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Widowhood and loneliness among Chinese older adults: the role of education and gender

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ABSTRACT

Objectives: Widowhood is a significant predictor of loneliness in older adults and research on the underlying mechanisms of this link using longitudinal data is limited. This study examined whether education would moderate the effect of widowhood on loneliness, and whether such a relationship would differ by gender among Chinese older adults.

Method: A total of 2,704 older adults from the 2008 wave of the Chinese Longitudinal Healthy Longevity Survey were included. They were aged 65 years and above, were not lonely, and were married. Logistic regression models were applied to examine the interaction between widowhood, education, and gender on loneliness in the 2011 wave.

Results: Widowhood was a significant predictor of loneliness and could increase the odds of becoming lonely by 193%. The interaction between widowhood and education was significant only in older women, not in older men. Literate older women reported lower loneliness than did their illiterate counterparts when they remained married during the follow-up. However, when their spouse passed away, literate women did not differ from their illiterate counterparts in loneliness.

Conclusion: This study revealed a gendered pattern in the interaction between widowhood and education on loneliness and demonstrated the complexity of the mechanisms. Furthermore, it highlighted the importance of considering the role of education and gender simultaneously in a Chinese context.

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Introduction

Loneliness is a subjective and distressing feeling that arises from the perception of 'a discrepancy between one's desired and achieved levels of social relations' (Perlman & Peplau, 1981, p. 31), and the discrepancy might be in the number or the intimacy of relationships (De Jong Gierveld, 1987; Yang & Gu, 2019). Research has shown that the level of loneliness in older adults actually increases because of demographic changes that are characterized by population aging and declines in fertility and in household size (Dykstra, van Tilburg, & Gierveld, 2005; Yan, Yang, Wang, Zhao, & Yu, 2014; Yang & Victor, 2008). This is especially true in the context of China, where the cultural values of interdependence and mutual support are strong. Moreover, loneliness is associated with a variety of risks, such as mortality (Luo, Hawkley, Waite, & Cacioppo, 2012; Luo & Waite, 2014; Patterson & Veenstra, 2010; Wang, Leng, Zhao, Fleming, & Brayne, 2018), depression (Luanaigh & Lawlor, 2008; Segel-Karpas, Ayalon, & Lachman, 2018), and cognitive impairment (Zhou, Wang, & Fang, 2018). Identifying factors that are critical to loneliness could inform current interventions and policy-making in alleviating loneliness.

Relevant studies have explored various risk factors for loneliness, one of which is widowhood, a distressing event that usually occurs in later stages of life. Widowhood has been found to be a significant predictor of loneliness (Aartsen & Jylha, 2011; Bennet & Victor, 2012; Carr, Kail, Matz-Costa, & Shavit, 2018; Dahlberg, Andersson, Mckee, & Lennartsson, 2015). Despite the well-established link between widowhood and loneliness, little is known about the mechanisms underlying this link. Drawing on research and theories of gender differences in the role of education and widowhood effects, this study attempted to explore the interplay of education and gender on the link between widowhood and loneliness. Education is associated with a variety of resources that could help individuals cope with stress (Mirowsky & Ross, 2003a, 2003b). However, the role of education may differ across women and men. According to resource substitution theory, education improves well-being more for women due to the socioeconomic disadvantages in women; whereas theory of resource multiplication claims that education improves well-being more for men (Ross & Mirowsky, 2006). Considering these inconsistencies, how education and gender play roles in the relationship between widowhood and loneliness needs more research. An exploration of the interplay of widowhood, education, and gender on loneliness could contribute to the understanding of how life transitions shape psychological health in individuals with different education levels, as well as how gender influences this relationship.

Widowhood and loneliness

According to socioemotional selectivity theory (Carstensen, Isaacowitz, & Charles, 1999), older adults focus on the

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social relationships that are emotionally gratifying, and marriage is especially important for older adults and there is an increasing spousal interaction occurring in later life. Marriage could provide older adults with emotional gratifications, behavioral confirmation, and cultivate positive interactions with their spouses when entering late life stage. Empirical research has shown that being in a marital relationship is associated with individuals' self-rated health, physical functioning, and psychological well-being (Robles & Kiecolt-Glaser, 2003; Schoenborn, 2004).

However, the death of a spouse indicates a loss of social, emotional, and instrumental support, as well as physical company and social interaction with the spouse, the effects of which still persist even when other forms of social support are available (Van Baarsen, 2002). Widowhood might also influence individuals' health, and poor health in turn is associated with decreased social interaction (Van Den Brink et al., 2004; Wilcox et al., 2003). All of these factors may lead to a high level of loneliness. Research has shown that widowhood is a significant predictor of loneliness in older adults, to the extent that widowed older adults are at a higher risk of loneliness than continuously married older adults (Aartsen & Jylha, 2011; Bennet & Victor, 2012; Carr, Kail, et al., 2018; Dahlberg et al., 2015).

Widowhood is a multidimensional transition, and individual characteristics, the spouse's condition, and contextual factors will play roles in the widowhood effect (Carr et al., 2000). Research has explored the potential factors that could moderate the effect of widowhood, such as volunteering experience (Carr, Kail, et al., 2018), military services (Carr, Urena, & Taylor, 2018), individuals' personality (Taga, Friedman, & Martin, 2009), social contact (Ha & Ingersoll-Dayton, 2011), family support (Xu, Li, Min, & Chi, 2017), neighborhood concentration of widowed individuals (Subramanian, Elwert, & Christakis, 2008), spouse's illness before widowhood (Carnelley, Wortman, & Kessler, 1999), and marital quality (Schaan, 2013). For instance, Carr, Kail, et al. (2018) found that widows who started to volunteer for 2+ hours per week after widowhood experienced a similar level of loneliness to those who were continuously married and volunteering at the same intensity. In addition, Schaan (2013) found that widowed individuals with higher marital quality at baseline demonstrated a larger increase in depressive symptoms than did those with lower marital quality. Such examinations greatly facilitate the understanding of possible factors that alleviate or exacerbate the widowhood effect; however, the widowhood-loneliness relationship may also vary across the socioeconomic status and by indicator of education. For example, education may influence individuals' identity reformulation in marriage and the level of the importance of marriage to their life, and these differences may lead to various responses to widowhood (Lopata, 1973, 2000). Ha, Carr, Utz, and Nesse (2006) found that educational attainment influences individuals' adherence to traditional gender roles, leading to differential adaptation to spousal loss. These findings raise questions as to whether the effects of widowhood on loneliness may also diverge by educational level. Therefore, findings on how widowhood is related to loneliness among older adults in the aggregate may overlook potential intragroup differences by education.

The role of education in the link between widowhood and loneliness

Education is part of the person rather than being external to the person and it indicates resourcefulness (Ross & Mirowsky, 2006). At school, individuals gain the ability to learn, develop effective skills and attitudes (such as confidence and effort), and more importantly foster a sense of competence. All of these could motivate individuals to solve problems and control their lives, which is called "learned effectiveness"(Ross & Mirowsky, 2006). Empirical evidence shows that education is associated with a wide range of advantages that can help individuals cope with the widowhood. First, education is positively related to psychological resilience (Mirowsky & Ross, 2003a), which could function as a buffer from various stressors, such as widowhood. Second, education is positively related to superior health practice and health status (Mirowsky & Ross, 2003b), and superior health could enable older adults to social interact with others and gain social support from their social network. Third, education could contribute to better material circumstances and financial resources (Mirowsky & Ross, 2003b), which could enable them to seek services when necessary. In this sense, education and its related resources could help function as a buffer from widowhood and decrease loneliness.

In the context of a marriage, education could influence marriage patterns and individuals' identity reformulation and perceptions of marriage. Homogamy is positively related to household income (Li & Wang, 2013; Luo & Klohnen, 2005; Ma, Yuan, & Gu, 2019) and marital satisfaction (Lucas et al., 2004). Educated couples are often expected to possess more resources and have a more satisfactory marital relationship than non-educated couples (Ma et al., 2019). In addition, education could influence individuals' identity reformulation and their perceived relevance of marriage or spouse. More educated women list marriage, whereas less educated women list birth of children as being of primary importance in their lives (Lopata, 1973). Moreover, the effects of education vary in women and in men (Ross & Mirowsky, 2006). More educated women may have had more opportunities to work when they were young and thus may be better equipped to manage financial matters in later life than less educated women (Ha et al., 2006). When they experience widowhood, more educated women may be concerned more about psychological and emotional aspects, rather than financial strain that less educated women may face. Thus, the loss of intimacy, social support and physical company associated with spousal passing-away might be perceived to be more negative for educated older adults than for their non-educated counterparts, and gender differences may exist.

Gender perspective

Studies have revealed inconsistent findings on gender and loneliness (Dong & Chen, 2017; Pinquart & Sorensen, 2001; Victor et al. 2015; Yang & Gu, 2018). For example, Dong and Chen (2017) found that older women were more likely to feel lonely, whereas Victor, Scambler, Marston, Bond, and Bowling (2005) found that gender was not independently associated with loneliness when controlling for other

covariates were controlled for. Several possible reasons exist for this: first, older women are more likely to become widowed than older men (Chappell, 1991), and tend to become lonely upon spousal loss. Second, older women's health status is usually worse than that of older men, and a poor health status imposes limitations on their social interactions, making older women more vulnerable to loneliness than older men (Jopp, Rott, & Oswald, 2008). Third, older women and men respond to age-related losses differently; moreover women engage in more social interactions and obtain greater benefits from social relationships than do men (Dykstra & Fokkema, 2007; Victor et al., 2005).

In addition, results on gender differences in the consequences of widowhood are also inconsistent (Perkins et al., 2016; Simon, 2002; Van Grootheest, Beekman, Broese van Groenou, & Deeg,1999). For instance, Van Grootheest et al. (1999) found that widowhood produced a stronger effect on depressive symptoms in men than in women. By contrast, Perkins et al. (2016) found that being widowed was related to worse health for women than for men. Despite the fact that both older men and older women must cope with the grief caused by the death of a spouse, gender differences in their social roles and coping mechanisms may lead to such gender differences in the consequences of widowhood. First, one study argued that older men face more challenges taking over the household chores after becoming widowed than do older women, because women are usually responsible for housework (Williams & Umberson, 2004). Second, compared with older women, older men are less active in participating in social activities and making social connections with others outside of the family, thus it would be more difficult for men to find substitutes to compensate for the loss imposed on them by widowhood (Cornwell, 2011). Therefore, older men seem to be more negatively impacted by widowhood.

However, the loss of a spouse leads to a decrease in behavioral confirmation, which is particularly more critical for women because they assume much of the care provision for their husbands (Schaan, 2013). The loss of a source of behavioral confirmation may threaten older women's mental health to a larger extent than it would for older men. Moreover, older women usually have more financial gains from a marriage, and thus the loss of a spouse may lead to greater financial problems for widowed women than it would for widowed men (Ha et al., 2006). In this sense, the death of a spouse may lead to a greater gap between pre-bereavement and post-bereavement, and thus is associated with a higher level of loneliness in older women than in older men.

The current study

That widowhood is a significant predictor of loneliness in older adults is well-documented; however, several research gaps exist in the literature. First, despite the well-established link between widowhood and loneliness, less is known about the mechanisms, especially how education and gender would moderate the link between widowhood and loneliness. Second, relevant research on gender differences in the consequences of widowhood are inconsistent; more research is required to examine how gender would interact with other factors and impact loneliness, specifically in the context of China. In addition, research on widowhood and its consequences in China is often based on small and non-representative samples, and therefore, more robust studies using a more representative sample are required. Thus, drawing on research regarding gender differences in the role of education and in widowhood effect, this study aimed to answer the following research questions using nationally representative data from Chinese Longitudinal Healthy Longevity Survey (CLHLS). First, whether education would moderate the relationship between widowhood and loneliness in older adults? Second, whether such a relationship would differ in older men and in older women?

Methods

Study sample

This study used the 2008 and 2011 waves of the CLHLS data. The CLHLS began in 1998, and was the first national longitudinal survey to investigate the determinants of health and longevity of older adults in China. The 2008 and 2011 waves of the CLHLS were conducted through in-home interviews in half of the randomly selected cities/counties in 22 out of 31 provinces plus one county in Hainan Province. The survey covered a wide range of information, including sociodemographics, health-related variables, and the family background. More details about the sampling can be found in other studies (Gu, 2008; Gu & Dupre, 2008; Yang & Gu, 2018).

In 2008, the total sample number was 16,563. In 2011, 2,644 participants were lost to follow-up, 5,633 died at follow-up, and 8,286 were followed-up in 2011.The study focused on participants who were married, were not lonely at baseline in 2008, and provided a valid response to the change in marital status in 2011; it excluded those who were lost to follow-up or died at follow-up in 2011. As a result, a sample of $N = 2704$ was included in the final analysis.

Measurements

Loneliness

In the 2008 survey, participants responded to the item "Do you often feel lonely and isolated?" on a 5-point Likert scale ranging from 1 (always) to 5 (never). Given that the responses were highly skewed, the item was dichotomized to the lonely category ("Sometimes," "Often," and "Always") and not-lonely category ("Seldom" and "Never"). The current study focused on whether older adults who reported not being lonely at baseline in 2008 had developed loneliness at the 2011 follow-up.

Widowhood

In the 2011 survey, participants were asked to answer the following question "Have you experienced the following marital status change: spouse passed away(died) since you were interviewed last time for CLHLS study in 2008?" The answer options included "yes" and "no." This question was intended to determine the number of participants who had experienced widowhood since 2008.

Education

Education was measured using one item "How many years did you attend school?" Given that the distribution of the item was highly skewed, this variable was dichotomized into two categories: literate (1+ years of schooling) versus illiterate (no schooling) (Yang & Gu, 2018). Considering that spousal education may also play a role in the effect of widowhood on loneliness (Cutler & Lleras-Muney, 2006; Monden, van Lenthe, De Graaf, & Kraaykamp, 2003), spousal education was also included in the model based on the same categorization.

Covariates

The covariates in the 2008 survey included: rural-urban residence, primary occupation before retirement, economic status, cognitive abilities, activities of daily living (ADL), instrumental activities of daily living (IADL), self-rated health (SRH), social support, and leisure activities, and these factors have been shown to be correlated with loneliness in previous research (Carr, Kail, et al., 2018; Pinquart & Sorensen, 2001; Yang & Gu, 2018). The sociodemographic variables included rural-urban residence (rural versus urban), primary occupation before retirement (white-collar versus others), family economic status (good [rich or very rich] family economic status in the local community versus other). In addition, health factors included cognitive functioning, ADL, IADL, and SRH. Cognitive functioning was assessed based on participants' responses to the Chinese version of the Mini-Mental State Examination (MMSE) with a total score of 30 (Lagona & Zhang, 2010). A score below 24 indicated cognitive impairment, whereas a score of 24 or above indicated normal cognitive function. Participants were classified as ADL or IADL disabled if they reported difficulty in one of the six basic ADL activities (e.g. bathing and dressing) ($\alpha = 0.81$) and in one of the eight IADL activities (e.g. cooking and shopping) ($\alpha = 0.89$), respectively. SRH was measured by the single item "How do you rate your health at present?" with responses ranging from 1 (very good) to 5 (very bad), and a higher score indicated a worse health status.

The social factors included social support and leisure activities. Social support was measured using three items, including "To whom do you usually talk most frequently in daily life?" "To whom do you talk first when you need to tell something of your thoughts?" and "Who do you ask first for help when you have the problems or difficulties?" Answer options included spouse, son, daughter, daughter-in-law, son-in-law, grandchildren and their spouses, other relatives, friends/neighbors, social workers, housekeeper, or nobody. If the answer was family members, friends, or relatives, then the answer was coded as 1; otherwise, it was coded as 0. These three items were summed up with a score ranging from 0 to 3 and higher scores indicating more extensive social support ($\alpha = 0.60$). Respondents also reported the kind of leisure activities that they participated in, such as garden work and social activities. The number of leisure activities was summed to indicate the leisure activities older adults participated in with a range of 8 to 40, with higher scores indicating more frequent leisure activities ($\alpha = 0.60$).

Methods of analysis

First, the study performed descriptive analyses on the total sample, including the sample characteristics and the likelihood of developing loneliness by covariates. In addition, the study also performed descriptive analyses by gender and tested gender differences in the covariates. Second, binary logistic regression analyses were performed to examine the interaction between widowhood and education, as well as the interaction between widowhood, education, and gender. Six models were designed. Model 1 included the covariates as mentioned above, Model 2 added widowhood and education, Model 3 added the interaction between widowhood and education, Model 4 added gender, Model 5 added the interaction between gender and widowhood, and the interaction between gender and education, and Model 6 added widowhood*education*gender.

Results

Descriptions of the sample

As seen in Table 1, the mean age of the sample was 76.27 years old (standard deviation = 8.3). Among the participants, 59.3% were rural residents, 65.5% were male, 9.5% had experienced widowhood since the 2008 survey, and 61.3% received 1 + year schooling. The majority of older adults in the study did not have a white-collar occupation (85.7%), did not have a good economic status (84.7%), were not cognitively impaired (85.1%), and were not ADL-disabled (95.8%) or IADL-disabled (67.2%).

In terms of the likelihood of developing loneliness at follow-up, differences were found in terms of gender, widowhood, education, occupation, economic status, cognitive impairment, and IADL disability. More specifically, the likelihood of developing loneliness was higher in older adults who were female, widowed, illiterate, cognitively impaired, and IADL disabled, as well as those who had a non-white-collar-occupation and a worse economic status than their counterparts.

Gender differences in the covariates were also examined. Results showed that older women were more likely to experience widowhood, cognitive impairment, and IADL disability than were older men, and older men were more likely to have received 1 + year schooling, have a white-collar occupation, and have better self-rated health than were older women.

Logistic regression results in the total sample

Results (Table 2) showed that age increased the odds of becoming lonely, whereas white-collar occupation and better economic status decreased the odds in Model 1. White-collar occupation decreased the odds of becoming lonely by 49%, better economic status decreased the odds by 36%, and every unit increase in age increased the odds of becoming lonely by 2%. In Model 2, widowhood increased the odds of becoming lonely by 193%. The two-way interaction between widowhood and education was significant in Model 3. The three-way interaction between widowhood, education and gender was significant in the last model. The significant interaction were plotted (Figure 1). As shown in the figure, in women, the likelihood of

Table 1. Characteristics of the sample.

Variables	*N*	%	Loneliness (%)		Female	Male	[a]Comparison
Sample size	2704		19.60				
Rural-urban residence							
Rural	1603	59.3	21.27	**	59.23	59.32	
Urban	1101	40.7	17.08		40.77	40.68	
Gender							
Female	932	34.5	22.42	**	NA	NA	
Male	1772	65.5	18.06				
Widowhood							***
Yes	258	9.5	40.70	***	14.91	6.72	
No	2446	90.5	17.33		85.09	93.28	
Education				***			***
1 + year schooling	1657	61.3	16.54		37.66	73.7	
No schooling	1047	38.7	24.36		62.34	26.3	
White-collar occupation				***			***
Yes	387	14.3	9.82		5.25	19.1	
No	2317	85.7	21.19		94.75	80.9	
Better economic status				***			
Yes	413	15.3	12.59		13.84	16	
No	2291	84.7	20.82		86.16	84	
Cognitive impairment				**			***
Yes	404	14.9	25.74		18.56	13	
No	2300	85.1	18.48		81.44	87	
ADL disability							
Yes	113	4.2	16.81		4.4	4.06	
No	2591	95.8	19.68		95.6	95.94	
IADL disability				**			***
Yes	887	32.8	22.42		37.55	30.3	
No	1817	67.2	18.16		62.45	69.7	
Age	76.27	8.3			74.72	77.1	***
Self-rated health (M,SD)	3.58	0.92			3.5	3.63	***
Social support (M,SD)	2.16	0.87			2.19	2.14	
Leisure activities (M,SD)	2.61	0.71			2.6	2.61	

Note. (1) All variables were measured in the 2008 wave. (2) NA = not applicable. ADL = activities of daily living. IADL = instrumental activities of daily living. (3)
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. (4)
[a]there are comparisons between women and men in terms of the variables listed on the first column.

becoming lonely was significantly lower for older women with 1+ year schooling compared with older women with no schooling if they remained married, whereas the likelihood of becoming lonely for older women with 1+ year schooling was not significantly different from their counterparts with no schooling if they experienced widowhood. In other words, education was protective only when older women remained married, and widowhood was a risk factor of loneliness regardless of their educational level. Nevertheless, there was no significant interaction between widowhood and education in older men.

Sensitivity analysis results

Comparing participants who were included in the analysis with those who were excluded, the results showed that older adults who were younger, male, white-collar individuals, had a lower level of ADL and IADL disability, as well as a higher level of social support were more likely to be included in the current sample.

Sensitivity analyses were also performed. First, I divided education into three categories: illiterate (0 years), primary school (1–5 years), and secondary and above (6+ years), and the results remained largely the same (Table A1). For simplicity, results were only presented when education was divided into two categories.

The dichotomization method for the single-item measure of loneliness has been widely used in the literature (Luo & Waite, 2014; Yang & Victor, 2008). Sensitivity analysis were performed by treating this single-item measure as a continuous variable, an ordinal variable, and a binary variable using a different cut off (Table A2). Results using a dichotomization method (lonely category: "Sometimes," "Often," and "Always," and not-lonely category: "Seldom" and "Never") were reported in this version for the following reasons. Older adults are reluctant to admit to feeling lonely, and it may be easier for those who are lonely to admit that they only feel that way sometimes instead of often or always; this is because being lonely carries a stigma (Tiikkainen & Heikkinen, 2005), especially in Chinese culture (Luo & Waite, 2014).

As the sample weight of the CLHLS is purely based on the distribution of single year of age, sex, and urban-rural residence of population in the survey area and these three variables are either stratified (i.e.sex) or controlled for in the models, all regression analyses are not weighted (Gu et al., 2009). I also performed the analysis from the weighted sample and results are very similar to those from the unweighted sample.

Discussion

This study is among the first in the literature to explore the interplay of widowhood, education, and gender on loneliness in China based on a nationally representative sample of the CLHLS. Results revealed a gendered pattern of widowhood and education on loneliness, and the interaction between widowhood and education was significant only in older women, not in older men. More specifically, older women with 1 + year schooling experienced a significantly lower level of loneliness compared with their counterparts with no schooling if they remained married at

Table 2. Odds ratio of variables in predicting loneliness in the total sample.

Variables	M1			M2			M3			M4			M5			M6		
	OR	SE	95%CI	OR	SE	95%CI	OR	SE	95%CI	OR	SE	95%CI	OR	SE	95%CI	OR	SE	95%CI
Age	1.02*	0.01	(1.01,1.03)	1.01	0.01	(0.99,1.02)	1.01	0.01	(0.99,1.02)	1.01	0.01	(0.99,1.02)	1.01	0.01	(0.99,1.02)	1.01	0.01	(0.99,1.02)
White-collar occupation	0.51***	0.19	(0.35,0.73)	0.55**	0.19	(0.37,0.80)	0.56**	0.19	(0.38,0.81)	0.56**	0.19	(0.38,0.82)	0.56**	0.19	(0.38,0.82)	0.55**	0.19	(0.37,0.80)
Economic status	0.64**	0.17	(0.46,0.88)	0.67*	0.17	(0.48,0.92)	0.67*	0.17	(0.48,0.92)	0.67*	0.17	(0.47,0.92)	0.67*	0.17	(0.47,0.92)	0.67*	0.17	(0.48,0.92)
Cognitive impairment	1.24	0.15	(0.92,1.66)	1.2	0.15	(0.88,1.61)	1.21	0.15	(0.89,1.63)	1.21	0.15	(0.89,1.63)	1.21	0.15	(0.89,1.63)	1.22	0.15	(0.89,1.64)
ADL disability	0.63	0.31	(0.34,1.15)	0.71	0.31	(0.38,1.30)	0.71	0.31	(0.38,1.30)	0.71	0.31	(0.38,1.30)	0.7	0.31	(0.38,1.29)	0.69	0.31	(0.37,1.27)
IADL disability	1.03	0.13	(0.80,1.31)	1.01	0.13	(0.78,1.28)	0.99	0.13	(0.77,1.27)	0.99	0.13	(0.77,1.27)	0.99	0.13	(0.77,1.27)	0.99	0.13	(0.77,1.28)
Self-rated health	0.94	0.06	(0.84,1.05)	0.95	0.06	(0.84,1.06)	0.95	0.06	(0.84,1.06)	0.95	0.06	(0.84,1.06)	0.95	0.06	(0.85,1.06)	0.95	0.06	(0.84,1.06)
Social support	0.91	0.06	(0.81,1.01)	0.91	0.06	(0.80,1.01)	0.90	0.06	(0.80,1.01)	0.90	0.06	(0.80,1.01)	0.9	0.06	(0.80,1.01)	0.90	0.06	(0.80,1.01)
Leisure	0.89	0.08	(0.76,1.05)	0.92	0.08	(0.77,1.07)	0.92	0.09	(0.78,1.08)	0.92	0.09	(0.77,1.08)	0.92	0.09	(0.77,1.08)	0.92	0.09	(0.77,1.08)
Spousal education	0.96	0.11	(0.78,1.18)	0.94	0.11	(0.75,1.16)	0.94	0.11	(0.76,1.16)	0.94	0.12	(0.74,1.17)	0.94	0.12	(0.74,1.17)	0.94	0.12	(0.75,1.18)
Urban-rural residence	0.90	0.11	(0.72,1.11)	0.91	0.11	(0.73,1.13)	0.91	0.11	(0.73,1.12)	0.91	0.11	(0.73,1.12)	0.91	0.11	(0.73,1.12)	0.91	0.11	(0.73,1.13)
Widowhood				2.93***	0.14	(2.21,3.88)	2.06***	0.20	(1.38,3.06)	2.06***	0.20	(1.37,3.06)	2.17***	0.22	(1.39,3.36)	1.71*	0.25	(1.05,2.77)
Education				0.83+	0.11	(0.67,1.02)	0.74**	0.12	(0.59,0.93)	0.75*	0.13	(0.58,0.95)	0.68+	0.20	(0.46,1.01)	0.57*	0.22	(0.37,0.88)
Widowhood*Education							2.03*	0.28	(1.16,3.52)	2.03*	0.28	(1.16,3.53)	2.23**	0.31	(1.22,4.09)	4.58***	0.43	(1.97,10.63)
Gender										0.98	0.13	(0.76,1.25)	0.96	0.17	(0.69,1.33)	0.87	0.17	(0.62,1.21)
Gender*Widowhood													0.81	0.31	(0.44,1.48)	1.75	0.44	(0.74,4.10)
Gender*Education													1.13	0.23	(0.72,1.76)	1.45	0.26	(0.88,2.39)
Widowhood*Education*Gender																0.23*	0.61	(0.068,0.75)
−2LL	2543.69			2486.934			2480.63			2480.613			2479.93			2474.02		
Cox&Snell R square	0.025			0.046			0.048			0.048			0.048			0.051		

Note. (1) ADL = activities of daily living. IADL = instrumental activities of daily living. (2) $+p<0.1$, $*p<0.05$, $**p<0.01$, $***p<0.001$.

follow-up. However, no significant differences existed in loneliness between older women with 1 + year schooling and those with no schooling if they experienced widowhood. In other words, education was protective against loneliness for older women only if there was no loss of marriage, whereas education did not protect older women from loneliness when they experienced widowhood. Such a pattern was not found in older men. This study contributes to the existing literature that has examined potential factors influencing widowhood effect by studying the role of older adults' educational level, hoping to shed lights on theoretical explorations of the role of education and gender in the link between widowhood and loneliness in older adults.

One major finding of the study is that widowhood is a significant predictor of loneliness regardless of educational level and gender. It is consistent with the literature suggesting that widowhood implied a loss of social, emotional, and instrumental support, as well as physical company and social interaction with the spouse, thus leading to a higher risk of developing loneliness (Aartsen & Jylha, 2011; Bennet & Victor, 2012; Carr, Kail, et al., 2018; Dahlberg et al., 2015; Van Baarsen, 2002). Perhaps widowhood is such a distressing event, and its impact overrides the role of education and gender in loneliness. However, among married older adults, education plays a role in loneliness, which is consistent with the protective role of education in loneliness in the literature (Pinquart & Sorensen, 2001).

Several possible reasons exist for the moderating role of education in the relationship between widowhood and loneliness in older women. First, widowhood could influence individuals' identity reformulation (Lopata, 1973, 2000). In particular, more educated women tend to list marriage or the role of a wife being of primary importance in their lives, and they share with their husband a definition of the world, build a set of social relations which involve their husband, and have a higher expectancy for intimacy and mutual support. However, less educated women tend to list the birth of their child or the role of mother as being of primary importance in their lives, and they share little knowledge or understanding of their husband (Lopata, 1973). In other words, more educated women's husbands play a more critical role in their identity reformulation than their less-educated counterparts. In this sense, upon the death of a spouse, more educated women are more likely to experience a greater sense of loss, especially the sense of continuity and of affiliation, and are more consciously affected in her identity reformulation by widowhood than less educated women (Lopata, 1973, 2000). Thus, there is a higher level of vulnerability to loneliness in literate older women than in illiterate older women.

Second, women usually marry men with a comparable or higher education level to themselves, and literate women benefit more from marriage in terms of resources and marital quality than their illiterate counterparts (Ma et al., 2019). Moreover, literate women themselves may be better equipped to manage financial matters upon widowhood than less educated women (Ha et al., 2006). Upon the death of a spouse, literate women experience a lower level of financial strain than illiterate women, and they are more concerned about their mental and psychological health. However, illiterate women may face more struggles

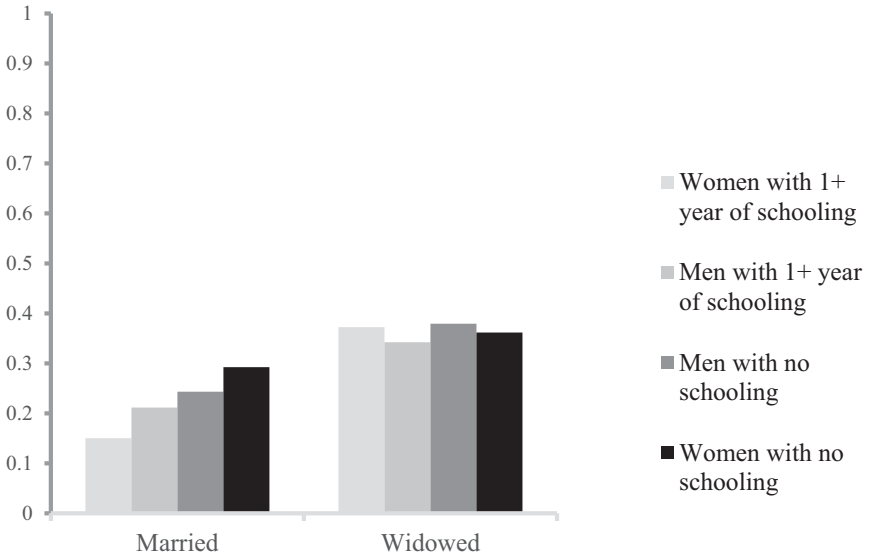

Figure 1. The probability of developing loneliness at follow-up by marital status, education, and gender.
Note. The interaction between widowhood and education was significant only in older women, not in older men. If older women remained married during follow-up, the loneliness level was significantly lower in older women with 1 + year schooling than in older women with no schooling. If older women lost their spouse during follow-up, there were no significant differences in loneliness between older women with 1 + year schooling and their counterparts with no schooling.

in the economic and material domains, thus are less concerned about psychological health (Umberson, Wortman, & Kessler, 1992).

Third, education is associated with higher self-esteem and sense of control (Mirowsky & Ross, 2003a, 2003b), thus literate older women perceive greater control over their life than do illiterate older women. However, spousal loss, especially when it is unexpected, may threaten the sense of control and self-esteem for literate older women to a larger extent than it would for illiterate women, because they feel that they should have control over their life (Wortman, Cohen-Silver, & Kessler, 1993). Thus, compared with illiterate older women, literate older women are more vulnerable to spousal loss and experience higher levels of loneliness.

Fourth, research has shown that the individuals with better pre-bereavement conditions reported more negative consequences of widowhood than did their counterparts. For instance, Schann (2003) found that older adults with a more satisfactory marital relationship reported a higher level of depression after widowhood. Similarly, Carr and colleagues (Carr & Boerner, 2009) found that individuals who reported high marital quality and rated their marriage positively experienced higher levels of negative emotions after spousal loss. Carnelley et al. (1999) found that widowed women whose husbands were not ill at baseline reported more depression, and women who were not depressed pre-bereavement were most vulnerable to depression following the loss of an ill spouse. Because literate older women usually possess more resources and have more satisfactory marital relationships than do illiterate older women, and the spousal loss may lead to a bigger gap between pre-bereavement and post-bereavement for literate older women than for illiterate older women. Thus it is reasonable to infer that literate older women might be more vulnerable to loneliness than would their illiterate counterparts.

The pattern for education was especially significant in women, but not in men, which might be for the following reasons. First, women have higher expectations for intimacy and emotional support from a marriage than do men (Williams, 1988), and spousal loss is a great threat to women's need for intimacy and makes them feel more lonely than men. Second, research has shown that older women are more vulnerable to chronic health diseases and financial insecurity upon widowhood, as well as relatively more disadvantaged and likely to experience emotional problems compared with older men (Lee, 2003). Third, women and men respond to marital transitions differently (Carr, 2018). Women tend to experience more internalizing emotional behaviors (e.g. loneliness and depression), whereas men may experience more externalizing emotional behaviors (e.g. substance use) (Simon, 2002). In short, gender differences in social roles and coping mechanisms are possible reasons for the gender differences in the consequences of widowhood found in this study.

The study has several implications. First, from a theoretical perspective, examining the role of education and gender is helpful to understand the complicated mechanisms underlying the link between widowhood and loneliness. For example, findings of this study suggest that literate women may face a greater vulnerability to loneliness than illiterate women in response to widowhood, and literate men experienced a lower level of loneliness than illiterate men regardless of marital status. This finding implied that the resources substitution theory or the resource multiplication theory might be contingent on marital status. Future research is needed to systematically examine how marital status affects the role of education in women and men. Second, as widowhood is a strong predictor of loneliness in older adults regardless of educational level and gender, psychosocial services are needed to help the widowed cope with spousal loss, such as providing psychological consultation and creating a platform for the widowed to social interact. Third, education influences older women's responses to spousal loss, and this finding implied that older women with different educational levels may have distinct perceptions of widowhood and demonstrate different needs. Thus, more research is required to assess the needs of older women in order to provide evidence for current practice and policy-making.

This study has several limitations. First, the information on widowhood is limited in the survey, and the CLHLS only covered whether individuals had experienced widowhood since the previous wave. It was unclear when the spouse had died during the study period, what the reasons for the death were, and whether the death was expected or unexpected. Future research is required to explore how the duration of and reasons for widowhood influence older adults' loneliness. Second, this study limited the sample to those who were married and not lonely at baseline and who were not lost or had not died at follow-up. As a result, the final sample size for this analysis was smaller than the total sample. Follow-up analysis showed that individuals with worse health were more likely to be lost or have died at follow-up, and this study may have underestimated the effect of health on loneliness. Third, this study followed the widely used approach and dichotomized variables that measured loneliness and education, which might lose rich information indicated by a continuous variable. That robustness tests have revealed similar findings may partially remedy this issue. Lastly, this study only used a single-item measure of loneliness, rather than a scale with sound psychometric property. Future research is needed to verify the findings of this study using a loneliness scale, such as UCLA loneliness scale.

Despite the limitations, this study revealed a gendered pattern in the interaction between widowhood and education on loneliness, and demonstrated the complexity of the mechanisms underlying the link between widowhood and loneliness in older adults in China. The results showed that the protective role of education from loneliness occurred only when older women remained married, whereas it disappeared when they became widowed. Future research is definitely required to elucidate and verify the reasons for the findings of the current study. Overall, this study implies the necessity of examining the interplay of widowhood, education, and gender on loneliness in older adults in the Chinese context to gain a enhanced understanding of the underlying mechanisms.

Disclosure statement

No conflicts of interest.

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Data availability statement

The data that support the findings of this study are openly available in the Peking University Open Research Data at http://opendata.pku.edu.cn/dataset.xhtml?persistentId=doi:10.18170/DVN/5DJWPI.

Authors' contributions

FY designed the study, performed the analysis, drafted and revised the text.

References

Aartsen, M., & Jylha, M. (2011). Onset of loneliness in older adults: Results of a 28-year prospective study. *European Journal of Ageing*, *8*(1), 31–38. doi:10.1007/s10433-011-0175-7

Bennet, K. M., & Victor, C. (2012). He wasn't in this chair': What loneliness means to widowed older people. *International Journal of Ageing and Later Life*, *7*(1), 33–52. doi:10.3384/ijal.1652-8670.127133

Carnelley, K. B., Wortman, C. B., & Kessler, R. C. (1999). The impact of widowhood on depression: Findings from a prospective survey. *Psychological Medicine*, *29*(5), 1111–1123. doi:10.1017/S0033291799008971

Carr, D. (2020). Mental health of older widows and widowers: Which coping strategies are most protective? *Aging & Mental Health*, *24*(2), 291–299. doi:10.1080/13607863.2018.1531381

Carr, D., & Boerner, K. (2009). Do spousal discrepancies in marital quality assessments affect psychological adjustment to widowhood? *Journal of Marriage and Family*, *71*(3), 495–509. doi:10.1111/j.1741-3737.2009.00615.x

Carr, D., House, J. S., Kessler, R. C., Nesse, R. M., Sonnega, J., & Wortman, C. (2000). Marital quality and psychological adjustment to widowhood among older adults: A longitudinal analysis. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *55*(4), S197–S207. doi:10.1093/geronb/55.4.S197

Carr, D. C., Kail, B. L., Matz-Costa, C., & Shavit, Y. Z. (2018). Does becoming a volunteer attenuate loneliness among recently widowed older adults? *The Journals of Gerontology: Series B*, *73*(3), 501–510. doi:10.1093/geronb/gbx092

Carr, D. C., Urena, S., & Taylor, M. G. (2018). Adjustment to widowhood and loneliness among older men: The influence of military service. *The Gerontologist*, *58*(6), 1085–1095. doi:10.1093/geront/gnx110

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, *54*(3), 165–181. doi:10.1037/0003-066X.54.3.165

Chappell, N. L. (1991). Living arrangements and sources of caregiving. *Journal of Gerontology*, *46*(1), S1–S8. doi:10.1093/geronj/46.1.S1

Cornwell, B. (2011). Independence through social networks: Bridging potential among older women and men. *The Journals of Gerontology: Series B*, *66B*(6), 782–794. doi:10.1093/geronb/gbr111

Cutler, D. M., & Lleras-Muney, A. (2006). Education and health: Evaluating theories and evidence. Working paper 12352. http://www.nber.org/papers/w12352

Dahlberg, L., Andersson, L., Mckee, K. J., & Lennartsson, C. (2015). Predictors of loneliness among older women and men in Sweden: A national longitudinal study. *Aging & Mental Health*, *19*(5), 409–417. doi:10.1080/13607863.2014.944091

De Jong Gierveld, J. (1987). Developing and testing a model of loneliness. *Journal of Personality and Social Psychology*, *53*, 119–128. doi:10.1037/0022-3514.53.1.119

Dong, X., & Chen, R. (2017). Gender differences in the experience of loneliness in U.S. Chinese older adults. *Journal of Women & Aging*, *29*(2), 115–125. doi:10.1080/08952841.2015.1080534

Dykstra, P. A., & Fokkema, T. (2007). Social and emotional loneliness among divorced and married men and women: Comparing the deficit and cognitive perspectives. *Basic and Applied Social Psychology*, *29*(1), 1–12. doi:10.1080/01973530701330843

Dykstra, P. A., van Tilburg, T. G., & Gierveld, J. D J. (2005). Changes in older adult loneliness. *Research on Aging*, *27*(6), 725–747. doi:10.1177/0164027505279712

Gu, D. (2008). General data assessment of the Chinese Longitudinal Healthy Longevity Survey in 2002. In: Y. Zeng, D. Poston, D. A. Vlosky, D. Gu, Y. Zeng, D. Poston, & D. A. Vlosky (Eds.), *Healthy longevity in China: Demographic, socioeconomic, and psychological dimensions* (pp. 39–59). Dordrecht: Springer.

Gu, D., & Dupre, M. E. (2008). Assessment of reliability of mortality and morbidity in the 1998 – 2002 CLHLS waves. In: Y. Zeng, D. Poston, D. A. Vlosky, & D. Gu (Eds.), *Healthy longevity in China: Demographic, socioeconomic, and psychological dimensions* (pp. 99–115). Dordrecht: Springer.

Gu, D., Dupre, M. E., Sautter, J., Zhu, H., Liu, Y., & Yi, Z. (2009). Frailty and mortality among Chinese at advanced ages. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *64B*(2), 279–289. doi:10.1093/geronb/gbn009

Ha, J. H., Carr, D., Utz, R. L., & Nesse, R. (2006). Older adults' perceptions of intergenerational support after widowhood. *Journal of Family Issues*, *27*(1), 3–30. doi:10.1177/0192513X05277810

Ha, J.-H., & Ingersoll-Dayton, B. (2011). Moderators in the relationship between social contact and psychological distress among widowed adults. *Aging & Mental Health*, *15*(3), 354–363. doi:10.1080/13607863.2010.519325

Jopp, D., Rott, C., & Oswald, F. (2008). Valuation of life in old and very old Age: The role of sociodemographic, Social, and health resources for positive adaptation. *The Gerontologist*, *48*(5), 646–658. doi:10.1093/geront/48.5.646

Lagona, F., & Zhang, Z. (2010). A missing composite covariate in survival analysis: A case study of the Chinese Longitudinal Health and Longevity Survey. *Statistics in Medicine*, *29*, 248–261. doi:10.1002/sim.3773

Lee, W. K. M. (2003). Women and retirement planning: Towards the "feminization of poverty in an aging Hong Kong." *Journal of Women & Aging*, *15*(1), 31–53. doi:10.1300/J074v15n01_04

Li, Y. N., & Wang, F. (2013). The assortative mating and changes in household income: 1991-2009. *Population and Economics*, (6), 39–46. (In Chinese)

Lopata, H. Z. (1973). Self-identity in marriage and widowhood. *The Sociological Quarterly*, *14*(3), 407–418. doi:10.1111/j.1533-8525.1973.tb00869.x

Lopata, H. Z. (2000). Widowhood: Reconstruction of self-concept and identities. In N. Denzin (Ed.), *Studies in symbolic interaction (Studies in symbolic interaction)* (Vol. 23, pp. 261–275). Bingley: Emerald Group Publishing Limited. 10.1016/S0163-2396(00)80041-1

Luanaigh, C. Ó., & Lawlor, B. A. (2008). Loneliness and the health of older people. *International Journal of Geriatric Psychiatry*, *23*(12), 1213–1221. doi:10.1002/gps.2054

Lucas, T. W., Wendorf, C. A., Imamoglu, E. O., Shen, J., Parkhill, M. R., Weisfeld, C. C., & Weisfeld, G. E. (2004). Marital satisfaction in four cultures as a function of homogamy, male dominance and female attractiveness. *Sexualities, Evolution & Gender*, *6*(2-3), 97–130. doi:10.1080/14616660412331327518

Luo, S., & Klohnen, E. C. (2005). Assortative mating and marital quality in newlyweds: A couple-centered approach. *Journal of Personality and Social Psychology*, *88*(2), 304–326. doi:10.1037/0022-3514.88.2.304

Luo, Y., Hawkley, L. C., Waite, L. J., & Cacioppo, J. T. (2012). Loneliness, health, and mortality in old age: A national longitudinal study. *Social Science & Medicine*, *74*, 907–914. doi:10.1016/j.socscimed.2011.11.028

Luo, Y., & Waite, L. J. (2014). Loneliness and mortality among older adults in China. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *69*(4), 633–645. doi:10.1093/geronb/gbu007

Ma, L., Yuan, H., & Gu, D. (2019). Assortative mating: A review of theoretical and empirical research. *Population and Economics*, (3), 1–15. in Chinese)

Mirowsky, J., & Ross, C. E. (2003a). *Social causes of psychological distress* (2nd ed.). New York: Aldine de Gruyter.

Mirowsky, J., & Ross, C. E. (2003b). *Social institutions and social change. Education, social status, and health*. Hawthorne, NY: Aldine de Gruyter.

Monden, C. W., van Lenthe, F., De Graaf, N. D., & Kraaykamp, G. (2003). Partner's and own education: Does who you live with matter for self-assessed health, smoking and excessive alcohol consumption? *Social Science & Medicine*, *57*(10), 1901–1912. doi:10.1016/S0277-9536(03)00055-8

Patterson, A. C., & Veenstra, G. (2010). Loneliness and risk of mortality: A longitudinal investigation in Alameda County, California. *Social Science & Medicine*, *71*(1), 181–186. doi:10.1016/j.socscimed.2010.03.024

Perkins, J. M., Lee, H.-Y., James, K. S., Oh, J., Krishna, A., Heo, J., … Subramanian, S. V. (2016). Marital status, widowhood duration, gender and health outcomes: A cross-sectional study among older adults in India. *BMC Public Health*, *16*(1), 1032. doi:10.1186/s12889-016-3682-9

Perlman, D. L., & Peplau, A. (1981). Toward a social psychology of loneliness. In R. Gilmour and S. Duck (Eds.), *Personal relationships 3: Personal relationships in disorder* (pp. 31–43). London: Academic Press.

Pinquart, M., & Sorensen, S. (2001). Influences on loneliness in older adults: A meta-analysis. *Basic and Applied Social Psychology*, *23*(4), 245–266. doi:10.1207/153248301753225702

Robles, T. F., & Kiecolt-Glaser, J. K. (2003). The physiology of marriage: Pathways to health. *Physiology & Behavior*, *79*(3), 409–416. doi:10.1016/S0031-9384(03)00160-4

Ross, C. E., & Mirowsky, J. (2006). Sex differences in the effect of education on depression: Resource multiplication or resource substitution? *Social Science & Medicine*, *63*(5), 1400–1413. doi:10.1016/j.socscimed.2006.03.013

Schaan, B. (2013). Widowhood and depression among older Europeans—The role of gender, caregiving, marital quality, and regional context. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *68*(3), 431–442. doi:10.1093/geronb/gbt015

Schoenborn, C. A. (2004). Marital status and health: United states, 1999-2002. Advance data from vital and health statistics. *Advances Data*, *15*(351), 1–32.

Segel-Karpas, D., Ayalon, L., & Lachman, M. E. (2018). Loneliness and depressive symptoms: The moderating role of the transition into retirement. *Aging & Mental Health*, *22*(1), 135–140. doi:10.1080/13607863.2016.1226770

Simon, R. (2002). Revisiting the relationships among gender, marital status and mental health. *American Journal of Sociology*, *107*(4), 1065–1096. doi:10.1086/339225

Subramanian, S. V., Elwert, F., & Christakis, N. (2008). Widowhood and mortality among the elderly: The modifying role of neighborhood concentration of widowed individuals. *Social Science & Medicine*, *66*(4), 873–884. doi:10.1016/j.socscimed.2007.11.029

Taga, K. A., Friedman, H. S., & Martin, L. R. (2009). Early personality traits as predictors of mortality risk following conjugal bereavement. *Journal of Personality*, *77*(3), 669–690. doi:10.1111/j.1467-6494.2009.00561

Tiikkainen, P., & Heikkinen, R.-L. (2005). Associations between loneliness, depressive symptoms and perceived togetherness. *Aging & Mental Health*, *9*(6), 526–534. doi:10.1080/13607860500193138

Umberson, D., Wortman, C. B., & Kessler, R. C. (1992). Widowhood and depression: Explaining long-term gender differences in vulnerability. *Journal of Health and Social Behavior*, *33*(1), 10–24. doi:10.2307/2136854

Van Baarsen, B. (2002). Theories on coping with loss: The impact of social support and self-esteem on adjustment to emotional and social loneliness following a partner's death in later life. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *57*(1), S33–S42. doi:10.1093/geronb/57.1.S33

Van Den Brink, C. L., Tijhuis, M., Van Den Bos, G. A. M., Giampaoli, S., Kivinen, P., Nissinen, A., & Kromhout, D. (2004). Effect of widowhood on disability onset in elderly men from three European countries. *Journal of the American Geriatrics Society*, *52*(3), 353–358. doi:10.1111/j.1532-5415.2004.52105

Van Grootheest, D. S., Beekman, A. T. F., Broese van Groenou, M. I., & Deeg, D. J. H. (1999). Sex differences in depression after widowhood. Do men suffer more? *Social Psychiatry and Psychiatric Epidemiology*, *34*(7), 391–398. doi:10.1007/s001270050160

Victor, C., Scambler, S. J., Marston, L., Bond, J., & Bowling, A. (2005). Older people's experiences of loneliness in the UK: Does gender matter? *Social Policy and Society*, *5*(1), 27–38. doi:10.1017/S1474746405002733

Wang, H., Leng, Y., Zhao, E., Fleming, J., & Brayne, C. (2020). Mortality risk of loneliness in the oldest old over a 10-year follow-up. *Aging & Mental Health, 24*(1), 35–40. doi:10.1080/13607863.2018.1510897

Wilcox, S., Evenson, K. R., Aragaki, A., Wassertheil-Smoller, S., Mouton, C. P., & Loevinger, B. L. (2003). The effects of widowhood on physical and mental health, health behaviors, and health outcomes: The Women's Health Initiative. *Health Psychology*, *22*(5), 513–522. doi:10.1037/0278-6133.22.5.513

Williams, D. G. (1988). Gender, marriage, and psychosocial well-being. *Journal of Family Issues*, *9*(4), 452–468. doi:10.1177/019251388009004002

Williams, K., & Umberson, D. (2004). Marital status, marital transitions, and health: A gendered life course perspective. *Journal of Health and Social Behavior*, *45*(1), 81–98. doi:10.1177/002214650404500106

Wortman, C. B., Cohen-Silver, R., & Kessler, R. C. (1993). The meaning of loss and adjustment to bereavement. In M. S. Stroebe, W. Stroebe, & R. O. Hansson (Eds.), *Handbook of bereavement* (pp. 349–366). Cambridge: Cambridge University Press.

Xu, L., Li, Y., Min, J., & Chi, I. (2017). Worry about not having a caregiver and depressive symptoms among widowed older adults in China: The role of family support. *Aging & Mental Health*, *21*(8), 879–888. doi:10.1080/13607863.2016.1181708

Yan, Z., Yang, X., Wang, L., Zhao, Y., & Yu, L. (2014). Social change and birth cohort increase in loneliness among Chinese older adults: A

cross-temporal meta-analysis, 1995–2011. *International Psychogeriatrics*, *26*(11), 1773–1781. doi:10.1017/S1041610214000921

Yang, F., & Gu, D. (in press). Predictors of loneliness incidence in Chinese older adults from a life course perspective: A national longitudinal study. *Aging & Mental Health*. doi:10.1080/13607863.2018.1558174

Yang, F., & Gu, D. (2019). Loneliness. In D. Gu & M. E. Dupre (Eds.), *Encyclopedia of gerontology and population aging*. Cham: Springer.

Yang, K., & Victor, C. R. (2008). The prevalence of and risk factors for loneliness among older people in China. *Ageing and Society*, *28*(3), 305–327. doi:10.1017/S0144686X07006848

Zhou, Z., Wang, P., & Fang, Y. (2018). Loneliness and the risk of dementia among older Chinese adults: Gender differences. *Aging & Mental Health*, *22*(4), 519–525. doi:10.1080/13607863.2016.1277976

Appendix

Table A1. Logistic regression of loneliness by treating education as three categories.

	OR	SE	95%CI
Age	1.01	0.01	(0.99,1.02)
White-collar occupation	0.55**	0.20	(0.36,0.80)
Economic status	0.67*	0.17	(0.48,0.93)
Cognitive impairment	1.21	0.15	(0.89,1.63)
ADL disability	0.7	0.31	(0.37,1.28)
IADL disability	1.01	0.13	(0.78,1.29)
Self-rated health	0.95	0.06	(0.85,1.06)
Social support	0.9	0.06	(0.80,1.01)
Leisure	0.92	0.09	(0.77,1.08)
Spousal education-primary	0.98	0.13	(0.75,1.26)
Spousal education-middle	0.85	0.16	(0.62,1.15)
Urban-rural residence	0.93	0.11	(0.74,1.15)
Widowhood	1.70*	0.25	(1.04,2.76)
Primary school	0.63+	0.26	(0.38,1.03)
Middle school	0.55+	0.33	(0.28,1.03)
Widowhood*Primary school	5.28**	0.53	(1.88,14.78)
Widowhood*Middle school	3.89*	0.61	(1.17,12.89)
Gender	0.86	0.17	(0.61,1.20)
Gender*Widowhood	1.77	0.44	(0.75,4.17)
Gender*Primary	1.33	0.30	(0.73,2.40)
Gender*Middle	1.61	0.36	(0.79,3.25)
Widowhood*Primary*Gender	0.14**	0.72	(0.03,0.58)
Widowhood*Middle*Gender	0.4	0.80	(0.08,1.90)
−2LL		2470.013	
Cox&Snell R square		0.052	

Note. (1) ADL = activities of daily living. IADL = instrumental activities of daily living. (2) $+p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table A2. Regression results of loneliness by coding loneliness in different ways.

	[a]Ordinal regression			[b]Logistic regression			Linear regression		
Variables	B	SE	95%CI	OR	SE	95%CI	B	SE	95%CI
Age	0.01	0.01	(−0.01,0.02)	0.99	0.02	(0.96,1.01)	0.01	0.01	(−0.01,0.01)
White-collar occupation	−0.53**	0.18	(0.17,0.88)	0.58	0.37	(0.27,1.20)	−0.13*	0.05	(−0.24,−0.02)
Economic status	−0.34*	0.15	(0.04,0.64)	1.02	0.29	(0.57,1.79)	−0.09	0.05	(−0.18,0.01)
Cognitive impairment	0.22	0.14	(−0.49,0.04)	1.21	0.26	(0.72,2.01)	0.12*	0.06	(0.01,0.23)
ADL disability	−0.42	0.26	(−0.08,0.92)	0.45	0.61	(0.13,1.50)	−0.12	0.10	(−0.32,0.07)
IADL disability	0.11	0.11	(−0.33,0.10)	1.11	0.22	(0.71,1.70)	0.01	0.05	(−0.08,0.09)
Self-rated health	−0.09	0.05	(−0.19,0.01)	0.85	0.10	(0.69,1.03)	−0.03	0.02	(−0.06,0.01)
Social support	−0.07	0.05	(−0.17,0.03)	0.89	0.10	(0.72,1.09)	−0.02	0.02	(−0.05,0.02)
Leisure	−0.14	0.08	(−0.28,0.01)	0.93	0.15	(0.68,1.24)	−0.04	0.03	(−0.09,0.01)
Spousal education	−0.06	0.11	(−0.14,0.26)	0.83	0.21	(0.53,1.25)	−0.05	0.04	(−0.12,0.03)
Urban-rural residence	−0.01	0.10	(−0.18,0.20)	1.18	0.19	(0.81,1.72)	−0.05	0.04	(−0.12,0.02)
Widowhood	0.75***	0.21	(−1.16,−0.33)	1.36	0.42	(0.60,3.08)	0.24*	0.10	(0.03,0.43)
Education	−0.56**	0.20	(0.17,0.95)	0.53	0.42	(0.23,1.19)	−0.22	0.07	(−0.34,−0.08)
Widowhood*Education	1.24**	0.39	(−2.00,−0.48)	4.58*	0.69	(1.19,17.56)	0.71***	0.18	(0.36,1.05)
Gender	−0.15	0.16	(−0.15,0.46)	0.88	0.31	(0.48,1.59)	−0.09	0.06	(−0.21,0.03)
Gender*Widowhood	0.10	0.39	(−0.86,0.66)	1.7	0.71	(0.42,6.80)	0.18	0.18	(−0.18,0.53)
Gender*Education	0.41	0.24	(−0.87,0.04)	1.44	0.49	(0.55,3.76)	0.14	0.08	(−0.02,0.29)
Widowhood*Education*Gender	−0.95+	0.55	(−0.13,2.03)	0.48+	0.96	(0.87,3.11)	−0.52*	0.26	(−1.01,−0.01)

Note. (1) ADL = activities of daily living. IADL = instrumental activities of daily living. (2) $+p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.(3)

[a]Ordinal regression: seldom and never = 0, sometimes = 1; often and always = 2.

[b]Logistic regression: often, always = 1; sometimes, seldom and never = 0.