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Trends in ADL and IADL Disability in Community-Dwelling Older Adults in Shanghai, China, 1998–2008

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Objectives. We investigated trends in activities of daily living (ADL) and instrumental activities of daily living (IADL) disability from 1998 to 2008 among elder adults in Shanghai, China.

Method. Our data came from 4 waves of the Shanghai Longitudinal Survey of Elderly Life and Opinion (1998, 2003, 2005, and 2008). ADL and IADL disabilities were recorded dichotomously (difficulty vs. no difficulty). The major independent variable was survey year. Covariates included demographics, socioeconomic conditions, family and social support, and other health conditions. Nested random-effect models were applied to estimate trends over time, referenced to 1998.

Results. In comparison with the baseline year (1998), older adults in 2008 had lower odds of being ADL disabled, though the effect was no longer statistically significant when other health conditions were taken into account. Elders in 2003, 2005, and 2008 were 20%–26%, 17%–38%, and 53%–64% less likely to be IADL disabled than those in 1998, respectively, depending on the set of covariates included in the model.

Discussion. Shanghai elders experienced substantial improvements in both ADL and IADL disability prevalence over the past decade. The trend toward improvement in IADL function is more consistent and substantial than that of ADL function.

Key Words: Activity of daily living (ADL)—Disability trend—Instrumental activity of daily living (IADL)—Shanghai, China.

IN tandem with a world population that has been experiencing an unprecedented and pervasive process of aging, functional decline and disability are posing significant medical and socioeconomic challenges across societies (Guralnik, Fried, & Salive, 1996; Kinsella & He, 2009). Understanding functional status trends of elders over time has become indispensable for gauging future health needs and associated public inputs, as well as for cross-cultural comparisons of health in different countries.

A number of theoretical models have been posited to explain relationships between social and medical advancement and functional health trends of older adults in developed countries. One hypothesis is that although improved socioeconomic conditions, new medical technologies, and better nutrition and health behaviors all serve to lower the mortality rate of elders, longer life may bring more opportunity for comorbidity and disability, hence increasing prevalence of both (Gruenberg 1977; Olshansky, Rudberg, Carnes, Cassell, & Brody, 1991). Another theory is that due to improvements affecting mortality rates, disability onset will be postponed in late life so that the time living with disability will be "compressed" for elders (Fries, 1980). More complicated scenarios posited by Manton (1982) suggest a dynamic equilibrium in which chronic diseases may be more prevalent (concurrent with decreases in mortality) but disease severity declines. Robine and Michel (2004) highlighted four elements, interactions of which are posited to shape the trend of disability of elders: an increase in the survival rates of sick persons, a control of the progression of chronic diseases, an improvement in health status and health behaviors of the new cohorts of older people; and an eventual emergence of the very old and frail populations (p. 595).

Empirical studies have indeed demonstrated that mixed functional trends coexist across Western societies in recent decades (Myers, Lamb, & Agree, 2003). In general, American elders appear to have become functionally healthier over the past two decades (Crimmins, Saito, & Reynolds, 1997; Freedman & Martin, 2000; Manton & Gu, 2001; Schoeni, Freedman, & Wallace, 2001). Based

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on several major studies of functional trends in the United States, Freedman, Martin, and Schoeni (2002) reported a general declining trend in the prevalence of functional limitations and disability throughout the 1990s in American elders. For instrumental activities of daily living (IADL), the rate of decline was about 0.4%–2.7% per year, and for activities of daily living (ADL), 1.0%–2.5% per year. Manton, Gu, and Lamb (2006) and Manton, Gu, and Lowrimore (2008) further reported that disability declines in U.S. older adults continued into 2004–2005 and at an accelerating rate. Throughout the 1990s, IADL disability prevalence in France and Poland declined as in America. On the other hand, the trend was reversed in Australia, the United Kingdom, Canada, and the Netherlands with increasing IADL disability prevalence over the same time period. Regarding ADL disability, the United Kingdom, Finland, Switzerland, and France showed declines similar to those in the United States, whereas in Australia and Japan, ADL disability prevalence increased over the same period (Christensen, Doblhammer, Rau, & Vaupel, 2009; Robine & Michel, 2004). Even the current trend toward declining disability prevalence in the United States may not be monotonous. At least one recent study reported that functional improvement in American seniors has ended and that disability may once again be on the rise (Fuller-Thomson, Yu, Nuru-Jerter, Guralnik, & Minkler, 2009). Accordingly, the National Institutes of Health recently funded a new and substantial prospective data collection initiative focusing on the most recent disability trends in American elders and their key causes and consequences (Kasper, Freedman, & Kalton, 2009).

Researchers have highlighted potential impacts of compositional changes in subpopulations on disability trends for an entire elderly population (Berk, Hubert, & Fries, 2006; Schoeni, Freedman, & Martin, 2008). Socioeconomic disparities in disability are well documented. Higher socioeconomic condition is closely linked with a lower prevalence or incidence rate in disability (Freedman, Martin, Schoeni, & Cornman, 2008; Wen & Gu, 2011; Wolf, Hunt, & Knickman, 2005). Studies also show that greater social support and absence of depression or cognitive impairment contribute to a better physical function (Drewes et al., 2011; Geerlings, Beekman, Deeg, Twisk, & van Tilburg, 2001; Hayward & Krause, 2012; Mendes de Leon, Gold, Glass, Kaplan, & George, 2001). Apparently, compositional changes in these characteristics of a given population would alter the prevalence of disability of the entire elderly population even if the prevalence is constant among subpopulations. For example, Schoeni and colleagues (2008) found that socioeconomic status accounted for almost two thirds of the linear trend from 1982 to 2004 among older Americans and that the estimated annual decrease in disability in this period was reduced from 1.50% to 1.35% once marital status was taken into account. In addition, the types and prevalence of conditions causing activity limitations are also changing with improvements in medical technology and healthier lifestyles. The percentage of older Americans attributing heart, vision, or arthritic conditions as a cause of their activity limitations has declined substantially since the early of the 1980s (Schoeni et al., 2008). A similar trend is also found in the United Kingdom since 1990 (Jagger et al., 2007).

In contrast to the ongoing awareness of the importance of disability surveillance in developed nations, less is known about how functional health changes over time for elders in developing societies where socioeconomic and medical conditions may experience comparatively more rapid changes in recent decades (notable exceptions include Gu, Dupre, Warner, & Zeng, 2009; Jitapunkul & Chayovan, 2000; Tu & Chen, 1994; Zimmer, Martin, & Chang, 2002). More importantly, developing countries host almost two thirds of the world's old population, have experienced faster rates of aging in recent decades than their developed counterparts, have higher prevalence rates of chronic conditions such as cardiovascular diseases and diabetes, and suffer relatively more from disability due to insufficient public health resources (United Nations Population Division, 2009). Among the limited studies published on developing countries, the data are far from conclusive regarding whether disability rates are improving or worsening. For example, although Gu and Zeng (2006) reported a declining trend in the ADL disability of Chinese elders from 1992 to 2002, Du and Wu (2006) reported that ADL disability prevalence increased from 1994 to 2004 in Chinese older adults.

The current study examines changes in ADL and IADL disability prevalence in Shanghai, China, from 1998 to 2008. China is an important nation for disability studies because it currently has the world's largest elderly population, which it will maintain into the foreseeable future. Chinese elders (65 and older) comprised approximately 110 million people in 2010 and will comprise 331 million in 2050, representing 20.9% and 21.9% of the world's total elderly population, respectively (United Nations Population Division, 2011). However, no study has reported on ADL disability trends in China since 2005, and no study on IADL disability trends has been ever reported in China, primarily due to lack of available data. In addition, few studies of disability trends have been conducted in China at the regional level. As in many developing countries, the aged population is unevenly distributed in China where eastern regions like Shanghai are aging much faster than the relatively underdeveloped western provinces, and it is often imperative to explore and compare local rates to efficiently distribute health care resources.

Some unique characteristics of Shanghai add to its importance as a regional case of special interest. Shanghai is the most populous city (13.9 million in 2008) and has the highest proportion of older adults in China (15.4% were aged 65 and older in 2008; Shanghai Statistics Bureau,

2009). Moreover, Shanghai is one of the most rapidly urbanized metropolitan areas in China: the ratio of local urban residents increased from 69.7% in 1979 to 87.5% in 2008 (Shanghai Statistics Bureau, 2003, 2009). It should be noted that unlike concepts of cities used in most Western societies, a Chinese city normally includes city proper, suburban areas, and some rural areas (Chan, 2007). Shanghai, with no exception, has both rural and urban areas. The large aged population and dramatic urbanization all make the disability trends of Shanghai elders especially important for exploring the disability trend in China, discussing policy implications, and providing a major reference for a rapidly urbanized aging population.

Shanghai makes a good case to examine the impact on disability changes of rapid socioeconomic development in a non-Western context. As the largest city of China, Shanghai has been often targeted by the Chinese government as a central location for implementation of its newest social and medical reforms. Long serving as an economic center even in prereform China, Shanghai's position in the national economy once declined in the 1980s but regained the central role since the 1990s. The investigation period in this study (1998–2008) captures a period of Shanghai's unprecedented economic revitalization, in which the local gross domestic production and the local fiscal revenue and expenditure increased approximately three to five times (Shanghai Statistics Bureau 2003, 2009). Moreover, Shanghai provides researchers the opportunity to explore wide disparities in disability trends for gender and rural/urban areas. Gender differences in disability trends have been well acknowledged in Western societies (Crimmins & Saito, 2000; Freedman et al., 2002), whereas for China, Gu and colleagues (2009) recently reported that elderly Chinese males had larger annual declines in rates of disability than females from 1992 to 2002. In comparison with developed countries, rural/urban disparities in disability trends could be more drastic in developing countries such as China because of nonuniform socioeconomic development and serious health inequalities (Tang et al., 2008). Chinese rural elders have much less access to health care resources and significantly less pension coverage in comparison with urban counterparts, and most of them did not have public medical insurance until very recently (Liu 2004). Lifestyle (e.g., smoking, drinking, and leisure physical activity) also differs between rural and urban residents (Wu, Mao, Rockett, & Yue, 2008).

The purpose of this study is to expand our understanding of disability trends and their social and medical correlates using a significant and novel case from a non-Western, developing society. More specifically, the current study will focus on the following specific research objectives: (a) to investigate changes in ADL and IADL disability prevalence among older adults in Shanghai, China from 1998 to 2008, including trends by gender and rural/urban subpopulations and (b) to explore the correlates of observed trends by focusing on selected social and medical factors, which have been shown to have an impact on disability in previous studies.

Method

Data

The data came from the Shanghai Longitudinal Survey of Elderly Life and Opinion (SLOSELO), which is a longitudinal investigation of Shanghai elders aged 60 and older. In this pooled analysis, we dropped individuals younger than 65 years to facilitate comparison with other literature. All respondents had valid local household registrations at the time of the interview. The survey was administered by the Shanghai Research Center on Aging (SRCA), a branch of the Shanghai Committee on Aging, and was conducted in 1998, 2003, 2005, and 2008. Informed consent was obtained from all participants.

SLOSELO followed a stratified and multistage random sampling procedure to reflect the gender, age, and rural/urban structure of the local elderly population. In the baseline survey of 1998, approximately 1.5% of the local elderly population was sampled. Four geographical zones were first delimited by their approximation to the city proper. Three districts were identified in each zone and one street residential committee, town, or village was chosen in each district to make up 12 data collection sites: three street residential committees from downtown, three street residential committees peripheral to the city proper, two villages and one town from immediate suburbs, and two villages and one town from outer suburbs. The total sample was stratified into the four zones and 12 sites. In each of the 12 sites, three candidate communities were randomly selected to allow for a sample frame twice the size of the predetermined sampling quota for the site. All qualified elders from the first community were first included into the sample framework; if there were not enough seniors to meet quota for the site, elders from the second and, if necessary, the third community became part of the random sampling frame. Finally, based on the gender and age structure of each site, a stratified random sample was selected from the established sample frame. When two or more individuals were sampled from the same family, a random assignment list was applied to retain only one family member. The same strategies were used in subsequent waves, with the exception that sampling was conducted with replacement for attrition. Respondents from previous waves were always reinterviewed unless they were dead or had moved out of site. In each wave, the sampling procedure was representative, in that it was designed to reflect the gender, age, and rural/urban structure of the local elderly population. Due to budget shortfalls in 2005 and 2008, the target sample size reduced from approximately 1.5% of local older adults to 1.0% of local older adults, and the final sample sizes of those 2 years for elders aged 65 or older were 1,680 and 2,195, respectively. Because the reductions

in the latter two waves were random, no significant bias in parameter estimation was expected. A post hoc sensitivity analysis was conducted by applying adjusted weights to the latter two waves, which ultimately resulted in comparably similar results (sensitivity analysis methodology and results are available upon request from the authors).

People living in institutions were excluded due to the low institutionalization prevalence of Shanghai seniors (<3%) and the consequent small sample size in the survey. As a result, the total sample size was 9,860 in the pooled data set. The sample attrition was comparable to other similar studies. Missing values in the sample (generally <2%) were imputed using the regression-based approach recommended by Allison (2002).

Measurements

The main dependent variables were ADL and IADL. For ADL items, the respondent was asked with "do you have any difficulty in doing the following activities?", which include eating, dressing, moving on and off bed, transferring indoor, washing face and brushing teeth, toileting, bathing, and moving upstairs and downstairs. The reliability coefficient of these eight items in terms of Cronbach's alpha is 0.89, indicating good consistency and reliability. Based on these eight items of ADL, we constructed a dichotomous indicator for ADL disability, as did previous similar studies of disability trends (Crimmins et al., 1997). A respondent was defined as ADL disabled if any difficulty in one or more of the above eight activities was reported. IADL disability was asked and coded in the same way, based on 10 questions about difficulty in cooking, washing clothes, cleaning, taking medicine, nailing, managing money, making phone calls, getting out in the rain, shopping, and going to a physician (Cronbach's $\alpha = 0.90$).

The major independent variable was year, coded with dichotomous indicators for each wave of the SLOSELO. This methodology is similar to many other studies of disability trends and as opposed to coding time continuously, using a categorical coding of time may better reflect reality (Freedman et al., 2004).

Covariates including demographic status, socioeconomic status, family and social support, and other competing health conditions were controlled in our analytical models. Inclusion of the covariates we selected is a common practice in studies of disability trend (Gu et al., 2009; Schoeni et al., 2001) and is necessary to insure robust estimation and an accurate understanding of how these factors are associated with disability trends (Berk, Hubert, & Fries, 2006; Schoeni et al., 2008). Demographic covariates controlled here included age, gender, and rural/urban residence. Socioeconomic covariates included self-reported economic status (good/poor) and educational achievement (illiterate/primary, middle school/high school, or above). Indicators of family and social support included marital status (currently with spouse or not), perception of children's support (satisfied or not), and entitlement to public medical service (yes/no). Four other health-related measurements were also controlled, including a comorbidity index, symptom index, depressive symptom index, and cognitive impairment. The comorbidity index included presence or absence of physician-diagnosed hypertension, coronary heart disease, stroke, diabetes, bronchitis, cancer, prostatitis, and arthritis with a total score count ranging from 0 to 8. The unhealthy symptom index included lack of appetite, difficulty in breathing, stomach pain, dizziness, sleeping problem, constipation, fatigue, swollen joints, chest and/or heart pain, and headache regularly experienced in the first half of the year (range is 0–10). The depressive symptom index was based on seven questions such as "do you always think optimistically?", "are you often afraid and strained?", "are you feeling lonely?", "are you feeling useless?", "are you as happy as before?", "are you able to make your own decisions?", and "do you keep everything clean and organized?". The index score ranges from 0 to 21 with higher scores indicating more depressive symptoms. Cognitive impairment was measured using 10 questions including current date and month, date for the Moon Festival on the lunar calendar, serial subtractions (from 20 by increments of 3), home address, living district or county, age, number of minutes in an hour, the year of establishment of People's Republic of China, and the name of the first prime minister of China. Cognitive impairment scores ranged from 0 to 10.

Analytical Strategies

We used random-effects logit models to model ADL and IADL disability trends of the Shanghai elderly population throughout the past decade. Since the study was designed to incorporate panel data, the waves of data for this study contained repeated measurements for participants. In other words, many participants were repeatedly sampled across time, even though the primary sampling design at each wave was designed to be cross-sectional and representative of the local area sampled. The random-effect logit model allows for correction of intrapersonal correlations incurred by repeated measurements using a random intercept for each participant in the model (Raudenbush, Bryke, Cheong, Congdon, & du Toit, 2004).

Five nested models were developed to explore how social and medical factors affected the disability trends: Model I included demographic variables such as age, gender, and rural/urban residence; Model II added socioeconomic variables including economic status and educational achievement; Model III further included family and social support variables (i.e., marital status, perception of children's support, and the entitlement of public medical insurance); Model IV additionally controlled for the four health variables (i.e., comorbidity index, unhealthy symptom index, depressive symptom index, and cognitive

impairment); Finally, Model V examined interaction effects between covariates (gender and rural/urban residence) and the survey years to examine whether the time trends were experienced differently in different population subgroups. Because construction of the weight in the SLOSELO was solely based on age, gender, and urban/rural distribution of the sample in comparison with that of the population, we did not apply weights to the multivariate analyses as long as these three variables (age, gender, urban/rural residence) were included in the models, which is a common and acceptable approach (Winship & Radbill, 1994). However, sensitivity analyses with weights were conducted and yielded very similar results as the ones without weight (results are available upon request from the authors). All analyses were performed using Stata/SE 12.0.

Results

Distributions of the sample for each wave are summarized in Table 1. From 1998 to 2008, the average age of sampled elderly population increased, likely reflecting the aging of the local population. Gender structure was fairly stable across waves. A decline was observed in proportion of rural residents across waves, consistent with the rapid urbanization in Shanghai during this period. Economic status, education, public medical service coverage, and marital status of the sampled elders all improved in each wave of the study compared with previous waves. Health conditions of the sample varied across waves depending on the health indicator evaluated. The crude proportion of the Shanghai population with ADL and IADL disability decreased over time.

Trends in ADL Disability

The first three rows of Table 2 presents adjusted odds of being ADL disabled for later waves compared with the baseline wave of 1998. Models I–IV reflect incremental control of confounders and Model V incorporates interaction terms. Model I shows that, compared with elders in the baseline year of 1998, elders in 2005 and 2008 had 22% and 36% lower odds of being ADL disabled when controlling only for three basic demographic factors. There was, however, no significant change in ADL disability in 2003 compared with 1998. Additionally controlling for socioeconomic status and family and social support factors led to statistical insignificance for the disability in 2005 compared with 1998, yet disability in 2008 still remained 28%–32% statistically lower than 1998 (Model II and Model III). However, as shown in Model IV, the improvements in ADL function in 2008 were further attenuated and no longer significant when other health conditions were added into the model.

Findings relevant to covariates in Table 2 were noteworthy. Higher age was consistently associated with poorer ADL disability. Although women were disadvantaged in ADL functioning, the effect was not statistically significant after socioeconomic factors were added. Rural elders had better ADL functioning than their urban counterparts when other health conditions, socioeconomic status, and family and social support factors were controlled (Model IV). Better economic conditions reduced the odds of being ADL disabled, but other socioeconomic differentials in ADL improvement were not observed. In general, family and social support were not significantly associated with ADL disability. As expected, all problems in other healthy conditions significantly increased the risk of being ADL disabled.

When sex-specific trend was further taken into consideration (interactions between sex and year) in the analysis (Model V), we found that ADL disability trends from 1998 to 2008 were different for women and men. For example, the odds ratios (OR) of being ADL disabled for men declined in 2003 (OR = 0.95), 2005 (OR = 0.79), and 2008 (OR = 0.77) compared with 1998, although these declines were not statistically significant. In contrast, women's OR of being

Table 1. Descriptive Statistics

Year	1998	2003	2005	2008
Sample size	2,763	3,222	1,680	2,195
Mean age (*SD*)	72.9 (6.2)	73.9 (6.4)	74.4 (6.5)	75.1 (6.5)
Women (%)	55.5	54.4	54.9	54.3
Rural residence (%)	31.5	31.5	21.5	9.2
Good economic status (%)	75.2	76.4	76.1	87.0
0 year of schooling (%)	48.2	39.3	33.2	28.7
1–9 years of schooling (%)	39.0	42.2	46.8	50.3
10+ years of schooling (%)	12.8	18.5	20.0	21.0
Married (%)	58.8	61.9	61.7	67.9
Satisfaction with children's support (%)	56.5	58.8	55.8	38.1
Public medical service (%)	61.6	64.6	64.2	75.3
Mean comorbidity (range: 0–8) (*SD*)	1.3 (1.2)	1.6 (1.3)	1.6 (1.2)	1.5 (1.2)
Mean unhealthy symptom (range: 0–10) (*SD*)	2.0 (2.0)	1.8 (2.0)	1.8 (1.6)	1.5 (1.5)
Mean depressive symptom (range: 0–21) (*SD*)	4.2 (3.7)	4.4 (3.5)	3.6 (3.8)	3.9 (3.6)
Mean cognitive impairment (range: 0–10) (*SD*)	1.2 (1.9)	0.8 (1.7)	0.6 (1.4)	0.6 (1.4)
Any ADL limitation (%)	15.9	16.9	15.5	14.9
Any IADL limitation (%)	42.1	39.7	37.6	30.1

Note. ADL = activities of daily living; IADL = instrumental activities of daily living; SD = standard deviation.

Table 2. Odds Ratios of Activities of Daily Living Disability by Study Variables in Shanghai Elders (1998–2008)

	Model I	Model II	Model III	Model IV	Model V
Year 2003 (1998)	1.00	1.02	1.03	1.00	0.95
Year 2005 (1998)	0.78*	0.80	0.82	1.03	0.79
Year 2008 (1998)	0.64***	0.72**	0.68**	0.83	0.77
Age	1.22***	1.21***	1.20***	1.16***	1.16***
Women	1.34**	1.15	1.12	0.87	0.62**
Rural	0.83	0.66***	0.78	0.73*	0.98
Good economic status		0.44***	0.45***	0.78*	0.76**
1–9 years of schooling (0)		0.85	0.83	1.23	1.19
10+ years of schooling (0)		0.76	0.73*	1.11	1.09
Married			0.86	1.02	1.02
Satisfaction with children support			0.70***	0.88	0.90
Free public medical insurance			1.26	1.06	1.09
Comorbidity				1.45***	1.45***
Unhealthy symptom				1.14***	1.15***
Depressive symptom				1.16***	1.14***
Cognitive impairment				1.47***	1.49***
2003 × female					1.60*
2005 × female					2.00**
2008 × female					1.22
2003 × rural					0.48**
2005 × rural					0.65
2008 × rural					1.65
P	0.47***	0.46***	0.46***	0.35***	0.36***
–LL	3655.24***	3614.68***	3601.70***	3168.99***	3154.01***

Note. *$p < .05$. **$p < .01$. ***$p < .001$.

ADL disabled in 2003 (OR = 0.95 × 0.62 × 1.60/0.62 = 1.52) and 2005 (OR = 0.79 × 0.62 × 2.00/0.62 = 1.58) increased and were statistically significant compared with 1998, yet their OR in 2008 was not statistically different from 1998. Model V further implies that rural elders had a different trajectory of ADL disability prevalence compared with their urban counterparts from 1998 to 2003. For example, rural elders' ADL function improved more during the first 5 years from 1998 to 2003 compared with years after 2003. The OR of being ADL disabled for rural elders in 2003 was only 0.46 (OR = 0.95 × 0.98 × 0.48/0.98) compared with 1998, whereas urban elders' OR of being ADL disabled in 2003 was 0.95 compared with 1998. There was no difference in the trajectory of ADL function between urban and rural elders after 2003.

Trends in IADL Disability

Model I in Table 3 shows that, compared with elders in 1998, elders in 2003, 2005, and 2008 were 26%, 38%, and 64% less likely to be IADL disabled, respectively, after controlling for demographic variables such as age, gender, and rural/urban residence. Further controlling for socioeconomic status, family, and social support factors, Models II and III showed almost no changes in the OR and their significance. Adding other health conditions decreased the magnitude of improvement in IADL in 2005 and 2008; however, the general pattern of reduced odds of IADL disability across the investigation years was not changed (Model IV). Compared with the improvement in ADL functioning shown in Table 2, the improvement in IADL functioning in Table 3 was much greater and more consistent.

With respect to covariates of IADL, older age and female gender were associated with greater likelihood of being IADL disabled, but the gender difference disappeared when other health conditions were controlled. Rural elders tended to have poorer IADL functioning but such disadvantage was eliminated after socioeconomic conditions were controlled. Better socioeconomic conditions were generally associated with better IADL functioning, although the effect of economic status disappeared once other health conditions were controlled.

Gender differences in IADL trends were not significant (Model V). However, similar to the findings of ADL, rural elders in Shanghai experienced greater improvement in IADL functioning from 1998 to 2003 compared with their urban counterparts. The likelihood of IADL disability for rural elders was reduced to 0.38 (OR = 1.14 × 1.63 × 0.33/1.63) in 2003 in comparison with 1998; meanwhile urban elders' odds ratio in 2003 was 1.14 compared with 1998, and it was not significant.

Discussion

This study contributes to the literature on disability trends in developing countries in a non-Western context and supports the notion that rapid economic development in a developing society may lead to substantial improvement in the functioning health of the elderly population. China recently experienced a marked epidemiological transition characterized by general health improvements throughout the 1990s

Table 3. Odds Ratios of Instrumental Activity of Daily Living (IADL) Disability by Study Variables in Shanghai Elders (1998–2008)

	Model I	Model II	Model III	Model IV	Model V
Year 2003 (1998)	0.74***	0.79**	0.80**	0.80**	1.14
Year 2005 (1998)	0.62***	0.68***	0.68***	0.83*	0.82
Year 2008 (1998)	0.36***	0.41***	0.39***	0.47***	0.55***
Age	1.19***	1.18***	1.18***	1.15***	1.15***
Women	1.96***	1.48***	1.43***	1.13	1.06
Rural	1.62***	1.11	1.04	0.99	1.63**
Good economic status		0.60***	0.64***	0.97	0.94
1–9 years of schooling (0)		0.45***	0.46***	0.59***	0.58***
10+ years of schooling (0)		0.53***	0.55***	0.75**	0.72**
Married			0.88	0.99	0.99
Satisfaction with children's support			0.77***	0.92	0.95
Free public medical insurance			0.88	0.80*	0.82
Comorbidity				1.28***	1.27***
Unhealthy symptom				1.15***	1.15***
Depressive symptom				1.12***	1.13***
Cognitive impairment				1.43***	1.44***
2003 × female					1.04
2005 × female					1.33
2008 × female					0.96
2003 × rural					0.33***
2005 × rural					0.72
2008 × rural					0.95
P	0.31***	0.30***	0.30***	0.24***	0.24***
–LL	5525.49***	5437.00***	5425.14***	4999.89***	4966.14***

Note. *$p < .05$. **$p < .01$. ***$p < .001$.

(Gu et al., 2009). The current study provides evidence that this epidemiological transition continued into the 2000s for the elders in Shanghai, the most populous and aged city. This article shows that the functional health of Shanghai elders improved markedly, as measured by both ADL and IADL for the 10-year period. However, when confounding effects of other competing health conditions were taken into consideration, the improvement in ADL function was not statistically significant (see Model IV of Table 2). This finding is consistent with one recent study on the disability trends of Chinese elders from 1992 to 2002 (Gu et al., 2009). That is, ADL disability improvement in Chinese elders was most closely associated with improvements in health, in dimensions such as comorbidity, depression, and cognitive impairment. Our study also provides unique evidence of IADL improvements, which has not been reported previously for the elderly population in China. We found that improvement in IADL function was more robust and substantial than that of major (ADL) disability for Shanghai elders (see Model IV of Table 3). In other words, the functional improvements we observed occurred mainly in instrumental activities, as was reported in a number of studies in developed countries (Crimmins et al., 1997; Freedman et al., 2002). Of great concern to nations such as China is that the more expensive type of disability in terms of costs to society and to individuals improved much less markedly.

Our finding that improvement in instrumental activities were more pronounced in comparison with basic activities possibly suggests that contextual factors, rather than the actual improvement of physical health, might be one of the factors underlying the observed trends. IADL disabilities are generally more sensitive than ADL disabilities to contextual changes such as improved accessibility, wheeled walkers with baskets, ready-made meals, and microwave ovens (Parker & Thorslund, 2007, p. 155). Shanghai experienced an unprecedented economic boom during the time period of this study, which may have stimulated favorable contextual changes with possible impact on functional health. For example, improved living standards are often accompanied by the introduction of new technology such as washing machines, microwaves, and wheelchairs into many households, which may impact elders' daily functioning. Improvements in local eldercare services and availability might also be at play. Since 1990, the municipal government of Shanghai began establishing publicly funded community health centers in every neighborhood and encouraging new forms of community-based eldercare such as the *bao-mu* (homecare aids) and *jia-zheng* (housekeepers; Wu, Carter, Goins, & Cheng, 2005). These programs have intensified since the early 2000s. In addition, the number of community-based elderly day care centers increased from 83 in 2005 to 229 in 2008 across Shanghai (Shanghai Civil Affair Bureau, SRCA, & Shanghai Statistics Bureau, 2009).

One intriguing finding we reported in this article is that individual socioeconomic factors and family and social support did not mediate a substantial part of the observed functional improvement in Shanghai. This is puzzling as higher socioeconomic status and better family and social support are known to be important factors for optimal functioning in late life (Berkman, Glass, Brissette, &

Seeman 2000; Parahyba, Stevens, Henley, Lang, & Melzer, 2009). One possible reason for this discrepancy could be a population-level "ceiling effect." As early as 2004, the local gross domestic product per capita of Shanghai had reached more than $5,000, an international standard for defining a medium-developed society. At such a high level of economic security, variability in socioeconomic status and in the degree of family and social support may not have been substantial enough to result in marked differentials in the health of Shanghai elders included in this study. However, it is still important to incorporate and examine disability-related socioeconomic factors for future study of disability trend (Schoeni et al., 2008).

The results of this study show that there are disparities in disability trends in rural and urban areas of Shanghai. The ADL and IADL improvement in Shanghai rural aged people from 1998 to 2003 was expedited compared with urban residents. The fact that the functional health of rural elders changed more rapidly is possibly related to the relatively lower access to health care service in rural areas of Shanghai in the past decades. In the 1980s and 1990s, with unfolding economic reforms, the medical care system for rural residents of China had been through a major transition, in which the old cooperative medical care system and the well-known institution of barefoot physicians was abandoned. In consequence, rural health workers dropped from approximately 350,000 in the 1970s to less than 50,000 in the 1990s (Zhang & Unschuld, 2008). In Shanghai, that situation was reversed from the year of 2000, when the new Rural Co-operative Medical Care System was put into practice. However, this new policy scheme is still under evaluation (Wagstaff, Lindelow, Jun, Ling, & Juncheng, 2009), and more studies are still needed to examine how this new medical scheme has influenced the physical and functional health of residents of Shanghai.

Finally, this study also reports some interesting results about gender differences in ADL disability trends. In general, women tend to live longer with more disabilities (Manton, 1988; von Strauss, Agüero-Torres, Kåreholt, Winblad, & Fratiglioni 2003); however, the gendered pattern in disability trends has not been reported the same across societies (Freedman et al., 2002; Tu & Chen, 1994). In this study, improvement in ADL functioning in Shanghai men was not significant when demographics, socioeconomic status, family and social support, and other competing health conditions are controlled for, whereas Shanghai women actually experienced a decline in ADL functioning in 2003 and 2005 compared with 1998. This pattern was not observed in IADL disability for the same period. Researchers have reported socioeconomic factors to be important mediators for gender differences in disability (Crimmins & Saito, 2000). In comparison with men, Chinese elderly women have less economic resources and are less likely to access to medical services and to benefit from public medical reforms (Gao, Raven, & Tang, 2007; Zeng, Liu, & George, 2003). Therefore, our results likely suggest that Shanghai women were less responsive to socioeconomic changes associated with improved ADL function.

The current study has several limitations. First, our results may not be generalizable to older adults in other parts of China given the heterogeneity of the population in China. Nevertheless, the observed trends in Shanghai are likely to be relevant for many other large cities in China and elsewhere. Second, due to limitations in funding, the SLOSELO sampling frequency was slightly less than the target 1.5‰ of the total elderly population in 2005 and 2008. Nevertheless, the samples in 2005 and 2008 are still large and represent one of the most substantial public disability surveillance efforts in a major Chinese city. Third, our data focused on people registered in the household system but did not survey the significant migrant population. Fortunately, however, migrant populations are still young in Shanghai, and few would have been eligible for our survey. This factor will become increasingly important in future waves of follow-up. Similarly, our analyses excluded elders in institutions, a subpopulation that has been slowly growing in recent years. Institutionalized elders in China are generally in worse physical health; therefore, omitting institutionalized persons may have led us to overestimate disability improvement in Shanghai. However, increases in the institutionalization ratio have been small and have remained at generally very low levels in Shanghai (<3% in 2008). Consequently, we believe that the potential magnitude of bias in our estimates would be minimal. Finally, we are aware that the results discussed in the study were associational and not necessarily causal. Advancement in medical technologies, changes in lifestyle, promotion of physical activities, community-level eldercare facilities might all be critical casual mechanisms responsible for the functional improvement in Shanghai elders. Further studies are warranted, especially with respect to contextual factors that potentially influence and/or contribute to variability of disablement trends in different subgroups.

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