Research paper

Social engagement in late life may attenuate the burden of depressive symptoms due to financial strain in childhood

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A B S T R A C T

Background: It remains poorly understood if childhood financial strain is associated with old-age depression and if active social life may mitigate this relationship.
Aims: To investigate the association between childhood financial strain and depressive symptoms during aging; to examine whether late-life social engagement modifies this association.
Method: 2884 dementia-free individuals (aged 60+) from the Swedish National study of Aging and Care-Kungsholmen were clinically examined over a 15-year follow-up. Presence of childhood financial strain was ascertained at baseline. Depressive symptoms were repeatedly assessed with the Montgomery–Åsberg Depression Rating Scale. Social engagement comprised information on baseline social network and leisure activities. Linear, logistic and mixed-effect models estimated baseline and longitudinal associations accounting for sociodemographic, clinical, and lifestyle factors.
Results: Childhood financial strain was independently associated with a higher baseline level of depressive symptoms (β = 0.37, 95%CI 0.10–0.65), but not with symptom change over time. Relative to those without financial strain and with active social engagement, depressive burden was increased in those without financial strain but with inactive social engagement (β = 0.43, 95%CI: 0.15–0.71), and in those with both financial strain and inactive engagement (β = 0.99, 95%CI: 0.59–1.40). Individuals with financial strain and active social engagement exhibited similar depressive burden as those without financial strain and with active social engagement.
Limitations: Recall bias and reverse causality may affect study results, although sensitivity analyses suggest their limited effect.
Conclusions: Early-life financial strain may be of lasting importance for old-age depressive symptoms. Active social engagement in late-life may mitigate this association.

1. Introduction

Depression in old age is a major challenge as it represents a common and heterogeneous condition linked to multifactorial determinants (Alexopoulos, 2005; Patel, 2017). Up to 10,6% of community dwelling older adults report depressive symptoms that, despite not fully fulfilling the criteria for a depression diagnosis (Sjöberg et al., 2017), contribute to distress, poor quality of life and increased disability. Moreover, mild depressive symptoms are underdetected and undertreated, exposing older people to a higher risk of deterioration into major depression (Karlsson et al., 2016; Patel, 2017). A better understanding of life-long

contributors and modifiers of depressive symptoms is crucial to properly address mental health needs of older individuals.

Unfavorable socioeconomic circumstances have been associated with depression in older people (Alexopoulos, 2005; Allen et al., 2014; Almeida et al., 2012; Areán and Reynolds, 2005; Virtanen et al., 2015). The timing of exposure to socioeconomic difficulties may be of particular importance for subsequent depressive symptoms (Schaakxs et al., 2017). Financial strain in childhood (FSC), a crucial phase for individual development, has been previously linked with adolescent and adulthood depression (Boe et al., 2017; Gilman et al., 2002; Quon and Mcgrath, 2014). It remains unclear, however, if FSC is associated with

depressive symptoms in late-life, and whether this association is explained by mid- or late-life contributors to depression (i.e. education, mid-life socioeconomic status, personality, health behaviors, or chronic disease burden).

Several protective factors in late life may contribute to positive psychological outcomes even in the face of exposure to financial strain in early life. For instance, a fulfilling socially-integrated life comprising multiple leisure activities and rich social networks may promote the maintainance of good cognition through biological, psychological and social mechanisms (Fratiglioni et al., 2004). Likewise, active social life is thought to act on mental health by enriching personal and societal resources (Kawachi and Berkman, 2001). Hence, we hypothesize that greater social engagement in late life may provide means that could counteract the detrimental consequences of prior disadvantages in relation to depression.

Few studies have investigated the association between early life financial strain and depressive symptoms in old age, and none to our knowledge have tested whether social engagement may buffer this association. This study aims to: (i) assess the association between financial strain in childhood and development of depressive symptoms after age 60; (ii) examine how the potential association between financial strain in childhood and depressive symptoms in late life evolves, once a set of relevant contributors to depression throughout the life course are taken into account; (iii) explore if rich social engagement in late life can mitigate the possible association between childhood financial strain for depressive symptoms during aging.

2. Methods

2.1. Study population

We examined data from the Swedish National Study on Aging and Care in Kungsholmen (SNAC-K), an on-going population-based cohort study that started in 2001 with a random sample of individuals from 11 age cohorts (60, 66, 72, 78, 81, 84, 87, 90, 93, 96, 99+) living in the Kungsholmen district of Stockholm (Lagergren et al., 2004). A total of 3363 people attended the baseline assessment (73.3% participation rate) at which they underwent detailed medical assessment, psychological testing, nurse interviews and laboratory examinations. These individuals have been re-examined at regular intervals: every six years for the younger birth cohorts (60–72) or every three years for the older birth cohorts (78+).

Data analyzed in this study have been collected over the follow-up spanning up to 15 years, from baseline (2001–2004) until wave four (2013–2016). Of the 3363 baseline participants, we excluded: 310 with prevalent dementia at baseline diagnosed according to DSM-IV criteria in a three-step procedure involving experienced physicians (Fratiglioni et al., 1992); one with intellectual disability; and ten individuals who refused to undergo medical evaluation. We subsequently excluded participants with missing information on financial strain in childhood ($n = 64$) or depressive symptomatology at study entry ($n = 94$), resulting in a sample of 2884 participants for the baseline analysis. A subsample of participants with at least two assessments during the follow-up ($n = 2094$) was used to explore the longitudinal variation in depressive symptomatology in relation to financial strain in childhood (See Flowchart, Fig. 1).

All participants provided written informed consent. For cognitively impaired participants, consent was collected from the next of kin. SNAC-K was approved by the Regional Ethical Review Board in Stockholm, Sweden, in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

2.2. Depressive symptomatology

The presence of depressive symptoms was assessed with the Montgomery–Åsberg Depression Rating Scale (MADRS) during the

medical interview at baseline and at each follow-up wave. MADRS is part of the Comprehensive Psychopathological Rating Scale and is a widely used and validated scale for older people (Montgomery and Asberg, 1979; Mottram et al., 2000). It comprises 10 items, including low mood, inner tension, sleep disturbances, change in appetite, pessimistic thoughts, lassitude, inability to feel, apparent sadness, suicidal thoughts and concentration difficulties. MADRS was used as a continuous (sum of symptoms; range 0–60) and as a categorical dependent variable, where a cut-off >6 in the MADRS sum score was adopted to detect clinically relevant depressive symptoms (Snaith et al., 1986).

2.3. Financial strain in childhood

As part of the nurse questionnaire at baseline, participants were asked if their family was under any financial strain when they were growing up (i.e. until age 16). A yes/no answer was collected and used as the independent variable. Self-reported assessments of socioeconomic status have been employed in previous works assessing the role of financial circumstances in childhood and later depression (Luo and Waite, 2005; Tani et al., 2016).

2.4. Social engagement index

The index of social engagement comprised both information on social network and leisure activities in late-life collected during the baseline nurse interview. Briefly, the social network construct was derived from a questionnaire which assesses both the number of social connections and the extent of social support received (Cornwell and Waite, 2009). Richness of leisure engagement was captured using a list of 26 predefined mental, social, and physical activities in accordance with the frequency of participation (Marseglia et al., 2019). To generate the global index of social engagement, two standardized continuous scores of social network and leisure activities were averaged into a continuous index, which was then categorized by the median into "Active" and "Inactive" social engagement (See supplementary materials for details on the operationalization of the social engagement index).

2.5. Covariates

Information on sex and age was collected during the nurse interview at baseline. Educational attainment was split into two categories (elementary and secondary or above). Information on alcohol consumption was based on the frequency and amount of alcohol intake in a regular day and operationalized as follows: no or occasional, light to moderate (1–14 drinks/week for men or 1–7 drinks/week for women) and heavy alcohol consumption (>14 drinks/week for men and >7 drinks/week for women) (Breslow et al., 2013). Smoking behaviour was categorized as never, former or current smoking. Personality traits of neuroticism and extraversion were assessed at baseline using the Swedish version of the self-reported NEO Five-Factor Inventory (NEO-FFI). Raw sum scores for each personality trait were calculated and transformed into T-scores according to the NEO-FFI procedure. Participants were dichotomized into "Low" (T-score < 45) and "High" (T-score ≥ 45) for neuroticism and extraversion (Rizzuto et al., 2017). Midlife socioeconomic status was assessed with the Swedish socioeconomic classification system (SEI), and categorized occupation into "manual" and "non-manual". Based on a previous operationalization (Calderón-Larrañaga et al., 2016), multimorbidity was defined as the presence of 2+ chronic diseases at baseline, excluding from the count psychiatric conditions and cardiovascular risk factors.

2.6. Statistical analysis

Linear and logistic regressions were used to estimate β-coefficients and odds ratios with 95% confidence intervals (CI's) describing the

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                    │   3363 SNAC-K participants   │
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                                  │
                                  │      ┌──────────────────────────────────────────────┐
                                  ├─────▶│  240 participants with DSM IV dementia         │
                                  │      │  70 participants with questionable dementia    │
                                  │      │  1 participant with intellectual disability    │
                                  │      │  10 participants refused medical assessment    │
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                    │ 3042 cognitively intact participants   │
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                                  ├─────▶│  64 participants with missing information on   │
                                  │      │  childhood financial strain                   │
                                  │      └──────────────────────────────────────────────┘
                                  │
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                                  ├─────▶│  94 participants with missing information on   │
                                  │      │  MADRS at baseline                            │
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                                  │
                    ┌───────────────────────────────┐
                    │  2884 eligible participants    │
                    └───────────────────────────────┘
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                       │                    ├─────▶│ 790 participants with no MADRS follow-up │
                       │                    │      └─────────────────────────────────────┘
                       │                    │
              ┌──────────────────┐  ┌──────────────────┐
              │ 2884 participants │  │ 2094 participants │
              │ for baseline      │  │ for longitudinal  │
              │ analysis          │  │ analysis          │
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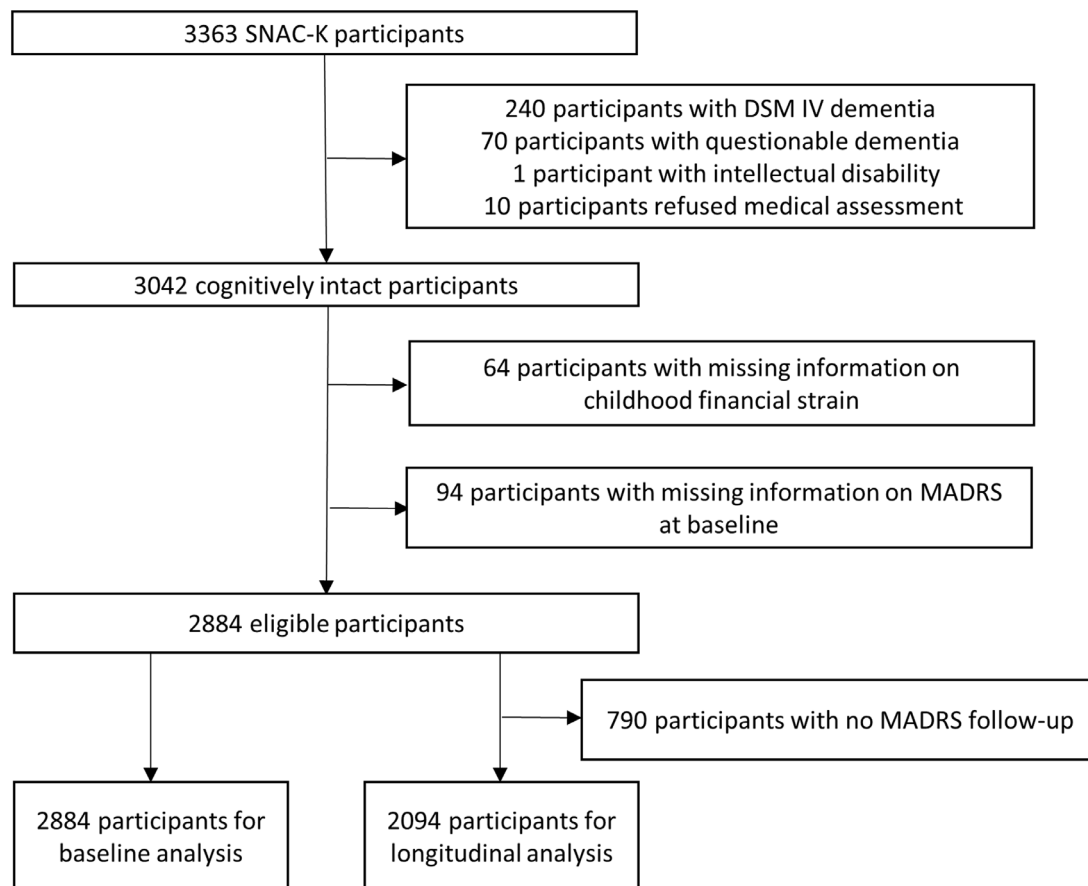
Fig. 1. Study population flowchart.

association between financial strain in childhood (FSC) and depressive symptoms at baseline, both continuously and categorically (MADRS cut-off > 6) in order to capture clinically relevant symptomatology. Three models progressively increasing the set of covariates in a step-wise manner were estimated: Model 1 (age, sex), Model 2 (Model 1 + educational attainment, smoking, alcohol use, socioeconomic status and multimorbidity) and Model 3 (Model 2 + personality traits). Furthermore, we examined if social engagement in late-life modified the association between FSC and baseline depressive symptoms. To do so, we first tested the interaction between FSC and social engagement. Then, we generated an indicator variable, designating the combinations of effect modifier (active/inactive social engagement) and exposure (absence/presence of FSC) and examined its association with baseline depressive symptoms. The most advantageous group (no FSC and high level of social engagement) was used as the reference group.

To explore the longitudinal variation of depressive symptomatology in relation to financial strain in childhood, 790 participants with less than two MADRS assessments during the follow-up were excluded (deceased $n = 440$; dropped out $n = 350$). Linear mixed models were employed to assess the association between financial strain in childhood (FSC) and depressive symptoms over the follow-up. To measure the association between financial strain in childhood and the average annual change in depressive symptoms, the interaction term FSC*follow-up time was included. Random effects for both individuals and follow-up time were included, with unstructured covariance assumed between the random parameters. Attrition and mortality were accounted for by adjusting all models with an indicator variable reflecting participation status (i.e. followed-up until the end of the study period; deceased before scheduled assessment; deceased after dropping out; alive drop-out).

2.7. Additional analyses

The main analysis investigating the association between FSC and baseline depressive symptoms was stratified by age and sex. We also repeated our effect modification analyses separately across the two components included in the social engagement index (i.e. social network and leisure activities, see Supplementary materials for the operationalization). The longitudinal analysis was additionally repeated with attrition and mortality adjusted using exposure time (i.e. time between baseline and time of death/drop-out/study end). Finally, to reduce the likelihood of reverse causality between depressive symptoms and social engagement, all analyses were repeated after restricting the sample to participants without DSM-IV-TR major or minor depression at baseline ($n = 139$) according to a previously described diagnostic procedure (Sjöberg et al., 2017).

STATA 15 was used for all statistical analyses (StataCorp, Texas, USA), and a p-value of < 0.05 was considered statistically significant.

3. Results

Participants excluded due to missing information on FSC or depressive symptoms ($N = 158$, 5%) were older, less educated, more depressed, had poorer social engagement, and higher number of chronic diseases, as compared to the participants included in the analysis (all $p < 0.05$).

Baseline characteristics of the study participants are reported in Table 1. Participants with a clinically relevant level of depressive symptoms at baseline were more likely to be women, older, less educated, with higher burden of chronic diseases and more likely to report financial strain in childhood (FSC). In addition, they engaged in fewer leisure activities, had less rich social networks, and exhibited higher

Table 1
Baseline characteristics of the study population by baseline depressive symptoms and childhood financial strain.

	Baseline MADRS (cut-off >6)			Financial strain in childhood		
	No symptoms *N* = 2540 (88.1%)	Yes symptoms *N* = 344 (11.9%)	*p-value*	No *N* = 2175 (75.4%)	Yes *N* = 709 (24.6%)	*p-value*
Women	1569 (61.8)	242 (70.3)	*<0.001*	1369 (62.9)	442 (62.3)	*.77*
Age (mean ± SD)	72.6 ± 10.2	75.8 ± 11.0	*<0.001*	72.9 ± 10.4	73.0 ± 10.4	*.64*
Education						
High school or below	1614 (63.6)	245 (71.2)	*<0.001*	1355 (62.3)	504 (71.1)	*<0.001*
University	925 (36.4)	99 (28.8)		819 (37.7)	205 (28.9)	
MADRS baseline (mean ± SD)	–	–		2.4 ± 3.7	3.3 ± 4.5	*<0.001*
Financial strain in childhood						
No	1953 (76.9)	222 (64.5)	*<0.001*	–	–	
Yes	587 (23.1)	122 (35.5)		–	–	
Multimorbidity						
<2	1117 (44.0)	92 (26.7)	*<0.001*	934 (42.9)	275 (38.8)	*.05*
≥2	1423 (56.0)	252 (73.3)		1241 (57.1)	434 (61.2)	
Socioeconomic status						
Manual	448 (17.8)	74 (21.7)	*.08*	347 (16.1)	175 (24.9)	*<0.001*
Non-manual	2063 (82.2)	267 (78.3)		1801 (83.9)	529 (75.1)	
Leisure activities						
Inactive	1264 (54.5)	181 (69.1)	*<0.001*	1079 (55.2)	366 (58.4)	*.16*
Active	1056 (45.5)	81 (30.9)		879 (44.8)	261 (41.6)	
Social network						
Poor	661 (27.4)	159 (52.6)	*<0.001*	582 (28.3)	238 (36.1)	*<0.001*
Rich	1752 (72.6)	143 (47.4)		1474 (71.7)	421 (63.9)	
Social engagement index						
Inactive	1072 (46.3)	180 (68.7)	*<0.001*	930 (47.6)	322 (51.4)	*0.10*
Active	1246 (53.7)	82 (31.3)		1023 (52.4)	305 (48.6)	
Neuroticism						
Low	869 (43.1)	17 (9.4)	*<0.001*	714 (42.4)	172 (33.4)	*<0.001*
Average to high	1150 (56.9)	164 (90.6)		971 (57.6)	343 (66.6)	
Extraversion						
Average to high	1488 (73.7)	84 (46.4)	*<0.001*	1226 (72.8)	346 (67.2)	*.01*
Low	531 (26.3)	97 (53.6)		459 (27.2)	169 (32.8)	
Alcohol consumption						
Occasional	786 (31.1)	164 (47.8)		692 (31.9)	258 (36.6)	
Light to moderate	1323 (52.3)	120 (35.0)	*<0.001*	1107 (51.1)	336 (47.7)	*.07*
Heavy drinking	420 (16.6)	59 (17.2)		369 (17.0)	110 (15.7)	
Smoking						
Never	1174 (46.5)	157 (45.8)		1002 (46.3)	329 (46.7)	
Ever	994 (39.3)	126 (36.7)	*.25*	850 (39.2)	270 (38.3)	*.87*
Current smoking	259 (14.2)	60 (14.5)		313 (14.5)	106 (15.0)	

Data presented as mean ± standard deviations or number (proportion,%). P-values from Chi2 test or *t*-test. Missing individuals (N) per covariate: Education: *N* = 1; SES: *N* = 32; Leisure activities: *N* = 302; Social network: *N* = 169; Social engagement: *N* = 304; Neuroticism: *N* = 684; Extraversion: *N* = 684; Alcohol: *N* = 12; Smoking: *N* = 14.

neuroticism and lower extraversion. Those with FSC were more likely to exhibit higher depressive burden at baseline, had lower education and socioeconomic status, and presented higher neuroticism, and poorer social network.

3.1. Baseline association: FSC-depressive symptoms

Estimates of the association between FSC and depressive symptoms at baseline are presented in Table 2. FSC was consistently associated with higher levels of baseline depressive symptoms, irrespective of whether the outcome was operationalized as a continuous or a categorical variable denoting a clinically relevant threshold of depressive symptoms. The association between FSC and depressive symptoms remained virtually unchanged after adjustment for mid- and late-life social and physical characteristics (Model 2). However, it was substantially attenuated upon further adjustment for personality traits (Model 3).

3.2. Longitudinal association: FSC-depressive symptoms

When exploring the role of FSC for the longitudinal development of depressive symptoms over time, no difference in the rate of accumulation of depressive symptoms between those with and without FSC was observed (Table 3). On average, depressive symptoms tended to increase over the follow-up period in both FSC groups.

Table 2
Association between financial strain in childhood (FSC) and depressive symptoms at baseline.

	Model 1	Model 2	Model 3
Beta coefficients; outcome: MADRS continuous			
No FSC	Ref.	Ref.	Ref.
FSC	0.84**	0.78**	0.37*
	(0.52; 1.17)	(0.45; 1.12)	(0.10; 0.65)
Odds Ratios; outcome: MADRS >6			
No FSC	Ref.	Ref.	Ref.
FSC	1.82**	1.79**	1.50*
	(1.43; 2.33)	(1.40; 2.30)	(1.06; 2.12)

Model 1: adjustment for age and sex; *N* = 2884 (FSC/no FSC: 709/2175).
Model 2: Model 1 adjustment plus education, smoking, alcohol consumption, socioeconomic status and multimorbidity; *N* = 2827 (FSC/no FSC: 695/2132).
Model 3: Model 2-adjustment plus personality traits; *N* = 2163 (FSC/no FSC: 507/1656).
  ** *p<0.01*.
  * *p<0.05*.

3.3. Social engagement as a modifier of the FSC-depressive symptoms association (baseline)

Given the presence of a statistically significant interaction between

Table 3
Longitudinal association between financial strain in childhood (FSC) and depressive symptoms over 15 years of follow-up from linear mixed models (beta coefficients and 95% confidence intervals).

	Model 1	Model 2	Model 3
Intercept			
No FSC	Ref.	Ref.	Ref.
FSC	0.59**	0.55**	0.35*
	(0.27; 0.92)	(0.22; 0.88)	(0.08; 0.64)
Slope			
No FSC x time	Ref.	Ref.	Ref.
FSC x time	−0.03	−0.03	−0.03
	(−0.07; 0.01)	(−0.07; 0.01)	(−0.07; 0.01)
Time	0.05**	0.05**	0.07**
	(0.03; 0.07)	(0.03; 0.07)	(0.05; 0.09)

Model 1: adjustment for age, sex and study participation status (followed-up until the end of study period; deceased before scheduled assessment; deceased after dropping out; alive drop outs); $N = 2094$ (FSC/no FSC: 709/2175).
Model 2: Model 1 adjustment plus education, smoking, alcohol consumption, socioeconomic status and multimorbidity; $N = 2059$ (FSC/no FSC: 503/1556).
Model 3: Model 2-adjustment plus personality traits; $N = 1712$ (FSC/no FSC: 404/1308).
  ** $p < 0.01$.
  * $p < 0.05$.

FSC and social engagement index for the level of baseline depressive symptoms (β-coefficient for the interaction term in a fully-adjusted regression model: β = −0.52, 95%CI −0.95; −0.09), we further examined the joint presence of FSC and social engagement index for depressive symptoms (Fig. 2).

In a fully-adjusted model, relative to individuals without a history of childhood financial strain and with active social engagement, the level of baseline depressive symptoms was higher in those without financial strain but with inactive social engagement (β = 0.43, 95%CI: 0.15 - 0.71), as well as in those who reported financial strain in childhood and were not actively socially engaged (β = 0.99, 95%CI: 0.59 - 1.40).

However, individuals with FSC and active social engagement did not statistically deviate from the level of depressive symptoms experienced by those in the optimal reference group (no FSC and active social engagement). A similar pattern of findings was observed when a clinically relevant cut-off was used as the outcome and logistic regression was performed (Supplementary Table 1b).

3.4. Additional analyses

The association between childhood financial strain and baseline depressive symptoms remained after stratification by sex and age, with the only exception of men and older participants in the fully-adjusted model (Supplementary Table 2 and 3). The results of longitudinal analysis did not change when attrition was accounted for by adjusting for exposure time instead of the participation status (Supplementary Table 4). The pattern of effect modification by social engagement remained consistent when individual components of the composite index (i.e. social network and leisure activities) were analyzed separately (Supplementary Tables 5a and 5b). Lastly, all findings were preserved after excluding participants with DSM-IV-TR diagnosis of major or minor depression from the analytic sample (Supplementary Tables 6a and 6b).

4. Discussion

In this population-based study, we found that financial strain in childhood (FSC) was associated with a higher baseline level of depressive symptoms in late-life, even after accounting for a set of potential contributors to late-life depression acting in mid- and late-life. An active engagement in social network and leisure activities demonstrated the capacity to mitigate the detrimental effect of financial strain on depressive symptoms burden. To the best of our knowledge, this is the first study to illustrate the role of compensatory late-life circumstances in countering the consequences of early disadvantage for late-life depression.
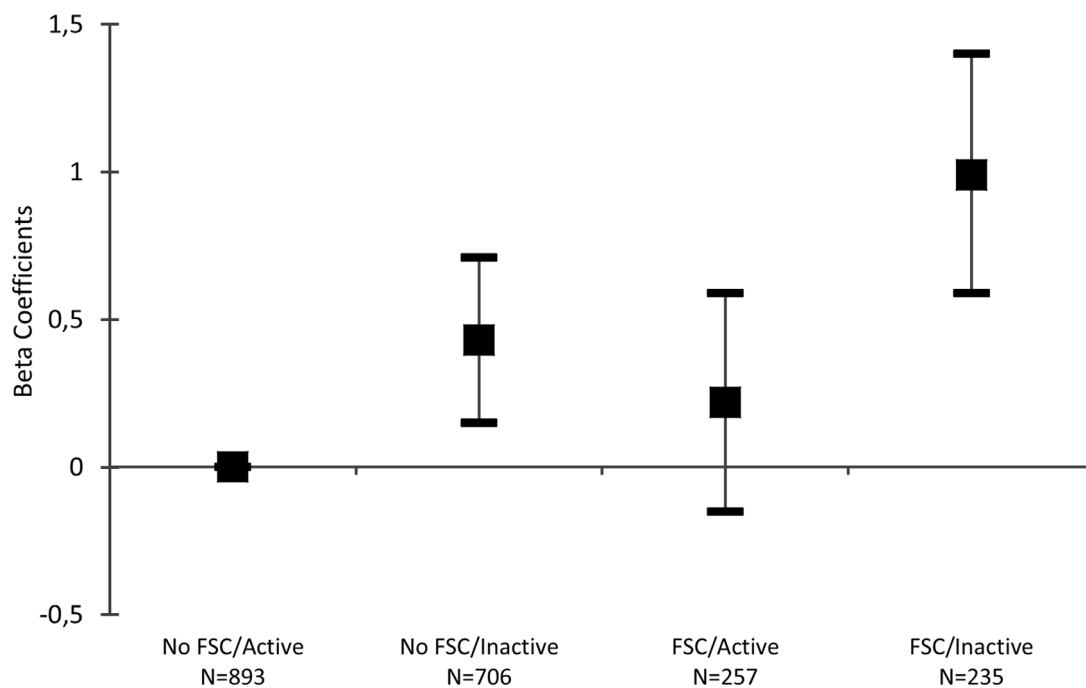
Fig. 2. Beta coefficients with 95% CI for the baseline level of depressive symptoms estimated in relation to the combinations of FSC (yes/no) and a social engagement index (active/inactive).
Reference group is individuals with no FSC and with active social engagement. Beta coefficients are estimated from one fully adjusted linear regression model (age, sex, participation status, education, midlife socioeconomic status, alcohol consumption, smoking, multimorbidity, personality traits). For the operationalization of the social engagement index, see Methods section. For complete analyses, see Supplementary Tables 1a.

4.1. Financial deprivation and late-life depression

Our results are consistent with previous studies reporting an association between financial strain in childhood and depressive symptoms in old age (Darin-Mattsson et al., 2018; Luo and Waite, 2005). Importantly, we confirmed that the association in question persists when a clinically relevant cut-off is used, as previously suggested by other studies (Ritchie et al., 2009; Tani et al., 2016). We observed the association in both men and women, pointing to a non-differential impact of sex on the association between FSC and depressive symptoms. Despite the evidence of sex differences in the vulnerability to depression (Derry et al., 2015; Hyde et al., 2008), our findings are consistent with several previous studies showing no sex-related differences in the association between financial condition in childhood and late-life depression (Luo and Waite, 2005; Ritchie et al., 2009). Future research investigating sex-specific responses to deprivation experiences in relation to old-age depression is needed to confirm these results.

However, we did not find evidence of worsening depressive trajectories over time in individuals aged 60 or above with prior experience of FSC. The association between FSC and baseline depressive symptoms was preserved after accounting for a host of contributors to depressive risk from mid- and late-life. Some of these factors may not just confound the exposure-outcome association but act on the mechanistic pathways. For instance, the accumulation of chronic diseases may explain the association between FSC and depression, as lower socioeconomic status is associated with a faster accumulation of chronic conditions (Dekhtyar et al., 2019), which in turn may contribute to depression (Read et al., 2017). Similarly, lower midlife socioeconomic position and unhealthy behaviors, including smoking and alcohol consumption may arise in relation to early-life financial disadvantage, and contribute over the life-course to worsening mental health. However, controlling for these factors did not substantially reduce the strength of the association between FSC and depression, suggesting their likely limited role as mediators. Instead, our results suggest that childhood is likely an important period for one's development, during which economic deprivation may exert an independent long-term impact on late-life depressive symptoms.

The process of neuronal maturation may explain the importance of childhood for later mental health. For instance, Ritchie et al. found a gene-environment interaction with childhood poverty on the risk of old-age depression (Ritchie et al., 2009), possibly acting through the altered expression of neuronal structures (Taylor et al., 2005). Interestingly, we observed a decrease in the magnitude of the association between FSC and depressive symptoms after additional adjustment for personality traits measured in older age. Personality development begins early in life and engages genetic, behavioral and social determinants, resulting into the constitution of features that characterize the way a person thinks, feels and behaves (Caspi et al., 2005). Experiences of financial deprivation (and the consequent internalization of perceived instability) may facilitate the development of personality traits (Conger et al., 2015a,b; Hart et al., 2008) more prone to psychopathological disorders such as mid- and late-life depression (Weber et al., 2011). Therefore, mid-life depression should be accounted for in future life-course investigations as a potential mediator between early-life factors and late-life mental health.

Yet, some evidence suggests that personality development also entails small changes beyond the early phases of childhood and adolescence, in particular in young adulthood but also in mid- and late-life (Roberts et al., 2006). Our findings confirm that early-life financial disadvantage contributes to depressive symptoms independently of the personality traits assessed in late-life, which themselves may be a product of the lifelong interplay between biological predispositions and environmental circumstances.

4.2. The buffering effect of social engagement

Our study demonstrated that active engagement in leisure activities and rich and supporting social networks may mitigate the detrimental impact of FSC on depressive symptoms. As summarized by Kawachi and Berkman, extended social relationships seem to exert beneficial effects on mental health through two pathways (Kawachi and Berkman, 2001). On the one hand, integrated social networks activate positive affective states, sense of purpose and self-worth, which in turn might promote healthy behaviors and modulate effective neuroendocrine responses, ultimately increasing psychological well-being. On the other hand, perceived availability of social resources may help engage positive coping strategies in the face of stress (Kawachi and Berkman, 2001). In addition, mental, social and physical stimulation through recreational activities may promote quality of life, improve health and reduce mortality through several pathways (Arem et al., 2019). First, social activities may increase integration and sense of togetherness among individuals, which prevent loneliness and reduce the risk of depression. Second, mental stimulation might protect from cognitive decline, which is strongly associated with depressive symptoms in older people (Fratiglioni et al., 2004; Singh-Manoux et al., 2017). Third, physical exercise may reduce the burden of depression by improving cardiovascular fitness and general health (Bridle et al., 2012). Thus, as already suggested for cognition and somatic diseases prevention (Marengoni et al., 2018; Ngandu et al., 2016), older people may benefit from multidomain intervention targeting physical, mental and social domains against depressive symptoms, even in the face of previous exposure to risk factors such as childhood financial deprivation.

4.3. Strengths and limitations

The strengths of this study are several including the population-based design, high participation rate, large sample size, the structured multidimensional assessments that took place at several time-points during a 15-year long follow-up period, and the presence of experienced physicians who clinically assessed depressive symptoms according to a validated rating scale. Several limitations need to be considered. First, participants lost to follow-up due to death or drop-out represented a frailer and more disadvantaged segment of the population (See Supplementary Figure 1 for information on attrition). This might have led to an underestimation of the association between FSC and depressive symptoms, resulting in more conservative estimates. Second, recording of FSC may have been subject to recall bias, which might have led to a differential misclassification of the exposure. To help reduce it, we excluded participants with overt cognitive and affective disorders, the major determinants of memory issues. Third, reverse causality between social engagement and depressive symptoms needs to be considered as the outcome and the modifier were assessed at the same time. In the attempt to rule out this issue, all analyses were repeated after exclusion of participants with clinical depression, and the results remained unchanged. Fourth, the possibility of residual confounding cannot be fully excluded. Finally, generalizability of these findings might be affected by the participation rate (73,3% at baseline) and the characteristics of the SNAC-K participants, who represent highly educated older individuals living in central Stockholm.

5. Conclusion

In this longitudinal population-based study, we found that the experience of financial strain in childhood was associated with depressive symptoms in late-life, even after accounting for several known contributors to depression from mid- and late-life. The long-lasting consequences of early financial deprivation for depressive symptoms reinforce the notion that depression is a disorder with multiple determinants that unfolds over the life-course. Our findings suggest that specific attention from the health care is warranted for men and women

alike, who suffered from early-life financial difficulties. The promotion of socially integrated life may offer a preventive strategy aimed at buffering the detrimental consequences of early disadvantage for late-life depression.

Author contributions

Conceptualization and study design: FT, LS, DVL, ADM, MB, LF, SD. Statistical analysis: FT SD. Interpretation of results: FT, LS, DVL, ADM, MB, LF, SD. Drafting of the original draft: FT, SD. Critical revision: FT, LS, DVL, ADM, MB, LF, SD. Approval of the version to be published: FT, LS, DVL, ADM, MB, LF, SD. Agreement to be accountable for all aspects of the work: FT, LS, DVL, ADM, MB, LF, SD. Funding acquisition: MB, SD, LF.

Data availability

The original data from the SNAC-K project (http://www.snac-k.se/) are available to the scientific community upon approval by the SNAC-K data management and maintenance committee. Applications can be submitted to Maria Wahlberg (maria.wahlberg@ki.se) at the Aging Research Center, Karolinska Institutet.

Declaration of Competing Interest

None

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2019.11.163.

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