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2021-06

Yang , L , Hu , Y , Silventoinen , K & Martikainen , P 2021 , ' Childhood adversity and trajectories of multimorbidity in mid-late life : China health and longitudinal retirement study ' , Journal of Epidemiology & Community Health , vol. 75 , no. 6 , pp. 593-600 . <https://doi.org/10.1136/jech-2020-214633>

<http://hdl.handle.net/10138/341522>

<https://doi.org/10.1136/jech-2020-214633>

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Childhood adversity and trajectories of multimorbidity in mid-late life: China

Health and Longitudinal Retirement Study

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Funding: This study was supported by the Ministry of Education of China for Youth Projects of Humanities and Social Sciences Research to LY (Grant Number 19YJC840053).

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Word count: 3300

What is already known on this subject?

Life course epidemiology suggests that health disparities in adulthood have their origins in the conditions of early childhood. While childhood circumstances are associated with multimorbidity in Western societies, further studies are warranted in a non-Western context.

What this study adds?

Parental physical abuse, inadequate of food, and poor parental mental health were associated with higher levels of multimorbidity at the baseline as well as higher rates of growth in multimorbidity in middle- and old-aged Chinese adults. Policies aiming to reduce childhood adversity in children and adolescents should be implemented to decrease the probability of the incidence of multimorbidity later in life.

Abstract:

Background: The association between childhood adversity and an individual's health in later life has been extensively studied in Western societies; however, little is known about this association for the development of multimorbidity in China.

Methods: Three waves (2011–2012, 2013, and 2015) of the China Health and Retirement Longitudinal Study were used for adults aged 45–101 years. Multimorbidity was assessed by the summed scores of self-reported physician diagnoses of fourteen chronic diseases. Childhood adversity was measured by the incidence of childhood abuse and neglect, negative caregiver's characteristics, and low socioeconomic status. Latent growth curve modelling was used to investigate the trajectory of multimorbidity by childhood adversity.

Results: Parental physical abuse was associated with increased number of chronic diseases (intercept, 0.119; 95% CI, 0.033, 0.205 for men and 0.268: 95% CI, 0.188, 0.348 for women) and a higher rate of increase (slope 0.013: 95% CI, 0.000, 0.027 for men and 0.022: 95% CI, 0.008, 0.036 for women) in multimorbidity. Adequacy of food was associated with a lower number chronic diseases at baseline (men: -0.171: 95% CI, -0.245, -0.097; women: -0.223: 95% CI, -0.294, -0.152) and a slower rate of change in multimorbidity (men: -0.015 per year: 95% CI, -0.027, -0.003; women: -0.012 per year: 95% CI, -0.024, -0.001).

Conclusions: The results demonstrate that childhood adversity exerts long-lasting effects on multimorbidity among older adults in China. Prevention of childhood maltreatment may delay or even avert the emergence of multimorbidity in later life.

Key words: childhood adversity, multimorbidity, trajectory, life course, CHARLS

Introduction

The number of older adults living with multimorbidity – the co-occurrence of two or more chronic diseases or medical conditions within the same individual^[1] – is rising globally.^[2] It is estimated that 30-50% of community-dwelling older adults in Western countries live with multimorbidity.^[3,4] A study from China showed that 30% of Chinese older adults have two or more chronic diseases.^[5] Multimorbidity has been linked to functional decline, reduced quality of life, and premature mortality, resulting in a greater demand for health and social care resources.^[6-8] Rapid ageing of the population, together with a heavy burden of chronic diseases, account for nearly 70% of all deaths in China.^[9] Therefore, it is timely and imperative to develop prevention strategies to tackle multimorbidity in the older Chinese population at both the individual and societal levels. In addition, a better understanding of modifiable risk factors for multimorbidity is needed.

Multimorbidity has been shown to be associated with childhood adversity (CA).^[10, 11] Research on the link between CA and the individual's health later in life has been rooted within the life-course epidemiology framework, which illustrates how life conditions from prenatal period to adulthood exert long-term effects on health later in life.^[12] Differences in what factors an individual is being exposed to and at which stage of life the exposure occurs lead to varied health outcomes between individuals and then set individuals on divergent health trajectories. CA is often conceptualised as an exposure to various types of traumatic events or situations during childhood, including sudden

distressing events (i.e., parental death or divorce), maltreatment (e.g., physical, emotional, or sexual abuse) and negative living environments (e.g., caregiver psychopathology). Previous studies have reported that lower childhood socioeconomic status (SES) and poor childhood health – two types of CA – are associated with an increased number of chronic conditions in mid-late life.^[10-14] Other types of CA, for instance, emotional and physical abuse from parents, have been shown to be independently associated with multimorbidity at older ages.^[10, 11, 14] However, the relationship between CA and multimorbidity is still less understood in China, largely due to the lack of detailed data on CA.

China provides a unique context to study the association between CA and multimorbidity from the life-course epidemiology perspective. Unlike middle-aged and older adults from many Western societies, their Chinese counterparts have a very different societal, economic, and cultural background. For example, parental corporal punishment of children was widely considered as an acceptable form of disciplinary practice until the law protecting the rights of children was enacted in 1991.^[15] This embedded social norm may mitigate one's psychological and biological responses to CA and thus modify the detrimental effects of CA on health later in life in the older Chinese population. Moreover, middle-aged and older Chinese adults had very distinctive life trajectories in comparison to those from Western countries. Crucial social events such as the Great Famine (1959–1961), the Cultural Revolution (1966–1976), and the Opening-up policy (1978), together with the subsequent rapid economic growth have profoundly shaped middle-aged and older Chinese adults' lives. These

important social transformations and transitions may have left different imprints on each individual, leading to varied individual-level health trajectories. In addition, the unique life trajectories of middle-aged and older Chinese adults, particularly with respect to the substantial improvement in living standards in China over the past few decades, may have alleviated the adverse impact of CA on adult health.

We are not aware of any previous studies that have examined the trajectories of multimorbidity as a result of CA in mid-late life from a life-course perspective in China. To address this issue, we investigated how three aspects of CA – childhood abuse and neglect, caregivers' characteristics, and childhood SES – were associated with the development of multimorbidity over four years among middle-aged and older Chinese men and women.

Data and Methods

Study design

The data were obtained from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative study of Chinese community-dwelling adults aged 45 years and older. The sample was randomly selected from 150 counties in 28 provinces using multistage probability sampling. The baseline survey (Wave 1) was conducted from 2011 to 2012, and three follow-up surveys were carried out in 2013 (Wave 2), 2014 (Wave 3, Life Event History survey), and 2015 (Wave 4). All the data was collected using face-to-face computer-assisted personal interviews and had a response rate of over 80% at the baseline.^[16] Comprehensive information on the health

status of the individual, the status of physical and cognitive functioning, socio-demographic characteristics, and health care insurance were collected at Waves 1, 2, and 4. CHARLS was approved by the Ethical Review Committee of Peking University (IRB00001052-11015), and all participants provided written informed consent. A detailed description of CHARLS can be found elsewhere.^[16] The analytical sample included 6,757 men and 7,336 women aged 45–101 years at the baseline.

Childhood adversity

Three aspects of CA of individuals under the age of 17 were assessed based on self-reports: childhood abuse and neglect (parental physical abuse and maternal emotional neglect), caregiver's characteristics, and childhood SES. Caregivers' characteristics were captured by the variables which recorded the quality of parental mental health, the quality of parents' relationship, and early parental death. We used father's education (illiterate/literate), father's occupation type (farming/non-agricultural), and childhood food adequacy (yes/no, reflecting childhood severe deprivation) to reflect childhood SES. Detailed measures of each CA item are provided in Appendix Table 1.

Multimorbidity

Multimorbidity was captured by measuring the count number of self-reported physician-diagnosed chronic diseases for each individual, including high blood pressure, diabetes, cancer, lung disease, heart problems, stroke, psychiatric problems, arthritis, dyslipidaemia, liver disease, kidney disease, digestive disease, asthma, and memory problems (0–14).

Covariates

All covariates were measured at the baseline, except adulthood physical injury led to any permanent handicap, disability, or limitations (Wave 3). Participants' socio-demographic characteristics included age, educational attainment (illiterate, can read and write, primary school, junior school, and above), the area of residence (rural vs. urban), and marital status (married vs. unmarried). Current smoking status and current drinking status were used to capture participants' lifestyles.

Statistical analyses

Consistent with previous studies^[12, 17], we took the “generalized health impact (GHI)” approach to model the accumulation of morbidities rather than analyse specific chronic disease, which allows us to estimate the overall association between childhood adversity and cumulative health^[18]. Individual-level trajectories of multimorbidity over the four years of follow-up were modelled using latent growth curve modelling (LGCM). Repeated measurements of multimorbidity (level 1) were nested within individuals (level 2). The trajectories of multimorbidity were depicted by two latent factors: the intercept factor that reflects the average number of chronic diseases at the baseline, and the slope factor that captures the rate of change in the number of chronic diseases per person per year over the follow-up period. Since multimorbidity was repeatedly measured at three time points (Waves 1, 2, and 4), we were only able to include a linear slope in the LGCM due to the model identification restriction. The intercept and slope factors were first only regressed on age to model how

multimorbidity developed over the follow-up period. Then, four models were estimated: 1) each item of CA was modelled separately with age in relation to multimorbidity trajectory (Model 1); 2) each item of CA was estimated with age and sociodemographic factors (Model 2); 3) each item of CA was estimated with age, sociodemographic factors, adult health, and behavioural characteristics (Model 3); and 4) all items of CA were mutually controlled for (Model 4). Since 47% of participants included in our study had missing data on at least one variable (incomplete cases), we imputed our datasets 50 times using multiple imputation by chained equations (MICE)^[19], and estimated LGCM in the imputed datasets. Given the interaction between CA and sex ($p < 0.05$), all analyses were conducted separately for men and women. We did not further stratify the analysis by age group as the interaction between CA and age groups (45-59 years vs. above 60 years) was not significant for most of the intercepts and slopes (p values 0.07-0.98), but we presented them in the appendix table 5. Models were conducted by Mplus 7.0 (Muthén and Muthén, 2012). The model fits were evaluated based on $TLI > 0.90$, $CFI > 0.90$, $RMSEA < 0.06$, and all models produced adequate models fits.

The multimorbidity trajectories over the follow-up for every two-year birth cohort by physical abuse and parental mental health (results from Model 3) were illustrated simultaneously in ageing-vector graphs.^[20] In these graphs, the starting point of the arrow represents the predicted initial status of multimorbidity scores at the baseline, while the arrow indicates the direction of the change in multimorbidity scores during the follow-up.

A sensitivity analysis was performed to examine the association between childhood adversity and the number of multimorbidity at baseline (0, 1, 2, 3, 4, 5+) using multinomial logistic regression model.

Results

The baseline sample characteristics are shown in Table 1. 33% of men and 22% of women experienced parental physical abuse before the age of 17, whereas 30% of men and 33% of women reported emotional neglect in their childhood. Approximately 21% of men and 19% of women reported parental death before the age 17. A majority of the participants (74% of men and 68% of women) experienced starvation during their childhood. In general, women had more chronic diseases than men (Appendix Table 2). In particular, women who experienced physical abuse or emotional neglect were more likely to develop conditions of multimorbidity than their male counterparts. The mean number of multimorbidity among men who experienced parental death was 1.3, whereas the number for women was 1.5. Nearly one third of the participants had no chronic disease (32.2% for male and 27.5% for female) and 20% of them had two chronic diseases.

Appendix Table 3 presents the intercept (i.e., the level of multimorbidity at baseline) and slope (i.e., the rate of increase in multimorbidity per year) in men and women, adjusting for age at the baseline. Multimorbidity increased by 2.6% per year in men and 2.2 % per year in women. In addition, the rate of increase in multimorbidity was 0.1% higher among older adults.

Tables 2 and 3 show the growth trajectories of multimorbidity over 4 years by each aspect of CA in men and women, respectively. Men who experienced parental abuse before the age of 17 were found to have a higher level of multimorbidity at the baseline (intercept in Model 1: 0.119, 95% confidence interval [CI]: 0.033, 0.205) and a faster increase in multimorbidity (slope in Model 1: 0.013; 95% CI: 0.000, 0.027), compared to those who did not have such adverse experiences. Similarly, a poor parent's relationship, poor parental mental health, and early parental death were consistently associated with increased number of chronic diseases at the baseline and a higher increase in multimorbidity per year of follow-up. Maternal emotional neglect, the level of father's education, and the father's job type were not associated with multimorbidity at the baseline or subsequent rate of change. Adequacy of food in childhood predicted less multimorbidity at the baseline and a slower increase in multimorbidity over four years (intercept in model 3: -0.160; 95% CI: -0.234, -0.086, and slope in model 3: -0.014; 95%CI: -0.026, -0.002, respectively). When all items which make up CA were mutually adjusted for in Model 4, the associations between CA and the level of multimorbidity at the baseline largely remained intact, whereas only poor parental mental health and adequacy of food were associated with a faster increase in multimorbidity.

For women, parental physical abuse was consistently associated with a higher multimorbidity at the baseline and a faster increase in the number of chronic diseases from Models 1 to 4. Similar to men, parent's relationship, parental mental health, and early parental death were generally related with higher levels of multimorbidity at the

baseline for women. Women who reported to have sufficient food in their childhood compared to those who did not, had lower levels of multimorbidity at the baseline (Model 1: -0.223, 95% CI: -0.294, -0.152) and a slower increase in multimorbidity over the follow-up years (-0.012, 95% CI: -0.024, -0.001). The type of the father's occupation was associated with the intercept (Model 3: 0.137, 95% CI: 0.037, 0.237), but not with the slope of multimorbidity. Similar to the results for men, poor parental mental health was associated with higher number of chronic diseases at the baseline and a rapid increase in multimorbidity over the four years of follow-up (Model 4: 0.177; 95% CI: 0.089, 0.265, and 0.017; 95% CI: 0.003, 0.031, respectively).

Figures 1- 2 plot the trajectory of the independent variable, levels of multimorbidity, over 4 years of follow-up for every two years of age at baseline by parental physical abuse and parental mental health, respectively. For both men and women, the differences in multimorbidity between those who experienced physical abuse and those without such experience widened over time for all ages. The trajectories of multimorbidity in the good, medium, and poor parental mental health groups also showed divergent trajectories over follow-up for both men and women at all ages.

The sensitivity analyses using multinomial logistic regression models (Appendix table 4) showed higher odds of chronic diseases at baseline among those with childhood adversity, which are in line with the results from the LGCM analyses (Tables 2 and 3).

Discussion

Using longitudinal data from a large nationally representative cohort in both middle-

aged and older Chinese men and women, we found a higher level of multimorbidity at the baseline and a faster rate of increase in multimorbidity over four years of follow-up associated with various aspects of childhood adversity. The evidence is weaker for childhood SES, as it was established that only an adequate supply of food was found to be protective against multimorbidity both at the baseline and over the follow-up in both genders. The father's education and occupation were generally not associated with either the multimorbidity level at the baseline or the rate of increase in the multimorbidity level among men and women.

Our findings for parental physical abuse, poor parental mental health, adequacy of food, and their relationships with the four-year multimorbidity trajectories were in line with previous studies from Western societies in which these aspects of childhood adversity have been shown to be associated with multimorbidity or chronic diseases in later life.^[10, 13, 21, 22] Borrowing the life-course epidemiology framework that links one's health from conception to the moment of death with exposure to a variety of risk factors,^[23] our cross-sectional findings suggest that the development of multimorbidity may be a lifelong process beginning in childhood. Our longitudinal findings of the faster increase in multimorbidity associated with CA indicate a diverging gap of multimorbidity between Chinese middle-aged and older adults with and without such adverse experiences in early life. This implies that the risk of multimorbidity related to CA accumulates over life. In contrast to our hypothesis, the dramatic economic development and the substantial increase in living standards among Chinese adults in the past few decades do not seem to offset the adverse impact of CA on multimorbidity.

Childhood adversity could affect adult socio-economic status (SES), which in turn can lead to unhealthy lifestyle practices in adulthood^[24, 25]. In our study, for all three aspects of CA, except father's education and occupation, adjustment for adult education, residential area, and marital status explained nearly 10% of the association between CA and multimorbidity trajectories, whereas about 4%-8% of the association was attributable to healthy behaviour and the health status of the individual as an adult. However, the associations that we observed after full adjustment of all covariates implies the existence of other mechanisms. It is of note that the covariates that we adjusted in our models, such as education and health behaviours, could be on the pathways linking childhood adversity with multimorbidity in mid-late life. Controlling for them as confounders therefore may lead to underestimated association between childhood adversity and multimorbidity. Exposure to adverse psychosocial experiences in early life can be associated with an increased risk of somatic diseases such as cardiovascular disease, asthma, and cancer as a result of an altered neural structure and function and heightened hypothalamic-pituitary-adrenal (HPA) sympathetic stress reactivity.^[26]

We hypothesised that the influence of parental physical abuse on multimorbidity in mid-late life would be smaller in China than in Western countries given the fact that parental corporal punishment is socially accepted in Chinese society.^[15] However, our findings did not support this hypothesis. Rather, it appears that the detrimental effects of parental physical abuse in childhood on multimorbidity are robust and are not modified by the social and cultural context. In line with one study in the UK^[14], we also found that poor

parent's relationship and parental mental health issues were associated with higher levels of multimorbidity as well as higher rates of increase in multimorbidity. These findings indicate that a history of CA (e.g., household dysfunction) represents a potentially important psychological burden and causes long-lasting distress over the life course.

In line with a previous study from the US,^[12] we did not find any association between childhood SES, reflected by a combination of the father's education level and occupation, and the rate of increase in multimorbidity. This could be partly due to the use of crude measures such as the level of the father's education as well as the type of father's occupation to represent socio-economic status in our study. However, given the government program instituted in 1949, which aimed to eliminate illiteracy, and the subsequent improvement in the provision of compulsory education, the correlation between fathers' SES and children's SES is very low (correlation=0.10) in our data, indicating a much smaller downwards intergenerational transmission of SES in China than in Western countries. Therefore, middle-aged and older adults' SES in China may be more important for their health than their parents' SES. A study from the US showed that adult SES mediated the association between childhood SES and multimorbidity.^[12] This is likely to be the case in China, and the role of adult SES may be greater in China than in the US.

Our study has several important strengths. Firstly, we used repeatedly measured data from a large representative sample of middle and older Chinese adults. CA was

comprehensively measured by a range of markers covering childhood abuse and neglect, caregiver's characteristics, childhood SES. Secondly, with the help of latent growth curve modelling, we were able to analyse the cross-sectional and longitudinal associations between CA and multimorbidity simultaneously. Lastly, missing outcomes were handled by the multiple imputation method.^[27] However, potential limitations should also be acknowledged. Our measures of CA were retrospective and based on self-reports, which may introduce recall bias into the data. Furthermore, some participants may choose not to disclose adverse experiences, resulting in an underestimation of the association between CA and multimorbidity. In addition, the dependent variable could also be associated with reporting bias as the variable was assessed via self-reported doctor-diagnosed chronic diseases rather than official medical records or clinical confirmation by a medical professional. Participants may be unaware of having certain chronic diseases as they may not use medical care often, particularly those living in rural areas in China. There are possibly other protective factors (e.g., resilience and self-regulation, stress coping, and adaptation) or genetic factors related to multimorbidity that could not be included in our study due to a lack of adequate data. Further studies may be able to establish their role in the incidence of multimorbidity.

In conclusion, parental physical abuse, poor mental health among parents, and food deprivation were associated with a higher initial level of multimorbidity and a corresponding higher rate of growth in multimorbidity for middle-aged and older Chinese men and women. The risk of multimorbidity related to childhood adversity

accumulates over a lifetime, which sheds light on the need for designing effective approaches and interventions to reduce childhood adversity experienced by children and adolescents in China, and underscores the long-term health benefits which result from tackling all aspects of childhood adversity in China. The most important policy implication of our study is that protecting children from parental abuse and targeting social policies to help fragile families with poor parental relationships and poor parental mental health may reduce multimorbidity in later life.

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Table 1. Percentages of variables and mean values of multimorbidity at baseline

Variables	Men	Women
Age (mean)	60.0	59.0
Multimorbidity ^a (mean)	1.4	1.5
Number of chronic diseases (%)		
Zero	32.2	27.5
One	29.9	29.2
Two	19.9	21.0
Three	9.7	11.5
Four	4.7	5.8
Five or more	3.2	4.4
Missing	0.4	0.6
<i>Childhood abuse and neglect</i>		
Parental physical abuse (%)		
Yes	32.8	21.9
No	63.2	74.0
Missing	4.0	4.1
Maternal emotional neglect (%)		
Yes	30.3	32.7
No	63.6	61.2
Missing	6.1	6.1
<i>Caregiver's characteristics</i>		
Parent's relationship (tertiles) (%)		
Good	38.0	42.8
Medium	21.9	19.5
Poor	27.6	25.7
Missing	12.5	12.0
Parental mental health (tertiles) (%)		
Good	48.0	47.5
Medium	18.7	19.9
Poor	29.1	28.1
Missing	4.2	4.5
Parental death before age 17 (%)		
Yes	21.0	18.7
No	70.2	69.9
Missing	8.8	11.4
<i>Childhood SES</i>		
Father's education (%)		
Illiterate	55.9	54.2
Literate	37.4	35.3
Missing	6.7	10.5
Father's occupation (%)		
Non-agricultural	16.2	17.2

Agricultural	77.0	75.6
Missing	6.8	7.2
Childhood adequacy of food (%)		
Yes	25.3	30.6
No	73.5	67.8
Missing	1.2	1.6
<i>Covariates</i>		
Educational attainment (%)		
Illiterate	12.8	42.3
Can read and write	19.0	18.3
Primary	26.5	16.7
Junior and high	41.6	22.7
Residential area (%)		
Rural	64.1	62.7
Marital status (%)		
Married	91.1	84.4
Un-Married	8.8	15.5
Missing	0.1	0.1
Current smoking status (%)		
Yes	73.9	8.0
No	25.7	91.3
Missing	0.4	0.7
Current drinking status (%)		
Yes	56.4	11.8
No	43.1	87.5
Missing	0.5	0.7
Physical injury in adulthood (%)		
Yes	11.1	5.8
No	88.4	93.6
Missing	0.5	0.6
N (%)	6,757 (48.0)	7,336 (52.0)

a. Number of chronic diseases includes blood pressure, diabetes, cancer, lung diseases, heart problem, stroke, psychiatric problem, arthritis, dyslipidemia, liver diseases, kidney disease, digestive disease, asthma, memory problem.

Table 2. Growth trajectory of multimorbidity over 4 years by childhood adversity in men

	Model 1 (b, 95% CI)	Model 2 (b, 95% CI)	Model 3 (b, 95% CI)	Model 4 (b, 95%CI)
Intercept				
<i>Childhood abuse and neglect</i>				
Parental physical abuse (no)				
Yes	0.119 (0.033, 0.205)	0.114 (0.041,0.186)	0.108 (0.035, 0.181)	0.071 (-0.002, 0.143)
Maternal emotional neglect (no)				
Yes	0.090 (0.002, 0.178)	0.029 (-0.045, 0.105)	0.034 (-0.042, 0.110)	0.041 (-0.035,0.112)
<i>Caregiver's characteristics</i>				
Parent's relationship (tertiles: good)				
Medium	0.106 (0.024, 0.188)	0.118 (0.036, 0.200)	0.013 (-0.069, 0.095)	0.107 (0.025, 0.189)
Poor	0.126 (0.042, 0.210)	0.114 (0.026, 0.202)	0.119 (0.037, 0.201)	0.090 (0.004, 0.176)
Parental mental health (tertiles: good)				
Medium	0.048 (0.020, 0.075)	0.070 (-0.018, 0.158)	0.046 (-0.034, 0.126)	0.057 (-0.029, 0.143)
Poor	0.175 (0.098, 0.251)	0.184 (0.102, 0.266)	0.181 (0.103, 0.259)	0.152 (0.070, 0.234)
Parental death before age 17 (no)				
Yes	0.092 (0.004, 0.180)	0.097 (0.009, 0.185)	0.097 (0.009, 0.185)	0.089 (0.001, 0.177)
<i>Childhood SES</i>				
Father's education (illiterate)				
Literate	0.007 (-0.065, 0.080)	-0.002 (-0.074,0.071)	-0.002 (-0.074,0.071)	-0.009 (-0.081, 0.064)
Father's occupation (farming)				
Non-agricultural	0.077 (-0.019, 0.173)	0.045 (-0.055, 0.145)	0.043 (-0.057, 0.143)	0.049 (-0.051,0.149)
Adequacy of food (no)				
Yes	-0.171 (-0.245, -0.097)	-0.174 (-0.248, -0.099)	-0.160 (-0.234, -0.086)	-0.123 (-0.197, -0.049)
Slope				
<i>Childhood abuse and neglect</i>				
Parental physical abuse (no)				
Yes	0.013 (0.000, 0.027)	0.013 (0.001, 0.025)	0.012 (0.001, 0.024)	0.007 (-0.004, 0.019)
Maternal emotional neglect (no)				
Yes	-0.001 (-0.015, 0.013)	-0.002 (-0.014, 0.010)	-0.001 (-0.013, 0.010)	-0.001 (-0.013, 0.010)
<i>Caregiver's characteristics</i>				
Parent's relationship (tertiles: good)				
Medium	0.005 (-0.009, 0.019)	0.003 (-0.011, 0.017)	0.004 (-0.010, 0.018)	0.002 (-0.012, 0.016)
Poor	0.015 (0.001, 0.029)	0.013 (-0.001, 0.027)	0.014 (0.000, 0.028)	0.011 (-0.003, 0.025)
Parental mental health (tertiles: good)				
Medium	0.009 (-0.005, 0.023)	0.008 (-0.006, 0.022)	0.009 (-0.005, 0.023)	0.006 (-0.008, 0.020)

Poor	0.027 (0.013, 0.041)	0.022 (0.010, 0.034)	0.027 (0.013, 0.041)	0.019 (0.005, 0.033)
Parental death before age 17 (no)				
Yes	-0.002 (-0.016, 0.012)	0.001 (-0.013, 0.015)	-0.001 (-0.015, 0.013)	-0.001 (-0.015, 0.013)
Childhood SES				
Father's education (illiterate)				
Literate	-0.001 (-0.013, 0.011)	-0.002 (-0.014, 0.010)	-0.002 (-0.014, 0.010)	-0.003 (-0.015, 0.009)
Father's occupation (farming)				
Non-agricultural	-0.001 (-0.015, 0.013)	-0.002 (-0.016, 0.012)	-0.002 (-0.016, 0.012)	-0.002 (-0.016, 0.012)
Adequacy of food (no)				
Yes	-0.015 (-0.027, -0.003)	-0.016 (-0.028, -0.004)	-0.014 (-0.026, -0.002)	-0.010 (-0.112, -0.088)

Intercept: level of multimorbidity at the baseline

Slope: rate of increase in the number of multimorbidity per year;

b: model coefficient

M1: Each adversity variable +age.

M2: Each adversity variable +age+sociodemographic variables (marital status, living in rural or urban/ educational attainment).

M3: Each adversity variable +age+sociodemographic variables+ adulthood health status+ smoking status+drinking status.

M4: All childhood adversity variables+all covariates.

Covariates include age, marital status, living areas (rural/urban), educational attainment, adulthood health status, smoking status, and drinking status.

Statistically significant beta coefficients ($p < 0.05$) have been bolded.

Table 3. Growth trajectory of multimorbidity over 4 years by childhood adversity in women

	Model 1 (b,95% CI)	Model 2 (b,95% CI)	Model 3 (b,95% CI)	Model 4 (b,95%CI)
Intercept				
<i>Childhood abuse and neglect</i>				
Parental physical abuse (no)				
Yes	0.268 (0.188, 0.348)	0.267 (0.185, 0.349)	0.266 (0.184, 0.348)	0.221 (0.137, 0.305)
Maternal emotional neglect (no)				
Yes	0.034 (-0.036, 0.105)	0.035 (-0.036, 0.106)	0.038 (-0.032, 0.109)	0.038 (-0.032, 0.109)
<i>Caregiver's characteristics</i>				
Parent's relationship (tertiles: good)				
Medium	0.042 (-0.045, 0.130)	0.030 (-0.058, 0.118)	0.030 (-0.058, 0.118)	0.017 (-0.071, 0.105)
Poor	0.132 (0.048, 0.216)	0.120 (0.036, 0.204)	0.122 (0.040, 0.204)	0.058 (-0.026, 0.142)
Parental mental health (tertiles: good)				
Medium	0.018 (-0.068, 0.104)	0.028 (-0.058, 0.114)	0.030 (-0.054, 0.114)	0.009 (-0.073, 0.091)
Poor	0.207 (0.127, 0.287)	0.230 (0.148, 0.312)	0.218 (0.136, 0.300)	0.177 (0.089, 0.265)
Parental death before age 17 (no)				
Yes	0.082 (-0.006, 0.170)	0.090 (0.002, 0.178)	0.088 (0.000, 0.176)	0.086 (-0.002, 0.174)
<i>Childhood SES</i>				
Father's education (illiterate)				
Literate	-0.009 (-0.083, 0.065)	-0.027 (-0.101, 0.045)	-0.024 (-0.098, 0.050)	-0.020 (-0.094, 0.054)
Father's occupation (farming)				
Non-agricultural	0.166 (0.072, 0.260)	0.134 (0.034, 0.234)	0.137 (0.037, 0.237)	0.132 (0.032, 0.232)
Adequacy of food (no)				
Yes	-0.223 (-0.294, -0.152)	-0.219 (-0.289, -0.148)	-0.212 (-0.283, -0.141)	-0.175 (-0.248, -0.102)
Slope				
<i>Childhood abuse and neglect</i>				
Parental physical abuse (no)				
Yes	0.022 (0.008, 0.036)	0.022 (0.008, 0.036)	0.022 (0.008, 0.036)	0.019 (0.005, 0.033)
Maternal emotional neglect (no)				
Yes	0.004 (-0.008, 0.016)	0.002 (-0.010, 0.014)	0.003 (-0.009, 0.015)	0.003 (-0.009, 0.015)
<i>Caregiver's characteristics</i>				
Parent's relationship (tertiles: good)				
Medium	-0.003 (-0.017, 0.011)	-0.003 (-0.017, 0.011)	-0.001 (-0.015, 0.012)	-0.004 (-0.018, 0.010)
Poor	0.006 (-0.008, 0.020)	0.006 (-0.008, 0.020)	0.007 (-0.005, 0.019)	0.001 (-0.013, 0.015)
Parental mental health (tertiles: good)				
Medium	0.016 (0.002, 0.030)	0.016 (0.002, 0.030)	0.015 (0.003, 0.027)	0.015 (0.001, 0.029)

Poor	0.020 (0.008, 0.032)	0.021 (0.009, 0.033)	0.024 (0.010, 0.038)	0.017 (0.003, 0.031)
Parental death before age 17 (no)				
Yes	-0.007 (-0.021, 0.007)	-0.006 (-0.020, 0.008)	-0.006 (-0.020, 0.008)	-0.007 (-0.021, 0.007)
Childhood SES				
Father's education (illiterate)				
Literate	-0.010 (-0.022, 0.002)	-0.010 (-0.022, 0.002)	-0.010 (-0.022, 0.002)	-0.011 (-0.023, 0.001)
Father's occupation (farming)				
Non-agricultural	0.010 (-0.006, 0.026)	0.006 (-0.010, 0.022)	0.007 (-0.009, 0.023)	0.006 ((-0.010, 0.022)
Adequacy of food (no)				
Yes	-0.012 (-0.024, -0.001)	-0.013 ((-0.025, -0.001)	-0.013 ((-0.025, -0.001)	-0.010 (-0.022, 0.002)

Intercept: level of multimorbidity at the baseline

Slope: rate of increase in the number of multimorbidity per year;

b: model coefficient

M1: Each adversity variable +age.

M2: Each adversity variable +age+sociodemographic variables (marital status, living in rural or urban/ educational attainment).

M3: Each adversity variable +age+sociodemographic variables+ adulthood health status+ smoking status+drinking status.

M4: All childhood adversity variables+all covariates.

Covariates include age, marital status, living areas (rural/urban), educational attainment, adulthood health status, smoking status, and drinking status.

Statistically significant beta coefficients ($p < 0.05$) have been bolded.