Original Article

AMERICAN SOCIOLOGICAL ASSOCIATION

Journal of Health and Social Behavior
1–18

DOI: 10.1177/00221465211069895
jhsb.sagepub.com
SAGE

Sandwiched Grandparents and Biological Health Risks in China

Hongwei Xu[1], Jinyu Liu[2], Zhenmei Zhang[3], and Lydia Li[4]

Abstract

This study examined the cross-sectional associations between intergenerational caregiving and health risks among sandwiched Chinese grandparents who provide care to grandchildren, great-grandparents, or both. Drawing on biomarker data from the 2011 wave of the China Health and Retirement Longitudinal Study (N range = 2,189–3,035), we measured age-related biological health risks of hypertension, diabetes, inflammation, and allostatic load. We found that health risks did not necessarily increase with the intensity of intergenerational caregiving. Providing care to grandchildren and great-grandparents simultaneously was not as detrimental to health as reported in earlier studies from the United States. Sandwiched grandparents could benefit from providing care to grandchildren or great-grandparents only. These unexpected findings might be related to the cultural mandates of filial piety and family solidarity in China. Grandfathers and grandmothers experienced different associations between varying types of intergenerational caregiving and health risks.

Keywords

biomarker, caregiving, grandchild, grandparent, great-grandparent

In many parts of the world, grandparents play an increasingly pivotal role in providing occasional and custodial grandchild care. Since the 1990s, a growing body of research has focused on potential health implications for grandparents who care for grandchildren. Earlier studies in the United States have associated extensive and custodial grandparenting with poor health outcomes (Minkler and Fuller-Thomson 2001; Szinovacz, DeViney, and Atkinson 1999). By contrast, emerging studies in Asia (Hartanto, Lau, and Yong 2020; Ku et al. 2013; Xu 2019), Europe (Di Gessa, Glaser, and Tinker 2016a, 2016b), and South America (Grundy et al. 2012) have found health advantages for grandparents who provide occasional, extensive, or even custodial care to grandchildren.

Meanwhile, the progressive increase in life expectancy, delayed marriage and childbearing, and declining fertility rate have led to rising demands on old people caring for their older relatives. As a result, a generation of grandparents who are sandwiched between potentially dependent parents or parents-in-law (i.e., great-grandparents) and two younger generations (adult children and grandchildren) is emerging in the United States (Abramson 2015), Europe (Huvent-Grelle et al. 2015; Luna, Ramos, and Rivera 2016; Luna, Rivera, and Ramos 2021; Železna 2018), and China (Xu 2019). According to a recent study of 14 European countries, nearly 30% of grandparents provided care to both great-grandparents and grandchildren; those who cared for great-grandparents were, contrary to conventional wisdom, more likely to care for grandchildren compared with those who did not care for great-grandparents (Železna 2018). Previous research from Great Britain and the United States

[1]Queens College – CUNY, Queens, NY, USA
[2]Columbia University, New York, NY, USA
[3]Michigan State University, East Lansing, MI, USA
[4]University of Michigan, Ann Arbor, MI, USA

Corresponding Author:
Hongwei Xu, Department of Sociology, Queens College – CUNY, 65-30 Kissena Blvd, Powdermaker Hall 252, Queens, NY 11367, USA.
Email: hongwei.xu@qc.cuny.edu

suggests that the sandwiched generation provides help (e.g., money, chores, grandchild care) to both elderly parents and adult children when they have a strong sense of family solidarity, close intergenerational ties, or a cultural expectation (Grundy and Henretta 2006; Henretta, Grundy, and Harris 2002). In China, recent estimates showed that more than 1 in 4 grandparents belonged to the sandwich generation, and among them, more than 1 in 10 were dual caregivers—providing informal care to both great-grandparents and grandchildren (Xu 2019).

Despite the rising dual burden of providing care to great-grandparents and grandchildren in many countries (Železna 2018), there is a dearth of research investigating the health risks faced by sandwiched grandparents. The handful of existing studies was cross-sectional, drew on small non-probability samples, or used self-reported measures of physical and mental health, which can be unreliable (Huvent-Grelle et al. 2015; Luna et al. 2016, 2021). Situated in the Chinese context, this study adopted a four-generation perspective to examine the relationship between intergenerational caregiving and health in Chinese grandparents who are sandwiched between grandchildren and great-grandparents. Biomarker data were used to construct clinically relevant measures of health risks in a nationally representative sample of sandwiched Chinese grandparents. Intergenerational living arrangements were incorporated to assess the extent to which grandparents are engaged in grandchild care and great-grandparent care.

BACKGROUND

Overview of Intergenerational Caregiving and Health

Many potential pathways link intergenerational caregiving to grandparents' health; some are positive, whereas others are negative. The negative pathways can be grouped under the umbrella of role strain theory (Goode 1960) and the stress process model (Pearlin 1989; Pearlin et al. 2005). Grandparents experience role strain when they are unable to fulfill the obligations of intergenerational caregiving due to limited resources or inadequate coping strategies, a situation known as role overload, or when they are unwilling to assume the caregiving role, a situation known as role captivity (Pearlin 1989). For example, grandparents may prefer to enjoy life after retirement rather than to be caregivers for older or younger generations. The role strain of intergenerational caregiving takes many forms, ranging from physical to psychological and from relational to financial. According to the stress process model, grandparents experience chronic role strain when they endure prolonged, daily intergenerational caregiving tasks, leading to a deleterious effect on various aspects of health.

Providing care to grandchildren or great-grandparents can be physically demanding for grandparents who themselves are experiencing age-related health decline. Caring for grandchildren and great-grandparents may also limit grandparents' time and opportunities for participation in leisure and recreational activities (Jendrek 1993), social engagement outside of family (Pruchno 1999), and self-care (Baker and Silverstein 2008), all of which undermine their health status. Furthermore, providing intergenerational care sometimes provokes unintended family conflicts. In the case of caring for grandchildren, intergenerational conflicts may arise between grandparents and their adult children who embrace different childrearing styles, triggering psychological stress in both generations (Leung and Fung 2014). When caring for older great-grandparents, conflicts may occur among sibling grandparents or between older great-grandparents and their daughters-in-law when the obligations and burdens of caregiving are unevenly distributed (Cong and Silverstein 2008). Last, providing intergenerational caregiving may incur a financial burden for grandparents. The financial burden can be substantial when grandparents are forced to take custodial care of grandchildren (Emick and Hayslip 1999; Szinovacz et al. 1999) or help pay for great-grandparents' medical expenditures (Wu and Li 2014). It is worth noting that one strain can beget other strains, a process known as stress proliferation (Pearlin et al. 2005). For example, grandparents may experience relational strain with siblings or adult children after struggling with the financial strain from paying for great-grandparents' medical expenditures or grandchildren's food and clothes.

On the other hand, providing intergenerational care may promote grandparents' emotional, psychological, and social well-being, which in turn are protective against biological health risks. According to role enhancement theory (Moen, Robison, and Dempster-McClain 1995), grandparents occupy additional roles at older ages when they provide care to grandchildren, great-grandparents, or both. In return, they enjoy emotional reward and gratification, a sense of empowerment, and social recognition. Similarly, the so-called activity theory of aging suggests that social role participation, in the form of interpersonal activity, helps people receive various

social support to reaffirm their specific role identities and sustain positive self-concept in older ages, which in turn is positively associated with life satisfaction (Lemon, Bengtson, and Peterson 1972). Empirical evidence in both Western and Eastern societies shows that grandparents who care for grandchildren enjoy an enhanced sense of self-efficacy and self-esteem, a stronger feeling of self-worth, a new purpose in later life, and more intimate ties with extended family members, all of which contribute positively to their psychological well-being (Emick and Hayslip 1999; Lou 2011). The boost in psychological well-being may translate into better physical health (Ku et al. 2013) and increased longevity (Hilbrand et al. 2017) for grandparent caregivers.

Similarly, grandparents may fulfill their family obligations by providing care to great-grandparents and thus promote their emotional well-being and health. This is particularly important in the Chinese context, where the cultural mandates of filial piety, mutual aid, and interdependence across generations still persist in many families (Silverstein, Cong, and Li 2006). Chinese grandparents place a stronger emphasis on the collective well-being of their extended families and value family solidarity, harmony, and continuity more than their peers in Western cultures (Burnette, Sun, and Sun 2013). Furthermore, the tradition of filial piety specifically prescribes the responsibility of elder care to adult children. For Chinese grandparents, providing care to great-grandparents and grandchildren is in accordance with these dominant cultural values and should be emotionally rewarding and life affirming, thereby enhancing well-being and health.

In addition, providing intergenerational care allows grandparents to sustain a physically active lifestyle at older ages. Research in Europe and East Asia has shown that grandparents who provide care to grandchildren have better physical strength and report fewer mobility limitations than their non-caregiving peers and that these physical health benefits could be partly attributable to increased physical activity from interacting with grandchildren (Di Gessa et al. 2016b; Ku et al. 2013). Similarly, caring for older great-grandparents provides an opportunity for grandparents to be physically active, at least in theory, although empirical evidence is limited.

The net health effect likely depends on the extent to which grandparents are involved in intergenerational caregiving. For example, many researchers have hypothesized a nonlinear relationship between grandparents' involvement in grandchild care and their health (Arpino and Bordone 2014; Di Gessa et al. 2016a, 2016b; Hilbrand et al. 2017; Minkler and Fuller-Thomson 2001). That is, grandparents derive health benefits from providing casual or supplementary care to grandchildren, but the benefits would be outweighed by caregiving burdens if they provide intensive or custodial care. Therefore, we expect that for sandwiched Chinese grandparents:

> *Hypothesis 1* (caregiving intensity): Compared with no caregiving, providing part-time intergenerational care (to grandchildren, great-grandparents, or both) is associated with lower health risks (*Hypothesis 1a*), whereas providing full-time intergenerational care is associated with higher health risks (*Hypothesis 1b*).

Generational Difference

There are important generational differences in the health implications of caring for grandchildren and caring for great-grandparents because of different natures and qualities of family ties with ascendants and descendants. In Western countries, societal norms tend to favor a downward flow of intergenerational support from parents to children rather than the reverse (Fingerman et al. 2016). Grandparents may be more emotionally invested in grandchildren as a legacy of their extended families than in their aging parents (Giarrusso, Du Feng, and Bengtson 2005). As a result, grandparents may derive a sense of generativity or fulfillment from the younger generation when they provide support to grandchildren. By contrast, providing care to great-grandparents may trigger grandparents' grief and death anxiety because it involves role restructuring—the parent–child roles remain unchanged between great-grandparents and grandparents, but the aging process alters the long-established patterns of intergenerational expectation and interaction (Pearlin 1989). That is, grandparents experience worries, sadness, and anxiety about their aging parents out of fear of imminent frailty, health declines, and mortality.

For Chinese grandparents, providing care to great-grandparents is in accordance with the cultural mandates of filial piety. Nevertheless, caring for great-grandparents is not viewed by Chinese grandparents as an equal contribution to the continuity of the family lineage as caring for grandchildren. In terms of intergenerational transfer, caring for great-grandparents involves mainly upstream personal care, emotional support, and financial assistance from grandparents, which in the view of filial piety, reciprocate great-grandparents'

investment in grandparents' early life (Xu 2019). Chinese grandparents who provide care to grandchildren in skipped-generation households may also receive greater remittances from adult children, which in turn is beneficial to their psychological well-being (Silverstein et al. 2006).

The few studies on sandwiched grandparents so far have suggested that caring for great-grandparents induces a heavier emotional and psychological burden than caring for grandchildren. In a nonrandom sample of sandwiched French grandparents, the majority of the respondents preferred to care for their grandchildren even though they were also willing to help the great-grandparents (Huvent-Grelle et al. 2015). On average, the surveyed grandparents felt happier about caring for grandchildren than caring for great-grandparents, and only a small minority considered caring for grandchildren as a burden. Similarly, in another nonrandom sample of Spanish grandmothers, those who cared for great-grandparents perceived higher levels of stress and experienced poorer psychological health, whereas those who cared for grandchildren perceived less stress and experienced better psychological health compared with noncaregivers (Luna et al. 2021). In a nationally representative sample, Chinese grandparents were less likely to derive pleasure or life satisfaction from caring for older great-grandparents, whose impending health decline, disability, and mortality induced negative emotions compared with caring for grandchildren (Xu 2019). Therefore, we expect that for sandwiched Chinese grandparents:

Hypothesis 2 (generational difference): Providing care to grandchildren is associated with lower health risks compared with providing care to great-grandparents.

Dual Caregiving

Compared with caring for grandchildren or great-grandparents alone, participation in multiple caregiving roles may be extremely demanding for the sandwich generation because they are pressed between competing needs from the older and younger generations. Thus, providing care to grandchildren and great-grandparents simultaneously is expected to further aggravate the physical, psychological, and economic strains experienced from participation in a single caregiving role (Abramson 2015). However, the few empirical studies on sandwiched grandparents have yielded mixed findings. In France, Huvent-Grelle et al. (2015) found that although sandwiched grandparents provided prolonged care (>5 years) to both great-grandparents and grandchildren, they felt happy with their lives and considered themselves relatively healthy. In Spain, Luna et al. (2021) found that sandwiched grandmothers perceived low to moderate levels of stress and reported good physical health. In China, Xu (2019) found that sandwiched grandparents reported greater life satisfaction, fewer depressive symptoms, and lower risk of hypertension compared with noncaregivers.

Several reasons may help explain these mixed findings on dual caregiving. First, the lack of evidence for the negative health effects of dual caregiving may reflect a selection bias. That is, because simultaneously caring for great-grandparents and grandchildren can induce high levels of emotional stress, physical burden, and even financial strain, only grandparents who are the healthiest and possess excellent coping skills are the most likely to assume multiple caregiving roles and responsibilities. Second, the few studies on the well-being and health of sandwiched grandparents have ignored the intensity of intergenerational caregiving. For example, Xu (2019) considered only whether Chinese grandparents provided any care to grandparents or great-grandparents but did not distinguish between casual care and intensive care. Third, the generational difference discussed earlier suggests that sandwiched grandparents may find a delicate balance between dual caregiving activities. The net health effect may not be negative if the psychological and physical rewards of caring for grandchildren outweigh the role strain of caring for great-grandparents.

To the extent that Chinese grandparents tend to associate happiness with relational harmony and perceive elder care as a cultural mandate of filial piety (Kitayama et al. 2010; Xu 2019), we expect that for sandwiched Chinese grandparents:

Hypothesis 3 (dual caregiving): Compared with no caregiving, providing part-time care to grandchildren and great-grandparents simultaneously is associated with lower health risks (*Hypothesis 3a*), whereas providing full-time dual care is associated with higher health risks (*Hypothesis 3b*).

Gender Difference

In both Western and Eastern societies, grandparenthood is a gendered experience. Women are typically expected to act as kin-keepers in multigenerational households and be responsible for elder care and child care, whereas men are expected to fill the gap only in the absence of able women (Leopold and

Skopek 2014). In accordance with these gendered norms, the obligations and burdens of providing care to grandchildren, great-grandparents, or both fall disproportionately on grandmothers (Železna 2018). Therefore, the health implications of intergenerational caregiving, positive or negative, tend to be more significant for grandmothers than for grandfathers simply because the former are more heavily involved in caregiving.

Conditional on similar levels of involvement, the health impacts of intergenerational caregiving may still differ between grandfathers and grandmothers. Compared with grandmothers, grandfathers may have acquired fewer skills, resources, and coping strategies over the life course to appropriately care for their parents and grandchildren. Grandfathers may also experience additional role strain or even social stigma if they are heavily involved in intergenerational caregiving, which deviates from the traditional norm. Therefore, the same amount of intergenerational caregiving may be more psychologically stressful for grandfathers than for grandmothers. In China, for example, even though providing intensive care to grandchildren was associated with worse self-rated health for both grandfathers and grandmothers, the rate of health decline over time was faster for grandfathers than for grandmothers (Chen and Liu 2012). In terms of elder care, female caregivers may have larger social networks and greater access to informal support, but male caregivers may be more likely to seek formal and informal support (Pinquart and Sörensen 2006).

To the extent that Chinese grandmothers are more accustomed to being caregivers and have better coping skills than their male counterparts, we expect that for sandwiched Chinese grandparents:

> *Hypothesis 4* (gender difference): Conditional on the same level of involvement in caregiving, the health risks of providing care to grandchildren, great-grandparents, or both are relatively lower for grandmothers than for grandfathers.

DATA AND METHODS

Data and Sample

Individual-level data were drawn from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative survey of adults age 45 or older and their spouses, if available. CHARLS sampled 17,708 residents from 150 counties across 28 provinces in China, with a response rate of 80.5%, in 2011. National follow-up surveys of CHARLS were carried out in 2013, 2014, and 2015. However, due to inconsistent measures of key variables in later waves, this study assessed intergenerational caregiving status and biological health risks only at the 2011 baseline.

This study focused on respondents aged 50 or older who were grandparents in four-generation families and provided care to their parents or parents-in-law (i.e., great-grandparents), grandchildren, or both. We chose 50 as the lower age limit so that our results would be comparable to results from other countries (Železna 2018). In addition, younger respondents were unlikely to be grandparents or at risk of the age-related chronic conditions under investigation in this study. There were 13,590 respondents aged 50 or older in the CHARLS baseline survey. Among them, 9,389 (or 69.1%) had at least one grandchild under age 16, and 5,033 (or 37.0%) had at least one living parent or parent-in-law. Only 3,786 (or 27.9%) respondents aged 50 or older had at least one living parent or parent-in-law and at least one grandchild under age 16 at the time of interview. In other words, they were grandparents in four-generation families, irrespective of coresidence. Among them, 356 respondents were excluded because of missing data on any outcome variable, and another 41 respondents were dropped because of missing data on any control variable, resulting in a sample size of 3,389. To maximize statistical power, the analytic sample size varied depending on the number of valid responses for each biomarker outcome. As a result, the final sample sizes ranged from 2,189 (for allostatic load) to 3,035 (for hypertension).

Measures

The CHARLS baseline surveys collected physical-performance measures and fasting blood samples from the respondents. These biomarker data were collected by trained medical students with assistance from local nurses (Chen et al. 2019). For blood-based biomarkers, respondents were asked to fast overnight and visit a local blood collection site in the morning. Several outcome variables were constructed to indicate moderate and high disease risks in cardiovascular, metabolic, and inflammatory systems because these are major health risk factors for the Chinese population.

Cardiovascular disease risk was captured by hypertension status. Hypertension is a major risk factor for cardiovascular diseases, and hypertensive heart disease itself is a leading cause of years of life lost in the Chinese population (Zhou et al. 2019).

Three measurements of blood pressures (BP) were taken 45 seconds apart, and the average was used. Respondents were classified as having prehypertension if their mean diastolic BP was in the range of 80 to 90 mmHg or their mean systolic BP was in the range of 120 to 139 mmHg or as having hypertension if their mean diastolic BP was 90 mmHg or higher or mean systolic BP was 140 mmHg or higher (Hu and Kong 2012). Metabolic disease risk was captured by diabetes status. Diabetes is another major chronic disease that affects more than 72 million middle-aged and older Chinese adults (Zhao et al. 2016). Respondents were classified as having prediabetes if their fasting glucose levels were in the range of 110 to 125 mg/dl or A1C levels were in the range of 6.0% to 6.4% or as having diabetes if their fasting glucose levels were 126 mg/dL or higher or A1C levels were 6.5% or higher (World Health Organization 2019). Inflammation has been implicated in a critical biological pathway through which psychosocial stress induces irregular neuroendocrine response and impairs the immune system, leading to increased risk of chronic illness (Acabchuk et al. 2017). Inflammation was captured by elevated levels of high-sensitivity C-reactive protein (hs-CRP). Respondents were classified as having chronic inflammation if their hs-CRP levels were between 3 and 10 mg/L or as having acute infection if their hs-CRP levels were above 10 mg/L (Thompson et al. 2014).

A composite index of allostatic load (AL) was constructed to provide a summary measure of cumulative dysregulation in multiple physiological systems (McEwen and Stellar 1993). Compared with measures of single biomarkers, AL may capture health risks resulting from small subclinical increases in multiple risk factors. The AL index score was calculated as the number of 11 biomarkers for which respondents were at high risk. As a robustness check, we calculated two separate AL scores by using clinically relevant cut points and empirically defined quartiles, respectively, to classify high-risk biomarkers (Beckie 2012). For the list of the biomarkers and the cut points, see Appendix A in the online version of the article.

The key independent variable was grandparents' self-reported family caregiving in the past year. Respondents who had any grandchildren under age 16 were asked whether they spent any time taking care of their grandchildren in the past year. Respondents were also asked whether they took care of their parents or parents-in-law in the past year. Those who provided any intergenerational care were further asked how many weeks and how many hours per week they spent caregiving. We also incorporated the measure of living arrangements, which was based on household rosters and questions about respondents' residential proximity to their family and extended family members.

We combined these measures to construct a multicategorical variable of intergenerational caregiving in several steps. First, we determined the caregiving status of each grandparent with respect to grandchildren using three categories: not a grandchild caregiver, part-time grandchild caregiver, or full-time grandchild caregiver. Grandparents were classified as noncaregivers if they did not provide care to any grandchild in the past year. Grandparents were considered full-time grandchild caregivers if they spent 40 hours a week or more (equivalent to a full-time job) taking care of grandchildren or provided custodial care to grandchildren regardless of how much time they spent caregiving. Custodial grandchild care was defined as providing care to coresident grandchildren in skipped-generation households where no parents or other adults (e.g., uncles or aunts of the children) were available to help with child care. Accordingly, grandparents were classified as part-time grandchild caregivers if they spent less than 40 hours a week taking care of grandchildren and did not provide custodial care.

Similarly, we determined the caregiving status of each grandparent with respect to great-grandparents using three categories: not a great-grandparent caregiver, part-time great-grandparent caregiver, and full-time great-grandparent caregiver. Grandparents were classified as noncaregivers if they did not provide care to any great-grandparent in the past year and as full-time great-grandparent caregivers if they spent 40 hours a week or more taking care of great-grandparents or provided custodial care to great-grandparents regardless of how much time they spent caregiving. Custodial great-grandparent care was defined as providing care to coresident great-grandparents in households where no siblings (or siblings-in-law) of the grandparents were available to help with caregiving. Last, grandparents were classified as part-time great-grandparent caregivers if they spent less than 40 hours a week taking care of great-grandparents and did not provide custodial care.

Last, we cross-classified the three categories of grandchild care with the three categories of great-grandparent care, resulting in nine types of intergenerational caregiving among the sandwiched grandparents (see Appendix B in the online version of the article). To avoid small cell sizes, we combined three types of dual caregiving into a single category, labeled as full-time dual caregivers: (a)

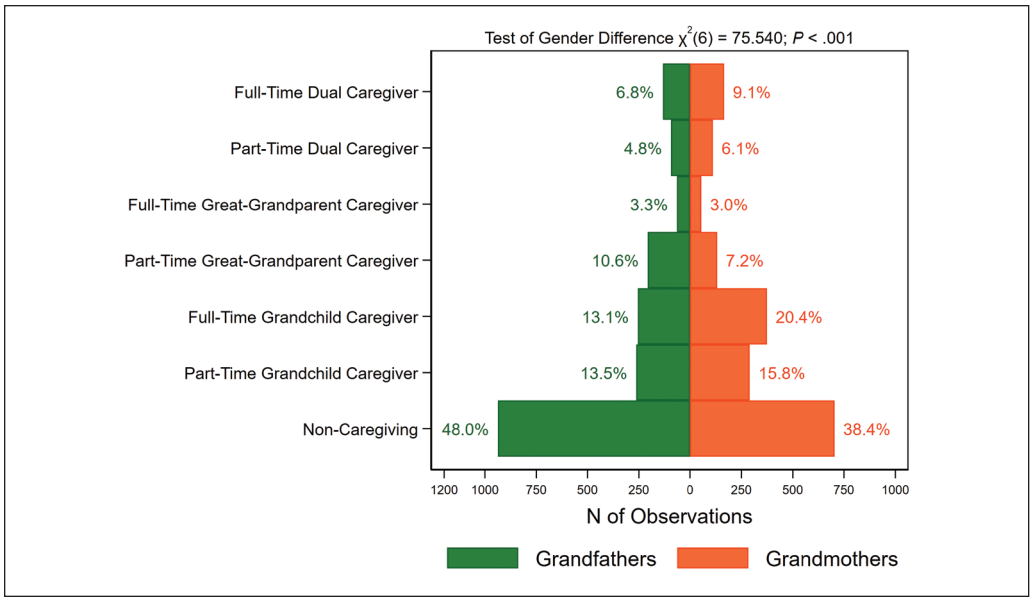

Figure 1. Frequency Distributions of Intergenerational Caregiving Status by Gender, CHARLS 2011.
Note: CHARLS = China Health and Retirement Longitudinal Study.

providing full-time care to great-grandparents and part-time care to grandchildren (n = 50), (b) providing part-time care to great-grandparents and full-time care to grandchildren (n = 151), and (c) providing full-time care to both great-grandparents and grandchildren (n = 81). The final classification consisted of noncaregivers (reference group) and six groups of intergenerational caregiving grandparents (see Figure 1).

Gender was used to stratify the full sample into subsamples of grandfathers and grandmothers. Demographic control variables included age, married status, number of living children, and number of living siblings. Socioeconomic control variables included educational attainment, employment status, and per capita value of household consumer durable assets. Health control variables include self-rated health and ability to perform activities of daily living, instrumental activities of daily living, or other mobility activities. Last, geographic variation was controlled by a dichotomous variable of rural–urban residence and provincial fixed effects.

Statistical Methods

Weighted logistic and ordinary least squares (OLS) models were fitted to categorical and continuous outcome variables, respectively. We estimated three logistic models for each set of hypertension, diabetes, and inflammation risks. The first model was used to estimate moderate risk (i.e., prehypertension, prediabetes, and chronic inflammation) as opposed to low risk. The second model was used to estimate high risk (i.e., hypertension, diabetes, and acute inflammation) as opposed to moderate and low risks. As a sensitivity check, the third model was used to estimate the combination of moderate and high risks as opposed to low risk. The 2011 baseline individual-level biomarker and blood sample weights were used to adjust for survey sampling, household and individual nonresponse, and missing data on the outcome variables. These baseline weights were constructed by the CHARLS research team and calculated as the product of the household sample selection weight, an inverse probability weighting (IPW) factor for household nonresponse, an IPW factor for individual nonresponse conditional on household participation, and an IPW factor for participating in the physical examination or the fasting blood sample collection. We calculated robust standard errors to adjust for the potential correlation of observations clustered in the same communities, the primary sampling units of CHARLS. We used the seemingly unrelated estimation (SUE) method to formally test gender differences in coefficient estimates from the models fitted to grandfather and grandmother subsamples separately.

Table 1. Descriptive Statistics of Dependent Variables, CHARLS 2011.

	Grandfathers		Grandmothers	
	M (*SD*) or %	Total *N*	*M* (*SD*) or %	Total *N*
Hypertension status				
Normal	55.9	1,536	57.8	1,499
Prehypertension only	18.0	1,536	15.5	1,499
Hypertension	26.2	1,536	26.6	1,499
Diabetes status				
Normal	70.2	1,304	69.7	1,316
Prediabetes only	17.2	1,304	17.1	1,316
Diabetes	12.7	1,304	13.2	1,316
Inflammation status				
Normal	82.4	1,292	82.4	1,298
Chronic inflammation	12.7	1,292	12.3	1,298
Acute infection	5.0	1,292	5.4	1,298
Allostatic load				
Clinical cut points	1.6 (1.6)	1,081	1.9 (1.7)	1,108***
Empirical cut points	2.6 (2.1)	1,081	2.9 (2.1)	1,108***

Note: CHARLS = China Health and Retirement Longitudinal Study.
***$p < .001$ (for two-tailed *t* tests or χ^2 tests of gender differences).

RESULTS

Descriptive Statistics

Table 1 shows the descriptive statistics of the dependent variables. The risks of prehypertension and hypertension were high among both grandfathers and grandmothers. About 26.2% of grandfathers and 26.6% of grandmothers had hypertension, and another 18% of grandfathers and 15.5% of grandmothers were classified as having prehypertension. Diabetes was less prevalent than hypertension, but still roughly 30% of grandfathers and grandmothers were either prediabetic or diabetic. Less than 20% of grandfathers and grandmothers were at risk of inflammation. Among them, chronic inflammation was more than twice as prevalent as acute infection. The average AL scores based on clinical cut points were 1.6 for grandfathers and 1.9 for grandmothers. The average AL scores based on empirical cut points were higher—2.6 for grandfathers and 2.9 for grandmothers. Grandmothers had on average significantly higher AL scores than grandfathers, regardless of the choice of cut points.

Figure 1 depicts the frequency distributions of intergenerational caregiving status among the sandwiched grandfathers and grandmothers separately before dropping missing data. Consistent with the gender norm, grandmothers were more likely than grandfathers to provide care to grandchildren, great-grandparents, or both. Only 38.4% of the grandmothers were not intergenerational caregivers, compared with 48.0% of the grandfathers. Among caregivers, providing care to grandchildren only (26.6% of grandfathers and 36.2% of grandmothers) was more popular than providing care to great-grandparents only (13.9% of grandfathers and 10.2% of grandmothers) or providing dual care (11.6% of grandfathers and 15.2% of grandmothers). For example, more than a third of the grandmothers provided part-time (15.8%) or full-time (20.4%) care to grandchildren, which amounted to more than half of all the caregiving grandmothers. It was relatively rare for grandfathers (3.3%) and grandmothers (3.0%) to provide full-time care to great-grandparents only, although it was not uncommon for them to provide part-time care to great-grandparents only (10.6% of the grandfathers and 7.2% of the grandmothers). It was also not uncommon to provide care to grandchildren and great-grandparents simultaneously. About 6.1% of the grandmothers were part-time dual caregivers, and another 9.1% were full-time dual caregivers, together accounting for one fourth of all the caregiving grandmothers. A similar pattern holds for dual caregiving grandfathers.

Table 2 summarizes the distributions of the baseline control variables. The full sample was split evenly between grandfathers and grandmothers with

Table 2. Descriptive Statistics of Baseline Control Variables in 2011, CHARLS.

	Grandfathers (N = 1,717)	Grandmothers (N = 1,668)
	M (SD) or %	M (SD) or %
Age (years)	57.9 (5.0)	56.7*** (4.4)
Married		
No	2.4	5.8***
Yes	97.6	94.2***
Living children	2.5 (1.1)	2.6 (1.1)
Living siblings	3.5 (1.9)	3.9*** (1.8)
Education		
No school	10.3	42.9***
Primary school	45.4	36.2***
≥ Middle school	44.4	20.9***
Currently working		
No	17.7	31.8***
Yes	82.3	68.2***
Per capita household assets (yuan)	986 (2,018)	947 (1,916)
Self-rated health		
Very good	7.8	5.5**
Good	19.5	14.5***
Fair	50.5	50.5
Poor	18.4	25.5***
Very poor	3.9	4.0
Any mobility limitation		
No	80.0	71.4***
Yes	20.0	28.6***
Residence		
Rural	62.3	62.2
Urban	37.7	37.8

Note: CHARLS = China Health and Retirement Longitudinal Study.
**$p < .01$, ***$p < .001$ (for two-tailed t tests or χ^2 tests of gender differences).

an average age of 57 to 58 years old, and most of them were married. Both grandfathers and grandmothers typically had more than two adult children and nearly four siblings alive and lived in rural areas (about 62%). Grandfathers were less likely to be illiterate (10.3%) and more likely to have attended middle school or above (44.4%) than grandmothers, of whom 42.9% were illiterate and only 20.9% attended middle school or above. Grandfathers were also more likely to be working (82.3%) than grandmothers (68.2%) at the time of interview. Lastly, grandfathers reported better health than grandmothers. Grandfathers were more likely to rate their general health status as good or very good (27.3%) and less likely to report poor health (18.4%) than grandmothers, of whom 20.0% reported good or very good health and 25.5% reported poor or very poor health. In addition, fewer grandfathers report having any mobility limitation (20.0%) than grandmothers (28.6%).

Regression Results

We focused on interpreting the results after adjusting for all the control variables because the estimates were qualitatively the same without adjusting for self-reported health and mobility. Tables 3 reports the coefficient estimates from weighted logistic models of the associations between caregiving status and risks of prehypertension and hypertension. Providing part-time care to great-grandparents only was associated with lower odds of prehypertension among grandfathers ($\beta = -.649$, $p < .10$) but not among grandmothers, and the gender difference in

Table 3. Estimates of Log Odds from Weighted Logistic Models of Prehypertension and Hypertension, CHARLS 2011.

	Prehypertension				Hypertension			
	Grandfather		Grandmother		Grandfather		Grandmother	
Independent Variables	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Caregiving status (reference = noncaregiving)								
Part-time grandchild caregiver	−.085	−.117	−.232	−.238	.154	.172	.052	.055
Full-time grandchild caregiver	−.334	−.338	.218	.187	.317	.318	−.127	−.129
Part-time great-grandparent caregiver	−.655†	−.649†	.271	.282	.280	.287	−.007	−.010
Full-time great-grandparent caregiver	−.008	−.027	.378	.393	−.459	−.436	.073	.074
Part-time dual caregiver	−.061	−.090	.596†	.613†	−.112	−.084	.536†	.530†
Full-time dual caregiver	.011	−.013	−.342	−.355	−.560†	−.543†	−.137	−.147
Age (years, centered)	−.005	−.004	.044*	.046*	.058**	.056**	.049**	.048**
Married (reference = no)	−.259	−.262	−.556	−.569†	−.364	−.377	.377	.379
Number of children alive	.049	.051	.136	.145	.093	.099	−.064	−.064
Number of siblings alive	.011	.008	−.055	−.064	.042	.048	−.024	−.025
Education (reference = no school)								
Primary school	.165	.141	.338	.329	−.185	−.159	.083	.085
Middle school or higher	−.332	−.353	.116	.062	−.275	−.240	−.230	−.234
Currently working (reference = no)	−.144	−.209	.169	.127	−.018	.054	−.301†	−.312†
Household assets (logged)	.044	.038	.053	.043	.005	.010	−.077	−.077
Mobility limitation (reference = no)		.086		−.260		−.062		.049
Self-rated health		−.189†		−.136		.177†		−.043
Rural residence (reference = urban)	−.455*	−.431*	−.061	−.006	−.433*	−.455*	−.380*	−.376*
Constant	.178	.855	−3.529**	−2.847*	−.258	−.778	.167	.286
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,132	1,132	1,090	1,090	1,534	1,534	1,499	1,499

Note: CHARLS = China Health and Retirement Longitudinal Study.
†$p < .10$, *$p < .05$, **$p < .01$ (based on robust standard errors in two-tailed tests).

the coefficient estimates was marginally significant according to the SUE test, $\chi^2(1) = 3.64$, $p < .10$. Grandmothers who were part-time dual caregivers had marginally higher odds of prehypertension ($\beta = .613$, $p < .10$) and hypertension ($\beta = .530$, $p < .10$) than their noncaregiving peers. These associations were not significant among grandfathers, and the gender differences in these associations were not significant either. When considering the risks of prehypertension and hypertension together (see Appendix C in the online version of the article), grandmothers who were part-time dual caregivers also had significantly higher odds ($\beta = .619$, $p < .05$), and the gender variation was marginally significant, $\chi^2(1) = 3.089$, $p < .10$. On the other hand, full-time dual caregivers had marginally lower odds of hypertension among grandfathers ($\beta = -.543$, $p < .10$).

Table 4 reports the coefficient estimates from weighted logistic models of the associations between caregiving status and risks of prediabetes and diabetes. None of the caregiving statuses were associated with the risk of prediabetes or diabetes among grandfathers. Among grandmothers, providing full-time care to grandchildren only was associated with higher odds of prediabetes ($\beta = .620$, $p < .05$), whereas providing full-time care to great-grandparents only was associated with lower odds of prediabetes ($\beta = -1.733$, $p < .05$). Compared with their

Table 4. Estimates of Log Odds from Weighted Logistic Models of Prediabetes and Diabetes, CHARLS 2011.

	Prediabetes				Diabetes			
	Grandfather		Grandmother		Grandfather		Grandmother	
Independent Variables	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Caregiving status (reference = noncaregiving)								
Part-time grandchild caregiver	.386	.376	.223	.216	−.177	−.175	−.208	−.190
Full-time grandchild caregiver	.144	.140	.654*	.620*	−.317	−.303	−.264	−.259
Part-time great-grandparent caregiver	.139	.149	−.118	−.115	−.284	−.258	−.328	−.330
Full-time great-grandparent caregiver	−.313	−.321	−1.758*	−1.733*	−.146	−.156	.034	.012
Part-time dual caregiver	−.352	−.325	.799*	.821*	−.414	−.387	−.205	−.193
Full-time dual caregiver	−.377	−.367	.347	.306	−.473	−.445	−.589	−.593
Age (years, centered)	.016	.015	.009	.011	−.021	−.022	−.028	−.031
Married (reference = no)	.212	.230	−.547	−.495	.148	.146	.580	.547
Number of children alive	−.133	−.133	.108	.112	−.100	−.106	.085	.084
Number of siblings alive	.065	.068	−.025	−.028	−.042	−.039	−.058	−.062
Education (reference = no school)								
Primary school	.618*	.625*	−.051	−.040	.560	.576	.000	.026
Middle school or higher	.360	.376	−.495	−.508	.573	.619	−.138	−.096
Currently working (reference = no)	.093	.144	−.018	−.066	.023	.121	−.270	−.248
Household assets (logged)	.064	.070	.026	.013	.055	.069	−.049	−.039
Mobility limitation (reference = no)		.045		−.015		.174		.270
Self-rated health		.093		−.203†		.208†		.034
Rural residence (reference = urban)	−.217	−.239	−.074	−.018	−.133	−.182	−.619**	−.642**
Constant	−3.887**	−4.257**	−1.751†	−1.080	−2.685**	−3.480**	−2.453*	−2.665*
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,129	1,129	1,141	1,141	1,304	1,304	1,300	1,300

Note: CHARLS = China Health and Retirement Longitudinal Study.
†$p < .10$, *$p < .05$, **$p < .01$ (based on robust standard errors in two-tailed tests).

noncaregiving peers, grandmothers who were part-time dual caregivers had higher odds of prediabetes ($\beta = .821$, $p < .05$), and the gender difference in the coefficient estimates was statistically significant according to the SUE test, $\chi^2(1) = 4.242$, $p < .05$. After combining prediabetes and diabetes into a single outcome category (see Appendix C in the online version of the article), grandmothers who were part-time dual caregivers were still at a higher risk ($\beta = .459$, $p < .10$), and the gender difference remained marginally significant, $\chi^2(1) = 3.390$, $p < .10$.

Table 5 reports the coefficient estimates from weighted logistic models of the associations between caregiving status and risks of chronic inflammation and acute infection. Compared with noncaregiving, providing part-time care to great-grandparents only was associated with significantly higher odds of acute infection among grandmothers ($\beta = 1.955$, $p < .001$) but not among grandfathers, and the gender difference in the coefficient estimates was statistically significant, $\chi^2(1) = 6.970$, $p < .01$. This association remained statistically significant for the combined risk of chronic inflammation and acute infection among grandmothers ($\beta = .747$, $p < .05$; see Appendix C in the online version of the article), although the gender difference was no longer statistically significant. Providing part-time dual care was associated with higher odds of chronic inflammation among grandfathers ($\beta = .840$, $p < .05$) and higher odds of acute infection among grandmothers ($\beta = .928$, $p < .05$). The gender difference in the former association was statistically significant, $\chi^2(1) = 7.174$, $p < .01$. Providing full-time dual care was associated with marginally lower odds of acute infection among grandfathers ($\beta = -1.466$, $p < .10$) and marginally lower combined odds of chronic inflammation and acute infection among grandmothers ($\beta = -.668$, $p < .10$; see Appendix C in the online version of the article).

Lastly, Table 6 reports the coefficient estimates from weighted OLS models of the associations between caregiving status and AL scores. Compared with noncaregiving, providing part-time care to grandchildren only was associated with significantly lower AL scores among grandfathers regardless of the choice of cut points ($\beta = -.380$, $p < .05$, based on clinical cut points; $\beta = -.570$, $p < .01$, based on empirical cut points). This association was not found among grandmothers, and the gender difference in this association was statistically significant when empirical cut points were applied, $\chi^2(1) = 5.370$, $p < .05$. Providing full-time care to great-grandparents only was associated with significantly lower AL scores among grandfathers, again regardless of the choice of cut points ($\beta = -.739$, $p < .05$, based on clinical cut points; $\beta = -.884$, $p < .01$, based on empirical cut points). This association was not found among grandmothers, but the gender difference was not statistically significant. Compared with their noncaregiving peers, full-time dual caregiving grandfathers had significantly lower AL scores based on clinical cut points ($\beta = -.515$, $p < .05$) and marginally lower AL scores based on empirical cut points ($\beta = -.510$, $p < .10$). Again, this association was not found among grandmothers, and the gender difference was not statistically significant.

Sensitivity Check

Entirely based on biomarker data, our measures of hypertension and diabetes status did not capture the health risks among the respondents who had been diagnosed with these chronic conditions and received medical treatments. As a sensitivity analysis, we recoded the dependent variables of prehypertension, hypertension, prediabetes, and diabetes to include self-reported experiences of doctor's diagnosis and treatment as being at risk of these conditions. We reestimated the logistic models of the recoded hypertension and diabetes status and reported the results in Appendices D and E in the online version of the article. The results remained qualitatively unchanged for prehypertension but changed for hypertension. Specifically, part-time dual caregiving grandmothers no longer had significantly higher odds of hypertension, whereas full-time dual caregiving grandfathers no longer had significantly lower odds of hypertension compared with their noncaregiving peers. Instead, full-time dual caregiving grandmothers were at marginally lower risk of hypertension ($\beta = -.493$, $p < .10$). The results remained substantively the same for prediabetes and diabetes. In addition, two associations became significant in the model of the combined risk of prediabetes and diabetes. Compared with noncaregiving, the odds of prehypertension or hypertension were marginally lower among grandmothers who provided full-time care to great-grandparents only ($\beta = -.812$, $p < .10$) and significantly lower among grandfathers who were full-time dual caregivers ($\beta = -.594$, $p < .05$).

DISCUSSION

Older adults are more likely to live long enough to become grandparents or even great-grandparents than in the past. As grandparents age, they are pressed between their own aging needs and multigenerational caregiving responsibilities for their frail older parents and grandchildren. In China, the average life expectancy at birth has increased from 68.6 years in 1990 to 77.3 years in 2019, whereas the percentage of people aged 65 or older has more than doubled, from 5.6% in 1990 to 13.5% in 2020, and the total fertility rate has declined sharply from about 2.3 to 1.3 during the same period (National Bureau of Statistics in China 2021). Chinese grandparents and adult children both experience the increasing tension between rapid population aging and limited progress in state-sponsored or market-based formal older age support and child care service. Meanwhile, despite China's dramatic demographic and socioeconomic changes in recent decades, few changes have occurred to expectations and obligations within the family (Raymo et al. 2015). As a result, Chinese grandparents must take on competing obligations to take care of older parents and grandchildren.

Adopting a four-generation perspective, this study adds new insights from China to the emerging literature on grandparents who are sandwiched between great-grandparent and grandchild care. We found mixed evidence to support Hypothesis 1. On one hand, providing part-time care to grandchildren or great-grandparents only did not lead to worse health for the sandwiched Chinese grandparents. Instead, some of them (mostly grandfathers) enjoyed relatively lower health risk compared with noncaregivers, providing evidence supporting Hypothesis 1. These findings are consistent with those from recent studies of European grandparents showing that the health benefit from providing casual care to grandchildren outweighs the health risk (Arpino and Bordone 2014; Di Gessa et al. 2016a, 2016b; Hilbrand et al. 2017). Unlike prior studies of grandchild care that relied on self-reported health outcomes, using biomarker data in this study allowed us to show that in a four-generation context,

Table 5. Estimates of Log Odds from Weighted Logistic Models of Chronic Inflammation and Acute Infection, CHARLS 2011.

	Chronic Inflammation				Acute Infection			
	Grandfather		Grandmother		Grandfather		Grandmother	
Independent Variables	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Caregiving status (reference = noncaregiving)								
Part-time grandchild caregiver	−.317	−.329	−.420	−.420	.182	.160	−.343	−.310
Full-time grandchild caregiver	.183	.205	−.479	−.465	−.136	.058	−.113	−.068
Part-time great-grandparent caregiver	.620	.635	.058	.068	.073	.259	1.956***	1.955***
Full-time great-grandparent caregiver	.380	.382	−.827	−.829	.505	.482	−.699	−.717
Part-time dual caregiver	.793*	.840*	−.730	−.740	−.443	−.447	.910*	.928*
Full-time dual caregiver	−.165	−.154	−.714	−.696	−1.476†	−1.466†	−.584	−.531
Age (years, centered)	−.032	−.035	.005	.006	−.006	−.020	.037	.033
Married (reference = no)	−.754	−.739	.524	.507	NA	NA	.175	.147
Number of children alive	.043	.039	.114	.112	−.003	.017	.049	.048
Number of siblings alive	−.011	−.009	.058	.059	−.047	−.048	−.017	−.018
Education (reference = no school)								
Primary school	−.387	−.392	.054	.043	−.705	−.580	−.188	−.188
Middle school or higher	−.861*	−.834*	−.297	−.298	−.869	−.663	.210	.240
Currently working (reference = no)	−.803**	−.721**	−.322	−.314	−.039	.219	−.390	−.311
Household assets (logged)	.063	.074	.000	.002	−.054	−.016	−.100	−.095
Mobility limitation (reference = no)		.120		−.110		1.640***		.166
Self-rated health		.181		.080		.029		.169
Rural residence (reference = urban)	−.321	−.373	−.356	−.365	−.488	−.757†	.417	.346
Constant	−.152	−.860	−2.009†	−2.224†	−1.547	−2.756*	−1.900	−2.542†
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,217	1,217	1,210	1,210	1,220	1,220	1,230	1,230

Note: CHARLS = China Health and Retirement Longitudinal Study.
†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$ (based on robust standard errors in two-tailed tests).

nonintensive intergenerational caregiving may "get under the skin" and affect the biological health of sandwiched grandparents in a positive way.

On the other hand, among dual caregivers, the health risk was higher among those who provided part-time care but lower among those who provided full-time care. In fact, this finding contradicts Hypothesis 3. Conventional wisdom depicts the sandwich generation as being torn by a complex configuration of conflicting multiple roles that involves aging, retirement, self-care, parental care, and grandchild caregiver (Abramson 2015). However, the positive health effect of providing intergenerational care may offset the negative effect, and the health benefit of caring for grandchildren and the health risk of caring for great-grandparents may cancel each other out, leading to a null net effect. In France, for example, Huvent-Grelle et al. (2015) found that grandmothers who provided care to both great-grandparents and grandchildren considered their quality of life and health to be good because they might find a balanced life by sharing their time between the two generations. In Spain, Luna et al. (2021) found that sandwiched grandmothers experienced family conflict and worse health when caring for older relatives, but meanwhile, they perceived less stress and reported better health when caring for grandchildren. In China, Xu (2019) reported better mental health status and lower hypertension rate among Chinese grandparents who provided simultaneous care to great-grandparents and grandchildren, but no distinction was made between part-time and full-time caregivers.

Table 6. Coefficient Estimates from Weighted Ordinary Least Squares Models of Allostatic Load Scores, CHARLS 2011.

	Allostatic Load							
	Clinical Cut Points				Empirical Cut Points			
Independent Variables	Grandfather		Grandmother		Grandfather		Grandmother	
Caregiving status (reference = noncaregiving)								
Part-time grandchild caregiver	−.379*	−.380*	−.068	−.070	−.565**	−.570**	.104	.110
Full-time grandchild caregiver	−.247	−.242	−.074	−.077	−.256	−.250	.123	.139
Part-time great-grandparent caregiver	.201	.207	−.062	−.066	.155	.160	−.106	−.101
Full-time great-grandparent caregiver	−.732**	−.739**	−.171	−.169	−.868**	−.884**	−.167	−.175
Part-time dual caregiver	−.282	−.274	.193	.192	−.150	−.156	.299	.304
Full-time dual caregiver	−.511**	−.515**	−.285	−.294	−.499†	−.510†	−.322	−.314
Age (years, centered)	−.020	−.021	−.013	−.014	−.018	−.020	−.001	−.003
Married (reference = no)	.549*	.568*	.128	.122	.499†	.522†	.150	.145
N children alive	.043	.042	.091	.090	.009	.008	.225**	.223**
N siblings alive	.038	.039	.028	.028	.052	.053	.009	.008
Education (reference = no school)								
Primary school	.185	.191	.113	.119	.266	.273	.049	.060
Middle school or higher	.128	.144	−.361*	−.362*	.281	.298	−.262	−.234
Currently working (reference = no)	−.240	−.200	−.424**	−.434**	−.462*	−.428†	−.359*	−.338*
Household assets (logged)	.026	.031	−.022	−.023	.085**	.091**	−.009	−.004
Mobility limitation (reference = no)		.092		.067		.169		.152
Self-rated health		.055		−.039		.023		.035
Rural residence (reference = urban)	−.505***	−.525***	−.372**	−.368**	−.435*	−.460**	−.362*	−.381*
Constant	1.502*	1.253†	1.286**	1.399**	2.105**	1.924***	2.179***	1.992***
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,081	1,081	1,108	1,108	1,081	1,081	1,108	1,108

Note: CHARLS = China Health and Retirement Longitudinal Study.
†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$ (based on robust standard errors in two-tailed tests).

Another possibility is that only the healthiest and most capable grandparents are willing to take up multiple caregiving responsibilities and can cope with competing demands from multiple generations. For example, European grandparents who regularly helped their parents were more likely to care for their grandchildren as well compared with those who did not help their parents at all (Železna 2018). Therefore, in this study, the Chinese grandparents who did not experience elevated health risk from providing full-time care to both great-grandparents and grandchildren might simply reflect a selection bias.

We did not find strong evidence to support Hypothesis 2—downward caregiving was not necessarily more beneficial than upward caregiving. Even though the culture of filial piety mandates adult children to care for their parents in older age, providing care to great-grandparents may have positive or negative health effect on grandparents depending on the intensity of caregiving, the measure of health risk, and the gender of caregiver. Existing research on grandparent caregivers has focused on the downward flow of help from grandparents to adult children and grandchildren and largely ignored the possible presence of great-grandparents. Echoing Abramson's (2015) call, we urge more research to accurately assess the prevalence, burden, and consequence of grandparents obliged to care for their frail older parents.

We found several instances of gender differences conditional on the same caregiving status, although grandmothers did not consistently enjoy health

advantages as we expected (Hypothesis 4). For grandmothers, we found both positive and negative associations between different arrangements of intergenerational caregiving and different health outcomes. For grandfathers, however, being an intergenerational caregiver was generally associated with lower health risks. Perhaps a fundamental source of gender difference pertains to the form and nature of caregiving activities. For example, in terms of caring for grandchildren, previous research has suggested that Chinese grandfathers tend to play roles such as fun-seeker, playmate, and companion rather than fulfilling more intensive responsibilities, such as feeding, bathing, and dressing, which are often assumed by grandmothers (Xie and Xia 2011). Such gendered caregiving expectations and responsibilities likely have different health implications for grandfathers and grandmothers. Unfortunately, CHARLS did not collect data on specific types of intergenerational caregiving activities performed by the respondents. In the current study, we combined time spent caregiving with living arrangements to better measure caregiving intensity. However, our approach is limited in its capacity to fully capture gendered experiences of caregiving.

Taken together, our findings highlight the new complicated life experience of grandparenthood in rapidly aging societies. In China and other countries where four-generation families are no longer rare but public systems of formal care for older adults and children are fragile, grandparents are particularly vulnerable to potential conflict in multigenerational caring responsibilities. In a four-generation context, grandparents are joining or even replacing their middle-aged adult children as the new sandwich generation. Normative or not, such a new position in the family lineage calls for continued research and policy attention to promote the well-being and health of the aging population.

Our findings also highlight the importance of cultural and family contexts in understanding the health consequences of intergenerational caregiving. As Pearlin (1989) noted three decades ago, social values play an important role in regulating the effect of stressors. The health impact of intergenerational caregiving likely varies by how caregiving grandparents perceive the associated social values. In a recent study comparing Japanese and American adults, Hartanto et al. (2020) found that the association between biological health risk and perceived obligation depends on whether individuals acted in accordance with their cultural mandates. For sandwiched Chinese grandparents, providing care to younger or older generations, even in a highly intensive manner, is in accordance with the cultural mandates of filial piety, interdependence, and family solidarity (Burnette et al. 2013). To the extent that health is achieved in part through culturally distinct pathways (Kitayama et al. 2010), sandwiched Chinese grandparents may be less susceptible to the detrimental health effect of intergenerational caregiving.

Our study has several important implications for future research in other settings. First, the attention of existing research on grandparenting is largely focused on caring for grandchildren in a three-generation context. Only a handful of studies have noticed the sandwiched grandparents who are increasingly struggling between the need to care for great-grandparents and the need to care for grandchildren in certain European countries (Luna et al. 2016, 2021; Železna 2018). As population aging becomes a global phenomenon, the research agenda of the sandwiched grandparents needs to be extended to other parts of the world. Second, as our study has illustrated, patterns and health implications of grandparents caring for older and younger generations can be heterogeneous in China, a country where family norms and behaviors are relatively stable and homogeneous (Raymo et al. 2015). Recent research in the United States, a more heterogenous setting, has noticed that the same patterns of multigenerational living arrangement and intergenerational caregiving can have drastically different health implications for Black and Hispanic grandparents due to important racial-ethnic variations in the social and cultural contexts (Choi 2020). Future research on sandwiched grandparents should carefully investigate the role of cultural context in shaping heterogeneous health effects of intergenerational caregiving. Lastly, the limited research on sandwiched grandparents often focused exclusively on grandmothers. However, we found notable gender differences in the association between intergenerational caregiving and grandparents' health. Future research on sandwiched grandparents should be mindful of potential gender differences in both forming and testing theoretical hypotheses.

FUNDING

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by a Cycle 50 PSC-CUNY Research Award (TRADA-50-116) and a Visiting Senior Research Fellowship at the Asia Research Institute, National University of Singapore.

ORCID ID

Hongwei Xu https://orcid.org/0000-0001-9227-8904

SUPPLEMENTAL MATERIAL

Appendices A through E are available in the online version of the article.

REFERENCES

Abramson, Tobi A. 2015. "Older Adults: The 'Panini Sandwich' Generation." *Clinical Gerontologist* 38(4):251–67.

Acabchuk, Rebecca L., Jayesh Kamath, John D. Salamone, and Blair T. Johnson. 2017. "Stress and Chronic Illness: The Inflammatory Pathway." *Social Science & Medicine* 185:166–70.

Arpino, Bruno, and Valeria Bordone. 2014. "Does Grandparenting Pay Off? The Effect of Child Care on Grandparents' Cognitive Functioning." *Journal of Marriage and Family* 76(2):337–51.

Baker, Lindsey A., and Merril Silverstein. 2008. "Preventive Health Behaviors among Grandmothers Raising Grandchildren." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 63(5):S304–11.

Beckie, Theresa M. 2012. "A Systematic Review of Allostatic Load, Health, and Health Disparities." *Biological Research For Nursing* 14(4):311–46.

Burnette, Denise, Juanjuan Sun, and Fei Sun. 2013. "A Comparative Review of Grandparent Care of Children in the U.S. and China." *Ageing International* 38(1):43–57.

Chen, Feinian, and Guangya Liu. 2012. "The Health Implications of Grandparents Caring for Grandchildren in China." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 67(1): 99–112.

Chen, Xinxin, Eileen Crimmins, Peifeng Hu, Jung Ki Kim, Qinqin Meng, John Strauss, Yafeng Wang, Junxia Zeng, Yuan Zhang, and Yaohui Zhao. 2019. "Venous Blood-Based Biomarkers in the China Health and Retirement Longitudinal Study: Rationale, Design, and Results from the 2015 Wave." *American Journal of Epidemiology* 188(11):1871–77.

Choi, Seung-won Emily. 2020. "Grandparenting and Mortality: How Does Race-Ethnicity Matter?" *Journal of Health and Social Behavior* 61(1):96–112.

Cong, Zhen, and Merril Silverstein. 2008. "Intergenerational Support and Depression among Elders in Rural China: Do Daughters-in-Law Matter?" *Journal of Marriage and Family* 70(3):599–612.

Di Gessa, Giorgio, Karen Glaser, and Anthea Tinker. 2016a. "The Health Impact of Intensive and Nonintensive Grandchild Care in Europe: New Evidence from Share." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 71(5): 867–79.

Di Gessa, Giorgio, Karen Glaser, and Anthea Tinker. 2016b. "The Impact of Caring for Grandchildren on the Health of Grandparents in Europe: A Lifecourse Approach." *Social Science & Medicine* 152:166–75.

Emick, Michelle A., and Bert Hayslip, Jr. 1999. "Custodial Grandparenting: Stresses, Coping Skills, and Relationships with Grandchildren." *The International Journal of Aging and Human Development* 48(1):35–61.

Fingerman, Karen L., Kyungmin Kim, Patrick S. Tennant, Kira S. Birditt, and Steven H. Zarit. 2016. "Intergenerational Support in a Daily Context." *The Gerontologist* 56(5):896–908.

Giarrusso, Roseann, Du Feng, and Vern L. Bengtson. 2005. "The Intergenerational-Stake Phenomenon over 20 Years." Pp. 55–76 in *Annual Review of Gerontology and Geriatrics, 2004: Focus on Intergenerational Relations across Time and Place*, edited by Merril Silverstein (Volume Editor) and K. Warner Schaie (Series Editor). New York, NY: Springer Publishing Co.

Goode, William J. 1960. "A Theory of Role Strain." *American Sociological Review* 25(4):483–96.

Grundy, Emily, Cecilia Albala, Elizabeth Allen, Alan D. Dangour, Diana Elbourne, and Ricardo Uauy. 2012. "Grandparenting and Psychosocial Health among Older Chileans: A Longitudinal Analysis." *Aging & Mental Health* 16(8):1047–57.

Grundy, Emily, and John C. Henretta. 2006. "Between Elderly Parents and Adult Children: A New Look at the Intergenerational Care Provided by the 'Sandwich Generation.'" *Ageing and Society* 26(5):707–22.

Hartanto, Andree, Ivy Yee-Man Lau, and Jose C. Yong. 2020. "Culture Moderates the Link between Perceived Obligation and Biological Health Risk: Evidence of Culturally Distinct Pathways for Positive Health Outcomes." *Social Science & Medicine* 244:112644. doi:10.1016/j.socscimed.2019.112644.

Henretta, John C., Emily Grundy, and Susan Harris. 2002. "The Influence of Socio-economic and Health Differences on Parents' Provision of Help to Adult Children: A British–United States Comparison." *Ageing and Society* 22(4):441–58.

Hilbrand, Sonja, David A. Coall, Andrea H. Meyer, Denis Gerstorf, and Ralph Hertwig. 2017. "A Prospective Study of Associations among Helping, Health, and Longevity." *Social Science & Medicine* 187:109–17.

Hu, Shengshou, and Lingzhi Kong. 2012. *Report on Cardiovascular Disease in China 2011*. Beijing: Encyclopedia of China Publishing House.

Huvent-Grelle, Dominique, Éric Boulanger, Jean Baptiste Beuscart, T. Martin, J. Podvin, and François L. Puisieux. 2015. "'Women in the Middle': An Observational Study of a Generation Story in Alzheimer Disease in France." *European Geriatric Medicine* 6(2): 124–27.

Jendrek, Margaret Platt. 1993. "Grandparents Who Parent Their Grandchildren: Effects on Lifestyle." *Journal of Marriage and Family* 55(3):609–21.

Kitayama, Shinobu, Mayumi Karasawa, Katherine Curhan, Carol Ryff, and Hazel Markus. 2010. "Independence and Interdependence Predict Health and Well-Being: Divergent Patterns in the United States and Japan." *Frontiers in Psychology* 1:163. doi:10.3389/fpsyg.2010.00163.

Ku, Li-Jung E., Sally C. Stearns, Courtney H. Van Houtven, Shoou-Yih D. Lee, Peggye Dilworth-Anderson, and Thomas R. Konrad. 2013. "Impact of Caring for Grandchildren on the Health of Grandparents in Taiwan." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 68(6):1009–21.

Lemon, Bruce W., Vern L. Bengtson, and James A. Peterson. 1972. "An Exploration of the Activity Theory of Aging: Activity Types and Life Satisfaction among In-Movers to a Retirement Community." *Journal of Gerontology* 27(4):511–23.

Leopold, Thomas, and Jan Skopek. 2014. "Gender and the Division of Labor in Older Couples: How European Grandparents Share Market Work and Childcare." *Social Forces* 93(1):63–91.

Leung, Cynthia, and Barbara Fung. 2014. "Non-custodial Grandparent Caregiving in Chinese Families: Implications for Family Dynamics." *Journal of Children's Services* 9(4):307–18.

Lou, Vivian W. Q. 2011. "Life Satisfaction of Chinese Grandmothers: The Impact of Grandparenting Role Changes." *Journal of Ethnic & Cultural Diversity in Social Work* 20(3):185–202.

Luna, Sara, Pilar Ramos, and Francisco Rivera. 2016. "Coping Strategies, Stress and Health of Grandmothers Caring for Ascending and Descending Relatives." *Estudios de Psicología* 37(1):90–114.

Luna, Sara, Francisco Rivera, and Pilar Ramos. 2021. "Dual Caregiving by Grandmothers with Older Relatives: Personal Factors Influencing Health and Stress." *Journal of Health Psychology* 26(11): 1882–900.

McEwen, Bruce S., and Eliot Stellar. 1993. "Stress and the Individual: Mechanisms Leading to Disease." *Archives of Internal Medicine* 153(18):2093–101.

Minkler, Meredith, and Esme Fuller-Thomson. 2001. "Physical and Mental Health Status of American Grandparents Providing Extensive Child Care to Their Grandchildren." *Journal of the American Medical Women's Association* 56(4):199–205.

Moen, Phyllis, Julie Robison, and Donna Dempster-McClain. 1995. "Caregiving and Women's Well-Being: A Life Course Approach." *Journal of Health and Social Behavior* 36(3):259–73.

National Bureau of Statistics of China. 2021. *2020 Population Census Data Bulletin Series*. Beijing: National Bureau of Statistics of China.

Pearlin, Leonard I. 1989. "The Sociological Study of Stress." *Journal of Health and Social Behavior* 30(3):241–56.

Pearlin, Leonard I., Scott Schieman, Elena M. Fazio, and Stephen C. Meersman. 2005. "Stress, Health, and the Life Course: Some Conceptual Perspectives." *Journal of Health and Social Behavior* 46(2): 205–19.

Pinquart, Martin, and Silvia Sörensen. 2006. "Gender Differences in Caregiver Stressors, Social Resources, and Health: An Updated Meta-analysis." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 61(1):33–45.

Pruchno, Rachel. 1999. "Raising Grandchildren: The Experiences of Black and White Grandmothers." *The Gerontologist* 39(2):209–21.

Raymo, James M., Hyunjoon Park, Yu Xie, and Wei-jun Jean Yeung. 2015. "Marriage and Family in East Asia: Continuity and Change." *Annual Review of Sociology* 41:471–92.

Silverstein, Merril, Zhen Cong, and Shuzhuo Li. 2006. "Intergenerational Transfers and Living Arrangements of Older People in Rural China: Consequences for Psychological Well-Being." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 61(5):S256–66.

Szinovacz, Maximiliane E., Stanley DeViney, and Maxine P. Atkinson. 1999. "Effects of Surrogate Parenting on Grandparents' Well-Being." *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 54B(6):S376–88.

Thompson, Amanda L., Kelly M. Houck, Linda S. Adair, Penny Gordon-Larsen, Shufa Du, Bing Zhang, and Barry M. Popkin. 2014. "Pathogenic and Obesogenic Factors Associated with Inflammation in Chinese Children, Adolescents and Adults." *American Journal of Human Biology* 26(1):18–28.

World Health Organization. 2019. *Classification of Diabetes Mellitus*. Geneva, Switzerland: World Health Organization.

Wu, Xiaoyu, and Lixing Li. 2014. "The Motives of Intergenerational Transfer to the Elderly Parents in China: Consequences of High Medical Expenditure." *Health Economics* 23(6):631–52.

Xie, Xiaolin, and Yan Xia. 2011. "Grandparenting in Chinese Immigrant Families." *Marriage & Family Review* 47(6):383–96.

Xu, Hongwei. 2019. "Physical and Mental Health of Chinese Grandparents Caring for Grandchildren and Great-Grandparents." *Social Science & Medicine* 229:106–16.

Železna, Lada. 2018. "Care-Giving to Grandchildren and Elderly Parents: Role Conflict or Family Solidarity?" *Ageing and Society* 38(5):974–94.

Zhao, Yaohui, Eileen M. Crimmins, Peifeng Hu, Yang Shen, James P. Smith, John Strauss, Yafeng Wang, and Yuan Zhang. 2016. "Prevalence, Diagnosis, and Management of Diabetes Mellitus among Older Chinese: Results from the China Health and Retirement Longitudinal Study." *International Journal of Public Health* 61(3):347–56.

Zhou, Maigeng, Haidong Wang, Xinying Zeng, Peng Yin, Jun Zhu, Wanqing Chen, Xiaohong Li, et al. 2019. "Mortality, Morbidity, and Risk Factors in

China and Its Provinces, 1990–2017: A Systematic Analysis for the Global Burden of Disease Study 2017." *The Lancet* 394(10204):1145–58.

AUTHOR BIOGRAPHIES

Hongwei Xu is an associate professor in the Department of Sociology at Queens College, City University of New York. His research interests include social and environmental determinants of health, the life course perspective on aging, and spatial demography. His recent work has been published in *American Journal of Sociology, Journal of Health and Social Behavior, Social Science and Medicine*, and *The Journals of Gerontology: Series B*.

Jinyu Liu is an associate professor at the School of Social Work, Columbia University. Her research focuses broadly on aging and health. In particular, she studies determinants of stress in Chinese family caregivers and effects of social support on the mental health of Asian older adults. Her current project seeks to develop and test a culturally sensitive intervention to reduce stress of dementia caregivers in Chinese American communities.

Zhenmei Zhang is a professor in the Department of Sociology at Michigan State University. Her research focuses on life course determinants of health in later life. With funding from the National Institute on Aging, her current project investigates how marital biography influences cognitive health in the United States. Her recent work has been published in *Social Science and Medicine, The Journals of Gerontology: Series B*, and *Journal of Aging and Health*. She is a fellow of the Gerontological Society of America.

Lydia Li is a professor at the University of Michigan School of Social Work. Her research aims to understand and advance healthy aging among older adults in socioeconomically disadvantaged positions. Her current research focuses on social isolation and ageism. She is a fellow of the Gerontological Society of America.