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Psychological Resilience and the Onset of Activity of Daily Living Disability Among Older Adults in China: A Nationwide Longitudinal Analysis

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Objectives. This study explores the influence of psychological resilience on the onset of activities of daily living (ADL) disability among Chinese older adults and examines whether this association varies by age.

Method. Using a sample of 11,112 older adults from 2 waves of the Chinese Longitudinal Healthy Longevity Survey, collected in 2002 and 2005, this study examines whether higher levels of psychological resilience (measured by a 5-item scale) predict lower risk of ADL incidence during a 3-year follow-up and whether this effect varies by age.

Results. Higher levels of resilience at the baseline are significantly associated with reduced risk of becoming ADL disabled during the 3-year follow-up period, independent of baseline sociodemographic characteristics, family support, and health. Moreover, resilience by age interaction is detected. Higher levels of resilience are more protective against the onset of disability for the younger old (aged 65–84) than the oldest old (aged 85 and older).

Discussion. Among older adults in China, psychological resilience is a protective factor against ADL disability, and the benefits are particularly significant for older adults younger than 85 years.

Key Words: Aging—China—Disability—Resilience.

THE population of China has been rapidly aging. There were more than 109 million people aged 65 or older in 2010, and this aging population is forecasted to grow to more than 228 million in 2030 and 333 million in 2050 (United Nations, 2010). The ability of older adults to maintain health and independence is clearly a great public health concern. Although evidence shows functional improvements in instrumental activities among urban older Chinese during the last 10 years, disability in basic activities of daily living (ADL), the more expensive type of disability in terms of personal and societal costs, did not exhibit much temporal change (Feng et al., 2013). With 44 million people, 59 years old or older with various levels of disabilities (OSCNSSD & IP, 2007: 24, cited in Fisher, Shang, & Li, 2011), China is facing a double challenge: aging and disability. More research is needed to better understand antecedents of disability incidence to inform policy makers and the public in order to more effectively delay or even prevent the onset of disability, reduce the associated human and financial costs, and achieve healthy aging for the majority of the older population.

Among a myriad of non-biological, amendable factors that affect old-age health, positive psychological assets (e.g., locus of control, self-confidence, and mastery) have only recently been examined. Limited evidence from studies conducted in western industrialized countries (particularly European countries) suggests the beneficial effect of positive psychological assets on health and longevity, but more research is needed to confirm these findings (e.g., Clarke & Smith, 2011; Cooper, Huisman, Kuh, & Deeg, 2011; Kempen, Ranchor, van Sonderen, van Jaarsveld, & Sanderman, 2006). Moreover, it remains unknown whether or not this relationship applies to the aging population in China. Though research has emerged in recent years to evaluate social determinants of health and the well-being for older adults in China (e.g., Beydoun & Popkin, 2005; Shen & Zeng, 2010; Zhang, Gu, & Hayward, 2008; Zeng & Shen, 2010), the prospective effects of positive psychological assets on disability in later life have not been adequately examined.

Using large-scale nationally representative data with a prospective cohort design, the current research examines the association between psychological resilience and the incidence of ADL disability and how this association may vary by age among older adults in China. To the best of our knowledge, this study is among the first to report longitudinal evidence on these relationships.

Background

Psychological Resilience and Disability

Psychological resilience (referred to as "resilience" hereafter) is one type of positive psychological asset that constitutes an important component of successful psychosocial adjustment (Lavretsky & Irwin, 2007). The operational definition of resilience often varies according to the specific

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context in which it is applied in the literature (e.g., Herrman et al., 2011; Wagnild & Young, 1993). It is widely agreed upon, however, that most measurements use similar conceptual domains to capture resilience. Research shows that these domains—represented by a number of psychological constructs, such as sense of coherence, locus of control, self-esteem, self-confidence, self-efficacy, and optimism—are either sources of or are correlates to resilience (e.g., Herrman et al., 2011; Judge, Erez, Bono, & Thoresen, 2002; Nygren et al., 2005). Moreover, studies reveal that these resilience domains are being developed and honed over time (e.g., Lövheim, Graneheim, Jonsén, Strandberg, & Lundman, 2012; Neupert & Allaire, 2012; Shaw, Liang, & Krause, 2010; White, Wójcicki, & McAuley, 2012). Evidence has also shown the effectiveness of some intervention programs in improving older adults' performance in these domains (e.g., Aswathy & Castelino, 2011; Sung, 2009; Wolinsky et al., 2009) and the ensuing positive health outcomes associated with elevated resilience (e.g., Chiang, Lu, Chu, Chang, & Chou, 2008; Williams, Gill, Butki, & Kim, 2000).

Both the disablement process model and the stress process model potentially provide valuable insights into mechanisms through which resilience may affect disability. Moderation of disablement by psychological factors is specified in the disablement process model (Verbrugge & Jette, 1994), a framework explicating individual differences in the dynamic process of disability development and management. According to this model, disability results from a gap between personal capability and environmental demand, labeled the person–environment misfit. That is, complex interactions among the underlying disease (i.e., the pathological lesion such as arthritis or cancer), personal resources (e.g., resilience), and environmental factors (e.g., living condition) determine the pace of disability development. The same type and severity of pathological impairment may lead to differential disability trajectories, depending on how the person, facilitated or undermined by his or her environment, handles the physically challenging situation. This is a dynamic process across time, and frequently, outcomes are unpredictable. Resilience may play a salient role in this process as the person is not just passively influenced by environment; he or she can actively modify the environment to minimize the person–environment misfit and check or slow down functional deterioration. Resilient people may be more likely to engage in positive behaviors and activities that promote health-enhancing social resources and healthy lifestyles as well as to process information and utilize available resources. In such cases, they are better able to combat physical challenges and delay the onset of disability (Cooper et al., 2011).

The stress process model (Pearlin, Menaghan, Lieberman, & Mullan, 1981) also provides a useful theoretical framework to understand the resilience–disability link, illuminating individual variations in vulnerability and response to stress (Lazarus & Folkman, 1984). When facing a difficult situation that is subjectively appraised as taxing or burdensome, individuals use various coping strategies, drawing on a number of personal and social resources to improve their ability to deal with the stressor. The stress process model suggests that people with abundant coping resources—including money, social support, and resilience—should be less susceptible to the deleterious effects of the stressor compared with those deprived of such coping resources (Thoits, 2010).

Functional decline in old age can be a serious stressor itself. When facing the possibility or process of disability, individuals of greater resilience may adopt both anticipatory and problem-focused coping strategies and benefit from effective coping (Taylor & Aspinwall, 1996). In terms of anticipatory coping, resilient elders may be more likely to take preventive steps in order to better manage the acute or chronic conditions that may lead to disability or to deter the progression of disease and disability by, for example, following medical and lifestyle recommendations and exerting better stress control. These individuals may also use problem-focused coping by actively engaging in situation analysis and problem solving. When faced with physical and functional decline, more resilient older adults may be more willing to make concerted efforts to test and revise different strategies (e.g., change the way they do an activity) in an effort to maintain their activity independence (Clarke & Smith, 2011). By actively copying, resilient elders may reduce exposure to stress hormones and therefore protect the brain (Vahia, Chattillion, Kavirajan, & Depp, 2011), which may in turn help maintain functional ability.

The strength of the resilience and disability link could supposedly vary across different stages of aging. Compared with the younger old (aged 65–84), the oldest old (aged 85 or older) experience more physical challenges and constraints and thus likely face more adaptational problems (Jopp & Rott, 2006). Some researchers, such as Baltes and Smith (2003), even suspect that resilience would come to an end in late life when the functioning in most domains of living reaches its lower limits. For instance, research consistently shows that the oldest old suffer from a higher prevalence of disability and experience a sharper decline to their sense of control over their life than the younger old (e.g., Fauth, Zarit, Malmberg, & Johansson, 2007; Mirowsky & Ross, 1992). It is thus reasonable to expect that the resilience–disability link tends weaken in older cohorts of elders.

Current Literature

Despite the theoretical plausibility of these relationships, empirical work has yet to corroborate them. Only a handful of studies have specifically examined the associations between some aspects of resilience and functional limitations or disabilities. For example, a cross-sectional and cross-national study (Clarke & Smith, 2011) reported that older Americans had a higher sense of personal control

than their British counterparts. This higher sense of personal control likely operated as a psychological resource to reduce disability among older Americans. Although cross-sectional studies cannot disentangle the direction of the link, longitudinal evidence has also emerged. A Swedish study (Fauth et al., 2007) showed that feelings of mastery and loneliness at the baseline predicted functional status change after 2 and 4 years. Two Dutch studies (Cooper et al., 2011; Kempen et al., 2006) identified low mastery as a risk factor for subsequent functional decline. A U.S.-based study (Gruenewald, Karlamangla, Greendale, Singer, & Seeman, 2007) reported that, compared with older adults who frequently felt useful to others, those who never or rarely felt useful were more likely over a 7-year period to experience an increase in disability or die.

Although these limited number of studies each suggests the beneficial effects of resilience on functional limitation, the small number of studies can hardly put these findings into context. Moreover, some of these studies were limited in design using cross-sectional data based on small non-representative samples. In addition, none of these studies examined how the resilience and disability link may vary by age and none were conducted in less developed countries.

The Case of China

Compared with Western societies, China is unique in several important ways. First of all, despite its remarkable economic growth during the reform and opening era, China remains a developing country. The country has far fewer resources than developed nations to provide public services to its older population. For example, the gap in per capita income between China and the United States was around 1:10 in 2000 (Wang, 2011). Partly as a result of this structural barrier, older Chinese rely more on personal resources, especially family supports (from spouse and especially adult children) for old-age care compared with their counterparts in developed countries.

Filial piety, the virtue of respecting one's parents and providing supports to meet their old-age needs, is arguably the most influential value in Chinese culture. It has shaped the expectations and behaviors of Chinese families for thousands of years (Ikels, 2004). However, family resources for elderly support may be dwindling in present-day China due to dramatic sociodemographic transformations. Two societal trends are particularly relevant here (Wang, 2010). Firstly, China has more than 160 million internal migrants who are out of the reach of their aging parents as a result of a rapid urbanization process. Additionally, more than 160 million Chinese families have only one child, largely due to China's one-child policy, which was implemented during the last three decades. Both forces are potential obstacles for old-age care in the years to come. These trends may make the development of within-person resources, such as resilience, more important for the older population in China.

From a cohort-period-effect point of view, older people in China may have experienced more detrimental exposures in earlier life (e.g., poverty and war) than people in western societies. As a result, in some cases, they are likely to be at greater risk for early onset of poor health and disability in later life. Older people in China are also likely to have experienced greater rates of mortality in earlier life than populations in western societies, possibly making those who survived into old age particularly resilient.

China thus offers a unique context to test whether the levels of resilience of older people may turn out to be stronger or weaker than those found in other settings. Two studies (Shen & Zeng, 2010; Zeng & Shen, 2010) conducted in China found prospective and protective effects of resilience on survival and longevity among older adults, but no evidence is readily available as to whether resilience has the same effect on disability. If this link between resilience and disability is confirmed in China, the finding could prove to promote healthy aging among a large share of the world's older population.

In this study, we use nationally representative longitudinal data to examine the association between resilience and the onset of ADL disability in China and explore the interaction effect of resilience with age. Drawing on the notion that resilience is a protective factor against the onset of ADL disability, we hypothesize that lower levels of baseline resilience are significantly and prospectively associated with increased risk for ADL disability, net of a range of confounding factors. We also expect that the protective effect of resilience against the onset of ADL disability is stronger for younger elders than the oldest old for two reasons: (a) psychological influences on health may get weaker when biological forces become overwhelmingly strong during advanced ages and (b) frailer individuals would have been selected out by mortality before reaching the oldest old stages, and thus, those who survived into advanced age may be the fittest in terms of both physiology and psychology, thereby exhibiting small variations in resilience as a whole.

Method

Data

The data used in this study are from the Chinese Longitudinal Healthy Longevity Survey (CLHLS), an ongoing longitudinal survey launched in 1998 with follow-up surveys implemented in 2000, 2002, 2005, and 2008–2009. The 1998 survey and the 2000 follow-up interviewed people aged 80 and older. Starting in 2002, younger older adults, aged 65–79, were included in the sample. The deceased were replaced with refresher cohorts in the follow-up waves. CLHLS is representative of the older population in China because the respondents are randomly sampled and the sampling frame covers about 85% of the total population of China (Zeng, 2004).

Analytic Sample

Because the fifth wave of 2008–2009 was not available for public use when this project was started, we use data from the third and fourth waves of the CLHLS (2002 and 2005—hereafter referred to as baseline and follow-up, respectively, in this study) that allows us to conduct a prospective cohort study examining the resilience–disability link and the variance in this link between the younger old and the oldest old groups. Including the younger old also helps reduce survival selection bias compared with a sample exclusively composed of the oldest old.

The baseline data contain information on 16,020 respondents who were interviewed in 2002. Among them, 2,012 (12.56%) were lost to follow-up in 2005, whereas 5,872 (36.65%) died before being interviewed during the follow-up in 2005. To further reduce sample selection bias and control for competing risks, we include all respondents who were 65 years old or older and free of ADL disability at the baseline regardless of their survival or attrition status during the follow-up period, resulting in a sample of 11,112 participants.

Measures

ADL disability is defined as having difficulty in doing any of the following six basic tasks: bathing, dressing, toileting, indoor transferring, continence, and feeding. Free of ADL disability means that the respondent was capable of independently performing all of the six activities ("without assistance"). A respondent is considered to have an "onset" of ADL disability during the 3-year follow-up time if s/he reported having ADL disability in follow-up but was free of ADL disability at the baseline.

The key independent variable of our research interest is resilience. Following previous operationalization (Shen & Zeng, 2010; Zeng & Shen, 2010), resilience is measured by a scale based on five items. Table 1 presents the five specific items. The responses to these questions range from 1 (*always*) to 5 (*never*), with items 2 and 5 reversely recoded. Item values are then added to create a summary scale ranging from 6 to 25 (mean 19.017), with higher scores indicating higher levels of resilience. The scale of resilience has good reliability with a Cronbach's alpha coefficient equal to .89. A principle component analysis is performed, which generated one factor with an eigenvalue of 3.52, explaining 70% of the total variance (see also Table 1).

A number of confounding variables associated with the onset of ADL disability (e.g., Beydoun & Popkin, 2005) are organized into three categories and controlled for in the analyses. The first set of controls is baseline sociodemographic characteristics— including age, gender (female vs. male), ethnicity (Han vs. non-Han), and socioeconomic status (SES). Age is continuously measured in years and is also dichotomized into the oldest old (85 and older) and the younger old (65–84) groups. SES is measured by four variables, which include education (years of formal schooling), residence (rural vs. urban), pension status (receiving vs. not receiving), and financial sources. Financial resources were determined based on the participants' responses to a question about the financial sources available to pay daily expenses (enough vs. not enough). The second set of controls taps into baseline family support with two variables: marital status (currently married vs. others) and coresidence (currently living with family members vs. living alone or in an institution).

The third set of controls concerns respondents' baseline heath, captured by self-rated health, self-reported presence of chronic conditions, and cognitive limitations. Self-rated health is measured by a single item, asking respondents to rate their health on a 5-point scale (very bad, bad, so-so, good, and very good). The 5-point scale is then dichotomized into "bad/fair" (very bad, bad, and so-so) and "good" (good and very good). Presence of chronic conditions is indicated by the respondent's reporting to have one or more of five main non-communicable diseases: hypertension, diabetes, heart disease, stroke-related conditions, and respiratory-related diseases. Cognitive impairment is measured as a dichotomized variable (impaired vs. unimpaired) using the well-validated Chinese version of the Mini-Mental State Examination (MMSE) (Zhang et al., 2008).

Analytical Strategy

Missing data for most variables of interest is modest except for the MMSE items. Simple imputation procedures, such as using sample mode and mean to substitute for the missing values, are used in the first place for variables with missing values less than 0.50% (including the outcome variable, which had less than 0.004% missing values in total

Table 1. Items of Resilience Scale[a] and Eigenvalues[b], Chinese Longitudinal Healthy Longevity Survey 2002 (N = 16,020)

Items	Alpha[c]	Eigenvalue[b]	Factor loading[b]
1. Do you feel the older you get, the more useless you are?	.866	3.522	0.831
2. Do you always look on the bright side of things?	.858	0.621	0.839
3. Do you often feel fearful or anxious?	.861	0.365	0.865
4. Do you often feel lonely and isolated?	.861	0.270	0.858
5. Can you make your own decisions concerning your personal affairs?	.875	0.223	0.803

Notes. [a]Reliability coefficient of the resilience scale is equal to 0.888.
[b]Eigenvalues and factor loading refer to each factor identified, rather than to individual items on the left part. We put the two parts in the same table to save space.
[c]These are alpha coefficients for the scale with the specified item removed.

for a couple of ADL items of both waves, respectively). For variables with more than 0.50% missing values, multiple imputations (MI) are conducted using Stata's Imputation by Chained Equations command. One hundred copies of MI data sets (Graham, Olchowski, & Gilreath, 2007) are created. A set of multinomial logistic regression models are fit in each of the 100 MI data sets separately to examine the resilience–disability link. Then, by using a suite of Stata's MI commands, the estimates from the imputed data sets are pooled, using Rubin Rules, to generate a single set of estimates (Statistical Computing Seminars: Multiple Imputation in Stata, Part 1). Model 1 tests the effects of resilience controlling for sociodemographic characteristics; Model 2 adds family support controls; and Model 3 adds baseline health controls, thus imposing the strongest control when testing the prospective effect of resilience on ADL disability incidence. Differences between groups of various ADL trajectories in follow-up are compared using χ^2 statistics for categorical variables and analysis of variance for continuous variables. All analyses are conducted in Stata 11.

Sensitivity tests are conducted to check the consistency and quality of the MI data sets (results available upon request). The results are sensitive neither to the number of imputations nor to the imputation methods (Statistical Computing Seminars: Multiple Imputation in Stata, Part 2). Sensitivity tests are also conducted to test whether analyses run on maximum available samples (without imputation) differ from the reported findings. The results are very similar in both sets of analyses (results available upon request).

Results

Table 2 presents sample characteristics at the baseline stratified by respondents' disability and attrition status during the 3-year follow-up period. The mean age of the total sample is 83 years. Slightly more than half of the sample is women (52.32%). The majority of the sample is Han Chinese (93.51%), currently not married (63.45%), without retirement pension (77.95%), residing in rural areas (56.04%), living with families (80.26%), and reporting that the financial supports they received from different channels together were sufficient to pay for their daily expenses (80.74%).

By ADL status in follow-up, 51% of the sample remained free of ADL disability, whereas more than 9% experienced the onset of ADL disability. The mean baseline resilience score for those who were free of ADL disability at the baseline but became disabled in follow-up (18.7) was lower than that of those who remained disability free (19.3) ($p < .001$) in follow-up. Compared with those who remained disability free, those who showed the onset of ADL disability were significantly older (88.4 vs. 78.6); less educated (1.9 vs. 2.5); less healthy in terms of self-rated health, chronic condition, and cognitive impairment; and less likely to be married (25.3% vs. 46.5%).

Table 3 shows the results from multinomial logistic regression analyses on ADL disability status with free of ADL disability at both waves being the reference category and having the onset of ADL disability at follow-up being the key comparison group. Two additional outcome categories, death

Table 2. Sample Characteristics at Baseline, Total, and Stratified by ADL Status at Follow-up[a], Chinese Longitudinal Healthy Longevity Survey 2002 (N = 11,112)

Variables	Total sample (100%)	RF (51.44%)	Onset (9.67%)	Died (26.89%)	Loss (12.00%)
Resilience scale (mean ± *SD*, range)[b]	19.017 ±3.049, 6–25	19.315*** ± 3.005, 6–25	18.719*** ± 3.127, 7–25	18.493*** ± 2.988, 6–25	19.153*** ± 3.129, 8–25
Age in years (mean ± *SD*, range)	82.974 ±11.117, 65–120	78.590*** ± 9.641, 65–116	88.375*** ± 9.499, 65–111	90.286*** ± 9.732, 65–120	81.031*** ± 10.829, 65–113
Female (vs. male; %)	52.32	50.33	60.93	52.84	52.74
Years of schooling (mean ± *SD*, range)	2.253 ±3.585, 0–25	2.477*** ± 3.668, 0–25	1.894*** ± 3.409, 0–25	1.641*** ± 3.053, 0–22	2.958*** ± 4.188, 0–20
Rural residence (vs. urban; %)	56.04	58.54	52.84	60.91	36.98
Han (vs. non-Han; %)	93.51	92.74	94.98	92.57	97.75
Had enough financial sources (vs. lack of; %)	80.74	80.67	81.02	78.75	85.30
Had pension (vs. no; %)	22.05	22.85	21.95	13.52	37.81
Currently married (vs. other marital status; %)	36.55	46.54***	25.30***	20.01***	39.83***
Living with family (vs. living alone/in an institution; %)	80.26	82.23***	81.95***	78.41***	74.64***
Self-rated bad health (vs. good health; %)[c]	47.59	44.85***	47.05***	52.42***	48.95***
Presence of chronic disease(s) (%)[d]	32.56	31.73***	34.93***	31.39***	36.81***
MMSE impaired (vs. unimpaired; %)[e]	22.68	13.91***	31.75***	38.51***	17.57***

Notes. ADL = activities of daily living; MMSE = Mini-Mental State Examination.

[a]ADL status at follow-up is a four-category variable: remained free of ADL disability (RF), had the onset of ADL disability (Onset), Died, and loss to follow-up (Loss). Reference group of each covariate is listed in the parentheses.

[b–e]Sample statistics reported for these variables are generated from summarizing all imputed data sets (m = 100); thus, sample sizes vary across these variables.

***$p < .001$.

Table 3. Odds Ratios of Multinomial Logistic Regression Models for ADL Status at Follow-up[a] (at All Ages), Chinese Longitudinal Healthy Longevity Survey 2002–2005 (N = 11,112)

	Model 1			Model 2			Model 3		
	Onset (95% CI)	Died (95% CI)	Loss (95% CI)	Onset (95% CI)	Died (95% CI)	Loss (95% CI)	Onset (95% CI)	Died (95% CI)	Loss (95% CI)
Resilience scale	0.960** (0.937–0.984)	0.949*** (0.933–0.967)	0.950*** (0.930–0.971)	0.961** (0.937–0.984)	0.953*** (0.936–0.970)	0.953*** (0.933–0.974)	0.972* (0.948–0.997)	0.975** (0.957–0.993)	0.962** (0.940–0.983)
Age in years	1.099*** (1.091–1.106)	1.118*** (1.112–1.124)	1.030*** (1.023–1.036)	1.096*** (1.088–1.104)	1.113*** (1.106–1.119)	1.028*** (1.021–1.035)	1.095*** (1.086–1.104)	1.110*** (1.103–1.117)	1.027*** (1.019–1.034)
Female (vs. male)	1.329*** (1.139–1.550)	0.748*** (0.670–0.836)	1.222** (1.068–1.398)	1.293** (1.103–1.515)	0.706*** (0.631–0.791)	1.197* (1.043–1.375)	1.264** (1.078–1.483)	0.677*** (0.604–0.760)	1.179* (1.027–1.355)
Years of schooling	0.997 (0.974–1.021)	0.988 (0.971–1.006)	1.006 (0.988–1.025)	0.997 (0.974–1.021)	0.989 (0.971–1.006)	1.006 (0.988–1.025)	0.997 (0.974–1.021)	0.991 (0.974–1.009)	1.007 (0.988–1.026)
Rural residence (vs. urban)	0.842* (0.725–0.978)	0.972 (0.870–1.085)	0.512*** (0.446–0.588)	0.837* (0.720–0.972)	0.975 (0.873–1.089)	0.521*** (0.453–0.598)	0.841* (0.724–0.979)	0.963 (0.861–1.076)	0.518*** (0.451–0.595)
Han (vs. non-Han)	1.760*** (1.298–2.387)	1.262* (1.038–1.534)	3.090*** (2.115–4.515)	1.822*** (1.342–2.472)	1.294* (1.064–1.574)	2.997*** (2.050–4.381)	1.769*** (1.301–2.404)	1.253* (1.028–1.528)	2.965*** (2.027–4.338)
Had enough financial sources (vs. lack of)	1.021 (0.855–1.221)	0.976 (0.859–1.108)	1.232* (1.036–1.465)	1.000 (0.836–1.196)	0.969 (0.853–1.100)	1.275** (1.071–1.517)	1.044 (0.871–1.251)	1.051 (0.923–1.197)	1.324** (1.111–1.578)
Had pension (vs. no)	1.596*** (1.303–1.956)	0.905 (0.773–1.060)	1.804*** (1.531–2.127)	1.616*** (1.317–1.983)	0.935 (0.797–1.096)	1.838*** (1.559–2.169)	1.535*** (1.249–1.887)	0.894 (0.761–1.049)	1.804*** (1.527–2.131)
Currently married (vs. other marital status)				0.862 (0.717–1.037)	0.731*** (0.639–0.835)	0.977 (0.834–1.145)	0.852 (0.708–1.026)	0.715*** (0.625–0.819)	0.967 (0.825–1.134)
Living with family (vs. living alone/ in an institution)				1.303** (1.083–1.568)	1.087 (0.954–1.238)	0.693*** (0.590–0.815)	1.329** (1.103–1.600)	1.127 (0.988–1.285)	0.704*** (0.599–0.827)
Self-rated bad health (vs. good health)							1.129 (0.973–1.311)	1.427*** (1.279–1.593)	1.178* (1.033–1.345)
Presence of chronic disease(s)							1.419*** (1.219–1.651)	1.322*** (1.180–1.481)	1.069 (0.934–1.224)
MMSE impaired (vs. unimpaired)							1.264* (1.058–1.510)	1.476*** (1.296–1.680)	1.172 (0.974–1.411)

Notes. ADL = activities of daily living; CI = confidence interval; MMSE = Mini-Mental State Examination. The number of imputed data sets is 100 (m = 100).

[a]ADL status at Wave 2 is a four-category variable: remained free of ADL disability (RF), had the onset of ADL disability (Onset), Died, and loss to follow-up (Loss). Remained free of ADL disability (RF) is the reference category. Reference group of each covariate is listed in the parentheses.

*p < .05. **p < .01. ***p < .001.

and loss-to-follow-up, are also included to minimize sample reduction due to longitudinal attrition. Resilience is a significant and protective factor throughout the three models. One unit increase in the resilience scale at the baseline corresponds to a 4.2% (1/0.96 = 1.04) reduction in the odds of developing ADL disability during the follow-up, net of sociodemographic characteristics at the baseline (Model 1). This association hardly changes with family support controls added to the model (Model 2) and slightly decreases with additional controls of baseline health included (Model 3). Although risks of deaths and loss-to-follow-up are not the focus of our attention, it is important to note that the resilience effect on mortality is similar to that on disability across the models.

In an ad hoc analysis, we tested the interaction term between resilience and age groups dichotomized into younger old group aged 65–84 and the oldest old group aged 85 or older. This interaction term turned out to be significant ($p = .01$). We then ran identical logistic regression models separately for the two age groups. The protective effect of resilience turns out to be statistically significant only in the younger old group (Table 4), where one unit increase in the baseline resilience scale is associated with a 7% reduction in the odds of ADL disability incidence during the 3-year follow-up. This association remains beneficial for the oldest old group, yet its magnitude does not reach statistical significance (Table 5).

The results on the control variables are largely consistent across the models and samples. Protective factors include younger age, male gender, non-Han ethnicity, rural residence, being currently married, and having no chronic diseases or cognitive impairment.

Discussion

Analyzing 2002 and 2005 waves of data from a large-scale, nationwide longitudinal survey (CLHLS) of older adults in China, we find resilience at the baseline is prospectively linked to the onset of ADL disability during the 3-year follow-up among ADL disability-free adults aged 65 or older, after controlling for a range of sociodemographic, family support, and health confounders at the baseline. Our results also reveal that this benefit is stronger for younger old than for the oldest old. To our knowledge, ours is the first prospective cohort study based on a nationally representative sample to explore these issues in China.

The resilience effect appears robust, independent of a host of strong controls given a relatively short follow-up time (3 years). This finding supports our main hypothesis as well as the conclusions of other studies that have reported the beneficial effects of positive psychological characteristics on functional status in developed countries (e.g., Clarke & Smith, 2011; Cooper et al., 2011; Gruenewald et al., 2007; Kempen et al., 2006) and on mortality and longevity in China (Shen & Zeng, 2010; Zeng & Shen, 2010). The finding confirms the robustness of the resilience effect in later life across settings. In other words, despite the unique socioeconomic and cultural contexts of Chinese society, the resilience and disability link does not seem to qualitatively differ from what has been found in western societies (e.g., Clarke & Smith, 2011; Cooper et al., 2011; Gruenewald et al., 2007; Kempen et al., 2006).

That said, no studies have been done to systematically compare the levels and effects of resilience of older adults in China to those elsewhere. Chinese culture is not one that traditionally encourages the pursuit of old-age independence, especially for the oldest old. Markus and Kitayama (1991) have argued that individuals in western societies hold an independent view of the self in which the self is constructed as an autonomously independent person who stands out through his or her unique abilities or attributes and is separate from and prior to society. In contrast, the self-definition of individuals in East Asian cultures is interdependent, presenting the self as part of an encompassing social relationship in which individuals are motivated primarily to fulfill their responsibilities and obligations to society, family members, and others.

This argument finds support in the "filial piety" that has operated as a central value of family life in Chinese society. Because people are expected to act in accordance with the anticipated expectations of others and the social norms in Chinese culture, adult children are supposed to take care of their aging parents and older parents may feel entitled to be dependent on their adult children. Statistics indicate that interdependence through intergenerational coresidence is common in China. In 2000, 68.7% of Chinese aged 65 or older lived in intergenerational households (Zeng & Wang, 2003), whereas only 17.8% of American aged 60 or older did the same (United Nations, 2005).

In view of these statistics, cultural difference might predict a stronger impact of resilience among older westerners because independence is highly valued and expected from all individuals regardless of age in western cultures. By contrast, in China, it is normal for older people to rely on the family and the community to get by, and their dependence is probably less harmful if the individual has a lower level of resilience. These ideas, albeit intuitively appealing, have not been tested. Only cross-national comparative work can test whether within-person resources, such as resilience, exert differential impacts on healthy aging across cultural settings.

Another important finding of our study is that the resilience effect is stronger for the younger old group (aged 65–84) but not for the oldest old (85 and older) group. In studies of aging, older adults are often divided into subgroups of "young-old" and "oldest old," which are defined using various cut-points such as 75, 80, or 85 years of age (e.g., Fauth et al., 2007; Nygren et al., 2005; Shen & Zeng, 2010). We test these different cut-points separately and find that only the age groups divided by the cut-point of 85 exhibit significant interaction effects with resilience ($p = .01$).

Table 4. Odds Ratios of Multinomial Logistic Regression Models for ADL Status at Follow-up[a], Younger Old (65–84), Chinese Longitudinal Healthy Longevity Survey 2002–2005 (N = 6,212)

	Model 1			Model 2			Model 3		
	Onset (95% CI)	Died (95% CI)	Loss (95% CI)	Onset (95% CI)	Died (95% CI)	Loss (95% CI)	Onset (95% CI)	Died (95% CI)	Loss (95% CI)
Resilience scale	0.917***	0.945***	0.937***	0.920***	0.955**	0.941***	0.934**	0.977	0.947***
	(0.884–0.952)	(0.920–0.971)	(0.912–0.962)	(0.887–0.955)	(0.929–0.981)	(0.916–0.966)	(0.899–0.971)	(0.950–1.004)	(0.921–0.974)
Female (vs. male)	1.062	0.734***	1.304**	1.003	0.663***	1.273**	0.978	0.640***	1.262**
	(0.841–1.341)	(0.622–0.867)	(1.105–1.540)	(0.791–1.273)	(0.560–0.786)	(1.075–1.508)	(0.770–1.242)	(0.539–0.760)	(1.065–1.496)
Years of schooling	0.979	0.978	0.999	0.982	0.983	1.000	0.983	0.988	1.000
	(0.946–1.014)	(0.953–1.004)	(0.977–1.022)	(0.949–1.016)	(0.957–1.009)	(0.978–1.023)	(0.949–1.017)	(0.963–1.014)	(0.978–1.023)
Rural residence (vs. urban)	0.717**	0.906	0.473***	0.721**	0.931	0.481***	0.727*	0.917	0.483***
	(0.563–0.913)	(0.763–1.075)	(0.396–0.564)	(0.566–0.919)	(0.784–1.106)	(0.403–0.574)	(0.569–0.929)	(0.769–1.092)	(0.404–0.576)
Han (vs. non-Han)	1.909*	1.023	2.489***	1.992*	1.071	2.439***	1.855*	0.989	2.419
	(1.057–3.448)	(0.749–1.398)	(1.545–4.010)	(1.102–3.603)	(0.782–1.467)	(1.513–3.934)	(1.024–3.358)	(0.720–1.359)	(1.499–3.902)
Had enough financial sources (vs. lack of)	1.023	0.905	1.277*	1.013	0.908	1.307*	1.089	1.017	1.351**
	(0.771–1.357)	(0.749–1.094)	(1.023–1.593)	(0.763–1.344)	(0.751–1.099)	(1.047–1.632)	(0.817–1.451)	(0.837–1.236)	(1.079–1.690)
Had pension (vs. no)	1.595**	0.840	1.840***	1.630**	0.897	1.889***	1.519**	0.852	1.840***
	(1.195–2.130)	(0.670–1.051)	(1.508–2.245)	(1.219–2.179)	(0.716–1.125)	(1.547–2.307)	(1.131–2.040)	(0.676–1.072)	(1.504–2.251)
Currently married (vs. other marital status)				0.711**	0.566***	0.959	0.700**	0.564***	0.949
				(0.555–0.910)	(0.474–0.675)	(0.796–1.156)	(0.546–0.897)	(0.472–0.675)	(0.787–1.143)
Living with family (vs. living alone/in an institution)				1.316	1.047	0.715**	1.372	1.094	0.724**
				(0.951–1.822)	(0.846–1.297)	(0.572–0.893)	(0.990–1.902)	(0.882–1.357)	(0.579–0.905)
Self-rated bad health (vs. good health)							1.187	1.416***	1.172
							(0.942–1.495)	(1.200–1.672)	(0.996–1.380)
Presence of chronic disease(s)							1.573***	1.306**	1.070
							(1.254–1.972)	(1.108–1.540)	(0.908–1.261)
MMSE impaired (vs. unimpaired)							1.582**	2.082***	0.991
							(1.119–2.238)	(1.651–2.625)	(0.726–1.354)

Notes. ADL = activities of daily living; CI = confidence interval; MMSE = Mini-Mental State Examination. The number of imputed data sets is 100 (m = 100).

[a]ADL status at follow-up is a four-category variable: remained free of ADL disability (RF), had the onset of ADL disability (Onset), Died, and loss to follow-up (Loss). Remained free of ADL disability (RF) is the reference category. Reference group of each covariate is listed in the parentheses.

*p < .05. **p < .01. ***p < .001.

Table 5. Odds Ratios of Multinomial Logistic Regression Models for ADL Status at Follow-up[a], Oldest Old (85 and up), Chinese Longitudinal Healthy Longevity Survey 2002–2005 (N = 4,900)

	Model 1			Model 2			Model 3		
	Onset (95% CI)	Died (95% CI)	Loss (95% CI)	Onset (95% CI)	Died (95% CI)	Loss (95% CI)	Onset (95% CI)	Died (95% CI)	Loss (95% CI)
Resilience scale	0.986	0.954***	0.970	0.989	0.959**	0.975	1.001	0.983	0.989
	(0.954–1.019)	(0.931–0.977)	(0.935–1.006)	(0.957–1.022)	(0.936–0.982)	(0.940–1.012)	(0.968–1.036)	(0.959–1.009)	(0.952–1.027)
Female (vs. male)	1.654***	0.877	1.089	1.475**	0.757***	1.021	1.407**	0.703***	0.981
	(1.340–2.041)	(0.757–1.016)	(0.863–1.375)	(1.185–1.836)	(0.649–0.884)	(0.802–1.300)	(1.128–1.754)	(0.601–0.822)	(0.769–1.251)
Years of schooling	0.985	0.966**	1.007	0.986	0.968	1.007	0.991	0.976	1.011
	(0.953–1.018)	(0.942–0.990)	(0.975–1.040)	(0.954–1.020)	(0.944–0.992)	(0.975–1.040)	(0.959–1.025)	(0.951–1.001)	(0.979–1.045)
Rural residence (vs. urban)	0.903	0.989	0.563***	0.897	0.991	0.574***	0.880	0.954	0.563***
	(0.744–1.096)	(0.857–1.141)	(0.450–0.703)	(0.739–1.089)	(0.858–1.144)	(0.460–0.718)	(0.724–1.070)	(0.825–1.104)	(0.450–0.704)
Han (vs. non-Han)	1.786**	1.379**	4.352***	1.907***	1.466**	4.239***	1.814**	1.396**	4.137***
	(1.251–2.552)	(1.095–1.737)	(2.334–8.117)	(1.333–2.728)	(1.162–1.850)	(2.270–7.916)	(1.265–2.600)	(1.102–1.768)	(2.212–7.735)
Had enough financial sources (vs. lack of)	1.052	1.017	1.161	1.015	0.993	1.212	1.035	1.058	1.259
	(0.834–1.328)	(0.860–1.203)	(0.878–1.537)	(0.802–1.283)	(0.839–1.177)	(0.914–1.607)	(0.817–1.312)	(0.891–1.257)	(0.948–1.674)
Had pension (vs. no)	1.451*	0.854	1.679**	1.539**	0.919	1.723***	1.546**	0.930	1.733***
	(1.077–1.957)	(0.678–1.076)	(1.239–2.274)	(1.139–2.081)	(0.727–1.161)	(1.268–2.340)	(1.141–2.093)	(0.734–1.178)	(1.273–2.358)
Currently married (vs. other marital status)				0.583***	0.487***	0.789	0.600***	0.499***	0.800
				(0.440–0.773)	(0.399–0.595)	(0.586–1.064)	(0.452–0.796)	(0.407–0.611)	(0.593–1.080)
Living with family (vs. living alone/in an institution)				1.431**	1.242**	0.692**	1.438**	1.275**	0.702**
				(1.138–1.799)	(1.055–1.462)	(0.547–0.876)	(1.142–1.809)	(1.081–1.504)	(0.554–0.890)
Self-rated bad health (vs. good health)							0.995	1.292**	1.164
							(0.816–1.214)	(1.115–1.497)	(0.930–1.456)
Presence of chronic disease(s)							1.183	1.163	1.071
							(0.958–1.460)	(0.993–1.362)	(0.842–1.363)
MMSE impaired (vs. unimpaired)							1.559***	1.849***	1.413**
							(1.269–1.914)	(1.586–2.155)	(1.114–1.793)

Notes. ADL = activities of daily living; CI = confidence interval; MMSE = Mini-Mental State Examination. The number of imputed data sets is 100 (m = 100).

[a]ADL status at follow-up is a four-category variable: remained free of ADL disability (RF), had the onset of ADL disability (Onset), Died, and loss to follow-up (Loss). Remained free of ADL disability (RF) is the reference category. Reference group of each covariate is listed in the parentheses.

*p < .05. **p < .01. ***p < .001.

The timing of stressful events over the life cycle (Neugarten, 1979) can be used to explain why resilience is less protective for the oldest old in the resilience–disability association. Research consistently shows that independence is more of a challenge to "older" than "younger" elders because risk of disability increases with advancing age. The oldest old segment of the aging population shows the highest levels of physical and cognitive disability and is most in need of receiving care for an ADL or instrumental activities of daily living disability (e.g., Beckett et al., 1996; Pavalko, 2011). Therefore, later-life disability could be expected or acceptable as an "on time" event among the oldest old and thus might be less stressful than "off time" disability that occurs in earlier old age. In their efforts to cope with "on time" events, the oldest old are less likely to demand coping resources such as resilience in very old age.

This study is the first to report resilience in relation to an age interaction effect. This interaction effect suggests that intervention programs aimed at enhancing resilience and promoting healthy aging for older adults should start early in old age, before biological forces get the upper hand and while resilience is still modifiable, and its health impact is still palpable (e.g., see Gruenewald et al., 2007; Seeman & Unger, 1999). More research is warranted to continue the investigation of this interaction and to explore its underlying causes.

Findings from this study should be interpreted with caution due to a few limitations. First, although this study makes use of a prospective cohort design and controls for a wide range of sociodemographic, family support, and health confounders, causation should not be assumed in the detected associations without an experimental design. Second, we include participants who were free of ADL disability at the baseline, excluding those with preexisting disability conditions. This exclusion criteria may have led to a positively selected sample of older adults healthier than the general aging population. Third, the follow-up period is only 3 years and that may not be long enough for the resilience effect to fully manifest. The main and interaction effect of resilience may be different if the follow-up period is longer.

In summary, the key contribution of this study to the literature is its use of a nationally representative longitudinal data to test the prospective effects of resilience on ADL disability incidence and the interaction effect of resilience with age on ADL disability incidence net of a set of strong controls and competing risks in China. The findings can be used to identify older adults at greater risks for developing severe and costly disabilities. They contribute to evidence-based interventions that enhance Chinese older adults' psychological resilience level, delay functional decline and the onset of disability, and in turn, promote longevity with compression of morbidity and disability. This study exclusively focuses on the incidence of ADL disability over a 3-year follow-up period. Future studies should investigate the resilience effect across longer follow-up periods of time and address additional health outcomes, such as incidence and progression of chronic conditions. Future research should also collect more longitudinal data from representative samples to test the effectiveness of various resilience-based intervention programs among older adults, providing evidence for the promotion of such programs to strengthen disease and disability prevention for the older population.

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