Associations between socio-economic status measures and functional change among older people in Taiwan

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ABSTRACT

The major purpose of this study was to examine the effects of socio-economic status (SES) on changes in functional abilities, as measured by Activities of Daily Living (ADL) scales, among older people in Taiwan. A prospective longitudinal study design was used. A panel of 874 community-dwelling older people were followed over four years (1994 to 1998). Three SES indicators, education, having 'extra' money (more than required for basic necessities), and principal lifetime occupation were included in separate multiple logistic regression models of functional change in physical ADL (PADL) and in instrumental ADL (IADL). Over the four years, the study cohort experienced greater decreases in IADL functioning than in PADL functioning. Having 'extra' money was significantly and negatively associated with PADL decline, while level of education had a strong positive relationship with IADL functioning. In addition to SES, age was significantly associated with PADL and IADL functioning change. The paper also reports a comparison of similar findings from several eastern and western countries. This has established that among the available SES indicators, the level of education has most consistently been shown in both eastern and western population studies to be related to health and health change, and that self-perceived economic resource is also related to older people's health in Asian populations.

KEY WORDS – socio-economic status (SES), Activities of Daily Living (ADL) scales, functional status, older people, Taiwan.

Introduction

Many studies have examined the relationships between specific socio-economic status (SES) factors and health-status change. While SES is

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universally 'a composite construct that is typically measured by income, education, and occupation' (Dutton and Levine 1989; Anderson and Armstead 1995), differences in samples and measures, as well as divergent findings, leave considerable room for debate about the nature of the relationship between SES and health in old age. In exploring the mechanisms that link the two constructs, Antonovsky (1967) found that SES differences existed among those with various diseases and conditions and could be associated with differing rates of mortality and morbidity. Robert and House (1994) ascertained that, as compared to those with low SES, those of high status receive higher incomes and enjoy the benefits of better environmental and social conditions and superior access to health care. Lundberg (1991) reported that physical working conditions were the main socio-economic factor associated with variations in physical illness. It has been suggested that the impact of occupational category on health status may begin early in working life and be cumulative over the life span (Haan, Kaplan and Syme 1989).

Studies in health variations among older people in western countries have focused on how SES varies by age and have sought to identify the particular factors that influence health in old age. One previous study reported that SES differentials in adult mortality were minimal during young adulthood, but significant in middle age, and then moderated in old age (Kaplan *et al.* 1987). On the other hand, a positive relationship between education level and functional status has been consistently found (Freedman and Martin 1999; Waidmann and Liu 2000; Schoeni, Freedman and Wallance 2001). One might conclude that relationships between SES and health status apply throughout the life span. As Abeles (1992) emphasised, the impacts of social stratification and ageing processes on health status are both contemporaneous (or simultaneous) and cumulative.

Several Asian studies for other than Chinese populations have explored the role of SES in health variations in old age (*e.g.* Zimmer and Amornsirisomboon 2001; Lee and Shinkai 2003). Liu and her associates (1995) found that low education increased the risk of disability among Japanese older people. Working for pay was also found to be a significant cross-sectional predictor among those aged 60 or more years in Japan (Lee and Shinkai 2003). There have also been studies of the relationship between SES and health status in Chinese older populations. One, of people in advanced old age in Hong Kong, confirmed the relationship between level of education and health (Ho *et al.* 1997). Another, by Liang, Liu and Gu (2001), studied older people in China and found that urban residence had significant direct and indirect effects on functional transitions, and that there were complicated underlying causal mechanisms. A third, of the

Taiwanese older people by Zimmer, Hermalin and Chuang (1998), found that education played a substantial role in delaying the onset of functional limitation over four years.

Compared with other nations in the world, Taiwan's population is rapidly ageing. It has been estimated that the share aged 65 or more years will increase from seven to 14 per cent in only 20 years, several times faster than the period of transition experienced by western developed countries (Chiu 2001). A better knowledge of the associations between SES, functional status and health status among older people will inform the social and health policies and practice development that are needed to respond to such rapid demographic change. With this goal in mind, this study adopted three objectives: to establish the amount of functional change (as measured by Activities of Daily Living (ADL) indicators) among older people in Taiwan over four years; to specify the relationship between SES factors and functional change or decline; and to compare the findings with those reported from earlier studies in eastern and western societies. The analysis was informed by a systematic review of the studies of the relationship between SES and health in western societies (Crimmins and Cambois 2003), but no comparable review of non-western population studies was available.

Methods

Most previous studies of the influence of SES on health have been cross-sectional (Zimmer and Amornsirisomboon 2001; Lee and Shinkai 2003), and few have analysed longitudinal data, but this study adopted a closed-panel longitudinal study design to describe functional change over time. Moreover, very few previous studies have examined simultaneously the effects of education, occupation and income on health inequality (Zimmer and Amornsirisomboon 2001). A longitudinal study approach was necessary to identify the independent roles of multiple SES factors in ADL deterioration.

Another refinement of the present study is its focus on the *Instrumental* Activities of Daily Living (IADL). Most previous studies of Asian populations have focused on the *Physical* Activities of Daily Living (PADL) (Liu *et al.* 1995; Ho *et al.* 1997; Zimmer *et al.* 1998; Li, Wu and Wen 2000; Liang, Liu and Gu 2001). PADL measures ability in the basic activities of hygiene and personal care, while IADL is a more sensitive measure of a person's ability to remain living independently in the community. The predictors for PADL and IADL functional change may differ, because of the different nature of the physical and the instrumental functional activities.

Study sample and data

The study setting is Kaohsioung, the second largest city of Taiwan, with a population of 1.5 million in 2003, eight per cent of whom were aged 65 or more years. The majority of Kaohsioung's older population was born in Taiwan, but 10.5 per cent came from Mainland China in or before 1949 and had been in military or government service for the Republic of Taiwan China (Republic of Taiwan, Office of National Statistics, Executive Yuan 1992). In 1994, about 85,824 (6.1% of 1.4 million) elders lived in the city. It has 11 administrative districts (or boroughs), and that of San-Min was selected for the study because its older population is representative of the city's.[1]

The study sample was a two-stage random sample of the older population drawn from a local census conducted by the city's administrative authority in 1994 and 1998. The first stage was a random selection of 21 basic administrative units (wards) in San-Min, and the second stage was a systematic one-in-two sample of the older residents for face-to-face interviews. The two-stage procedure identified 1,436 eligible elders; 1,260 consented and were successfully interviewed for the baseline interviews in 1994 (87.7% response), and 874 gave interviews at the follow-up in 1998 (83.7% response).[2] Each interview lasted 45–60 minutes, and was conducted at the respondent's home by senior public health or nursing students of Kaohsiung Medical University.

The survey instrument

The survey instrument was the Chinese-version of the *Multidimensional Functional Assessment Questionnaire* (CMFAQ). This is based on the *Older American Resources and Services Center* (OARS) assessment instrument developed at Duke University, North Carolina (Fillenbaum 1988). Double-back translations were made to identify and resolve the different terminology and meanings that apply in America and Taiwan. Mandarin, Taiwanese and Hakka are the three most prevalent spoken languages or dialects in Taiwan,[3] and each required modifications of some questions to overcome the reliability and validity problems generated by differences in vocabulary and usage. Each respondent was interviewed in the language or dialect of first preference. The reliability and validity of CMFAQ were investigated and found satisfactory (Chiu *et al.* 1997).[4]

Measures

The demographic, SES and health status (chronic conditions) measures were taken from the baseline (or 1994) data and used as input variables

when analysing change during 1994 to 1998. On the other hand, the functional status or ADL data collected in both the 1994 and 1998 surveys were used in calculating the outcome or dependent measures. Activities of Daily Living (ADL) refer to an individual's ability to perform activities in normal daily life (McDowell and Newell 1987). They include the physical activities of daily living (PADL) and the instrumental activities of daily living (IADL): both are in the CMFAQ. The PADL describe the basic activities of hygiene and personal care, such as bathing, dressing, eating, getting to the bathroom, getting in and out of bed, and walking; while the IADL describe the activities necessary to reside in the community, such as meal preparation, housekeeping, shopping, handling money, using the telephone, getting to places beyond walking distance, and self-administering medication.

Each respondent was asked whether they had any difficulty in undertaking the specified activities during the past month. The pre-coded answers were: 'no need for help' ('2'), 'need some help' ('1'), and 'cannot do' ('0'). A continuous disability score was calculated by adding the sum of responses to each specific item of ADL capacity. The PADL scale had six items, so the scores ranged from '0' to '12'; while the IADL scale had seven items and the scores ranged from '0' to '14'. A low ADL score indicates poor functioning. If the PADL and/or IADL score at follow-up was lower than at baseline, it was taken to indicate functional decline (and *vice versa*). The subjects were then categorised into three groups, with 'decreased', 'unchanged' and 'improved' functioning.

The level of education received, principal lifetime occupation, and having 'extra money' were the three major *SES indicators*. As most subjects had completed elementary school (1–6 school years) but had had no further education, three categories for level of education were used: illiterate or no formal education, 1–6 years of schooling, and 7 or more years of schooling. The variable 'extra money' was generated by the question, 'Do you usually have enough money to buy those little "extras", that is, those small luxuries?' and was a proxy for financial resources. In Taiwan, no population register with income data exists, so it is very difficult to obtain reliable information on the personal or household income of older people. Besides, pensions are only available for those who had retired from the government or military service. It was believed that having extra money for purchasing 'small luxuries' would serve as a proxy for personal financial security.[5]

The occupational variable was generated from the self-reported principal lifetime occupation. These were classified into Taiwan's standard occupational classification system (NS-SOCS) which has 32 categories and five broad groups: (1) professional/managerial; (2) clerical, lower

non-manual; (3) skilled manual; (4) semi-skilled and unskilled; and (5) never worked or housewife (Republic of Taiwan, Office of National Statistics, Executive Yuan 1992).[6] The role of housewife was distinguished, for until the 1950s most women were engaged in housekeeping and helping on farms or in family firms. The responsibility and arduousness were no less than having a named job, but there was no regular pay cheque. Information deficits and classification difficulties meant that housewives and 'never having worked' had to be taken as a single category.

Turning to the *control variables*, age in years was entered as a continuous variable, while marital status was dichotomised according to whether the subject was living with a spouse or not. To avoid the bias associated with being widowed during the study interval, three marital status categories were defined: (1) no spouse in 1994 or 1998; (2) had a spouse at both dates; and (3) had a spouse in 1994 but not in 1998. Chronic health conditions were also used as covariates in the regression models. The six self-reported chronic diseases or conditions with the highest prevalence were selected from the 26 on the CMFAQ checklist.

Analyses

A descriptive analysis provided an overview of the study sample at baseline and follow-up. Then, the sample characteristics including functional change in both PADL and IADL between 1994 and 1998 were examined by gender. Finally, two multivariate logistic regression models were calibrated to examine the effects of education, principal occupation, and extra money on the decline of PADL and IADL. In addition to the SES indicators, age, marital status and number of chronic conditions were entered into the two logistic regression models.

The characteristics of the sample

In total, 874 of the baseline subjects were successfully followed-up in 1998.[2] To determine whether there was a significant difference between the contacted and not-contacted subjects, their baseline socio-demographic and physical status characteristics were compared (Table 1). The two groups had similar demographic characteristics and no statistically significant differences were found except for marital status: a lower percentage of the not-followed-up group had a spouse than the follow-up group (64.7 % *versus* 75.4 %). The average age of the follow-up sample was

TABLE 1. *The baseline characteristics in 1994 of the study sample, those followed-up and those not followed-up*

Variable	Baseline N	Baseline %	Follow-up N	Follow-up %	Non follow-up N	Non follow-up %
Socio-demographic						
Men	650	(51.6)	433	(49.5)	80	(47.1)
With spouse in 1994**	915	(72.9)	659	(75.4)	110	(64.7)
Educational level						
Illiterate	399	(31.7)	292	(33.4)	54	(31.8)
1–6 years' schooling	495	(39.3)	354	(40.5)	63	(37.1)
7 + years' schooling	354	(28.1)	226	(25.9)	50	(29.4)
Has extra money	933	(74.0)	671	(76.8)	124	(72.9)
Occupational group						
Professional/managerial	53	(4.2)	59	(6.7)	8	(4.7)
Clerical, lower non-manual	318	(25.2)	229	(26.2)	44	(25.9)
Skilled-manual	332	(26.3)	232	(26.5)	38	(22.4)
Semi-skilled and unskilled	148	(11.7)	73	(8.4)	20	(11.8)
Never worked/housewife	387	(30.7)	274	(31.3)	53	(31.2)
	Mean ± s.d.		Mean ± s.d.		Mean ± s.d.	
Age in 1994	71.6 ± 5.8		70.9 ± 5.3		71.6 ± 6.0	
No. of chronic diseases in 1994	0.99 ± 1.07		0.95 ± 1.04		0.89 ± 1.09	
Sample sizes	1,260		874		170	

Notes: 1. The follow-up was in 1998. 216 deceased subjects were excluded from the unfollowed-up group. s.d. Standard deviation. *Significance level*: For difference between follow-up and non follow-up groups: ** $p < 0.01$.

70.9 years (standard deviation (s.d.) = 5.3), and there were approximately the same number of men and women.

For the SES variables on education, occupational group, and 'had extra money', no statistically-significant difference was found between the two groups. In the follow-up group, 41 per cent had completed elementary education, 33 per cent were illiterate, and 26 per cent had had seven or more years of schooling (Table 1). Among the five principal occupational groups, 'never worked or housewife' accounted for 31 per cent of the follow-up sample, and both skilled-manual workers (26.5%) and clerical, lower non-manual workers (26.2%) accounted for more than one quarter. More than 75 per cent of the follow-up subjects reported having enough money to buy small extras.

Gender differences

The demographic and SES characteristics and the health status of the male and female subjects are shown in Table 2. Among the 874 follow-up

T A B L E 2. *Comparison of sample subject characteristics by gender*

Variable	Females		Males	
	N	%	N	%
Marital status change 1994–98***				
With spouse throughout	198	44.9	358	82.7
Without spouse throughout	159	36.0	46	10.6
Loses spouse	84	19.1	29	6.7
Educational level***				
Illiterate	242	54.9	50	11.6
1–6 years schooling	150	34.0	204	47.3
7+ years schooling	49	11.1	177	41.1
Extra money: Yes	332	75.3	339	78.3
Work status***				
Professional/managerial	1	2.3	58	13.4
Clerical, lower non-manual	43	9.8	187	43.2
Skilled-manual	81	18.4	151	34.9
Semi-skilled and unskilled	46	10.4	27	6.2
Never worked/housewife	270	61.2	2	0.5
	Mean ± s.d.		Mean ± s.d.	
Age (years)	71.2 ± 5.7		70.6 ± 5.0	
Number of chronic diseases	1.05 ± 1.15		0.84 ± 1.01**	
Activities of Daily Living Scores				
1994 ADL	11.86 ± 0.91		11.89 ± 0.75	
1998 ADL	11.23 ± 2.51		11.39 ± 2.23***	
1994 IADL	13.03 ± 2.07		13.59 ± 1.44	
1998 IADL	11.69 ± 3.76		12.55 ± 3.44***	
Sample sizes	441		433	

Significance levels: For differences between men and women: $* p < 0.05$; $** p < 0.01$; $*** p < 0.001$.

subjects, 441 were female and 433 were male, and their respective mean ages were 71.2 and 70.6 years. One of the most marked gender differences was in marital status, for 44.9 per cent of the women but 82.7 per cent of the men lived with their spouses in both 1994 and 1998. Among the women, 19.1 per cent had lost their husbands over the four years, but only 6.7 per cent of the men lost their wives.

There were significant gender differences in both the level of education and the former occupation. Most women (54.9%) had had no formal education, compared to only 11.6 per cent of the men; and 60 per cent of the women had never had a formal job but only 0.6 per cent of the men. The former principal occupations of the men were in clerical or lower non-manual occupations (43.2%), followed by skilled-manual jobs (34.9%). There was no significant difference between men and women in the proportion having above subsistence or 'extra' money. The women had a higher mean number of chronic diseases than the men (1.05 *versus*

T A B L E 3. *Functional change of PADL and IADL between 1994–1998 by gender*

	Females		Males		Total	
	N	%	N	%	N	%
Physical ADL						
Declined	54	(12.2)	43	(9.9)	97	(11.1)
Unchanged	380	(86.2)	384	(88.7)	764	(87.4)
Improved	7	(1.6)	6	(1.4)	13	(1.5)
Instrumental ADL***						
Declined	170	(38.6)	89	(20.5)	259	(29.6)
Unchanged	240	(54.4)	329	(76.0)	569	(65.1)
Improved	31	(7.0)	15	(3.5)	46	(5.3)
Sample sizes	441	(100.0)	433	(100.0)	874	(100.0)

Significance test: Mantel-Haenszel statistic, *** $p < 0.001$.

0.84). There was no significant gender difference in the PADL scores at baseline and at follow-up, but there was for IADL functioning at baseline (males 13.0, females 13.6) and at follow-up (11.7 *versus* 12.6). The IADL score declined over the four years by 10.2 per cent for women and by 7.6 per cent for men.

The change in functional abilities from 1994 to 1998 by gender

Table 3 presents the changes in the PADL and IADL scores between 1994 and 1998 by gender. For the entire sample, 97 (11.1%) experienced deterioration in their PADL score, and 87.4 per cent maintained the same level of functioning. For IADL functioning, 29.6 per cent experienced functional decline and 65.1 per cent maintained the same level. Women had a higher rate of PADL and IADL deterioration than men, but the differences were not statistically significant.

The multiple logistic regressions of PADL and IADL functional decline

The results of the multiple logistic regression models of the factors that influenced the decline of PADL and IADL are presented in Table 4. After controlling for demographic characteristics and physical status, having 'extra' money significantly associated with PADL functional decline. Older people who had money for small luxuries were 40 per cent less likely to have experienced PADL functional decline than those who did not (OR = 0.60; 95% CI = 0.37–0.98). Two other SES indicators, level of education and occupation, as hypothesised associated negatively with PADL decline, but not significantly. PADL functioning was however

T A B L E 4. *Multiple logistic regression models of PADL and IADL functional decline, 1994–98*

Model variable	PADL decline		IADL decline	
	OR	(95 % CI)	OR	(95 % CI)
Level of education				
Illiterate	1.00		1.00	
1–6 years schooling	0.94	(0.53–1.67)	0.63	(0.42–0.95)*
7 or more years schooling	0.55	(0.23–1.30)	0.28	(0.15–0.51)***
Has 'extra' money				
No	1.00		1.00	
Yes	0.60	(0.37–0.98)*	0.79	(0.55–1.14)
Former principal occupation				
Professional/managerial	1.00		1.00	
Clerical, lower non-manual	1.98	(0.43–9.07)	0.83	(0.35–1.97)
Skilled-manual	2.38	(0.49–11.55)	0.86	(0.35–2.16)
Semi-skilled and unskilled	3.95	(0.72–21.72)	0.67	(0.23–1.93)
Never worked/housewife	2.54	(0.49–13.21)	0.48	(0.18–1.26)
Socio-demographic measures				
Age (years)	1.12	(1.08–1.16)***	1.11	(1.07–1.14)***
Gender (male = 1)	1.27	(0.64–2.52)	0.42	(0.26–0.67)***
Marital status				
1994–1998 with spouse	1.00		1.00	
1994–1998 without spouse	0.77	(0.42–1.40)	0.76	(0.50–1.15)
1994–1998 lost spouse	1.27	(0.64–2.52)	1.07	(0.67–1.73)
Physical health in 1994				
Number of chronic diseases	1.38	(1.14–1.67)***	1.12	(0.96–1.29)
Sample sizes		867		867
Goodness of fit statistic[1]	6.21	(*p* = 0.62)	6.95	(*p* = 0.54)

Notes: CI Confidence interval. 1. Hosmer and Lemeshow goodness of fit statistic.
Significance levels: * *p* < 0.05; ** *p* < 0.01; *** *p* < 0.001.

significantly associated with age and the number of chronic diseases. Each additional year of age, and each additional chronic condition, brought respectively a 12 per cent and a 38 per cent greater likelihood of a decline in PADL functioning.

Among the examined SES variables, the level of education was the most significant predictor of IADL functional decline. As compared with those who were illiterate, the subjects who had finished primary school or who had had seven or more years of schooling had a 63 per cent lower likelihood of such a decline.[7] Extra money was insignificantly predictive of IADL functioning change, but age and gender significantly associated with an IADL decline.[8] Men were 58 per cent less likely to experience a decline in functioning than women (OR = 0.42; CI 0.26–0.67).

Discussion

This study has explored functional change over four years in a panel sample of elderly people in a large Taiwanese city. The incidence of decline in IADL functions was much higher than in the PADL functions. The differential might be because IADL activities, *e.g.* financial management, are less frequent than PADL activities. It is likely that the older the subject, the fewer their opportunities for participation in social activities. This may result in decreasing IADL capability over time, especially among women, who were not only over-represented among those with PADL declines, but also, on average, experienced more substantial PADL declines than men.

Socio-economic status and functional decline

The analyses found that different SES variables were associated with the different types of functional decline. Losses of PADL functioning were most related to income and the number of chronic conditions, while level of education and gender were significantly predictive of reduced IADL capacities. Chronological age significantly influenced the prevalence and amount of declines in both PADL and IADL functioning. Having enough money to buy personal extras was a strong predictor of PADL decline, as found in other Asian studies using different indicators such as bank savings or household possessions (Zimmer and Amornsirisomboon 2001; Zimmer and Kwong 2004). On the other hand, no significant association was found between ADL decline and occupational group, although there was a tendency for those who had worked in manual occupations to have higher ADL declines than those who had held professional and managerial positions, as found in two British studies (Arber and Cooper 1999; Bartley, Sacker and Clarke 2004).

The strong association between level of education and health was confirmed by our findings. Illiterate subjects were more likely to have experienced IADL decline than those who had completed primary school or had had more education. Level of education may both influence and act as a proxy for health-related aspects of the lifecourse and individual behaviour (Berkman and Gurland 1998; Schoeni, Freedman and Wallace 2001). Most of those of low education in the study cohort had had arduous manual jobs, had experienced considerable barriers to medical care, had unhealthy habits and behaviour, and had little access to rehabilitation when disability occurred (as from stroke). From this perspective, the level of education influences both aspects of the lifecourse with strong health

implications and the outcomes in old age: this SES indicator has unusually strong predictive power.

Other determinants of health

Even after taking SES effects into consideration, chronological age remained significantly associated with PADL and IDAL functioning decline. In other words, and as other studies have found, ageing decreased the average subject's ability to take care of their own personal needs and to continue living independently in the community (Haan, Kaplan and Syme 1989; Abeles 1992; Crimmins and Cambois 2003). Gender also exerted a significant influence on IADL functional change. After controlling for covariates, men were 58 per cent less likely than women to develop IADL disability over the four years: at any given age, women had a higher risk of being IADL disabled than men.

Peek and Coward (1999) have drawn attention to the gendered nature of the IADL tasks, *e.g.* preparing meals and doing housework, as applied in the Taiwanese cohort being studied. The included items will clearly produce a gender differential in IADL score change over time. They may also arise from the greater social isolation of elderly women (through widowhood) and consequently their relatively low access to information about health-care or social-service programmes. Another factor is that, in the cohort, social roles, experience and skills varied by gender. Men generally took responsibility for managing finances, telephone calls and providing transport, all of which are related to IADL items.

Comparisons with other studies

The findings of this and other studies of eastern and western populations on the relationships between socio-economic status and health and functioning in old age are presented in Tables 5 and 6. Table 5 adopts the format and inclusion criteria of Crimmins and Cambois (2003); Table 6 includes only cohort panel studies.

Table 5 lists the studies of associations between socio-economic variables and health and functioning in old age using various functioning and socio-economic status measures, cross-sectional and longitudinal designs, and various age groups. Regardless of the study design, the level of education is identified as the single variable that most consistently has a significant influence on health. The two UK studies are exceptions, perhaps because they were not limited to older adults. Interestingly, being in paid work and current employment status were also found to be significant influences on health in the Japanese, Korean and UK studies. The role

of being employed in protecting health needs further confirmation. As well as the customary SES measures of level of education and occupation, financial security as measured by savings, having 'extra' money, and household possessions were positively associated with health in the Asian but not in the western studies. The importance of self-perceived economic resources to older people's health in Asian societies may be because of the absence of the universal or state pensions provided in western welfare states. It is suggested that self-reported economic resources serves as a useful proxy for income in developing countries when direct income information is unavailable.

The criteria for the inclusion of a panel cohort study in Table 6 were that: it used a prospective cohort design, the subjects were mainly elderly, the outcome measure was a decline in functioning, and multivariate analysis with controls for covariates such as age and marital status was used. We first compare the findings of our study with those from other studies of Chinese populations, then with those of studies in Asian nations that share Chinese culture and values, and lastly with those from the United Kingdom and the United States.

China, Hong Kong and Taiwan are very different countries, not least in their political systems, but have similar ethnicity and shared cultural values. For Chinese populations, low education is significantly associated with functional decline. Occupation and income were not included in a previous Taiwan study nor in a Chinese study, preventing a comparison with our findings. Although Japan, the most developed country in Asia, has many shared values with the countries that share Chinese culture, the effects of SES on health present a different picture. In the cohorts born before 1920, a higher proportion of the Japanese population completed seven or more years of schooling than in Taiwan or in other Chinese populations. Nonetheless, as with the findings for Chinese populations, the level of education was the only SES indicator that significantly predicted functioning decline among Japanese older people.

One British and one American study are included in Table 6 for comparison. The former used *British Household Panel Survey* data, and found that occupational class had strong effects on individual self-rated health among economically-active adults, while household social advantage and personal income were significant determinants of health for economically-inactive participants. Since the British study subjects ranged in age from 18 to 75 or more years, it is reasonable to assume that many of the economically-inactive were older people. As found by other studies, personal income had a significant influence on health in the British sample. For the American 1996 study, the level of education was the only SES indicator that explained the decline of health. Notably, occupational group did not

T A B L E 5. *Comparison of studies examining socio-economic differences*

Country	Authors	Measures	SES indicators	Ages	Study Design	Findings
China	Liang, Liu, and Gu (2001)	ADL (6 items)	Urban/rural residence, education	65+	LS 1991–94	Education has a positive direct effect on functional status, but that is partially offset by negative indirect effects.
China	Zimmer and Kwong (2004)	Self-care limitation (5 items)	Education, income, savings, h'hld amenities, urban/rural	60+	CSS 1992 survey in Beijing	Bank savings is the strongest predictor with health care limitation in both urban and rural areas. Being pension-eligible is a strong predictor in urban but not in rural areas.
H. Kong	Ho *et al.* (1997)	ADL (walking, climbing stairs)	Education, income	70+	LS 1991 + 18 months	No formal level of education was associated with mobility decline.
Japan	Liu *et al.* (1995)	ADL (bathing, stairs, walking)	Education	60+	LS 1987–90	Less education may increase the risk of disability.
Japan	Lee and Shinkai (2003)	ADL and IADL (10 items)	Education, working for pay, rural residence	60+	CSS 1987[1]	Less than 7 years was associated with functional disability.
Korea	Lee and Shinkai (2003)	ADL and IADL (10 items)	Education, working for pay, rural residence	60+	CSS 1994[2]	Rural residence and working were associated with functional disability.
Taiwan	Zimmer *et al.* (1998)	ADL (walking, stairs, bathing)	Education	60+	LS 1989–93	High educational attainment results in a decreased incidence of functional limitation for those originating in a state of independence, but has little influence on those originating as functionally limited.

Taiwan	Li, Wu and Wen (2000)	ADL (6 items)	Occupation	65+	LS 1993–97	Occupation more influential than education on ADL disability. Unskilled blue-collar workers had higher risk of ADL disability than white-collar workers.
Thailand	Zimmer and Amorn-sirisomboon (2001)	ADL (walking , loss of memory)	Education, bank saving, occupation	50+	CSS 1994	Income and household possessions had significant independent influences on functional disorders.
UK	Chandola *et al.* (2003)	Self rated health decline	Social advantage, personal Income	18+	LS 1991–98	Occupation has strong effects on self-rated health of the econ. active. Household social advantage has strong effects on self-rated health of econ. inactive.
UK	Bartley, Sacker and Clarke (2004)	Disability in ADL and LI	Occupation, income	21–59/64[3]	LS 1991–2001	Lower income is associated with a higher risk of limiting illness, independently of education, social class, and employment status.
USA	Crimmins, Hayward and Saito (1996)	ADL and IADL	Education	70+	LS 1984–90	Level of education is inversely related to life expectancy.
USA	Manton, Stallard and Corder (1997)	ADL and IADL	Education	65+	LS 1982–94	Higher education results in longer life expectancy.

Notes: ADL Physical activities of daily living. IADL Instrumental activities of daily living. LS Longitudinal study. CSS Cross-sectional study. LI Limiting illness(es).
1. National Survey of the Japanese Elderly. 2. Survey of the Living Status of the Korean Elderly. 3. Women 21–59 years; Men 21–64 years.

T A B L E 6. *Findings from cohort panel studies about the association between SES and functional declines among older people*

Country	Study and year of publication	Socio-economic status			Functional change		
		Level of education	Occupation group	Income	PADL	IADL	PADL +IADL
Taiwan	This study 2005	Sig.	N.s.	Sig.	Yes	Yes	–
Taiwan	Zimmer *et al.* 1998	Sig.	–	–	–	–	Yes
China	Liang, Liu, and Gu 2001	Sig.	–	–	Yes	–	–
H. Kong	Ho *et al.* 1997	Sig.	–	Sig.	Yes	–	–
Japan	Liu *et al.* 1995	Sig.	–	–	–	–	Yes
UK	Chandola *et al.* 2003	–	N.s.	Sig.	Yes	–	–
USA	Crimmins, Hayward and Saito 1996	Sig.	–	–	–	–	Yes

Notes: Sig. Statistically significant association between functional decline and SES indicator ($p < 0.05$). N.s. Not statistically significant. −SES or functional items not included in the analysis. PADL Physical activities of daily living. IADL Instrumental activities of daily living.

play a significant role in determining elderly health across populations and societies.

To summarise, education is the most important significant indicator of elderly health cross-nationally. As Crimmins and Cambois (2003) noted, the level of education is the only SES indicator that (for most people) remains constant after the earliest adult years, in contrast to income or occupational group that are subject to ups and downs. This may be why neither income nor occupation is a powerful predictor of health and functioning among older people. Except for the current study, most of the others listed in Table 6 did not include all three SES indicators: education, occupation and income. If all three had been included and controlled for, the findings might have changed in detail. By the same token, the present study distinguished the effects of SES on PADL functioning separately from those on IADL functioning; most previous studies have used only the PADL measure or a combination of PADL and IADL. As the current study found that the number of chronic diseases predicted PADL functional decline, while gender predicted IADL functional decline, it is clear that future studies of the factors influencing activities of daily living should measure and analyse PADL and IADL independently.

In conclusion, this study has corroborated previous research findings on the association between socio-economic attributes and change over time in older people's scores on the widely used *Activities of Daily Living* measures. In Taiwan, variations in socio-economic status have a long-term effect on an older person's functioning capacities, and higher status 'protects' against the health hazards that are intrinsic to the later stages of human

ageing. A review of comparable studies in other countries suggests that there are cross-cultural differences in the predictive power of SES for health. The level of education is the most consistently influential single variable in both eastern and western populations and societies, but Asian studies also find that self-perceived economic resources are related to older people's health and health declines.

Acknowledgments

NOTES

1 The mean age of the elderly residents of San-Min was almost identical to that for Kaohsiung City (71.4 and 71.3 years). Second, the age and gender distributions did not significantly differ ($p < 0.05$). Thirdly, the male to female ratio for the older population in San-Min was similar to that of the other 10 boroughs.

2 Among the 386 subjects who were not followed-up, 216 had died and 170 refused to participate or had moved to other areas.

3 The linguistic geography of Taiwan is complex. Mandarin is the 'standard' form of the Han or Chinese languages, in Taiwan as well as the People's Republic of China, and Hakka is a dialect. Taiwanese is a quite different language, from the Malayo-Polynesian family (see Crystal 1997: 315). All three languages/dialects are spoken in Kaohsiung City.

4 As to reliability, 85.7 per cent of the ADL scores were identical in a test-retest study. The highest inter-rater agreement for the PADL and IADL scales was r = 0.61. As to internal consistency, the Cronbach's coefficient for ADL was 0.93. Construct validity was satisfactory (Chiu *et al.* 1997).

5 It has been suggested that income may not be an appropriate indicator for measuring the financial status of older people (Crimmins and Cambois 2003).

6 The classification is based on levels of knowledge, skills and the physical effort required to perform a job. It is exactly the same as that used in a Hong Kong study (Ko *et al.* 2001) and comparable with that used in a UK study (Chandola *et al.* 2003).

7 Odds ratio (OR) = 0.63 (95% confidence interval 0.42–0.95). After controlling for covariates OR = 0.28 (CI 0.15–0.51).

8 Each additional year of age increased the likelihood of IADL decline by 11 per cent (CI 1.07–1.14).

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