National Health Insurance, community development, and cognitive functioning in late life: Longitudinal findings from a natural experiment in Taiwan

Significance

As decades of demographic changes have resulted in a larger population of older adults worldwide, cognitive functioning in later life has appeared to be growing international concern to health researchers and policy advocates alike (Al Hazzouri Haan, et al., 2011; Plassman, Langa, et al., 2008). Research found that older adults who live in poorer and more disadvantaged communities have inferior cognitive functioning outcomes even taking individual covariates into consideration (Aneshensel, Ko, et al., 2011; Clarke, Ailshire, et al., 2012; Lang, Llewellyn, et al., 2008; Sheffield & Peek, 2009; Shih, Ghosh-Dastidar, et al. 2011; Wight, Aneshensel, et al., 2006). Yet, the mechanism relationships between cognitive function and community effects are still not well understood. In particular, differences between communities in the availability of structural resources, including healthcare, have led researchers to hypothesize one mechanism is decreased access to and use of health care.

Taiwan has had its National Health Insurance (NHI) program since 1995. Before NHI, about half of Taiwan's population was uninsured with children and adults over 65 accounting for the majority of the uninsured group (Cheng & Chiang, 1998). Using data from the Taiwan

Longitudinal Study on Aging (TLSA) gave the researchers the opportunity to examine whether NHI was associated with improved cognitive functioning and helped to close the gaps over time across various pre-NHI insurance groups among older adults via a natural experiment. TLSA began collecting data in 1989 prior to the initiation of NHI; data collection continued until 2007, covering an 18-year period during which NHI was available. The present paper thus asks whether NHI is one plausible mechanism explaining the disparities in cognitive function between communities in a nationally representative cohort of older populations in Taiwan.

Methods

Study population

The data for this analysis were from the Taiwan Longitudinal Study on Aging (TLSA), a nationally representative cohort sample of adults 60 years of age and older. The first interview was in 1989 and included 4,049 participants who were followed at three to four year intervals. Measures of cognitive functioning were added to the TLSA survey in 1993 and followed up to 2007. The measures of pre-NHI insurance status and community development index were obtained from the 1989 survey. The analytic sample was excluded proxy reports and restricted to the adult respondents with complete self-reported data on cognitive functioning. The study protocol for secondary data analysis of TLSA was

approved by the ethical committee of National Yang-Ming University.

Measures

Cognitive functioning was assessed with via in-person interview with the short portable mental status questionnaire (SPMSQ) (Pfeiffer, 1975). The SPMSQ measured five items that include: “what are the day, month, and year”; “what day of the week is it; how old are you”; “what is your home address”; and “count backwards from 20 by 3 a total of four times”. For the last SPMSQ item, all four correct subtractions were recorded as having completed the task correctly. The measure used for all analyses was based on a count of correct answers. Cognitive functioning scores ranged from 0 to 5 with higher scores indicating better cognitive functioning.

Pre-NHI insurance status was assessed by pre-NHI surveys in 1989 and/or 1993. Taiwan had three separate, occupation-based insurance programs before 1995: Government Employee Insurance, Farmers Insurance, and Labor Insurance. Information on health insurance was not collected until 1993, but prior research established the stability of an older adult’s insurance status between 1989 and 1993, thereby allowing us to use 1989 occupations to assign pre-NHI insurance status for those without 1993 reports (Chiao, Ksobiech, Wei, 2013). Four categories of pre-NHI insurance status were identified: pre-NHI

insured (government employee insurance, farmers' insurance, and labor insurance) and pre-NHI uninsured.

Establishment of NHI was critical to this inquiry. This study assessed differences in cognitive functioning before versus after implementing NHI over an 18-year timeframe (1989-2007). Data from pre-NHI (1989 and 1993) and post-NHI (1996, 1999, 2003 and 2007) were utilized and a dichotomized variable was created.

Community development was assessed by a community-level indicator, index of urbanization (Tzeng & Wu, 1986). This index was operationalized with Taiwan Census tract data and operationalized by a wide range of information such as population (density, structure and change), economic activity, residential level, education and culture, public health, environmental quality, family income in districts. A higher score represents a more comprehensive development planning in this district.

Statistical Analysis

All analyses were conducted using STATA 12. Growth curve models were employed to assess the relative effects of NHI establishment as well as community development on trajectories of cognitive functioning in later life. The three-level growth curve models were specified with communities at Level 3, individuals at Level 2, and age at Level 1 (Singer & Willett, 2003; Raudenbush & Bryk, 2002). The intercept at Level 1 was the individual's initial status,

representing initial cognitive level at baseline assessments, and the slope indicating the rate of change across time. At level 2, the means and the variances of individual intercepts and rates of changed were estimated; the means and the variances of community intercepts and rates of changes were estimated at level 3. The random intercept and slope models in the *xtmixed* program of STATA were also specified for estimation of these individual cognitive functioning trajectories (Rabe-Hesketh & Skrondal, 2008). To achieve our research goals, we assessed the relationships between NHI, community development, and changes in cognitive functioning as age increased and taking individual covariates into account. These explanatory variables and their interactions with intercept and slope at Level 1 indicated whether there was significant variability in cognitive functioning at the time of initial measurement and over time for different categories of pre-NHI insurance status and degrees of community development.

Preliminary results

Adjusted for aging and practice effects, community development and pre-NHI insurance status were associated with cognitive functioning (Table 1). A more comprehensive urbanization was found to be significantly associated with higher initial levels of cognitive functioning (β=0.05, p<0.001). Compared with older adults with government employee insurance, older adults with labor insurance and no pre-NHI significantly reported lower initial levels of cognitive functioning; in contrast, establishment of NHI was significantly associated with higher initial levels of cognitive functioning (β=0.30, p<0.001).

Our preliminary results underscored the impacts of community development and NHI establishment on levels of cognitive functioning, independent of aging and practice effects.

To our knowledge, this might be the first research on non-western respondents that used longitudinal data to report differences resulting from NHI and community development on cognitive functioning decline among older adults. These findings suggest program designers aimed at promoting cognitive functioning among older adults need to consider the consequences of NHI and community development when seeking to control, decrease, and/or decrease minimize cognitive decline among older adults.

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Table 1. Associations of National Health Insurance (NHI) and community development with trajectories of cognitive functioning for Taiwanese older adults

	Contemporaneous Association With Cognitive Score			Association With Slope		
	Estimate		**S.E.**	**Estimate**		**S.E.**
NHI variables						
Pre-NHI insurance status (ref=Government Employee insurance)						
Farmer insurance	-0.10		0.10	-0.01		0.01
Labor insurance	-0.21	**	0.07	-0.01		0.01
No pre-NHI insurance	-0.13	§	0.08	-0.003		0.005
Implementing NHI (ref= before NHI)	0.30	***	0.05	-0.01	***	0.003
Community development						
Index of urbanization	0.05	**	0.02	-0.0002		0.001
Covariates						
Female (ref=Male)	-0.28	***	0.06	-0.02	***	0.004
Social participation						
Ever participating in a social activity	0.02		0.06	0.01	*	0.004
Cognitive score						
Intercept	4.96	***	0.08			
Mean growth				-0.03	***	0.01
Practice effect				0.01		0.01

§ $p<0.1$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$