

ARTICLE

# Decomposing the effects of childhood adversity on later-life depression among Europeans: a comparative analysis by gender

Georgia Verropoulou<sup>1,2\*</sup> , Eleni Serafetinidou<sup>1</sup> and Cleon Tsimbos<sup>1</sup> 

<sup>1</sup>Department of Statistics and Insurance Science, University of Piraeus, Piraeus, Greece and <sup>2</sup>Centre for Longitudinal Studies, UCL Institute of Education, London, UK

\*Corresponding author. Email: [gverrop@unipi.gr](mailto:gverrop@unipi.gr)

(Accepted 25 June 2019; first published online 15 August 2019)

## Abstract

The aims of the present study are twofold: first, to examine the importance of socio-economic disadvantage, adverse experiences and poor health in childhood on later-life depression by sex and, second, to discern the direct and indirect effects of childhood circumstances using a decomposition technique. Data are derived from Waves 2 and 3 of the Survey of Health, Ageing and Retirement in Europe (SHARE). The methods involve use of logistic regression models and a decomposition approach. The findings indicate that childhood socio-economic status (SES) for both genders and cognitive function for men have only a significant direct effect, consistent with the critical period model. Childhood health for men and poor parental mental health for women are nearly fully mediated by adulthood and later-life circumstances, a fact in line with the pathway model. Poor childhood health, parental excessive alcohol consumption and cognitive function for women and adverse experiences for men have both significant direct and indirect effects, consistent with both models. Mediating factors include poor adulthood and later-life health, socio-economic adversity and stress; adulthood and later-life SES mediate early life health and adverse experiences more strongly for men, whereas stress seems to mediate early life adverse experiences to a greater extent among women. Intervening policies should address childhood adversity while considering the differential vulnerability of men and women.

**Keywords:** later-life depression; childhood adversity; mediation; KHB method; critical period model; pathway model; Survey of Health, Ageing and Retirement in Europe (SHARE); Europe

## Introduction

Depression is a prevalent mental health disorder in older ages, representing the largest contributor to ‘years lived with disability’ (World Health Organization (WHO), 2017a). It is associated with a decline in wellbeing (D’Alisa *et al.*, 2006), increased morbidity and mortality (Nuyen *et al.*, 2005; Farrokhi *et al.*, 2014) and frequent use of health-care services (Andersson *et al.*, 2011; Belloni *et al.*, 2016).

Hence, identification of factors that are related to this disorder is of importance, especially among older persons, whose numbers are on the increase (WHO, 2017b).

Past analyses have pointed out the importance of early life conditions for later-life health (Arpino *et al.*, 2018); exposure to diseases, low socio-economic status (SES) and adverse life experiences may undermine physical and mental health both in adulthood and older ages (Galobardes *et al.*, 2004; Case *et al.*, 2005; Luo and Waite, 2005; Haas, 2007; Doblhammer *et al.*, 2013; Pudrovska and Anikputa, 2014). Further, adverse adulthood and later-life circumstances, including bereavement, loneliness, disability, negative and stressful life events (Aziz and Steffens, 2013), poor health and financial strain, are partly accountable for later-life mental health disorders (Butterworth *et al.*, 2009; Gallagher *et al.*, 2013; Halmdienst and Winter-Ebmer, 2014; Crowe and Butterworth, 2016). By contrast, higher educational attainment is an important protective factor (Ladin, 2008) which may attenuate the effects of childhood financial adversity (Schaan, 2014).

A thorough analysis of later-life depression would involve the study of conditions pertaining to three major domains of life: health, SES and adverse experiences (Moore *et al.*, 2014; WHO, 2014; Monnat and Chandler, 2015; Montez *et al.*, 2016). However, associations are complex, as these three domains are interrelated; further, childhood circumstances may have an effect on adulthood and later-life conditions. For instance, lower childhood SES may affect health in later life both directly and indirectly (Luo and Waite, 2005); on the one hand, it is related to lower adulthood SES (which itself is related to worse health both in adulthood and later life) and, on the other hand, to worse childhood health, which is associated with poorer health and lower SES in adulthood and, subsequently, in later life. Adverse experiences in childhood are also of interest in tracing the origins of depression in older ages (Dvir *et al.*, 2014), acting either independently or in conjunction with other adverse and stressful adulthood experiences (Nurius *et al.*, 2015).

To disentangle these multifaceted associations and assess causality, life trajectories and paths leading from childhood to later-life depression have been explored in past research. Potential mechanisms are outlined below.

### **Conceptual framework and mechanisms**

There are four theories dealing with mechanisms leading from early life disadvantage to later-life poor health (Pudrovska and Anikputa, 2014). First, the critical period model stresses the importance of childhood conditions which may irrevocably affect biological processes, having thus a direct effect on later-life health, independently of other experiences over the lifecourse. Second, the accumulation of disadvantage model purports that exposure to risk factors accrues over the lifecourse. Hence, adversity experienced in different stages of life contributes equally to poor health later on. Third, the pathway model deals with trajectories over the lifecourse; adverse early life circumstances may lead to disadvantage in mid-life and, subsequently, to poor health. Hence, this model emphasises the role of mediators in the relationship between childhood conditions and later-life health. Fourth, the social mobility model claims that early life adversity is mitigated by improved adulthood circumstances while adulthood adversity may obliterate the beneficial effects of a more advantageous childhood.

An alternative approach describing how early life circumstances may affect later-life health categorises the relevant mechanisms into three groups (Hertzman and Boyce, 2010). The first group includes latent mechanisms or direct effects. These reflect the long-term consequences of biological processes, initiated by exposure to risk factors during gestation and early childhood, and are unrelated to intervening adulthood circumstances. In that sense, latent mechanisms conform with the critical period model. The second group involves pathway mechanisms or indirect effects; childhood adversity influences adulthood circumstances which, in turn, affect later-life health. These mechanisms are consistent with the pathway model. Finally, the third group includes conditional effects: the consequences of early life adversity on later-life health are conditioned on mid-life circumstances which can modify these associations. These mechanisms conform with the social mobility model.

Although the above-mentioned theoretical models and mechanisms offer different explanations of how early life adversity may impact later-life health, in practice they may be viewed as complimentary. In fact, past analyses have found that mechanisms often co-exist. Pakpahan *et al.* (2017a) suggest that the effect of low childhood SES on later-life self-rated health is nearly fully mediated by adulthood SES, a fact in line with the pathway model, whereas the effect of childhood health remains substantial, supporting the critical period model partly. Torres and Wong (2013), on the other hand, examining the effects of childhood poverty on later-life depression in Mexico, find both a strong direct effect and an indirect one, the latter partly mediated by adulthood SES, supporting thus both the latency and the pathway mechanisms. By contrast, Tani *et al.* (2016) find that the effects of childhood SES on the onset of later-life depression are consistent mainly with latency mechanisms, as they remain significant in spite of adjusting for adulthood SES and current health status. The findings of Pudrovska and Anikputa (2014) support, on the one hand, the pathway model, as parental SES seems related to adolescent and mid-life SES which, in turn, is related to lower mortality, and, on the other hand, the social mobility model, as downward social mobility seems to have a detrimental effect. Zimmer *et al.* (2016) show that early life and adulthood SES have an independent effect on later-life health, which is consistent with the accumulation of disadvantage model. Finally, Nurius *et al.* (2015) also find evidence supporting the accumulation of disadvantage model regarding the effects of childhood adverse experiences on adult mental health.

### **A gender perspective**

An issue of special interest is the study of disparities in depression between genders. Depression is more prevalent among girls and women both in adulthood and later life (Hankin, 2002; Van de Velde *et al.*, 2010). In many cases, this is due to hormonal differences and personal traits (Albert, 2015), as well as to the way males and females deal with stressful life events. Additionally, females experience more stressful events and adversity in childhood compared to males (St Clair *et al.*, 2015), while they also tend to perceive the cause of such events in a negative way (Hankin, 2002).

Findings regarding the importance of childhood circumstances on later-life health also imply the existence of gender differentials. Though Kendig *et al.* (2017) find a strong direct and an indirect effect of childhood health on later-life self-rated health in China, consistent both with latency and pathway mechanisms, the indirect effect is mediated differently by gender; among men marital status and urban residence matter more whereas among women educational attainment is an important mediator. Angelini *et al.* (2019) find that the association of childhood SES with later-life depression, which persists even after controlling for later-life socio-economic circumstances, is stronger for women. Arpino *et al.* (2018) suggest that poor childhood health has a direct effect on later-life health, which is in accordance with the critical period model, whereas the effects of low SES in early life are mediated by educational attainment, supporting thus the pathway model. Moreover, the mediating effects of educational attainment are more substantial among women.

### **Aims of the study**

In this context, the present study attempts to shed light on these multilayered associations, considering in a comprehensive manner, first, the direct impact of socio-economic disadvantage, adverse experiences and poor health over the lifecourse on later-life depression and, second, the indirect effect of childhood circumstances and the extent that these are mediated by different adulthood and later-life predictors. Emphasis is given on disparities between genders as later-life depression is more prevalent among women, who also exhibit greater vulnerability to adversity compared to men. Hence, the analysis addresses separately the mechanisms that lead from childhood circumstances to later-life depression for men and women. It is anticipated that both mechanisms are relevant. Further, based on past analyses, we expect to observe differentials between men and women; more specifically, it seems possible that SES may have a stronger effect among men (Back and Lee, 2011) where adverse experiences may be more important among women (Flores and Kalwij, 2014; Almuneef *et al.*, 2017).

The contribution of the study lies in the holistic approach, which deals simultaneously with adversity in three domains of life and in three different periods, *i.e.* childhood, adulthood and later life. Most similar analyses deal only with the effects of childhood SES while a few additionally include childhood health, but none, to the best of our knowledge, considers also adverse experiences. In the analysis, cross-sectional and retrospective data from the Survey of Health, Ageing and Retirement in Europe (SHARE) have been used while mediation is assessed on the basis of a decomposition technique.

### **Data and methods**

#### **Sample**

In the analysis SHARE data have been used. SHARE is a multi-disciplinary and cross-national database of micro data on health, demographic and socio-economic characteristics of persons aged 50 or higher resident in several European countries (Börsch-Supan *et al.*, 2013). The sample studied here includes cross-sectional data

from the second wave of the survey, carried out in 2006–2007, and retrospective material from SHARELIFE (Wave 3), carried out in 2008–2009. There were 25,052 respondents who participated at both the second and third waves; out of these, 23,768 (10,489 males and 13,279 females) were retained in the analysis, due to the requirement of complete data in the variables of interest. As the percentage of missing cases is around 5 per cent, application of imputation techniques was deemed unnecessary (Jakobsen *et al.*, 2017). Respondents originate in 13 countries, covering geographically most of Europe: Greece, Germany, Sweden, Netherlands, Spain, Italy, France, Switzerland, Denmark, Austria, Belgium, Czech Republic and Poland.

## Measures

### Dependent variable

Depression in SHARE is represented by the EURO-D scale (Beekman *et al.*, 1999; Prince *et al.*, 1999a, 1999b; Börsch-Supan and Jürges, 2005), comprising 12 symptoms (depression, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment and tearfulness). In the present study, a binary indicator based on that scale has been employed, comparing respondents reporting four or more depressive symptoms (having depression) to those reporting zero to three symptoms (no depression: reference category). This cut-off point has been provided by the SHARE team and has been validated psychometrically against several clinically relevant indicators at the EURODEP study while several analyses have also shown that it is appropriate and measures depression caseness (Dewey and Prince, 2005; Castro-Costa *et al.*, 2007, 2008).

### Independent variables

The independent variables cover circumstances over the lifecourse and correspond to three distinct periods: (a) childhood (age 10), (b) adulthood (events occurring after age 15 but well before the interview), and (c) later life (the year preceding the interview). Further, the events/circumstances considered pertain to three domains of life: health, socio-economic status (SES) and adverse experiences and are described in detail below.

**Childhood predictors.** Health status is represented by childhood self-perceived health (CSPH) at age 10 in binary form (Angelini *et al.*, 2016; Pakpahan *et al.*, 2017a, b; Arpino *et al.*, 2018); respondents having poor, fair and good CSPH (= 1) are compared to those having very good or excellent (= 0) CSPH. SES is based on the number of books the respondent had access to at age 10; this measure reflects the educational attainment of the parents (Cavapozzi *et al.*, 2011; Pakpahan *et al.*, 2017a, b; Van Bergen *et al.* 2017; Arpino *et al.*, 2018) and contrasts individuals who had access to none or very few books to those who had access to at least ten books. Cognitive function is represented by the respondent's relative position in mathematics compared to his/her classmates at age 10 (Verropoulou and Zakyntinou, 2016): better, much better or about the same (= 0) *versus* worse and much worse (= 1). Finally, adverse experiences in childhood are represented by two binary variables reflecting circumstances when the respondent was 10

years old; the first variable denotes whether the respondent's parents drank heavily while the second one denotes whether they had mental health problems (Angelini *et al.*, 2016; Verropoulou and Zakyntinou, 2016). These two variables are used as proxies since other information on child abuse or neglect is unavailable in SHARE; further, there are analyses indicating that childhood maltreatment (physical or psychological) and other adverse experiences are often related to parental alcohol abuse or parental mental health problems (Dube *et al.*, 2001; Angelini *et al.*, 2016).

**Adulthood predictors.** Health is measured by an indicator of whether the respondent had experienced in the past a period of poor health as information on SPH is unavailable for that period. SES is based on educational attainment divided into two categories (0–12 years *versus* at least 13 years) and an indicator of whether the respondent had experienced a period of financial hardship; the latter has been used in past studies as a measure of SES (Conklin *et al.*, 2013; Amlaev, 2015). Finally, adverse experiences are also represented by two indicators, a binary variable denoting whether the respondent had experienced a period of stress and another one showing whether he or she had experienced a period of hunger (Halmdienst and Winter-Ebmer, 2014).

**Later-life predictors.** Health status is represented by SPH (ranging from 1 to 5, *i.e.* from excellent to poor). Though SPH is a subjective indicator of health which might be influenced by mental health status, it exhibits strong associations with several aspects of physical health and has been found to be a strong predictor of mortality, even when controlling for morbidity and depression (Verropoulou, 2014). Further, it has been shown to be a strong predictor of concurrent depression and mental health (Aziz and Steffens, 2013; Padayachey *et al.*, 2017), while it also mediates the association between physical illness and depressive symptoms (Segel-Karpas, 2015). Health indicators also include mobility limitations in binary form (0 = less than three limitations, 1 = at least three limitations). SES is represented by whether the household was able to make ends meet the year preceding the survey with great or some difficulty (= 1) *versus* fairly easily or easily (= 0).

### Control variables

All models control for age of the respondent at the time of the interview and welfare system. Regarding the latter variable, four welfare models are distinguished: the Nordic model which includes Sweden, Denmark and the Netherlands; the Continental model including Austria, France, Germany, Belgium and Switzerland; the Southern model including Italy, Spain and Greece; and the Central/Eastern model including Poland and the Czech Republic. In this way the estimates are adjusted for differentials related to the standards of living, social assistance, benefits and health care (Sengoku, 2003; Norden, 2013; Popova and Kozhevnikova, 2013).

### Statistical analysis

For the purposes of the analysis, three binary logistic regression models were applied separately by sex. The first model includes childhood and control variables

only; the second model is an extension of the first one, additionally including adulthood predictors; and the third model is built on the second one and also incorporates later-life predictors. The sequential additive nature of these models allows an assessment of the relevant importance of circumstances pertaining to different stages of the lifecourse. More specifically, it allows an evaluation of how addition of adulthood conditions affects the predictive power of childhood circumstances on later-life depression and, second, of whether childhood and adulthood circumstances retain their importance after controlling for concurrent factors.

Subsequently, a decomposition technique was implemented via use of the KHB module, developed for the Stata 13 software (Kohler *et al.*, 2011). The method, apart from the direct effect of each childhood factor, provides estimates of their relative (or indirect) effect, which is mediated by adulthood and later-life circumstances. More specifically, the method involves the estimation of the direct effect of a variable of interest, based on a comprehensive model including all predictors (full or adjusted model), as well as the estimation of the total effect of that variable in a reduced or unadjusted model, which omits the influence of the specific mediator. The indirect effect is derived as the difference between the total and the direct effect. As the method allows for simultaneous use of multiple mediators, it can provide estimates of the indirect effect due to each of them. The overall confounding percentage, *i.e.* the proportion of the total effect of a childhood variable expressed through mediators, is computed as the overall indirect effect due to all mediators divided by the coefficient of the total effect. The percentage contribution of each mediator to the overall confounding percentage for a specific childhood variable is estimated as the ratio of the indirect effect of the respective mediator divided by the sum of all indirect effects of the mediators for that variable. These estimates are provided by the KHB module.

In fact, the decomposition method compares the estimated coefficients of two nested nonlinear probability models, thus allowing assessment of the degree that a variable mediates or explains the relationship of a predictor with the outcome (Kohler *et al.*, 2011; Breen *et al.*, 2013), extending the decomposition properties of linear models to nonlinear probability models under the sequential ignorability assumption (Imai *et al.*, 2010a, 2010b), according to which, given baseline covariates, mediators are selected randomly (Small, 2013). The decomposition estimates provided by the method are unbiased, as effects are rescaled, and more robust compared to logit models (Kendig *et al.*, 2017; Berg *et al.*, 2018). Another advantage of the method is the simultaneous use of multiple mediators which allows disentangling the relative contribution of each of them to the indirect effect of a variable of interest (Arpino *et al.*, 2018). Further, the method also allows for the inclusion of variables that control for confounding influences on the decomposition.

## Results

### Descriptive analysis

Table 1 shows descriptive statistics for the total sample and by sex. The mean age of males in the sample is 66.4 years while for females it is 65.8 years. The percentage of women suffering from depression is double that for men (30.3% *versus* 14.9%). Regarding childhood, females report slightly worse CSPH and more perform worse in mathematics at age 10 compared to men. On the other hand, slightly

**Table 1.** Descriptive statistics for the total sample and by gender

Predictors	Total	Males	Females
Depression (%):			
No (0–3 symptoms)	76.5	85.1	69.7
Yes (4 or more symptoms)	23.5	14.9	30.3
Childhood (%):			
Self-perceived health:			
Excellent, very good and good	91.9	92.8	91.1
Fair and poor	8.1	7.2	8.9
Relative position to peers in mathematics at age 10:			
Much better/better/about the same	83.6	85.9	81.8
Worse/much worse	16.4	14.1	18.2
Number of books at age 10:			
0–10 books	43.7	44.6	43.0
10 or more books	56.3	55.4	57.0
Parents drank heavily:			
No	91.5	91.5	91.6
Yes	8.5	8.5	8.4
Parents had mental health problems:			
No	97.7	98.1	97.4
Yes	2.3	1.9	2.6
Adulthood (%):			
Period of stress:			
No	48.8	53.1	45.5
Yes	51.2	46.9	54.5
Period of poor health:			
No	59.0	60.8	57.5
Yes	41.0	39.2	42.5
Period of financial hardship:			
No	67.2	69.3	65.5
Yes	32.8	30.7	34.5
Period of hunger:			
No	92.2	91.1	93.0
Yes	7.8	8.9	7.0
Educational attainment:			
0–12 years of education	69.2	64.5	72.9

*(Continued)*



**Table 1.** (Continued.)

Predictors	Total	Males	Females
13 or more years of education	30.8	35.5	27.1
Later life:			
Mean self-perceived health <sup>1</sup>	3.02	2.94	3.07
Mobility:			
0–2 limitations	78.5	85.6	73.0
3+ limitations	21.5	14.4	27.0
Household able to make ends meet:			
Easily or fairly easily	60.5	63.4	58.3
With some difficulty or with great difficulty	39.5	36.6	41.7
Controls:			
Mean age at the time of interview	66.05	66.36	65.81
Welfare systems (%):			
Nordic model	23.4	23.9	23.0
Continental model	33.6	33.5	33.6
Southern model	28.2	28.4	28.1
Central/Eastern model	14.8	14.2	15.3
Sample size	23,768	10,489	13,279

Note: <sup>1</sup>1 = excellent, 5 = poor.

more women than men had, at age 10, access to at least ten books. Concerning adverse experiences, percentages of parents drinking heavily are nearly equal for both genders while among women it is somewhat more frequent to have parents with mental health problems. In adulthood, women have experienced a period of stress (54.5%), a period of poor health (42.5%) and a period of financial hardship (34.5%) in higher proportions compared to men (46.9, 39.2 and 30.7%, respectively), whereas fewer have experienced a period of hunger; further, they have, on average, fewer educational qualifications. Concerning later life, women have worse SPH than men and a much higher proportion reports at least three mobility difficulties (27.0% compared to 14.4%). Finally, females experience greater financial hardship.

### **Logistic regression analysis**

Tables 2 and 3 present the results of the three logistic regression models separately for males and females. In the first model for males (Table 2), which includes only childhood circumstances and controls, poor parental mental health is the factor having the greatest adverse effect on later-life depression. Nevertheless, all childhood circumstances are significant predictors and the associations point to the expected direction. In the second model, which additionally includes adulthood conditions, childhood circumstances remain very significant, though their effect

**Table 2.** Odds ratios and 95 per cent confidence intervals (CI) for males

Predictors	Model 1 (childhood)	Model 2 (childhood and adulthood)	Model 3 (childhood, adulthood and later life)
<i>Odds ratios (95% CI)</i>			
<b>Childhood:</b>			
<b>Self-perceived health:</b>			
Excellent, very good and good (Ref.)	1	1	1
Fair and poor	1.595*** (1.319–1.929)	1.321*** (1.087–1.604)	1.161 (0.943–1.429)
<b>Relative position to peers in mathematics at age 10:</b>			
Much better/better/ about the same (Ref.)	1	1	1
Worse/much worse	1.416*** (1.225–1.637)	1.322*** (1.139–1.535)	1.220** (1.040–1.431)
<b>Number of books at age 10:</b>			
10 or more books (Ref.)	1	1	1
0–10 books	1.603*** (1.425–1.804)	1.547*** (1.366–1.753)	1.296*** (1.135–1.480)
<b>Parents drank heavily:</b>			
No (Ref.)	1	1	1
Yes	1.481*** (1.242–1.765)	1.326*** (1.107–1.587)	1.261** (1.039–1.531)
<b>Parents had mental health problems:</b>			
No (Ref.)	1	1	1
Yes	2.090*** (1.473–2.965)	1.790*** (1.253–2.556)	1.708*** (1.159–2.515)
<b>Adulthood:</b>			
<b>Period of stress:</b>			
No (Ref.)		1	1
Yes		1.400*** (1.241–1.578)	1.484*** (1.306–1.687)

(Continued)

**Table 2.** (Continued.)

Predictors	Model 1 (childhood)	Model 2 (childhood and adulthood)	Model 3 (childhood, adulthood and later life)
Period of poor health:			
No (Ref.)		1	1
Yes		2.030*** (1.808–2.279)	1.175** (1.034–1.336)
Period of financial hardship:			
No (Ref.)		1	1
Yes		1.426*** (1.265–1.608)	1.304*** (1.146–1.484)
Period of hunger:			
No (Ref.)		1	1
Yes		1.277*** (1.071–1.523)	1.155 (0.956–1.396)
Educational attainment:			
13 or more years of education (Ref.)		1	1
0–12 years of education		1.202** (1.049–1.377)	0.918 (0.794–1.061)
Later life:			
Self-perceived health <sup>1</sup>			2.058*** (1.914–2.213)
Mobility:			
0–2 limitations			1
3+ limitations			2.325*** (2.010–2.690)
Household able to make ends meet:			
Easily or fairly easily (Ref.)			1
With some difficulty or with great difficulty			1.516*** (1.324–1.737)
Controls:			
Age at the time of interview	1.020*** (1.013–1.025)	1.016*** (1.010–1.023)	0.999 (0.992–1.006)

(Continued)

Table 2. (Continued.)

Predictors	Model 1 (childhood)	Model 2 (childhood and adulthood)	Model 3 (childhood, adulthood and later life)
Welfare systems:			
Nordic model (Ref.)	1	1	1
Continental model	1.404*** (1.188–1.658)	1.264*** (1.067–1.496)	1.085 (0.907–1.296)
Southern model	1.300*** (1.087–1.555)	1.343*** (1.117–1.615)	0.953 (0.778–1.168)
Central/Eastern model	2.687*** (2.228–3.241)	2.759*** (2.275–3.346)	1.233* (0.993–1.532)
Pseudo- $R^2$ Nagelkerke	0.056	0.107	0.241
Classification percentage	85.1	85.1	86.3

Notes: 1 = excellent, 5 = poor. Pseudo- $R^2$ , showing the amount of variance of the outcome explained by the independent variables, indicates an increase in the explanatory power of Model 3 ( $R^2 = 0.241$ ) compared to Model 1 ( $R^2 = 0.056$ ) and Model 2 ( $R^2 = 0.107$ ). Classification tables of the models show the percentage of cases of the dependent variable predicted correctly for Models 1, 2 and 3 and hence they are very high (85.10, 85.10 and 86.30%, respectively), this is an indication of a very good fit for all models. Ref.: reference category.

Significance levels: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

is somewhat reduced. Adulthood conditions are also significant predictors of later-life depression; most important among them seems to be having experienced a period of poor health. Addition of later-life factors in the third model renders childhood health, educational attainment and having experienced a period of hunger in adulthood non-significant. Nevertheless, all other childhood and adulthood conditions remain important, especially poor parental mental health and having experienced poor health in adulthood. Later-life poor health and financial hardship exhibit a strong association with concurrent depression. It is worth noting that the substantial differentials between all welfare systems and the Nordic one are nearly wholly explained by later-life covariates.

Considering females (Table 3), it seems that all childhood factors are very significant in the first model, though poor parental mental health is not as important. Addition of adulthood circumstances (Model 2) renders poor parental mental health non-significant; the remaining childhood conditions, however, maintain their importance as predictors of depression while all adulthood factors are significant. Inclusion of later-life health and SES do not change appreciably the existing relationships, though the effects of childhood and adulthood circumstances are reduced somewhat in most cases while the association with educational attainment, significant only at the 10 per cent level, points now to the opposite direction. Later-life covariates have a significant association with depression. It is worth noting that the significant differentiations observed between the Nordic and the other welfare systems, which are very pronounced in Model 1, especially regarding the Central/Eastern model, are reduced in Model 3 but remain substantial for women.

**Table 3.** Odds ratios and 95 per cent confidence intervals (CI) for females

Predictors	Model 1 (childhood)	Model 2 (childhood and adulthood)	Model 3 (childhood, adulthood and later life)
<i>Odds ratios (95% CI)</i>			
<b>Childhood:</b>			
Self-perceived health:			
Excellent, very good and good (Ref.)	1	1	1
Fair and poor	1.836*** (1.618–2.085)	1.520*** (1.334–1.732)	1.212*** (1.054–1.394)
Relative position to peers in mathematics at age 10:			
Much better/better/about the same (Ref.)	1	1	1
Worse/much worse	1.564*** (1.421–1.722)	1.483*** (1.344–1.637)	1.358*** (1.222–1.509)
Number of books at age 10:			
10 or more books (Ref.)	1	1	1
0–10 books	1.477*** (1.360–1.604)	1.437*** (1.318–1.568)	1.248*** (1.137–1.369)
Parents drank heavily:			
No (Ref.)	1	1	1
Yes	1.650*** (1.448–1.882)	1.479*** (1.293–1.692)	1.440*** (1.247–1.662)
Parents had mental health problems:			
No (Ref.)	1	1	1
Yes	1.256* (0.986–1.599)	1.078 (0.842–1.379)	1.091 (0.839–1.420)
<b>Adulthood:</b>			
Period of stress:			
No (Ref.)		1	1
Yes		1.576*** (1.447–1.717)	1.664*** (1.520–1.823)
Period of poor health:			
No (Ref.)		1	1
Yes		1.785***	1.182***

*(Continued)*

Table 3. (Continued.)

Predictors	Model 1 (childhood)	Model 2 (childhood and adulthood)	Model 3 (childhood, adulthood and later life)
		(1.646–1.936)	(1.081–1.291)
Period of financial hardship:			
No (Ref.)		1	1
Yes		1.273***	1.151***
		(1.170–1.386)	(1.051–1.262)
Period of hunger:			
No (Ref.)		1	1
Yes		1.362***	1.255***
		(1.174–1.579)	(1.071–1.471)
Educational attainment:			
13 or more years of education (Ref.)		1	1
0–12 years of education		1.154**	0.958*
		(1.044–1.275)	(0.865–0.990)
Later life:			
Self-perceived health <sup>1</sup>			1.927***
			(1.832–2.028)
Mobility:			
0–2 limitations			1
3+ limitations			1.911***
			(1.730–2.111)
Household able to make ends meet:			
Easily or fairly easily (Ref.)			1
With some difficulty or with great difficulty			1.403***
			(1.277–1.540)
Controls:			
Age at the time of interview	1.012***	1.011***	0.991***
	(1.008–1.016)	(1.007–1.016)	(0.986–0.995)
Welfare systems:			
Nordic model (Ref.)	1	1	1
Continental model	1.395***	1.287***	1.180***

(Continued)

**Table 3.** (Continued.)

Predictors	Model 1 (childhood)	Model 2 (childhood and adulthood)	Model 3 (childhood, adulthood and later life)
	(1.245–1.563)	(1.146–1.446)	(1.043–1.335)
Southern model	1.651*** (1.460–1.866)	1.795*** (1.581–2.038)	1.233*** (1.071–1.419)
Central/Eastern model	2.765*** (2.424–3.153)	2.859*** (2.497–3.274)	1.456*** (1.251–1.696)
Pseudo- $R^2$ Nagelkerke	0.078	0.131	0.260
Classification percentage	70.3	71.4	75.6

Notes: <sup>1</sup>1 = excellent, 5 = poor. Pseudo- $R^2$ , showing the amount of variance of the outcome explained by the independent variables, indicates an increase in the explanatory power of Model 3 ( $R^2 = 0.260$ ) compared to Model 1 ( $R^2 = 0.078$ ) and Model 2 ( $R^2 = 0.131$ ). Classification tables of the models show the percentage of cases of the dependent variable predicted correctly for Models 1, 2 and 3 and hence they are quite high (70.30, 71.40 and 75.60%, respectively) this is an indication of a quite good fit for all models.

Significance levels: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Comparing the findings for men and women there are some marked differences. Among men, childhood poor health has no significant impact in the third model whereas poor parental mental health maintains a strong effect. By contrast, among women the first factor maintains a significant impact while the latter predictor has a minor effect even in the first model. Further, financial hardship in adulthood and later life are more important among men whereas among women adulthood adverse experiences such as stress and hunger have a greater impact. Finally, differentials across welfare systems become non-significant for men in Model 3 but for women they remain important.

### Decomposition analysis

Table 4 shows the decomposition of the total effects of selected childhood predictors on later-life depression into their direct and indirect parts separately by gender. As mediators all adulthood and later-life factors included in Model 3 have been considered, with the exception of educational attainment and concurrent SPH, which are included only as control variables. Preliminary analysis indicated that educational attainment does not mediate the effects of childhood circumstances. Moreover, concurrent SPH, in spite of having a strong mediating role (see Figures 1–4) was excluded from Table 4 on the grounds that, as it represents a subjective measure of health, it may reflect to some extent the outcome variable of depression. Finally, as the number of books at age 10 had only a non-significant indirect effect for both genders, it was included in these models only as control, along with age and welfare systems.

In Table 4, apart from the indirect effect (*i.e.* the effect of a childhood factor mediated by adulthood and later-life conditions), coefficients for the reduced and the full models are shown, along with the respective confounding percentages.

**Table 4.** Coefficients of total, direct and indirect effects of childhood predictors, confounding percentages and percentage contribution of mediators by gender, based on the decomposition method

Childhood predictors	Males	Females
Childhood self-perceived health:		
Indirect effect (OR)	1.107*	1.147***
Reduced model (coefficient of total effect)	0.250	0.330
Full model (coefficient of direct effect)	0.149	0.193
Difference (coefficient of indirect effect)	0.101	0.137
Total confounding percentage	40.42	41.67
Due to adulthood and later-life mediators (%):		
Period of stress	<b>32.64</b>	27.29
Period of poor health	21.00	17.91
Period of financial hardship	18.96	8.67
Period of hunger	12.53	12.49
Mobility limitations	12.36	<b>28.48</b>
Household able to make ends meet	2.52	5.17
Relative position with others in mathematics at age 10:		
Indirect effect (OR)	-	1.097**
Reduced model (coefficient of total effect)	-	0.398
Full model (coefficient of direct effect)	-	0.306
Difference (coefficient of indirect effect)	-	0.092
Total confounding percentage	-	23.20
Due to adulthood and later-life mediators (%):		
Period of stress	-	11.38
Period of poor health	-	3.19
Period of financial hardship	-	11.70
Period of hunger	-	11.88
Mobility limitations	-	28.53
Household able to make ends meet	-	<b>33.32</b>
Parents drank heavily:		
Indirect effect (OR)	1.116*	1.111**
Reduced model (coefficient of total effect)	0.342	0.469
Full model (coefficient of direct effect)	0.232	0.364
Difference (coefficient of indirect effect)	0.110	0.105
Total confounding percentage	32.13	22.38
Due to adulthood and later-life mediators (%):		

(Continued)



**Table 4.** (Continued.)

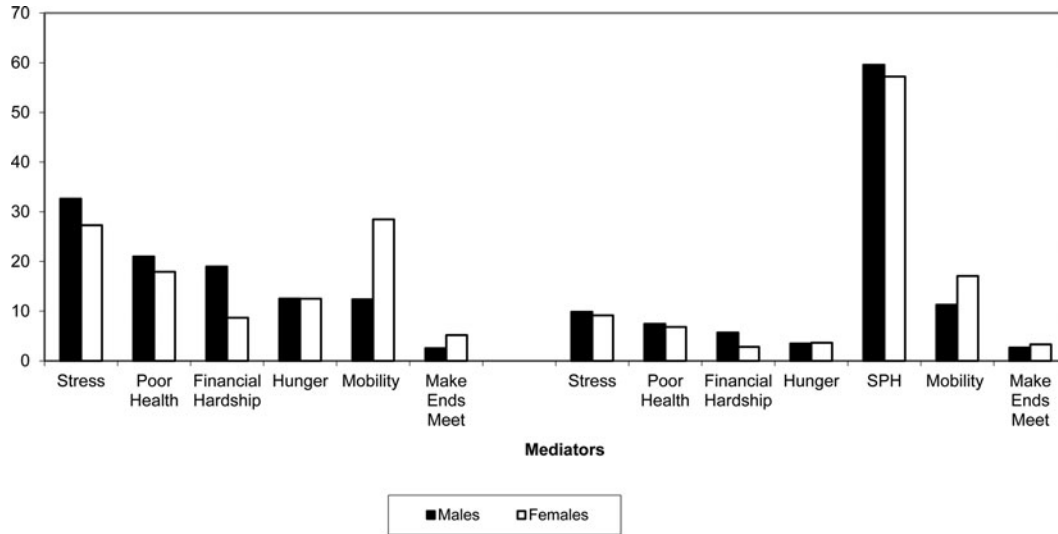
Childhood predictors	Males	Females
Period of stress	17.81	<b>42.01</b>
Period of poor health	8.16	9.80
Period of financial hardship	18.59	12.39
Period of hunger	4.41	10.37
Mobility limitations	22.13	25.35
Household able to make ends meet	<b>28.90</b>	0.08
Parents had mental health problems:		
Indirect effect (OR)	1.179***	1.130**
Reduced model (coefficient of total effect)	0.700	0.209
Full model (coefficient of direct effect)	0.535	0.087
Difference (coefficient of indirect effect)	0.165	0.122
Total confounding percentage	23.54	58.28
Due to adulthood and later-life mediators (%):		
Period of stress	<b>31.53</b>	<b>58.19</b>
Period of poor health	7.06	14.94
Period of financial hardship	27.17	7.99
Period of hunger	3.58	9.86
Mobility limitations	22.57	6.06
Household able to make ends meet	8.09	2.96

Notes: Bold values denote the mediators with the highest contribution for each childhood predictor. Confounding percentage is defined through the quantity  $((\beta_R - \beta_F)/\beta_R) \times 100 = (\beta_I/\beta_R) \times 100$  where  $\beta_R$  is the coefficient of the reduced model (total effect),  $\beta_F$  is the coefficient of the full model (direct effect) and  $\beta_I$  is the coefficient of the difference model (indirect effect). Alternatively, confounding percentage is the percentage of the total effect due to adulthood and later-life mediators. OR: odds ratio.

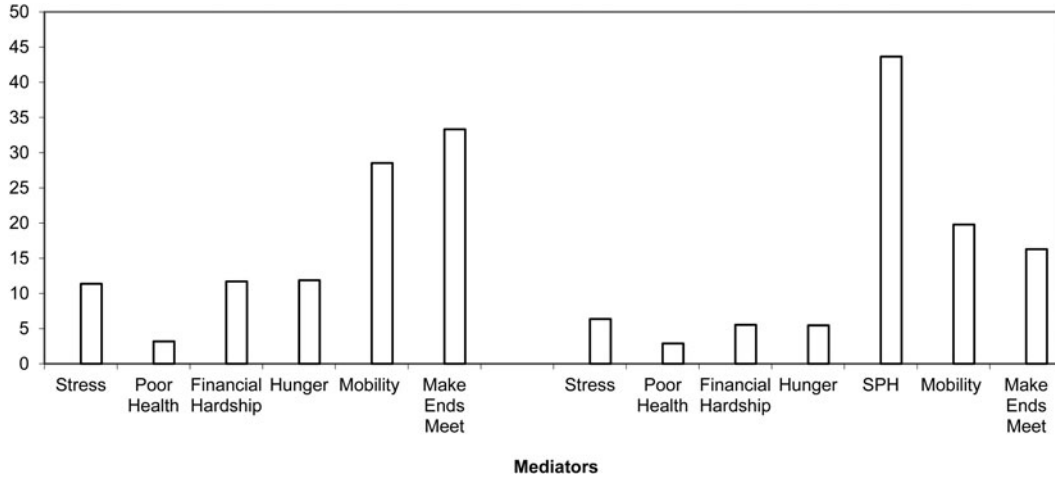
Significance levels: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

For instance, for males, fair or poor CSPH increases the log odds of later-life depression by 0.250 (reduced model coefficient); controlling for all mediators included in the model, the effect of CSPH declines to 0.149 (full model coefficient), indicating thus an indirect effect of 0.101 (their difference). In other words, the probability of an individual suffering from later-life depression increases by 25 percentage points for a standard deviation change in CSPH (reduced model); controlling for all mediators, this average increase is reduced to 14.9 percentage points (full model coefficient). Hence, poor, fair and good CSPH leads to higher values of the mediating variables, which is translated into an increase of the probability of depression in later life by 10.1 percentage points (the difference between the reduced and full model coefficients).

All indirect effects for both sexes are significant, with the exception of relative position in mathematics at age 10 for males. Among men, the childhood variable with the most significant indirect effect is poor parental mental health, which is



**Figure 1.** Percentage contribution of adulthood and later-life mediators to the indirect effect of 'childhood self-perceived health' for males and females, with and without later-life self-perceived health (SPH) as mediator.



**Figure 2.** Percentage contribution of adulthood and later-life mediators to the indirect effect of 'relative position to others in mathematics at age 10' for females, with and without later-life self-perceived health (SPH) as mediator.

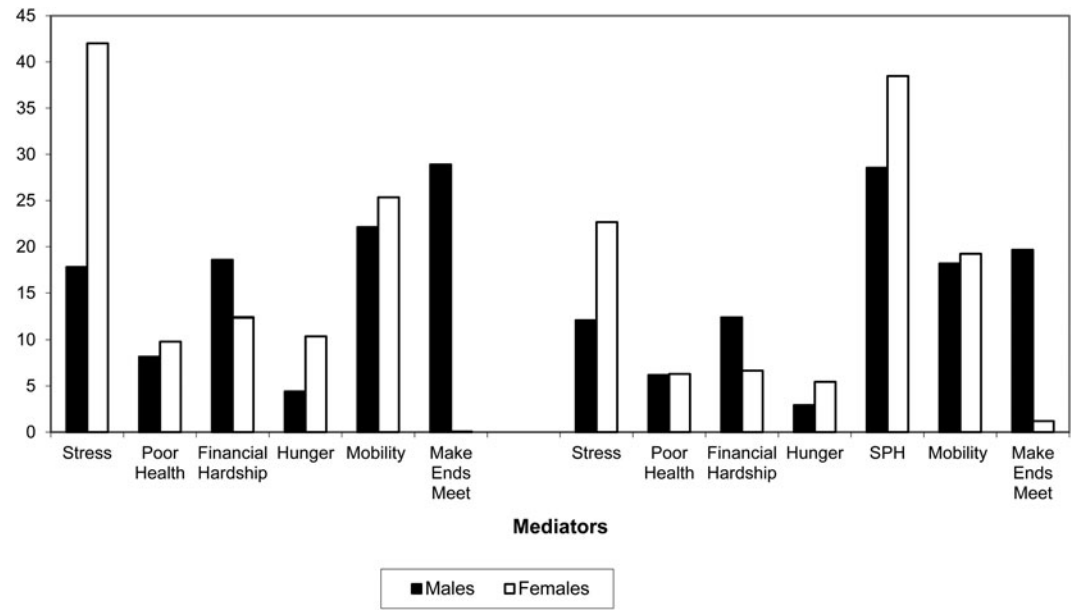
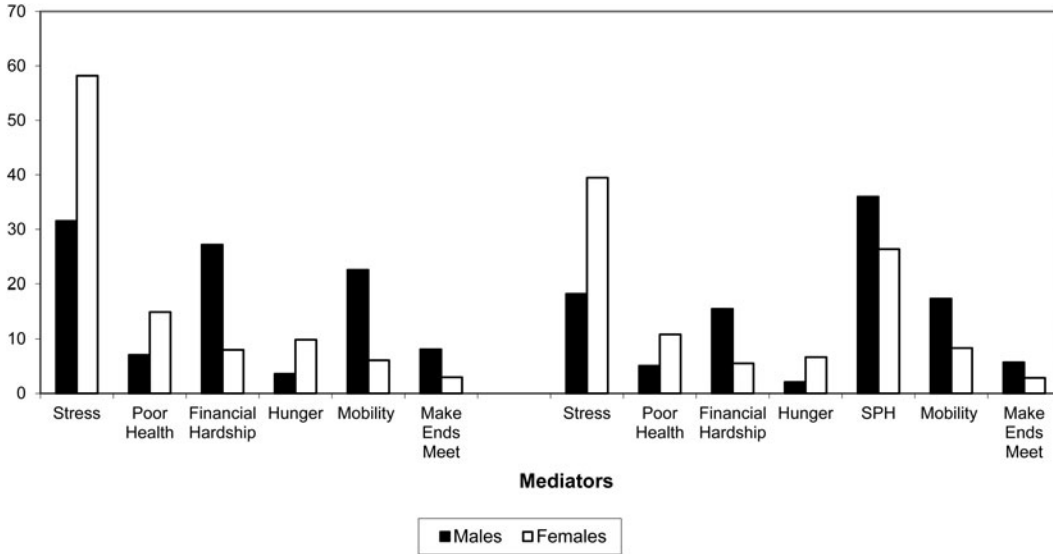


Figure 3. Percentage contribution of adulthood and later-life mediators to the indirect effect of 'parental excessive alcohol consumption' for males and females, with and without self-perceived health (SPH) as mediator.



**Figure 4.** Percentage contribution of adulthood and later-life mediators to the indirect effect of ‘parents had mental health problems’ for males and females, with and without self-perceived health (SPH) as mediator.

mediated by adulthood and later-life factors by about 24 per cent; CSPH is mediated by 40 per cent and parental excessive alcohol consumption by 32 per cent. Among women, CSPH and poor parental mental health have the most significant indirect effects; these are mediated by post-childhood conditions by 42 and 58 per cent, respectively. Parental excessive alcohol consumption and relative position in mathematics at age 10 are mediated by about 22 per cent.

The percentage contribution of each mediator to the indirect effect of childhood predictors for men and women is presented in Figures 1–4. All figures include two panels; in the left panel the relative contribution is depicted for the models including later-life SPH only as control variable whereas in the right panel SPH is included as mediator. Regarding CSPH (Figure 1, left panel), it is mediated to a greater extent by adulthood rather than later-life circumstances, especially among men. The more important mediators for both genders are stress, which contributes about 30 per cent to the indirect effect, and poor health, which contributes roughly another 20 per cent. Financial hardship in adulthood is more important for men whereas concurrent conditions are fairly significant for women, especially mobility limitations. Inclusion of later-life SPH in the model as mediator shows that over 60 per cent of the indirect effect of CSPH may be attributable to that factor; the importance of all other mediators, especially of adulthood factors, is reduced drastically.

Relative position in mathematics at age 10 (Figure 2) has a significant indirect effect only for women. This is mediated mainly by later-life circumstances; financial hardship contributes 33 per cent to the indirect effect while mobility limitations another 29 per cent. Of the adulthood conditions, poor health is the least important. Inclusion of SPH again reduces drastically the relative importance of all mediators, especially of adulthood conditions, while SPH has now the highest contribution to the indirect effect (44%).

Regarding adverse experiences in childhood, parental excessive alcohol consumption for males (Figure 3) is mediated mostly by later-life conditions whereas for female's adulthood circumstances are more important, especially having experienced a period of stress (42%). Mobility difficulties are also important for women while adulthood financial hardship is of consequence for men. Inclusion of SPH again indicates that it is the most substantial mediator.

Poor parental mental health (Figure 4) is mediated to a great extent by adulthood circumstances for both sexes: having experienced a period of stress and financial hardship contribute by 32 and 27 per cent, respectively, to the indirect effect for males, while stress and poor health contribute by 58 and 15 per cent, respectively, for females. Concurrent circumstances are fairly important for men only. Inclusion of SPH again reveals this mediator as the most significant for men (a contribution of 36%) but, for women, having experienced a period of stress still contributes the highest percentage to the indirect effect.

## Discussion

The present study aimed to fill in a gap in the literature not only by considering in a comprehensive manner the direct and the indirect effects of childhood SES, health and adverse experiences on later-life depression, but also by estimating how the latter are mediated by adulthood and later-life events and conditions, for men and

women separately, while also discussing potential mechanisms. To achieve these aims cross-sectional and retrospective data were combined from the SHARE study (Waves 2 and 3) and a decomposition technique was used (KHB module).

The descriptive analysis indicates that there is a greater prevalence of depression among females, a fact which is in accordance with past research (Hankin, 2002; Van de Velde *et al.*, 2010; WHO, 2017a). Further, women experience more adversity than men in all three domains of life and in all three periods under consideration, with few exceptions (parental excessive alcohol consumption in childhood and having experienced a period of hunger in adulthood). Similar findings have been reported before (Zender and Olshansky, 2009; McLean *et al.*, 2011; St Clair *et al.*, 2015).

The findings based on the consecutive addition of predictors, first those pertaining to childhood, then to adulthood and finally to later life (comprehensive model), indicate that: (a) though childhood circumstances have a significant effect on later-life depression, some predictors are mediated partly or fully by adulthood and later-life conditions; (b) several early, mid- and later-life factors have a strong and independent effect; (c) there are differentials by gender regarding the importance of different childhood circumstances as well as the way these are mediated.

Among men, childhood health is nearly fully mediated by adulthood and later-life circumstances, a fact consistent with the pathway model. By contrast, childhood SES and cognitive function remain significant predictors in the comprehensive model while their indirect effects are non-significant; hence, their effects are consistent with the critical period model. Finally, childhood adverse experiences retain a significant direct effect on later-life depression while they are, also, partly mediated by adulthood and later-life covariates, a fact in line with both models. Among women, poor parental mental health is nearly wholly mediated by adulthood and later-life covariates and is, thus, consistent with the pathway model. Childhood SES, just as for males, retains a significant direct effect in the comprehensive model while its indirect effect is insignificant, a fact in line with the critical period model. Finally, childhood health, cognitive function and excessive parental alcohol consumption retain a significant effect in the comprehensive model but are, also, partly mediated by adulthood and later-life conditions. These effects are thus consistent with both the critical period and the pathway models. Hence, our hypothesis that both mechanisms are relevant has been confirmed.

Regarding the direct effects of childhood circumstances, health is of greater significance for women whereas poor parental mental health is very important for men. Childhood SES status, on the other hand, seems equally important for both genders though adulthood and later-life SES has a greater effect among men. Adulthood adverse experiences (stress and hunger) are of greater consequence for women. With respect to the mediators, childhood health among men is mediated to a great extent by stress, poor health and financial hardship in adulthood while poor parental mental health is mediated by stress and financial hardship in adulthood as well as by mobility difficulties in later life. By contrast, parental excessive alcohol consumption is mediated mainly by later-life health and SES. Among women, childhood health is mediated largely by health in adulthood and later life as well as by stress in adulthood. Cognitive function is mediated mainly by later-life health and SES. Adverse experiences, on the other hand, are

mediated among women to a great extent by stress in adulthood. Overall, regarding mediators, it seems that stress in adulthood is more important for women, whereas SES is of greater consequence among men. Hence, our hypothesis about gender differentials in the relative importance of childhood circumstances and how these are mediated has been confirmed. It has been suggested that women are more susceptible to stress due to hormonal changes and biological factors (Verma *et al.*, 2011; Albert, 2015). Further, a greater effect of SES on later-life health among men has been observed before (Back and Lee, 2011; Verropoulou and Zakyntinou, 2016).

The findings of the present study stand out compared to other similar analyses as most of them focus solely on the effects of socio-economic adversity on later-life health or examine the effects of SES in conjunction with childhood health. By contrast, the present study additionally considers adverse childhood experiences. Our findings regarding the effects of childhood health on later-life depression among women are roughly in agreement with Kendig *et al.* (2017) and Pakpahan *et al.* (2017a), who also find that both the critical period and the pathway models apply regarding effects on later-life SPH. However, our results contrast with those of Arpino *et al.* (2018), who suggest that these effects are solely direct and are not mediated. Regarding childhood SES, our findings are fairly consistent with Tani *et al.* (2016), who find latency mechanisms in operation, and with Zimmer *et al.* (2016), who find a strong and independent effect of both early and adult SES on later-life depression; however, they contrast with analyses suggesting pathway mechanisms regarding later-life SPH or depression (Torres and Wong, 2013; Pakpahan *et al.*, 2017a; Angelini *et al.*, 2019). Finally, a strong and independent effect of early life and adulthood adverse experiences on adult poor mental health has been noted before (Nurius *et al.*, 2015).

Some limitations of the study should be considered when interpreting the findings. First, depressive symptoms and all independent variables included in the analysis are self-reported and, thus, they may be subject to misreporting. Additionally, retrospective material may be affected by recall errors. Hence, it would be of great interest to confirm these findings using longitudinal material from a cohort study, based on interviews carried out in childhood, adulthood and later life. Unfortunately, such studies are scarce and there is currently none covering several European countries. Second, information on adverse childhood circumstances is based on proxy variables (excessive parental alcohol consumption and poor parental mental health). Other measures of child abuse/neglect (unavailable in SHARE) would have provided more reliable conclusions. Third, there is no available information on the onset of depression; early onset may exhibit a stronger association with early life factors. Fourth, the present analysis does not control for biological and hereditary factors predisposing to depression, as the relevant information is not included in SHARE. Further analyses should attempt to control for such factors, thus enabling more accurate assessment of the relative effects of childhood disadvantage on depression in later life. Finally, around 5 per cent of the respondents were excluded from the analysis due to missing information in the variables of interest. These persons are on average slightly older, include more females, have somewhat worse health and are slightly more disadvantaged compared to the sample used in the study. Hence, their exclusion from the analysis may have led to a slight underestimation of the impact of adversity on later-life depression.



## Conclusions

Despite the limitations, the present study provides evidence of the long-term impact of childhood health, SES and adverse experiences on later-life depression for both men and women. Most childhood factors have a significant direct and indirect effect, the latter mediated by adulthood and later-life conditions; SES for both genders and cognitive function for men exhibit a direct effect only, while childhood health for males and poor parental mental health for females have only an indirect effect. Hence, the findings indicate that both the critical period and the pathway models are relevant. Regarding gender differentials in mediation, adulthood and later-life SES mediate early life health and adverse experiences more strongly for men, while stress seems to mediate early life adverse experiences to a greater extent among women.

Intervening policies aiming to reduce the incidence of depression should first seek to address childhood adversity, considering at the same time the differential vulnerability of men and women. Putting emphasis on social and psychological support for abused and maltreated children as well as for those experiencing material deprivation might help to prevent depression both in adulthood and in later life.

Future research could seek to validate these findings based on longitudinal data, additionally distinguishing between early and late onset of depression. Further, it would be worth examining interactions between the three domains of life (health, SES and adverse experiences) and to construct trajectories over the lifecourse. Finally, it would be of interest to examine whether associations differentiate across European welfare systems and countries.

**Data.** This paper uses data from SHARE Waves 2 and 3 (SHARELIFE) (DOIs: 10.6103/SHARE.w2.600, 10.6103/SHARE.w3.600), see Börsch-Supan *et al.* (2013) for methodological details. The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: No. 211909, SHARE-LEAP: No. 227822, SHARE M4: No. 261982). Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the US National Institute on Aging (U01\_AG09740-13S2, P01\_AG005842, P01\_AG08291, P30\_AG12815, R21\_AG025169, Y1-AG-4553-01, IAG\_BSR06-11, OGHA\_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see [www.share-project.org](http://www.share-project.org)).

**Financial support.** The second author has been supported by the General Secretariat for Research and Technology (ES) and the Hellenic Foundation for Research and Innovation (ES, Scholarship Code 991).

**Conflict of interest.** The authors declare no conflicts of interest.

## References

- Albert PR (2015) Why is depression more prevalent in women? *Journal of Psychiatry & Neuroscience* **40**, 219–221.
- Almuneef M, ElChoueiry N, Saleheen HN and Al-Eissa M (2017) Gender-based disparities in the impact of adverse childhood experiences on adult health: findings from a national study in the Kingdom of Saudi Arabia. *International Journal for Equity in Health* **16**, 90.
- Amlaev K (2015) *Health Inequity, Treatment Compliance, and Health Literacy at the Local Level: Theoretical and Practical Aspects*. Russia: Ridero.
- Andersson D, Magnusson H, Carstensen J and Borgquist L (2011) Co-morbidity and health care utilisation five years prior to diagnosis for depression. A register-based study in a Swedish population. *BMC Public Health* **11**, 552–560.

- Angelini V, Howdon DDH and Mierau JO (2019) Childhood socioeconomic status and late-adulthood mental health: results from the Survey on Health, Ageing and Retirement in Europe. *Journals of Gerontology: Psychological Sciences and Social Sciences* 74B, 95–104.
- Angelini V, Klijs B, Smidt N and Mierau JO (2016) Associations between childhood parental mental health difficulties and depressive symptoms in late adulthood: the influence of life-course socio-economic, health and lifestyle factors. *PLOS ONE* 11, 12.
- Arpino B, Gumà J and Julià A (2018) Early-life conditions and health at older ages: the mediating role of educational attainment, family and employment trajectories. *PLOS ONE* 13, 4.
- Aziz R and Steffens DC (2013) What are the causes of late-life depression? *Psychiatric Clinics of North America* 36, 497–516.
- Back JH and Lee Y (2011) Gender differences in the association between socioeconomic status (SES) and depressive symptoms in older adults. *Archives of Gerontology and Geriatrics* 52, e140–e144.
- Beekman AT, Copeland JR and Prince MJ (1999) Review of community prevalence of depression in later life. *British Journal of Psychiatry* 174, 307–311.
- Belloni A, Morgan D and Paris V (2016) Pharmaceutical expenditure and policies: past trends and future challenges. Organisation for Economic Co-operation and Development, Health Working Paper 87.
- Berg LVD, Kalmijn M and Leopold T (2018) Family structure and early home leaving: a mediation analysis. *European Journal of Population* 34, 873–900.
- Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmacher J, Malter F, Schaap B, Stuck S, Zuber S and SHARE Central Coordination Team (2013) Data resource profile: the Survey of Health, Ageing and Retirement in Europe (SHARE). *International Journal of Epidemiology* 42, 992–1001.
- Börsch-Supan A and Jurges H (2005) *The Survey of Health, Aging and Retirement in Europe. Methodology*. Mannheim, Germany: Mannheim Research Institute for the Economics of Ageing.
- Breen R, Karlson KB and Holm A (2013) Total, direct, and indirect effects in logit and probit models. *Sociological Methods & Research* 42, 164–191.
- Butterworth P, Rodgers B and Windsor TD (2009) Financial hardship, socio-economic position and depression: results from the PATH Through Life Survey. *Social Science & Medicine* 69, 229–237.
- Case A, Fertig A and Paxson C (2005) The lasting impact of childhood health and circumstance. *Journal of Health Economics* 24, 365–389.
- Castro-Costa E, Dewey M, Stewart R, Banerjee S, Huppert F, Mendonca-Lima C, Bula C, Reisches F, Wancata J, Ritchie K, Tsolaki M, Mateos R and Prince M (2007) Prevalence of depressive symptoms and syndromes in later life in ten European countries: the SHARE study. *British Journal of Psychiatry* 191, 393–401.
- Castro-Costa E, Dewey M, Stewart R, Banerjee S, Huppert F, Mendonca-Lima C, Bula C, Reisches F, Wancata J, Ritchie K, Tsolaki M, Mateos R and Prince M (2008) Ascertaining late-life depressive symptoms in Europe: an evaluation of the survey version of the EURO-D scale in 10 nations. *The SHARE project. International Journal of Methods in Psychiatric Research* 17, 12–29.
- Cavapozzi D, Garrouste C and Paccagnella O (2011) Childhood, schooling and income inequality. In Börsch-Supan A, Brandt M, Hank K and Schröder M (eds), *The Individual and the Welfare State. Life Histories in Europe*. Berlin: Springer, pp. 31–43.
- Conklin AI, Forouhi NG, Suhrcke M, Surtees P, Wareham NJ and Monsivais P (2013) Socioeconomic status, financial hardship and measured obesity in older adults: a cross-sectional study of the EPIC-Norfolk cohort. *BMC Public Health* 13, 1039.
- Crowe L and Butterworth P (2016) The role of financial hardship, mastery and social support in the association between employment status and depression: results from an Australian longitudinal cohort study. *BMJ Open* 6, e009834.
- D'Alisa S, Miscio G, Baudo S, Simone A, Tesio L and Mauro A (2006) Depression is the main determinant of quality of life in multiple sclerosis: a classification-regression (CART) study. *Disability and Rehabilitation* 28, 307–314.
- Dewey ME and Prince MJ (2005) Mental health. In Börsch-Supan A, Brugiavini A, Jurges H, Mackenbach J, Siegrist J and Weber G (eds), *Health, Ageing and Retirement in Europe, First Results from the Survey of Health, Ageing and Retirement in Europe*. Mannheim, Germany: Mannheim Research Institute for the Economics of Ageing.
- Doblhammer G, Van den Berg GJ and Fritze T (2013) Economic conditions at the time of birth and cognitive abilities late in life: evidence from ten European countries. *PLOS ONE* 8, 9.

- Dube SR, Anda RF, Felitti VJ, Croft JB, Edwards VJ and Giles WH** (2001) Growing up with parental alcohol abuse: exposure to childhood abuse, neglect, and household dysfunction. *Child Abuse & Neglect* **25**, 1627–1640.
- Dvir Y, Ford JD, Hill M and Frazier JA** (2014) Childhood maltreatment, emotional dysregulation, and psychiatric comorbidities. *Harvard Review of Psychiatry* **22**, 149–161.
- Farrokhi F, Abedi N, Beyene J, Kurdyak P and Jassal SV** (2014) Association between depression and mortality in patients receiving long-term dialysis: a systematic review and meta-analysis. *American Journal of Kidney Diseases* **63**, 623–635.
- Flores M and Kalwij A** (2014) The associations between early life circumstances and later life health and employment in Europe. *Empirical Economics* **47**, 1251–1282.
- Gallagher D, Sawa GM, Kenny R and Lawlor BA** (2013) What predicts persistent depression in older adults across Europe? Utility of clinical and neuropsychological predictors from the SHARE study. *Journal of Affective Disorders* **147**, 192–197.
- Galobardes B, Lynch JW and Davey G** (2004) Childhood socioeconomic circumstances and cause-specific mortality in adulthood: systematic review and interpretation. *Epidemiologic Reviews* **26**, 7–21.
- Haas SA** (2007) The long-term effects of poor childhood health: an assessment and application of retrospective reports. *Demography* **44**, 113–135.
- Halmdienst N and Winter-Ebmer R** (2014) Long-run relations between childhood shocks and health in late adulthood – evidence from the Survey of Health, Ageing, and Retirement in Europe. *CESifo Economic Studies* **60**, 402–434.
- Hankin BL** (2002) Gender differences in depression from childhood through adulthood: a review of course, causes, and treatment. *Primary Psychiatry* **9**, 32–38.
- Hertzman C and Boyce T** (2010) How experience gets under the skin to create gradients in developmental health. *Annual Review of Public Health* **31**, 329–347.
- Imai K, Keele L and Tingley D** (2010a) A general approach to causal mediation analysis. *Psychological Methods* **15**, 309–334.
- Imai K, Keele L and Yamamoto T** (2010b) Identification, inference and sensitivity analysis for causal mediation effects. *Statistical Science* **25**, 51–71.
- Jakobsen JC, Gluud C, Wetterslev J and Winkel P** (2017) When and how should multiple imputation be used for handling missing data in randomised clinical trials – a practical guide with flowcharts. *BMC Medical Research Methodology* **17**, 162.
- Kendig H, Gong CH, Yiengprugsawan V, Silverstein M and Nazroo J** (2017) Life course influences on later life health in China: childhood health exposure and socioeconomic mediators during adulthood. *SSM – Population Health* **3**, 795–802.
- Kohler U, Karlson KB and Holm A** (2011) Comparing coefficients of nested nonlinear probability models using khb. *Stata Journal* **11**, 420–438.
- Ladin K** (2008) Risk of late-life depression across 10 European Union countries: deconstructing the education effect. *Journal of Aging and Health* **20**, 653–670.
- Luo Y and Waite LJ** (2005) The impact of childhood and adult SES on physical, mental, and cognitive well-being in later life. *Journals of Gerontology: Psychological Sciences and Social Sciences* **60B**, S93–S101.
- McLean CP, Asnaani A, Litz BT and Hofmann SG** (2011) Gender differences in anxiety disorders: prevalence, course of illness, comorbidity and burden of illness. *Journal of Psychiatric Research* **45**, 1027–1035.
- Monnat SM and Chandler RF** (2015) Long-term physical health consequences of adverse childhood experiences. *Sociological Quarterly* **56**, 723–752.
- Montez JK, Bromberger JT, Harlow SD, Kravitz HM and Matthews KA** (2016) Life-course socioeconomic status and metabolic syndrome among midlife women. *Journals of Gerontology: Psychological Sciences and Social Sciences* **71B**, 1097–1107.
- Moore T, McDonald M and McHugh-Dillon H** (2014) *Early Childhood Development and the Social Determinants of Health Inequities: A Review of the Evidence*. Parkville, Australia: Centre for Community Child Health at the Murdoch Children’s Research Institute and the Royal Children’s Hospital.
- Norden** (2013) *Focus on the Nordic Welfare Model*. Available at [http://www.nordicwelfare.org/PageFiles/7117/Nordic\\_Welfare\\_Model\\_Web.pdf](http://www.nordicwelfare.org/PageFiles/7117/Nordic_Welfare_Model_Web.pdf).

- Nurius PS, Green S, Logan-Greene P and Borja S** (2015) Life course pathways of adverse childhood experiences toward adult psychological well-being: a stress process analysis. *Child Abuse & Neglect* **45**, 143–153.
- Nuyen J, Volkers AC, Verhaak PFM and Schellevis FG** (2005) Accuracy of diagnosing depression in primary care: the impact of chronic somatic and psychiatric co-morbidity. *Psychological Medicine* **35**, 1185–1195.
- Padayachee U, Ramlall S and Chipps J** (2017) Depression in older adults: prevalence and risk factors in a primary health care sample. *South African Family Practice* **59**, 61–66.
- Pakpahan E, Hoffmann R and Kröger H** (2017a) The long arm of childhood circumstances on health in old age: evidence from SHARELIFE. *Advances in Life Course Research* **31**, 1–10.
- Pakpahan E, Hoffmann R and Kröger H** (2017b) Retrospective life course data from European countries on how early life experiences determine health in old age and possible mid-life mediators. *Data in Brief* **10**, 277–282.
- Popova Y and Kozhevnikova M** (2013) Interdependence of HDI and budget redistribution within the Scandinavian and Continental Social Models. *Economics and Management* **18**, 562–575.
- Prince MJ, Beekman AT, Deeg DJ, Fuhrer R, Kivela SL, Lawlor BA, Lobo A, Magnusson H, Meller I, van Oyen H, Reischies F, Roelands M, Skoog I, Turrina C and Copeland JR** (1999a) Depression symptoms in late life assessed using the EURO-D scale. Effect of age, gender and marital status in 14 European centres. *British Journal of Psychiatry* **174**, 339–345.
- Prince MJ, Reischies F, Beekman AT, Fuhrer R, Jonker C, Kivela SL, Lawlor BA, Lobo A, Magnusson H, Fichter M, van Oyen H, Roelands M, Skoog I, Turrina C and Copeland JR** (1999b) Development of the EURO-D scale – a European Union initiative to compare symptoms of depression in 14 European centres. *British Journal of Psychiatry* **174**, 330–338.
- Pudrovska T and Anikputa B** (2014) Early-life socioeconomic status and mortality in later life: an integration of four life-course mechanisms. *Journals of Gerontology: Psychological Sciences and Social Sciences* **69B**, 451–460.
- Schaan B** (2014) The interaction of family background and personal education on depressive symptoms in later life. *Social Science & Medicine* **102**, 94–102.
- Segel-Karpas D** (2015) Number of illnesses, self-perceived health, and depressive symptoms: the moderating role of employment in older adulthood and old age. *Work, Aging and Retirement* **1**, 382–392.
- Sengoku M** (2003) *Emerging Eastern European Welfare States: A Variant of the 'European' Welfare Model?* Available at [http://src-h.slav.hokudai.ac.jp/coe21/publish/no2\\_ses/3-2\\_Sengoku.pdf](http://src-h.slav.hokudai.ac.jp/coe21/publish/no2_ses/3-2_Sengoku.pdf).
- Small DS** (2013) Mediation analysis without sequential ignorability: using baseline covariates interacted with random assignment as instrumental variables. *arXiv* 1109.1070.
- St Clair M, Croudace T, Dunn V, Jones P, Herbert J and Goodyer I** (2015) Childhood adversity subtypes and depressive symptoms in early and late adolescence. *Development and Psychopathology* **27**, 885–899.
- Tani Y, Fujiwara T, Kondo N, Noma H, Sasaki Y and Kondo K** (2016) Childhood socioeconomic status and onset of depression among Japanese older adults: the JAGES prospective cohort study. *American Journal of Geriatric Psychiatry* **24**, 717–726.
- Torres JM and Wong R** (2013) Childhood poverty and depressive symptoms for older adults in Mexico: a life-course analysis. *Journal of Cross-cultural Gerontology* **28**, 317–337.
- Van Bergen E, van Zuijlen T, Bishop D and de Jong PF** (2017) Why are home literacy environment and children's reading skills associated? What parental skills reveal. *Reading Research Quarterly* **52**, 147–160.
- Van de Velde S, Bracke P and Levecque K** (2010) Gender differences in depression in 23 European countries. Cross-national variation in the gender gap in depression. *Social Science & Medicine* **71**, 305–313.
- Verma R, Balhara YP and Gupta CS** (2011) Gender differences in stress response: role of developmental and biological determinants. *Industrial Psychiatry Journal* **20**, 4–10.
- Verropoulou G** (2014) Specific versus general self-reported health indicators predicting mortality among older adults in Europe: disparities by gender employing SHARE longitudinal data. *International Journal of Public Health* **59**, 665–678.
- Verropoulou G and Zakyntinou M** (2016) Contrasting concurrent and childhood socioeconomic predictors of self-rated health among older European men and women. *Journal of Biosocial Science* **49**, 478–491.
- World Health Organization (WHO)** (2014) *Social Determinants of Mental Health*. Geneva: WHO.

- World Health Organization (WHO)** (2017a) *Depression and Other Common Mental Disorders. Global Health Estimates*. Geneva: WHO.
- World Health Organization (WHO)** (2017b) *World Population Ageing 2017 – Highlights*. New York, NY: United Nations.
- Zender R and Olshansky E** (2009) Women's mental health: depression and anxiety. *Nursing Clinics of North America* **44**, 355–364.
- Zimmer Z, Hanson HA and Smith KR** (2016) Childhood socioeconomic status, adult socioeconomic status, and old-age health trajectories: connecting early, middle, and late life. *Demographic Research* **34**, 285–320.