The associations of physical incapacity and wealth with remaining in paid employment after age 60 in five middle-income and high-income countries

Abstract

Previous studies on health and socioeconomic determinants of later-life labour force participation have mainly come from high-income European countries and the United States of America (USA). Findings vary between studies due to different measures of socioeconomic status and labour force outcomes. This study investigated longitudinal associations of physical incapacity and wealth with remaining in paid employment after age 60 in middle- and high-income countries. Using harmonised cohort data in the USA, England, Japan, Mexico and China (N=32,132), multilevel logistic regression was applied for main associations. The age-related probabilities of remaining in paid employment by physical incapacity and wealth were estimated using marginal effects. This study found that physical incapacity predicted lower odds of remaining in paid employment in each country. Wealth was associated with higher odds of remaining in paid employment in the USA, England, and Japan, but not in Mexico. Probabilities of remaining in paid employment were high in Mexico but low in China. The absolute difference in the probability of remaining in paid employment between the richest and the poorest groups was greater in the USA than that in any other country. In the USA, England and Japan, the inverse association between physical incapacity and remaining in paid employment could be partially compensated by wealth only when physical incapacity was not severe. National policies, including considering older adults' changing capacities for job placement and prioritising the provision of supportive services for socioeconomically disadvantaged older adults, developing pathways for informal workers to access social security and pension coverage, and encouraging employers to hire socioeconomically disadvantaged older workers and enhancing their employability, could be facilitated. Future studies, such as exploring health and socioeconomic determinants of

remaining in part-time and full-time paid employment separately in more countries, and the moderating effects of relevant policies on these associations, are needed.

Key words: socioeconomic status, labour force participation, physical capacity, United States of America, United Kingdom, China, Japan, Mexico

Introduction

The global labour force will age substantially over the next decades, as governments worldwide are encouraging older adults to stay longer in the labour market, in order to tackle the challenges of demographic transition for the world economy (Poplawski-Ribeiro 2019). Labour force participation is not important only for the economy. One systematic review suggested that later-life paid employment has a positive effect on older adults' mental health in high-income countries (Maimaris, Hogan and Lock 2010). One study in Japanese men also reported that older adults who engaged in paid work less than 35 hours per week were able to maintain their physical health (Kajitani 2011). For older adults, participating in paid employment in later life could help meet their basic needs and increase opportunities for them to develop social relationships (World Health Organization 2015). However, the health and social benefits of working at older age depend on an individual's capacity and the suitable working conditions (International Labour Organization 2015). Older adults in disadvantaged socioeconomic status (SES) are less likely to have high levels of skills and education that provide them with desirable and flexible jobs, and they are less likely to be sufficiently healthy to perform desirable jobs (World Health Organization 2015). Therefore, the health and social benefits of later-life paid employment are unlikely to be universal due to disparities in labour force participation by individual capacity and SES.

Health and socioeconomic determinants of later-life labour force participation

Many studies have investigated the relationship between health and later-life labour force participation. One study in London-based civil servants in the United Kingdom (UK) found that having chronic disease was associated with increased risks of all types of work exit, including "retirement" (reported being retired, not on health grounds), "health-related exit" (reported being long-term sick or retirement on health grounds), "unemployment" (reported being unemployed) and "other exit" (other reasons for work exit), and specifically

the health-related work exit (Fleischmann *et al.* 2018). Another UK study also suggested that poor physical and cognitive performance was associated with a lower likelihood of participating in bridge employment after retirement (Stafford *et al.* 2017). One systematic review based on forty-four longitudinal studies indicated that poor health (measured by self-perceived health, mental health and chronic diseases) was associated with exiting from paid employment (van Rijn *et al.* 2014). All these studies were from high-income European countries and the United States of America (USA). Epidemiological evidence on health determinants of later-life labour force participation in other countries is limited.

The socioeconomic determinants of later-life labour force participation have also been examined. However, findings vary between studies due to different measures of SES and later-life labour force outcomes. One study in Finland indicated that lower levels of education, occupational position and income were all associated with higher risks of disability retirement (reported receiving any form of disability pension at the end of each year) (Leinonen, Martikainen and Lahelma 2012). One study in the UK also found that a lower level of household wealth was related to an increased probability of leaving from paid employment (McMunn *et al.* 2009). One study based on data of seven longitudinal studies in Finland, France, the UK and the USA suggested that lower levels of education and occupational position were associated with increased risks of health-related work exit (i.e., reported leaving work due to their own health/disability, or being receiving a health-related benefit/pension one year before or one year after the date they stopped working) in most studies but any paid work exit (i.e., retirement, health-related exit, unemployment, and other exits) only in some of the studies (Carr *et al.* 2018). One study in the USA suggested that participants with a higher level of net wealth (including lifetime wealth and savings) or pension wealth were less likely to work full-time at age 62; whereas those with a higher level of income would continue working full-time at age 62 (McGarry 2004). Another study in the

US men indicated that a higher level of net wealth was associated with an earlier retirement expectation (leave the labour market before normal pension age); however, the effect size of the net wealth was small: per $100,000 increase in net wealth resulted in only 14 days earlier for retirement (Dwyer and Mitchell 1998).

Researchers also explored the joint contribution of health and SES to later-life labour force participation. One study based on two Finish cohorts found a significant interaction between occupational position and cardiovascular disease, suggesting that compared with those with a high occupational position and no cardiovascular disease, participants with both a low occupational position and cardiovascular disease had a 4.5-fold risk of having disability retirement (Virtanen *et al.* 2017). The reason behind this amplifying effect of a low occupational position on disability retirement might still relate to the universal mechanism of the socioeconomic inequality in health: people with disadvantaged SES were less likely to approach/afford/accept healthcare services to prevent, treat and monitor their chronic conditions, leading to a higher risk of having disability retirement (Virtanen *et al*. 2017). Moreover, older adults in lower occupational positions are likely to have physically demanding jobs, which may not allow them to continue working because of their health problems. The World Health Organization also proposed that participating in work depends on not only older adults' intrinsic capacities – what they can do physically or mentally, but also the fit between older adults and the social environment. The supportive environment in advantaged socioeconomic settings can remove barriers to compensate for the loss of mental or physical capacity, enabling those with a decrement in physical or mental health to stay in the labour market longer. This is important for both the economy and building an age-friendly world (World Health Organization 2015).

Dynamics of remaining in paid employment

A few studies about the health and socioeconomic determinants of work exit did not consider individuals' return to paid employment after an initial work exit (Carr *et al*. 2018, Fleischmann *et al*. 2012, Virtanen *et al*. 2017). In later life, older adults could leave work and re-enter the labour market more than once. One study in the USA found that around 50 per cent of retirees had non-traditional retirement paths which involved remaining in full and partial paid employment after normal pension age (Maestas 2010). One study in the UK suggested that there was an inverted U-shaped relationship between age and unretirement; and the possibility of remaining in paid employment was the highest when an individual was in their mid-late 60s (Kanabar 2015). Another UK study also found that among older participants aged 50–69 years, around 25 per cent of them experienced returning to paid employment after retirement (Platts *et al.* 2019). One study in Finland also indicated that, on average, older workers who were still employed at age 62 would spend another 13.5 months to work before retirement during the flexible pension age range (age 63–68); and they would also return to paid employment for another 4.8 months after retirement (Leinonen *et al.* 2020).

Remaining in paid employment after normal pension age might be due to failures in planning, low wealth accumulations, or financial shocks, but might also be due to a more complicated retirement process. In a dynamic model of retirement, older adults' expectations could be updated and reoptimized by their health conditions, finances, and life satisfaction after retirement; and their psychological "burnout" caused by the long-term employment during earlier adulthood could also recede after retirement. These transitions could render work relatively attractive again, making older adults return to the labour market (Maestas 2010). There have been studies examining dynamic changes in later-life labour force participation. For example, one longitudinal study in the USA identified five work–retirement

patterns including full retiree, partial retiree or part-time worker, full-time worker, work-disabled, and homemaker in each wave of data collection (1998–2004). This study suggested that both older men and women could experience multiple transitions across waves (e.g., transiting from full-time worker to work-disabled, partial retiree, or full retiree in older men; or transiting full retiree to partial retiree or part-time worker in older women) (Tang and Burr 2015). Instead of identifying work-retirement patterns in each wave, another longitudinal study summarised four patterns of labour force activities over eight interviews during 28 months of follow-up in US older men. The four patterns were no transitions–working, no transitions–nonworking, transitions–crisp exit, and transitions–blurred exit (Mutchler *et al.* 1997).

Health and SES can determine older adults' return to paid employment after retirement, as well as dynamic changes in later-life labour force status. For example, older adults with poor self-rated health were more likely to be in the work-disabled status (Tang and Burr 2015), have no return to paid employment after retirement (Platts *et al*. 2019), and experience crisp exit from paid employment (Mutchler *et al*. 1997). Returning to paid employment after retirement was more common among older adults who were more educated (Platts *et al*. 2019) or had a higher occupational position (Leinonen *et al.* 2020). However, for economic-related factors, findings were mixed. For example, in the Finnish study, high household income seemed to encourage later retirement and participation in post-retirement employment (Leinonen *et al.* 2020). While in the US study, having more non-housing economic resources was associated with a higher probability of becoming a full retiree in older men (Tang and Burr 2015). Another US study also suggested that older male workers with high non-wage income and pension availability tended to transit from full-time working to blurred exit from the labour market (Mutchler *et al.* 1997). The UK study found no

association between income and post-retirement employment after controlling for a wide range of confounders (Platts *et al.* 2019).

Limitations in methodology still existed in these studies. Only time-invariant variables for health and socioeconomic factors were used in these studies (Leinonen *et al.* 2020, Mutchler *et al.* 1997, Platts *et al.* 2019, Tang and Burr 2015). Participants may experience more than one work exit/return event; but in these studies, only the first-time work exit was considered (Leinonen *et al.* 2020, Platts *et al.* 2019). Although dynamic changes in later-life labour force status across waves were identified, determinants of these dynamic changes were not examined; instead, only associations between health/socioeconomic factors and fixed patterns of labour force status at baseline were examined (Tang and Burr 2015). Moreover, there were no statistical approaches to handling missingness in covariates when testing these associations (Tang and Burr 2015). Therefore, when identifying determinants of later-life labour force participation, choosing time-varying covariates, and considering repeatable events of labour force participation in later life, are needed. Furthermore, appropriate analytical methods to handle missing data could be applied.

Research gap, aim, objectives and hypotheses

In summary, previous studies about health and socioeconomic determinants of later-life labour force participation have been mainly from high-income European countries and the USA. Evidence from other countries is limited. Findings vary between studies due to different measures of SES and later-life labour force outcomes. Additionally, appropriate analytical methods for the inclusion of time-varying covariates and repeatable events of labour force participation in later life is needed.

We aimed to investigate the associations of older adults' intrinsic capacity and SES with participating in work in later life in countries of different regions, using the harmonised measures of SES and later-life labour force outcomes. The Ageing Trajectories of Health:

Longitudinal Opportunities and Synergies (ATHLOS) consortium (Sanchez-Niubo*et al.* 2019) harmonised 17 ageing cohorts worldwide, providing an opportunity for us to look into this research question cross-nationally. Five cohort studies were selected including the US Health and Retirement Study (HRS) (Sonnega *et al.* 2014), the English Longitudinal Study of Ageing (ELSA) (Steptoe *et al.* 2013), the Japanese Study of Aging and Retirement (JSTAR) (Hidehiko, Satoshi and Hideki 2010), the Mexican Health and Aging Study (MHAS) (Wong, Michaels-Obregon and Palloni 2017), and the China Health and Retirement Longitudinal Study (CHARLS) (Zhao *et al.* 2014). These countries are all major economies in their regions and account for approximately 50 per cent of the global economy and 40 per cent of the world population aged 65 and over; while they also represent diverse economic, social, cultural and epidemiological contexts (International Monetary Fund 2019, The World Bank 2015). The five cohorts all have at least three waves of data collection and available variables in labour force participation, SES, and intrinsic capacity, which are ideal for investigating our main research question using time-varying variables for covariates and labour force outcomes (considering the repeatable events of labour force outcomes, which can be recurrent and collected repeatedly over time). Exploring differences and similarities in the associations of older adults' intrinsic capacity and SES with participating in work in later life within and across countries will be instructive for setting common and country-specific strategies to promote healthy labour force participation and healthy ageing in later life.

Specifically, our objectives were to a) examine the longitudinal association of physical incapacity (measured by a mobility score as well as three levels of this score) and SES (measured by quintiles of wealth) with remaining in paid employment (a subset of labour force participation) in older adults in each country; b) test whether wealth moderated the association between physical incapacity and remaining in paid employment in each

country; and c) compare inequalities in probabilities of remaining in paid employment by physical incapacity and wealth across countries.

We hypothesised that: (1) older adults with a higher level of physical incapacity are less likely to remain in paid employment than those without physical incapacity in each country; and (2) wealth is a moderator for the relationship between physical incapacity and remaining in paid employment in each country (i.e., although the odds of remaining in paid employment decreases with increasing physical incapacity among both socioeconomically advantaged and disadvantaged older adults, the decreasing rate in odds is slower among socioeconomically advantaged individuals than disadvantaged individuals).

Methods

Sample

We included 8,003 (waves 6–11, 2002–2013) US participants, 7,225 (waves 1–7, 2002–2015) English participants, 2,163 (waves 1–3, 2007–2011) Japanese participants, 7,374 (waves 1–3, 2001–2013) Mexican participants, and 7,367 (waves 1, 2 and 4, 2011–2016) Chinese participants. Wave 6 (2002) rather than Wave 1 (1992) of HRS was used as the baseline wave, to minimise the variations in period effect on the age-cohort model for the longitudinal analysis across countries (Fannon and Nielsen 2018). In each country, samples whose individual-level weights at baseline were missing or zero, and samples aged less than 60 years old at baseline were excluded. Supplementary Figure S1 illustrates the procedure of sample selection.

Physical incapacity

Physical incapacity (time-varying) was measured as the sum score (range 0–7) of seven self-reported indicators of mobility (yes/no) in each wave, including difficulties for walking without equipment, sitting for long periods, climbing stairs, stooping/kneeling/crouching, reaching/extending arms, lifting/carrying weights, and picking

up coins. A higher score indicates higher incapacity. The internal consistency of the sum score was ≥0.7, in an acceptable range (Price, Jhangiani and Chiang 2015). The predictive validity of the score for mortality was similar to or better than that by the scales of (Instrumental) Activities of Daily Living ([I]ADL) (Hajian-Tilaki 2013) (Supplementary Table S1 and Figure S2). We also re-categorised the sum score into three levels in each country (0=None, 1–2=middle, ≥3=highest).

Socioeconomic status (SES)

The SES was assessed by household wealth (time-varying) in each wave. Household wealth was the sum of all wealth components minus the sum of all debts. All wealth components included net values of primary and second residence and other real estates, vehicles, business, stocks, mutual funds and investment trusts, checking, savings and money market accounts, governmental savings bonds, T-bills and certificates of deposit, bonds and bond funds, and others. All debts included first and second mortgages, other home loans, and other debts.

For each continuous wealth variable in each wave of each country, we firstly applied the inflation adjustment using the consumer price index provided by the World Bank (The World Bank 2017). Secondly, all continuous wealth variables across waves in each country were organised into quintiles based on the analytical sample size at baseline, ranging from the highest to the lowest levels.

Paid employment

Paid employment (time-varying) was measured by asking participants whether having paid employment currently (yes or no) in each wave. Paid employment was one of the elements of labour force participation. Through using time-varying variables for remaining in paid employment, we captured the dynamics of remaining in paid employment before and after normal retirement age during follow-up.

Confounding factors

Time-varying age, marital status, smoking, the eligibility for full retirement and long-term conditions, and time-invariant gender, birth cohort group and education, were included as confounders. The long-term conditions included diabetes, respiratory diseases, joint disorders, cancer, hypertension, and stroke. The time-varying variable for the eligibility for full retirement was created based on every participant's age in each wave and also normal pension age in each country, namely, 65 years for all US participants (born in/before 1942), 65 years for English male participants and 60 years for English female participants (born in/before 1943), 65 years for all Japanese participants (born in/before 1947), 65 years for all Mexican participants (born in/before 1941), and 60 years for Chinese male participants and 55/50 years for Chinese female participants (born in/before 1952) in our study (Social Security Administration 2018-2019).

Missing data

Supplementary Table S2 shows percentages of non-respondents and non-responding items for all variables in each wave of each country. During follow-up, around 31% of US participants, 65% of English participants, 41% of Japanese participants, 18% of Mexican participants, and 21% of Chinese participants became non-respondents. JSTAR, MHAS and CHARLS have more missing data than the HRS and ELSA, particularly for wealth, physical incapacity, smoking and long-term conditions. For example, percentages of missing data for baseline wealth in JSTAR, MHAS, and CHARLS were around 56%, 17%, and 10%, respectively. While there was no missing data for baseline wealth in HRS; and in ELSA, the percentage of missing data for baseline wealth was around 1%. Due to larger missingness in JSTAR, MHAS, and CHARLS, conducting complete case analyses might exclude a large number of valid samples in the three countries, resulting in a decreased power of analysis.

Results based on complete case analyses thus might not be representative in the three countries.

Multiple imputation (using 50 datasets) was used to address missing data for covariates and outcome variables across waves in the five countries. Imputation models were built using the two-fold fully conditional specification (FCS) algorithm (Welch, Bartlett and Petersen 2014), by including all covariates, outcome variables, and individual-level weights. Imputed covariates and outcome variables were used for data analysis. Age in each wave was used as the timing variable. Compared with the wave number, which assumes that every respondent is measured at the same time point, age is more accurate in measuring changes in paid employment status over time, as it specifies an entry and exit time for each individual differently. With the two-fold FCS algorithm, interactions between age and other variables were automatically considered in the imputation model. Records with imputed values for non-respondents in each wave were automatically excluded, as the two-fold FCS algorithm only imputed non-responding items within each wave, rather than non-responders (attrition/wave non-response) in that wave. For each country, 50 imputed datasets were created.

Statistical analyses

We applied multilevel mixed-effects logistic regression to estimate the association of physical incapacity (categorical) and wealth (quintiles) with remaining in paid employment in each country, allowing for random intercepts for each participant (Sommet and Morselli 2017). In longitudinal data, the multilevel logistic model is suitable for the repeatable events of paid employment, which can be recurrent and collected repeatedly over time, allowing for the correlation between durations to events experienced by the same individual, or individuals who are clustered into the higher-level units (Steele 2008). Age was the timing metric and centred on 60 to aid interpretation. In each country, we built both basic and fully

adjusted models. The basic model was controlled for gender and linear and quadratic terms of age. The fully adjusted model was additionally controlled for cohort group, marital status, education, smoking, long-term conditions and eligibility for a full retirement pension. We also tested the multiplicative interactions between physical incapacity and wealth. The Wald test (Rodríguez 2007) was applied to compare the difference between a model with interaction and a model without interaction. Odds Ratios (ORs) with 95% confidence intervals (CIs) were calculated.

In the next step, we quantified cross-country inequalities in the probability of remaining in paid employment by physical incapacity (continuous) and wealth (quintiles) with increasing age. We combined country-specific data into one pooled dataset and generated a country variable (0=USA [Reference], 1=England, 2=Japan, 3=Mexico, 4=China). This allowed us to test whether the cross-country differences in age-related probabilities of remaining in paid employment by physical incapacity and wealth were statistically significant, through including the multiplicative interaction terms among country, physical incapacity and wealth. Both linear and quadratic terms of the physical incapacity score were included in the model. The model was additionally adjusted for linear and quadratic terms of age, cohort group, gender, marital status, education, smoking, long-term conditions and eligibility for a full retirement pension. The Wald test helped build the final model. Probabilities of remaining in paid employment by physical incapacity and wealth at age 60, 65 and 70 years across countries were predicted using marginal effects with 95% CIs (Norton, Dowd and Maciejewski 2019), to aid interpretations for comparing inequalities in the probability of remaining in paid employment between countries.

Finally, we conducted sensitivity analyses. Firstly, we used time-varying continuous scores of physical incapacities to examine the main association of physical incapacity and wealth with remaining in paid employment in each country, adjusting for all confounding

factors. Secondly, since agricultural work in China was not considered as paid employment during data harmonisation, we identified persons who mainly worked on farmland (around 70 per cent of the Chinese sample) as having paid employment and re-ran multilevel analysis in China. The reason is that agricultural employment in China is associated with an increased opportunity for rural older workers to continue working in later life (Clark, York and Anker 1999).

All analyses were performed using the Stata MP 16.1 (StataCorp 2017).

Results

Baseline sample characteristics

Table 1 shows sample characteristics at baseline. US, Japanese and Chinese participants were younger than English and Mexican participants. All countries had more women than men except for China. English, Mexican, and Chinese participants were more likely to be widowed but have a lower level of educational attainment than their US and Japanese counterparts. Remaining in paid employment was more common in the USA, Japan and Mexico than in England and China. Japanese and Mexican participants had the lowest (0) and the highest (2) median value of the sum score of physical incapacity, respectively. Around 80 per cent of Japanese participants had no physical incapacity, whereas, in other countries, proportions were less than 50 per cent. China had the highest proportion of smokers. Long-term conditions were common in all countries but more so in the USA. The majority of participants had been eligible for full retirement pension in each country.

<Insert Table 1 here>

Within-country analyses

Table 2 presents results of basic models for the within-country association of physical incapacity and wealth with remaining in paid employment. In all countries, compared to those without physical incapacity, participants in the highest level of physical incapacity had

significantly lower odds of remaining in paid employment, with odds ratios ranging between 0.07 (95%CI: 0.03 – 0.16) in Japan to 0.36 (95%CI: 0.23 – 0.58) in China. Compared with participants with the highest level of wealth, those with the lowest level of wealth had significantly lower odds of remaining in paid employment in the USA, England, and China; in Japan, the odds of remaining in paid employment was the lowest among participants with the second-lowest level of wealth; but the relationship between wealth and remaining in paid employment was non-significant in Mexico. The multiplicative interactions between physical incapacity and wealth were non-significant in all countries. In each country, the Wald test suggested that model fitness did not increase significantly by adding this multiplicative interaction (P-value > 0.05). After full adjustment, results for main associations shown in Table 3 remained similar to the basic models shown in Table 2. Models in Table 2 and Table 3 did not include the multiplicative interactions between physical incapacity and wealth.

<Insert Table 2 and Table 3 here>

Inequalities in the probability of remaining in paid employment by physical incapacity and wealth

Figure 1 shows predicted probabilities of remaining in paid employment by wealth and physical incapacity at age 60, 65 and 70 in each country, based on the estimation of the fully adjusted model shown in Supplementary Table S3. Generally, probabilities of remaining in paid employment decreased with the increase of age and with the increase of the score of physical incapacity. Patterns of the probability of remaining in paid employment by wealth were not uniform across countries. Wealth gradients in remaining in paid employment were clearer in the USA, England, and Japan than that in Mexico and China. Particularly in the USA, when having no physical incapacity (sum score = 0), the absolute differences in the probability of remaining in paid employment between the richest and the poorest groups were approximately 60 per cent, 50 per cent and 40 per cent at age 60, 65 and 70, respectively,

which were greater than that in any other country at the same age. The multiplicative interaction between wealth and physical incapacity was not statistically significant: as the score of physical incapacity increased from zero to seven, the probability of remaining in paid employment declined by half in each wealth group. However, in the USA, England and Japan, the absolute decline in the probability of remaining in paid employment with increasing physical incapacity was the largest in the richest group, due to a distinctly higher probability of remaining in paid employment in the richest group when having no physical incapacity (sum score = 0). Thus, the absolute inequality in the probability of remaining in paid employment by wealth was large when physical incapacity was low, but small when physical incapacity was high in the USA, England, and Japan. Probabilities of remaining in paid employment were high in all wealth groups in Mexico (e.g., approximately 40% – 60% at age 65), but low in all wealth groups in China (e.g., less than 5% at age 65). With increasing physical incapacity, compared to the US, trajectories of the probability of remaining in paid employment declined faster in England and Japan, but slower in China and Mexico. This was due to a significant interaction between physical incapacity and country (Supplementary Table S3).

<Insert Figure 1 here>

Sensitivity analyses

Supplementary Table S4 shows the association of continuous physical incapacity score and wealth with remaining in paid employment in each country. Results were identical to the results of our main analyses. In each country, the increased score of physical incapacity was associated with decreased odds of remaining in paid employment in later life. A higher level of wealth was associated with higher odds of remaining in paid employment in the USA, England, Japan, and China, but not Mexico.

Supplementary Table S5 presents results for the main association in China when re-categorising the participation of agricultural work into the group of remaining in paid employment. Different from the main results shown in Table 2 and Table 3, less wealthy participants had higher odds of remaining in employment than their richest counterparts in China.

Discussion

In summary, in all countries, increased physical incapacity was associated with lower odds of remaining in employment (confirming hypothesis one). Older adults with lower levels of wealth were less likely to remain in paid employment than those with the highest level of wealth in the USA, England, and Japan, but not in Mexico. Wealth was not a moderator for the relationship between physical incapacity and remaining in paid employment in any country (rejecting hypothesis two). We also found that the absolute inequality in the probability of remaining in paid employment by wealth was large when physical incapacity was low, but small when physical incapacity was high in the USA, England, and Japan; and probabilities of remaining in paid employment were high and low in all wealth groups in Mexico and China, respectively.

Consistent with previous work (Fleischmann *et al.* 2018, Stafford *et al*. 2017, van Rijn *et al*. 2014), we found that physical incapacity, as an indicator of individual health, was a predictor of remaining in paid employment in later life in each country. We also found that compared to US participants, with increasing physical incapacity, trajectories of the probability of remaining in paid employment declined faster in England and Japan, but slower in Mexico and China. One potential explanation is that England and Japan have had free or low-cost national healthcare for the long term. Without salary income and sufficient wealth in later life, English and Japanese older adults could still have protection against the major health care costs that go beyond income level. This might encourage them to quit the

labour market, especially when having more illness or increased incapacity (NHS 2018, Reich and Shibuya 2015). Countries including the USA, Mexico, and China are making progress to achieve universal health coverage under new healthcare programmes, such as the Medicaid expansion (including Affordable Care Act) in the USA (Barnett and Sommers 2017), Seguro Popular in Mexico (King *et al.* 2009), and New Cooperative Medical Scheme in China (Zhang *et al.* 2021). However, there is heterogeneity in actual healthcare reimbursements and changes in healthcare policies across regions within countries; and the overall out-of-pocket spending on health services in the general population is still high (Hero, Zaslavsky and Blendon 2017, King *et al.* 2009, Zhang *et al.* 2021). These issues might discourage older adults to leave the labour market, particularly if they have catastrophic spending on health services for themselves and their families.

Significant wealth inequalities in remaining in paid employment were found in countries including the USA, England, and Japan. This finding supported the notion that older adults in socioeconomically disadvantaged settings were more likely to leave from paid employment (Carr *et al.* 2018, Fleischmann *et al.* 2018, Leinonen, Martikainen and Lahelma 2012). This finding could be potentially explained by several reasons. Compared with socioeconomically advantaged older adults, socioeconomically disadvantaged older adults are more likely to have unskilled or manual jobs, making them suffer from health problems in earlier older ages (Padilla 2011). From the supply side, socioeconomically disadvantaged older adults at an older age might not be healthy enough to work even if they need or want to; from the demand side, employers might be reluctant to employ older workers for manual jobs, particularly if companies need to cover older workers' health insurance, making them have a high risk of layoffs and a low possibility to find a new job in later life (Staudinger*et al.* 2016). Other structural factors such as pension and public benefits can also influence older adults' labour force participation in these countries. Researchers have found that public

benefits for American older adults have been largely protected over the past decades, especially for those in disadvantaged socioeconomic settings; compared with the working-age population, government transfers have been more equally distributed among the ageing population in the USA (Bosworth, Burtless and Zhang 2016). In the UK, the pension system is also effective in preventing the "very bottom" poverty although compared with the USA, the average pension income of older adults in the UK is lower (Sefton, Evandrou and Falkingham 2007). Some researchers suggested that greater public pension entitlement is still important for reducing inequalities in unmet medical needs among older adults in the UK (Reeves *et al.* 2017). Therefore, stable pension and public benefits might encourage socioeconomically disadvantaged older adults to leave from paid employment in the USA and England. Differently, the public pension scheme in Japan seemed unlikely to encourage older adults to leave from paid employment, as Japan has both stringent minimum earnings and working-time requirements for pension entitlement, while over half of Organisation for Economic Co-operation and Development (OECD) countries have no such requirements (OECD 2019). In Figure 1, we could also notice that for participants within the same level of wealth, the probability of remaining in paid employment was always higher in Japan than in England and the USA.

Wealth can be both an indicator of SES and a measure of economic hardship in later life. Previous evidence suggested that a low level of wealth could be associated with continued employment in later life since older adults may not be able to afford retirement due to economic constraints (Dwyer and Mitchell 1998, Leinonen *et al.* 2020, McGarry 2004, Tang and Burr 2015). This could potentially explain the non-significant association between wealth and remaining in paid employment in Mexico in our study. Similar to older adults in the USA, England and Japan, socioeconomically advantaged older Mexicans would have continued employment probably due to better job opportunities and working conditions in

later life. However, socioeconomically disadvantaged older Mexican workers might be forced to stay in the labour market for a longer-term because of poverty. In OECD countries, Mexico ranked third for the labour force participation rate in people aged 65 years and over in 2015 (OECD 2015). Due to low levels of education and skills, socioeconomically disadvantaged older workers in Mexico are mainly employed in informal sectors, resulting in earning insufficient income and having no pension through social security schemes in later life (AARP & Foreign Policy Analytics 2017). A lack of economic security for daily living and health care might make Mexican workers continue to stay in the labour market during older age. Although the introduction of Seguro Popular in Mexico has largely improved citizens' access to quality healthcare, healthcare service is provided by many social security institutes which are not well connected. Mexicans may have to switch doctors when quitting from their work, leading to disruption of their continuous healthcare (King *et al.* 2009). Therefore, older Mexicans, particularly those with financial constraints, would remain in paid employment, to maintain their stable access to quality healthcare. In summary, probabilities of remaining in paid employment were high in Mexican participants with both high and low levels of wealth; but reasons for remaining in paid employment between rich and poor Mexican participants could be different (i.e., choices related to socioeconomic advantage versus necessities related to economic disadvantage).

Although a high level of wealth was significantly associated with remaining in paid employment in China in our main analyses, the probabilities of remaining in paid employment are very low in all Chinese participants. In the original composition of the CHARLS sample, those who were categorised as having paid employment in each wave were mainly officials, managers, leaders, and paid workers (Lu, Pikhart and Sacker 2019). Despite inequalities in their occupational positions, all these participants can have stable and secure pension income covered by the urban pension system (Social Security Administration 2018-

2019, Hou *et al.* 2021). Thus, they might have a strong incentive of being retired after passing the eligible age. In our sensitivity analyses, socioeconomically disadvantaged agricultural workers were more likely to remain in employment than others. In China, pension participation for agricultural workers is voluntary and the benefits of the rural pension system are far less generous than the urban pension system (Fjeld and Sagli 2011, Hou *et al.* 2021). Therefore, rural agricultural workers would still work on farmland in a later age to accumulate savings for expenditures of daily livings and health care.

From a global perspective, two studies in the 1990s indicated that older adults from middle- and low-income countries in Africa, Asia and Latin America had significantly higher labour force participation rates than their counterparts from high-income countries in Europe and North America (Clark and Anker 1993, Clark, York and Anker 1999). However, neither of the two studies considered the existing socioeconomic inequality in labour force participation within each country. In our study, we found clear wealth gradients in remaining in paid employment in the USA, England and Japan. Particularly in the USA, the absolute difference in the probability of remaining in paid employment between the poorest and the richest groups was daunting (Figure 1). The United Nations in 2013 projected that the gap of later-life labour force participation rate between middle-/low-income and high-income countries would decrease over next decades, due to an increased retirement income on average among men in middle-/low-income countries, and positive attitudes towards later-life labour force participation, improved health in general and the reduction in pension replacement rates among both men and women in high-income countries (Staudinger *et al.* 2016, United Nations 2013). However, our results suggested that this gap might not be decreasing if considering socioeconomic inequalities in labour force participation within countries. Older adults from high-income countries could still have a very low probability of remaining in paid employment in later life if they are socioeconomically disadvantaged.

Regarding the absolute inequality in the probability of remaining in paid employment by wealth, we found that this absolute inequality was large when physical incapacity was low, but small when physical incapacity was high in the USA, England, and Japan (Figure 1). This finding suggested that the protective effect of wealth on remaining in paid employment in the three high-income countries decreased as physical incapacity increased. The adverse effect of physical incapacity on remaining in paid employment could be compensated by wealth only when the physical incapacity was mild or moderate. Although older adults nowadays are healthier than their counterparts in previous generations, having illness or incapacity is still one of the most frequent reasons for leaving the labour market worldwide (Staudinger *et al.* 2016).

Strengths and limitations

Using harmonised data from five sister longitudinal studies of ageing worldwide, our study filled the research gap by using comparable and time-varying variables to investigate health and socioeconomic determinants of remaining in paid employment in later life in both high-income and middle-income countries. We applied an advanced statistical method – multilevel mixed-effects logistic regression, considering repeated events of having paid employment over up to 14 years of follow-up. We also predicted age-related probabilities of remaining in paid employment by wealth and physical incapacity in each country.

Our study has several limitations. Firstly, data harmonisation resulted in the omission of some country-specific covariates. For example, our model did not adjust for the occupational position due to disparities and missingness in occupational classifications across countries. We have the 1980 U.S. Census Occupation in HRS (for those who had not been in work since entering the cohort, their occupational positions were not identified in the original data), the National Statistics Socio-Economic Classification in ELSA, the Japan Standard Occupational Classification in JSTAR (more than 70 per cent of participants had

unclassifiable occupations), the Mexican Classification of Occupations in MHAS, but missing occupational classifications in CHARLS. The *post-hoc* analyses controlling for the occupational position were conducted in England and Japan (Supplementary Table S6). Findings were identical to the main findings in Table 3, suggesting that the exclusion of occupational position did not influence the direction of the main relationship. We did not consider specific types of paid employment (full-time versus part-time) due to unavailability of relevant information and (or) large missingness in original variables in CHARLS, JSTAR and MHAS. Future studies exploring health and socioeconomic determinants of remaining in part-time and full-time paid employment separately, are needed. This is important, as many countries are encouraging bridge employment (i.e., participation in the labour force between retirement from full-time work and complete workforce withdrawal) and setting flexible pension age ranges to encourage part-time paid employment before fully leaving from the labour market (Alpass 2015). Additionally, alcohol consumption was not considered in the current analysis. This is because more than 70 per cent of Mexican participants had missing data for alcohol consumption. However, alcohol consumption might be associated with physical incapacity (Hu *et al.* 2016), SES (Collins 2016), and labour force participation (Jorgensen *et al.* 2019).

Secondly, we only imputed item non-response instead of wave non-responders in each wave. Participants who dropped out of the study after the baseline wave might be more likely to have severe illness than those who remained. Our main statistical approach multilevel modelling is capable of handling attrition and wave non-response, unequal time spaces, and the inclusion of time-varying and between-individual covariates that are either continuous or discrete measures (Steele 2008). We also created 50 imputed datasets in each country to ensure that the number of imputation was large enough not to affect the conclusions or inhibit analysis reproducibility, particularly for countries like Japan, Mexico and China, as the

number of imputed datasets should be approximately equal to or larger than the percentage of incomplete cases (White, Royston and Wood 2011). Although statistical strategies can, to some extent address the potential bias caused by missingness, they are not perfect. Therefore, our findings might still underestimate the adverse effect of physical incapacity on remaining in paid employment.

Thirdly, we excluded those aged less than 60 years at baseline, limiting the generalisability of our findings to individuals aged 60 years and older. Previous studies on health and socioeconomic determinants of remaining in paid employment have largely focused on younger age groups (participants were mainly aged 60 years or less) (Carr *et al.* 2018, Dwyer and Mitchell 1998, Fleischmann *et al.* 2018, McGarry 2004, Stafford *et al.* 2017, van Rijn *et al.* 2014). However, currently, many adults aged 65 or more remain active, healthy and refuse to accept that they are old. The United Nations has not adopted a standard cut-off to define old age globally either (British Geriatrics Society 2017). Our study would therefore provide evidence on determinants of remaining in paid employment after age 60. Nevertheless, distributions of some covariates among participants might be altered and variations in risk factors might also be reduced due to survival selection. Our study might underestimate the association of physical incapacity and wealth with remaining in paid employment.

Policy implications

Health is still a vital predictor of remaining in paid employment in later life. More efforts should be made to achieve universal health coverage in the USA, Mexico, and China. National policies should consider older adults' changing capacities in older age for job placement and prioritise the provision of supportive services for less wealthy older adults to avoid premature loss of function and institutionalisation, to reduce the socioeconomic gap in later-life labour force participation. Reasonable adjustments in the workplace for older adults

with disabilities and health conditions could also maintain the rate of remaining in paid employment and decrease the rate of unemployment due to disability (Office of Disability Employment Policy 2018).

Countries such as Mexico and China have not had adequate old-age income support for older adults, particularly for those in socioeconomically disadvantaged settings (e.g., informal workers in Mexico, or agricultural workers in China). Their high probabilities of remaining in paid employment in our study might not be an optimistic phenomenon since the hardship could be entailed in working until death. However, informal work (including agricultural work) has represented a substantial part of the labour market in some middle- and low-income countries. The development of pathways for informal workers to access different forms of social security and pension coverage in middle-/low-income countries like Mexico and China is needed (Staudinger *et al.* 2016). Additionally, we found very low probabilities of remaining in paid employment in Chinese participants who were officials, managers, leaders, and paid workers. One study based on CHARLS also reported that the additional work capacity among age groups 60–64 and 65–69 was 42.4% and 38.3% respectively for men and 37.6% and 37.7% respectively for women in urban China; and in the post-retirement age cohorts, there was more excessive work capacity among the better educated older adults (Hou *et al.* 2021). Therefore, improvements in retirement policies to encourage older adults' later-life labour force participation in urban China are needed. A waste of more educated human resources caused by retirement age policies should be avoid (Hou *et al.* 2021).

Countries such as the USA, England, and Japan have had comprehensive old-age income support for older adults. To help unwealthy older adults remain in paid employment for a longer-term, apart from raising normal pension age and incentivising later retirement, policies for encouraging employers to hire socioeconomically disadvantaged older workers (e.g., monetary incentives, and anti-age discrimination policies) and enhancing older

workers' employability (e.g., vocational training) could also be facilitated (Staudinger *et al.* 2016).

Conclusions

Physical capacity was a predictor of remaining in paid employment in each country. Wealthier older adults were more likely to remain in paid employment in the USA, England, Japan, but not in Mexico. Probabilities of remaining in paid employment were generally high in Mexico but very low in China. The absolute difference in the probability of remaining in paid employment between the richest and the poorest groups was greater in the USA than that in any other country. The inverse association between physical incapacity and remaining in paid employment could be partially compensated by wealth only when physical incapacity was not severe in the USA, England and Japan.

Ethical approval

We used secondary data. Ethical approval is not required.

Conflict of interest

None.

Data

The HRS (http://hrsonline.isr.umich.edu/) was developed by a team of researchers based at the University of Michigan, supported by the National Institute on Aging and the Social Security Administration. ELSA (http://www.data-archive.ac.uk/) was developed by a team of researchers based at NatCen Social Research, University College London and the Institute for Fiscal Studies. CHARLS (http://charls.pku.edu.cn/en) was supported by the Behavioural and Social Research division of the National Institute on Aging, the Natural Science Foundation of China, the World Bank, the China Medical Board, and Peking

University. JSTAR (https://www.rieti.go.jp/en/projects/jstar/) was conducted by the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University and the University of Tokyo. MHAS (http://www.mhasweb.org/index.aspx) is a collaborative effort among researchers from the University of Texas Medical Branch (UTMB), the Instituto Nacional de Estadística y Geografía (INEGI, Mexico), the University of Wisconsin, the Instituto Nacional de Geriatría (INGER, Mexico), the Instituto Nacional de Salud Pública (INSP, Mexico), and University of California Los Angeles (UCLA). Harmonised datasets from the Ageing Trajectories of Health – Longitudinal Opportunities and Synergies (ATHLOS) project (http://athlosproject.eu/) were used where possible.

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Table 1 Sample characteristics at baseline in the USA, England, Japan, Mexico and China

Variables	USA (N=8003)	England (N=7225)	Japan (N=2163)	Mexico (N=7374)	China (N=7367)
Age (Mean (S.D.))	66 (4.11)	71 (7.78)	67 (4.37)	70 (7.70)	68 (6.97)
Physical incapacity (Median)	1	1	0	2	1
Gender (%)					
Men	48.47	45.26	48.59	46.49	50.10
Women	51.53	54.74	51.41	53.51	49.90
Birth cohort (%)					
Born in 1950–1959	-	-	-	-	13.10
Born in 1940–1949	20.17	12.68	47.90	10.18	55.90
Born in 1930–1939	73.02	45.18	52.10	53.60	25.06
Born in 1929 and earlier	6.81	42.14	-	36.22	5.95
Paid employment (%)					
No	64.17	89.40	68.67	62.63	92.19
Yes	35.83	10.60	31.33	37.37	7.81
Physical incapacity (%)					
None	41.47	39.60	79.34	46.20	36.78
Middle	34.10	31.57	13.53	26.53	37.12
Highest	24.43	28.83	7.13	27.27	26.09
Wealth (%)					
Highest	17.96	13.56	12.07	17.72	14.62
2nd	19.49	17.03	16.49	17.21	16.35
3rd	20.40	22.34	23.84	17.39	19.47
4th	21.02	24.42	22.51	18.56	21.57
Lowest level	21.12	22.65	25.08	29.12	27.98
Marital status (%)					
Married/partnered	71.61	62.62	80.96	60.67	77.26
Separated/divorced/single	14.77	12.36	6.08	11.45	2.31
Widowed	13.62	25.02	12.96	27.88	20.43
Education (%)					
Tertiary education	18.19	9.01	8.45	3.56	2.12
Secondary education	56.47	34.62	49.36	11.35	16.86
Primary education	25.34	-	42.19	52.39	23.57
Less than primary education	-	56.37	-	32.70	57.45
Smoking					
Non-smoker	37.82	35.00	54.37	54.97	58.25
Ex-smoker	46.45	50.60	25.76	29.93	12.72
Smoker	15.73	14.40	18.87	15.10	29.03
Long-term conditions					
None	20.71	27.48	41.38	37.51	36.04
1	35.19	37.07	43.31	36.34	38.15
≥2	44.10	35.45	15.31	16.14	25.81
Eligibility for full retirement pension					
No	41.06	11.18	31.90	31.08	0.00
Yes	58.94	88.82	68.10	68.92	100.00

Table 2 Results of basic multilevel models for associations between physical incapacity, wealth and paid employment in the five countries

	USA (N = 8003)	England (N = 7225)	Japan (N = 2163)	Mexico (N = 7374)	China (N = 7367)
Fixed effects	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**
Physical incapacity					
None (Reference)	1.00	1.00	1.00	1.00	1.00
Middle	0.79 (0.71 – 0.89)***	0.62 (0.48 – 0.79)***	0.55 (0.38 – 0.81)**	0.49 (0.43 – 0.56)***	0.59 (0.49 – 0.72)***
Highest	0.31 (0.26 – 0.36)***	0.15 (0.10 – 0.22)***	0.07 (0.03 – 0.16)***	0.25 (0.20 – 0.31)***	0.36 (0.23 – 0.58)**
Wealth					
Highest (Reference)	1.00	1.00	1.00	1.00	1.00
2nd	0.52 (0.45 – 0.60)***	0.62 (0.47 – 0.83)**	0.85 (0.37 – 1.94)	1.05 (0.86 – 1.28)	1.13 (0.77 – 1.67)
3rd	0.27 (0.23 – 0.32)***	0.22 (0.16 – 0.30)***	0.46 (0.23 – 0.94)*	1.29 (1.00 – 1.67)	1.16 (0.91 – 1.48)
4th	0.15 (0.12 – 0.18)***	0.07 (0.05 – 0.10)***	0.33 (0.15 – 0.75)**	1.01 (0.81 – 1.26)	0.72 (0.53 – 0.97)*
Lowest	0.04 (0.03 – 0.05)***	0.04 (0.03 – 0.06)***	0.58 (0.28 – 1.17)	0.91 (0.73 – 1.14)	0.57 (0.45 – 0.73)***
Random effects	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**
Variance: intercept	3.49 (3.37 – 3.61)	3.69 (3.45 – 3.93)	3.00 (2.73 – 3.29)	1.35 (1.20 – 1.52)	2.12 (1.96– 2.29)

Each model was adjusted for age, age^2 and gender only.
**P-value <0.05 ** P-value<0.01 *** P-value<0.001*

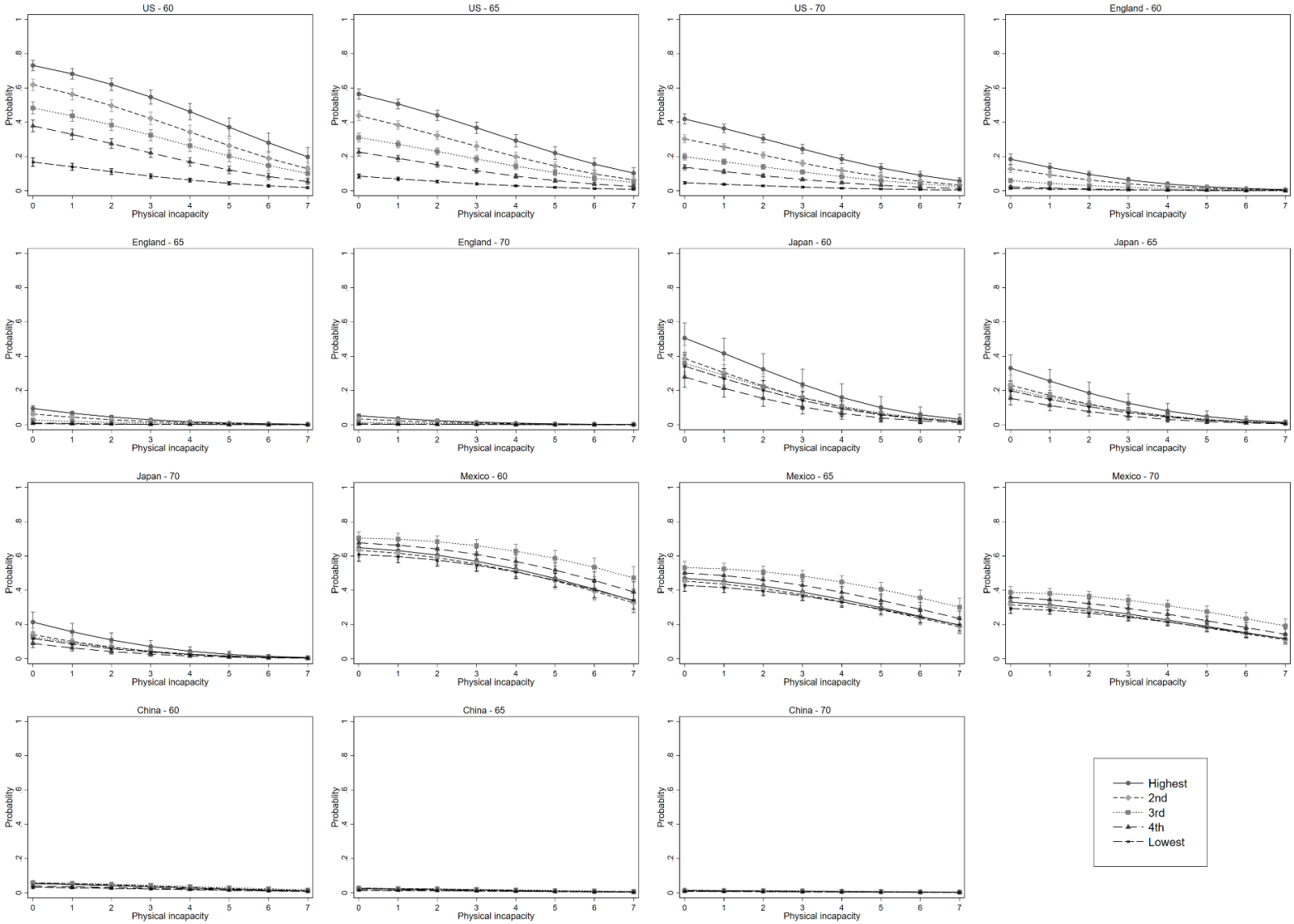
Table 3 Results of fully adjusted multilevel models for associations between physical incapacity, wealth and paid employment in the five countries

	USA (N = 8003)	England (N = 7225)	Japan (N = 2163)	Mexico (N = 7374)	China (N = 7367)
Fixed effects	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**
Physical incapacity					
None (Reference)	1.00	1.00	1.00	1.00	1.00
Middle	0.85 (0.76 – 0.95)**	0.66 (0.52 – 0.85)**	0.61 (0.41 – 0.90)**	0.53 (0.46 – 0.61)***	0.62 (0.51 – 0.76)***
Highest	0.36 (0.30 – 0.42)***	0.18 (0.12 – 0.27)***	0.08 (0.04 – 0.18)***	0.29 (0.23 – 0.36)***	0.39 (0.23 – 0.65)**
Wealth					
Highest (Reference)	1.00	1.00	1.00	1.00	1.00
2nd	0.52 (0.45 – 0.60)***	0.57 (0.42 – 0.76)***	0.84 (0.36 – 1.96)	1.01 (0.83 – 1.24)	1.10 (0.70 – 1.73)
3rd	0.26 (0.22 – 0.31)***	0.20 (0.14 – 0.28)***	0.44 (0.21 – 0.91)*	1.23 (0.95 – 1.60)	1.10 (0.85 – 1.41)
4th	0.13 (0.11 – 0.16)***	0.06 (0.04 – 0.09)***	0.31 (0.13 – 0.71)**	0.93 (0.74 – 1.18)	0.66 (0.49 – 0.89)**
Lowest	0.03 (0.02 – 0.04)***	0.03 (0.02 – 0.04)***	0.52 (0.23 – 1.18)	0.84 (0.67 – 1.06)	0.52 (0.40 – 0.67)***
Random effects	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**
Variance: intercept	3.44 (3.32 – 3.56)	3.77 (3.53 – 4.04)	3.03 (2.75 – 3.32)	1.37 (1.22 – 1.54)	2.17 (2.01 – 2.35)

Each model was adjusted for age, age^2, gender, cohort group, education, smoking, marital status, long-term conditions and eligibility for full retirement pension.

**P-value <0.05 **P-value<0.01 ***P-value<0.001*

Figure 1 Marginal effects of changes in probability of remaining in paid employment by quintiles of wealth with increasing physical incapacity at 60, 65 and 70 years old



Supplementary documents

Figure S1 Procedure of sample selection in each country

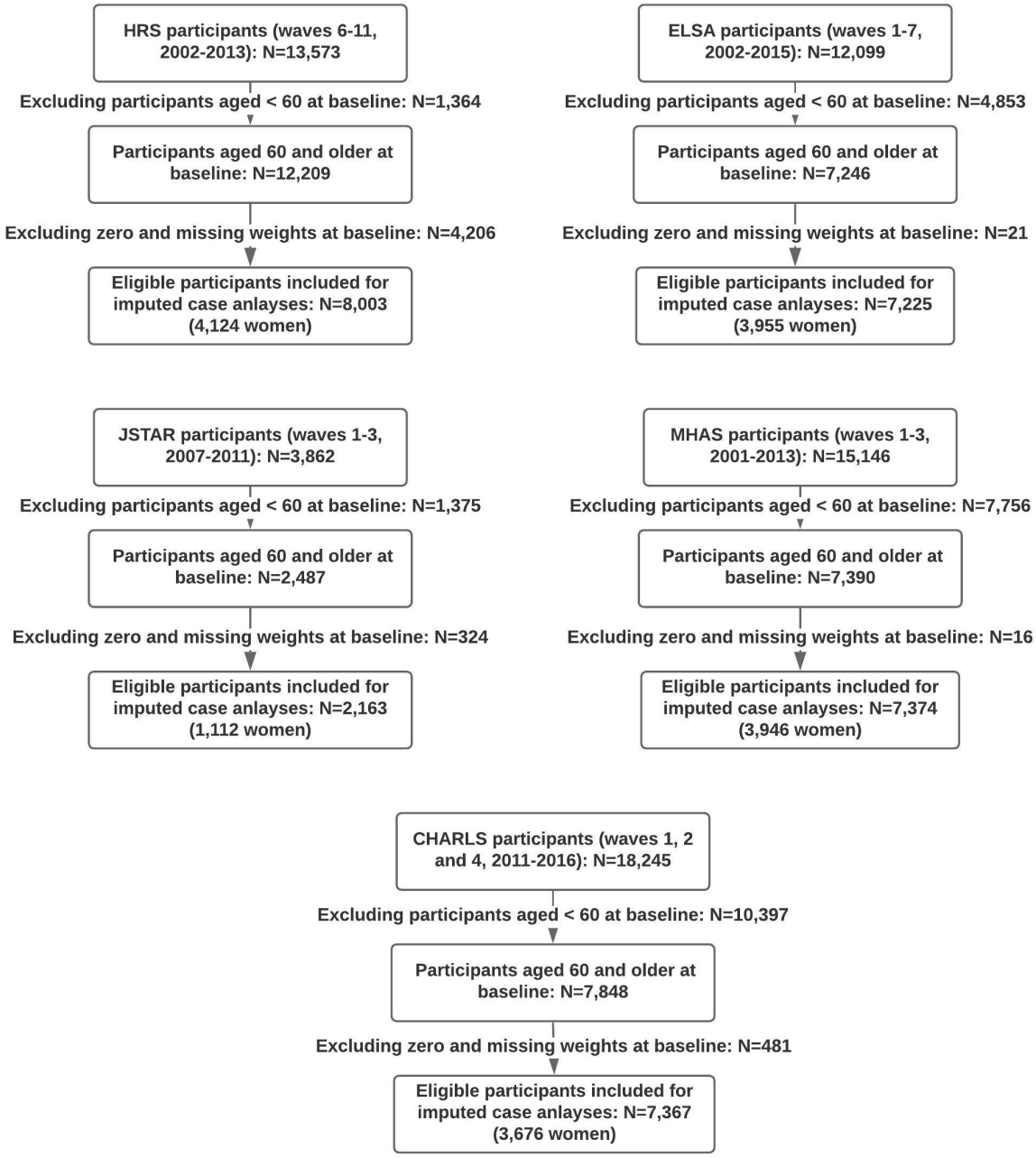
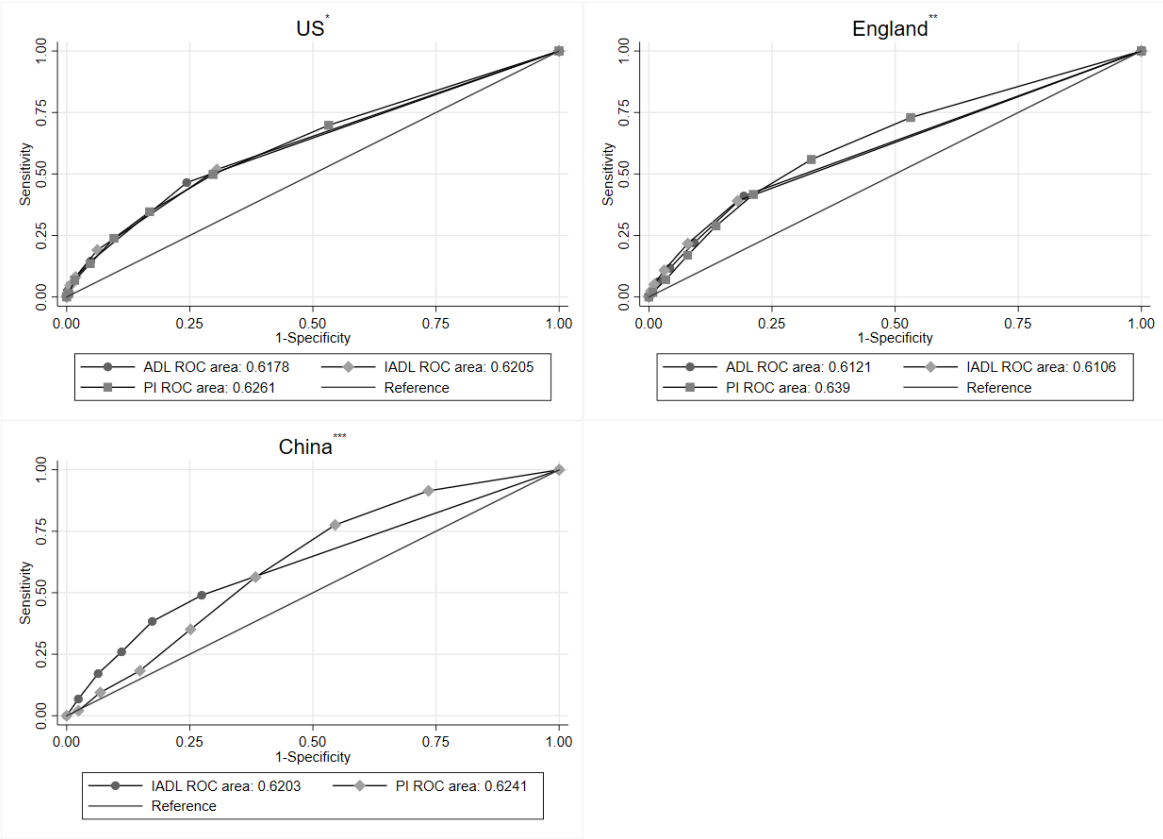


Table S1 Internal consistency of scores of physical incapacities in each country

Cronbach's α	USA (N=8003)	England (N=7225)	Japan (N=2163)	Mexico (N=7374)	China (N=7367)
Coefficients	0.9	0.9	0.8	0.7	0.7

Figure S2 Empirical ROC curves of Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL) and PI (physical incapacity) in the USA, England and China



* P-value =0.615; ** P-value<0.001 *** P-value=0.845; ADL was unavailable for analysis in CHARLS; In the US and China, there were non-significant differences in AUC between PI and (I)ADL (P-value = 0.615 or 0.845), indicating that the accuracy of predicting subsequent mortality risks for the PI was similar to that for the (I)ADL. In England, there were statistically differences in AUC between PI and (I)ADL (P-value <0.001). indicating that the accuracy of predicting subsequent mortality risks for the PI was better than that for the (I)ADL.

Table S2 Percentages (%) of non-respondents and non-responding items for all variables at each wave in each country

US	**Wave 6**	**Wave 7**	**Wave 8**	**Wave 9**	**Wave 10**	**Wave 11**
Non-respondents during follow-up	Reference (Initial non-response rate: 13.4)	7.7	13.9	18.8	25.7	31.4
Time-varying variables						
Age	0.0	0.0	0.0	0.0	0.0	0.0
Paid employment	0.1	0.1	0.1	0.1	0.1	0.1
Physical incapacity	7.3	8.2	6.4	7.1	5.8	7.1
Wealth	0.0	0.0	0.0	0.0	0.0	0.0
Marital status	0.0	0.0	0.0	0.0	0.0	0.0
Smoking	0.0	0.0	0.0	0.0	0.0	0.0
Long-term conditions	0.0	0.0	0.0	0.0	0.0	0.0
Eligibility for full retirement pension	0.0	0.0	0.0	0.0	0.0	0.0
Time-invariant variables						
Cohort group	0.0					
Gender	0.0					
Education	0.0					

England	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
Non-respondents during follow-up	Reference (Initial non-response rate: 33)	24.7	36.8	45.9	51.1	57.2	64.7
Time-varying variables							
Age	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid employment	0.4	0.2	0.2	0.1	0.1	0.1	0.1
Physical incapacity	1.9	0.0	0.0	0.0	0.0	0.0	0.1

Wealth	1.4	0.7	2.5	2.9	3.1	2.9	1.2
Marital status	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smoking	1.9	0.1	0.0	1.3	2.2	0.1	0.0
Long-term conditions	0.1	0.0	0.0	0.1	0.1	0.1	0.1
Eligibility for full retirement pension	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time-invariant variables							
Cohort group	0.0						
Gender	0.0						
Education	9.4						
Japan	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
Non-respondents during follow-up	Reference (Initial non-response rate: 40)	26.0	41.2				
Time-varying variables							
Age	0.0	0.0	0.0				
Paid employment	0.4	1.1	0.4				
Physical incapacity	0.3	0.5	0.0				
Wealth	56.2	20.1	15.4				
Marital status	0.2	3.0	3.8				
Smoking	5.2	9.2	4.6				
Long-term conditions	25.8	2.7	0.2				
Eligibility for full retirement pension	0.0	0.0	0.0				
Time-invariant variables							
Cohort group	0.0						
Gender	0.0						

Education	0.5						
China	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
Non-respondents during follow-up	Reference (Initial non-response rate: 19.5)	12.9		20.8			
Time-varying variables							
Age	0.0	0.0		0.0			
Paid employment	1.1	0.1		0.6			
Physical incapacity	15.0	36.7		2.4			
Wealth	10.4	25.9		64.4			
Marital status	2.7	1.9		0.0			
Smoking	3.6	27.6		0.4			
Long-term conditions	2.7	2.4		7.2			
Eligibility for full retirement pension	0.0	0.0		0.0			
Time-invariant variables							
Cohort group	0.0						
Gender	0.0						
Education	0.1						
Mexico	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
Non-respondents during follow-up	Reference (Initial non-response rate: 8.2)	11.5	18.0				
Time-varying variables							
Age	0.0	0.0	0.0				
Paid employment	19.9	0.1	0.0				
Physical incapacity	22.7	24.5	53.4				

Wealth	16.9	13.6	35.7
Marital status	2.7	0.0	35.0
Smoking	0.1	25.8	50.1
Long-term conditions	3.6	1.3	36.6
Eligibility for full retirement pension	0.0	0.0	0.0
Time-invariant variables			
Cohort group	0.0		
Gender	0.0		
Education	0.2		

Table S3 Results of fully adjusted multilevel models for inequalities in paid employment across countries

	Combined (N = 32132)
Fixed effects	**ORs (95%CIs)**
Age	0.83 (0.82 – 0.84)***
Age^2	1.003 (1.003 – 1.004)***
Physical incapacity	0.78 (0.73 – 0.83)***
Physical incapacity^2	0.98 (0.97 – 0.99)***
Wealth	
Highest – Reference	
2nd	0.56 (0.49 – 0.64)***
3rd	0.30 (0.26 – 0.34)***
4th	0.18 (0.15 – 0.21)***
Lowest	0.05 (0.04 – 0.06)***
Country	
USA – Reference	
England	0.06 (0.05 – 0.07)***
Japan	0.33 (0.22 – 0.50)***
Mexico	0.65 (0.53 – 0.80)***
China	0.01 (0.01 – 0.02)***
Country*Physical incapacity	
USA – Reference	
England	0.88 (0.81 – 0.95)**
Japan	0.86 (0.75 – 0.98)*
Mexico	1.20 (1.15 – 1.25)***
China	1.16 (1.09 – 1.24)***
Country*wealth	
England*2nd	1.11 (0.87 – 1.43)
England*3rd	0.85 (0.64 – 1.12)
England*4th	0.49 (0.36 – 0.67)***
England*Lowest	1.03 (0.71 – 1.49)
Japan*2nd	1.02 (0.60 – 1.74)
Japan*3rd	1.67 (1.01 – 2.77)*
Japan*4th	1.80 (1.07 – 3.02)*
Japan*Lowest	8.84 (5.27 – 14.81)***
Mexico*2nd	1.66 (1.34 – 2.06)***
Mexico*3rd	4.49 (3.59 – 5.60)***

	Combined (N = 32132)
Mexico*4th	6.36 (5.07 – 7.98)***
Mexico*Lowest	15.87 (12.45 – 20.23)***
China*2nd	2.00 (1.49 – 2.68)***
China*3rd	3.72 (2.77 – 4.99)***
China*4th	3.93 (2.89 – 5.33)***
China*Lowest	10.88 (7.96 – 14.87)***
Intercept	12.36 (10.03 – 15.23)***
Random effects	**S.D. (95%CIs)**
Variance: intercept	6.26 (5.97 – 6.56)

* *P-value <0.05* ** *P-value<0.01* *** *P-value<0.001*

The model was additionally adjusted for gender, cohort group, education, smoking, marital status, long-term conditions, and eligibility for full retirement pension.

Table S4 Results of fully adjusted multilevel models for associations between scores of physical incapacities, wealth and remaining in paid employment in the five countries

	US (N = 8003)	**England (N = 7225)**	**Japan (N = 2163)**	**Mexico (N = 7374)**	**China (N = 7367)**
Fixed effects	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**	**ORs (95%CIs)**
Physical incapacity	0.87 (0.78 – 0.98)*	0.89 (0.68 – 0.93)***	0.96 (0.55 – 0.99)*	0.79 (0.72 – 0.87)**	0.92 (0.75 – 0.98)*
Wealth					
Highest (Reference)					
2nd	0.50 (0.42 – 0.60)***	0.60 (0.43 – 0.84)**	0.93 (0.40 – 2.18)	1.01 (0.79 – 1.29)	0.97 (0.67 – 1.42)
3rd	0.23 (0.19 – 0.28)***	0.21 (0.14 – 0.31)***	0.51 (0.24 – 0.98)*	1.15 (0.89 – 1.49)	1.09 (0.75 – 1.59)
4th	0.13 (0.11 – 0.17)***	0.06 (0.04 – 0.09)***	0.33 (0.14 – 0.78)*	0.95 (0.74 – 1.21)	0.78 (0.53 – 0.80)**
Lowest	0.04 (0.03 – 0.05)***	0.03 (0.02 – 0.05)***	0.63 (0.27 – 1.45)	0.80 (0.63 – 1.01)	0.46 (0.31 – 0.69)***
Random effects	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**	**S.D. (95%CIs)**
Variance: intercept	3.44 (3.32 – 3.56)	3.75 (3.50 – 4.01)	3.02 (2.75 – 3.32)	1.37 (1.22 – 1.54)	2.17 (2.00 – 2.35)

Each model was adjusted for age, age^2, gender, cohort group, education, smoking, marital status, long-term conditions, and eligibility for full retirement pension.

**P-value <0.05* ***P-value<0.01* ****P-value<0.001*

Table S5 Results of fully adjusted multilevel models for associations between physical incapacity, wealth and paid employment (including agriculture work) in China

Variables	ORs (95%CIs)
Fixed effects	
Physical incapacity	
None (reference)	1.00
Middle	0.75 (0.66 – 0.85)***
Highest	0.42 (0.36 – 0.49)***
Wealth	
Highest (reference)	1.00
2nd	1.15 (0.94 – 1.41)
3rd	1.48 (1.21 – 1.82)***
4th	2.00 (1.64 – 2.45)***
Lowest	1.67 (1.38 – 2.01)***
Random effects	**S.D. (95%CIs)**
Variance: intercept	2.52 (2.40–2.65)

This model was adjusted for age, age^2, gender, cohort group, education, smoking, marital status, long-term conditions and eligibility for full retirement pension.
*P-value <0.05 **P-value<0.01 ***P-value<0.001

Table S6 Results of the fully adjusted multilevel model for associations between physical incapacity, wealth and paid employment in England and Japan

	England (N = 7225)	**Japan (N=2163)**
Fixed effects	**ORs (95%CIs)**	**ORs (95%CIs)**
Physical incapacity		
None (Reference)	1.00	1.00
Middle	0.58 (0.45– 0.74)***	0.58 (0.32 – 1.05)
Highest	0.13 (0.09 – 0.17)***	0.11 (0.04 – 0.31)***
Wealth		
Highest (Reference)	1.00	1.00
2nd	0.55 (0.41 – 0.73)***	1.26 (0.50 – 3.16)
3rd	0.17 (0.12 – 0.23)***	0.31 (0.13 – 0.72)**
4th	0.05 (0.03 – 0.07)***	0.22 (0.09 – 0.52)**
Lowest	0.03 (0.02 – 0.04)***	0.38 (0.15 – 0.97)*
Random effects	**S.D. (95%CIs)**	**S.D. (95%CIs)**
Variance: intercept	12.92 (11.32 – 14.74)	10.14 (7.64 – 13.46)

**P-value <0.05 **P-value<0.01 ***P-value<0.001*

Each model was additionally adjusted for gender, cohort group, education, occupation, smoking, marital status, long-term conditions and eligibility for full retirement pension; Japanese participants without occupational information were categorized as unclassifiable occupation.