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Preventive Medicine 126 (2019) 105764

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

A longitudinal study of neighbourhood conditions and depression in ageing European adults: Do the associations vary by exposure to childhood stressors?

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ARTICLE INFO

Keywords:
Depression
Healthy ageing
Residence characteristics
Resilience
Psychological
Adverse childhood experiences

ABSTRACT

Emerging literature emphasises the association between neighbourhood conditions and late life depression. Childhood experiences, crucial for life course development of mental health, may modify how neighbourhood affects subsequent depression. This study assessed the longitudinal associations of access to services and neighbourhood nuisance with depression among older adults, and tested whether these associations varied by exposure to childhood stressors. Data were drawn from the cross-national Survey of Health, Ageing and Retirement in Europe, a prospective cohort study between 2004/2005 and 2015, representative for European adults over the age of 50. Individual perceptions of neighbourhood were measured at baseline; childhood stressors, defined as socioeconomic conditions, adverse experiences and health problems, were collected retrospectively. Multilevel logistic regression estimated the risk of depression (n = 10,328). Access to services were negatively (OR = 0.78, 95% CI 0.68–0.90) and neighbourhood nuisance positively (OR = 1.36, 95% CI 1.18–1.56) associated with the probability of depression during follow-up. We found interactions between neighbourhood and childhood socioeconomic conditions, but not with adverse experiences and health problems. While older adults who grew up in better childhood socioeconomic conditions benefited more from living in a residential area with good access to services, they were at higher risk of developing depression when residing in areas with more neighbourhood nuisances. Older adults' mental health can benefit from better access to public transportation and neighbourhood amenities, while physical and social problems in the local area increase the risk of depression. Importantly, socioeconomic circumstances in early life may influence vulnerability to neighbourhood effects in older age.

1. Introduction

Depression is one of the most common threats to mental health in late life, causing emotional suffering and dramatically reduced quality of life over the age of 55 (Beekman et al., 1999; Blazer, 2003). The aetiology of depression in older adults differs from younger populations with medical comorbidities and functional impairments gaining more importance (Buchtemann et al., 2012). Age-specific material and psychosocial factors, such as lower income, loss of status, critical life events, or living in residential care settings, also contribute to higher risk of depression in this age group (Daly and Allen, 2016; Stahl et al., 2017).

Due to limited mobility, functional decline and life course changes (i.e. retirement), the activity spaces of older adults become increasingly restricted to their immediate surroundings, making them particularly vulnerable to neighbourhood stressors and dependent on local resources (Barnett et al., 2017; Julien et al., 2012). The majority of studies in this field are cross-sectional (Barnett et al., 2017), which can hardly establish causal links between neighbourhood and mental health. The few existing longitudinal investigations, however, point to elevated risk of depression among those residing in areas with higher poverty (Almeida et al., 2012), more neighbourhood problems (such as crime, noise, littering and drug use) (Astell-Burt et al., 2015; Bierman, 2009; Orban et al., 2016; Stafford et al., 2011) or higher air pollution

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https://doi.org/10.1016/j.ypmed.2019.105764
Received 21 January 2019; Received in revised form 12 June 2019; Accepted 28 June 2019
Available online 30 June 2019

(Kioumourtzoglou et al., 2017). Limited evidence is available on the effects of access to transportation and neighbourhood services, which suggests lower risk of depression by the presence of essential amenities (Barnett et al., 2017; Eibich et al., 2016; Moore et al., 2016).

Exploring differential vulnerability to neighbourhood exposures across the life course might further our understanding of the mechanisms affecting the development of depressive symptoms and help to identify policy opportunities for addressing health inequalities among older populations (Diderichsen et al., 2018). Individual, (e.g. marital status (Bierman, 2009), social support (Schieman and Meersman, 2004)), and area-based factors (e.g. social cohesion in the community (Fone et al., 2014)) have been shown to buffer the adverse effects of neighbourhood disadvantage. Although there is an increasing interest in the mental health impact of childhood circumstances (Angelini et al., 2019; Arpino et al., 2018; Barboza Solis et al., 2015), the moderating role of these conditions on the relationship between neighbourhood and mental health is poorly understood. There is evidence for increased risk of depression among adults residing in high crime neighbourhoods with previous exposure to childhood trauma (Lowe et al., 2016). However, the lasting effect of adversity may depend on the level of hardship (Seery, 2011). While no or high levels of lifetime adversity is associated with higher vulnerability, moderate levels might lead to resilience (i.e. the process of positively adapting to adversities and recovering from negative life events) (Harris et al., 2016; Seery, 2011).

There is a lack of prospective data in the literature and little evidence exist on whether common childhood stressors (e.g. disadvantaged socioeconomic conditions) modify the effects of residential area on depression among older adults. The current study, therefore, assessed longitudinal associations of neighbourhood nuisances and access to services with depression among older European adults. Moreover, it examined whether childhood stressors, defined as socioeconomic disadvantage, adverse experiences and health problems, modify the neighbourhood - mental health relationship.

2. Methods

2.1. Study design and participants

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a cross-national European panel study, representative for the community-dwelling population aged 50 and over (Borsch-Supan et al., 2013). Since 2004/2005, individuals have been followed-up regularly, approximately every second year; the latest available sweep (wave 6) was conducted in 2015 in 18 countries. Our analyses made use of all waves at the time of data analysis. Non-institutionalised respondents between the age of 50 and 96 were included in the sample, if they provided valid answers on neighbourhood characteristics and depression at baseline (waves 1 or 2), participated in the life history assessment (wave 3, SHARELIFE), and had at least one assessment of depressive symptoms during the follow-up (waves 4–6). As the same neighbourhood questions were asked in wave 1 and 2, we extracted for each participant the latest available information and defined the respective wave as baseline. Survey participants remained part of the analytic dataset, as long as they stayed at the same residential address; if residential movement occurred during follow-up, we censored participant's observations from all consecutive waves. The SHARE study was approved by the relevant research ethics committees in the participating countries, and all participants provided written informed consent.

2.2. Neighbourhood conditions

Neighbourhood was assessed with four binary questions, capturing the characteristics of the area immediately surrounding the participants' place of residence. Multiple correspondence analysis indicated two underlying dimensions behind the four items: two items focused on access to services ("*sufficient supply of facilities such as pharmacy, medical care, grocery and the like within reasonable distance*"; "*sufficient possibilities for public transportation*") and two on neighbourhood nuisances ("*pollution, noise or other environmental problems*"; "*vandalism or crime*"). Dimensions were statistically independent from each other ($p < 0.001$), while items belonging to the same dimensions showed moderate tetrachoric correlation ($r_{tetAccess} = 0.52$ and $r_{tetNuisances} = 0.66$). Scores were computed by summarizing the corresponding binary items and dichotomising them (yes, no).

2.3. Depression

The EURO-D scale from waves 1, 2, 4, 5 and 6 was used for the measurement of current depressive symptoms. The instrument consists of 12 binary items capturing the presence of depression, pessimism, wishing death, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment and tearfulness in the preceding month. This scale has adequate internal consistency and criterion validity in older populations (Castro-Costa et al., 2008; Prince et al., 1999). The score ranged from 0 to 12, with higher values indicating more depressive symptoms. We used the cut-off score of ≥ 4 to detect clinically significant levels of depressive symptoms (Prince et al., 1999).

2.4. Childhood stressors

SHARELIFE retrospectively collected information on participants' life history, which we used to compute three composite measures of childhood stressors. Childhood socioeconomic conditions (CSCs) at the age of 10 were measured using 4 questions, indicating (1) the occupational position of the main breadwinner based on skill levels (low, high); (2) number of books at home (< 10, ≥ 10); (3) home overcrowding (measured by household size and number of rooms available); and (4) housing quality based on the presence or absence of basic amenities (fixed bath, cold running water supply, hot running water supply, inside toilet, central heating). After dichotomising the answers, we computed a common score with five categories labelling the social condition of the family ranging from 'most disadvantaged' to 'most advantaged' (Wahrendorf and Blane, 2015).

Adverse childhood experiences (ACEs) were defined as traumatic or stressful conditions in the children's immediate environment occurring until the age of 15. The following variables were used: (1) child in care; (2) parental death; (3) parental mental illness; (4) parental drinking problem; (5) period of hunger; and (6) property taken away. Dichotomised answers have been summed up and classified into 3 categories, indicating 'no ACE', '1 ACE', and '2 or more ACEs'.

Finally, childhood health problems (CHPs) before the age of 15 were measured with the following non-mutually exclusive items: (1) hospitalization for longer than one month; (2) multiple hospitalizations; (3) childhood illnesses (e.g. asthma, polio); and (4) serious childhood health conditions (e.g. epilepsy, leukemia). We calculated a binary variable indicating 'no CHP' versus '1 or more CHPs'.

2.5. Covariates

Demographic variables included age [in ten years, centred at the midpoint of the sample's age range (73 years)], age^2 (to examine accelerated change over ageing), birth cohorts (1919–1928, 1929–38, 1939–45, after 1945), gender and born in the country of interview (yes, no). Highest educational attainment (primary or lower, secondary, tertiary) was measured using on the International Standard Classification of Education. We computed equalized household net wealth as an indicator of socioeconomic status by dividing household non-pension net wealth by the square root of benefiting members. Low, medium and high wealth groups with equal number of participants were classified within each participating country. Further covariates included labour market status (employed, out of the labour force, retired, unemployed), living in status (in couple, alone) and restrictions

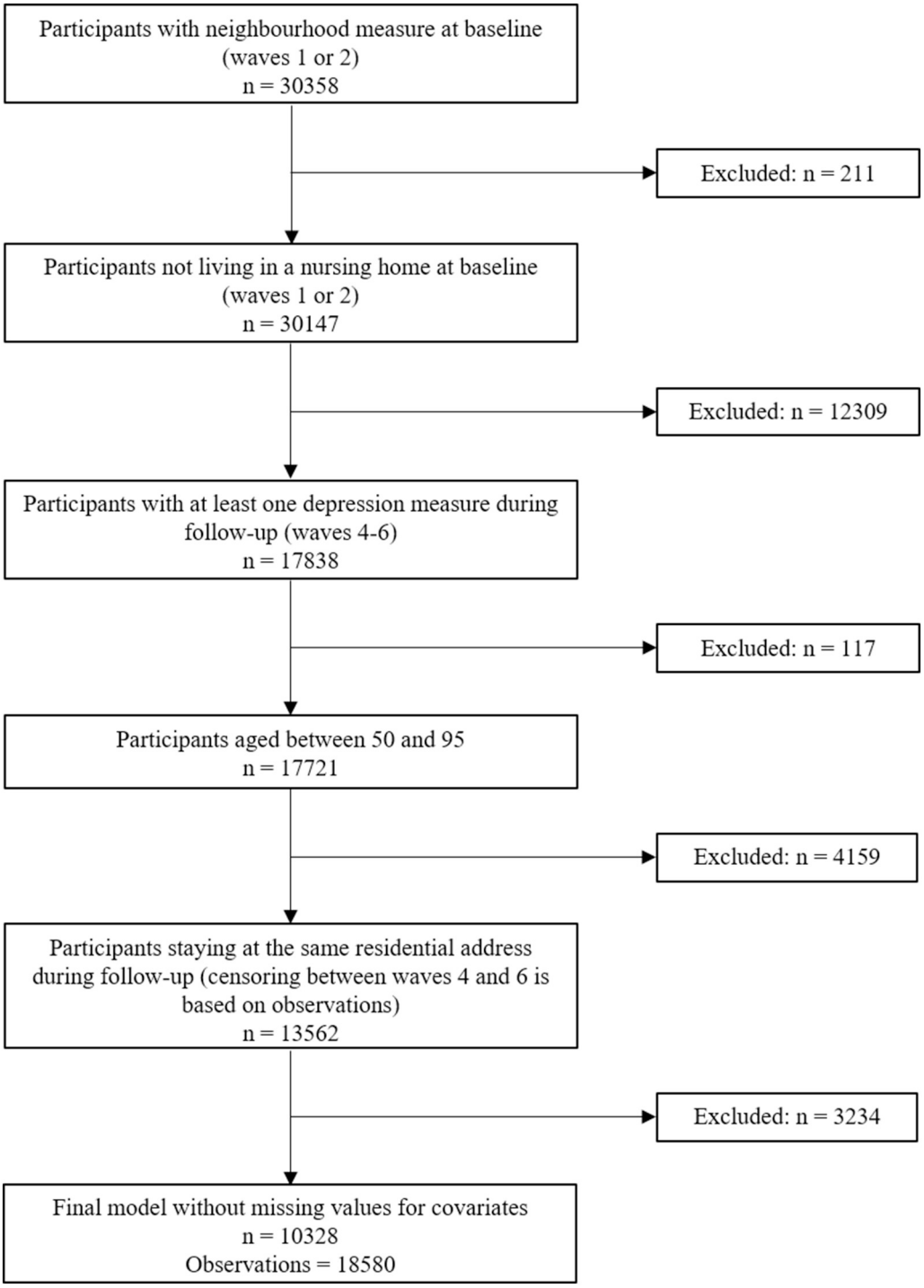

Fig. 1. Flowchart indicating sample selection into the analytic sample, Survey of Health, Ageing and Retirement in Europe, 2004/2005–2015.

(yes, no) in Activities of Daily Living (ADL) and in Instrumental Activities of Daily Living (IADL) (Chan et al., 2012). While socio-demographic and health covariates were measured at baseline, we computed a composite index for health behaviour (alcohol consumption, physical inactivity, smoking and unhealthy diet (Cheval et al., 2018)) using the mode of their values across waves.

2.6. Statistical analyses

Multilevel logistic regression analyses estimated the effect of perceived neighbourhood conditions on the risk of depression, presented in Odds Ratios (OR) with 95% Confidence Intervals (CI). Considering the clustered nature of the SHARE dataset, i.e. observations (level 1) are nested in individuals (level 2), and individuals in countries (level 3), we used multilevel models to take into account the dependency of repeated measurements within the same level.

The first set of models examined the associations between neighbourhood and depression. In Model 1 (M1), we adjusted for the effects of age, age^2, birth cohorts and gender. M2 further controlled for all other individual factors (born in the country, education, equalized household net wealth, living status, labour market status, ADL, IADL and health behaviours). While M1 and M2 were conducted separately

for access to services (M1a, M2a) and for neighbourhood nuisance (M1b, M2b), in M3 we included both factors in the fully adjusted model in order to assess their independent associations with depression. In M4, we additionally adjusted for baseline levels of depression to test a more causal pathway between neighbourhood (wave 1 or 2) and depression (waves 4–6). For all main models, intra-class correlation (ICC) was calculated indicating group resemblance within countries.

The second set of models explored the associations between childhood stressors and depression, and assessed interaction effects with neighbourhood exposures; all models were run separately for CSCs, ACEs and CHPs. After we estimated the effects of the childhood stressors on depression (M5), while adjusting for all aforementioned individual covariates and baseline levels of depression, interaction terms were added to the models, separately for access to services (M6a) and for neighbourhood nuisance (M6b). In the last model (M7), we considered interaction terms for both neighbourhood variables simultaneously.

We conducted supplementary and sensitivity analyses to further explore the robustness of our findings. First, instead of using the binary indicators of depression we conducted multilevel linear regression imputing continuous EURO-D scores. Second, in order to test, whether urban-rural difference attenuates neighbourhood effects, we repeated all analyses by including a variable on the type of residence (rural, urban). Third, we reran the main analyses in a subsample (n = 7928) who were free of depression at baseline. Fourth, we explored whether results evolve with ageing by including an interaction term between age and neighbourhood; when appropriate between age, neighbourhood and childhood conditions.

All models were controlled for participant attrition since inclusion in SHARE (no attrition, dropped out, deceased) and conducted in R Studio.

3. Results

The final analytical sample comprised 10,328 participants with 18,580 observations during follow-up, living in 13 different European countries (Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Italy, The Netherlands, Poland, Spain, Sweden, and Switzerland) (Fig. 1). The majority of the sample was female (56.4%) and the average age was 68.6 at baseline. 70.7% of the participants described having sufficient access to services and a similar proportion (71.2%) did not report any signs of neighbourhood nuisance (Table 1). 63.2% had never reported being suffering from clinically relevant levels of depressive symptoms; 23.2% had depression at baseline and an additional 13.6% developed during follow-up.

Good access to services was significantly associated with lower risk of depression (OR = 0.82, 95% CI 0.73–0.93) in the initial model (M1a), which only slightly changed after adjusting for all socioeconomic and health covariates (M2a: OR = 0.86, 95% CI 0.76–0.98) (Table 2). Similarly, the presence of neighbourhood nuisances increased the risk of depression in the initial (M1b: OR = 1.43, 95% CI 1.27–1.62) and in the fully adjusted model (M2b: OR = 1.38, 95% CI 1.22–1.56). When simultaneously considering both neighbourhood variables in a fully adjusted regression (M3), the effects of access to services and neighbourhood nuisances did not materially change, confirming independent and robust effects on depression. In M4, we adjusted for baseline levels of depression: participants with sufficient access to services had 22% lower odds for reporting depression during the follow-up, while any signs of neighbourhood nuisance in the residential area increased the risk of depression with 36% (Table 2). Country differences explained approximately 3.5–3.7% of the total variation in the initial models ($ICC_{country}$).

Childhood stressors were significantly associated with depression in the fully adjusted models (M5). In comparison to the most disadvantaged CSCs, those who grow up in disadvantaged, middle, advantaged and in the most advantaged conditions, showed better mental health outcomes as older adults (Table 3). Similarly, having reported one or two and more ACEs increased the risk of depression (Table A.1), and so did one or more CHPs (Table A.2).

Interaction models revealed significant modification of neighbourhood effects by CSCs (Table 3). Living in an area with good access to public transportation and basic amenities was particularly beneficial for those coming from middle (OR = 0.60, 95% CI 0.41–0.89), advantaged (OR = 0.55, 95% CI 0.35–0.87) and most advantaged CSCs (OR = 0.42, 95% CI 0.21–0.83) (M6a). Furthermore, reporting presence of neighbourhood nuisances in the residential area increased the risk of depression for older adults coming from less disadvantaged families (M6b). In comparison with the most disadvantaged CSCs,

Table 1
Descriptive statistics of the analytic sample (n = 10,328), Survey of Health, Ageing and Retirement in Europe, 2004/2005–2015.

Variable		n (%)
Gender	Male	4502 (43.6)
	Female	5826 (56.4)
Age at baseline (mean [SD])		68.6 (9.1)
Birth cohorts	1919 and 1928	845 (8.2)
	1929 and 1938	2504 (24.2)
	1939 and 1945	2448 (23.7)
	After 1945	4531 (43.9)
Attrition during follow-up	No dropout	9044 (87.6)
	Dropped out	806 (7.8)
	Deceased	478 (4.6)
Born in the country	Yes	9769 (94.6)
	No	559 (5.4)
Highest educational attainment	Primary	2837 (27.4)
	Secondary	5294 (51.3)
	Tertiary	2197 (21.3)
Equalized household net wealth	Low	2957 (28.6)
	Medium	3504 (33.9)
	High	3867 (37.4)
Health behaviours index (mean [SD])		0.3 (0.3)
Living status	Living alone	3189 (30.9)
	Living in a couple	7139 (69.1)
Labour market status	Employed	3482 (33.7)
	Out of the labour force	1674 (16.2)
	Retired	4826 (46.7)
	Unemployed	346 (3.4)
ADL	Any restriction	718 (7.0)
	No restrictions	9610 (93.0)
IADL	Any restrictions	1079 (10.4)
	No restrictions	9249 (89.6)
Access to services	Yes	7305 (70.7)
	No	3023 (29.3)
Neighbourhood nuisances	Yes	2971 (28.8)
	No	7357 (71.2)
Childhood socioeconomic conditions	Most disadvantaged	1804 (17.5)
	Disadvantaged	2474 (24.0)
	Middle	3445 (33.4)
	Advantaged	2003 (19.4)
	Most advantaged	602 (5.8)
Adverse childhood experiences	No	7946 (76.9)
	1 adverse childhood experience	1948 (18.9)
	2 or more adverse childhood experiences	434 (4.2)
Childhood health problems	No	7565 (73.2)
	1 or more childhood health problems	2763 (26.8)
Depression at baseline	Yes	2401 (23.2)
	No	7927 (76.8)
Depression at follow-up	Yes	2657 (25.7)
	No	7671 (74.3)
Countries	Austria (455, 4.4%), Belgium (1174, 11.4%), Czech Republic (701, 6.8%), Denmark (972, 9.4%), France (686, 6.6%), Germany (693, 6.7%), Greece (866, 8.4%), Italy (969, 9.4%), The Netherlands (839, 8.1%), Poland (716, 6.9%), Spain (802, 7.8%), Sweden (817, 7.9%), Switzerland (638, 6.2%)	

Abbreviations: ADL, activities of daily living; IADL, instrumental activities of daily living; SD, standard deviation.

Table 2
Depression by neighbourhood conditions among 10,328 older European adults (OR with 95% CI), Survey of Health, Ageing and Retirement in Europe, 2004/2005–2015.

Variable	Access to services		Neighbourhood nuisances		M3: Access and nuisances	M4: Control for baseline depression
	M1a: Initial	M2a: Fully-adjusted	M1b: Initial	M2b: Fully-adjusted		
Age (centred, in 10 years)	1.58 (1.32–1.89)	1.41 (1.17–1.69)	1.60 (1.34–1.92)	1.42 (1.18–1.70)	1.43 (1.19–1.72)	1.48 (1.21–1.81)
Age^2 (centred, in 10 years)	1.30 (1.20–1.42)	1.28 (1.17–1.40)	1.32 (1.21–1.44)	1.29 (1.18–1.41)	1.29 (1.18–1.41)	1.34 (1.21–1.47)
Gender (ref: female)	0.30 (0.26–0.34)	0.34 (0.30–0.39)	0.30 (0.26–0.34)	0.35 (0.30–0.39)	0.35 (0.30–0.40)	0.44 (0.38–0.51)
Birth cohorts (ref: after 1945)						
1919 and 1928	0.79 (0.47–1.33)	0.61 (0.36–1.03)	0.78 (0.46–1.30)	0.60 (0.36–1.02)	0.59 (0.35–1.00)	0.54 (0.30–0.96)
1929 and 1938	1.18 (0.87–1.61)	0.99 (0.72–1.35)	1.18 (0.86–1.60)	0.99 (0.72–1.36)	0.97 (0.70–1.33)	0.96 (0.67–1.37)
1939 and 1945	1.15 (0.93–1.43)	1.01 (0.81–1.26)	1.15 (0.93–1.43)	1.01 (0.81–1.26)	1.02 (0.82–1.27)	1.00 (0.78–1.27)
Attrition during follow-up (ref: no attrition)						
Dropped out	1.09 (0.85–1.39)	0.99 (0.78–1.27)	1.06 (0.83–1.36)	0.99 (0.77–1.27)	0.98 (0.77–1.26)	1.00 (0.76–1.32)
Deceased	2.27 (1.70–3.02)	1.76 (1.32–2.34)	2.27 (1.70–3.02)	1.76 (1.32–2.35)	1.77 (1.33–2.36)	1.91 (1.38–2.64)
Born in the country (ref: no)		0.65 (0.51–0.83)		0.66 (0.52–0.84)	0.66 (0.52–0.84)	0.74 (0.56–0.98)
Education (ref: primary)						
Secondary		0.81 (0.70–0.94)		0.79 (0.68–0.91)	0.80 (0.69–0.92)	0.71 (0.61–0.83)
Tertiary		0.77 (0.64–0.93)		0.75 (0.62–0.91)	0.76 (0.63–0.92)	0.68 (0.55–0.83)
Equalized household net wealth (ref: low)						
Medium		0.84 (0.73–0.97)		0.86 (0.75–0.99)	0.85 (0.74–0.98)	0.92 (0.78–1.08)
High		0.71 (0.62–0.83)		0.73 (0.63–0.84)	0.72 (0.62–0.84)	0.80 (0.68–0.94)
Health behaviours index		4.62 (3.65–5.84)		4.60 (3.64–5.81)	4.60 (3.64–5.82)	4.30 (3.33–5.57)
Living status (ref: living alone)		1.04 (0.91–1.18)		1.05 (0.93–1.19)	1.04 (0.92–1.18)	1.17 (1.02–1.35)
Labour market status (ref: employed)						
Out of the labour force		2.05 (1.69–2.50)		2.03 (1.67–2.48)	2.04 (1.67–2.48)	2.31 (1.85–2.87)
Unemployed		2.00 (1.46–2.74)		1.98 (1.45–2.71)	1.98 (1.44–2.70)	1.96 (1.37–2.80)
Retired		1.62 (1.34–1.95)		1.60 (1.33–1.93)	1.60 (1.32–1.93)	1.85 (1.50–2.28)
ADL (ref: no restrictions)		1.94 (1.55–2.42)		1.93 (1.54–2.41)	1.91 (1.53–2.39)	1.55 (1.19–2.00)
IADL (ref: no restrictions)		2.06 (1.71–2.49)		2.08 (1.72–2.51)	2.05 (1.70–2.48)	1.53 (1.23–1.91)
Access to services (ref: no)	0.82 (0.73–0.93)	0.86 (0.76–0.98)			0.84 (0.74–0.95)	0.78 (0.68–0.90)
Neighbourhood nuisances (ref: no)			1.43 (1.27–1.62)	1.38 (1.22–1.56)	1.40 (1.23–1.59)	1.36 (1.18–1.56)
Baseline depression (wave 1 or 2)						8.41 (6.93–10.21)
$ICC_{country}$	3.66%	1.61%	3.50%	1.54%	1.45%	0.00%

Abbreviations: ADL, activities of daily living; IADL, instrumental activities of daily living; CI, confidence intervals; OR, odds ratios.

disadvantaged (OR = 1.78, 95% CI 1.17–2.71), advantaged trend-wise (OR = 1.56, 95% CI 0.98–2.48) and most advantaged (OR = 2.16, 95% CI 1.07–4.35) childhood conditions predicted depression when living in areas with neighbourhood nuisances. These interaction effects remained fairly constant when all interaction terms were considered within the same model (M7) (Table 3).

We did not find any evidence for effect modification by ACEs and CHPs (Tables A.1, A.2). In the first sensitivity analysis, we tested the robustness of our findings by using continuous measures of depression. Although the main (Table A.3) and interaction effects of access to services were slightly attenuated (Table A.4), the overall pattern of the findings did not change. Similarly, adjusting for rural-urban differences lessened the interaction effects of access to services and CSCs, but they remained close to the significance level (Tables A.5, A.6). In the

Table 3
Interaction effects of childhood socioeconomic conditions and neighbourhood conditions on depression among 10,328 older European adults (OR with 95% CI), Survey of Health, Ageing and Retirement in Europe, 2004/2005–2015.

Variable	M5: without interaction	M6a: access to services interaction	M6b: neighbourhood nuisances interaction	M7: access and nuisances interactions
Access to services (ref: no)	0.81 (0.70–0.93)	1.16 (0.86–1.56)		1.07 (0.79–1.45)
Neighbourhood nuisances (ref: no)	1.35 (1.17–1.55)		0.94 (0.68–1.30)	0.86 (0.62–1.19)
CSCs (ref: most disadvantaged)				
Disadvantaged	0.80 (0.65–0.97)	0.92 (0.66–1.28)	0.66 (0.52–0.84)	0.70 (0.50–0.99)
Middle	0.57 (0.47–0.70)	0.88 (0.64–1.21)	0.54 (0.43–0.68)	0.67 (0.48–0.94)
Advantaged	0.50 (0.40–0.64)	0.81 (0.55–1.18)	0.44 (0.34–0.58)	0.61 (0.41–0.90)
Most advantaged	0.47 (0.33–0.66)	0.98 (0.54–1.77)	0.37 (0.25–0.55)	0.51 (0.27–0.95)
Access to services × CSCs				
Access × disadvantaged		0.88 (0.59–1.32)		0.87 (0.58–1.31)
Access × middle		0.60 (0.41–0.89)		0.68 (0.46–1.00)
Access × advantaged		0.55 (0.35–0.87)		0.61 (0.39–0.95)
Access × most advantaged		0.42 (0.21–0.83)		0.60 (0.30–1.20)
Neighbourhood nuisances × CSCs				
Nuisances × disadvantaged			1.78 (1.17–2.71)	1.98 (1.29–3.03)
Nuisances × middle			1.25 (0.84–1.88)	1.41 (0.94–2.13)
Nuisances × advantaged			1.56 (0.98–2.48)	1.77 (1.11–2.82)
Nuisances × most advantaged			2.16 (1.07–4.35)	2.47 (1.23–4.99)

All models were adjusted for age, age^2, gender, birth cohort, attrition during follow-up, born in the country, education, equalized household net wealth, health behaviours, living status, labour market status, activities of daily living, instrumental activities of daily living and baseline depression.
Abbreviations: CI, confidence intervals; CSC, childhood socioeconomic conditions; OR, odds ratios.

subsample with no depression at baseline, the main effect of neighbourhood nuisances remained preserved; the association with access to services was only in the initial model significant (Table A.7). Although the interaction coefficients had the same direction and pattern as in the main sample, the reduced power and large standard errors due to decreased sample size likely led to overlapping confidence intervals (Table A.8). Finally, the supplementary analyses including age slopes for neighbourhood found a weak evidence for decreasing effect of neighbourhood nuisance on depression by ageing, which was attenuated after adjustment for baseline level of depression (Tables A.9, A.10).

4. Discussion

This study examined the longitudinal associations between perceived neighbourhood conditions and depression in older European adults and tested whether this relationship varied by exposure to childhood stressors. Our findings showed independent effects of neighbourhood conditions: living in an area with good access to services reduced by 22% the odds of developing depression during the follow-up, whereas being exposed to neighbourhood nuisances increased the odds by 36%. Less advantaged CSCs, ACEs and CHPs were associated with depression. While ACEs and CHPs did not modify the associations between neighbourhood exposure and mental health, we found differential vulnerability by CSCs. Older adults who grew up in better circumstances benefited more from living in a residential area with good access to local services, but they were also at higher risk of developing depression when residing in areas with more neighbourhood nuisances; suggesting early childhood determination of place-based protective and risk factors on late life mental health.

4.1. Study strengths and limitations

Our findings are based on a large population-based sample of > 10,000 older adults from 13 European countries and present longitudinal findings over a 10-year period, which place this study among the very few long-term examinations in this field offering a prospective design (Barnett et al., 2017; Moore et al., 2016). Moreover, to our knowledge this is one of the first studies exploring the modifying effects of different childhood stressors on the neighbourhood-mental health link in this age group. However, it has also important limitations warranting for cautious interpretation. First, both predictor and outcome were assessed through self-report measures and thus can be subject to same source bias (Diez Roux, 2007). Although we tried to mitigate against reverse causation (i.e. depression leads to less favourable perception of the neighbourhood) by adjusting for baseline levels of depression, we could not exclude the possibility of other non-measured conditions, such as psychological disposition, distorting the associations (Weden et al., 2008). Subjective measures of neighbourhood conditions often show stronger associations with health outcomes than objective characteristics (Weden et al., 2008). Although the latter can better capture area features respondents might not be aware of, they are not able to take into account the substantial variation in how individuals define their own neighbourhoods (Elliott et al., 2014). Subjective perception might be the mediating pathway between objective neighbourhood characteristics and mental health (Weden et al., 2008). Second, early childhood stressors were collected retrospectively; therefore, they may be affected from recall bias. Although retrospectively measured ACEs might potentially overestimate the effect of childhood on subjective outcomes (Reuben et al., 2016), CSCs and CHPs showed good level of internal and external consistency in the SHARE study (Havari and Mazzonna, 2015). Third, attrition during follow-up presents a possible bias to the representativeness of the findings. Although, in all models we included a variable indicating attrition during follow-up, our study design required respondents to participate in at least 3 out of 6 waves, which led to a substantial drop in the sample size.

4.2. Comparison with the literature

Our study provided longitudinal evidence of the protective effects of good access to public transportation, pharmacy, medical care and grocery. As the mobility of older adults is often restricted, sufficient availability of and access to local services can provide basic and essential daily resources, help to maintain physical and mental health, and support social participation (Barnett et al., 2017; Eibich et al., 2016); presenting opportunities for public health interventions. Previous research suggested adverse effects of neighbourhood problems on mental health among older adults (Barnett et al., 2017; Bierman, 2009; Stafford et al., 2011), which we were able to confirm in the SHARE study using subjective measures of pollution, noise, vandalism and crime. Possible neuropathological mechanisms contributing to higher risk of depression might lead through direct (e.g. elevated level of proinflammatory cytokines in the blood caused by air pollution (Kioumourtzoglou et al., 2017), distress induced by exposure to noise or crime (Bierman, 2009; Orban et al., 2016)) or indirect (e.g. declining physical and social activities in the local area) pathways.

In line with findings highlighting the impact of early life experiences on mental health (Angelini et al., 2019; Arpino et al., 2018; Barboza Solis et al., 2015), CSCs, ACEs and CHPs predicted late life depression. Exposure to stressors in this age might meet a so-called sensitive period, a time-limited developmental window when experiences and external exposures may alter developmental processes and influence prospective health (Angelini et al., 2019; Rudenstine, 2013). ACEs and CHPs did not modify the effect of neighbourhood, which was particularly unexpected for ACEs, where interaction has been already shown (Lowe et al., 2016). However, ACEs were defined as intrafamilial events in our analysis, while the previous study focused on interpersonal trauma (e.g. abuse, neglect) (Lowe et al., 2016).

CSCs predicted how neighbourhood influences depression. Living in an area with sufficient access to services was only beneficial for older adults, if they grew up in neutral or advantaged families; older people who experienced disadvantaged childhood circumstances did not benefit from better neighbourhood resources. According to the pathway hypothesis, children with different socioeconomic background are channelled into pathways leading to divergent adult circumstances and health outcomes (Power and Hertzman, 1997), which, because of low social mobility, accumulates advantages and disadvantages, further widening health inequalities throughout the life course (Dannefer, 2003). Childhood socioeconomic conditions did not only predict who could benefit from neighbourhood resources, but also influenced individual reactions for neighbourhood stressors. Previous research highlighted two distinct mechanisms for how childhood stressors may interact with later stressors, depending on the toxicity of exposure (Harris et al., 2016). Severe adversities in early life can make individuals more vulnerable to psychopathology when exposed to subsequent stressors (Harris et al., 2016). The stress sensitisation hypothesis in neighbourhood context has been confirmed in a US study showing elevated rates of depression among childhood trauma survivors living in high crime neighbourhoods as adults (Lowe et al., 2016). However, moderate levels of childhood stressors may contribute to resilience and help to build up resources and coping mechanism which can buffer the effect of future stressors (Harris et al., 2016; Shapero et al., 2015). This stress inoculation hypothesis provides a framework for our findings on the interaction of CSCs and neighbourhood nuisances, where participants with most disadvantaged CSCs did not indicate increased risk of depression when residing in adverse areas. An alternative explanation would emphasise the mental health consequences of downward intergenerational mobility (Melchior et al., 2018), i.e. coming from better childhood circumstances but ending up in adverse neighbourhood conditions.

5. Conclusion

Our longitudinal results provide valuable insights into how childhood can modify the effects of neighbourhood on mental health among older adults, differently for protective and risk factors. Childhood is an important life stage where early experiences, exposure to stressors and living conditions can shape future coping mechanisms and resources relevant for healthy ageing. Future research on neighbourhood effects should prioritise the implementation of the life course approach to better understand differential vulnerability to neighbourhood conditions and confirm our findings by using prospective childhood measures and objectively measured area characteristics. Furthermore, providing access to neighbourhood amenities and public transportation, as well as reducing environmental problems in the residential area, present public health opportunities to support healthy ageing. Policy makers may consider opportunities mitigating childhood stressors through supporting low-income families and investing in early childhood development and education, which can minimise the health impact of childhood socioeconomic inequalities.

Funding

This publication was supported (to GB) by the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie Grant agreement No. 676060 (LONGPOP - Methodologies and Data mining techniques for the analysis of Big Data based on Longitudinal Population and Epidemiological Registers). The work benefited (to SS, BC and SC) from the support of the Swiss National Centre of Competence in Research “LIVES – Overcoming vulnerability: Life course perspectives”, which is financed by the Swiss National Science Foundation (grant number: 51NF40-160590).

Author contributions

GB and SC developed the research design and prepared the first draft of the study. GB and SS conducted the data analysis. All authors supported the research design, reviewed and commented on the manuscript, and approved the final version.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

Acknowledgments

This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4, 5 and 6 (DOIs: https://doi.org/10.6103/SHARE.w1.600, https://doi.org/10.6103/SHARE.w2.600, https://doi.org/10.6103/SHARE.w3.600, https://doi.org/10.6103/SHARE.w4.600, https://doi.org/10.6103/SHARE.w5.600, https://doi.org/10.6103/SHARE.w6.600). The SHARE data collection was 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: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). The authors gratefully acknowledge additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. 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 various national funding sources (see www.share-project.org).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2019.105764.

References

Almeida, O.P., Pirkis, J., Kerse, N., Sim, M., Flicker, L., Snowdon, J., Draper, B., Byrne, G., Lautenschlager, N.T., et al., 2012. Socioeconomic disadvantage increases risk of prevalent and persistent depression in later life. J. Affect. Disord. 138, 322–331.
Angelini, V., Howdon, D.D.D., Mierau, J.O., 2019. Childhood socioeconomic status and late-adulthood mental health: results from the survey on health, ageing and retirement in Europe. J. Gerontol. B Psychol. Sci. Soc. Sci. 74, 95–104.
Arpino, B., Guma, J., Julia, A., 2018. Early-life conditions and health at older ages: the mediating role of educational attainment, family and employment trajectories. PLoS One 13, e0195320.
Astell-Burt, T., Feng, X.Q., Kolt, G.S., Jalaludin, B., 2015. Does rising crime lead to increasing distress? Longitudinal analysis of a natural experiment with dynamic objective neighbourhood measures. Soc. Sci. Med. 138, 68–73.
Barboza Solis, C., Kelly-Irving, M., Fantin, R., Darnaudery, M., Torrisani, J., Lang, T., Delpierre, C., 2015. Adverse childhood experiences and physiological wear-and-tear in midlife: findings from the 1958 British birth cohort. Proc. Natl. Acad. Sci. U. S. A. 112, E738–E746.
Barnett, A., Zhang, C.J.P., Johnston, J.M., Cerin, E., 2017. Relationships between the neighborhood environment and depression in older adults: a systematic review and meta-analysis. Int. Psychogeriatr. 30, 1153–1176.
Beekman, A.T., Copeland, J.R., Prince, M.J., 1999. Review of community prevalence of depression in later life. Br. J. Psychiatry 174, 307–311.
Bierman, A., 2009. Marital status as contingency for the effects of neighborhood disorder on older adults' mental health. J. Gerontol. B Psychol. Sci. Soc. Sci. 64, 425–434.
Blazer, D.G., 2003. Depression in late life: review and commentary. J. Gerontol. A Biol. Sci. Med. Sci. 58, 249–265.
Borsch-Supan, A., Brandt, M., Hunkler, C., Kneip, T., Korbmacher, J., Malter, F., Schaan, B., Stuck, S., Zuber, S., et al., 2013. Data resource profile: the survey of health, ageing and retirement in Europe (SHARE). Int. J. Epidemiol. 42, 992–1001.
Buchtemann, D., Luppa, M., Bramesfeld, A., Riedel-Heller, S., 2012. Incidence of late-life depression: a systematic review. J. Affect. Disord. 142, 172–179.
Castro-Costa, E., Dewey, M., Stewart, R., Banerjee, S., Huppert, F., Mendonca-Lima, C., Bula, C., Reisches, F., Wancata, J., et al., 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. Int. J. Methods Psychiatr. Res. 17, 12–29.
Chan, K.S., Kasper, J.D., Brandt, J., Pezzin, L.E., 2012. Measurement equivalence in ADL and IADL difficulty across international surveys of aging: findings from the HRS, SHARE, and ELSA. J. Gerontol. B Psychol. Sci. Soc. Sci. 67, 121–132.
Cheval, B., Boisgontier, M.P., Orsholits, D., Sieber, S., Guessous, I., Gabriel, R., Stringhini, S., Blane, D., van der Linden, B.W.A., et al., 2018. Association of early- and adult-life socioeconomic circumstances with muscle strength in older age. Age Ageing 47, 398–407.
Daly, S., Allen, J., 2016. Inequalities in Mental Health, Cognitive Impairement and Dementia Among Older People. University College London. Institute of Health Equity, London.
Dannefer, D., 2003. Cumulative advantage/disadvantage and the life course: cross-fertilizing age and social science theory. J. Gerontol. B Psychol. Sci. Soc. Sci. 58, S327–S337.
Diderichsen, F., Hallqvist, J., Whitehead, M., 2018. Differential vulnerability and susceptibility: how to make use of recent development in our understanding of mediation and interaction to tackle health inequalities. Int. J. Epidemiol. dyy167.
Diez Roux, A.V., 2007. Neighborhoods and health: where are we and were do we go from here? Rev. Epidemiol. Sante Publique 55, 13–21.
Eibich, P., Krekel, C., Demuth, I., Wagner, G.G., 2016. Associations between neighborhood characteristics, well-being and health vary over the life course. Gerontology 62, 362–370.
Elliott, J., Gale, C.R., Parsons, S., Kuh, D., 2014. Neighbourhood cohesion and mental wellbeing among older adults: a mixed methods approach. Soc. Sci. Med. 107, 44–51.
Fone, D., White, J., Farewell, D., Kelly, M., John, G., Lloyd, K., Williams, G., Dunstan, F., 2014. Effect of neighborhood deprivation and social cohesion on mental health inequality: a multilevel population-based longitudinal study. Psychol. Med. 44, 2449–2460.
Harris, M.A., Brett, C.E., Starr, J.M., Deary, I.J., McIntosh, A.M., 2016. Early-life predictors of resilience and related outcomes up to 66 years later in the 6-day sample of the 1947 Scottish mental survey. Soc. Psychiatry Psychiatr. Epidemiol. 51, 659–668.
Havari, E., Mazzonna, F., 2015. Can we trust older people's statements on their childhood circumstances? Evidence from SHARELIFE. Eur. J. Popul. 31, 233–257.
Julien, D., Richard, L., Gauvin, L., Kestens, Y., 2012. Neighborhood characteristics and depressive mood among older adults: an integrative review. Int. Psychogeriatr. 24, 1207–1225.
Kioumourtzoglou, M.A., Power, M.C., Hart, J.E., Okereke, O.I., Coull, B.A., Laden, F., Weisskopf, M.G., 2017. The association between air pollution and onset of depression among middle-aged and older women. Am. J. Epidemiol. 185, 801–809.
Lowe, S.R., Quinn, J.W., Richards, C.A., Pothen, J., Rundle, A., Galea, S., Ressler, K.J., Koenen, K.C., Bradley, B., 2016. Childhood trauma and neighborhood-level crime interact in predicting adult posttraumatic stress and major depression symptoms. Child Abuse Negl. 51, 212–222.
Melchior, M., Ziad, A., Courtin, E., Goldberg, M., Zins, M., van der Waerden, J., 2018. Intergenerational socioeconomic mobility and adult depression: the CONSTANCES Study. Am. J. Epidemiol. 187, 260–269.
Moore, K.A., Hirsch, J.A., August, C., Mair, C., Sanchez, B.N., Roux, A.V.D., 2016. Neighborhood social resources and depressive symptoms: longitudinal results from the multi-ethnic study of atherosclerosis. J. Urban Health 93, 572–588.
Orban, E., McDonald, K., Sutcliffe, R., Hoffmann, B., Fuks, K.B., Dragano, N., Viehmann,

A., Erbel, R., Jöckel, K.H., et al., 2016. Residential road traffic noise and high depressive symptoms after five years of follow-up: results from the Heinz Nixdorf Recall study. Environ. Health Perspect. 124, 578–585.
Power, C., Hertzman, C., 1997. Social and biological pathways linking early life and adult disease. Br. Med. Bull. 53, 210–221.
Prince, M.J., Reischies, F., Beekman, A.T., Fuhrer, R., Jonker, C., Kivela, S.L., Lawlor, B.A., Lobo, A., Magnusson, H., et al., 1999. Development of the EURO-D scale - a European Union initiative to compare symptoms of depression in 14 European centres. Br. J. Psychiatry 174, 330–338.
Reuben, A., Moffitt, T.E., Caspi, A., Belsky, D.W., Harrington, H., Schroeder, F., Hogan, S., Ramrakha, S., Poulton, R., et al., 2016. Lest we forget: comparing retrospective and prospective assessments of adverse childhood experiences in the prediction of adult health. J. Child Psychol. Psychiatry 57, 1103–1112.
Rudenstine, S., 2013. Applying a life course perspective to depression. In: Koenen, K.C., Rudenstine, S., Susser, E., Galea, S. (Eds.), A Life Course Approach to Mental Disorders. Oxford University Press, Oxford.
Schieman, S., Meersman, S.C., 2004. Neighborhood problems and health among older adults: received and donated social support and the sense of mastery as effect modifiers. J. Gerontol. B Psychol. Sci. Soc. Sci. 59, S89–S97.
Seery, M.D., 2011. Resilience: a silver lining to experiencing adverse life events? Curr. Dir. Psychol. Sci. 20, 390–394.
Shapero, B.G., Hamilton, J.L., Stange, J.P., Liu, R.T., Abramson, L.Y., Alloy, L.B., 2015. Moderate childhood stress buffers against depressive response to proximal stressors: a multi-wave prospective study of early adolescents. J. Abnorm. Child Psychol. 43, 1403–1413.
Stafford, M., McMunn, A., de Vogli, R., 2011. Neighbourhood social environment and depressive symptoms in mid-life and beyond. Ageing Soc. 31, 893–910.
Stahl, S.T., Beach, S.R., Musa, D., Schulz, R., 2017. Living alone and depression: the modifying role of the perceived neighborhood environment. Aging Ment. Health 21, 1065–1071.
Wahrendorf, M., Blane, D., 2015. Does labour market disadvantage help to explain why childhood circumstances are related to quality of life at older ages? Results from SHARE. Aging Ment. Health 19, 584–594.
Weden, M.M., Carpiano, R.M., Robert, S.A., 2008. Subjective and objective neighborhood characteristics and adult health. Soc. Sci. Med. 66, 1256–1270.