AN EVALUATION OF THE FACTOR STRUCTURE OF THE INSTRUMENTAL ACTIVITIES OF DAILY LIVING INVOLVEMENT AND CAPACITY SCALES OF THE MINIMUM DATA SET FOR HOME CARE FOR ELDERLY CHINESE COMMUNITY DWELLERS IN HONG KONG

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ABSTRACT. The objective of this study was to evaluate the factor structure of the Instrumental Activities of Daily Living (IADL) Involvement and Capacity scales of the Chinese version of the Minimum Data Set-Home Care (MDS-HC), in a sample of Chinese older adults living in Hong Kong (n = 3523). The results of confirmatory factor analyses supported the one-factor model for both IADL Involvement and IADL Capacity scales. Evidence indicated that both scales had good internal consistency (0.88) and were reliable and valid in assessing IADL among elderly Chinese community-dwellers.

KEYWORDS. Chinese, IADL, factor structure, MDS-HC, home care, elderly community-dwellers.

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INTRODUCTION

Functioning ability is a major focus in aging studies. It is commonly conceptualized as a measure of the ability to perform personal care and self-maintenance activities. Information on daily function is used in a variety of clinical (Katz, Kabeto, & Langa, 2000), policy (Lai et al., 2009; Leichsenring & Alaszewski, 2004) and research contexts (Lee, Chau, Hui, Chan, & Woo, 2009; Wang, Kane, Eberly, Virnig, & Chang, 2009). Service providers use the information to describe the stages and severity of disabling chronic diseases and to develop individualized care plans for treatment purposes. Policy makers use the information as one of the eligibility criteria for services provided by health and social services agencies and for the planning of new social policies. Researchers frequently include the measure as an outcome in their clinical studies (Friedman, Wamsley, Liebel, Saas, & Eggert, 2009).

Functioning ability is frequently assessed in older adults according to their performance of the basic activities of daily living (ADL) - such as eating, bathing, dressing, - and the instrumental ADL (IADL) - that includes activities such as meal preparation, shopping and medication management (Spector & Fleishman, 1998). Compared with ADLs, IADLs include more complex and higher-order activities that require higher levels of neuropsychological organization (Lawton & Brody, 1969; Ng, Niti, Chiam, & Kua, 2006). Both ADL and IADL measures are important for evaluating older community-dwellers who must take care of themselves or be cared for by caregivers.

The dimensionality of a measuring tool is another critical consideration because it directly relates to the definition of the construct and to the interpretation of scale scores (Anderson & Gerbing, 1982). IADL measures lack clear specification of the underlying construct, and there is still debate over whether IADLs should be conceptualized as a unidimensional or two-dimensional construct (Lindeboom, Vermeulen, Holman, & De Hann, 2003; Thomas, Rockwood, & McDowell, 1998). In the most common two-dimensional conceptualization, activities related to intermediate self-care like household chores (e.g. preparing a meal, performing ordinary housework) and transport (e.g. walking, using public transportation), are categorized as physical IADLs, while those requiring higher cognitive resources for more complex self-management (e.g. managing finances or medication, using the phone) are categorized as cognitive IADLs (Ng et al., 2006; Thomas et al., 1998; Wolinsky & Johnson, 1991). However, Vittengl, White, McGovern and Morton (2006) show that a set of eight IADL items can be expressed as a single dimension. Furthermore, other studies show that the ADL and IADL items are highly correlated and hence can be combined into a single measure of functional disability (Fleishman, Spector, & Altman, 2002; LaPlante, 2010; Spector & Fleishman, 1998).

The Resident Assessment Instrument (RAI) is a series of standardized comprehensive assessment tools that was developed by an international group of academics, clinicians and other health care professionals for analyzing different services, such as home care, residential care, acute care and mental health care (Carpenter, 2006; Hirdes et al., 1999; Morris et al., 1990). The Minimum Data Set for Home Care (MDS-HC) is one of the RAI assessment tools specifically developed for the

home care setting, and is also known as the RAI-Home Care (RAI-HC) (Morris et al., 2000). The MDS-HC is typically used as a screening instrument for home care providers in assessing the multiple key domains of functioning, health, social support and service use (Hirdes, 1996). The MDS-HC provides two scales that measure IADL from two different perspectives: The IADL Involvement scale aims to measure the client's involvement level, while the IADL Capacity scale assesses the client's difficulty level in performing seven specific tasks (Kwan, Chi, Lam, Lam, & Chou, 2000). The Hong Kong-Chinese version of the MDS-HC was validated in previous studies that showed adequate reliability and criterion validity (Chou, Chi, Leung, Wu, & Liu, 2001; Kwan et al., 2000). A few studies have examined the factor structure of some measures in other versions of MDS (Casten, Lawton, Parmelee, & Kleban, 1999; Morris, Fries, & Morris, 1999), but no study thus far has addressed the IADL scales in the MDS-HC. The objective of the current study is to examine the underlying factor structures of the IADL Involvement and Capacity scales in the Chinese version of the MDS-HC through confirmatory factor analysis by using a secondary data sample of Hong Kong community-dwelling elderly people who have sought long-term care services.

METHODS

SAMPLE AND PROCEDURE

We conducted a secondary analysis of data collected from a large cohort of elderly community-dwellers applying for long-term care service in Hong Kong in 2006. The MDS-HC was mandated for use as the placement assessment tool for existing service users to determine the care needs of the elderly and match them with appropriate services in Hong Kong. With the implementation of the central waiting list for government-subsidized long-term care services, the instrument has been further mandated for use in the eligibility screening of applications for long-term care services since November 2003 (Lai, Tse, & Lau, 2008). Older adults in Hong Kong who applied for long-term care services had to be referred from designated local government departments and non-governmental organizations which provide social care services in order to be registered on the central waiting list (Social Welfare Department, 2009). Trained assessors, professionals from various disciplines (e.g. social workers, nurses, occupational therapists and physiotherapists) who had completed a five-day training program on the use of the MDS-HC assessment tool, conducted the assessment. The assessment included direct questioning of the client and the primary family caregiver - if the client was being cared for - observation of the client in the home environment, and a review of secondary documents if they were available. In the case of dubious answers, the assessor would make a further in-depth assessment to arrive at the most accurate professional judgment. For example, the assessor would ask the client's caregiver regarding receiving medication as prescribed by physician/nurse practitioner if either the client is cognitively impaired, or the caregiver administers the medications to the client. The assessor would also check the client's medical record in case the caregiver could not clearly state the details. A total of 10,331 clients on the central waiting list completed

the MDS-HC in 2006. The sample in the current analysis consisted of 3523 elderly persons aged 60 or older, who lived in private homes and had no prior or current home care services.

INSTRUMENTAL ACTIVITIES OF DAILY LIVING INVOLVEMENT AND CAPACITY ITEMS IN THE MDS-HC2.0

There are seven items measuring the functioning of older adults in their instrumental activities of daily living (IADL) in the MDS-HC. Each item was measured from two perspectives: a) the level of involvement and b) how difficult it is or would be for older adults to carry out the activity on their own. The IADL Involvement scale measured the client's performance at home or in the community during the seven days prior to the assessment date using a 4-point Likert scale ranging from 0='independent' to 3='totally dependent on others' when performing an activity - with one additional option when the activity did not occur at all. In line with the previous study on ADL in the MDS by Morris et al. (1999), we also converted the additional code of 'activity did not occur' to 3='totally dependent on others' in the analysis. The IADL Capacity scale assessed the extent of difficulty when clients were performing the activity solely by themselves, using a 3-point Likert scale, ranging from 0='no difficulty' to 2='great difficulty'.

DATA ANALYSIS

Confirmatory factor analysis (CFA) was used to assess the factor structure of each of the IADL Involvement and Capacity scales. A one-factor model with all the items as indicators and a two-factor model with three items (managing finance, managing medication and phone use) corresponding to the cognitive IADL factor and four items (meal preparation, ordinary housework, shopping and transport) corresponding to the physical IADL factor were fitted to the covariance matrix of the corresponding IADL items for the Involvement and Capacity scales respectively. To test the stability of the resulting factor structure after identifying the most economical model, we performed a cross-validation examination of the model by randomly splitting the sample into half and by gender. The reliability of the two scales was assessed by computing and interpreting Cronbach's alpha. Scores of the IADL Involvement and Capacity scales were computed by summing the corresponding items. Katz et al., (2000) found, in a national survey in the United States, that women reported more IADL impairment and were more likely to be living alone than men. Hence, we compared the IADL scores by gender and their living status using the Mann-Whitney test with SPSS17.0. For each comparison, the standardized mean difference effect sizes (Cohen's *d*) were computed and values of 0.2, 0.5 and 0.8 and greater were considered as small, medium and large differences respectively (Cohen, 1992). For all tests, a p-value <0.05 is considered as statistically significant.

All the CFAs were performed by the EQS 6.0 package (Bentler, 2006) using the maximum likelihood estimation with a robust procedure to adjust for non-multivariate normality of the data (Satorra & Bentler, 1994). Assessment of the model's fit to the data was based on four fit indices: (a) Robust Comparative Fit Index (R-CFI); Bentler

1990), (b) Robust Normed Fit Index (R-NFI; Benlter & Bonnett, 1980), (c) standardized root mean squared residuals (standardized root mean squared residuals (SRMR); Bentler, 2006), and (d) root mean square error of approximation (RMSEA; Browne & Cudeck, 1993). The cutting values of R-CFI>0.90, R-NFI>0.90, SRMR<0.08, and RMSEA<0.08 indicate a good fit to the data and will not be rejected (Hoyle, 1995). We also reported the robust χ^2 (R-χ^2) and its associated degree of freedom (*df*) for completeness, although they were not used for model evaluation because the R-χ^2 test is sensitive to sample size (Hu, Bentler, & Kano, 1992).

RESULTS

CHARACTERISTICS OF THE SUBJECTS

The average age of the subjects was 79.6 years (*SD*=7.5). Sixty percent were females (*n*=2122) and 21% were living alone (*n*=736). Most had no formal education (57%, *n*=2008) or a minimum primary education (32%, *n*=1125): 6% had completed primary education (*n*=217) and only 5% had at least some secondary education (*n*=173). Forty-three percent were married (*n*=1496), 50% were widowed (*n*=1743), 5% had never married (*n*=163), and 3% were divorced/separated/cohabiting (*n*=121).

Table 1 presents frequencies and mean scores of the individual IADL items, with a higher mean Involvement score indicating higher dependency on others and a higher Capacity score indicating more difficulty performing tasks. The respondents were least

frequently dependent in the case of the cognitive IADL items concerning phone use and managing medication and to a lesser extent in managing finances on the Involvement scale. A similar pattern was observed regarding their level of difficulty in performing the IADLs on the Capacity scale.

FACTOR STRUCTURE OF THE INSTRUMENTAL ACTIVITIES OF DAILY LIVING INVOLVEMENT SCALE

Examination of the fit indices in Table 2 reveals that, although the Root Mean Square Error of Approximation (RMSEA) values exceeded the cut-off of 0.08, both the one-factor and two-factor models provided good fits for the data of the IADL Involvement scale. This was supported by the other indices (R-CFI; R-NFI and SRMR), for the overall sample, males and females, and both split halves. The CFA results further suggested that the two-factor model provided a better fit than the one-factor model. However, a closer examination of the factor correlations between the physical and cognitive IADL factors in the two-factor model showed that they were highly correlated (>0.88), using Cohen's criterion (Cohen, 1988) in the overall sample and gender and random split sub-samples, which indicates they are combinable into a single measure (Spector & Fleishman, 1998). Table 2 also shows that all the standardized factor loadings of the one-factor model for the IADL Involvement scale were greater than 0.50 for the overall sample as well as the split halves and male and female sub-samples. In addition, the Cronbach alpha for the overall sample was 0.882, which was greater than the cut-off point of 0.7 (Kline, 2000). Therefore, we could conclude that the IADL Involvement scale was reliable in the sample of the Hong Kong community-dwelling elderly.

FACTOR STRUCTURE OF INSTRUMENTAL ACTIVITIES OF DAILY LIVING CAPACITY SCALE

Table 3 shows the two-factor model provides a superior fit to the one-factor model for the data of the IADL Capacity scale for the overall sample and the gender and the split half sub-samples. However, the high factor correlations between the physical and cognitive IADL factors (>0.75) indicate that the two factors are highly correlated. The one-factor model gave marginally acceptable fits except for the female sub-sample, where a good fit was observed but it was primarily chosen for its efficiency (Spector & Fleishman, 1998). Again, the values of RMSEA were greater than the cut-off of 0.08 for the overall samples and all the sub-samples. Table 3 shows that all the standardized factor loadings were greater than 0.54 for the one-factor structure of the IADL Capacity scale. The Cronbach alpha value of the IADL Capacity scale was 0.881 for the overall sample, suggesting the scale has acceptable internal consistency for the sample of elderly community-dwellers.

COMPARISON OF INSTRUMENTAL ACTIVITIES OF DAILY LIVING INVOLVEMENT AND CAPACITY SCORES

Scores of the IADL Involvement and Capacity scales were then computed by summing the corresponding items. Ranging from 0 to 21, the IADL Involvement scores indicate the clients' dependency level in performing IADL. The higher the Involvement score, the higher the client's level of dependency. Similarly, the level of capacity the client

achieved when performing IADL was reflected by the Capacity scores, ranging from 0 to 14, with higher scores indicating the increasing difficulty clients found when performing the activities on their own.

Moderate levels of dependency were reported in both the IADL Involvement (*M*=13.2, *SD*=5.9 out of 0-21) and Capacity (*M*=9.7, *SD*=3.7 out of 0-14) in the community-dwelling sample. The effect sizes in the IADL Involvement and Capacity scales with respect to gender were small, although females scored significantly lower than males on both the IADL Involvement scale (*M*=12.8, *SD*=6.1 vs. *M*=13.8, *SD*=5.7; p<0.001; *d*=0.08) and the Capacity scale (*M*=9.6, *SD*=3.8 vs. *M*=10.0, *SD*=3.5; p<0.001; *d*=0.06). There were small to medium effect sizes in the two mean scores concerning living arrangement; older adults living alone had significantly lower scores on both the IADL Involvement scale (*M*=8.9, *SD*=6.1 vs. *M*=14.4, *SD*=6.1; p<0.001; *d*=0.38) and the Capacity scale (*M*=7.4, *SD*=3.8 vs. *M*=10.4, *SD*=3.4; p<0.001; *d*=0.33), compared to those living with others.

CONCLUSION

Measuring instrumental activities of daily living (IADL) among older adults is valuable because of its usefulness in various clinical, policy and research contexts. In our study, we examined the factor structure of the IADL Involvement and Capacity scales of the Chinese version of the MDS-HC through confirmatory factor analysis, using a large sample of community-dwelling older adults seeking long-term care services in Hong

Kong. Although the two-factor model was a better fit than the one-factor model, the current findings support the one-factor structure of both IADL Involvement and Capacity scales - given that the physical IADL and cognitive IADL factors were highly correlated (≥0.80), indicating the two factors were combinable. We were also able to replicate the factor structures of the two IADL scales in two random sub-samples of females and males; internal consistency estimates for the two IADL scales were satisfactory.

Ng et al. (2006) also found that a two-factor structure provided a better fit for an eight-item IADL Involvement scale, with a moderate correlation in their sample of Asian older adults between the physical and cognitive IADL factors (0.61). The discrepancy in the factor correlations of the two studies might be due to the differences in respondents' characteristics. Compared with respondents randomly drawn from the community, our own respondents (all applying for subsidized long-term care services) were older and frailer - many needed at least some help with performing the seven IADL tasks. Previous studies also showed that a greater proportion of older than younger adults had difficulty performing physical IADL activities, but such a pattern was not observed in cognitive IADL activities (LaPlante, 2010; Niti, Ng, Chiam, & Kua, 2007). Further studies should investigate the heterogeneity in the seven IADL items of the MDS by age among elderly Chinese.

The results of our study have significant clinical implications for healthcare services. In response to the increasing demand for home-care support for disabled elderly people in the community, healthcare organizations in many countries, including Hong Kong, are developing programs to provide a myriad of community support services (Lai et al., 2009). The clinical assessment of daily function and disability thus

becomes an integral part of the clinical decision-making process in service provision. The IADL Involvement scale in the Hong Kong Chinese version of MDS-HC was shown to have an acceptance factorial validity and is therefore a valid overall measure of the self-reported IADL Involvement of the community-dwelling elderly. Healthcare providers can use the overall score of the IADL Involvement scale with confidence as a reliable and essential component for the determination of a client's eligibility for service. The IADL Capacity scale, on the other hand, offers healthcare providers with more informative guidance in designing the individualized care plan that will best fit the particular needs of each elderly adult, especially those living alone who were found to be more vulnerable in their functional daily living activities.

There are a number of limitations to the current study that are worth noting. First, the one-factor solution for the IADL Involvement and the IADL Capacity scales was replicated in the same sample. In order to arrive at firm conclusions about the best-fitting factor solutions, cross-validation using new samples would be necessary. Second, given the cross-sectional data used in the current study, we were unable to examine the predictive validity of the scales. Hence, further studies utilizing a longitudinal design will be desirable for examining the predictive validity as well as stability of the factor structures of the two IADL scales over time. Third, although the sample consisted of a large cohort of older Hong Kong adults seeking long-term care services for the first time, replication of our study with more representative samples of the whole Chinese elderly community would definitely further enhance the generalizability of the study's results.

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TABLE 1 Summary statistics for Instrumental Activities of Daily Living (IADL) (n = 3523)

	Percentage reporting				
IADL Involvement scale	Independent (0)	Needs some help (1)	Needs full help (2)	By others (3)	Mean score (SD)
Meal preparation	12.0	14.5	16.0	57.5	2.19 (1.08)
Ordinary housework	10.7	17.5	15.5	56.4	2.18 (1.06)
Managing finance	18.5	15.5	20.2	45.8	1.93 (1.16)
Managing medication	32.9	25.9	26.3	14.9	1.23 (1.06)
Phone use	44.9	14.5	8.0	32.5	1.28 (1.32)
Shopping	9.7	16.3	21.5	52.5	2.17 (1.02)
Transport	8.6	14.6	22.2	54.6	2.23 (0.99)

	Percentage reporting			
IADL Capacity scale	No difficulty (0)	Some difficulty (1)	Great difficulty (2)	Mean score (SD)
Meal preparation	6.9	24.2	68.9	1.62 (0.61)
Ordinary housework	5.9	26.7	67.4	1.62 (0.59)
Managing finance	17.4	27.6	55.0	1.38 (0.76)
Managing medication	28.9	39.6	31.5	1.03 (0.78)
Phone use	37.8	32.0	30.2	0.92 (0.82)
Shopping	6.1	26.0	67.9	1.62 (0.60)
Transport	6.2	32.2	61.6	1.55 (0.61)

Response categories for the IADL Involvement scale: 0 = 'Performed independently', 1 = 'Performed with help some of the time', 2 = 'Performed with help all the time', 3 = 'Performed by others', and 8 = 'Activity did not occur' during the last 7 days. Category 8 combined with category 3; Response categories for the IADL Capacity scale: 0 = 'Performed with no difficulty', 1 = 'Performed with some difficulty', and 2 = 'Performed with great difficulty' during the last 7 days; SD = Standard deviation.

TABLE 2 Results of confirmatory factor analysis of the IADL Involvement Scale for the total sample, random and gender sub-samples

Fit statistics	Total (n = 3523)	Male (n = 1401)	Female (n = 2122)	Split half 1 (n = 1761)	Split half 2 (n = 1762)
One-factor model (*df* = 14)					
R-χ^2	758.03	298.33	450.18	439.11	334.53
R-NFI	0.936	0.922	0.940	0.930	0.940
R-CFI	0.937	0.925	0.946	0.932	0.942
R-RMSEA	0.123	0.120	0.121	0.131	0.114
SRMR	0.050	0.053	0.049	0.050	0.050
Two-factor model (*df* = 13)					
R-χ^2	573.01	223.75	343.02	323.53	263.07
R-NFI	0.951	0.941	0.957	0.948	0.953
R-CFI	0.952	0.944	0.959	0.950	0.955
R-RMSEA	0.111	0.108	0.109	0.117	0.105
SRMR	0.042	0.044	0.041	0.043	0.043
Standardized solution of the one-factor model					
Item	F1	F1	F1	F1	F1
Meal preparation	0.835	0.794	0.854	0.839	0.830
Ordinary housework	0.856	0.840	0.864	0.853	0.859
Managing finance	0.811	0.804	0.820	0.804	0.819
Managing medication	0.566	0.541	0.580	0.574	0.558
Phone use	0.597	0.544	0.627	0.609	0.584

Shopping	0.812	0.827	0.807	0.818	0.804
Transport	0.562	0.597	0.544	0.564	0.560

Standardized solution of the two-factor model

Item	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Meal preparation	0.853	-	0.812	-	0.870	-	0.863	-	0.844	-
Ordinary housework	0.876	-	0.864	-	0.880	-	0.879	-	0.874	-
Managing finance	-	0.858	-	0.862	-	0.862	-	0.856	-	0.862
Managing medication	-	0.618	-	0.593	-	0.629	-	0.631	-	0.604
Phone use	-	0.639	-	0.586	-	0.667	-	0.658	-	0.619
Shopping	0.803	-	0.820	-	0.801	-	0.803	-	0.800	-
Transport	0.555	-	0.590	-	0.539	-	0.554	-	0.556	-
Factor correlation	0.895		0.884		0.906		0.881		0.900	

R-χ^2 = Robust chi-square statistic; R-NFI = Robust Normed Fit Index; R-CFI = Robust Comparative Fit Index; R-RMSEA = Robust Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Squared Residuals

TABLE 3 Results of confirmatory factor analysis of the IADL Capacity scale for the total sample, random and gender sub-samples

Fit statistics	Total (n = 3523)	Male (n = 1401)	Female (n = 2122)	Split half 1 (n = 1761)	Split half 2 (n = 1762)
One-factor model (*df* = 14)					
R-χ^2	1119.38	516.30	586.75	567.37	563.17
R-NFI	0.890	0.850	0.913	0.893	0.884
R-CFI	0.891	0.853	0.915	0.895	0.887
R-RMSEA	0.150	0.160	0.139	0.150	0.149
SRMR	0.071	0.080	0.066	0.070	0.073
Two-factor model (*df* = 13)					
R-χ^2	577.01	274.52	291.18	312.24	274.30
R-NFI	0.943	0.920	0.957	0.941	0.944
R-CFI	0.944	0.924	0.959	0.943	0.946
R-RMSEA	0.111	0.120	0.100	0.114	0.107
SRMR	0.046	0.054	0.042	0.048	0.046
Standardized solution of the one-factor model					
Item	F1	F1	F1	F1	F1
Meal preparation	0.832	0.787	0.855	0.825	0.838
Ordinary housework	0.847	0.809	0.865	0.834	0.860
Managing finance	0.752	0.733	0.768	0.757	0.747
Managing medication	0.561	0.550	0.569	0.579	0.543
Phone use	0.556	0.536	0.569	0.566	0.545

Shopping	0.822	0.823	0.829	0.818	0.827
Transport	0.706	0.725	0.698	0.716	0.697

Standardized solution of the two-factor model

Item	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Meal preparation	0.852	-	0.820	-	0.866	-	0.847	-	0.856	-
Ordinary housework	0.873	-	0.845	-	0.882	-	0.861	-	0.883	-
Managing finance	-	0.834	-	0.809	-	0.852	-	0.830	-	0.839
Managing medication	-	0.686	-	0.701	-	0.676	-	0.693	-	0.681
Phone use	-	0.677	-	0.681	-	0.675	-	0.684	-	0.671
Shopping	0.818	-	0.811	-	0.832	-	0.815	-	0.822	-
Transport	0.697	-	0.715	-	0.692	-	0.706	-	0.689	-
Factor correlation	0.798		0.759		0.824		0.806		0.789	

R-χ^2 = Robust chi-square statistic; R-NFI = Robust Normed Fit Index; R-CFI = Robust Comparative Fit Index; R-RMSEA = Robust Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Squared Residuals