The impact of social isolation on functional disability in older people: A multi-cohort study

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HIGHLIGHTS

- Overall, social isolation was not clearly related to ADL disability in older people.
- Subgroup analysis showed that in Asian regions, social isolation was related to ADL disability.
- Not participating in social clubs or religious groups consistently showed an association with ADL disability.

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ABSTRACT

Objectives: We assessed the relationship between social isolation and functional disability in older people.
Design: Comparison of longitudinal cohort studies.
Setting and participants: Harmonised longitudinal datasets from the United States, England, European countries, Japan, Korea, China and Hong Kong.
Methods: Social isolation was operationalised as a composite score with five domains, such as marital status, living alone, and social contact with others. Functional disability was defined as whether the cohort participant had any difficulty in activities of daily living (ADL). In each dataset, we used robust Poisson regression models to obtain the relative risks (RRs) and the corresponding 95 % confidence intervals (CI). We combined the RRs to synthesize a pooled estimate using meta-analysis with random-effects models.
Results: Overall, the social isolation composite score was not associated with ADL disability (pooled RR = 1.05, 95 % CI [0.97–1.14], n = 40,119). Subgroup analysis suggested social isolation composite score was associated with ADL disability in Asian regions (pooled RR = 1.09, 95 % CI [1.02, 1.16], but not in Western regions (pooled RR = 1.01, 95 % CI [0.96, 1.07]). The relationships between different domains of social isolation and ADL disability were heterogeneous, except that no participation in any social clubs or religious groups was consis- tently associated with ADL disability (pooled RR = 1.12, 95 % CI [1.04, 1.21]).
Conclusion: Targeting social isolation may prevent decline in functional abilities in older adults, providing an avenue to active and healthy ageing. Nonetheless, interventions tackling social isolation should tailor to the unique cultural and social underpinnings. A limitation of the study is that reverse causality could not be ruled out definitively.

1. Introduction

Although there is no established definition, social isolation is generally considered as the absence of social contact and reduced size of social network (Smith et al., 2021), measured by objective indicatorssuch as living alone, marital status and frequency of social contacts. As a closely related but distinct concept, loneliness is viewed as a subjective negative experience arising from the situation when one's social relationships do not meet their needs and expectations (Thege et al., 2021). Early literature on social network analysis might have considered social isolation and loneliness interchangeably due to inconsistent definitions. However, more recently researchers increasingly recognise that they are indeed distinct concepts and could influence health via different pathways (Ge et al., 2017), supporting the distinction between social isolation and loneliness.

A wealth of previous literature showed that social isolation is related to a collection of detrimental health outcomes in the older ages, such as all-cause mortality, falls, re-hospitalization, institutionalization, cardiovascular diseases, stroke, diabetes, cognitive decline, dementia, depression, anxiety and suicide (Nicholson, 2012). There have been a number of theories and proposed psychosocial and biological mechanisms regarding how social relationships (or therein the lack of) are related to health. On the one hand, family members, including spouses, children and grandchildren, play an important role to offer social support to older people's healthy living. It is proposed that there is a universal human need to form close affectional bonds, especially with significant others such as family members (Blane et al., 1996). In his renowned *attachment theory*, John Bowlby posited that these bonds are necessary to satisfy individuals' need for secure attachment for its own sake, for the love and the reliability it provides—being one's own "safe haven" (Bowlby, 1969; Carstensen, 1992). Meanwhile, instrumental support provided by family members could cater assistance for tangible needs, such as getting groceries, getting to appointments, cleaning or paying bills. Hence, the living arrangement with the older people in a household and spousal presence both play important roles in promoting health. On the other hand, social participation and social engagement, such as getting together with friends, attending social functions, participating in social groups, provide individuals with sense of value, belonging and attachment, in turn giving meaning to the individual's life (Berkman & Syme, 1979). Such sense of meaningfulness in life has been shown to be related to better functional abilities (Takkinen & Ruoppila, 2001) and lower risks of mortality in older people (Krause, 2009). Regarding how social isolation translates to poorer health, Berkman hypothesised a biological pathway that social isolation is a chronically stressful situation, which would accelerate the biological ageing processes via the upregulation of the hypothalamic-pituitary-adrenal axis (Berkman, 1988; Smith & Vale, 2006).

Loss of muscle mass, reduced mobility and disability are commonly observed in the older population (Brown & Flood, 2013). The WHO is also promoting 2020–2030 as the Decade of Healthy Ageing, which advocated that the ability to maintain optimum functional capacity is important for healthy ageing (World Health Organization, 2020). It is therefore important to identify factors that determine functional decline in older people because such decline could be prevented or mitigated with appropriate interventions (Amuthavalli Thiyagarajan et al., 2022). Previous literature has shown the impact of social isolation on functional status in the older people, but the findings have been mixed. For instance, Mendes de Leon and colleagues, using data from a cohort of community-dwelling older people with yearly longitudinal follow-up in Connecticut, the United States, showed that older people with more frequent engagement in social activities reported less functional disability over time. Buchman and colleagues investigated in a US cohort of community-dwelling older people and showed that the size of social network was not related to motor function or decline rate (Buchman et al., 2010). Some other previous studies also reported limited or no significant impact of social relationships on functional abilities in older people (Avlund et al., 2004; Green et al., 2008). Taken together, previous studies might have measured social isolation and functional status differently, which limits the comparability across different settings. It is possible various indicators of social isolation may influence functional disability differentially, which warrants further investigation.

Moreover, the impact of social isolation on functional decline in older people was seldom reported in settings outside of western countries. Particularly, the East Asian region is home to approximately one-fifth of the world's population; life expectancies are being the longest compared to other regions of the world (United Nations Department of Economic & Social Affairs Population Division, 2022). By some estimates, functional disabilities were experienced by around a quarter of older people in Asia (Yau et al., 2022). In the face of the rapidly ageing profile, it is therefore warranted to understand the determinants of functional disabilities in these populations. In a cross-sectional analysisin a sample of older people in rural eastern China, Wang and colleagues found that unmarried (widowed or divorced) older people who wereliving with their children had worse functional status compared to married older people living with and without their children (Wang et al., 2013). A recent study using data from the China Health and Retirement Longitudinal Study (CHARLS) showed that social isolation was related to functional disability four years later in Chinese women but not men (Guo et al., 2021). Interestingly, this study also found that social isolation is more prevalent in Chinese women than men, which was in contrast to the usual phenomenon in the western settings that women tend to have wider social contacts with family and friends than do men (Kalmijn, 2003).

Cross-national analyses could offer unique opportunities to improve our understanding on different mechanisms between social relationships and health in different cultural backgrounds. Investigating the roles of social isolation in functional disabilities enables researchers to understand whether such relationship is universal, or reflects different confounding structure by the underlying macrosocial and economic contexts (Ailshire & Carr, 2021). For instance, in societies under the influence of Confucianism and/or collectivism, such as Chinese, Korean and Japanese, adult children are often expected to provide support and company to their older parents especially when they are frail (Ikels, 2004). Consequently, the relationship between social isolation and functional disabilities could vary across various settings with different cultural underpinnings. In this study, we aim to assess the relationship between social isolation and functional disabilities in longitudinal co-horts of older people in different settings using harmonised data. In particular, we assessed the following research questions:

1. What is the longitudinal relationship between social isolation and subsequent functional disability?
2. Is this relationship different across different settings with heterogeneous cultural and social values?
3. Are there specific indicator(s) of social isolation more related to functional disabilities?

2. Methods

2.1. Participants

We assessed the above research questions with datasets available in the Gateway to Global Aging Data (Lee et al., 2021) that contains harmonised or harmonizable data regarding social isolation and the subsequent functional disabilities. Data were extracted from the English Longitudinal Study of Ageing (ELSA, 2002) of the United Kingdom (Steptoe et al., 2013), the Health and Retirement Study (HRS, 2004) of the United States (Sonnega et al., 2014), the Survey of Health, Ageing and Retirement in Europe (SHARE, 2004) of European countries (Borsch-Supan et al., 2013), the Japanese Study of aging and Retirement

(JSTAR, 2007) of Japan (Ichimura et al., 2009) and the Korean Longitudinal Study of Ageing (KLoSA, 2006) of South Korea (Korea Employment Information Service, 2018), and the CHARLS (2011) of China (Zhao et al., 2014). Additionally, we will supplement the current anal- ysis with data from the Hong Kong old-old study (1991) of Hong Kong (Lai et al., 2022). Further details of the cohorts involved could be found in the corresponding references. In the current study, we will only include respondents who were 60 or above, and will exclude those who reported to have functional disability at baseline (see definition below). Specific variables that were harmonisable across the respective cohorts were detailed in Supplementary Table 1.

2.2. Measures

2.2.1. Social isolation

Following a similar methodology in Berkman and Syme (1979); Steptoe et al. (2013); Smith et al. (2021) and our recent study (Lai et al., 2023), we computed a composite score of social isolation with five indicators: being unmarried, living alone, no contact with family members within a month, no contact with relatives and/ friends within a month, no participation in any social clubs or religious groups. It is noted that the JSTAR does not contain any items on frequency of contact with relatives or friends, so items on a lack of emotional and instrumental support from friends were used as a proxy for that indicator. The composite score ranged from 0 to 5, enabling us to examine the dose-response relationship between social isolation and subsequent ADL disability. In addition, we also defined social isolation (vs no social isolation) using a cut-off of 2, as in Steptoe et al. (2013) Next, we then examined the relationship of individual indicators and subsequentfunctional disability.

2.2.2. Functional status

Measures of functional status were taken from the next wave of follow up where social isolation was measured in order to measure the longitudinal association of social isolation and functional status. The time span between the two measures ranged between 18 months to four years among the harmonised datasets. Following the harmonisation documentation by Young et al. (2021) we assessed whether the cohort participant had difficulty in any of the following tasks of activities ofdaily living (ADL): bathing, eating, dressing, transferring, walking across a room, using a toilet. Individuals were considered to experience no functional disability if they experience no difficulty at all in any of these tasks. A dichotomous variable was then created to indicate thepresence of functional disability, in accordance with our previous study (Lai et al., 2023) and others (Stessman et al., 2014; Connolly et al., 2017).

2.3. Statistical analysis

To assess the longitudinal association between the composite score of social isolation and subsequent functional disability, we used multivariable robust Poisson regression to estimate the relative risks (RRs) and the corresponding 95 % confidence intervals (CI) in each dataset. For binary dependent variables (e.g., presence/ absence of functional disability), RRs are more preferable to odds ratios as a measure of risks since ORs commonly overestimate RRs when the outcome is common among cohort participants (Zou, 2004); and RRs could avoid the issue of non-collapsibility of ORs when comparing effect estimates between subgroups and cohorts (Schuster et al., 2021). Covariates were chosen on the basis of being potential confounders of the association being assessed, which could be considered as common causes of both social isolation and functional disability or factors potentially on the confounding pathways (VanderWeele, 2019) (Supplementary Fig. 5). In this analysis, we adjusted for age, sex, physical activity level, underlying chronic diseases and socioeconomic status (SES). SES was operationalised as the highest education attainment by the respondents and household income in each cohort, each of which was scaled to form a score from 0 to 1 for comparability (Lai et al., 2019). Sampling weights were used to account for sampling design attrition for each cohort (Kwak et al., 2021). Next, to examine if specific constituent domains of social isolation was associated with subsequent functional disability, we repeated the analysis with individual indicators. Missing data were handled with multiple imputation by chain equations (Van Buuren & Groothuis-Oudshoorn, 2011). The number of imputations needed were determined using von Hippel's two-stage method on the basis of fraction of missing information (FMI) in the dataset (Von Hippel, 2020). The imputation model included the exposure variable (social isolation), outcome variable (ADL disability) and also all the covariates used in the models. We also repeated the analysis using complete case analysis. The proportions of missingness of the variables used in corresponding cohorts were reported in Supplementary Table 2.

After computing the RR in each cohort, we combined these effectsizes to synthesize a pooled estimate using meta-analysis with random-effects models. Statistical heterogeneity was assessed using the Q-statistics and was quantified by the I^2 statistic. I^2 statistics of 0 %, 25 %, 50 %, and 75 % indicate no, low, medium, and high levels of statistical heterogeneity, respectively (Higgins et al., 2003). Subgroup analyses were conducted to compare the effect sizes between Asian and Western regions. We also assessed whether additional subgroup analyses were necessary by assessing the interaction term between social isolation and age, and social isolation and sex group. As a sensitivity analysis, we also repeated the analysis by excluding the cohort from Hong Kong, because this group of older people were recruited in 1991, which is temporally more distant from the other cohorts. We also computed the E-value to examine the robustness of the RR relative to potential unmeasured confounding (VanderWeele & Ding, 2017).

3. Results

3.1. Descriptive statistics of the cohorts

Of the 54,587 individuals aged 60 and over in the seven cohorts, we excluded 519 who lived in residential or nursing facilities, 5138 with missingness on all ADL items and 8811 with any ADL difficulties at baseline, resulting in 40,119 individuals at the baseline. There were 21.6 % of the participants who did not complete the follow-up so the final sample consisted of 31,470 individuals (Supplementary Fig. 1). The prevalence of social isolation (i.e. any two domains) ranged from 27.5 % to 70.5 %. The mean of the social isolation composite score ranged from 0.97 to 2.09 across cohorts (Table 1).

3.2. Impact of social isolation on ADL disability across cohorts

3.2.1. Social isolation composite score

The forest plot of the meta-analytic analysis with the social isolation index score, with the Hong Kong Old-old cohort and without, can be found is Fig. 1 and Supplementary Fig. 2, respectively. Overall, the social isolation composite score was not clearly associated with ADL disability (pooled RR = 1.05, 95 % CI [0.97, 1.14]). Statistical heterogeneity was found to be high and significant (I^2 = 76.7 %, $p < 0.001$). Among the cohorts, more severe social isolation was associated with ADL disability in HRS (RR = 1.14, 95 % CI [1.04, 1.24]), JSTAR (RR = 1.73, 95 % CI [1.17, 2.57]), and CHARLS (RR = 1.10, 95 % CI [1.02, 1.19]). Subgroup analysis suggested social isolation composite score was associated with ADL disability in Asian regions (pooled RR= 1.09, 95 % CI [1.02, 1.16], but not in Western regions (pooled RR 1.01, 95 % CI [0.96, 1.07]), although both estimates did not clearly differ (p 0.366).The pattern of results remained consistent if the Hong Kong old-old cohort wasexcluded from the analysis (Supplementary Fig. 2).

3.2.2. Presence of social isolation (≥2 composite score)

The forest plot of the meta-analysis with the presence of social

Table 1

Descriptive statistics across cohorts.

	Western			Asian			
	ELSA (N = 4006)	HRS (N = 5527)	SHARE (N = 10,836)	Hong Kong old-old (N = 1255)	JSTAR (N = 1636)	KLoSA (N = 4419)	CHARLS (N = 3791)
Cohort year as baseline:	2002–2003	2006 & 2008[#]	2004	1991–1992	2007	2006	2011
Demographics:							
Age (M (SD))	70.62 (7.60)	72.08 (7.51)	69.47 (7.05)	78.17 (6.25)	67.55 (4.57)	69.57 (6.76)	68.47 (6.94)
Gender: Female (n, %)	1800 (44.9 %)	2065 (37.4 %)	5084 (46.9 %)	574 (45.7 %)	818 (50.0 %)	1906 (43.1 %)	1782.05 (47.0 %)
Educational attainment: (n, %)							
Primary	2291 (57.19 %)	164.57 (2.98 %)	4425.78 (40.84 %)	980 (78.09 %)	689.38 (42.14 %)	2873.78 (65.03 %)	3166.9 (83.54 %)
Secondary	904 (22.57 %)	3202.72 (57.95 %)	4651.58 (42.93 %)	213 (16.97 %)	804.17 (49.15 %)	1240.05 (28.06 %)	574.1 (15.14 %)
Tertiary	811 (20.24 %)	2159.72 (39.08 %)	1758.63 (16.23 %)	62 (4.94 %)	142.45 (8.71 %)	305.17 (6.91 %)	50 (1.32 %)
Social isolation: (n, %)							
Any 2 indicators of social isolation	2731.70 (68.2 %)	3237.27 (58.6 %)	6661.72 (61.5 %)	712 (56.7 %)	450.47 (27.5 %)	1296 (29.3 %)	2674.20 (70.5 %)
Social isolation score (range: 0–5) (M (SD))	1.03 (1.05)	1.73 (0.80)	1.92 (1.17)	1.75 (1.02)	1.09 (0.90)	0.97 (1.09)	2.09 (0.01)
Social isolation indicators							
Being unmarried	2082.82 (52.0 %)	2082.82 (37.7 %)	3167 (29.2 %)	603 (48.1 %)	297 (18.2 %)	1305 (29.5 %)	844 (22.3 %)
Living alone	1139 (28.4 %)	3910 (70.7 %)	2639 (24.6 %)	106 (8.5 %)	419.22 (25.6 %)	584 (13.2 %)	1788.52 (47.2 %)
No contact with family within a month	47.72 (1.2 %)	321.25 (5.8 %)	1008.07 (9.3 %)	188 (15.0 %)	134.08 (8.2 %)	193 (4.4 %)	471.62 (12.4 %)
No contact with relatives/friends within a month	258.18 (6.4 %)	358.22 (6.5 %)	6804.70 (62.8 %)	445 (35.5 %)	31.25 (1.9 %)	734 (16.6 %)	2047.48 (54.0 %)
No participation in any social clubs or religious groups	1182.82 (29.5 %)	2879.90 (52.1 %)	7215.95 (66.6 %)	860 (68.5 %)	905.43 (55.3 %)	1483 (33.6 %)	2745.90 (72.4 %)

Note: Figures not in integers due to averaging across imputed datasets.
Household income, number of chronic diseases and frequency of exercise are not harmonizable across cohorts, so they are reported separately in the supplementary materials.

[#] The HRS includes the Psychosocial and Lifestyle Questionnaire (SAQ) starting from wave 2006. In wave 2006, half the sample received the SAQ, the remaining half received the SAQ in wave 2008. The current study combined both subsamples and their subsequent waves (i.e. wave 2008 and 2010, respectively) for the analysis.

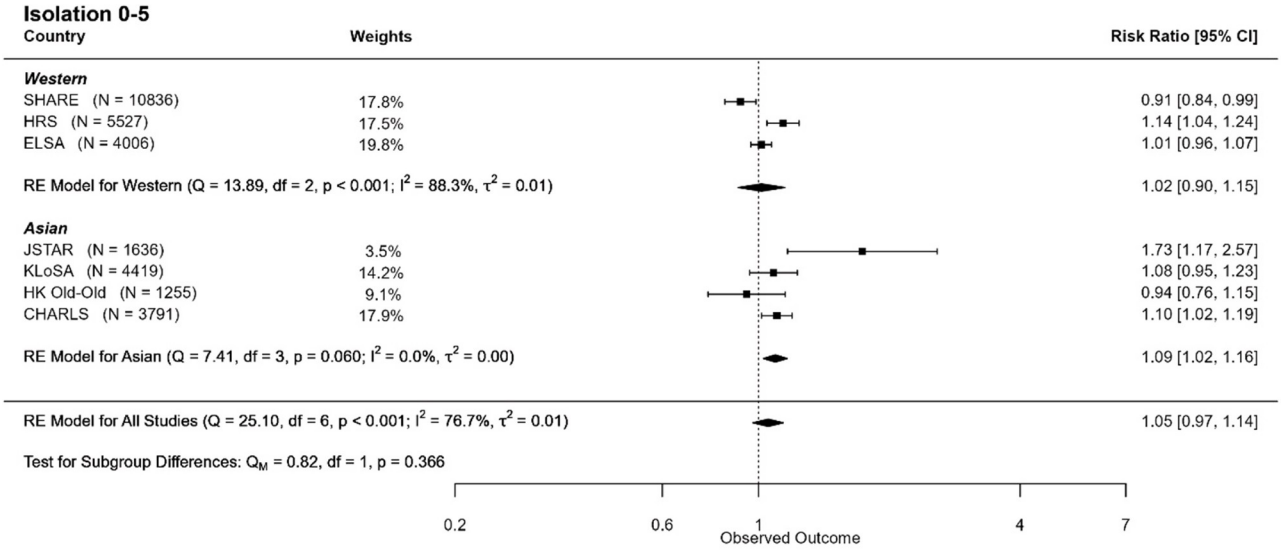

Fig. 1. Forest plot of the meta-analysis of the impact of social isolation (composite score) on ADL disability.

isolation defined by scoring any 2 domains or more, with the Hong Kong Old-old cohort and without, can be found is Fig. 2 and Supplementary Fig. 3, respectively. Overall, social isolation tended to be related to ADL disability (pooled RR = 1.08, 95 % CI [0.99, 1.19]). Heterogeneity was found to be minimal and not significant (I^2 = 18.9 %, p = 0.181). Notably, among the cohorts, the JSTAR observed the strongest association between social isolation and ADL disability (RR = 2.67, 95 % CI [1.01, 7.06]). Subgroup analysis suggested that the relationship between social isolation and ADL disability was marginally stronger in Asian (pooled RR 1.24, 95 % CI [1.05, 1.47]) than Western cohorts (pooled RR = 1.03, 95 % CI [0.94, 1.14]) (p = 0.054). The pattern of results remained consistent if the Hong Kong old-old cohort was excluded from the analysis.

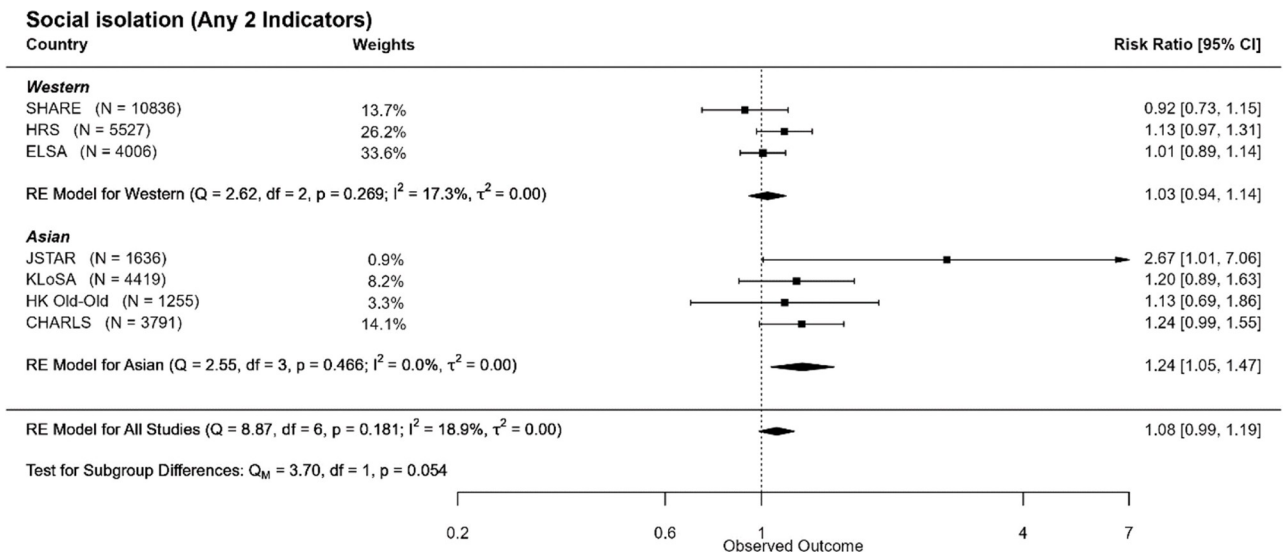

Fig. 2. Forest plot of the meta-analysis of the impact of social isolation (cutoff of composite score ≥2) on ADL disability.

3.2.3. Specific domains of social isolation

The forest plot of the meta-analysis with individual indicators of social isolation, with the Hong Kong Old-old cohort and without, can be found is Fig. 3 and Supplementary Fig. 4, respectively. Among indicators of social isolation, lack of participation in social clubs was associatedwith ADL disability (pooled RR 1.12, 95 % CI [1.04, 1.21]), with the association being larger in Asian (pooled RR: 1.32, 95 % CI [1.10, 1.60]) than Western cohorts (pooled RR: 1.08, 95 % CI [0.99, 1.17]) regions ($p = 0.031$). There was no statistical heterogeneity ($I^2 = 0$ %, $p = 0.280$).

However, living alone was associated with lower ADL disability (pooled RR = 0.87, 95 % CI [0.76, 0.99]), although substantial heterogeneity was noted ($I^2 = 50.9$ %, $p < 0.010$). Among the cohorts, living alone was associated with higher ADL disability in JSTAR (RR = 3.04, 95 % [1.35, 6.86]), but lower ADL disability in HRS (RR = 0.80, 95 % CI [0.69, 0.94]) and CHARLS (RR = 0.80, 95 % CI [0.42, 2.11]). The RRs were comparable between Asian and Western cohorts ($p = 0.679$).

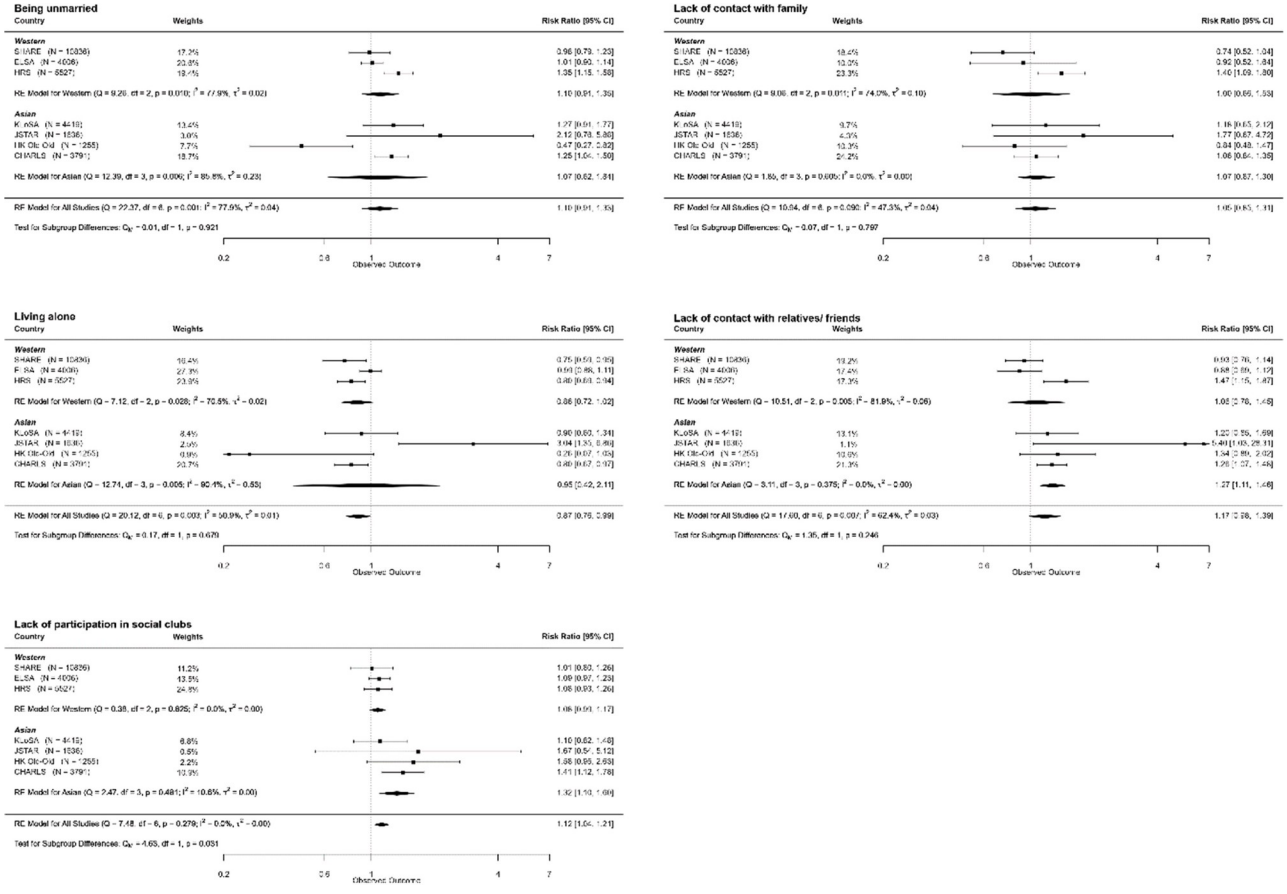

Fig. 3. Forest plot of the meta-analysis of the impact of social isolation (individual indicators) on ADL disability.

Being unmarried, lack of contact with family, and lack of contact with relatives/ friends and were not associated ADL disability. Results of the indicator-level analyses remained similar without the Hong Kong cohort (Supplementary Fig. 4), except that being unmarried became associated with ADL disability after Hong Kong cohort was removed from analysis (pooled RR 1.16, 95 % CI [1.02, 1.33]).

Complete case analysis showed similar but slightly attenuated relationship between social isolation and ADL disability (Supplementary Fig. 6). Additional interaction analyses suggested that the relationship between social isolation and ADL disability was not different by age and sex groups in respective cohorts (p for interaction >0.05). The E-values of the main analyses are reported in Supplementary Table 1. Generally, the observed association between social isolation (aggregated score or using the binary cut-off of 2) and individual domains of social isolation could be subject to unmeasured confounding of moderate strength (Supplementary Table 3).

4. Discussion

Using harmonized data across seven nationally/ regionally representative longitudinal cohorts, we examined the impact of social isolation on the development of ADL disability in community-dwelling older adults. A strength of our study is the meta-analytic approach to poolestimates from multiple cohorts, synthesizing evidence for the longitudinal association of social isolation and functional disability. Extending from previous studies on the negative impact of social isolation on health outcomes (e.g. Nicholson, 2012) our findings showed that the impact of social isolation might not be universal across settings but perhaps differ according to the underlying social and cultural contexts. Our findings showed the impact of social isolation on ADL disability in Asian regions, either using a composite score or a cutoff of 2, whereas the impact in Western regions appears to be less conclusive. This finding supported our hypothesis that the impact of accumulated social isolation is stronger in settings where collectivistic cultures are more dominant, which highly value interdependence and connectedness among members in social groups, including family members and friends (Markus & Kitayama, 2003). In this regard, accumulated social isolation would be particularly harmful in Asian regions (Ikels, 2004). Our findings of the impact of being exposed to social isolation (cutoff score ≥2 vs. <2), particularly in Asian settings (RR 1.24, 95 % CI [1.05, 1.47]) couldalso be put in comparison to the detrimental effect of muscle loss in older people. A meta-analysis conducted by Braun et al. (2022) showed that each point decrease in Short Physical Performance Battery score was related to increased risk of ADL disability by 30 % (RR = 1.30, 95 % CI: 1.23–1.38).

Notably, our indicator-wise analyses offer a more complex picture that distinct aspects of social isolation may exhibit disparate relationships with ADL disability. These findings echo the conceptualization of social isolation as a multidimensional construct, with its underlying components being qualitatively distinct in terms of their impact on physical health. Our findings suggested that different domains of social isolation could have distinct psychosocial and biological pathways to health outcomes, including functional disability, supporting the use of multiple indicators to capture the breadth of the construct.

Among the domains of social isolation, the most robust association was reported for a lack of participation in social clubs and religious groups, with null heterogeneity found across cohorts. Our findings supported that participation in social clubs and religious groups could be beneficial against functional disability, in line with previous findings that social and civic participation is beneficial to the maintenance of functional abilities (Ma et al., 2020; Tomioka et al., 2017). Our results indicated that the association of lack of participation in social clubs and religious groups on ADL disability is stronger in Asian than Western regions. While social connections with members of social clubs and religious groups are perhaps less valued than connections with family members and friends in collectivistic than individualistic cultures (Realo & Allik, 2009), the health benefits of these extended connection are being increasingly recognized (Lin et al., 2015).

However, the results for the remaining indicators were more mixed across cohorts. Between-region variations in economic development, dominant family structure and living arrangement, healthcare policies, and the rural-urban divide may partly explain the heterogeneity. In particular, the sociocultural underpinning of the different domains of social isolation for specific settings may be important to the understanding of their impact of functional disability (Holt-Lunstad & Steptoe, 2022). For example, being unmarried and living alone in old age is culturally more acceptable in some regions, especially in places where their housing policies and public welfare systems are supportive to independent living (Mudrazija et al., 2020). However, being unmarried and living alone might be stigmatized in some Asian regions, where children and family members are expected to live with their older parents to offer them support and care (Lou & Ng, 2012).

In contrast to our expectation, living alone was associated with lower ADL disability. It could be plausible that living alone may be a manifestation of functional independence, especially for those who are in good health and capable of managing daily household tasks, such as cleaning and cooking. Indeed, older adults who live alone and are incapable of taking care of their own are more likely to reside in nursery facilities (Wang et al., 2015), which have been excluded from the current analysis. In addition, the shrinkage in social networks associated with living alone could be compensated with additional social connections with friends and other non-co-resident relatives (Perissinotto & Covinsky, 2014). Empirically, some studies found null associations between living alone and risks of negative health outcomes, such as cognitive decline and dementia (Evans et al., 2019), mobility and number of chronic diseases (Iliffe et al., 1992), as well as all-cause hospitalizations (Ennis et al., 2014). Extending from these findings, our results corroborated with the previous literature that living alone may not necessarily be related to poorer health outcomes.

4.1. Policy implications

Maintaining functional abilities among older adults should become an important priority for policies targeting healthy ageing in order to achieve what the United Nations Decade of Healthy Ageing in 2020–2030 advocates. The trend of shrinking household size in some countries (Gu et al., 2021), including China (Hu & Peng, 2015) the USA (Bradbury et al., 2014) and some European countries (Eurostat, 2003), has become more prominent. The recent COVID-19 pandemic has often highlighted the plight faced by the socially isolated older people, and yet there has been little research on how the pandemic has aggravated social isolation in the older population, and whether this phenomenon is linked to any worsened functional abilities. Therefore, targeting social isolation would be one of the policy goals to slow down the decline in functional abilities in older adults, providing an avenue to active andhealthy ageing. However, various settings have their own healthcare and social care policies and macro-socioeconomic profiles which make a universal solution for structural changes in older adults' social network difficult, corroborating with our findings that much heterogeneity is observed for some specific indicators of social isolation. Indeed, our current result sheds light on the possibility of targeting social participation to bring about improvement in ADL, which seems to be more promising in Asian regions. Interventions or programmes targeting to build social connections in the community, in particular those offering group-based social activity and support, are found to be feasible and efficacious means to alleviate social isolation (Dickens et al., 2011).

4.2. Limitations

There are several limitations in this study. First, as indicated by the E-values, our results could have been biased by unmeasured confounders of moderate strengths. Second, harmonizing data across

cohorts implies that the measure of social isolation was limited to indicators that were commonly available and conceptually compatible across the selected cohorts. As a result, some aspects of the social relationship, such as contact with grandchildren and members of the community (e.g. neighbours), were not considered in the analysis. Third, although we excluded older adults with ADL disability at baseline to minimise the risk, reverse causality could not be completely eliminated, given basic functioning is essential to maintain social connection.Fourth, we acknowledge that some of the cultural comparisons may be underpowered, due to a small number of cohorts in each region.

5. Conclusions

Synthesizing the findings from nine nationally/regionally representative cohorts, we offer evidence supporting the impact of social isola- tion on ADL disability in community-dwelling older adults. More importantly, our results indicated differential impact by specific in- dicators of social isolation. Our findings also offer some support for a stronger impact of social isolation on ADL disability in Asian than in Western regions. Policymakers and service providers should be mindful
of the long-term impact of social connection on older adults' functional abilities. Targeted policies and programmes aiming at building social connections may be helpful to slow down functional decline.

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CRediT authorship contribution statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.archger.2024.105502.

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