

Intrinsic Capacity and Life Quality Among Taiwanese Older People: A Cross-Sectional Study

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Abstract

Intrinsic capacity (IC), an internal composite ability proposed by the World Health Organization, is fundamental to older people's health. The present study examined potential models explaining the association between IC and quality of life (QoL) among older people in Taiwan. Frailty, basic activities of daily living (BADL), and instrumental activities of daily living (IADL) were hypothesized to be mediators in the association between IC and QoL. Older people aged 50 years or above from community or medical center ($N = 1,235$; $M_{\text{age}} = 72.63$ years [$SD = 7.19$]; 601 males [48.7%]) completed a series of self-report and functional measures assessing IC, frailty, ADLs, and QoL. Results showed that IC was significantly associated with frailty, BADL, IADL, and QoL in the mediation models. Frailty was found to be a significant mediator in the association between IC and QoL alone or together with IADL. The findings indicate that IC is an important factor for older people to maintain good health and live a fulfilling life.

Plain language summary

Why was the study done? The World Health Organization has identified a set of health-related abilities, known as intrinsic capacity (IC), that are crucial for quality of life (QoL) of older adults. However, it remains unclear as to how IC is associated with QoL, and the present study provided empirical evidence to help better understand the underlying mechanisms between IC and QoL.

What did the researchers do? A group of 1,235 older adults, with an average age of 72.63 years, from several communities and one medical center in Taiwan participated in this study. The researchers used different measures in a standardized interview procedure to understand older people's IC, QoL, frailty, and activities of daily living (ADLs). The researchers then used advanced statistical methods to better understand the associations between IC, QoL frailty, and ADLs.

What did the researchers find? The findings revealed a clear connection between the participants' health abilities and their physical frailty, daily task performance, and life

satisfaction. Notably, physical frailty was a key factor linking health abilities to life satisfaction, either on its own or combined with the ability to perform complex daily tasks.

What do the findings mean? This research highlights the importance of maintaining health abilities to ensure a high QoL for older adults.

Introduction

In the era of aging societies, health is an important issue for older people, as exemplified by the World Health Organization (WHO) which promotes the concept of healthy aging (World Health Organization 2019, 2020, 2021). In addition to the concept of healthy aging, the WHO (2019) acknowledges the needs of understanding older people's intrinsic capacity (IC). IC is defined as "*the sum of all the individual's physical and mental capacities*" by the WHO (2015) and echoed in a recent systematic review (López-Ortiz et al., 2022). The WHO has additionally proposed a framework for IC maintenance or improvement (i.e., the Integrated Care for Older People; ICOPE) for healthcare authorities worldwide to facilitate healthy aging (Leung et al. 2022).

Because IC includes factors relating to cognition, psychological capabilities, vitality, sensory functioning, and locomotion (Beard et al. 2022; George et al. 2021; Gonzalez-Bautista et al. 2020), older people are supposed to have good health if their IC is in a high level. Indeed, prior research has shown that older people can maintain their health when their cognition, psychological capabilities, vitality, sensory functioning, and locomotion are intact (Liu et al., 2021, 2023; Robertson et al., 2013). In contrast, older people with health problems often have problems in these five areas (Liu et al. 2021). Similar results have been found in the associations between IC factors and activities of daily living (ADL) among older people. Older people with these problems (i.e., poor IC) are likely to have ADL problems either in basic ADL (BADL) or instrumental ADL (IADL) (Beard et al. 2019). In other words, it can be tentatively concluded that IC is an important predictor for older people to be physically robust and independent in ADL.

Frailty and ADL issues are important for older people because both factors are fundamental in assisting older people for a life with dignity, satisfaction, and happiness (Crocker et al. 2019). When older people are in a frail condition and their daily activities are

compromised, they are unable to do the things they want to and this may cause high levels of frustration and desperation in living (Al Snih et al. 2009). Subsequently, older people may have quality of life (QoL) problems due to their issues in frailty or problems with ADL. Consequently, frailty and ADL problems are potential factors explaining older people's poor QoL (Crocker et al. 2019). Given that QoL is an important health index for healthcare providers to evaluate people's overall health condition, it is important for healthcare providers in geriatric care to maintain older people's QoL.

Moreover, it has been postulated that frailty could be an antecedent of ADL for older people (Al Snih et al. 2009). Frailty is an index to assess the vulnerable condition of an older person (Hu et al. 2022). When an older person is frailer, the older person is more vulnerable and being less likely to be capable of performing daily activities independently. In this regard, frail older people are less likely than more robust older people to be independent in ADL (either BADL or IADL). Therefore, frailty and ADL may have major roles in explaining older people's QoL (i.e., frailty may be associated with older people's QoL via their ADL functions).

According to the aforementioned literature, IC factors potentially explain the levels of frailty (being frail, pre-frail, or robust) and ADL (being dependent, partially dependent, or independent) (Beard et al. 2019; Liu et al. 2021; Liu et al. 2023; Robertson et al. 2013), and frailty and ADL influence QoL level (Crocker et al. 2019). However, to the best of the present authors' knowledge, there is no empirical evidence showing if frailty and ADL are significant mediators in the association between IC and QoL. If frailty and ADL are mediators, the mediation framework could help healthcare providers in geriatric care to understand how IC assists older people in having a higher QoL. With such understanding, healthcare providers may design and develop different programs to improve older people's QoL in different domains. For example, programs on IC maintenance may be of benefit for frailty, ADL, and QoL simultaneously. In other words, having the evidence regarding whether frailty and ADL are

mediators would provide insight concerning the underlying mechanisms in the association between IC and QoL among older people.

The present study comprised a Taiwanese sample (aged 50 years or above) to examine if frailty and ADL are sequential mediators in the association between IC and QoL. Being aged 50 years or above was used as the criterion for being an ‘older adult’ following an international evaluation tool of older adults’ QoL applied in the present study (i.e., WHOQOL-AGE) (Lin et al., 2020). Moreover, given that ADL comprises two types (BADL and IADL), the present study separately tested BADL and IADL to avoid collinearity problems between the two types of ADL. The mediation effects of frailty and ADL in the relationship between IC and QoL were examined in the present study to address a literature gap by specifically examining the underlying mechanisms in the association between IC and QoL. If the mediating roles of frailty and ADL are clearly identified with regards to their effects (i.e., whether the mediation effect is substantial), occupational therapy practitioners could focus on the mediators (i.e., frailty and QoL) in developing effective programs for improving QoL. For example, if IADL rather than BADL is found to be a significant mediator, occupational therapy practitioners could design programs based on IADL rather than BADL to effectively improve QoL among older adults.

More specifically, the present study tested two mediation models: (i) from IC to frailty (the first mediator) and BADL (the second mediator), and then, to QoL; (ii) from IC to frailty (the first mediator) and IADL (the second mediator), and then, to QoL. In the mediation models, the following hypotheses were proposed: (i) frailty and BADL would mediate the association between IC and QoL individually and sequentially; (ii) frailty and IADL would mediate the association between IC and QoL individually and sequentially.

Methods

Participants and data collection

This is a cross-sectional study. The target participants of the present study were older people residing in Tainan with the following inclusion criteria: (i) being aged 50 years or above; (ii) having the ability to understand and interact with the interviewers in either Mandarin or Taiwanese; and (iii) being able to provide a written informed consent with clear understanding of the present study and participation rights. Additionally, older people with the following conditions were excluded: (i) not being able to understand the survey questions after interacting with the interviewers; and (ii) being severely ill based on medical records (i.e., receiving palliative care).

Several interviewers helped in the data collection and all of them were well trained regarding appropriate interaction with older people and in the standardized interview procedure, including assessing frailty and identifying cognitive dysfunction and mood issues of the target participants. The training lasted one day and was led by experienced researchers in the research team (BLINDED FOR REVIEW) who are experts in geriatric care. The interviewers collecting data from communities were research assistants without specific allied health training, and those collecting data from inpatient wards and outpatient departments had a background in allied health training (e.g., nursing, occupational therapy, and physiotherapy).

All the participants were assessed using a standardized interview procedure, where one older adult was interviewed by one interviewer in-person. Potential participants were approached by the interviewers in the following locations: (i) communities in Tainan City ($n=421$); (ii) inpatient wards at National Cheng Kung University Hospital (NCKUH) ($n=123$); and (iii) outpatient departments at NCKUH ($n=691$). For the recruitment of the community sample, the researchers approached older adults undergoing health check-ups in community centers organized by the Tainan City Government, and interviewed them on site. For the recruitment of the inpatient and outpatient sample, the researchers collaborated with the medical doctors who screened for eligible participants in their inpatient and outpatient wards.

The medical doctors then invited eligible participants during their ward visits to participate in the study. The participants from (i) communities were interviewed in a community center, (ii) inpatient wards were interviewed in their wards, and (iii) outpatient departments were interviewed in a room inside the hospital. All interviews were done in private rooms without disturbance.

Although participants from inpatient wards may have had a poor and unstable frailty level, ADL, and QoL, they were recruited to increase the external validity of the present study. More specifically, most participants recruited from communities or outpatient departments were in relatively good health and findings from these groups alone may not have provided clinical implications for those with a poor health condition. However, the inpatients were assessed by their medical doctors to ensure that they were stable in their medical conditions before enrolling them into the study. The declaration of the Helsinki was strictly followed and adhered to during the entire study procedure, and the study was approved by the BLINDED FOR REVIEW Institutional of Review Board (IRB No.: BLINDED FOR REVIEW).

Measures

Demographics. The participants' demographics were assessed using a background information sheet and administered by the interviewers. The demographics included age (in years), sex (male or female), marital status (married, cohabited, widowed, or unmarried), educational status (primary school or below, junior or senior high school, or college or above), and living status (living with others or living alone).

Intrinsic capacity (IC). The IC of each participant was assessed using the Integrated Care for Older People Screening Tool for Taiwanese (ICOPES-TW). The 14-item ICOPES-TW is an instrument combining self-report and interviewer-observations that contains eight subscales (scoring 0 or 1 for each subscale). The ICOPES-TW was developed using the IC framework proposed by the World Health Organization (World Health Organization 2019). A lower

ICOPE-TW score indicates a higher level of IC (Su et al., 2024). However, for easier interpretation of the scores, the present study reversely coded the ICOPE-TW score so that higher ICOPE-TW score indicated better IC. It has been validated among Taiwanese older people with satisfactory psychometric properties (Su et al., 2024). More specifically, the ICOPE-TW had good concurrent validity with psychosocial factors and known-group validity across sex, educational level, and marital status.

Frailty. Frailty of each participant was assessed using the Clinical Frailty Scale (CFS). The CFS is an interviewer-assessed instrument that comprises only one item (scores ranging from 1 to 9). A higher CFS score indicates a more severe level of frailty (Rockwood et al. 2005). Moreover, the CFS score classifies individuals into one of three conditions: robust (scores 1 and 2), pre-frail (scores 3 and 4), and frail (scores 5 to 9) (Chou et al., 2022; Church et al., 2020) (Chou et al., 2022; Church et al., 2020). It has been validated among Taiwanese older people with satisfactory psychometric properties (Chou et al. 2022).

Basic activities of daily living (BADL). The BADL of each participant was assessed using the Barthel Index (BI). The BI is a self-report instrument comprising ten items (score ranges differently for each item including a (i) 0 and 5 scale, (ii) 0, 5, and 10 scale, and (iii) 0, 5, 10, and 15 scale). A higher BI score indicates a more independent level of BADL (Mahoney et al. 1965). It has been validated among Taiwanese older people with satisfactory psychometric properties (Hsueh et al. 2001).

Instrumental activities of daily living (IADL). The IADL of each participant was assessed using the Lawton Instrumental Activities of Daily Living Scale (Lawton IADLS). The Lawton IADLS is a self-report instrument comprising eight items (scores ranging from 0 to 8 for a total score). A lower Lawton IADLS score indicates a more independent level of IADL (Graf 2008). However, for easier interpretation of the scores, the present study reverse coded the IADL score so that higher IADL score indicating better IADL. It has been validated among Taiwanese older

people with satisfactory psychometric properties (Chang et al. 2006; Yang et al. 2012).

Quality of life (QoL). The QoL of each participant was assessed using the WHOQOL-AGE. The WHOQOL-AGE is a self-report instrument comprising 13 items (scores ranging from 0 to 4 for each item). A higher WHOQOL-AGE score indicates a higher level of QoL (Santos et al. 2018). It has been validated among Taiwanese older people with satisfactory psychometric properties (Lin et al. 2020).

Statistical analysis

The participants' demographics and performance on each measure (i.e., ICOPE-TW, BI, Lawton IADL, CFS, and WHOQOL-AGE) were first analyzed using descriptive statistics: continuous variables using means and standard deviations (SD); categorical variables using frequencies and percentages. Then, Pearson correlations were used to examine the associations between the studied variables (i.e., IC [assessed using ICOPE-TW], BADL [assessed using BI], IADL [assessed using Lawton IADL], frailty [assessed using CFS], and QoL [assessed using WHOQOL-AGE]). Lastly, two mediation models with sequential mediators were constructed using the Hayes' PROCESS Macro Model 6 (Hayes 2022). The first mediation model was constructed with two sequential mediators of frailty (the first mediator) and BADL (the second mediator) in the association between IC (independent variable) and QoL (outcome variable). The second mediation model was constructed with the two sequential mediators of frailty (the first mediator) and IADL (the second mediator) in the association between IC and QoL (Figure 1). Moreover, both mediation models controlled for age, educational level, marital status, and living status. The mediated effects were examined using the bootstrapping method. More specifically, 5000 bootstrapping datasets were resampled for each mediation model and the mediated effects were significant if the 95% confidence interval (CI) of the bootstrapping datasets did not include 0 (Lin et al. 2016). Because participants were recruited from different sites which might result in differently impact IC, frailty, ADL, and QoL (e.g., the community

population may have ceiling effects for frailty and BADL performance, while the inpatient population may be living in unstable conditions and have no opportunities or needs for IADL activities yet), the mediation models were further analyzed separately for each recruitment site.

(Insert Figure 1 here)

Results

The study sample ($N=1235$; 421 from communities, 691 from outpatient departments, and 123 from inpatient wards) had a mean age of 72.63 years ($SD=7.19$) with slightly less than half of them being male ($n=601$; 48.7%). Table 1 reports the participants' performance regarding their IC, BADL, IADL, frailty, and QoL. Moreover, Supplementary Table S1 shows that participants from the community were mostly robust, those from inpatient wards tended to be pre-frail or frail, and those from outpatient departments were in between.

(Insert Table 1 here)

The studied variables (IC, frailty, BADL, IADL, and QoL) had moderate to large effects of associations (absolute Pearson's $r=0.283$ to 0.648 ; p -values <0.001). IC was (i) positively associated with BADL, IADL, and QoL, and (ii) negatively associated with frailty. Frailty was negatively associated with BADL, IADL, and QoL. QoL was positively associated with BADL and IADL (Table 2).

(Insert Table 2 here)

The mediation model with frailty and BADL proposed as sequential mediators showed that there was only one significant mediated pathway. More specifically, frailty was the only significant mediator in the association between IC and QoL (unstandardized effect [95% bootstrapping CI]=1.10 [0.89, 1.33]). Apart from the mediated effect of frailty, IC was found to have direct effect on QoL (unstandardized coefficient= 0.87 [$p < 0.001$]) and the two proposed mediators (unstandardized coefficient= -0.48 for frailty [$p < 0.001$]; = 1.11 for BADL

[$p < 0.001$]) (Figure 2).

(Insert Figure 2 here)

The mediation model with frailty and IADL proposed as sequential mediators showed that there were two significant mediated pathways. The first path, similar to the mediated model with frailty and BADL proposed as sequential mediators, was only via frailty in the association between IC and QoL (unstandardized effect [95% bootstrapping CI]=1.09 [0.89, 1.31]). The second path was via frailty and IADL sequentially in the association between IC and QoL (unstandardized effect [95% bootstrapping CI]=0.05 [0.002, 0.09]). Apart from the mediated effects of frailty and combination of frailty and IADL, IC was found to have direct effect on QoL (unstandardized coefficient=0.86 [$p < 0.001$]) and the two proposed mediators (unstandardized coefficient= -0.48 for frailty [$p < 0.001$] and 0.03 for IADL [$p < 0.03$]) (Figure 3).

(Insert Figure 3 here)

Supplementary Table S2 reports the results of mediation model with frailty and BADL as sequential mediators in each recruitment site. The findings indicated that frailty was the only significant mediator in the association between IC and QoL across the three stratified recruitment sites. IC had a significantly direct effect on QoL among the outpatient sample, a marginally non-significant effect among the community sample ($p = 0.054$), and no effect among the inpatient sample. Similar findings were observed in the mediation model with frailty and IADL as sequential mediators in each recruitment site (Supplementary Table S3).

Discussion

To the best of the present authors' knowledge, the present study is the first to examine the mediating roles of frailty and ADL in the association between IC and QoL among older people. The proposed mediation models were partially supported by the present findings. More

specifically, frailty was a significant mediator in the association between IC and QoL; IADL was found to be a subsequently significant mediator after frailty in the association between IC and QoL. However, IADL itself was not a significant mediator in the association between IC and QoL when there was no frailty in the association. Moreover, BADL was not a significant mediator either alone or together with frailty in the association between IC and QoL. BADL itself was not a significant factor explaining QoL in the present sample.

As expected, IC was found to significantly explain QoL for older people. The present mediation models further identified the associations between IC and QoL across three different types of effect: direct effect (i.e., how IC directly associated with QoL without other variables being involved), indirect effect (i.e., how IC associated with QoL via frailty, ADL, or frailty plus ADL), and total effect (i.e., the sum of the direct and indirect effects). The unstandardized coefficients shown in the mediation models indicated how much the unit of QoL changes when IC increases by one unit (e.g., 0.87 in the direct effect of frailty on QoL means that when IC increases one unit, the QoL increases by 0.87 of a unit). Moreover, given that the BADL had a larger scale range (0-100 scale) than the IADL (0-8 scale), this may be why the BADL coefficients were larger than the IADL coefficients (e.g., -5.63 from frailty to BADL, and -0.16 from frailty to IADL).

The finding of association between IC and QoL reinforces the WHO's position regarding the importance of IC because it serves as a crucial factor in promoting healthy aging (Beard et al. 2022; George et al. 2021; Gonzalez-Bautista et al. 2020; World Health Organization 2019). Additionally, the association found between IC and QoL in the present study supports the need for maintaining or improving IC among older people. Therefore, the ICOPE framework should be implemented to tackle the issue of aging societies worldwide (Leung et al. 2022). Apart from the direct association between IC and QoL that is consistent with previous literature (Salinas-Rodriguez et al. 2022), the present findings extend the association between IC and

QoL from a direct relationship to potentially mediated relationships. More specifically, IC appears to be associated with QoL via the following two routes: (i) solely frailty; (ii) frailty and subsequently IADL.

The mediated role of frailty in the association between IC and QoL can be explained by the association between IC and frailty, followed by the association between frailty and QoL. IC comprises the fundamental abilities for older people to live functionally (Beard et al. 2022; George et al. 2021; Gonzalez-Bautista et al. 2020). Therefore, it is evident that when older people do not have better IC, they have declining body functions which lead to frailty. Consequently, frailty causes health problem issues and lowers the QoL among older people (Crocker et al. 2019). In other words, frailty itself could be a single mediator that mediates the association between IC and QoL. However, because frailty can cause health problem issues (Crocker et al. 2019), frailty may also cause IC problems. Indeed, signs of pre-frailty (e.g., being less active, “slowing up”, and fatigue) can impact older adults’ IC, including their time and space orientation, locomotion function, appetite, and psychological conditions (Hanlon et al., 2018). Therefore, the relationship between IC and frailty could be reciprocal. Nevertheless, given that the present study used a cross-sectional design, the reciprocal relationship could not be determined. Future studies with a longitudinal design are therefore warranted to further identify the directions between IC and frailty.

Apart from frailty, IC was found to be a significant factor explaining older people’s ADL, including BADL and IADL. Because BADL and IADL usually require older people having sufficient cognition, mobility, sensory functioning, and good mental health to perform every task (Beard et al. 2019), IC as a composite ability of cognition, psychological capabilities, vitality, sensory functioning, and locomotion appears to be essential factor contributing to both BADL and IADL. For example, when performing the BADL of showering, older people may need to identify the showering procedure (e.g., use some water to apply body wash; then, use

water to clean up the body wash) with sufficient mobility and muscle strength (e.g., can step into bathroom without falling). Therefore, IC is an important composite internal ability for older people to engage in both BADL and IADL.

Although IADL was found to be a sequential mediator in the association between IC and QoL (after the mediator of frailty), BADL was not a significant mediator in the present study's proposed mediation model. This finding contradicts the hypothesis that BADL would be a mediator in the association between IC and QoL (because it was neither the sole mediator or a sequential mediator along with frailty). The main reason for the nonsignificant mediated effect of BADL was the nonsignificant association between BADL and QoL. A potential explanation for the nonsignificant association between BADL and QoL could be the ceiling effect of the BADL (83.2% did not have any BADL difficulties; Table 1). Therefore, it is possible that the participants did not suffer from the disruption of poor BADL and might not have their QoL impacted by the BADL dysfunction. However, there were ceiling effects for both IADL (92.8% did not have any IADL difficulties) and frailty (58.7% were robust). Therefore, the present findings could be biased due to these ceiling effects. Consequently, future studies with a wider spectrum of BADL performance are needed to reexamine if BADL is not associated with QoL and is not a mediator in the association between IC and QoL. Another potential explanation for the nonsignificant association between BADL and QoL could be the element of social interactions. More specifically, BADL does not include elements regarding social interaction whereas IADL does. Social interaction has been found to be an important factor contributing the QoL among older people (Siah et al., 2023; Siette et al., 2022). Consequently, IADL may be more likely associated with QoL, whereas BADL would not.

In order to better understand the mediation effects, the present study separated the study participants according to their recruitment sites for additional mediation analyses. The additional mediation analyses showed that IC itself had direct effects on QoL for participants

recruited from outpatient departments, a marginally non-significant effect for those from communities, and no effect for those from inpatient wards. However, for all participants (irrespective of their recruitment sites), IC had indirect effects on QoL via frailty. This may be explained by the physical conditions of the participants. More specifically, inpatients had more frailty problems than outpatients and community-dwelling older adults, while community-dwelling older adults had very minor frailty problems (Supplementary Table S1). For inpatient older adults, frailty problems may thus disrupt the effects of IC on QoL. When their frailty does not improve, their QoL decreases. In contrast, outpatients and community-dwelling older adults do not have frailty problems, and their IC is more directly associated with their QoL. The finding that IC only had a marginally non-significant direct effect on QoL among community-dwelling older adults may be explained by the much healthier condition of this group compared to inpatient older adults. When older people are very healthy, their problems regarding QoL might be minor and only occur when they have some frailty issues. In contrast, inpatient older adults may have problems other than frailty (e.g., need to regularly visit the hospital) which negatively impact on their QoL. Based on this finding, healthcare providers should pay attention to both IC and frailty for inpatient older adults to improve their QoL. For outpatient and community-dwelling older adults, healthcare providers may only need to focus on either IC or frailty.

Limitations and clinical implications

There are some limitations in the present study. First, the present study utilized a cross-sectional study design, which was unable provide evidence regarding the causal relationships between the studied variables (i.e., IC, frailty, BADL, IADL, and QoL). Therefore, future studies with longitudinal study designs are needed to further corroborate the utility of the mediation models proposed in the present study. Second, data for the study were collected utilizing a convenience sampling method, which restricts the generalizability of the present

findings. Although the present sample had a wide age range of older people from communities, outpatient wards, and inpatient wards, all the participants resided in Southern Taiwan. Given that Southern and Northern Taiwan may have somewhat different living styles, caution is advised when generalizing the present findings to a Northern Taiwan population. Third, some of the instruments (e.g., BI and Lawton IADLS) were completed via self-reports. Therefore, methods biases (e.g., social desirability, memory recall) could not be eliminated. However, given that all the instruments were found to have satisfactory psychometric properties among Taiwanese populations, this limitation might not be severe. Fourth, participants in the present study were aged between 59 and 97 years. Therefore, the findings may not be generalizable to individuals in their 50s. Lastly, some demographic variables (e.g., family income) could be potential mediators in the relationship between IC and QoL. However, the present study did not assess these mediation relationships. Future studies may want to investigate other potential mediators in the relationship between IC and QoL.

Despite the limitations, the present findings provide clinical implications for occupational therapists and healthcare providers in geriatric care. First, based on the direct associations of IC with QoL found in the community and outpatient participants, occupational therapy practitioners should implement activities that help older adults with relatively good health condition to maintain their IC. For example, prior evidence shows that physical activity programs designed by occupational therapists using the medium of board games could help community-dwelling older adults maintain their IC (Lee et al., 2024). Second, frailty was found to be a significant mediator in the association between IC and QoL across community, outpatient, and inpatient participants. Therefore, occupational therapists should design programs to enhance physical robustness for older adults across different frailty conditions to improve their QoL.

Conclusion

The present study demonstrated that frailty was a significant mediator in the association between IC and QoL among Taiwanese older people. Moreover, IADL (rather than BADL) was a subsequent mediator after frailty in mediating the association between IC and QoL in this population. In addition, frailty and IADL (but not BADL) were significant factors explaining QoL among older people. IC was also a significant factor explaining older people's frailty, BADL, IADL, and QoL. The findings of the present study should be incorporated by healthcare providers in geriatric care given that IC is important factor for older people to maintain good health and live a fulfilling life.

References

- Al Snih, S., Graham, J. E., Ray, L. A., Samper-Ternent, R., Markides, K. S., & Ottenbacher, K. J. (2009). Frailty and incidence of activities of daily living disability among older Mexican Americans. *Journal of Rehabilitation Medicine, 41*(11), 892-897. <https://doi.org/10.2340/16501977-0424>.
- Beard, J. R., Jotheeswaran, A. T., Cesari, M., & Araujo de Carvalho, I. (2019). The structure and predictive value of intrinsic capacity in a longitudinal study of ageing. *BMJ Open, 9*(11), e026119. <https://doi.org/10.1136/bmjopen-2018-026119>.
- Beard, J. R., Si, Y., Liu, Z., Chenoweth, L., & Hanewald, K. (2022). Intrinsic capacity: Validation of a new WHO concept for healthy aging in a longitudinal Chinese study. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 77*(1), 94-100. <https://doi.org/10.1093/gerona/glab226>.
- Chang, H., Lee, S., Chen, P., & Hsieh, C. (2006). Assessment of instrumental activities of daily living needs among residents in long-term care facilities. *Taiwan Geriatrics and Gerontology, 2*(2), 116-129.
- Chou, Y. C., Tsou, H. H., Chan, D. D., Wen, C. J., Lu, F. P., Lin, K. P., Wu, M. C., Chen, Y. M., & Chen, J. H. (2022). Validation of clinical frailty scale in Chinese translation. *BMC Geriatrics, 22*(1), 604. <https://doi.org/10.1186/s12877-022-03287-x>.
- Church, S., Rogers, E., Rockwood, K., & Theou, O. (2020). A scoping review of the Clinical Frailty Scale. *BMC Geriatrics, 20*(1), 393. <https://doi.org/10.1186/s12877-020-01801-7>
- Crocker, T. F., Brown, L., Clegg, A., Farley, K., Franklin, M., Simpkins, S., & Young, J. (2019). Quality of life is substantially worse for community-dwelling older people living with frailty: Systematic review and meta-analysis. *Quality of Life Research, 28*(8), 2041-2056. <https://doi.org/10.1007/s11136-019-02149-1>.

- George, P. P., Lun, P., Ong, S. P., & Lim, W. S. (2021). A rapid review of the measurement of intrinsic capacity in older adults. *Journal of Nutrition, Health and Aging*, 25(6), 774-782. <https://doi.org/10.1007/s12603-021-1622-6>.
- Gonzalez-Bautista, E., Andrieu, S., Gutierrez-Robledo, L. M., Garcia-Chanes, R. E., & de Souto Barreto, P. (2020). In the quest of a standard index of intrinsic capacity. A critical literature review. *Journal of Nutrition, Health and Aging*, 24(9), 959-965. <https://doi.org/10.1007/s12603-020-1394-4>.
- Graf, C. (2008). The Lawton instrumental activities of daily living scale. *American Journal of Nursing*, 108(4), 52-62. <https://doi.org/10.1097/01.NAJ.0000314810.46029.74>.
- Hanlon, P., Nicholl, B. I., Jani, B. D., Lee, D., McQueenie, R., & Mair, F. S. (2018). Frailty and pre-frailty in middle-aged and older adults and its association with multimorbidity and mortality: A prospective analysis of 493 737 UK Biobank participants. *The Lancet Public Health*, 3(7), e323–e332. [https://doi.org/10.1016/S2468-2667\(18\)30091-4](https://doi.org/10.1016/S2468-2667(18)30091-4)
- Hayes, A. F. (2022). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Guilford Press.
- Hsueh, I. P., Lee, M. M., & Hsieh, C. L. (2001). Psychometric characteristics of the Barthel activities of daily living index in stroke patients. *Journal of Formosan Medical Association*, 100(8), 526-532. <https://www.ncbi.nlm.nih.gov/pubmed/11678002>
- Hu, F. W., Lin, C. H., Yueh, F. R., Lo, Y. T., & Lin, C. Y. (2022). Development and psychometric evaluation of the Physical Resilience Instrument for Older Adults (PRIFOR). *BMC Geriatrics*, 22(1), 229. <https://doi.org/10.1186/s12877-022-02918-7>.
- Lee, C.-H., Hsieh, M.-T., Laio, C.-Y., Tseng, S.-M., Chen, J.-S., Griffiths, M. D., Chuang, H.-L., & Lin, C.-Y. (2024). The effects of a physical activity program on quality of life and wellbeing among community-dwelling older people in Taiwan: Empirical evidence from Taiwan Long-Term Care System 2.0. *International Journal of Gerontology*, 18(1),

29-35. [https://doi.org/10.6890/IJGE.202401_18\(1\).0006](https://doi.org/10.6890/IJGE.202401_18(1).0006)

- Leung, A. Y. M., Su, J. J., Lee, E. S. H., Fung, J. T. S., & Molassiotis, A. (2022). Intrinsic capacity of older people in the community using WHO Integrated Care for Older People (ICOPE) framework: A cross-sectional study. *BMC Geriatrics*, *22*(1), 304. <https://doi.org/10.1186/s12877-022-02980-1>.
- Lin, C. Y., Wang, J. D., & Liu, L. F. (2020). Can we apply WHOQOL-AGE to Asian population? Verifying its factor structure and psychometric properties in a convenience sample from Taiwan. *Frontiers in Public Health*, *8*, 575374. <https://doi.org/10.3389/fpubh.2020.575374>.
- Lin, C.-Y. Tsai, M.-C. (2016). Effects of family context on adolescents' psychological problems: Moderated by pubertal timing, and mediated by self-esteem and interpersonal relationships. *Applied Research in Quality of Life*, *11*, 907-923. <https://doi.org/10.1007/s11482-015-9410-2>.
- Liu, S., Kang, L., Liu, X., Zhao, S., Wang, X., Li, J., & Jiang, S. (2021). Trajectory and correlation of intrinsic capacity and frailty in a Beijing elderly community. *Frontiers in Medicine* *8*, 751586. <https://doi.org/10.3389/fmed.2021.751586>.
- Liu, X., Chen, T., Chen, S., Yatsugi, H., Chu, T., & Kishimoto, H. (2023). The relationship between psychological distress and physical frailty in Japanese community-dwelling older adults: A cross-sectional study. *Journal of Frailty & Aging*, *12*(1), 43-48. <https://doi.org/10.14283/jfa.2022.63>.
- López-Ortiz, S., Lista, S., Peñín-Grandes, S., Pinto-Fraga, J., Valenzuela, P. L., Nisticò, R., Emanuele, E., Lucia, A., & Santos-Lozano, A. (2022). Defining and assessing intrinsic capacity in older people: A systematic review and a proposed scoring system. *Ageing Research Reviews*, *79*, 101640. <https://doi.org/10.1016/j.arr.2022.101640>
- Mahoney, F. I. Barthel, D. W. (1965). Functional evaluation: The Barthel Index. *Maryland*

- Medicine Journal* 14, 61-65. <https://www.ncbi.nlm.nih.gov/pubmed/14258950>
- Robertson, D. A., Savva, G. M., & Kenny, R. A. (2013). Frailty and cognitive impairment — A review of the evidence and causal mechanisms. *Ageing Research Reviews*, 12(4), 840-851. <https://doi.org/10.1016/j.arr.2013.06.004>.
- Rockwood, K., Song, X., MacKnight, C., Bergman, H., Hogan, D. B., McDowell, I., & Mitnitski, A. (2005). A global clinical measure of fitness and frailty in elderly people. *CMAJ*, 173(5), 489-495. <https://doi.org/10.1503/cmaj.050051>.
- Salinas-Rodriguez, A., Gonzalez-Bautista, E., Rivera-Almaraz, A., & Manrique-Espinoza, B. (2022). Longitudinal trajectories of intrinsic capacity and their association with quality of life and disability. *Maturitas*, 161, 49-54. <https://doi.org/10.1016/j.maturitas.2022.02.005>.
- Santos, D., Abad, F. J., Miret, M., Chatterji, S., Olaya, B., Zawisza, K., Koskinen, S., Leonardi, M., Haro, J. M., Ayuso-Mateos, J. L., & Caballero, F. F. (2018). Measurement invariance of the WHOQOL-AGE questionnaire across three European countries. *Quality of Life Research*, 27(4), 1015-1025. <https://doi.org/10.1007/s11136-017-1737-8>.
- Siah, P. C., Ooi, C. S., Zaman, W. B., & Low, S. K. (2023). Social networking sites usage and quality of life among senior citizens. *Asian Journal of Social Health and Behavior* 6(2), 79-85. https://doi.org/10.4103/shb.shb_138_22
- Siette, J., Dodds, L., Surian, D., Prgomet, M., Dunn, A., & Westbrook, J. (2022). Social interactions and quality of life of residents in aged care facilities: A multi-methods study. *PloS One*, 17(8), e0273412. <https://doi.org/10.1371/journal.pone.0273412>
- Su, H. C., Liu, C. H., Chen, H. Y., Wu, Y. L., Griffiths, M. D., Li, C. Y., Hou, W. H., Lin, C. Y., & Yang, Y. C. (2024). Assessing intrinsic capacity in Taiwan: Initial psychometric properties of the Integrated Care for Older People Screening Tool for Taiwanese

(ICOPES-TW). *BMC Geriatrics*, 24(1), 477. <https://doi.org/10.1186/s12877-024-05071-5>

World Health Organization (2015). *World report on ageing and health*. Retrieved August 21, 2024, from: <https://www.who.int/publications/i/item/9789241565042>.

World Health Organization (2019). *Integrated care for older people (ICOPE): Guidance on person-centred assessment and pathways in primary care*. Retrieved August 21, 2024, from: <https://apps.who.int/iris/handle/10665/326843>.

World Health Organization (2020). *GHE: Life expectancy and healthy life expectancy*. August 21, 2024, from: <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghelifeexpectancyandhealthy-life-expectancy>.

World Health Organization (2021). *Ageing and health*. Retrieved August 21, 2024, from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>.

Yang, K., Hsu, C., Tang, Y., & Kung, C. (2012). Correlation among activities of daily living, quality of life, and sense of well-being in elderly community dwellers. *Taiwan Geriatrics and Gerontology*, 7(4), 217-232.

Table 1. Participants' characteristics (N=1235)

	Mean (SD) or n (%)	Value range	Ceiling proportion
<i>Age (years)</i>	72.63 (7.19)	59-97	
59-69 years	481 (39.0)		
70-79 years	529 (42.8)		
80-89 years	201 (16.3)		
90-99 years	23 (1.9)		
<i>Sex (male)</i>	601 (48.7)		
<i>Marital status</i>			
Married or cohabiting	891 (72.1)		
Widowed or unmarried	344 (27.9)		
<i>Educational status</i>			
Primary school or below	491 (39.8)		
Junior or senior high school	477 (38.6)		
College or above	250 (20.2)		
<i>Living status (alone)</i>	136 (11.0)		
<i>Recruitment site</i>			
Community	421 (34.1)		
Inpatient ward	123 (10.0)		
Outpatient department	691 (56.0)		
<i>Intrinsic capacity score</i>	5.64 (1.43)	0-7	433 (35.1%)
Score 0	4 (0.3)		
Score 1	11 (0.9)		
Score 2	31 (2.5)		
Score 3	67 (5.4)		

Score 4	126 (10.2)		
Score 5	222 (18.0)		
Score 6	341 (27.6)		
Score 7	433 (35.1)		
<i>BADL score</i>	95.96 (13.64)	0-100	1028 (83.2%)
<i>IADL score</i>	7.86 (0.59)	0-8	1146 (92.8%)
<i>Frailty score</i>	2.53 (1.30)	1-9	724 (58.7)
Robust (score 1-2)	724 (58.7)		
Pre-frail (score 3-4)	412 (33.4)		
Frail (score 5-9)	99 (0.3)		
<i>Quality of life score</i>	34.29 (6.53)	8-52	7 (0.6)

Note. Intrinsic capacity was assessed using Integrated Care for Older People Screening Tool for Taiwanese (higher score indicates better intrinsic capacity); basic activity of daily living (BADL) was assessed using Barthel Index (higher score indicates better BADL); instrumental activity of daily living (IADL) was assessed using Lawton Instrumental Activities of Daily Living Scale (higher score indicates better IADL); frailty was assessed using Clinical Frailty Scale (higher score indicates more severe frailty); quality of life was assessed using WHOQOL-AGE (higher score indicates better quality of life).

Table 2. Pearson's correlations between the studied variables (N=1235).

	IC	Frailty	BADL	IADL	QoL
IC	--				
Frailty	-0.601	--			
BADL	0.447	-0.648	--		
IADL	0.313	-0.475	0.526	--	
QoL	0.447	-0.559	0.390	0.283	--

Note. Intrinsic capacity (IC) was assessed using Integrated Care for Older People Screening Tool for Taiwanese (higher score indicates better IC); basic activity of daily living (BADL) was assessed using Barthel Index (higher score indicates better BADL); instrumental activity of daily living (IADL) was assessed using Lawton Instrumental Activities of Daily Living Scale (higher score indicates better IADL); frailty was assessed using Clinical Frailty Scale (higher score indicates more severe frailty); quality of life (QoL) was assessed using WHOQOL-AGE (higher score indicates better QoL).