

# Adoption and Handling Information Communication Technology as Instrumental Activities of Daily Living for Aging-in-Place in Chinese Older Adults

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## Research article

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# Abstract

**(Background)** The use of information communication technology and smartphone application are crucial to individuals' functional independence of community living. Previous studies did not reveal how older adults' in applying the information communication technology will affect their aging-in-place in our contemporary community.

**(Methods)** This study aimed at developing the psychometric properties of the instrument named Advanced Instrumental Activities of Daily Living (AIADL), and to explore the adoption and handling information communication technology in instrumental activities of daily living for aging-in-place of older adults. 100 home-living participants who are functionally and socially independent, 100 hostel-living participants who are functionally independent but need social assistance, and 100 care-and-attention home living participants who need environment support and assistance in daily functioning were recruited for this study.

**(Results)** AIADL showed good test-retest reliability and good-to-excellent internal consistency. Exploratory factor analysis revealed a two-factor structure with "home living and management" and "community living". Validity analysis with the known-groups method showed a high overall accuracy of prediction of individuals' capability of independent living in the community.

**(Conclusions)** AIADL is a valid and reliable instrument to assess older adults' ability in handling contemporary instrumental activities in their daily life. This instrument can serve as a reference in measuring individuals' ability of aging-in-place.

## Background

Instrumental activities of daily living (IADL) are key life tasks that older adults need to manage, in order to live in the community and be functionally independent (Chen & Chippendale, 2017; d'Orsi et al., 2014). IADLs are important parameters for older adults' successful aging in place (Cloutier et al., 2020; Gontijo Guerra, Berbiche, & Vasiliadis, 2020). Occupational therapists play an important role in assisting older adults to overcome individuals' functional decline (Dickson & Toto, 2018; Hunter & Kearney, 2018; Liu, Chang, & Chang, 2018) and support engagement of their own life roles in the community (Dickson & Toto, 2018).

The Lawton Instrumental Activities of Daily Living (Lawton IADL) scale is a well-known and classical instrument in assessing individuals' independent living skills (Lawton & Brody, 1969; Roley et al., 2008; Vlachantoni, Maslovskaya, Evandrou, & Falkingham, 2016). Over the years, the popularity of Lawton IADL still outweighs more recent measures (McGrory, Shenkin, Austin, & Starr, 2014; Vlachantoni et al., 2016) like Assessment of Living Skills and Resource (ALSAR), due to its easy administration (Graf, 2009; Vergara et al., 2012) and frequent citations in international journals (Tong & Man, 2002). The Lawton IADL has been cited by over 3000 published studies (Vlachantoni et al., 2016) and has considerable evidence of its reliability and concurrent validity (Czaja, Loewenstein, Lee, Fu, & Harvey, 2017). Its Chinese

version, namely the Lawton Instrumental Activities of Daily Living – Chinese Version (IADL-CV) was validated in 2002 using data from 155 older adults living in homes for the aged and care-and-attention homes (Tong & Man, 2002). The IADL-CV consists of nine items: use of telephone, transportation, shopping, medication management, money management, meal preparation, housework, laundry and handyman work. It was shown to be a reliable instrument for assessing older adults' ability to live independently in the community. With the use of the known-groups method, the IADL-CV had been validated with a one-factor structure (Tong & Man, 2002). However, the psychometric properties of IADL-CV had not been further examined in past decades and it does not measure individuals' ability in applying information communication technology (Graf, 2009).

Applied technology, such as the use of information communication technology and smartphone applications, has had a huge impact on the world and individuals' lifestyles. Ability in handling this technology is not only considered essential for daily functioning but also to formulate an individual's sense of independence in the community, thus increasing the quality of life in older adults (Reppermund et al., 2017; van Boekel, Peek, & Luijkx, 2017). This ability is getting more and more common in the contemporary digitalized world (D'Onofrio et al., 2017; Percheski & Hargittai, 2011) and regarded as a core essential skill for the elderly (Arthanat, 2019; Klimova & Valis, 2017; Vahia, 2019; York Cornwell & Cagney, 2017). Due to the huge gap of existing daily living measurement tools, such as Lawton IADL and IADL-CV, being unable to reflect the currently technologically heavy times (Atkins et al., 2018; Czaja et al., 2017; Graf, 2009), therefore, we should have an instrument that can evaluate individuals' functions in the contemporary community nowadays.

The aim of this study is to validate the Advanced Instrumental Activities of Living (AIADL) and apply this to measure individuals' aging in place. Instead of sacrificing the established psychometric properties of the IADL-CV that framed from the well-known Lawton IADL. This study enriched the content of the IADL-CV to the AIADL including reference to information communication technologies and smartphone applications for engaging in IADLs nowadays. The development of this validation study was under classical test theory (Cappelleri, Jason Lundy, & Hays, 2014; Salkind, 2010) to examine and test (1) the degree of clarity, understandability, and relevance (i.e. content validity), (2) the test-retest reliability score of AIADL, (3) the degree of the inter-relatedness among AIADL items like internal consistency, (4) the factor structure of the AIADL by exploratory factor analysis, (5) the correlation between Lawton IADL score and the AIADL measure, and (6) to determine construct validity and by using the AIADL to predict the residence of older adults with know-groups method (in parallel to the method adopted by the validation of IADL-CV (Tong & Man, 2002)).

## Method

### Participant selection criteria and ethics consideration

To ensure generalizability, participants were recruited from six different districts in Hong Kong. Written consents were sought from every participant with their first-degree relatives as witnesses. The inclusion

criteria were: (a) age between 65 and 80 inclusive, (b) the ability to understand verbal and written Chinese instructions, and (c) the ability and willingness to provide written consent and sign the relevant document. The following exclusion criteria were applied: (a) a history of substance abuse including alcohol, drugs, or any medication/substances indicative of chronic abuse; (b) participants with major physical dysfunction such as stroke and head injury. Approval was given by the university research ethics committee and the study was conducted according to the Declaration of Helsinki.

## Measurements

The items of the AIADL assessment involved the recruitment of a panel of experts to review the content validity, cultural relevance and how these items were relevant to aging-in-place in this contemporary society nowadays. The expert panel, should had more than 20 years' experience in domiciliary healthcare services, examined each item in the IADL-CV. The panel used the tailor-made questionnaire to evaluate the relevance of the IADL-CV to IADL for community-living older adults. The relevance of each item was assessed using a visual analog scale ranging from 1 to 10 (1 = no relevance; 10 = cultural relevance). The panel agreed that a score of less than 7 indicated that an item may not be relevant. Panel members recommended the item on the adoption and handling of information communication technology should be added to measure individuals' ability in community living. Additionally, the concept of using stored-value-smart-card for electronic payments should be added on money management. With the modification of IADL-CV items, the AIADL is a 10-item instrument in assessing instrumental activity of daily living of older people in the community. These ten items include use of information communication technology, use of telephone (in accessing internet to obtain information), transportation, shopping, medication management, using electronic payments and money management, meal preparation, housework, laundry, and handyman work. The score ratings are from 0 – dependent, 1- with help to 2- Independent, accumulatively ranging from 0–20. Higher scores indicate higher levels of functional independence in instrumental activities of daily living. Additionally, individuals' cognitive function was screened by using the Hong Kong Montreal Cognitive Assessment (HK-MoCA) (Wong et al., 2009), scoring 19 or less would be classified as cognitive impairment. Furthermore, individuals' physical disability was assessed by the Chinese version of the Disability Assessment for Dementia (CDAD) (Mok et al., 2005). This was used to assess the convergent validity of the AIADL, as CDAD has been well recognized for the measurement of individuals' function disability.

## Statistical Plan

The AIADL was tested with degrees of clarity, understandability, and relevance. Moreover, kappa coefficient was used in interpreting expert panels' degree of agreement for these items in AIADL. Content validity and cultural relevance of the AIADL were measured by the content validity index. In construct validation, this study recruited three different types of participants. First, home-living (HL) participants who are independent dwellers live in their own homes with or without an attendant. Second, participants

who are capable and independent in terms of self-care and community living but with social support needs and live in Hostels for the Older People (HE). These two groups of participants provided their self-rating of AIADL. Third, Care and Attention Home (C&A) dwellers who need environmental support and assistance in IADL tasks. According to their limited cognitive function, research assistants provided AIADL ratings for this specific group of participants. The flow diagram demonstrates the recruitment of participants as shown in Fig. 1.

Demographic information, social information and health history were collected. Data analyses were conducted using IBM-SPSS (version 23) on Windows 10 OS. Standard descriptive statistics were computed for continuous data and frequency distributions for noncontinuous data. Parametric analysis would be employed as far as possible, with data transformation to better comply with mathematical assumptions of parametric analysis whenever appropriate. Statistical significance of 0.05 would be applied throughout. The intra-class correlation coefficient (ICC) would measure the reliability and internal consistency, by two-way mixed-effects model and absolute-agreement model, of ratings in AIADL. We used chi-square tests to compare frequency distributions between the different groups of participants. For construct comparison, Pearson correlation coefficients were computed to compare scores on cognitive (HK-MoCA) and functional disability (CDAD) parameters. ANOVA comparison and post-hoc analysis of cognitive function and the AIADL mean scores among these groups were conducted. Moreover, the interdependencies between variables could be used to reduce the set of variables in this dataset, the exploratory factor analysis using a principal-axis factor extraction was conducted to determine the factor structure of AIADL. Bartlett's test of sphericity tests was used to test if the correlation matrix was an identity matrix, which indicated variables are unrelated and therefore unsuitable for structure detection. Statistical significance of 0.05 indicated that a factor analysis could be useful. The Kaiser-Meyer-Olkin (KMO) test was used to determine the sampling adequacy of data that were used for factor analysis. Validity analysis by using the known-groups method was used to predict the accuracy of their residence in community.

## Sample Size Estimation

Power analysis was performed using G\*Power based on the previous reference study of IADL-CV (Tong & Man, 2002) and calculated with a medium effect size = 0.4, statistical significance = 5%, and estimated power = 0.8. G\*Power indicates that the required sample size per group is 84 for test-retest reliability. Each participant was asked to complete the AIADL twice, the interval between the two measures should be within one week for the test-retest reliability. For factor analysis, 85 participants per group for HL and HE, was required in producing small to medium effect size = 0.3. Taking 10% attrition rate, 100 HL and 100 HE participants were recruited. Another one hundred functionally dependent participants from C&A were recruited for validity analysis using the known-groups method. The levels of IADL were classified according to the 3 groups of living residences (HL, HE and C&A), in which each group had 100 estimated participants.

## Results

### Content Validity of the AIADL

Ten Chinese-speaking home living older people (6 females and 4 males; ages ranged from 65 to 75, mean = 68.76, SD = 2.76) were recruited from the day activity centre to complete a questionnaire, in order to assess content validity of the AIADL. The participants' education ranged from primary to tertiary levels. The refinement of the AIADL assessment involved the recruitment of a panel of experts to review the content validity and cultural relevance of the IADL-CV. The panel of experts consisted of five members (three occupational therapists and two community nurses) with more than 20 years' experience in domiciliary healthcare. One item on adoption and handling of information communication technology was added to AIADL. Additionally, the concept of using stored value smart card for electronic payments was refined in money management, so as to increase the comprehensibility and relevance to money management nowadays. All ten items showed satisfactory clarity and understandability in IADL-CV (with a mean score > 7 out of 10) except the item on handyman work scored 6.82 out of 10 (SD = .29). This was referred back to the panel for further discussion and confirmed to be retained.

Moreover, the kappa score was used to indicate the level of agreement between the panel members. As depicted in Table 1, all items of AIADL result with the Kappa score range from .61 to .75, which indicate there are moderate to substantial agreement of items among the AIADL (Landis & Koch, 1977). Moreover, all of the I-CVI (item-level content validity index) indicated the item-level content validity  $\geq .81$ , and S-CVI/Ave (scale-level content validity index based on the average method) = .83 that indicate good content validity and cultural relevance of the new AIADL scale.

Table 1  
Agreement of items by expert panel (n = 10)

Item of AIADL	Kappa Score (95% confidence interval)	I-CVI (item-level content validity index)
1. Use of telephone	.75 (.43 - .95)	.83
2. Use of Information Communication Technology (*new item)	.74 (.42 - .94)	.81
3. Transportation	.72 (.45 - .89)	.86
4. Shopping	.68 (.46 - .92)	.81
5. Meal Preparation	.66 (.47 - .93)	.86
6. Housework	.71 (.46 - .92)	.81
7. Handyman Work	.65 (.43 - .95)	.84
8. Laundry	.67 (.38 - .86)	.84
9. Medication Management	.62 (.41 - .87)	.82
10. Money Management (* refined item)	.62 (.43 - .82)	.83

## Test-retest Reliability Of The Aiadl Assessment

In test-retest reliability analysis. 100 participants from the HL group (65 females and 35 males; ages ranged from 65 to 75, mean = 69.71, SD = 2.58) were recruited. They had a MoCA score of mean = 23.89, SD = 1.65, the CDAD score of mean = .92, SD = .03. The AIADL was repeated one week after the pre-test. The ICC and 95% confidence intervals were calculated on the basis of an absolute-agreement, two-way mixed-effects model. There was good test-retest reliability with an ICC of .88 from the AIADL summation score (individual item ICCs ranging from .86 to .92, and 95% CI: .84–.95) as shown in Table 2. There was good to excellent internal consistency (Cronbach's alpha = 0.94).

Table 2  
Reliability testing of the AIADL ( n = 100, home living participants)

Items of AIADL	Test-retest Reliability (ICC) (n = 100)
1. Use of telephone	.90 (95% C.I. = .89- .91)
2. Use of Information Communication Technology (*new item)	.86 (95% C.I. = .84- .91)
3. Transportation	.91 (95% C.I. = .86- .94)
4. Shopping	.91 (95% C.I. = .85 - .95)
5. Meal Preparation	.90 (95% C.I. = .86- .91)
6. Housework	.92 (95% C.I. = .87- .93)
7. Handyman Work	.90 (95% C.I. = .88- .91)
8. Laundry	.92 (95% C.I. = .89- .93)
9. Medication Management	.89 (95% C.I. = .84-.91)
10. Money Management (* refined item)	.88 (95% C.I. = .86- .93)

## Factor Analysis Of The Aiadl

In analyzing the factor structure, apart from the 100 HL participants that were recruited initially, another one hundred HE participants (53 females and 47 males; ages ranged from 67 to 77, mean = 68.34, SD = 1.47; with MoCA score with mean = 23.72, SD = 1.39) and CDAD score with mean = .91, SD = .03 were recruited. The mean score of AIADL of HL group was 19.52 (SD = 1.26) and HE group was 19.48 (SD = 1.21). There was no significant difference between the HL and HE group ( $p < .05$ ). There was good linear relationship between individual items in AIADL (Pearson  $r$  ranging from .72 to .91), item-factor correlation with Pearson  $r$  ranged from .78 to .90, and item-total correlation ranged from .79 to .89. To test for the correlation matrix of variables, Bartlett's test of sphericity was used to establish the adequacy of the data set, all items in AIADL showed with  $p$  value less than .05. Kaiser-Meyer-Olkin measure of sample adequacy showed with .82, which indicated a factor analysis would be useful with the collected data.

Category quantification was applied to treat the levels of the trichotomized data directly as values from a continuous distribution. The exploratory factor analysis using a principal-axis factor extraction was conducted to determine the factor structure. Direct oblimin rotation methods were used and created two factors with sums of squared loadings ranging from .72 to .81. Two dimensions were yielded from the factor analysis, their loading was depicted in Table 3. The first dimension had an eigen value of 3.95 (with 95% CI from 2.47 to 4.21) which contributed 45.60% of the variance; the second dimension had an eigen value of 1.98 (with 95% CI from 1.21 to 3.21), which contributed 39.92% of the variance.

Table 3  
Factor loading of AIADL (n = 100, home living (HL) and n = 100, hostel for older people (HE))

Items of AIADL	Item Scores	Item Scores	Factor 1	Factor 2
	(HL)	(HE)		
1. Use of telephone	1.81 ± .12	1.80 ± .11	.72	.11
2. Use of Information Communication Technology (*new item)	1.67 ± .23	1.65 ± .18	.17	.72
3. Transportation	1.67 ± .23	1.66 ± .21	.12	.72
4. Shopping	1.63 ± .23	1.63 ± .21	.12	.72
5. Meal Preparation	1.72 ± .09	1.72 ± .11	.81	.07
6. Housework	1.34 ± .42	1.34 ± .41	.72	.12
7. Handyman Work	1.47 ± .39	1.47 ± .38	.72	.21
8. Laundry	1.62 ± .23	1.63 ± .32	.72	.09
9. Medication Management	1.67 ± .21	1.65 ± .22	.77	.12
10. Money Management (* refined item)	1.72 ± .23	1.71 ± .23	.11	.72
Total Score	19.52 ± 1.26	19.48 ± 1.21		

#### Confidence Intervals (CIs) for Eigenvalues

Factor Number	Observed Eigenvalue	95% CI
1	3.95	[2.47 – 4.21]
2	1.98	[1.21 – 3.21]

Factor one was labelled “home living and management” and included six items: use of telephone, meal preparation, housework, handyman work, laundry, and medication management. Factor two was named “community living” and consisted of four items: transportation, shopping, money management and use of mobile electronic communication devices. The ranges of item total correlation were from .75 to .82 (for home living and management), and .71 to .83 (for community living). In measuring the internal consistency of these two individual factors and the overall AIADL, the Cronbach’s alphas were .96, .94, and .94, respectively. The high internal consistency suggests that the two factors and the overall AIADL measure the same construct. Moreover, the Lawton-IADL showed higher correlation with AIADL ( $r = .87, p < .01$ ), with “Home living and management” factor ( $r = .89, p < .01$ ) and “Community Living” factor ( $r = .73, p < .01$ ). The distribution of items’ score is depicted in Table 3.

# Examine Group Difference From Three Types Of Residences

In examining if there were group differences, apart from the HL and HE participants, we recruited another 100 C&A participants, 45 females and 55 males, with ages ranging from 66 to 80 years (mean = 71.23, SD = 7.38) and MoCA score with mean = 14.29, SD = 2.19, CDAD score with mean = .42, SD = .09. Their AIADL score was 13.28 (SD = 2.84).

In accordance with the methodology in validating the IADL-CV (Tong & Man, 2002), by using the known-groups method, the AIADL was used to predict participants into their corresponding living institutions- HL, HE and C&A homes. Table 4 shows that there was a high accuracy of older adults' residence in the community (91.67%). This figure came from concordant pairs (92 + 88 + 95)/300. The correlation coefficient between AIADL scores and known group was .85, a correlation matrix was constructed using their cognitive function and factors of AIADL. Cognitive function showed a significant correlation with home living and management ( $r = .78, p < .001$ ), and with community living ( $r = .72, p < .01$ ).

Table 4

Classification Results of Grouping [with N = 300; with home living (HL): n = 100, hostel for older people (HE) : n = 100, care and attention home (C&A):n = 100]

		Institution	Predicted Group Membership		C&A	
			HL	HE	n	
Original	Count	HL	92	6	2	100
		HE	10	88	2	100
		C&A	1	4	95	100
%		HL	92.0%	6.0%	2.0%	100%
		HE	10.0%	88.0%	100.0	100%
		C&A	1.0%	4.0%	95.0%	100%
91.67% [Concordant pairs = (92 + 88 + 95)/ 300] of original grouped cases correctly classified.						
* In cross validation, each case is classified by the functions derived from all cases other than that case.						

A one-way between subjects' ANOVA was conducted to compare the effect of groups on AIADL and cognitive conditions. There was a significant effect of grouping on AIADL at the  $p < .05$  level for the three groups [ $F(2,297) = 202, p = .03$ ]. Post-hoc comparison using the Tukey HSD test indicated that the mean score for the C&A group ( $M = 13.28, SD = 2.84$ ) was significantly different from the HL and HE group ( $M = 19.52, SD = 1.26$  &  $M = 19.48, SD = 1.21$  respectively). Likewise, there was a significant effect of grouping on cognitive function at the  $p < .05$  level for the three groups [ $F(2,297) = 189, p = .03$ ]. Post-hoc comparison using the Tukey HSD test indicated that the mean score for the C&A group ( $M = 14.29, SD = 2.19$ ) was significantly different from the HL and HE group ( $M = 23.89, SD = 1.65$  &  $M = 23.72, SD = 1.39$ ).

respectively). However, there was no significant difference in both AIADL and cognitive functions from HL and HE participants.

In convergent validity, the score of AIADL had a high correlation with the cognitive construct- the MoCA-HK ( $r = .86, p = .02$ ), and the functional construct -the CDAD ( $r = .85, p = .01$ ); the Lawton IADL ( $r = .96, p = .01$ ). The AIADL was shown to be reliable and valid in assessing the daily function of community-residing older adults.

## Discussion

Aging in place is a process that involves both the person and the environment; it is a continuous dynamic interaction as both the person and the environment change. With the influence of information communication technology, our living environment has changed substantially (Atkins et al., 2018; Percheski & Hargittai, 2011). Rehabilitation practitioners should be sensitive to changing environment, cultural, and social factors over time. Information communication technology, such as smartphone application or other mobile electronic devices (Dobransky & Hargittai, 2012), use of stored value smart cards for making electronic payments (Bleijenberg et al., 2017) and Internet browsing are considered essential for older adults in the community nowadays (Czaja et al., 2017). Nevertheless, this trend of daily community living with technology has been constantly developing in “young old” population (Chien & Lin, 2016). However, the conventional assessment on instrumental activities of daily living such as Lawton IADL cannot totally reflect the capability and limitations of them in these daily activities nowadays.

In aging theory, capabilities and limitations of people change across their lifespan. There are general patterns of physical and cognitive changes that occur with age. However, the decline of cognitive functions may not be easily noticeable until later stages of neuro-cognitive disorders. This study evaluated individuals' dysfunctions with their cognitive functions in contemporary instrumental activities of daily living and illustrated the importance of both cognitive functions and physical functions in the IADL for older adults. AIADL showed comparable standards of disability and cognitive measures to other well cited literature (Koskas et al., 2018; Romdhani et al., 2018), and over-weighting the conventional instrumental activities of daily living measure (Forsman et al., 2017; Koskas et al., 2018). Our findings echoed previous literature that documented the instrumental activities of daily living demand performance in cognitive domains such as memory<sup>15</sup>, attention and executive function<sup>15</sup>.

To maintain the coherence with the research design of the IADL-CV (Tong & Man, 2002), HE participants were recruited in the current study. Moreover, the present validation study of AIADL transcended the IADL-CV by recruiting a significantly larger group of participants and wider population spectrum (total participant population = 300) that can provide a more laudable evidence in aging research. The coverage of participants nearly encompassed the main groups of older adults in our community. Taking into consideration this wide spectrum of coverage, the capability to use mobile technology in handling communication and finance was considered an important ability that older adults need to live independently in the community (Koskas et al., 2018).

HE is a distinct group of participants who were functionally independent by required social support to different extents. Therefore, in both functional (by AIADL and CDAD) and cognitive measure (by MoCA), they showed no significant differences. However, in cross group comparison, C&A group showed to be a distinct group and scored significantly lower in items of transportation, shopping, meal preparation, housework, handyman work and medication management. This study documented and justified participants living in different residency types would show different patterns of scoring in AIADL. It is reasonable to believe that participants in the HE and C&A groups should maintain communication with their relatives via information communication technology and smartphone application for communication with friends and relatives and even for handling emergencies. The present study would help the authors in their future work to change in instrumental activities of daily living by identifying tasks and activities that differ among living contexts. Individuals' deficit area of instrumental activities of daily living can be referred for occupational therapists for further remediation training and compensatory intervention. This can further enhance individuals' capability to be aging in place. Moreover, it is interesting to note for the discordant pairs  $(10 + 1 + 6 + 4 + 2 + 2)/300 = 8.33\%$ , as shown in Table 4. Ten people classified as HE were predicted to be HL. This can be partially explained by the functional level of older adults in HE who were independent in terms of self-care and community living as in HL group, except HE needed social support.

Measuring an individual's inability to perform the IADLs is important not just in determining the level of assistance required, but as a metric for a variety of services and programs related to caring for the older adults and for those with disabilities. Many Chinese older adults wish to remain living in the community they have occupied for decades, while others have already downsized or moved into institutional care facilities. The validated AIADL helps rehabilitation practitioners to assess individuals' ability to successfully manage their IADLs in the contemporary community, a key element that supports age-in-place plans. To achieve the goal of aging-in-place, it is necessary to plan for the future and be prepared to respond to changes that come with aging. The validated AIADL will serve as a useful reference tool to help identify important areas that are a priority for future planning of our aging populations. Occupational therapists can also assist with the planning process by making recommendations to maximize independence and helping to overcome any areas of difficulty. Recommendations may relate to individuals' care plan, the use of assistive devices, suggesting activities adaptation, or linking to community support services and programs.

## Study Limitation

The limitations of the AIADL assessment include the fact that it is based on the self-report method of administration rather than performance of functional tasks. This may lead to either overestimation or under-estimation of older adults' ability<sup>16</sup>. Moreover, lacking comparison in measuring the efficacy of using information communication devices objectively limits the generalization of the study findings. Furthermore, in test-retest reliability assessment, the one-week test-retest interval could be lengthened to three weeks in order to alleviate the memory and learning effect. Further study can address this gap in order to further enhance the quality of the AIADL assessment.

## Conclusion

To ensure aging-in-place, older adults must maintain their instrumental activities of daily living in the community as independently as possible. Their adoption and handling information communication technology should be a crucial parameter to be assessed and addressed. Rehabilitation practitioners should also be sensitive to changing environment, cultural, and social factors of our aging population over time. The two-factor structure AIADL assessment, “home living and management” and “community living”, is shown to be a valid and reliable instrument that can assess older adults’ instrumental activity of daily living in this contemporary community.

## Abbreviations

The Advanced Instrumental Activities of Daily Living (AIADL)

The Instrumental activities of daily living (IADL)

The Lawton Instrumental Activities of Daily Living (Lawton IADL)

The Assessment of Living Skills and Resource (ALSAR)

The Lawton Instrumental Activities of Daily Living – Chinese Version (IADL-CV)

The Hong Kong Montreal Cognitive Assessment (HK-MoCA)

The Chinese version of the Disability Assessment for Dementia (CDAD)

Participants from home-living (HL)

Participants from Hostels for the Older People (HE)

Participants from Care and Attention Home (C&A)

## Declarations

**Ethics approval and consent to participate:** Approval was given by The Hong Kong Polytechnic University Research Ethics Committee with reference number HSEARS 20190405001 and the study was conducted according to the Declaration of Helsinki.

**Consent for publication:** All authors consent for the publication

**Availability of data and material:** The data that support the findings of this study are available from different day centres but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of these day centres.

**Competing interests:** The authors report no competing interest.

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**Authors' contributions:** Dr Frank Lai coordinated the whole study and developed the research idea. He executed the research plan and monitored the progress. Dr Frank Lai and Ms Angela Tong both had substantially contributed to the conception and design of the work, analysis and interpretation of research data. Ms. Elaine Yan and Ms. Kathy Yu had conducted the literature review and data collection. Ms. Kathy Yu and Ms. Wing-sze Tsui assisted in the literature search and served as the blinded assessors in the study. Dr. Frank Lai, Dr Ada Fung and Dr. Cynthia Lai had helped in the earlier drafts of the manuscript and assisted in subsequent revision of the text, and thus had contributed significant to the paper's intellectual content. All authors have agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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## Figures

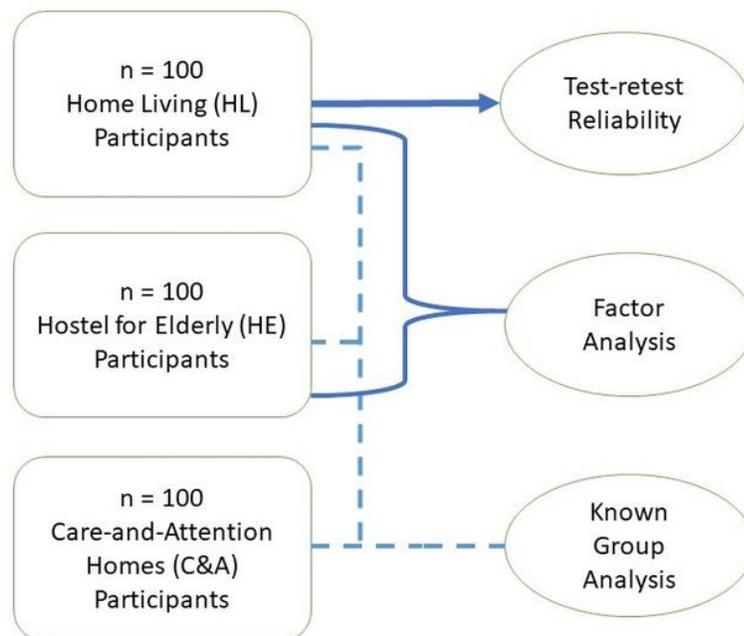


Figure 1

## Flow Diagram to Demonstrate Recruitment of Participants