Journal Pre-proof

Do multigenerational living arrangements influence depressive symptoms in mid-late life? Cross-national findings from China and England

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Please cite this article as: Yaoyue Hu , Milagros Ruiz , Martin Bobak , Pekka Martikainen , Do multigenerational living arrangements influence depressive symptoms in mid-late life? Cross-national findings from China and England, *Journal of Affective Disorders* (2020), doi: https://doi.org/10.1016/j.jad.2020.07.142

Highlights

- Living arrangements influenced depressive symptoms similarly in China and England.

- Men and women living alone had a greater risk of elevated depressive symptoms.

- Living with children/grandchildren but with no partner also increased the risk.

- Male disadvantage in depressive symptoms was more evident in England than in China.

Highlights

Research Paper

Do multigenerational living arrangements influence depressive symptoms in mid-late life? Cross-national findings from China and England

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Abstract

Background: While living alone predicts depression in diverse ageing populations, the impact of multigenerational living is unclear. This study compared mid-late life depressive symptoms by living arrangements between societies with distinct kinship ties.

Methods: Repeated data on depressive symptoms and living arrangements over 4 years from 16,229 Chinese (age≥45) and 10,403 English adults (age≥50) were analyzed using multilevel mixed-effects logistic regression. Elevated depressive symptoms were identified using the Center for Epidemiological Depression Scale criteria in each study.

Results: Higher odds ratios (ORs) of elevated depressive symptoms were found in both Chinese and English adults aged<60 living with no partner but with children/grandchildren, compared to those living with partner only. These ORs were greater for men (Chinese men: 3.09, 95% confidence interval: 2.00-4.78; English men: 3.44, 1.36-8.72) than for women (Chinese women: 1.77, 1.23-2.56; English women: 2.88, 1.41-3.67), after controlling for socioeconomic position, health behaviors, and health status. This male disadvantage was also observed for English, but not for Chinese, adults aged<60 living alone. For adults aged 60+, the increased odds among those living with no partner but with children/grandchildren and those living alone were smaller in both countries.

Limitations: Bias may exist because depressed participants are more likely to experience divorce or separation prior to baseline.

Conclusions: The relationship between living arrangements and depressive symptoms appears robust and consistent across social contexts, although the mechanisms differ. The protective role of partners in both China and England supports targeting those who do not live with partners to reduce depression.

Key words: Multigenerational living arrangements, depressive symptoms, middle and older

ages, cross-national comparison.

Introduction

Population ageing has resulted in an increased share of older adults living only with their spouse or partner or living by themselves in high-income countries (Beard and Bloom, 2015; Grundy, 2006). Similar shifts have also begun in low- and middle-income countries due to more recent population ageing dynamics (Reher and Requena, 2018). Older adults' changing living arrangements pose considerable long-term social and public health challenges given the rapidly increasing need for high-quality elder care and support (Galiana and Haseltine, 2019), which must include targeted interventions at multiple levels to ameliorate high rates of mid-late life mental illness (Briggs et al., 2018).

Much of the evidence linking living arrangements with mental health in mid-late life has focused on living alone (Hays, 2002). Having a co-residential spouse/partner may help secure more economic resources, social ties, and social support into the household, provide better monitoring of one's health and social control of one's behaviors, and encourage help-seeking behaviors at early stages of illness; all of which have positive impacts on one's health (Carr and Springer, 2010; Clouston et al., 2014; Wong et al., 2018; Young and Grundy, 2009). These mechanisms appear important for mental health as well, given findings showing detrimental effects of living alone on common mental disorders (Dean et al., 1992; Russell and Taylor, 2009; Weissman and Russell, 2018), and on psychological distress and wellbeing (Michael et al., 2001) at older ages.

Since multigenerational living is much less common among older adults in high income countries than in emerging economies (Reher and Requena, 2018), its relationship to mental health has been less studied. However, more recently attention has been re-directed to the upswing in adult children moving back to their parental home due to the Great Recession in high income countries and its impact on their parents' mental health (Aranda, 2015; Caputo,

2019; Courtin and Avendano, 2016). In other words, multigenerational residence may be driven by economic necessity rather than preference. Health benefits of multigenerational living may operate through additional economic resources brought in by household members who share domestic responsibilities and help defray living costs, enable greater access to structural social capital, and provide emotional and instrumental support generated by living together under one roof. While these mechanisms may buffer against stress and loneliness among older adults, multiple generations sharing one house may also lead to lack of space and exacerbate interpersonal conflicts that undermine one's mental health (Muennig et al., 2018). Two European-wide studies of adults aged 50+ demonstrated that co-residing with adult children had positive impacts on their older parents' depressive symptoms (Buber and Engelhardt, 2008; Courtin and Avendano, 2016), but it appeared that spouse/partner played a more protective role than the children (Buber and Engelhardt, 2008). A cross-sectional study also showed that co-residing with adult children brought benefits to emotional well-being for widowed but not for married Chinese adults aged 80+ (Wang et al., 2014). On the other hand, Caputo (2019) found that US parents aged 50+ with a newly coresidential adult child experienced an increase in depressive symptoms compared to their counterparts with no coresidential adult children. Nevertheless a study from Spain found no differences in depressive symptoms by co-residing with children or not (Zunzunegui et al., 2001).

As the abovementioned studies have focused on single societies, the mixed findings may reflect cross-cultural differences in older adults' preferences and resources for residential options, intertwined with their expectations of support from their family and community. A comparative perspective is therefore needed. In order to unravel these uncertainties, this study compares the relationship between living arrangements, multigenerational living arrangements in particular, with the risk of elevated depressive symptoms in middle-aged and older adults living in China and England.

We choose China and England for several reasons. First, depression ranks as the fourth leading cause of disability in both countries (Vos et al., 2017). This will demand more policy action as this burden is likely to grow with population ageing (United Nations, 2017). Second, a comparative case study of China and England – each with its own unique set of preferences and resources for ageing in place alongside very distinctive cultural norms – provides a vital opportunity to advance our understanding on the relationship between living arrangements and mental health. Citizens of the two countries have very different expectations and practices regarding kinship ties and filial piety, and the two countries are also at different stages of economic development. These two macro-level determinants may influence household preferences and living arrangements (Reher and Requena, 2018) and their associations with mental health, given that living alone among adults aged 60+ was much rarer in China (8%) than in the UK (21%) in 2000/1, whereas multigenerational living was the dominant arrangement in China (60%) (United Nations, 2018). As the social, cultural and economic context may modify the effects of particular living arrangements on depression symptoms, the present study examines whether and how much such variation exists between China and England.

Methods

Study design

We used repeatedly measured data from two nationally representative studies of middle-aged and older community-dwelling adults in China and England – the China Health and Retirement Longitudinal Study (CHARLS, age≥45) and the English Longitudinal Study of Ageing (ELSA, age≥50). CHARLS sample was restricted to those living in private households and not institutionalized from 450 villages or urban communities in 28 provinces. ELSA drew its sample from participants of the 1998, 1999 or 2001 Health Survey for

England (HSE), a series of annual cross-sectional surveys designed to monitor the health of the general English population. Participants from the three HSE surveys were eligible for inclusion if they resided in a participating HSE private household at baseline in which at least one person had agreed to follow-up and were born before 1 March 1952. The baseline survey was conducted in 2011/2 for CHARLS and 2002/3 for ELSA, which collected comprehensive information on sociodemographic, family, and health characteristics, with a response rate of 81% and 70%, respectively (Steptoe et al., 2013; Zhao et al., 2014). Both CHARLS (N=17,234) and ELSA (N=11,391) cohorts were eligible for biannual re-examinations. Details of CHARLS and ELSA can be found elsewhere (Steptoe et al., 2013; Zhao et al., 2014). Data from the first three examinations (Waves 1, 2, and 4 for CHARLS, and Waves 1-3 for ELSA) were used. Ethical approval was provided by the Ethical Review Committee of Peking University and the London Multi-Centre Research Ethics Committee, respectively for CHARLS and ELSA. All CHARLS and ELSA participants provided written informed consent. The present study uses participant data on depressive symptoms, living arrangements, and covariates collected at any of the three waves (N=16,229 in CHARLS, N=10,403 in ELSA).

Elevated depressive symptoms

Depressive symptoms were repeatedly measured using the ten-item Center for Epidemiological Depression (CES-D) scale (Andresen et al., 1994) in CHARLS and the eight-item CES-D scale (Turvey et al., 1999) in ELSA at all waves. The CES-D-10 asked respondents to rate their frequency of experiencing ten depressive symptoms during the past week, ranging from less than 1 day, 1-2 days, 3-4 days, to 5-7 days. The CES-D-8 assessed whether respondents experienced eight depressive symptoms for 'much of the time' during the past week (yes/no). The summed scores of CES-D-10 (0-30) and CES-D-8 (0-8) were

calculated for CHARLS participants who responded to at least 9 items (Andresen et al., 1994) and for ELSA participants who responded to at least 7 items. For participants with one missing item, the missing value was imputed using the mean of the completed CES-D items. Elevated depressive symptoms were identified using version-specific cut-off thresholds previously validated to detect probable depression in older general populations, i.e. CES-D-10 score≥12 (Cheng and Chan, 2005) and CES-D-8 score≥3 (Turvey et al., 1999).

Living arrangements

At each wave, CHARLS and ELSA assessed the relation of each participant to other household members using the household grid, capturing relationships ranging from parents (-in-law), siblings (-in-law), children, spouse of children, grandchildren to other relatives and non-relatives, among others. Co-residing with a spouse or partner was additionally assessed using the household grid in ELSA but ascertained by marital status in CHARLS. CHARLS participants who were married but not living with spouse temporarily, separated, divorced, widowed, or never married were categorized as not co-residing with a spouse/partner. Living arrangements were categorized as: 1) living with partner only (spouse or cohabiting partner), 2) living with partner and children/grandchildren, 3) living with no partner but with children/grandchildren, 4) living with or without partner in other multigenerational household, i.e. co-residing with parents/grandparents while children/grandchildren could be present or absent, and 5) living alone. Living in other multigenerational household was very rare in ELSA (1.1%), therefore it was not further split by the presence of partner. We excluded participants who lived with siblings (-in-law), other relatives or non-relatives at all three waves in CHARLS (N=10) and ELSA (N=72).

Covariates

Study-specific geographical region (CHARLS: urban vs. rural area; ELSA: government office region) was used. Socioeconomic position (SEP) was captured by education attainment, physical wealth, and home ownership. Using the International Standard Classification of Education mapping scheme, educational levels were grouped into low (CHARLS: elementary school or lower; ELSA: no qualifications), middle (CHARLS: lower secondary school; ELSA: NVQ1/CSE other grade equivalent qualification, NVQ2/GCE O-level equivalent qualification, NVQ3/GCE A level equivalent qualification, or foreign/other), or high (CHARLS: upper secondary school and higher; ELSA: higher education below degree, NVQ4/NVQ5/Degree or equivalent qualification). Physical wealth was captured by the total number of household assets (e.g. electronics, vehicles, valuables, holiday properties, land etc.), and were categorized into study-specific tertiles. Home ownership was based on ownership of the current residence by the participant or other household members. Health behaviors included smoking status (never, past, and current smokers) and alcohol drinking frequency (CHARLS: never, <1/month, 1-3/month, 1-3/week, 4-6/week, almost daily or more; ELSA: never, <1/month, 1-2/month, 1-2/week, 3-6/week, almost daily or more) in the past year using study-specific categories for liquor, wine, or beer in CHARLS and for any alcoholic beverage in ELSA. We also included self-rated health and number of limitations in activities of daily living (ADLs, covering bathing, dressing, eating, getting into/out of bed, and using the toilet). Geographical region and educational levels were assessed at baseline. All other covariates were treated as time-varying using repeated measures from all waves.

Statistical analyses

The association between living arrangements and elevated depressive symptoms was analysed using multilevel mixed-effects logistic regression, which included all available repeated measurements (level 1) grouped by individuals (level 2). Multilevel modelling

accounts for dependency of repeated measurements within the same individual, and provides unbiased estimates under the assumption of missing at random (i.e. missingness depends only on observed data) (Jansen et al., 2006). Participants with missing living arrangements and covariates at all waves were excluded as the proportion was small for both CHARLS (N=474, 2.8% of the cohort) and ELSA (N=988, 8.7% of the cohort). We compared the random-intercept model (i.e. intercept varies by individuals) and random-slope model (i.e. both intercept and slope on waves vary by individuals) in both cohorts. The random-slope model was favored in CHARLS according to the likelihood-ratio test (p<0.01 in both genders) but not in ELSA (p>0.10 in both genders). Accordingly, the more parsimonious random-intercept model was applied for ELSA whereas the random-slope model was used for CHARLS. In addition, we found strong interaction between living arrangements and age groups (<60 vs. ≥60) in Chinese men (p<0.01) and English women (p<0.01). Three models were therefore estimated separately for men and women and for the two age groups, adjusting for: age, age squared, and geographical region (Model 1), Model 1 covariates plus educational levels, physical wealth, and home ownership (Model 2), and Model 2 covariates plus smoking status, alcohol drinking frequency, self-rated health, and ADL limitations (Model 3). Both age and age squared were entered into all models to account for the possible non-linear relationship between age and depressive symptoms. The CHARLS and ELSA non-response sampling weights at baseline were incorporated in the multilevel analyses to minimize sampling bias and ensure the generalizability of the results. As depressive symptoms can mask cognitive impairments (Panza et al., 2010), a sensitivity analysis was performed on a sub-sample which excluded participants with doctor-diagnosed cognitive disorders (e.g. Parkinson's disease, Alzheimer's disease, and dementia), and those who fell into the worst gender- and age-specific quintile of episodic memory measured by word recall test scores, at any wave (CHARLS=14,433, ELSA=8,721). Since most of the multigenerational living was co-

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residing with children only in ELSA but it was more diverse in CHARLS, we repeated our weighted multilevel logistic regression using detailed living arrangements in CHARLS. All data analyses were conducted in Stata 15 (StataCorp, 2017).

Results

Elevated depressive symptoms were more prevalent among middle-aged and older Chinese adults (28.4%) than their English counterparts (23.9%) at baseline (Table 1). While the majority of English adults either lived only with their partner (53.2%) or lived alone (24.4%), most Chinese adults lived with their partner and children/grandchildren (52.1%) or with their partner only (26.5%). Women had higher levels of elevated depressive symptoms than men at baseline in both China and England (Table 2). Elevated depressive symptoms were also more prevalent in Chinese adults aged 60+ than in those under 60. For each country, gender, and age group, elevated depressive symptoms were more common among those living with no partner but with children/grandchildren or living alone than among those co-residing with a partner.

Table 1. Baseline study characteristics of the CHARLS and ELSA analytic samples

	CHARLS Baseline (N=15,266)	ELSA Baseline (N=10,208)
Mean age (years, SD)	59.5 (9.6)	64.6 (10.0)
Female	52.3%	54.2%
Elevated depressive symptoms*	28.4%	23.7%
Living arrangements		
Living with partner only	26.5%	53.2%
Living with partner and children/grandchildren	52.1%	17.2%
Living without partner but with children/grandchildren	10.3%	4.0%
Living with/without partner in other multigenerational household	5.3%	1.1%
Living alone	5.8%	24.4%
Educational level		
Low	66.8%	40.8%
Medium	20.6%	36.4%
High	12.7%	22.8%
Physical wealth tertiles		
Low	40.5%	43.7%
Medium	34.0%	41.2%
High	25.5%	15.1%
Does not own current residence	9.8%	18.6%
Smoking status		
Never smoker	60.5%	35.5%
Past smoker	8.9%	46.8%
Current smoker	30.6%	17.7%
Alcohol drinking frequency		
Never	71.0%	11.0%
Less than once a month	8.1%	19.2%
1-3 times a month†/1-2 times a month‡	4.0%	10.5%
1-3 times a week†/1-2 times a week‡	4.4%	30.8%
4-6 times a week†/3-6 times a week‡	1.0%	24.1%
Almost daily or more	11.5%	4.4%
Self-rated health		
Very good or good	23.1%	54.5%
Fair	49.3%	27.6%
Bad or very bad	27.5%	17.9%
Mean number of limitations in activities of daily living (0-5)	0.3	0.4

SD: standard deviation

*Elevated depressive symptoms were defined as CES-D 10 score ≥ 12 in CHARLS and CES-D 8 score ≥3 in ELSA.

†CHARLS-specific drinking frequency categories.

‡ELSA-specific drinking frequency categories.

Table 2. Gender- and age-stratified elevated depressive symptoms (%) by living arrangements at baseline in CHARLS and ELSA

	CHARLS (CES-D 10 score≥ 12)		ELSA (CES-D 8 score≥ 3)	
	<60 years	≥60 years	<60 years	≥60 years
Men				
Living with partner only	16.6%	22.8%	15.6%	15.4%
Living with partner and children/grandchildren	16.6%	25.6%	15.6%	19.5%
Living with no partner but with children/grandchildren	35.9%	37.4%	42.5%	34.9%
Living with/without partner in other multigenerational setting	19.7%	19.4%	22.5%	7.7%
Living alone	38.8%	35.1%	34.8%	33.6%
Total	18.6%	26.0%	18.8%	20.0%
Women				
Living with partner only	31.9%	38.1%	20.9%	23.9%
Living with partner and children/grandchildren	28.0%	39.4%	21.2%	26.9%
Living with no partner but with children/grandchildren	37.7%	46.1%	42.9%	30.6%
Living with/without partner in other multigenerational setting	28.5%	45.5%	34.1%	21.1%
Living alone	36.0%	39.5%	37.0%	34.4%
Total	30.0%	40.3%	25.0%	28.5%

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After controlling for age, age squared, and geographic region (Model 1), compared to living with partner only, living with no partner but with children/grandchildren and living alone were both associated with a higher risk of elevated depressive symptoms for Chinese and English adults under 60 (Table 3). However, no increased risk was observed among those living with partner and children/grandchildren for either country or gender. The strength of these associations was larger in English than in Chinese adults. Additional adjustment for SEP (Model 2) decreased these associations by 31-46% among English adults but only by 8-19% among Chinese adults. The elevated risk associated with living with no partner but with children/grandchildren increased by 4% among Chinese men under 60 after controlling for SEP. The gender difference in the heightened odds ratios (ORs) related to living with no partner but with children/grandchildren when all covariates were controlled for (Model 3) remained in both Chinese adults (men: 3.09, 95% confidence interval: 2.00-4.78; women: 1.77, 1.23-2.56) and English adults (men: 3.44, 1.36-8.72; women: 2.28, 1.41-3.67). While the association for living alone further attenuated by 14-38% in English adults (men: 3.55, 2.19-5.75; women: 2.10, 1.50-3.00) in Model 3 compared to Model 2; this association enlarged by 6-12% in Chinese adults (men: 2.53, 1.22-3.44; women: 2.27, 1.49-3.45).

Table 3. Odds ratios of elevated depressive symptoms by living arrangements, ages<60 years

	CHARLS (CES-D 10 score ≥ 12)			ELSA (CES-D 8 score ≥ 3)		
	Model 1* OR (95% CI)	Model 2† OR (95% CI)	Model 3‡ OR (95% CI)	Model 1* OR (95% CI)	Model 2† OR (95% CI)	Model 3‡ OR (95% CI)
Men						
Living with partner only	1.00	1.00	1.00	1.00	1.00	1.00
Living with partner and children/grandchildren	1.04 (0.82, 1.31)	1.15 (0.90, 1.46)	1.07 (0.84, 1.35)	0.99 (0.68, 1.45)	0.98 (0.67, 1.42)	0.97 (0.68, 1.40)
Living with no partner but with children/grandchildren	3.97 (2.18, 7.22)	4.08 (2.35, 7.06)	3.09 (2.00, 4.78)	6.31 (2.22, 17.94)	3.90 (1.45, 10.52)	3.44 (1.36, 8.72)
Living with/without partner in other multigenerational setting	1.40 (0.81, 2.44)	1.41 (0.86, 2.32)	1.36 (0.83, 2.22)	1.53 (0.52, 4.50)	1.15 (0.38, 3.46)	0.79 (0.31, 2.01)
Living alone	2.22 (1.14, 4.30)	1.99 (1.12, 3.52)	2.05 (1.22, 3.44)	6.46 (3.74, 11.17)	3.95 (2.34, 6.66)	3.55 (2.19, 5.75)
Women						
Living with partner only	1.00	1.00	1.00	1.00	1.00	1.00
Living with partner and children/grandchildren	0.95 (0.78, 1.16)	1.02 (0.85, 1.24)	1.01 (0.84, 1.22)	1.08 (0.80, 1.48)	1.10 (0.81, 1.50)	1.14 (0.84, 1.53)
Living with no partner but with children/grandchildren	1.86 (1.11, 3.13)	1.79 (1.15, 2.77)	1.77 (1.23, 2.56)	4.43 (2.57, 7.62)	3.17 (1.84, 5.46)	2.28 (1.41, 3.67)
Living with/without partner in other multigenerational setting	1.02 (0.73, 1.42)	1.09 (0.79, 1.49)	1.07 (0.79, 1.44)	2.42 (0.98, 5.96)	2.03 (0.83, 4.95)	1.96 (0.85, 4.54)
Living alone	2.34 (1.49, 3.67)	2.13 (1.36, 3.32)	2.27 (1.49, 3.45)	3.61 (2.48, 5.26)	2.80 (1.93, 4.04)	2.12 (1.50, 3.00)

OR: odds ratio; CI: confidence interval

*Adjusted for age, age squared, and geographical region (CHARLS: urban vs. rural area; ELSA: government office region).

†Adjusted for Model 1 covariates plus educational level, physical wealth and home ownership.

‡Adjusted for Model 2 covariates plus smoking status, alcohol drinking frequency, self-rated health and number of ADL limitations.

The increased risk associated with living with no partner but with children/grandchildren and living alone was smaller in Chinese and English adults aged 60+ (Table 4) than in those under 60, but these two living arrangements also appeared more harmful for men than for women in each country irrespective of age. The ORs for living with no partner but with children/grandchildren attenuated by 53% in English men aged 60+ after further adjustment for SEP in Model 2 but increased by 59% and 4 % in Chinese older men and women, respectively. In contrary, these ORs decreased by 22-23% in Chinese men (2.00, 1.39-2.90) and women (1.39, 1.04-1.87) but enlarged by 48% in English men (2.07, 1.10-3.92) with additional adjustment in Model 3. Similar increase in the risk associated with living alone in Model 3 compared to Model 2 was found among English men (2.56, 1.95-3.35) and Chinese women (1.62, 1.19-2.19). At older ages, however, Chinese men who lived with partner and children/grandchildren were also at a higher risk of elevated depressive symptoms after controlling for all covariates (Model 3: 1.64, 1.34-2.00). In unweighted multilevel analyses, results were mainly similar (Supplementary Table 1).

After excluding participants with cognitive disorders and/or poor episodic memory, the direction of association between living arrangements and elevated depressive symptoms remained largely the same in both China and England (Supplementary Tables 2-3). When further specify the generations under one roof in CHARLS, the most prevalent multigenerational living arrangements were living with partner and children, as well as living with partner, children, and grandchildren (Supplementary Table 4). It was also common for older Chinese women to co-reside with both their children and grandchildren but not with partner. The largest risk of elevated depressive symptoms was found in Chinese men and women living with no partner but with their grandchildren, irrespective of age (except for women under 60) (Supplementary Table 5). When partner was absent, co-residing with

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children was also associated with a higher risk in both Chinese men and women, as well as

co-residing with children and grandchildren in Chinese men.

Table 4. Odds ratios of elevated depressive symptoms by living arrangements, ages≥60 years

	CHARLS (CES-D 10 score ≥ 12)			ELSA (CES-D 8 score ≥ 3)		
	Model 1[*] OR (95% CI)	Model 2[†] OR (95% CI)	Model 3[‡] OR (95% CI)	Model 1[*] OR (95% CI)	Model 2[†] OR (95% CI)	Model 3[‡] OR (95% CI)
Men						
Living with partner only	1.00	1.00	1.00	1.00	1.00	1.00
Living with partner and children/grandchildren	1.45 (1.19, 1.77)	1.74 (1.40, 2.15)	1.64 (1.34, 2.00)	1.33 (0.90, 1.95)	1.18 (0.81, 1.72)	1.00 (0.72, 1.40)
Living with no partner but with children/grandchildren	1.82 (1.17, 2.82)	2.30 (1.49, 3.56)	2.00 (1.39, 2.90)	2.55 (1.21, 5.37)	1.73 (0.83, 3.59)	2.07 (1.10, 3.92)
Living with/without partner in other multigenerational setting	1.25 (0.69, 2.26)	1.33 (0.72, 2.45)	1.36 (0.77, 2.39)	0.99 (0.26, 3.81)	0.86 (0.23, 3.32)	1.45 (0.42, 5.00)
Living alone	2.15 (1.53, 3.02)	1.85 (1.30, 2.63)	1.85 (1.34, 2.55)	3.65 (2.66, 5.02)	2.36 (1.73, 3.21)	2.56 (1.95, 3.35)
Women						
Living with partner only	1.00	1.00	1.00	1.00	1.00	1.00
Living with partner and children/grandchildren	1.01 (0.79, 1.29)	1.06 (0.84, 1.34)	1.09 (0.88, 1.36)	1.26 (0.83, 1.92)	1.14 (0.75, 1.72)	1.02 (0.70, 1.50)
Living with no partner but with children/grandchildren	1.48 (1.07, 2.05)	1.50 (1.09, 2.07)	1.39 (1.04, 1.87)	1.52 (0.96, 2.40)	1.29 (0.82, 2.01)	0.95 (0.63, 1.44)
Living with/without partner in other multigenerational setting	1.41 (0.76, 2.62)	1.43 (0.77, 2.66)	1.23 (0.70, 2.19)	0.70 (0.23, 2.13)	0.64 (0.20, 2.02)	0.53 (0.20, 1.43)
Living alone	1.59 (1.14, 2.22)	1.48 (1.07, 2.05)	1.62 (1.19, 2.19)	2.14 (1.71, 2.68)	1.80 (1.44, 2.26)	1.76 (1.43, 2.17)

OR: odds ratio; CI: confidence interval
*Adjusted for age, age squared, and geographical region (CHARLS: urban vs. rural area; ELSA: government office region).
†Adjusted for Model 1 covariates plus educational level, physical wealth and home ownership.
‡Adjusted for Model 2 covariates plus smoking status, alcohol drinking frequency, self-rated health and number of ADL limitations.

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Discussion

In this large-scale cross-national comparison between China and England, middle-aged and older men and women who lived with no partner but with children/grandchildren and who lived alone were found to have a higher risk of elevated depressive symptoms than those living with their partner only. The extent of these associations were larger in men than in women, and at younger compared to older ages. No difference was found between living with partner only and living with partner and children/grandchildren in either country, gender, or age group, except for Chinese men aged 60+.

Multigenerational living arrangements

Our study contradicts several previous studies in which positive impacts of co-residing with adult children (Aranda, 2015; Courtin and Avendano, 2016) and co-residing with children and grandchildren (Silverstein et al., 2006) on depressive symptoms have been documented. However our study echoes a study from China, where adults aged 60+ living with adult children were found to be more depressed, particularly if no co-residential spouse was present (Ren and Treiman, 2015). In both China and England, we showed a heightened risk of depressive symptoms associated with co-residing with children/grandchildren when the partner was absent but not when the partner was present. This is in line with Buber and Engelhardt (2008) and Wang et al. (2014) that confirms the greater protective role of partner for one's mental health than other family members despite the varied context of China and England. Our findings also suggest that the theorized mental health benefits linked to multigenerational residence either do not exist or are overridden by its negative impacts such as stress, burden to care for other generations, and increased interpersonal conflicts between generations (Courtin and Avendano, 2016; Muennig et al., 2018), particularly for men. Although caring for others may promote positive psychological states and greater self-worth

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(Tosi and Grundy, 2019), these benefits appear greater for women at older ages as evidenced by a European study which found positive health effects among grandmothers, but not grandfathers, who care for grandchildren (Di Gessa et al., 2016). This may relate to the detrimental effect of co-residing with children/grandchildren that we observed in Chinese men aged 60+, regardless whether the partner was present.

While older adults in societies with stronger kinship ties – such as China – may experience more intense feelings of abandonment or distress if they do not reside with adult children (Tosi and Grundy, 2019), and thus lead to poor mental health, our study did not find stronger effects in China compared to England. The rapid socioeconomic transition in the past few decades has altered older Chinese's living arrangements voluntarily as well as involuntarily, although filial piety still strongly regulates Chinese's expectations towards family life (Chen, 2018; Lei et al., 2015; Song, 2017). As for older UK adults since the post-war period (Grundy, 1992), some elder Chinese may no longer choose multigenerational residence as they increasingly value their privacy and dislike interpersonal conflicts (Chen, 2018); whereas others may be compelled into living in an 'empty nest' because their adult children seek better life chances elsewhere (Lei et al., 2015; Song, 2017). Therefore, older Chinese who involuntarily fall into multigenerational living may be exceptionally vulnerable to worse mental health. Co-residential living rises significantly following widowhood in China as well as in high income countries (Grundy, 1992; Korinek et al., 2011). Older European widows who lived with their children were found to be happier than those who did not (Grundy and Murphy, 2018). Widowhood may therefore partly explain the smaller effect of living with no partner but with children/grandchildren at older than younger ages in both China and England.

Adverse effects of caregiving to grandchildren (Blustein et al., 2004; Brunello and Rocco, 2019) and to older parents (Capistrant, 2016) have been reported for mental health. However, we found co-residing with elderly parents rare in both China (5%) and England (1%). Chinese older parents living in multigenerational households often take heavy responsibilities to prepare meals for the family and care for grandchildren (Hermalin and Yang, 2004). This may explain the poorer mental health associated with co-residing with children and co-residing with grandchildren when the partner was absent in China. The care burden appears to outweigh the happiness and satisfaction brought by helping children and/or grandchildren, particularly while there is no one else in the household to share the burden with as evidenced by the worse mental health that we found among Chinese men who lived in a skipped-generation household with grandchildren only.

Living alone

Our findings regarding living alone are in line with previous studies (Dean et al., 1992; Russell and Taylor, 2009). The disadvantage of living alone was larger at younger than older ages in both China and England, which was consistent with a study from Finland (Hu et al., 2019). This could be explained by the hypotheses that good health enables people to live independently at old ages (Davis et al., 1997; Young and Grundy, 2009), and that elders become universally fragile at advanced ages (Hu et al., 2019). A gender difference was also observed for living alone in both countries, supporting Gove's theory (Gove, 1972) on the greater mental health benefits from marriage for men than for women. There has been a shift for older Chinese adults living in cities who prefer to live independently but close to their children in the same community/neighborhood rather than living together (Meng et al., 2017). Therefore, it is possible that older Chinese living alone may have an adult child living nearby who supports them, or that they receive sufficient emotional and instrumental support from

their relatives and friends who live nearby. These factors may explain the smaller effect of living alone on depressive symptoms in China than in England.

Role of socioeconomic position and health status

Disadvantaged individuals (e.g. with lower SEP and ill health) may benefit more from the resource sharing in a multigenerational household (Muennig et al., 2018). This was not supported by our study as no interaction between living arrangements and SEP or health status was found, expect for education and home ownership in Chinese and English women aged 60+, respectively. Stratifying the sample by education and home ownership, the more socioeconomically disadvantaged Chinese and English older women however were not at a lower risk of depressive symptoms (Supplementary Tables 6-7).

Despite the association between living arrangements and depressive symptoms was remarkably similar between China and England, the mechanisms differed. Adjustment for SEP in Model 2, in general, attenuated the associations between multigenerational living categories and elevated depressive symptoms in England irrespective of age, while these associations became greater in China (negative confounding) except for living with no partner but with children/grandchildren in Chinese women aged under 60. This negative confounding by SEP in China implies that Chinese adults who fall into multigenerational living arrangements are not particularly disadvantaged and are not financially constrained (Supplementary Table 8), which may be the case for English older adults. The discrepancy in the role of SEP between China and England suggests that one of the proposed mechanisms – having better economic security in multigenerational households – holds in China but not in England. In addition, SEP explained the heightened risk of elevated depressive symptoms associated with living alone to a smaller extent in China (16-19%) than in England (30-31%), suggesting that SEP also plays a less important role in this association in China than in

England. The negative confounding of health behaviors and health status observed for living alone in Chinese adults irrespective of age and in English men aged 60+ implies that Chinese adults and older English men living alone had better health and lifestyle compared with their counterparts living with partner only. Therefore, the mechanism that older adults' good health enables them to live independently, rather than the hypothesis that living with partner provides better social control of one's lifestyle, applies in China and in older English men.

Strengths and limitations

This study has several strengths. To our knowledge, this is the first longitudinal study that compared the relationship of multigenerational living arrangements with depressive symptoms during mid-late and later life in two very different social contexts – China where kinship ties are stronger vs. England where kinship ties are weaker. Using two national-representative ageing cohort studies, which are sister studies of the Health and Retirement Study, maximized data comparability.

We also acknowledge several limitations of this study. The different instruments employed to measure depressive symptoms in CHARLS and ELSA may contribute to some of the cross-country differences in the observed associations. However, this is unlikely to bias our findings as the 10-item and 8-item CES-D scales correlate strongly within samples (O'Halloran et al., 2014). Reverse causation may play a role as for example middle-aged and older adults with poorer mental health may be more likely to experience union dissolution. Since mental and physical health often coincide (Ohrnberger et al., 2017), individuals with poor mental health may also have poor physical health, increasing the likelihood of co-residing with younger generations for help. Other important aspects were not touched upon in this study. For example, the relationship between co-residing with children and parents' mental health may be modified by parental satisfaction of this arrangement (Chen and

Silverstein, 2000) and by whom benefits more from this arrangement – the parents or the children. Furthermore, it is possible that it is not the actual living arrangements which affect middle-aged and older adults' mental health, but rather the discrepancy between actual and preferred living arrangements (Chen, 2018). All of these aspects need further consideration to further disentangle the link between living arrangements and mental health in mid-late and later life, as well as its mechanisms in China.

In summary, middle-aged and older men and women co-residing with children/grandchildren but with no partner and living alone had poorest mental health in both China and England. The similarity of these associations in China and England suggests that effects of living arrangements on depression were not mitigated by the strength of kinship ties and other contextual factors, although the mechanisms underlying these associations differed. The central role of partner in protecting against mid-late life depression was confirmed in both countries. To reduce depression in mid-late life, adults who do not live with partner, regardless the presence of other co-residential generations, should be targeted.

Contributors

Yaoyue Hu and Milagros Ruiz designed the study, undertook the statistical analysis, and interpreted the results. Yaoyue Hu wrote the first draft of the manuscript. All authors reviewed, commented, and edited the manuscript and have approved the final manuscript.

Conflict of Interest

None.

Role of the Funding Source

Author Statement

Contributors

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Role of the Funding Source

Acknowledgements

Conflict of Interest

All authors declare no conflicts of interest.

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