to the data and approved the final draft.

Conflicts of interest

The authors have no conflicts of interest to declare.

Data sources and reproducibility

The English Longitudinal Study of Ageing (ELSA) is available to registered users from the UK Data Service website (https://beta.ukdataservice.ac.uk/datacatalogue/series/series?id=200011). Please contact the corresponding author for access to derived datasets, and Stata syntax for data management and analysis as part of this study.

References

Aldwin, C. M. (1990). The Elders Life Stress Inventory: Egocentric and nonegocentric stress. In M. A. P. Stephens, J. H. Crowther, S. E. Hobfoll and D. L. Tennenbaum (Eds.) Stress and coping in later-life families (pp. 49–69). Washington, DC: Hemisphere.

Alwin, D. F. (2012). Integrating varieties of life course concepts. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 61, 206–220. doi: 10.1093/geronb/gbr146.

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders, 4th Edition (p. 427). Washington, DC: American Psychiatric Association.

Australian Psychological Society. (2019). Understanding and managing psychological trauma. Retrieved from: https://www.psychology.org.au/publications/tip_sheets/trauma/ (Accessed Mar 3 2020).

Baird, K. and Kracen, A. C. (2006). Vicarious traumatization and secondary trauma stress: a research synthesis. *Counselling Psychology Quarterly*, 9, 181–188. doi: 10.1080/09515070600811899.

Bebbington, P. *et al*. (1993). Life events and psychosis: Initial results from the Camberwell Collaborative Psychosis Study. *British Journal of Psychiatry*, 162, 72–79. doi: 10.1192/bjp.162.1.72.

Ben-Shlomo, Y. and Kuh, D. (2002). A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, 31, 285–293. doi: 10.1093/ije/31.2.285.

Blane, D. (1996). Collecting retrospective data: Development of a reliable method and a pilot study of its use. *Social Science and Medicine*, 42, 751–757. doi: 10.1016/0277-9536(95)00340-1.

Breslau, N., Kessler. R, C., Chilcoat, H. D., Schultz, L. R., Davis, G. C. and Andreski, P. (1998). Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of General Psychiatry*, 55, 626–632. doi: 10.1001/archpsyc.55.7.626.

Breslau, N., Chilcoat, H. D., Kessler, R. C. and Davis, G. C. (1999). Previous exposure to trauma and PTSD effects of subsequent trauma: results from the Detroit Area Survey of Trauma. *American Journal of Psychiatry*, 156, 902–907. doi: 10.1176/ajp.156.6.902.

Brown, G. W. and Harris, T. O. (1978). Social origins of depression: a study of psychiatric disorder in women (pp. 63–149). London: Tavistock.

Brown, G. W., Bifulco, A. and Harris, T. O. (1987). Life events, vulnerability and onset of depression: some refinements. *British Journal of Psychiatry*, 150, 30–42. doi: 10.1192/bjp.150.1.30.

Brown, G. W., Sklair, F., Harris, T. and Birley, J. L. T. (1973). Life-events and psychiatric disorders Part 1: some methodological issues. *Psychological Medicine*, 3, 74–87. doi: 10.1017/S0033291700046365.

Brown, L. L., Mitchell, U. A. and Ailshire, J. (2018). Disentangling the stress process: race/ethnic differences in the exposure and appraisal of chronic stressors among older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 75, 650–660. doi: 10.1093/geronb/gby072.

Cohen, S., Janicki-Deverts, D., Chen, E. and Matthews, K. A. (2010). Childhood socioeconomic status and adult health. *Annals of the New York Academy of Sciences*, 1186, 37–55. doi: 10.1111/j.1749-6632.2009.05334.x.

Courtin, E., Knapp, M., Grundy, E., and Avendano-Pabon, M. (2015). Are different measures of depressive symptoms in old age comparable? An analysis of the CES-D and Euro-D scales in 13 countries. *International Journal of Methods in Psychiatric Research*, 24, 287–304. doi: 10.1002/mpr.1489.

Elder, G. H. (1998). The life course as developmental theory. *Child Development*, 69, 1–12. doi: 10.2307/1132065.

Felitti, V. J. *et al*. (1998). Relationship of childhood abuse and household dysfunction to many leading causes of death in adulthood. *American Journal of Preventative Medicine*, 14, 245–258. doi: 10.1016/S0749-3797(98)00017-8.

Galobardes, B., Lynch, J. and Smith, G. D. (2007) Measuring socioeconomic position in health research. *British Medical Bulletin*, 81, 21–37. doi: 10.1093/bmb/ldm001.

Galobardes, B., Shaw, M., Lawlor, D. A., Lynch, J. W. and Davey Smith, G. (2006) Indicators of socioeconomic position (part 1). *Journal of Epidemiology and Community Health*, 60, 7–12. doi: 10.1136/jech.2004.023531.

Green, J. G. *et al*. (2010). Childhood adversities and adult psychiatric disorders in the national comorbidity survey replication I: associations with first onset of DSM-IV disorders. *Archives of General Psychiatry*, 67, 113–123. doi: 10.1001/archgenpsychiatry.2009.186.

Hardt, J. and Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: review of the evidence. *Journal of Child Psychology and Psychiatry*, 45, 260–273. doi: 10.1111/j.1469-7610.2004.00218.x.

Hepp, U. *et al*. (2006). Inconsistency in reporting potentially traumatic events. *British Journal of Psychiatry*, 188, 278–283. doi: 10.1192/bjp.bp.104.008102.

Holmes, T. H. and Rahe, R. H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research*, 11, 213–218. doi: 10.1016/0022-3999(67)90010-4.

Hyde, M., Wiggins, R. D., Higgs, P. and Blane, D. B. (2003). A measure of quality of life in early old age: the theory, development and properties of a needs satisfaction model (CASP-19). *Aging & Mental Health*, 7, 186–194. doi: 10.1080/1360786031000101157.

Kamiya. Y., Timonen, V. and Kenny, R. A. (2016). The impact of childhood sexual abuse on the mental and physical health, and healthcare utilization of older adults. *International Psychogeriatrics*, 28, 415–422. doi: 10.1017/S1041610215001672.

25

Kessler, R. C. and Magee, W. J. (1993). Childhood adversities and adult depression: basic patterns of association in a US national survey. *Psychological Medicine*, 23, 679–690. doi: 10.1017/S0033291700025460.

Kessler, R. C. *et al*. (2010). Childhood adversities and adult psychopathology in the WHO World Mental Health Surveys. *British Journal of Psychiatry*, 197, 378–385. doi: 10.1192/bjp.bp.110.080499.

Krause, N. (2004). Lifetime trauma, emotional support, and life satisfaction among older adults. The *Gerontologist*, 44, 615–623. doi: 10.1093/geront/44.5.615.

Krause. N., Shaw, B. A. and Cairney, J. (2004). A descriptive epidemiology of lifetime trauma and the physical health status of older adults. *Psychology and Aging*, 19, 637–648. doi: 10.1037/0882-7974.19.4.637.

Kuh, D., Ben-Shlomo, Y., Lynch, J., Hallqvist, J. and Power, C. (2003). Life course epidemiology. *Journal of Epidemiology and Community Health*, 57, 778–783. doi: 10.1136/jech.57.10.778.

Lacey, R. E., Bartley, M., Pikhart, H., Stafford, M., Cable, N. and Coleman, L. (2012). Parental separation and adult psychological distress: evidence for the 'reduced effect' hypothesis. *Longitudinal and Life Course Studies*, 3, 359–368. doi: 10.14301/llcs.v3i3.195.

Loftus, E. F. (1993). The reality of repressed memories. *American Psychologist*, 48, 518–537. doi: 10.1037/0003-066X.48.5.518.

McEwen, B. S. and Wingfield, J. C. (2003). The concept of allostasis in biology and biomedicine. *Hormones and Behavior*, 43, 2–15. doi: 10.1016/S0018-506X(02)00024-7.

Magruder, K. M., Kassam-Adams, N., Thoresen, S. and Olff, M. (2016). Prevention and public health approaches to trauma and traumatic stress: a rationale and a call to action. European Journal of Psychotraumatology, 7: 29715. doi: 10.3402/ejpt.v7.29715.

Office for National Statistics. (2000). Standard Occupational Classification 2000, Volume 1. London: Her Majesty's Stationery Office.

Office for National Statistics. (2016). Small area income estimates: model-based estimates of the mean household weekly income for middle layer super output areas (2013/14 Technical Report). London: Her Majesty's Stationery Office.

Ogle, C. M., Rubin, D. C. and Siegler, I. C. (2014). Cumulative exposure to traumatic events in older adults. *Aging & Mental Health*, 3, 316–325. doi: 10.1080/13607863.2013.832730.

Organisation for Economic Co-operation and Development. (2019). OECD.Stat. Retrieved from https://stats.oecd.org/ (Accessed Mar 8 2020).

Palgi, Y., Shrira, A., Ben-Ezra, M., Shiovitz-Ezra, S. and Ayalon, L. (2012). Self- and other-oriented potential lifetime traumatic events as predictors of loneliness in the second half of life. *Aging & Mental Health*, 16, 423–430. doi: 10.1080/13607863.2011.638903.

Paykel, E. S. (1978). Contribution of life events to causation of psychiatric illness. *Psychological Medicine*, 8, 245–53. doi: 10.1017/S003329170001429X.

Pine, C. J., Padilla, A. M. and Maldonado M. (1985). Ethnicity and life event cognitive appraisals and experiences. *Journal of Clinical Psychology*, 41, 460–465. doi: 10.1023/A:1022800118777.

Phillips, A. C., Carroll, D. and Der, G. (2015). Negative life events and symptoms of depression and anxiety: stress causation and/or stress generation. *Anxiety, Stress and Coping*, 28, 357–371. doi: 10.1080/10615806.2015.1005078.

Qi, W., Gevonden, M. and Shalev, A. (2016). Prevention of post-traumatic stress disorder after trauma: current evidence and future directions. *Current Psychiatry Reports*, 18, 20. doi: 10.1007/s11920-015-0655-0.

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1, 385–401. doi: 10.1080/10615806.2015.1005078.

Richardson, S., Carr, E., Netuveli, G. and Sacker, A. (2018). Country-level welfare-state measures and change in wellbeing following work exit in early old age: evidence from 16 European countries. *International Journal of Epidemiology*, 48, 389–401. doi: 10.1093/ije/dyy205.

Riley, J. C. (1989). Sickness, recovery and death: a history and forecast of ill-health (p. 47). Basingstoke: Macmillan.

Ross, M. (1989). Relation of implicit theories to the construction of personal histories. *Psychological Review*, 96, 341–357. doi: 10.1037/0033-295X.96.2.341.

Rutter, M. (1996). Transitions and turning points in developmental psychopathology: as applied to the age span between childhood and mid-adulthood. *International Journal of Behavioral Development*, 19, 603–626. doi: 10.1177/016502549601900309.

Searle, S. D., Mitnitski, A., Gahbauer, E. A., Gill, T. M. and Rockwood, K. (2008). A standard procedure for creating a frailty index. *BMC Geriatrics*, 8, 24. doi: 10.1186/1471-2318-8-24.

Shmotkin, D. (2003). Vulnerability and resilience intertwined: a review of research on Holocaust survivors. In R. Jacoby, and G. Keinan (Eds.) Between stress and hope: from a disease-centered to a health-centered perspective (pp. 213–233). Westport, CT: Praeger.

Shmotkin, D. and Litwin, H. (2009). Cumulative adversity and depressive symptoms among older adults in Israel: the differential roles of self-oriented versus other-oriented events of potential trauma. *Social Psychiatry and Psychiatric Epidemiology,* 44, 989–997. doi: 10.1007/s00127-009-0020-x.

Shrira, A., Shmotkin, D. and Litwin, H. (2012). Potentially traumatic events at different points in the life span and mental health: findings from SHARE-Israel. *American Journal of Orthopsychiatry*, 82, 251–259. doi: 10.1111/j.1939-0025.2012.01149.x.

StataCorp. (2015). Stata Statistical Software: Release 14 [Computer software]. College Station, TX: StataCorp LP.

Steptoe, A., Breeze, E., Banks, J. and Nazroo, J. (2013). Cohort profile: the English Longitudinal Study of Ageing. *International Journal of Epidemiology*, 42, 1640–1648. doi: 10.1093/ije/dys168.

Suh. E., Diener, E. and Fujita, F. (1996). Events and subjective well-being: only recent events matter. *Journal of Personality and Social Psychology*, 70, 1091–1102. doi: 10.1037/0022-3514.70.5.1091.

Turner, R. J. and Lloyd, D. A. (1995). Lifetime traumas and mental health: the significance of cumulative adversity. *Journal of Health and Social Behavior*, 36, 360–376. doi: 10.2307/2137325.

Turner, H. A. and Schieman, S. (2008). Stress processes across the life course: introduction and overview. *Advances in Life Course Research*, 13, 1–15. doi: 10.1016/S1040-2608(08)00001-4.

Turvey, C. L., Wallace, R. B. and Herzog, R. (1999). A revised CES-D measure of depressive symptoms and a DSM-based measure of major depressive episodes in the elderly. *International Psychogeriatrics*, 11, 139–148. doi: 10.1017/S1041610299005694.

Vanhoutte, B. (2014). The multidimensional structure of subjective wellbeing in later life. *Journal of Population Ageing*, 7, 1–20. doi: 10.1007/s12062-014-9092-9.

Weiss, T. (2004). Correlates of posttraumatic growth in husbands of breast cancer survivors. *Psycho-oncology*, 13, 260–268. doi: 10.1002/pon.735.

Wheaton, B. (1994). Sampling the stress universe. In W. R. Avison, and I. H. Gotlib (Eds.) Stress and mental health: contemporary issues and prospects for the future (pp. 77–114). New York: Plenum Press.

White, J., et al. (2016). Duration of depressive symptoms and mortality risk: the English Longitudinal Study of Ageing (ELSA). *British Journal of Psychiatry*, 208, 337-342. doi: 10.1192/bjp.bp.114.155333.

World Health Organization. (2013). Mental Health Action Plan 2013–2020 (p. 17). Geneva: World Health Organization.

Figures

Figure 1. Cumulative proportions of respondents in the ELSA Wave 3 Life History module experiencing specific adverse events by age (weighted, n=4,521)

Cumulative proportion experiencing adverse events by age
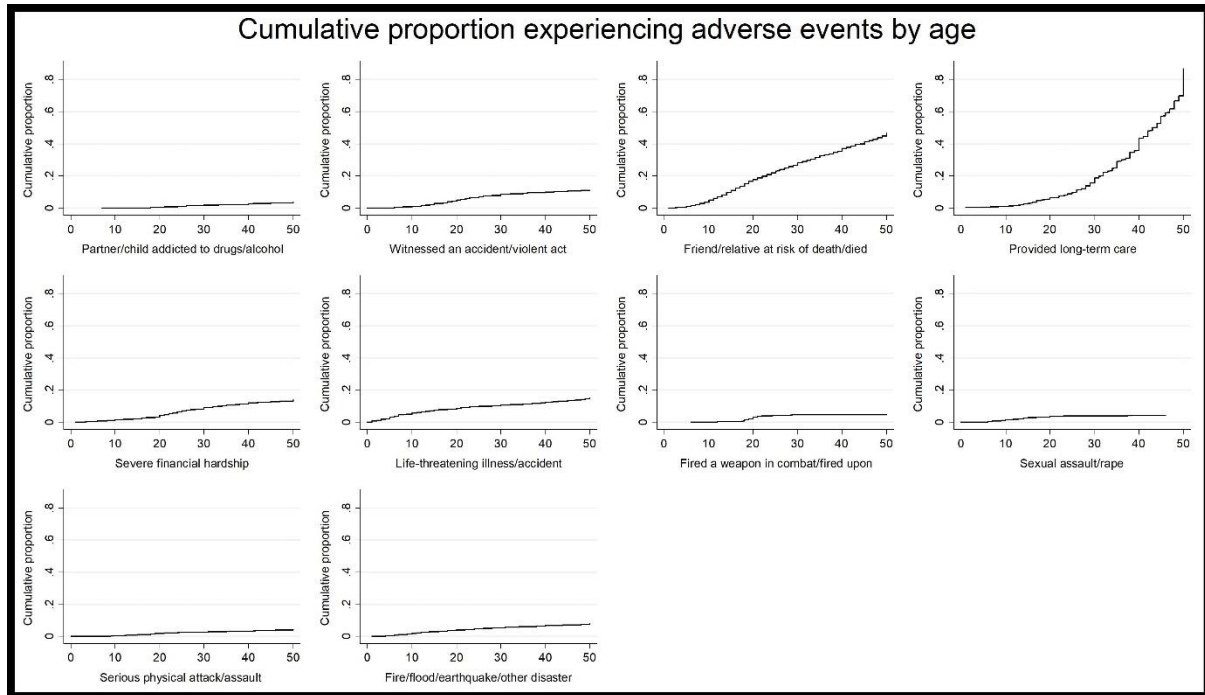
Tables

Table 1. A summary of adverse life events in ELSA Wave 3 Life History Module by self- or other-orientation and proportions of respondents experiencing specific adverse events by age 16 and age 50 (weighted, n=4,521)

Orientation	Adverse life events (any age)	Experienced by age 16 (%)	Experienced by age 50 (%)
Self-oriented	Ever experienced a major fire, flood, earthquake or other natural disaster	3.0	7.9
	Ever had a life-threatening illness or accident	7.7	15.7
	Ever been a victim of serious physical attack or assault	1.2	4.3
	Ever been a victim of sexual assault (including rape or harassment)	2.7	4.0
	Ever fired a weapon in combat or been fired upon	0.4	5.1
	Ever experienced severe financial hardship	2.3	14.3
Other-oriented	Ever provided long-term care to disabled/impaired relative or friend	79.8	90.6
	Ever had a husband/wife/partner/child who has been addicted to drugs or alcohol	0.1	3.5
	Ever witnessed accident/violent act when someone was killed/seriously wounded (not war)	2.8	11.6
	Ever had a friend/relative at risk of death/died due to illness/serious accident	10.7	47.7
Adverse events in childhood (before 16 years)			
Self-oriented	Whether physically abused by parents	2.2	N/A
	Whether separated from mother for 6 months or more	13.1	
Other-oriented	Whether parents ever permanently separated or divorced	4.0	N/A
	Whether parents argued or fought very often	13.9	
	Whether either parent was involuntarily unemployed for over 6 months	5.4	
	Whether parents drank/took drugs/had mental health problems	4.3	

Table 2. Complete results of fully-adjusted model for the association between total adverse events (0–49 years) and CASP-12 scores (n=20,176 observations/4,176 unique individuals) and CES-D depressive caseness (n=22,039 observations/4,208 unique individuals)

Variable	Categories	CASP-12		CES-D depressive caseness	
		Coefficient (95% CI)	p	OR (95% CI)	p
Adverse events	Total (0–49 years)	-0.49 (-0.58, -0.41)	<0.001	1.19 (1.14, 1.25)	<0.001
Age		-0.14 (-0.15, -0.13)	<0.001	0.99 (0.98, 1.00)	0.023
Gender	Male	ref		ref	
	Female	0.39 (0.12, 0.67)	0.005	1.51 (1.28, 1.78)	<0.001
Physical frailty index	Frailty Index	-8.83 (-9.47, -8.18)	<0.001	1497.46 (887.14, 2527.66)	<0.001
Current labour market status (self-reported)	Retired	ref		ref	
	In paid employment	-0.58 (-0.75, -0.41)	<0.001	1.05 (0.88, 1.25)	0.599
	Unemployed	-1.06 (-1.64, -0.48)	<0.001	1.87 (1.07, 3.26)	0.029
	Permanently sick or disabled	-1.77 (-2.13, -1.41)	<0.001	1.31 (0.99, 1.74)	0.055
	Looking after home / other	-0.38 (-0.60, -0.16)	0.001	1.33 (1.08, 1.62)	0.007
Participation in social activities	Never	ref		ref	
	Yes	0.55 (0.42, 0.67)	<0.001	0.71 (0.63, 0.80)	<0.001
Partnership status	Partnered	ref		ref	
	Non-partnered	-0.43 (-0.66, -0.21)	<0.001	2.28 (1.95, 2.67)	<0.001
Born abroad	No	ref		ref	
	Yes	-0.06 (-0.62, 0.50)	0.841	1.09 (0.79, 1.52)	0.591
Quintile of household net worth	1 (poorest)	ref		ref	
	2	0.40 (0.19, 0.62)	<0.001	0.93 (0.77, 1.13)	0.475
	3	0.74 (0.52, 0.96)	<0.001	0.71 (0.58, 0.87)	0.001
	4	1.20 (0.97, 1.43)	<0.001	0.64 (0.52, 0.79)	<0.001
	5	1.50 (1.25, 1.75)	<0.001	0.62 (0.50, 0.78)	<0.001
Household income	Logged equivalized income	0.14 (0.04, 0.23)	0.005	0.88 (0.80, 0.96)	0.006
Housing tenure	Outright ownership	ref		ref	
	Ownership with mortgage	-0.52 (-0.70, -0.33)	<0.001	0.94 (0.79, 1.12)	0.481
	Renting / other	-0.60 (-0.91, -0.28)	<0.001	1.17 (0.95, 1.44)	0.144
NS-SEC (five-category)	I. Managerial / professional occupations	0.90 (0.62, 1.17)	<0.001	0.82 (0.68, 0.99)	0.043
	II. Intermediate occupations	0.73 (0.40, 1.05)	<0.001	0.85 (0.68, 1.07)	0.167
	III. Small employers/ own account workers	0.54 (0.20, 0.89)	0.002	0.78 (0.61, 1.00)	0.046
	IV. Technical occupations	0.38 (0.01, 0.76)	0.046	0.84 (0.64, 1.09)	0.182
	V. Semi routine / routine occupations	ref		ref	
	Never worked	-1.23 (-2.75, 0.29)	0.113	0.72 (0.30, 1.71)	0.458

Table 3. Results of fully-adjusted models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and CASP-12 scores (n=20,701 observations/4,176 unique individuals)

Categories	Model A* Coefficient (95% CI)	p	Model B Coefficient (95% CI)	p	Model C Coefficient (95% CI)	p	Model D Coefficient (95% CI)	p	Model E Coefficient (95% CI)	p
Total (0–49 years)	-0.49 (-0.58, -0.41)	<0.001								
Early childhood (0–5 years)			-0.38 (-0.65, -0.11)	0.005						
Late childhood (6–15 years)			-0.41 (-0.56, -0.26)	<0.001						
Early adulthood (16–30 years)			-0.58 (-0.75, -0.40)	<0.001						
Late adulthood (31–49 years)			-0.59 (-0.78, -0.41)	<0.001						
Self-oriented, total (0–49 years)					-0.41 (-0.56, -0.26)	<0.001				
Other-oriented, total (0–49 years)					-0.57 (-0.70, -0.43)	<0.001				
Self-oriented, childhood (0–15 years)							-0.10 (-0.32, 0.11)	0.354		
Self-oriented, adulthood (16–49 years)							-0.71 (-0.92, -0.49)	<0.001		
Other-oriented, childhood (0–15 years)							-0.63 (-0.82, -0.44)	<0.001		
Other-oriented, adulthood (16–49 years)							-0.50 (-0.68, -0.31)	<0.001		
Self-oriented, early childhood (0–5 years)									0.07 (-0.34, 0.49)	0.738
Self-oriented, late childhood (6–15 years)									-0.16 (-0.42, 0.09)	0.208
Self-oriented, early adulthood (16–30									-0.47 (-0.75, -0.20)	0.001
Self-oriented, late adulthood (31–49									-1.07 (-1.43, -0.71)	<0.001
Other-oriented, early childhood (0–5									-0.83 (-1.23, -0.43)	<0.001
Other-oriented, late childhood (6–15									-0.58 (-0.80, -0.37)	<0.001
Other-oriented, early adulthood (16–30									-0.63 (-0.89, -0.38)	<0.001
Other-oriented, late adulthood (31–49									-0.38 (-0.61, -0.14)	0.002

*All models were fully adjusted for covariates including age, gender, physical frailty index, current labour market status, participation in social activities, partnership status, quintile of household net worth, household income, housing tenure at the time of interview, birth abroad and last-known occupational position (five-category NS-SEC).

Table 4. Results of fully-adjusted models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and CES-D depressive caseness (n=22,039 observations/4,208 unique individuals)

Categories	Model A* Odds ratio (95% CI)	p	Model B Odds ratio (95% CI)	p	Model C Odds ratio (95% CI)	p	Model D Odds ratio (95% CI)	p	Model E Odds ratio (95% CI)	p
Total (0–49 years)	1.19 (1.14, 1.25)	<0.001								
Early childhood (0–5 years)			1.23 (1.06, 1.42)	0.005						
Late childhood (6–15 years)			1.17 (1.08, 1.27)	<0.001						
Early adulthood (16–30 years)			1.20 (1.08, 1.32)	<0.001						
Late adulthood (31–49 years)			1.20 (1.08, 1.33)	0.001						
Self-oriented, total (0–49 years)					1.20 (1.10, 1.30)	<0.001				
Other-oriented, total (0–49 years)					1.18 (1.10, 1.28)	<0.001				
Self-oriented, childhood (0–15 years)							1.07 (0.95, 1.21)	0.261		
Self-oriented, adulthood (16–49 years)							1.33 (1.18, 1.50)	<0.001		
Other-oriented, childhood (0–15 years)							1.27 (1.14, 1.40)	<0.001		
Other-oriented, adulthood (16–49 years)							1.10 (0.99, 1.22)	0.063		
Self-oriented, early childhood (0–5 years)									1.01 (0.80, 1.26)	0.951
Self-oriented, late childhood (6–15 years)									1.09 (0.95, 1.26)	0.231
Self-oriented, early adulthood (16–30									1.37 (1.18, 1.60)	<0.001
Self-oriented, late adulthood (31–49									1.26 (1.04, 1.53)	0.019
Other-oriented, early childhood (0–5									1.46 (1.18, 1.80)	0.001
Other-oriented, late childhood (6–15									1.21 (1.07, 1.36)	0.002
Other-oriented, early adulthood (16–30									1.04 (0.90, 1.21)	0.574
Other-oriented, late adulthood (31–49									1.14 (1.00, 1.31)	0.043

*All models were fully adjusted for covariates including age, gender, physical frailty index, current labour market status, participation in social activities, partnership status, quintile of household net worth, household income, housing tenure at the time of interview, birth abroad and last-known occupational position (five-category NS-SEC).

Online supplement

Tables

Table S1. Characteristics of the analytic sample for ELSA Wave 3 respondents and for observations in ELSA Waves 1–7

Exposure measures		Wave 3 respondents (n=3,459)[1]		Observations, Waves 1–7 (n=22,146)[2]	
Variable	Categories	mean		mean	
Adverse events by life course stage	Total (0–49 years)	1.65		1.68	
	Early childhood (0–5 years)	0.18		0.18	
	Late childhood (6–15 years)	0.55		0.56	
	Early adulthood (16–30 years)	0.47		0.47	
	Late adulthood (31–49 years)	0.44		0.46	
Adverse events by self- or other-orientation and life course stage	Self-oriented, total (0–49 years)	0.65		0.65	
	Other-oriented, total (0–49 years)	0.99		1.02	
	Self-oriented, childhood (0–15 years)	0.33		0.33	
	Self-oriented, adulthood (16–49 years)	0.33		0.32	
	Other-oriented, childhood (0–15 years)	0.40		0.41	
	Other-oriented, adulthood (16–49 years)	0.59		0.61	
Covariates					
Variable	Categories	mean		mean	
Frailty index	Frailty Index	0.13		0.11	
Household income	Equivalized income (2011 £)	18,880.08		19,589.45	
Age	Years	67.35		67.36	
		n	%	n	%
Gender	Male	1,613	46.6	10,237	46.2
	Female	1,846	53.4	11,909	53.8
Current labour market status (self-reported)	Retired	2,045	59.1	13,319	60.1
	In paid employment	998	28.9	6,461	29.2
	Unemployed	27	0.78	151	0.7
	Permanently sick or disabled	113	3.3	674	3.0
	Looking after home / other	276	8.0	1,541	7.0
Participation in social activities	Never	1,415	40.9	8,555	38.6
	Yes	2,044	59.1	13,591	61.4
Partnership status	Partnered	2,464	71.2	16,059	72.5
	Non-partnered	995	28.8	6,087	27.5
Born abroad	No	3,301	95.4	21,023	94.9
	Yes	158	4.6	1,123	5.1
Quintile of household net worth	1 (poorest)	432	12.5	2,654	12.0
	2	556	16.1	3,492	15.8
	3	725	21.0	4,618	20.9
	4	798	23.1	5,193	23.5
	5	948	27.4	6,189	28.0
Housing tenure	Outright ownership	2,376	68.7	15,636	70.6
	Ownsership with mortgage	634	18.3	3,834	17.3
	Renting / other	449	13.0	2,676	12.1
NS-SEC (five-category)	I. Managerial / professional occupations	1,239	35.8	8,256	37.3
	II. Intermediate occupations	524	15.2	3,351	15.1
	III. Small employers/ own account workers	384	11.1	2,556	11.5
	IV. Technical occupations	333	9.6	2,112	9.5
	V. Semi routine / routine occupations	944	27.3	5,738	26.1
	Never worked	35	1.0	103	0.5

[1]3,459 of 4,208 respondents in Wave 3 with complete information on adverse events and their age of occurrence also had complete covariate data in Wave 3. [2]The 4,208 respondents with complete information on adverse events and their age of occurrence in Wave 3 gave 22,146 observations over Waves 1–7 in which they had complete covariate data.

Table S2. Complete results of fully-adjusted model for the association between total adverse events (0–49 years) subjective life satisfaction scores (n=17,948 observations/4,152 unique individuals)

Variable	Categories	Subjective life satisfaction	
		Coefficient (95% CI)	p
Adverse events	Total (0–49 years)	-0.11 (-0.13, -0.09)	<0.001
Age		0.00 (0.00, 0.00)	0.918
Gender	Male	ref	
	Female	-0.03 (-0.10, 0.03)	0.302
Physical frailty index	Frailty Index	-1.76 (-1.94, -1.57)	<0.001
Current labour market status (self-reported)	Retired	ref	
	In paid employment	-0.08 (-0.14, -0.03)	0.002
	Unemployed	-0.48 (-0.66, -0.29)	<0.001
	Permanently sick or disabled	-0.50 (-0.61, -0.39)	<0.001
	Looking after home / other	-0.07 (-0.14, 0.00)	0.038
Participation in social activities	Never	ref	
	Yes	0.12 (0.08, 0.16)	<0.001
Partnership status	Partnered	ref	
	Non-partnered	-0.41 (-0.47, -0.34)	<0.001
Born abroad	No	ref	
	Yes	0.11 (-0.03, 0.24)	0.113
Quintile of household net worth	1 (poorest)	ref	
	2	0.07 (0.00, 0.13)	0.047
	3	0.10 (0.03, 0.17)	0.004
	4	0.14 (0.07, 0.22)	<0.001
	5	0.18 (0.10, 0.25)	<0.001
Household income	Logged equivalized income	0.02 (-0.01, 0.05)	0.170
Housing tenure	Outright ownership	ref	
	Ownership with mortgage	-0.06 (-0.12, 0.00)	0.036
	Renting / other	-0.09 (-0.17, 0.00)	0.041
NS-SEC (five-category)	I. Managerial / professional occupations	0.06 (-0.02, 0.13)	0.121
	II. Intermediate occupations	0.01 (-0.08, 0.10)	0.820
	III. Small employers/ own account workers	0.03 (-0.06, 0.13)	0.456
	IV. Technical occupations	0.03 (-0.07, 0.13)	0.572
	V. Semi routine / routine occupations	ref	
	Never worked	0.02 (-0.33, 0.38)	0.891

2

Table S3. Results of fully-adjusted models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and life satisfaction scores (n=17,948 observations/4,152 unique individuals)

Categories	Model A* Coefficient (95% CI)	p	Model B Coefficient (95% CI)	p	Model C Coefficient (95% CI)	p	Model D Coefficient (95% CI)	p	Model E Coefficient (95% CI)	p
Total (0–49 years)	-0.11 (-0.13, -0.09)	<0.001								
Early childhood (0–5 years)			-0.07 (-0.13, -0.01)	0.026						
Late childhood (6–15 years)			-0.11 (-0.14, -0.07)	<0.001						
Early adulthood (16–30 years)			-0.11 (-0.15, -0.07)	<0.001						
Late adulthood (31–49 years)			-0.12 (-0.17, -0.08)	<0.001						
Self-oriented, total (0–49 years)					-0.08 (-0.12, -0.05)	<0.001				
Other-oriented, total (0–49 years)					-0.13 (-0.16, -0.09)	<0.001				
Self-oriented, childhood (0–15 years)							-0.04 (-0.09, 0.01)	0.118		
Self-oriented, adulthood (16–49 years)							-0.13 (-0.18, -0.08)	<0.001		
Other-oriented, childhood (0–15 years)							-0.14 (-0.19, -0.10)	<0.001		
Other-oriented, adulthood (16–49 years)							-0.11 (-0.15, -0.07)	<0.001		
Self-oriented, early childhood (0–5 years)									-0.02 (-0.12, 0.08)	0.716
Self-oriented, late childhood (6–15 years)									-0.05 (-0.11, 0.01)	0.097
Self-oriented, early adulthood (16–30									-0.10 (-0.16, -0.03)	0.004
Self-oriented, late adulthood (31–49									-0.18 (-0.26, -0.09)	<0.001
Other-oriented, early childhood (0–5									-0.12 (-0.22, -0.03)	0.009
Other-oriented, late childhood (6–15									-0.15 (-0.20, -0.10)	<0.001
Other-oriented, early adulthood (16–30									-0.12 (-0.18, -0.06)	<0.001
Other-oriented, late adulthood (31–49									-0.10 (-0.15, -0.04)	<0.001

*All models were fully adjusted for covariates including age, gender, physical frailty index, current labour market status, participation in social activities, partnership status, quintile of household net worth, household income, housing tenure at the time of interview, birth abroad and last-known occupational position (five-category NS-SEC).

Figures

Figure S1. Flow diagram describing the definition of the ELSA Wave 3 sample for investigation of adverse events
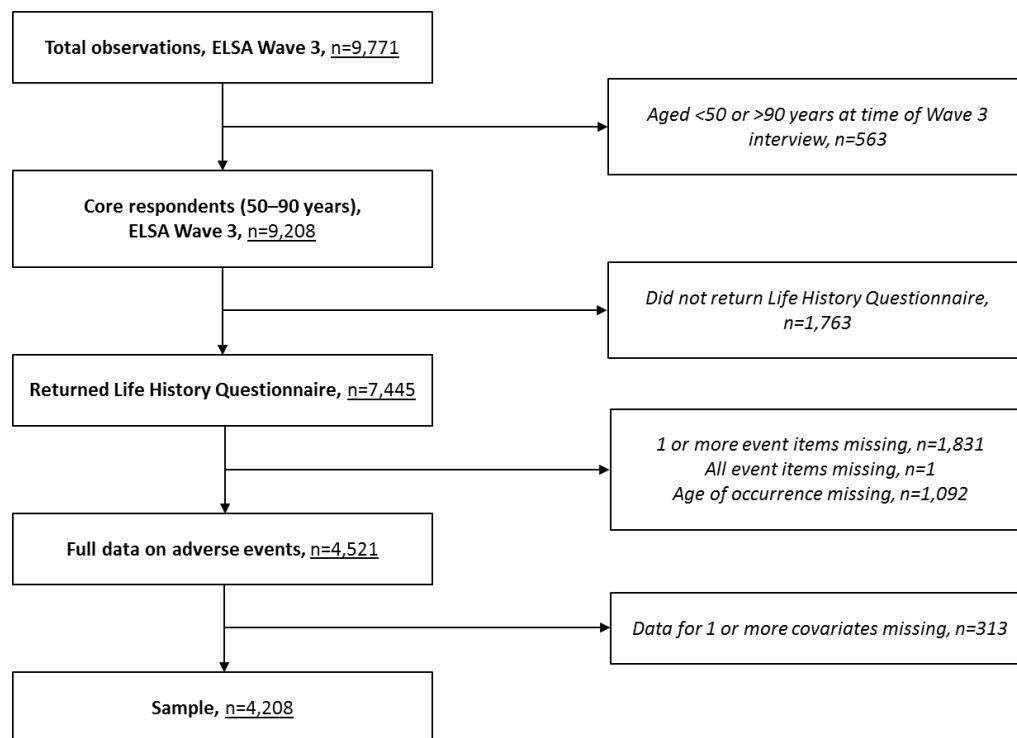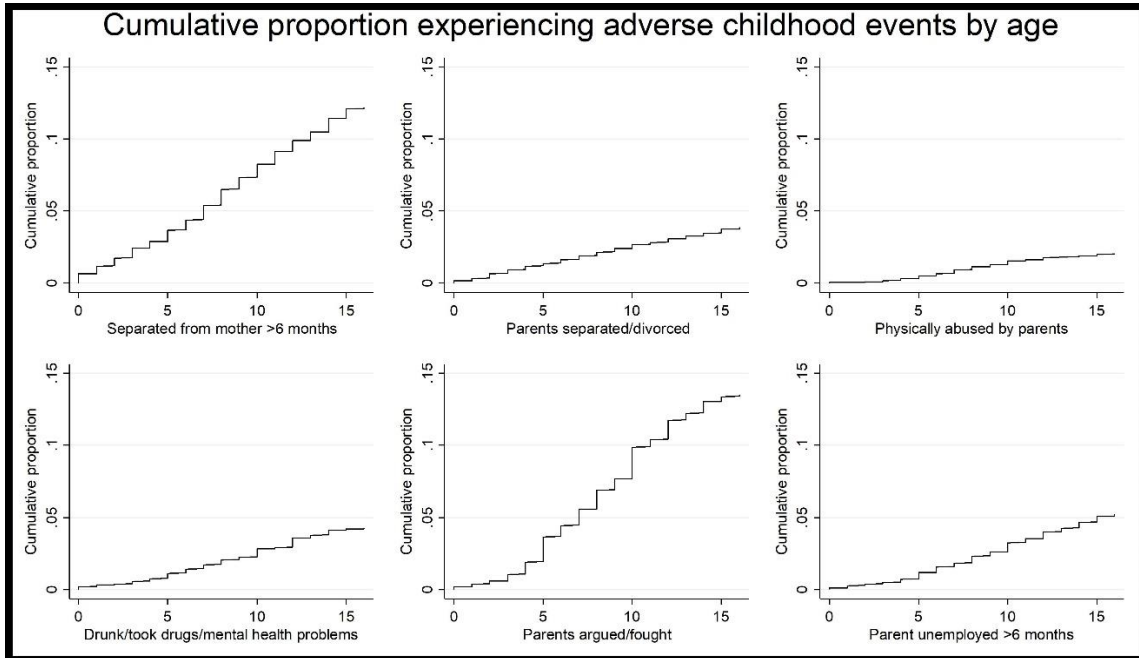
Figure S2. Cumulative proportions of respondents in the ELSA Wave 3 Life History module experiencing specific adverse events in childhood by age (weighted, n=4,521)

Cumulative proportion experiencing adverse childhood events by age

5

Appendices

Appendix A1: The CASP-12 scale encompasses twelve items across four domains: Control ("How often do you think your age prevents you from doing the things you would like to do?" "How often do you feel that what happens to you is out of your control?*" "How often do you feel left out of things?*"), Autonomy ("How often do you think that you can do the things that you want to do?" "How often do you think that family responsibilities prevent you from doing what you want to do?*" "How often do you think that shortage of money stops you from doing the things you want to do?*"), Self-realisation ("How often do you look forward to each day?" "How often do you feel that your life has meaning?" "How often, on balance, do you look back on your life with a sense of happiness?"), and Pleasure ("How often do you feel full of energy these days?" "How often do you feel that life is full of opportunities?" "How often do you feel that the future looks good for you?"). Responses were rated on a four-point Likert scale and scored from one to four. Asterisked items were reverse-coded. CASP-12 summary scores were obtained by summing scores across all individual items. Possible scores ranged from 12 to 48 with higher scores representing a higher degree of wellbeing. The CASP scale (including its CASP-12 and CASP-19 variants) has been validated using exploratory (Hyde, Wiggins, Higgs and Blane, 2003; Vanhoutte, 2014; Higgs, Hyde, Wiggins and Blane, 2003) and confirmatory (Vanhoutte, 2014; Sexton, King-Kallimanis, Conroy and Hickey, 2013; Wiggins, Netuveli, Hyde, Higgs and Blane, 2008) factor analyses.

References

Higgs, P., Hyde, M., Wiggins, R. and Blane, D. B. (2003). Researching quality of life in early old age: the importance of the sociological dimension. *Social Policy and Administration*, 37, 239–252. doi: 10.1111/1467-9515.00336.

6

Hyde, M., Wiggins, R. D., Higgs, P. and Blane, D. B. (2003) .A measure of quality of life in early old age: the theory, development and properties of a needs satisfaction model (CASP-19). *Aging & Mental Health*, 7, 186–194. doi: 10.1080/1360786031000101157.

Sexton, E., King-Kallimanis, B. L., Conroy, R. M. and Hickey, A. (2013). Psychometric evaluation of the CASP-19 quality of life scale in an older Irish cohort. *Quality of Life Research*, 22, 2549–2559. doi: 10.1007/s11136-013-0388-7.

Vanhoutte, B. (2014). The multidimensional structure of subjective wellbeing in later life. *Journal of Population Ageing*, 7, 1–20. doi: 10.1007/s12062-014-9092-9.

Wiggins, R., Netuveli, G., Hyde, M., Higgs, P. and Blane, D. B. (2008). The evaluation of a self-enumerated scale of quality of life (CASP 19) in the context of research on ageing: a combination of explanatory and confirmatory approaches. *Social Indicators Research*, 89, 61–77. doi: 10.1007/s11205-007-9220-5.

Appendix A2: Depression outcomes were measured using the eight-item Centre of Epidemiological Studies Depression Scale (CES-D). Items comprised eight self-reported depressive symptoms including "depressed", "felt that activities were an effort", "restless during sleep", "lonely", "sad", "could not get going" or did not "enjoy life" in the past week. Scores from zero to eight were derived based on the self-reported number of symptoms. *A score of 3 or more was used to define probable depressive caseness.*

In addition to high reliability and validity, measures of CES-D collected using the self-completion version of the questionnaire (as in the present study) have been shown to have a high sensitivity and specificity both in an English sample (89% and 86% respectively) and in populations in other countries (Head et al., 2013).

References

Head. J. *et al*. (2013). Use of self-administered instruments to assess psychiatric disorders in older people: validity of the General Health Questionnaire, the Center for Epidemiologic Studies Depression Scale and the self-completion version of the revised Clinical Interview Schedule. *Psychological Medicine*, 43, 2649–2656. doi: 10.1017/S0033291713000342.

Appendix A3: Self-reported subjective life satisfaction was measured in ELSA participants using the question "Please say how much you agree or disagree with the following statement: I am satisfied with my life." Responses were given on a Likert scale ("strongly agree", "agree", "slightly agree", "neither agree nor disagree", "slightly disagree", "disagree" or "strongly disagree") and scored from zero to seven with a score of seven representing the highest level life satisfaction and corresponding to a response of "strongly agree". Although data on subjective life satisfaction was available in Wave 1 of ELSA, observations could not be harmonized with other waves as it employed a different response scale.

Appendix A4: The physical frailty index comprised the following 36 items: medically diagnosed conditions including myocardial infarction, hypertension, stroke, diabetes or elevated blood sugar, chronic obstructive pulmonary disease, arthritis, osteoporosis, cancer, Parkinson's disease and cataracts; medical symptoms including problem sleeping or restlessness, difficulty seeing objects at distance and difficulty seeing objects at arm's length; difficulties with functional activities including walking short distances (100 yards), sitting for long periods (≥2 hours), standing up from sitting down, climbing several flights of stairs, climbing one flight of stairs without resting, kneeling or crouching, extending arms above shoulders, pulling or pushing large objects, carrying or lifting heavy objects (≥10lbs) and picking up a small coin from a table; and difficulties with activities of daily living including dressing (including shoes and socks), walking across a room, bathing or showering, eating independently, getting in or out of bed, using the toilet (including getting up or down), using a map to navigate in a strange place, preparing a hot meal, shopping for groceries, making telephone calls, taking medication, work in the home or garden and managing money. Each item was assigned one point and these were summed to generate an index score from 1 to 36. Scores were rescaled to give a continuous variable with a range of 0 to 1. For more information, see Richardson et al. (2018).

References

Richardson, S., Carr, E., Netuveli, G. and Sacker, A. (2018). Country-level welfare-state measures and change in wellbeing following work exit in early old age: evidence from 16 European countries. *International Journal of Epidemiology*, 48, 389–401. doi: 10.1093/ije/dyy205.

Appendix A5: Activities included participating in a political party, trade union or environmental group, tenant group, resident group or neighbourhood watch, charitable association, education, arts or music group, a social club, or sports club, gym or exercise class.

Appendix A6: A manual likelihood-ratio-test-based forward stepwise selection procedure was used to determine which independent variables would be included in the final model in addition to measures of exposure to adverse events according to their age of occurrence, or self or other orientation, over the life course. The significance level for inclusion in the model was p=0.05.

We attempted to identify the widest-possible range of covariates available over Waves 1–7 of ELSA covering health, socioeconomic position, and other factors, to adjust for potential confounding of the association between experiences of adverse events and later-life wellbeing and depression outcomes. The list of potential covariates was defined a priori, based on the full list of covariates considered for inclusion in a previous analysis conducted by Richardson et al. (2018) on the association between route and timing of work exit and change in wellbeing following labour market transitions, excluding variables related to work and labour market exit (route of exit from work, age at exit from work, number of hours worked per week, effort-reward ratio in employment), but including current labour market status and last-known occupational position measured using the five-category National Statistics Socio-economic Classification (NS-SEC) groupings. The final list of potential covariates included age, gender, physical frailty index, current labour market status, participation in social activities, partnership status, quintile of household net worth, equivalized household income, housing tenure at the time of interview, birth abroad and last-known occupational position. This model selection procedure was applied to CASP-12 outcomes, and it was found that the best-fit model was the maximally-adjusted model with all covariates included. The same covariates were employed in analyses of CES-D and subjective life satisfaction outcomes.

The table below shows models for all three outcomes adjusted for different groups of covariates to determine whether their inclusion in the model influenced the association between exposure to adverse events and wellbeing outcomes. After fitting unadjusted multilevel models for the associations between total adverse events (0–49 years) and CASP-12, CES-D depression caseness and and subjective life satisfaction scores, five further models were fitted for each of these outcomes. Model 1 adjusted for frailty index and age. Model 2 further adjusted for gender, current labour

12

market status, participation in activities, partnership status and birth abroad. While both Models 3 and 4 included all covariates fitted in Model 2, Model 3 further adjusted for NS-SEC) and Model 4 adjusted for household net worth, household income and housing tenure. A fully-adjusted model was then fitted with inclusion of all variables mentioned above.

We considered whether the model covariates may act as mediators rather than confounders for the associations tested (VanderWeele, 2016). The results of the six models show that counts of adverse events were significantly and independently associated with all three outcomes, and that effect sizes were similar and unattenuated regardless of covariates included. This finding suggests that the covariates included in the fully-adjusted model were unlikely to act as mediators for the relationship between experiences of adverse events and later-life wellbeing and depression outcomes.

Results of linear and logistic random-effects regression models for the associations between total counts of adverse life events (0–49 years) and CASP-12 scores, CES-D depressive caseness (logistic model) and subjective life satisfaction scores with adjustment for different groups of covariates

| | Total adverse life events (0–49 years) | | | | | |
| | CASP-12 (n=20,701 observations /4,176 unique individuals) | | CES-D (n=22,039 observations /4,208 unique individuals) | | Subjective life satisfaction (n=17,948 observations /4,152 unique individuals) | |
Model	Coefficient (95% CI)	p	Odds ratio (95% CI)	p	Coefficient (95% CI)	p
No adjustment	-0.53 (-0.63, -0.44)	<0.001	1.29 (1.22, 1.36)	<0.001	-0.14(-0.15, -0.11)	<0.001
Model 1	-0.52 (-0.61, -0.44)	<0.001	1.19 (1.14, 1.25)	<0.001	-0.11 (-0.13, -0.09)	<0.001
Model 2	-0.52 (-0.60, -0.43)	<0.001	1.21 (1.16, 1.27)	<0.001	-0.11 (-0.13, -0.09)	<0.001
Model 3	-0.53 (-0.62, -0.44)	<0.001	1.22 (1.16, 1.28)	<0.001	-0.12 (-0.14, -0.10)	<0.001
Model 4	-0.49 (-0.58, 0.41)	<0.001	1.19 (1.14, 1.26)	<0.001	-0.11 (-0.13, -0.09)	<0.001
Full model	-0.49 (-0.58, 0.41)	<0.001	1.19 (1.14, 1.25)	<0.001	-0.11 (-0.13, -0.09)	<0.001

Model 1: frailty index and age
Model 2: Model 1 + gender, current labour market status, participation in activities, partnership status and born abroad
Model 3: Model 2 + NS-SEC
Model 4: Model 2 + household net worth, household income and housing tenure
Full Model: Model 2 + NS-SEC, household net worth, household income and housing tenure (all covariates)

References

Richardson, S., Carr, E., Netuveli, G. and Sacker, A. (2018). Country-level welfare-state measures and change in wellbeing following work exit in early old age: evidence from 16 European countries. *International Journal of Epidemiology*, 48, 389–401. doi: 10.1093/ije/dyy205.

VanderWeele, T. J. (2016). Mediation analysis: a practitioner's guide. *Annual* Review of *Public Health*, 37, 17–32. doi: 10.1146/annurev-publhealth-032315-021402.

Appendix A7: We fitted fully-adjusted fixed-effects linear and logistic regression models for models for the association between total adverse events (0–49 years), and CASP-12 scores, CES-D depressive caseness (logistic model) and subjective life satisfaction scores (Model A) for the purposes of calculating variance inflation factors (VIFs) to measure the degree of multicollinearity for each model covariate. Random-effects models were not fitted as calculation of VIFs was not supported in Stata 14.

VIF provides an index of how much the variance of a given estimated regression coefficient in a multivariate model is increased due to collinearity with other covariates, compared with that of a model with one term alone. A VIF of 10 is typically considered to signify a problematic degree of multicollinearity for a model variable (Neter et al., 1989).

VIFs for linear regression models were calculated using the `estat vif` command. The package and command `collin` was used for calculating results for CES-D depressive caseness outcomes as a logistic model was used.

The table below shows the VIFs for each model covariate from the three models fitted. In no instance did the VIF for any model covariate exceed 3.5; this suggests that multicollinearity was unlikely to have posed a significant issue for model estimation.

References

Neter, J., Wasserman, W. and Kutner, M. H. (1989). Applied Linear Regression Models. Homewood, IL: Irwin.

Table of variance inflation factors (VIFs) for covariates of fully-adjusted fixed-effects models for the association between total adverse events (0–49 years), and CASP-12 scores (n=20,176), CES-D depressive caseness (n=22,039) and subjective life satisfaction scores (n=17,948) (Model A)

Variable	Categories	CASP-12 VIF	CES-D depressive caseness VIF	Subjective life satisfaction VIF
Adverse events	Total (0–49 years)	1.05	1.05	1.05
Age		1.86	1.88	1.81
Gender	Male			
	Female	1.26	1.26	1.25
Physical frailty index	Frailty Index	1.31	1.32	1.32
Current labour market status (self-reported)	Retired			
	In paid employment	1.86	1.87	1.78
	Unemployed	1.04	1.04	1.04
	Permanently sick or disabled	1.27	1.27	1.25
	Looking after home / other	1.13	1.13	1.12
Participation in social activities	Never			
	Yes	1.08	1.08	1.08
Partnership status	Partnered			
	Non-partnered	1.23	1.24	1.24
Born abroad	No			
	Yes	1.01	1.01	1.01
Quintile of household net worth	1 (poorest)			
	2	2.07	2.06	2.12
	3	2.53	2.49	2.59
	4	2.83	2.77	2.86
	5	3.45	3.37	3.49
Household income	Logged equivalized income	1.39	1.40	1.05
Housing tenure	Outright ownership			
	Ownership with mortgage	1.33	1.33	1.31
	Renting / other	1.30	1.30	1.29
NS-SEC (five-category)	I. Managerial / professional occupations	1.91	1.88	1.90
	II. Intermediate occupations	1.44	1.42	1.43
	III. Small employers/ own account workers	1.35	1.34	1.35
	IV. Technical occupations	1.30	1.29	1.30
	V. Semi routine / routine occupations			
	Never worked	1.02	1.02	1.03

Appendix A8: The table below shows results of a random-effects Poisson model for the association between total adverse events (0–49 years) and count of CES-D symptoms. There was a significant association between events experienced and number of CES symptoms identified (p<0.001).

Results of a fully-adjusted random-effects Poisson model for the association between adverse events (0–49 years) and CES-D depressive caseness (n=22,039 observations/4,208 unique individuals)

Variable	Categories	CES-D depressive caseness	
		Coefficient (95% CI)	p
Adverse events	Total (0–49 years)	0.09 (0.13, 0.09)	<0.001
Age		0.00 (0.01, 0.00)	0.168
Gender	Male	ref	
	Female	0.29 (0.23, 0.36)	<0.001
Physical frailty index	Frailty Index	-.64 (2.49, 2.79)	<0.001
Current labour market status (self-reported)	Retired	ref	
	In paid employment	0.02 (-0.04, 0.07)	0.529
	Unemployed	0.18 (0.03, 0.33)	0.018
	Permanently sick or disabled	0.07 (0.00, 0.14)	0.056
	Looking after home / other	0.08 (0.02, 0.14)	0.007
Participation in social activities	Never	ref	
	Yes	-0.12 (-0.16, -0.09)	<0.001
Partnership status	Partnered	ref	
	Non-partnered	0.39 (0.33, 0.44)	<0.001
Born abroad	No	ref	
	Yes	0.04 (-0.09, -0.18)	0.514
Quintile of household net worth	1 (poorest)	ref	
	2	-0.05 (-0.10, 0.01)	0.085
	3	-0.14 (-0.20, -0.08)	<0.001
	4	-0.18 (-0.24, -0.12)	<0.001
	5	-0.21 (-0.27, -0.14)	<0.001
Household income	Logged equivalized income	-0.03 (-0.06, -0.01)	0.014
Housing tenure	Outright ownership	ref	
	Ownership with mortgage	0.04 (-0.02, 0.09)	0.161
	Renting / other	0.08 (0.01, 0.16)	0.027
NS-SEC (five-category)	I. Managerial / professional occupations	-0.11 (-0.18, -0.04)	0.002
	II. Intermediate occupations	-0.13 (-0.21, -0.04)	0.004
	III. Small employers/ own account workers	-0.15 (-0.24, -0.06)	0.001
	IV. Technical occupations	-0.03 (-0.13, 0.06)	0.501
	V. Semi routine / routine occupations	ref	
	Never worked	-0.04 (-0.38, 0.29)	0.806

Appendix A9: We conducted a sensitivity analysis to provide evidence against the hypothesis that there exists reverse causation between reporting of adverse life events in the Wave 3 ELSA Life History Questionnaire and depressive caseness among respondents in the same survey wave (i.e. due to overreporting of adverse events among those with depressive symptoms). This was accomplished by fitting fully-adjusted random-effects logistic regression models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and CES-D depressive caseness in Waves 1, 2, 4, 5, 6 and 7 among respondents who were not identified as having depressive caseness in Wave 3 (n=3,147).

The model results are shown in the table below. The results show that there was a positive association between total adverse events experienced (0–49 years) and odds of depressive caseness, with an effect of approximately 15% greater odds of depressive caseness per additional adverse event experienced (OR: 1.15, 95% CI: 1.09, 1.21, p<0.001). While the strength of the associations were slightly attenuated compared to those of models when data from respondents identified as having depressive caseness in Wave 3 were included (see Table 4), the results suggest that the findings of this study are not wholly as a result of reverse causation due to recall bias.

Results of fully-adjusted random-effects logistic regression models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and CES-D depressive caseness (n=15,482 observations/3,147 unique individuals) in Waves 1, 2, 4, 5, 6 and 7

Categories	Model A* Odds ratio (95% CI)	p	Model B Odds ratio (95% CI)	p	Model C Odds ratio (95% CI)	p	Model D Odds ratio (95% CI)	p	Model E Odds ratio (95% CI)	p
Total (0–49 years)	1.15 (1.09, 1.21)	<0.001								
Early childhood (0–5 years)			1.16 (0.99, 1.36)	0.060						
Late childhood (6–15 years)			1.17 (1.07, 1.28)	<0.001						
Early adulthood (16–30 years)			1.12 (1.01, 1.25)	0.039						
Late adulthood (31–49 years)			1.14 (1.02, 1.28)	0.023						
Self-oriented, total (0–49 years)					1.08 (1.10, 1.28)	0.082				
Other-oriented, total (0–49 years)					1.21 (1.10, 1.30)	<0.001				
Self-oriented, childhood (0–15 years)							0.96 (0.84, 1.10)	0.587		
Self-oriented, adulthood (16–49 years)							1.21 (1.06, 1.39)	0.005		
Other-oriented, childhood (0–15 years)							1.35 (1.20, 1.51)	<0.001		
Other-oriented, adulthood (16–49 years)							1.06 (0.97, 1.22)	0.168		
Self-oriented, early childhood (0–5 years)									1.01 (0.81, 1.29)	0.943
Self-oriented, late childhood (6–15 years)									0.94 (0.81, 1.11)	0.496
Self-oriented, early adulthood (16–30									1.23 (1.04, 1.46)	0.015
Self-oriented, late adulthood (31–49									1.17 (0.94, 1.47)	0.148
Other-oriented, early childhood (0–5									1.33 (1.06, 1.69)	0.015
Other-oriented, late childhood (6–15									1.34 (1.19, 1.53)	<0.001
Other-oriented, early adulthood (16–30									1.04 (0.89, 1.23)	0.574
Other-oriented, late adulthood (31–49									1.12 (0.96, 1.30)	0.141

*All models were fully adjusted for covariates including age, gender, physical frailty index, current labour market status, participation in social activities, partnership status, quintile of household net worth, household income, housing tenure at the time of interview, birth abroad and last-known occupational position (five-category NS-SEC).

Appendix A10: We fitted fully-adjusted fixed-effects Poisson models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and number of waves (Waves 1–7) in which respondents were identified with CES-D depressive caseness. The analytic sample included respondents with complete data in all seven waves. The outcome variable was expressed as a count for number of waves in which a given individual respondent with available Wave 3 Life History Questionnaire data (n=2,069) was identified as having depressive caseness (three or more CES-D depressive symptoms). There was no significant evidence of model over-dispersion.

Findings are displayed in the table below. The results of Model A for the association between total adverse events experienced (0–49 years) and number of waves in which an individual was identified as having depressive caseness show that each additional event experienced by a given individual was significantly associated with depressive caseness in an additional 0.10 (95% CI: 0.07, 0.12, p<0.001) ELSA survey waves. The results of Models B–D show that events at all stages of the lifecourse, and both self and other oriented events, were positively associated with the number of waves in which an individual was found to have depressive caseness (three or more CES-D depressive symptoms).

These findings strengthen the overall inferences that can be drawn from this study; not only was the number of adverse experiences positively and significantly associated with depressive caseness at a given point in time (see Table 4), they were also associated with the frequency with which an individual is identified as having depressive caseness over time (over the period 2002 to 2015)

Results of fully-adjusted fixed-effects Poisson models for associations between total adverse events disaggregated by age of occurrence and self- or other-orientation (Models A–E), and number of waves (Waves 1–7) in which respondents were identified with CES-D depressive caseness (n=2,069)

Categories	Model A* Coefficient (95% CI)	p	Model B Coefficient (95% CI)	p	Model C Coefficient (95% CI)	p	Model D Coefficient (95% CI)	p	Model E Coefficient (95% CI)	p
Total (0–49 years)	0.10 (0.07, 0.12)	<0.001								
Early childhood (0–5 years)			0.17 (0.10, 0.26)	<0.001						
Late childhood (6–15 years)			0.07 (0.03, 0.11)	0.002						
Early adulthood (16–30 years)			0.08 (0.02, 0.13)	0.008						
Late adulthood (31–49 years)			0.12 (0.06, 0.18)	<0.001						
Self-oriented, total (0–49 years)					0.11 (0.06, 0.15)	<0.001				
Other-oriented, total (0–49 years)					0.09 (0.05, 0.13)	<0.001				
Self-oriented, childhood (0–15 years)							0.08 (0.01, 0.14)	0.018		
Self-oriented, adulthood (16–49 years)							0.13 (0.07, 0.20)	<0.001		
Other-oriented, childhood (0–15 years)							0.10 (0.05, 0.16)	0.001		
Other-oriented, adulthood (16–49 years)							0.07 (0.02, 0.13)	0.012		
Self-oriented, early childhood (0–5 years)									0.08 (-0.04, 0.21)	0.185
Self-oriented, late childhood (6–15 years)									0.06 (-0.01, 0.14)	0.078
Self-oriented, early adulthood (16–30									0.13 (0.04, 0.21)	0.004
Self-oriented, late adulthood (31–49									0.15 (0.04, 0.25)	0.005
Other-oriented, early childhood (0–5									0.26 (0.14, 0.38)	<0.001
Other-oriented, late childhood (6–15									0.06 (-0.00, 0.13)	0.053
Other-oriented, early adulthood (16–30									0.03 (-0.06, 0.10)	0.532
Other-oriented, late adulthood (31–49									0.10 (0.03, 0.17)	0.006

*All models were fully adjusted for covariates including age, gender, physical frailty index, current labour market status, participation in social activities, partnership status, quintile of household net worth, household income, housing tenure at the time of interview, birth abroad and last-known occupational position (five-category NS-SEC).