31st REVES MEETING – Abstracts by session

29th of May

SESSION 1: Well-being and Working Life Expectancy

The impact of loneliness on health expectancy among older adults (Chan, Angelique et al.) email: angelique.chan@duke-nus.edu.sg

Background: Loneliness is prevalent among older adults. While it is associated with poor self-rated health (SRH), limitation in basic or instrumental activities of daily living (ADLs) and death, the impact of loneliness on health expectancy – the duration of remaining life with and without health problems – has not been elucidated. We estimate total life expectancy (TLE), healthy and unhealthy life expectancy (HLE and UHLE; years in excellent/verygood/good and in fair/poor SRH, respectively), and active and inactive life expectancy (ALE and IALE; years without and with limitation in ADLs, respectively) for lonely and non-lonely older adults (≥60 years) using data on 3450 participants of a national longitudinal survey (3 waves: 2009, 2011 and 2015) from Singapore.

Methods: Loneliness, at each wave, was assessed using the University of California, Los Angeles' (UCLA) 3-item loneliness scale (score: 0-12), and classified as never lonely (score: 0), sometimes lonely (score: 1-3), and mostly lonely (score: 4-12). SRH was based on the question "In general, how would you describe your state of health?", and health-related difficulty in any basic or instrumental ADL was self-reported. Multistate life table analysis with 200 bootstraps, considering loneliness as time-varying and adjusting for a range of socio-demographic and health variables, was conducted.

Results: Just over half (53%) of the respondents reported being sometimes or mostly lonely at Wave 1. Compared to never lonely older adults, those feeling lonely had lower absolute values for TLE, HLE and ALE, and higher relative values (i.e. proportion of TLE) for UHLE and IALE - the relationship held at age 60, 70 and 80. For example, at age 60, relative to those never lonely, those sometimes lonely had lower TLE (by 4.0 years [95% Confidence Interval: 1.9, 6.4]), HLE (by 4.8 years [2.9, 7.2]) and ALE (by 4.4 years [2.7, 6.5]), and greater relative UHLE (higher by 6.2 [1.3,10.6] percentage points) and IALE (higher by 5.7 [1.1,11.7] percentage points). And, those mostly lonely

had lower TLE (by 3.3 years [-0.3, 6.7]), HLE (by 6.0 years [3.9, 8.9]) and ALE (by 3.4 years [1.1, 5.8]), and greater relative UHLE (higher by 13.5 [7.9,23.5] percentage points) and IALE (higher by 5.7 [-1.1,13.9] percentage points).

Conclusion: Loneliness affects not only life expectancy but also health expectancy, reinforcing its public health importance. Finding ways to prevent loneliness among older adults, and implementing relevant and effective public health measures could potentially lengthen TLE, HLE as well as ALE.

Keywords: loneliness; health expectancy; self-rated health; activities of daily living; Asia

Social Stratification and Happy Life Expectancy: differences in longevity by occupation status and gender at ages 50 and 65 in Spain, 2016 (Lozano, Mariona et al.) email: mlozano@ced.uab.es

This paper assesses social stratification inequalities in longevity by computing life expectancy (LE) and happy life expectancy (HappyLE) at age 50 and at age 65 by gender and occupation in Spain, 2016. Current concerns about the future sustainability of public pension systems are focused on increasing the average age at retirement, but differences in well-being by occupation category are less often considered in this debate. Examining them will allow us to determine how inequalities accumulate according to socio-economic statuses. We compute occupational life tables using Sullivan's method. Age-specific death rates by gender and occupation status are calculated using administrative data from the Spanish Continuous Working Life Sample in 2016. Happiness prevalence

is estimated using the 8th round of the European Social Survey. Our results showed that Spanish women, no matter their occupational group, had a higher LE. However, we observed larger HappyLE differentials for females despite reduced LE differentials. Furthermore, women out of the labour market seemed to spent a higher proportion of their life happy than those in the labour market. It is not clear, yet, whether working makes women less happy, or it is the imbalance between work and family that damage their well-being. Regarding occupational differentials, we see a double disadvantage of non-qualified and manual workers, who were expected to live shorter and unhappier. Inequalities at 50 years old tended to reproduce at 65, pointing at unskilled manual careers being more damaging for well-being after retirement.

Socioeconomic differences in working life expectancy and healthy working life expectancy between ages 50-75: evidence from the English Longitudinal Study of Ageing (ELSA) (Head, Jenny et al.) email: j.head@ucl.ac.uk

Government policy in the UK and many industrialised countries is to increase state pension age and extend working lives in response to increasing life expectancy. However, extending working lives for older workers is partly dependent on their health status.

In this paper, we investigate differences by socioeconomic position and health status in working life expectancies between ages 50-75, that is, the expected number of years that will be spent in paid work between these ages. We also study variations in healthy working life expectancy, the combination of both being in paid work and in good health.

Using the first six waves of the English Longitudinal Study of Ageing, we applied multistate life table models to estimate working life expectancies and healthy working life expectancies from the ages of 50 to 75. We used two health indicators: (i) sub-optimal self-rated health and (ii) having a chronic disease (heart disease, stroke, diabetes, chronic lung disease, cancer and musculoskeletal disease). Socioeconomic position was measured by occupation grouped into professional, intermediate and routine occupations.

We found that men and women with good self-rated health can expect to spend around double the number of years in paid employment from age 50 compared to those in poor health. Among people with poor health, those in routine occupations can expect fewer years of working life than those in professional occupations. We also found differences according to presence or absence of chronic disease. We consider implications of these findings for policies related to employment of older people.

Healthy Working Life Expectancy in adults aged 50 and over in England (Parker, Marty et al.) email: m.e.parker@keele.ac.uk

Objectives: Retirement ages are rising in many countries due to population ageing and increasing life expectancy. However, poor health and a lack of appropriate job opportunities are a major reason for

early retirement as well as work absence and reduced productivity. It is unclear if people in later working-age life (age ≥50) are able to work for longer. The objective of this study was to determine the number of years that adults are healthy and in work from age 50 in a nationally representative sample of England.

Methods: Data were used from six waves of the English Longitudinal Study of Aging (waves 2-7, 2004-2015); a population-based cohort study of adults aged 50 years and over with data collected through interviews. Mortality data were obtained from the National Health Service Central Register. Healthy Working Life Expectancy (HWLE) was defined as the average number of years spent from age 50 in both health and paid work. Health was measured by combining information from single items on the presence of long-standing illness and subsequent activity limitation; healthy was defined as no long-standing illness or no activity limitation if long-standing illness was present. Work was measured using a single item on employment status; work was defined as employment or self-employment.

A multi-state life table approach was taken to estimate male and female HWLE where individuals occupy any of the four combinations of binary health and work states or the absorbing death state. Transition probabilities were estimated between states using interpolated Markov chains and maximum likelihood estimation. Health expectancies in each state were computed from the transition probabilities to give HWLE for men and women. Analyses were carried out with IMaCh software version 0.99r16.

Results: There were 15,375 core ELSA sample members (7067 males, 8308 females) with survey and mortality data for the study period. Total life expectancies at age 50 were 37.0 years for women and 33.4 years for men. Healthy Working Life Expectancy at age 50 was 8.8 years for women and 10.7 years for men on average. In addition to years spent healthy and in work, most years from age 50 were spent healthy and not working (women: 14.3 years, men: 12.0 years) followed by unhealthy and not working (women: 12.1 years, men: 8.9 years) and with just under two years spent working but unhealthy (women: 1.7 years, men: 1.9 years).

For those initially healthy and in work at age 50, women could expect a further 9.8 years of healthy working life expectancy and men 11.5 years, in contrast to those healthy but not in work at age 50 where HWLE was 5.9 years for women and 7.1 years for men.

Conclusion: These findings provide a starting point for evaluating the potential for success of policies to extend working lives of older workers in England. They suggest that, on average, men and women in England do not enjoy years that are healthy and in

work until the current state pension age (65 years). Interventions that increase HWLE will be key to the feasibility and success of extended working life policies. Identifying the factors that contribute to lower HWLE will be the first component for realising extensions to working life. These factors are likely to include downstream as well as upstream factors, ranging from health conditions and workplace factors to policies on creating appropriate job opportunities for older workers.

SESSION 2: Socio-economic Differences in Life and Health Expectancy

Health expectancy and healthy lifespan inequality by educational attainment in Spain 2015 (Pemnayer, Iñaki et al.) email: Inaki.Permanyer@uab.cat

Objectives: Report life expectancy (LE), health expectancy (HE), lifespan inequality (LI) and healthy lifespan inequality (HLI) by educational attainment in contemporary Spain (i.e. around year 2015).

Methods: Sullivan method applied to the Spanish life tables around year 2015 (by level of education). Prevalence rates of adult individuals' daily activities limitations based on the GALI index derived from the Spanish EU-SILC sample.

Inequality measured with the Gini index (0 and 1 indicating minimal and maximal inequality, respectively).

Results: Figure 1 plots the estimated age-at-death (top row) and age-at-limitation onset (bottom row) density functions for ages 35-85 by sex and level of education for Spain in 2015, together with the truncated version of the corresponding life expectancy, health expectancy, lifespan inequality and healthy lifespan inequality. Ages were bottom truncated at 35 to allow virtually all individuals to complete their formal education, and top truncated at 85 because of lacking representative data at higher ages for all education groups. In line with the existing literature, (i) women are consistently more longevous than men across all education groups, (ii) lifespan inequality decreases with increasing educational attainment, and (iii) lifespan inequality is larger among men than among women. Inspecting the trends for the 'health corrected indicators, very interesting patterns arise. To begin with, while the gaps in LE are relatively small across education groups (from 45.5 to 47 for women and from 41.2 to 44.7 for men), they are considerably larger

when comparing HE indicators (i.e. they range from 29.2 to 36.3 for women and from 28.8 to 36.4 for men).

As regards to the HLI indicators, we observe that they are larger than their LI counterparts, with the former being around 30%-40% larger than the latter.

Conclusions: Our results for Spain suggest that the uncertainty about the ages at which daily activity limitations start might be substantially larger than the uncertainty about the age at death. The HLI indicators shown in Figure 1 decrease with increasing educational attainment both for women and for men (i.e. the onset of activity limitations is more unequally distributed among the lower educated) – thus paralleling the trends observed in overall lifespan inequality. Lastly, the levels of HLI among men are relatively similar to those of women – a result that coheres with the disappearance of the female advantage in longevity when healthy life expectancy is taken into consideration (i.e. women are expected to live longer, but not to enjoy healthier lifespans).

"Deaths of Despair" Revisited: Widening educational disparities in US adult life expectancy, 2010-2017 (Sasson, Isaac et al.) (Presentation by Mark Hayward) email: mhayward@prc.utexas.edu, isasson@tauex.tau.ac.il

Objectives: The stagnation and recent declines in US adult life expectancy partly reflect growing socioeconomic disparities in life expectancy, with less-educated people experiencing declining life expectancy and well-educated people experiencing improving life expectancy. Less clear are how specific causes of death are contributing to widening socioeconomic disparities in adult life expectancy and whether those causes constitute "deaths of despair."

Methods: Using vital statistics data, this study decomposes the contribution of specific causes of death to widening educational disparities in US adult life expectancy, by race and gender, from 2010 to 2017.

Results: The findings reveal that between 2010 and 2017, life expectancy at age 25 declined among persons with a high school degree or less in almost all race-gender groups: –1.0 years for white men, –1.1 years for white women, and –0.3 years for black men (but increased by +0.3 years for black women). College-noncompleters experienced similar declines in life expectancy: –0.9 years for white men, –0.6 years for white women, –0.5 years for black men, and –0.4 years for black women. By contrast, life expectancy at age 25 increased among the college-educated across all race-gender groups: +0.6 years for white men, +0.8 years for white women, +0.9 years for black men, and +1.7 years for

black women. Deaths due to drug poisoning, alcohol use, and suicide—collectively known as "deaths of despair"—increased dramatically since 2010, and among less-educated whites nearly matched circulatory diseases in years of life lost by 2017. "Deaths of despair" accounted for a substantial part of the growing gap in years of life lost between persons with a high school degree or less and the college educated: 70.2% among white men, 44.3% among white women, 62.4% among black men, and 44.6% among black women. However, drug poisoning overwhelmingly accounted for the widening education gap in life expectancy, with only minor contributions from suicide and alcohol-related deaths.

Conclusions: The opioid epidemic is having a substantial effect on US adult mortality. Because these deaths are concentrated among the non-college educated population, they also contribute to the growing inequality in US adult mortality. The pace at which these changes are occurring is dramatic and it is likely that future US adult mortality trends and inequality will be heavily influenced by drug poisoning deaths.

Evolution of educational inequalities in life and health expectancies at 25 years in Belgium between 2001 and 2011: a census-based study. (Van Oyen, Herman et al.)

email: Herman.VanOyen@sciensano.be

Background

Reducing socio-economic health inequalities is a public health priority, necessitating careful monitoring that should take into account changes in the population composition. We analyzed the evolution of educational inequalities in life expectancy and disability-free life expectancy at age 25 (LE 25 and DFLE 25) in Belgium between 2001 and 2011.

Methods

The 2001 and 2011 census data were linked with the national register data for a five-year mortality follow up. Disability prevalence from the health interview surveys (2001 to 2013) were used to compute DFLE according to Sullivan's method. LE 25 and DF LE 25 were computed by educational level (EL). Absolute differentials of LE 25 and DFLE 25 were

calculated for each EL and for each period, as well as composite inequality indices (CII) of population-level impact of inequality. Changes over the 10 years period were calculated for each inequality estimates.

Results

The LE 25 increased in all ELs and both genders, except the lowest EL for women. The increase was larger in the highest EL. The 2011 low-versus-high LE 25 gaps were respectively 6.07 and 4.58 years respectively in men and women, compared to 5.19 and 3.76 years in 2001. The increase in the gap was respectively 17% and 22%. The upwards shift of the EL distribution led to a limited 7% increase of the CII among men but no change in women. The substantial increase of the DFLE25 in males with high EL (+4.5 years) and the decrease of the DFLE25 in women with low EL (-3.8 years), resulted in a substantial increase of all considered DFLE 25 inequality measures in both gender. In 2011, DFLE 25 gaps were respectively 10.4 and 13.5 years in males and females compared to 6.51 and 9.30 in 2001, representing increases of 61% and 44% of the gaps, and 72% and 20% for the CII.

Conclusion

The LE 25 increased in all Els, but at a higher pace in highly educated, leading to an increase in LE 25 gaps in both genders. After accounting for the upwards shift of the educational distribution, the population-level inequality index increased only for men. The DFLE 25 increased only in highly educated men, and decreased in low educated women, leading to large increases of inequalities in both genders. A general plan to tackle health inequality should be set up, with particular efforts to improve the health of the low educated women.

SESSION 3: Developments in Methods, part 1

Backward prevalences from cross-longitudinal surveys: estimates derived from backward logistic regressions (Brouard, Nicolas et al.) email: brouard@ined.fr

Over time, cross-longitudinal surveys are getting more available world- wide. The free access to these data has been established in the US, Asia and Europe, motivating researchers to develop new methods to investigate transitions among states. This fact has encouraged people to develop specific software offering multi-state life tables analyses like the SPACE program (Stochastic Population Analysis for Complex Events), developed by Liming Cai (Cai et al., 2010) and ELECT (Estimation of life expectancies using continuous-time multi-state survival models) from Ardo van den Hout which utilizes the 'msm' package for R developed by Christopher H. Jackson (Jackson, 2011).

IMaCh, an acronym for Interpolated Markov Chain was one of the first softwares in late 90's (version 0.64) that provides multistate life tables. Since that time, it has been continuously developed with an important step in 2003 (Lièvre et al., 2003) (version 0.96d) and later with new versions 0.99 (2017) which allowed time varying covariates.
And since versions 0.99r16 (2018), IMaCh estimates not only multistate life tables based on the classical (or forward) probability to move from one state to another, but in addition, this software also offers backward multistate tables derived from backward probabilities, as defined in Brouard (2019).
As the name suggests, backward probabilities are the probabilities to move backward between states.
The backward probabilities were calculated indirectlty using both, the estimated forward probabilities and the cross-sectional prevalences, but in this forthcoming version 1.0 of IMaCh, we aimed to calculate the backward parameters directly from the maximisation of the backward likelihood. The backward likelihood is simply built from the probabilities to move backward between states by suppressing the information of differential mortality from each state.
Advantages (better confidence intervals) as well weaknesses (necessity of a second and costly maximisation) of each method to get backward prevalences to be compared to the cross-sectional and forward prevalences will be presented.

Health longevity: Markov chain methods for incidence-based health models

(Caswell, Hal et al.) email: H.Caswell@uva.nl

Objectives: It has recently become possible to calculate not only the mean of healthy longevity (health expectancy sensu stricto), but also its variance and higher moments. The calculations use age-specific prevalence data and the theory of Markov chains with rewards (Caswell and Zarulli, 2018, Population Health Metrics). Our objective here is to present new methods to calculate healthy longevity from multistate, incidence-based matrix models in which individuals are jointly classified by age and health status.

Methods: This is a methodological talk, so its methods are also its results. We use vec-permutation matrix methods to construct age x health-classified absorbing Markov chains. We use the theory of Markov chains with rewards to measure various types of longevity. We will show how to construct reward matrices for occupancy of, or transitions to or from, any health state or combination of health states. From these matrices we

compute the mean, variance, and higher moments of healthy longevity for any initial age-health combination[s].

Results: As formidable as the mathematical description may sound, the methods we present are actually straightforward to implement, and are tailored specifically to the incidence-based health models in common use. As an example, we analyze a published model for dementia. This model contains states for healthy, dementia without care, care without dementia, and dementia with care. The model was parameterized by Zhou et al. (2016, BMC Geriatrics) using health insurance data from Germany. We use our methods to calculate the mean, standard deviation, coefficient of variation, and skewness of longevity in each health state. We show how these figures can be extended to include costs, benefits, or quality of life as well.

Conclusions: It is widely acknowledged that incidence-based models contain valuable information beyond that included in prevalence-based models. But it is also known that the availability of incidence models is limited by their need for longitudinal data. Our results make it possible to analyze both prevalence and incidence-based models of healthy longevity in the same terms, using the same methods, and going far beyond the expected values of longevity. Measures of variance and skewness are critical to evaluating risk, and we anticipate that our methods will be used for such purposes.

Keywords: healthy longevity, Markov chains with rewards, multistate models, matrix models

Effect of transplantation on the survival of patients with cystic fibrosis: IMaCH contribution to registry data. (Giudici, Cristina et al.) email: cristina.giudici@uniroma1.it

Cystic fibrosis (CF) is a multiorgan disease that affects several body systems, and primarily the lungs. Morbidity and mortality is mostly caused by bronchiectasis, small airways obstruction, and progressive respiratory impairment (Nkam, 2017). Remarkable improvements in quality of life and survival have been achieved in last decades, thanks to lung transplantation (Thabut et al. 2013). Nonetheless, predicting life and health expectancy with or without transplantation is still a major issue.

We analyse transitions from different degrees of pulmonary function and mortality with and without transplantation, using data from the French Cystic Fibrosis Registry. This registry contains longitudinal data on more than 8500 patients since 1992, which represents approximately 90% of all CF patients in France (Bellis, 2015). The period of

the study is 1992–2014. Individuals enter the analysis in different years and patient health status is regularly monitored.

A number of study have been carried out on this kind of data using classical statistical model (Nkam, 2017). Using the latest version of Interpolated Markov Chain (IMaCh) model we compute life expectancy at birth and compare results with the most common demographic methods.

Assessment of impact of traffic-related air pollution on disease-free life expectancy in Copenhagen Municipality and the health gain of reduced exposure (Brønnum-Hansen, Henrik et al.) email: henrik.bronnum-hansen@sund.ku.dk

Objectives: Health impact assessment (HIA) of exposure to air pollution is commonly based on city level (fine) particle concentration and may underestimate health consequences of changing local traffic.

Exposure to traffic-related air pollution can be assessed at a high resolution by modelling levels of nitrogen dioxide (NO_2), which together with ultrafine particles mainly originate from diesel-powered vehicles in urban areas. The purpose of this study was to estimate the health benefits of reduced exposure to vehicle emissions assessed as NO_2 at the residence among the citizens of Copenhagen Municipality, Denmark.

Methods: We utilized residential NO_2 concentrations modelled by use of chemistry transport models to calculate contributions from emission sources to air pollution. The DYNAMO-HIA model was applied to the population of Copenhagen Municipality by using NO_2 concentration estimates combined with demographic data and data from nationwide registers on incidence and prevalence of selected diseases, cause specific mortality, and total mortality of the population of Copenhagen.

We used exposure-response functions linking NO_2 concentration estimates at the residential address with the risk of diabetes, cardiovascular diseases, and respiratory diseases derived from a large Danish cohort study with the majority of subjects residing in Copenhagen between 1971 and 2010. Different scenarios were modelled to estimate the dynamic impact of NO_2 exposure on related diseases and the potential health benefits of lowering the NO_2 level in the Copenhagen Municipality.

Results: The annual mean NO_2 concentration was 19.6 $\mu g/m^3$ and for 70 % of the population the range of exposure was between 15 and 21 $\mu g/m^3$. If NO_2 exposure was reduced to the annual mean rural level of 6 $\mu g/m^3$, life expectancy in 2040 would increase by one year. The greatest gain in disease-free life expectancy would be lifetime

without ischemic heart disease (1.4 years), chronic obstructive pulmonary disease (1.5 years for men and 1.6 years for women), and asthma (1.3 years for men and 1.5 years for women). Lowering NO 2 exposure by 20 % would increase disease-free life expectancy for the different diseases by 0.3-0.5 years.

Conclusions: Reducing the NO 2 exposure by controlling traffic-related air pollution reduces the occurrence of some of the most prevalent chronic diseases and increases life expectancy. Such health benefits can be quantified by DYNAMO-HIA in a high resolution exposure modelling. This paper demonstrates how traffic planners can assess health benefits from reduced levels of traffic-related air pollution.

Keywords: Health Impact Assessment, Disease modeling, Air pollution, Prevention

BMI Exposure Metrics and their Relation to Health Outcomes (NG, Carmen et al.)
email: carmen.ng@emory.edu

Objectives: Models exploring the implications of high BMI/overweight/obesity often use these measures at the time of survey, despite the fact that BMI is a dynamic measure that fluctuates over time. Instead of measuring BMI at one time point, its dynamics over a period of time and cumulative exposure to elevated levels of BMI are investigated with a view to developing a better understanding of how adiposity operates over the life course to influence health outcomes.

Methods: We used the National Longitudinal Survey of Youth 1997 (NLSY97), a longitudinal survey of individuals who were adolescents in 1997 and are now in their 30s, to analyze eight specifications of BMI: most recent BMI, maximum BMI, mean BMI, median BMI, proportion of time spent overweight, proportion of time spent obese, excess BMI-years relative to overweight, and excess BMI-years relative to obese. We compared them numerically for the young adult population of the United States and demonstrated their use as covariates in models of general health, chronic conditions, and diabetes.

Results: These BMI metrics were significantly different from one another, and measured different facets of BMI over time. There was consistency across the models, in that the variables generally had the same significance conclusions. However, the answer to which BMI metric provided the best model fit seemed to depend on the health outcome of interest.

Conclusions: This paper investigated eight different ways of operationalizing BMI to take into consideration its intensity, history, and duration. We demonstrated how the

various metrics varied, both in terms of their population-level statistics and their role as covariates in models of health outcomes.

Keywords: body mass index; dynamics; exposure

Comparison of Healthy Life Years by GALI between Japan and EU countries

(Ojima, Toshiyuki) email: ojima@hama-med.ac.jp

Objectives: Healthy Life Years (HLY) by Global Activity Limitation Indicator (GALI) for EU countries are annually calculated. On the other hand, healthy life expectancies without activity limitation are calculated every 3 years in Japan; however, the questionnaire is a little different. The aim of the study is to compare HLY by GALI between Japan and EU countries in 2016.

Methods: HLY in 2016 were calculated from the data of the Japanese National Comprehensive Survey of Living Conditions and the national Life Table using Sullivan method. As we reported before (EUPHA, 2013), a mail survey was conducted for 2,700 randomly selected residents in 6 municipalities in Japan. The questions for activity limitation of both Japanese and EU surveys were included in the questionnaire. Then conversion tables from the Japanese national questionnaire to the EU questionnaire were developed. We applied the table to estimate national sex and age-group specific prevalence of activity limitation by GALI in Japan. Finally, HLY at birth and at age 65 were compared between Japan and EU countries.

Results: HLY at birth in 2016 were 70.0 and 67.3 years for females and males in Japan, while they were 73.3 and 73.0 years for Sweden, 66.5 and 65.9 years for Spain, and 64.2 and 63.5 years for EU-28 countries. HLY at age 65 in 2016 were 14.0 and 12.1 years in Japan, while they were 16.6 and 15.1 years for Sweden, 10.4 and 10.4 years for Spain, and 10.1 and 9.8 years for EU-28 countries.

Conclusion: HLY by the latest data were calculated using conversion table from Japanese to EU questionnaire. International comparison would be useful to discuss factors and possible interventions to promote healthy life expectancy.

Determinants of inequalities in disability-free life expectancy in Europe

(Rubio-Valverde, José et al.) email: j.rubiovalverde@erasmusmc.nl

Rationale: Socioeconomic inequalities in length and quality of life have been found across all European countries, yet the driving determinants of these differences are not known. Therefore, we quantified the impact impact on inequalities in disability-free life

expectancy (DFLE) of equalizing the distribution of eight risk factors for mortality and disability: father's manual occupation, childhood financial hardship, low income, low social contacts, smoking, obesity, lack of physical exercise, low physical activity, and low fruit & vegetable consumption.

Data and methods: We collected register-based mortality data and survey-based data (European Social Survey 2014) on risk factors and disability from 15 countries in Northern, Western, Southern and Central & Eastern Europe. For each country, we calculated partial disability-free life expectancies between the ages of 35 and 80 by education and gender, and determined the effect of changing the prevalence of risk factors among the low and mid educated to that of the high educated in the same country, using a previously developed method based on Population Attributable Fractions.

Results: There was a substantial gap in partial disability-free life expectancy between low and high educated, of between 6 and 13 years among men and between 3 and 13 years among women. The gap was larger in Central and Eastern Europe than in other regions. The average European educational gap is 8.5 years for men and 7 years for women. For the European average, income is the risk factor that impacts the most on closing the DFLE gap between educational levels in the upward levelling scenario for both genders. For men, the impact of income is followed by smoking, while father's occupation and overweight/obesity, take the third place at similar levels. For females, the impact of income is followed by overweight/obesity and father's occupation, with smoking not playing as prominent of a role as for men. For both genders, fruit and vegetable consumption has a small impact on closing the gap, while alcohol consumption, social contact and physical activity estimates are close to having null impact.

Conclusions: In order to reduce inequalities in disability-free life expectancy among adults, policy makers in European countries should target low income, overweight/obesity and smoking particularly in the case of men.

Our results also show, however, that the scope for reducing inequalities in disability-free life expectancy by equalizing the distribution of the studied risk factors is limited and that interventions that impact several risk factors could be considered to maximize the impact on educational gaps.

30th of May

SESSION 5: Sensory Perception: Vision and Hearing

Hearing and Disability-Free Life Expectancy in the U.S (Chiu, Chi-Tsun) email: ctchiu@gate.sinica.edu.tw

Poor hearing may limit both quality and quantity of life in older adults. Data is from the Health and Retirement Study (1998-2014) with analysis sample aged 50 and above. Hearing is classified as poor when respondents said their hearing is "fair" or "poor" and is classified as good when respondents said their hearing is excellent/very good/good. Disability was measured as having difficulty with any of the six Activities of Daily Living. We used the Stochastic Population Analysis for Complex Events (SPACE) program to estimate Multistate Life Table (MSLT) functions vis microsimulation technique. SPACE program adopted the bootstrap method to obtain the sampling variability of MSLT functions. The bootstrap method takes sample design into account to correct the potential bias in variance estimates. The preliminary results indicate that among those who experienced poor hearing have about 2-3 less years of total life expectancy and about 3-5 less years in disability-free life expectancy than those who reported good hearing. Our study indicates that hearing has a major impact on quality of life and a significant impact on length of life.

Gaps finally narrowing? 18-year trends in difficulty in mobility, hearing and vision among 61-91-year-olds in the Netherlands (Deeg, Dorly et al.) email: djh.deeg@vumc.nl

Objectives. The Netherlands is one of the few countries that uses the disability indicator developed by the Organisation for Economic Cooperation and Development (OECD) in its national health interview survey, and thus, for its national estimates of activity limitations. The OECD-indicator includes items on hearing, vision, mobility, and activities of daily living. Recently published findings on activity limitations combined the domains hearing, vision, and mobility (RIVM 2018). They show a decrease in activity limitations since 1990, particularly at older ages. This positive trends stands in contrast to an earlier meta-analysis of five studies in the Netherlands, that showed a stable trend in the prevalence of mobility disability between 1990 and 2007 for the ages 55-84 (Van

Gool et al 2011). This raises the question if the positive trend is due to improvements in hearing or vision. The current study first examines if the positive trend is replicated in another Dutch national dataset. Second, it examines trends in hearing, vision, and mobility separately for both sexes and for low and high education.

Methods. Data are used from six waves of the nationally representative Longitudinal Aging Study Amsterdam (LASA), including subsamples aged 61-91 years at each wave (1999, 2002, 2006, 2009, 2012, and 2016). The number of participants at each wave varied from 2013 to 1320. The mobility, hearing, and vision questions are derived from the OECD indicator and allow for use of assistive devices. Generalised estimating equations are used to test linear and quadratic trends.

Results. The downward trend in total OECD disability is replicated: a linear trend is observed with OR(CI)=0.983(0.970-0.995) for men and 0.981(0.970-0.993) for women. Notably, the downward linear trend is significant for the low educated (OR(CI)=0.986(0.974-0.998)), but non-significant for the high educated (OR(CI)=0.994(0.981-1.006)). In both men and women and for both the low and high educated, mobility and hearing contribute to the downward trend; whereas hearing shows a linear decline, mobility declined only after 2002. The trend in vision is stable in both men and women and in the high educated, and in the low educated declines only after 2012. Whenever a downward trend is observed, it is steeper in women than in men, as well as steeper in the low educated than in the high educated.

Conclusions. In conclusion, in the course of the 2000s a positive trend emerged in mobility disability and in hearing impairment, but not in vision impairment. The findings suggest a narrowing of the gap between men and women and between low and high educated. The wider availability and better usability of assistive devices such as mobility and hearing aids may contribute to the trends observed.

Keywords: trends, mobility, hearing, vision

Regional, Racial, and Socioeconomic Disparities in Life Expectancy with Hearing Impairment in the U.S (Lynch, Scott et al) (Presentation by Jessica West) email: scott.lynch@duke.edu, jessie.west@duke.edu

Hearing loss is one of the most common impairments associated with aging, but it is surprisingly understudied in demography and population health. Previous research has found variation in hearing impairment by sex and race, specifically that the prevalence of hearing impairment is greater among men than women, and among whites than blacks,

with Hispanic prevalence falling between that of whites and blacks. While prevalence studies are informative, there are currently no population level estimates of years individuals can be expected to live with hearing impairment in the U.S., but this is an important and easily understood metric for assessing the quality of individuals' remaining lifetimes in middle and later adulthood. Moreover, nothing is known about geographic variation in hearing-impaired life expectancy, but there are strong reasons to suspect that both birth locale and current region of residence may affect it. Inadequate access to medical treatment is associated with the development of otitis media (ear infections), which, if not treated, can cause hearing impairment. Access to care varies by region, with those living in the south being less likely to access medical care or have health insurance. Noise-induced hearing injury and blast-related comorbidities from military service are a major driver of the increasing prevalence of hearing impairment, and individuals from the south are more likely to enlist in the military compared to other regions of the U.S. Studies of road and aircraft traffic noise reveal that median noise levels disproportionately affect neighborhoods occupied by minorities or low-income individuals. Overall, there is evidence to suggest that there may be regional variation in hearing impairment, but the extent to which regional differences may simply reflect socioeconomic inequalities between regions. Using Bayesian multistate life table methods applied to nine waves of data from the Health and Retirement Study, we provide one of the first investigations of social disparities in life expectancy with hearing impairment.

Specifically, we investigate 1) the number of years the average person can expect to live with and without hearing impairment after age 50; 2) sex, race, regional, and socioeconomic differences in these expectancies; and 3) the implication of hearing impairment for remaining life expectancy. Preliminary results indicate large sex, racial, and regional differences in years to be spent with hearing impairment in the U.S. but few disparities in the implications of hearing impairment for total remaining life expectancy.

Keywords: Disability; Hearing impairment; Life tables; Demography

The association of vision and hearing impairment with health expectancy among older Singaporeans (Malhotra, Rahul et al.) email: rahul.malhotra@duke-nus.edu.sg

Background: Vision and hearing impairment are associated with a range of morbidities as well as mortality among older adults. It is then pertinent to gauge the impact of these two sensory impairments, alone and in combination, on a holistic measure of population health that simultaneously considers morbidity and mortality. Using data on 3452 older

adult (≥60 years) participants of a national longitudinal survey in Singapore, we examined the impact of vision and hearing impairment on health expectancy – the duration of remaining life with and without health problems – defining health using two indicators, physical function and activities of daily living (ADLs).

Methods: Difficulty in any of nine tasks involving upper or lower extremities was considered as limitation in physical function, and health-related difficulty in any basic ADL or instrumental ADL as limitation in ADLs. We utilized the multistate life table method with a microsimulation approach, considering vision and hearing impairment status as time-varying.

Results: Either or both impairments, versus neither, were associated with less years of life without limitation in physical function and in ADLs and more years of life with limitation in physical function and in ADLs, with the greatest impact on health expectancy among those with both impairments, who also had the lowest life expectancy. For example, at age 60, those with both impairments, versus neither, could expect not only shorter LE (4.2 [95% Confidence Interval: 1.9, 5.7] less years; 20.7 years versus 24.9 years) but also more years of life with limitation in physical function (3.3 [0.9, 5.8] more years; 12.8 years versus 9.5 years) and with limitation in ADLs (2.4 [0.8, 4.3] more years; 6.4 years versus 4.0 years).

Conclusion: Timely and appropriate management of vision and hearing impairment, especially when coexisting, among older adults may lead to a reduction in the years of remaining life they live with limitation in physical function and in ADLs. This has the potential for downstream benefits for both older adults, in terms of the need for assistance, and health and social care systems, in terms of service planning and costs.

Keywords: sensory impairment; health expectancy; activities of daily living; Asia

SESSION 6: Alternative Definitions of Healthy Life Expectancy

Decomposing sex differences in hospitalization-free years at age 60 by age and cause of admission to hospital in Denmark, 1995-2014 (Seaman, Rosie et al.) email: seaman@demogr.mpg.de

Objectives: Increasing life expectancy is a marker of improving population health. Whether extra years lived by individuals are spent in good or bad health is unclear.

Empirical studies using self-reported measures show contrasting trends in chronic diseases, disability and functional limitations. Hospital admission data provide an alternative, objective indicator for the onset of health deterioration. Existing evidence shows that average age at first hospital admission has increased over time in line with average life expectancy. This can be interpreted as an indicator of a delaying in the onset of health deterioration. However, changes in the age distribution of first hospital admission after age 60 have not previously been quantified. This will help to understand if morbidity is expanding or compressing for ageing populations.

Methods: Individual level data on hospital admissions and population estimates for the total Danish population between 1987 and 2014 were matched. We defined a first hospital admission as an in-patient admission lasting for a minimum of 3 days. We tested the sensitivity of our results by varying the length of stay from 1 to 7 days. Matched data were then used to constructed sex specific life tables for first hospital admission, from all causes, after age 60. From these lifetables we calculated the annual coefficient of variation to quantify the amount of uncertainty surrounding age at first hospital admission. A 7-year-wash-out period was applied to remove cases of readmission.

Results: Between 1987 and 2001 there was only a small decrease in the proportion of first hospital admissions across ages 60 to 70 years old. However, between 2001 and 2014 we observed two major changes. First, across ages 60 to 70 years the proportion of individuals experiencing their first hospital admission decreased. Second, the distribution expanded across older ages as a greater proportion of the population experienced their first hospital admission later in life. This meant that uncertainty in age at hospital admission was decreasing at the start of the study period but changed to an increasing trend. For men, the coefficient of variation increased from 9.8% in 1987 to 10.8% in 2014. For women the increase between the start and the end of the study period was slightly similar in magnitude, but in the context of higher variation, from 10.8% to 11.5%.

Conclusions: A reduction in the proportion of people experiencing a first hospital admission, after age 60, may partly reflect improvements in the health of ageing populations. However, it may also reflect changes in admission strategies. Defining the first hospital admission as an inpatient admission lasting a minimum of 3 days meant we would capture the most severe deteriorations in health that are less likely to be vulnerable to changes in admissions strategies over time. Future research could identify how the age distribution of hospital admissions has changed over time for different causes of admission. This could further help to disentangle the opposing trends between chronic

disease and disability to better identify whether we live longer in good health or bad health. Hospital data provides an opportunity for monitoring changes and can provide valuable insights into the health of ageing populations. Although average measures of health are an important indicator they do not tell the whole story. We must also pay attention to how the distribution of health indicators are changing.

Keywords: Ageing and health, hospital admission, morbidity compression or expansion.

Years of life by living arrangement among older Singaporeans (Saito, Yasuhiko et al.) email: saito.yasuhiko@nihon-u.ac.jp

Living alone is relatively uncommon among older persons in Asian societies including Singapore, where living with a spouse or coresidence in a multigenerational household with children are usually the norm. However given a rapidly ageing population and several decades of fertility well below replacement, it is expected that co-residence rates in Singapore will decline and the proportion of older persons living alone or with a spouse only in the absence of children will increase over time. In this context, it is of interest to create multi-state life tables to estimate the number of years that older persons can expect in different living arrangements at a population level as well as based on their initial living arrangement.

Using the Panel on Health and Ageing of Singaporean Elderly, a 2009 nationally representative survey of 4990 older Singaporeans aged 60 years and above, along with two follow-up surveys in 2011 and 2015, we calculate transitions probabilities between types of living arrangements at older ages, and apply these to multi-state life tables to calculate the years of remaining life that older persons can expect to live either alone or with others.

We stratify our analysis by sex, educational attainment, and ethnicity. Our population based estimates indicate that women can expect to spend a significantly higher proportion of their remaining life alone, about 16% (4.1 years) compared to 8% (1.7 years) for men. Similarly at the age of 70, women can expect to spend about 18% (3.2 years) of their remaining lives alone, compared to 9% (1.2 years) for men. Older persons at age 60 with no formal education compared to those with primary or higher education have a higher proportion of life years living alone, and we find this difference for both men and women. Status-based estimates indicate that among older persons living alone at age 60, women can expect to spend 42% (11.2 years) of their remaining life alone, whereas the proportion is higher for men at 47% (10 years). This suggests that older women living alone may be

more likely compared to older men living alone to transition to a living arrangement where they live with family members or others as they age further.

Our research sheds light on the importance of expanding research on life expectancy and ageing beyond health, to consider analysis using other forms of social stratification, particularly gender and education differences in states of living arrangement.

Population segmentation into categories of health and social service needs: the basis of actionable metrics of system performance (Matchar, David B. et al.) email: david.matchar@duke-nus.edu.sg

Objectives: With increasing emphasis on providing universal health care, policy makers at the national and organizational levels require metrics of population health. One measure is health expectancy (HLE), for example, life-expectancy free of disability, which can be useful for benchmarking (i.e., comparing jurisdictions) and evaluation (i.e., monitoring changes over time). However, HLE does not provide a guide to leverage points for improving system performance – what might we do to improve population well-being? We sought to establish an approach to population health measurement that provides a guide to action based on categories of health and health-related social service (HASS) needs, and applied this approach to data from a community-based survey of elders in Singapore.

Methods: Based on the "Bridges to Health" model to segmenting the population into categories of need, we created a brief survey instrument and classification algorithm to assign individuals into 5 medical needs (I - healthy, II – asymptomatic chronic condition(s); III - chronic condition(s) with significant symptoms; IV - general decline without a dominant condition (including frailty); V - late stage conditions/frequent exacerbations) and 8 features likely to complicate the care of individuals in these 5 categories (deficits in activities of daily living and instrumental ADL, nursing-type skilled task needs, organization of care, activation in own care, disruptive behavioural/psychiatric issues, social support, hospital admissions in the last 6 months, and polypharmacy). We applied the instrument and algorithm to a community-based survey of 928 adults aged 60 years and older in Singapore.

Results: The most common medical need category for community-based older persons were healthy (14%) or asymptomatic chronic conditions (41%) and only a minority were in the more intensive medical needs categories (III, 14%; IV, 29%; V, 3%). Presence of some significant complicating feature was relatively common; 41% of respondents

reported an ADL or IADL deficit, while 38% of respondents reported a lack of social support (measured by the presence of a friend or relative to talk to or receive help from in times of need). Conditional on age and educational attainment, respondents in higher medical need categories were more likely to be female (OR 1.39, 95% CI: 1.04-1.87; p=0.028), report facing difficulties in meeting day-to-day expenses (OR 2.28, 95% CI: 1.70-3.06; p<0.0001) and cite financial assistance, either formal or informal, as their primary source of income (OR 1.40, 95% CI: 1.04-1.89; p=0.026).

Conclusions: Improving health outcomes in a sustainable way depends on our ability to effectively address unmet medical and social needs. Segmenting the population based on HASS needs can be accomplished efficiently in the context of conventional community-based surveys and has the potential to characterise subpopulations, identify districts of unmet need and, in conjunction with simulation, facilitate planning and evaluation of clinical and public health policies aimed at improving population health.

Keywords: Population health; segmentation; Health needs; Health policy; simulation

SESSION 7. Cognition and Dementia

Lifelong education and cognition (Bennet, Holly et al.) email: Holly.Bennett@newcastle.ac.uk

Objectives: To find out whether continuing education after young adulthood is beneficial for cognition later in life whilst controlling for cognitive lifestyle items. Another aim was to determine whether any level of education later in life would be beneficial for cognition.

Methods: The Cambridge Centre for Ageing and Neuroscience (CamCAN) study is a large population based study that includes demographic, epidemiological, behavioral and neuroimaging data. A self-completion questionnaire returned at baseline home interview included cognitive lifestyle, education and occupation questions for young adulthood (age 13-29 years), midlife (age 30-64 years) and later life (age 65 years and over). Education at each life stage was categorized into university level or equivalent, A/AS level or equivalent, O-level/GCSE or equivalent and other. Cognition was measured by the Addenbrooke's Cognitive Examination Revised (ACE-R). Associations between education at each life stage and cognition as the outcome were estimated through Structural Equation Models (SEMs) using inverse probability weighting to account for

study design and to ensure population representativeness. First an unadjusted model, then a demographic adjusted model and finally a fully adjusted (for demographics and cognitive lifestyle measures) model were analysed.

Results: Midlife education categories had to be grouped as none/GCSE/A-level, other or university level and later life education categories had to be grouped as none/GCSE/A-level/university or other due to low numbers. Unadjusted, higher young adulthood education and university level midlife education were associated with better cognition whilst later life education was not associated with cognition. After adjustment for age, higher young adulthood education and other education in later life were associated with better cognition. Midlife education was no longer directly associated with cognition but was indirectly associated with cognition as those who completed education in midlife were more likely to continue education in later life. The association between both young adulthood education and later life education with cognition still held after adjustment for cognitive lifestyle measures in addition to adjustment for demographics.

Conclusions: Continuing education later in life could be beneficial for cognitive function. Education later in life does not need to be at university level to provide benefits for cognitive function. This is positive as completing requirements for university level education could be a barrier for individuals to continue with education. This project is one of few on lifelong education and cognition conducted in a population representative cohort and on different levels of education later in life rather than only university level. However, the analysis is cross-sectional and therefore causal direction is questionable. Further research should be conducted using longitudinal data to control for prior cognition. Other areas for further research include style of education for instance length of course, long distance versus in person course attendance or part time versus full time courses.

Keywords: Lifelong education, cognitive lifestyle, cognition

Toward a Better Understanding of the Downward Trend in US Dementia Prevalence, 2000-2014 (Farina, Matthew et al.) email: mfarina@utexas.edu

Background. The prevalence of dementia has declined in recent years in the U.S. population. Estimates document that the age- and sex-standardized prevalence of dementia in the US older population in 2012 was 8.6%. Intriguingly, these estimates are lower than recently reported for 2000 – a decline from 11.6% to 8.8% in dementia prevalence. Less clear are whether these dementia trends are shared broadly in the

population. Is the trend more evident in a particular age group? Is the trend similar across racial groups? Black Americans appears to be especially at risk of developing dementia, although almost nothing is known about dementia trends in this important and vulnerable group.

Contributions. This study makes several important contributions. First, we move beyond prior studies that have typically inferred a trend based on the comparison of two time points. Instead, we assess the trend from 2000-2014 using 7 biannual time points over the 14-year period. We also examine two age groups of older adults, 65-74 and 75+, to assess whether the trend is evident across all ages. Second, we assess whether the trends are similar for older white and black Americans. No research of which we are aware has examined dementia trends for black Americans who appear to be an especially vulnerable population. Third, we directly assess a hypothesis that a number of researchers have suggested may account for the downward trend in dementia – improved educational levels of the population. To our knowledge, no study has directly examined this hypothesis.

Data and Approach. The analysis is based on the nationally-representative Health and Retirement Study. Validated cognitive scores allow us to identify dementia status for self-respondents and for respondents who required proxy assessment. We first used logistic-regression equations to estimate the prevalence rates of dementia for the 7 time points for men and women, blacks and whites, and 65 to 74 and 75+. Age composition within age groups is controlled. We then included educational attainment as a covariate to assess how the prevalence rates changed when education was controlled.

Results. Preliminary results show that all demographic groups exhibited a linear and downward trend in dementia prevalence. The downward trend was greatest among black men and less steep for white women. When education was controlled, all demographic groups experienced a significant flattening in the trend. The flattening of the trend was especially evident for older black Americans.

Discussion. Educational composition is fundamental to understanding the changes to prevalence in the population in recent years in the United States. The US experienced an expansion of higher education and increased rate of high school graduation, both of which significantly shifted the educational composition of older adults, making them less prone to cognitive disability. The reduction in dementia prevalence does not appear to reflect some change in medical care or intervention, but it reflects rather a significant demographic shift in the population. Understanding how demographics influence

dementia appears to be key in providing a better projection of the future burden of dementia in the population, with significant implications for future research and policies.

Keywords: dementia, prevalence, trend, race

SESSION 8: Regional Differences in Mortality and Disability-Free Life Expectancy

Subnational disability-free life expectancies in France: are the variations associated with the Local Long-Term Care Organization. (Cambois, Emmanuelle et al.) email: cambois@ined.fr

Introduction. The increasing longevity is a public health challenge due to the increasing risk of disabling conditions with age, requiring long-term care. In this context, the infranational variations of health and longevity raises the question of possible inequalities in the satisfaction of needs across territories. These variations are challenging for the French policy makers: first due to the variations in longevity that suggest also variations in health and needs and second because in France the long-term care (LTC) schemes are operationalized at the local level, with potential differences in care provision. Yet, it is unclear how locally available LTC adequately relates to different local needs. This research uses recent datasets, representative of the population at local level, to assess whether local LTC provision matches the potential needs.

Method. To assess local differences in LTC needs, we computed disability-free life expectancy and life expectancy with disability in the 100 French "departments" for men and women aged 60+. We used the Sullivan method, combing 2014 life tables and the disability data collected by the 2014 survey "Health and daily life", based on the Global Activity Limitation Indicator. We analyzed the variation across departments through meta-regressions, using administrative contextual variables: (1) for the socioeconomic context (tax potential; minimum income transfers; rural/urban; occupations; inactivity or unemployment) and (2) for the LTC provision (nurse density, LTC bed density, physician density, nursing homes). Analyses are conducted separately for men and women, for DFLE and DLE variations.

Results. In 2014, DFLE at age 60 was 17 years in women and 15.7 years in men. Local variations are close to 6.5 years both in women (from in women 18.1 years in Paris to 11.4 in Guadeloupe) and in men (from 17.0 years in Paris to 11.5 in Pas-de-Calais in men). Some of the most socioeconomic advantaged departments are among the longest DFLE. We found more mix-socioeconomic profiles for the longest DLE, suggesting different patterns of local variations in DFLE and DLE. DFLE and DLE are associated with local socioeconomic contexts, however with different patterns. Regarding LTC context, nurse density is negatively associated with DFLE and physician density positively associated with DFLE; but when adjusting for socioeconomic context variables, only nurse density remained associated with DLE, in women only.

Discussion. These preliminary results need to be extended, testing other indicators to reflect the LTC provision and to reflect disability. Despite some limitations in the current analyses, we found large infranational variations in DFLE and DLE. When accounting for the socioeconomic context, the local LTC context is not related to DFLE and DLE (except nurse density in women). These results suggest that LTC needs relate to the socioeconomic context but not so much to LTC provision. This conclusion raises the question of unmet needs by LTC that could be related to informal caregiving.

Keywords: Disability free-life expectancy – infranational variations – Long term care – (un)met needs.

How do US State Differences in Disability and Mortality Shape Geographic Inequality in HLE? (Hayward, Mark et al.) email: mhayward@prc.utexas.edu

Background. Many countries around the globe are assessing whether longer lifespans are accompanied by extensions in healthspans. In terms of lifespan variability, the 50 states comprising the United States are much like 50 countries with life expectancies ranging from developed to developing countries. Some states' mortality regimes resemble those of Sweden while other states' mortality regimes are more like Bulgaria and Equador. Unclear are the implications of this enormous variability in life expectancy for state-differences in healthy life expectancy.

Objectives. Here, we show how state-specific mortality and disability rates combine to shape geographic inequality in disability-free (DFLE) and disabled (DLE) life expectancy. We assess whether states' populations with longer lives also experience longer healthy lives, and whether this association differs for men and women. We make use of state variations in mortality and disability rates to also calculate the potential

maximum and minimum health state life expectancies based on the lowest/highest values of disability and mortality. As part of this exercise, we identify which states contribute to the minimum and maximum healthy life expectancies.

Data and Measures. Our analysis examines the mortality and disability experiences of US adults ages 25-89 for the 2010-2014 period. We rely on the American Community Survey for 2010-2014 to provide age-specific estimates for ADL disability. ADL disability is gauged in terms of difficulty dressing or bathing (1=had difficulty dressing or bathing; 0 otherwise). Age-specific mortality rates for 2010-2014 are drawn from the United States Mortality Database. Sex specific life expectancy (LE) between the ages of 25-89 is calculated for each state. Sullivan-based life tables combining the disability and mortality rates were then calculated for each state for males and females.

Results. The results show that the range in LE is less than the range in DFLE(x) (4 years compared to 6 years). Geographic variability in DFLE is much greater than variability in LE. LE is the tip of the iceberg in terms of state differences in health. The South has the lowest LE and the lowest DFLE. Midwestern states are diverse in both DFLE and LE, while Northeastern states are more advantaged and homogeneous. That said, higher life expectancy is strongly related to higher DFLE. The correlation between LE and DFLE is .98. Longer life in a state points to longer healthy life.

The association between LE and DLE is negative, showing that DLE declines with greater levels of e(x). In terms of the overall distribution of e(x), disability becomes compressed with longer life. That said, the overall association appears to be largely driven by the very strong negative association at the low end of LE. (0.79). For example, DLE moves virtually in lockstep with e(x) for the Southern states. However, the negative association substantially weakens (i.e., there is more state variation) at the upper part of the life expectancy distribution. Thus, low levels of life expectancy are strongly associated with higher values of DLE, but compression is less evident as life expectancy increases.

The associations between LE, DFLE, and DLE are almost parallel for men and women. States appear to have similar “effects” for both sexes. Very few states contribute to the hypothetical min and max DFLE/DLE values. The most advantaged and disadvantaged states are very close to the synthetic best and worst scenarios for DFLE and DLE.

Conclusions. State context clearly matter for DFLE and DLE. Why is this so? Prior studies point to some influence of population composition, i.e., different types of people live in different states. However, there is growing evidence that the policy context matters too. Federal control over social safety nets have largely developed back to the states.

States have also deregulated many labor market, industrial, and educational policies that previously protected states' populations. Increasingly states are using a policy tool, pre-emption, that disallows local areas from having more stringent regulations protecting its residents. States vary enormously in terms of policies affecting health directly and indirectly, including educational policies, tobacco control policies and minimum wage control.

Keywords: Disability-free life expectancy, US states, public policy, disability compression

Health Life Expectancy Analysis of Urban and Rural Elderly in China and its impact on Long-term Care – Based on the sample survey data of the elderly in China from 2015 to 2016. (Mi, Hong et al.) email: hongmi_1962@163.com

Overview: Life expectancy (LE) is one of the important indicators of measuring the health of the population, and also an significant indicator of the level of comprehensive social development and the quality of human life. Understanding healthy life expectancy (HLE) helps to assess the effects of resources, the environment, and social policies on the health of the population, thereby provides a basis for the development of policies and measures to improve human health, such as health care services and social resource redistribution.

Life expectancy is one indicator for comprehensively measuring the death level of a region's population. It is not affected by changes in the age structure of the population, and it can be compared at different time points, different regions, and different populations. Based on the survey data of the living conditions of the elderly over 60 years old in China's urban and rural areas from 2015 to 2016, this paper uses the ADL scale to classify the health and disability status of the elderly, calculates the healthy life expectancy at the certain age of urban and rural elderly in China in 2016, and then analyzes the life expectancy of the population as well as the impact of long-term care.

Data and methods: The "Sampling Survey on the Living Conditions of Urban and Rural Elderly in China" surveyed Chinese residents aged 60 and over, and studied the healthy conditions, care service, family, economy and other aspects of the elderly in urban and rural areas. The sample of the survey covered all provinces in China, with a total sample size of 223,700 and a total sampling ratio of about 1‰. After cleaning the data, the effective sample size in 2015 was 224,142, and the effective sample size of the 2016 follow-up survey was 22,973.

This paper is based on the indicators of daily living self-care (ADL) to measure the health status of the elderly. According to the ADL score, the elderly are divided into three status, including health, semi-disability, and disability. Using the multi-state health life table method, it is assumed that various health status convert to each other and the mortality rates of various health status are different. The multi-state health life table uses tracking data for the same group, and directly calculates the observed transition rates with high accuracy. This paper uses the multi-state health life table method to explore the trend of healthy life expectancy of urban and rural residents aged 60 and over in China during 2015-2016.

Results: First, in all age groups, the HLE of urban elderly is higher than that of rural areas. The lower the age, the more obvious the urban-rural difference, and the urban-rural differences in the older age group are gradually narrowing. Our results show that at the age of 60-64, the HLE of urban elderly is 1.7 years higher than that of rural elderly. At the age of 85 and older, the HLE of urban elderly is 0.75 years higher than that of rural elderly. Second, female's HLE is greater than that of male regardless of age and health status. Our results show that at the age of 60-64, female’s HLE is 2.9 years higher than male’s. And that the age of 90 and older, the difference will be 0.2 years.

Conclusion: China's long-term care insurance has just begun to be piloted, and urban and rural areas should focus on different types of care. First, to enhance the fairness of the provision of care services, the government could gradually reduce the care resources imbalance between urban and rural areas. Measures can be done to build a fair and equitable long-term care system, and focus on solving the problem of care for the disadvantaged groups of the disabled elderly, especially the care of the rural elderly disabled. Second, policies could be focused on the development of rural community pensions and provide corresponding services. It is particularly significant to develop rural community pensions and provide corresponding services and resources.

31st of May

SESSION 9: Developments in Methods, part 2.

Is the story about sensitive women and stoical men true? Gender differences in health after adjustment for reporting behavior. (Oksuzyan, Anna et al.) email: Oksuzyan@demogr.mpg.de

Background. Research indicates that women have higher levels of physical disability and depression and lower scores on physical performance tests compared to men, while the evidence for gender differences in self-rated health is equivocal. Scholars note that these patterns may be related to women over- reporting and men under-reporting health problems, but gender differences in reporting behaviors have not been rigorously tested.

Objectives. The present study investigates the extent to which adjusting for differences in reporting behavior modifies gender differences in health and whether these changes are due to men and women over- and/or under-reporting poor and good health.

Data and methods. Using Wave 1 of the Survey of Health, Ageing and Retirement in Europe (SHARE, n =27,345), we applied a generalized ordered probit model in order to assess gender differences in health reporting. This method was previously applied by Jürges (Jürges 2007) to explore cross-national differences in reporting general health. According to this approach, when responding to a survey question about their general health, participants assess their true health, which is measured on a continuous scale and is unobserved, and translate it onto a provided discrete 5-point scale. The thresholds that each individual uses to categorize their true health into a specific response option may be affected by the choice of a reference group, earlier health experiences, and cross-cultural differences in using scales, and thus, may differ across individuals depending on their gender, age, cultural background, education, and personality traits, among other factors. Following Jürges' (2007) methodology, we computed a continuous estimate of individuals' underlying, latent health based on a wide range of health measures included in the data, and accounting for variations in reporting across socio-demographic and cultural groups. We then recoded these continuous health latent estimates into five categories that reflect the five response options on SRH. The result is a categorical health

measure that is comparable to SRH, but which adjusts for heterogeneity in individuals' reporting styles.

Results. We found small gender differences in the prevalence of poor health on the original scale among persons in their fifties and sixties, and a consistent male advantage in the prevalence of poor health among older persons. The percentage of people reporting good health on the original scale was higher among men than in women at all ages. After adjusting for differences in men's and women's reporting behaviors, gender differences in both poor and good health widened. Contrary to widespread assumptions about gender-stereotypical reporting behaviors, we found no clear evidence for gender-specific patterns in reporting of either poor or good health. Rather, health reporting varied greatly by age: younger (50-59 and 60-69 year old) women and men in our study population tended to over-report poor health and under-report good health, while the oldest women and men tended to under-report poor health and over-report good health. Men in their seventies had fairly accurate reporting of both poor and good health.

Conclusions. The results challenge prevailing stereotypes that women over-report and men under-report health problems and highlight the importance of attending to health problems reported by women and men with equal care.

Key words: gender, self-rated health, reporting heterogeneity, gender stereotypes

Prevalence and the variance of state occupancy time. (Riffe, Tim) email: riffe@demogr.mpg.de

Keywords: Healthy life expectancy; Sullivan method; Healthy life variance

Background: Markov reward methods have been proposed to calculate the variance of state occupancy time based on age-structured prevalence and survivorship.

Objectives: I aim to clarify the assumptions of this approach, give bounds to its reasonableness, and suggest improvements.

Methods: I use simplified toy data to demonstrate concepts, and then I use HRS data for different health conditions to derive some empirical guidelines. I calculate results for extreme cases to provide bounds, simulate variance under simple assumptions, and simulate a more natural inter-individual state distribution.

Results: I show that state occupancy variance for Sullivan-style inputs is not identified, and I show where previously proposed methods fall with respect to reasonable bounds, randomly generated variances, and my own opinion about what a reasonable inter-individual state distribution might look like.

Conclusions: The variance of state occupancy time is only identified if a) state life trajectories are directly observed or b) a process model that can generate an asymptotic life trajectory distribution, such as an incidence-based Markov model, is specified. Sullivan-calculations of life expectancy do not imply a single variance, and are therefore insufficient to make statements on within-group inter-individual disparities in state occupancies.

A counterfactual Simulation Method to Evaluate Mortality Selection Effect in the Cohort Trend of Health Disparities (Zheng, Hui) email: zheng.64@osu.edu

Objectives: Unobserved individual frailty is prevalent and consequential in the population pattern of health and mortality. Changing frailty variance across cohorts can alter the "survivor" compositions of the population over life course and the slope of mortality acceleration across cohorts. If frailty variance changes within groups (e.g., lower educated vs. higher educated) across cohorts, mortality selection mechanism may further alter the slope of mortality acceleration for each group, and complicate the cohort trend in health disparities and life expectancy gap between groups. Besides mortality selection, cross-cohort changes in health disparities can be affected by various confounding mechanisms.

Methods: We propose a counterfactual simulation procedure to remove these confounding factors and evaluate the extent to which the widening mortality disparities by two educational groups (any college vs. high school or less) in the United States are due to mortality selection.

The basic idea is to create two scenarios: one with mortality selection effect present, the other counterfactual one with mortality selection effect absent. Then the residual differences in cross-cohort changes in health disparities between these two scenarios are due to mortality selection effect.

Results: Using the number of diseases before age 17 from Panel Studies of Income Dynamics as a proxy for frailty and cohort changes in age-dependent mortality pattern from National Health Interview Survey data, we find mortality selection contributes to -14% of the widening life expectancy gap between these two educational groups from the 1950s to 1960s cohort among men while 41% of the widening life expectancy gap among women.

Conclusions: We can either overestimate or underestimate life expectancy gap across cohorts without purging mortality selection effect. Counterfactual simulation method is flexible in its assumptions with regard to hazard function and distribution form of frailty.

SESSION 10: Investigation Pertaining to the Oldest-Old and Frailty

Trends in functioning and disability-free life expectancy among the oldest old 2001 – 2018: Evidence from The Vitality 90 + Study. (Enroth, Linda et al.) email: linda.enroth@tuni.fi

Objectives: The recent decades have witnessed a tremendous increase in the oldest old population. Most of the long-living individuals face a period of functional disability at the end of life but the length of the period and possible changes over time needs more attention. We examined trends in functioning in six birth cohorts born between 1911 and 1928 and assessed how long period of life is expected to be disability-free at the age of 90 for birth cohorts 1911-1924.

Methods: Data for age, sex and functioning came from the Vitality 90+ Study, which is a population-based survey with repeated questionnaires in years 2001, 2003, 2007, 2010, 2014 and 2018 in the city of Tampere. In total, the number of participants was 7,589 (women 78%) with median age of 92. The response rates varied from 76.7 to 86.3%. Functioning was measured as being independent in activities of daily living (ADL = dress and undress, and get in and out of bed) and being independent in mobility (move indoors, walk 400m, and climb stairs). Mortality rates came from period life tables and the remaining life expectancy (LE) at the age of 90, with and without disabilities, was calculated with the Sullivan method.

Findings: In 90+ population, independence in ADL functioning increased significantly from 69.9 to 76.8% and mobility from 39.2 to 42.0% for women between 2001 and 2018. For men, we found some improvement in mobility but the trend was not significant. LE at the age of 90 increased from 3.9 to 4.4 years (Y) for women and from 3.4 to 3.8Y for men in 2001-2014. Disability-free LE increased for both sexes for both disability indicators; ADL (from 2.69Y to 3.15Y men, from 2.75Y to 3.24Y women) and mobility (from 1.93Y to 2.27Y men, from 1.52Y to 1.77Y women).

Conclusions: The study suggests that the later birth cohorts, especially those born in 1928, have better ADL and mobility functioning than the earlier birth cohorts at least among women. LE increased for both sexes and most of the increase was spent free from mobility disability and all of it free from ADL disability.

Drivers of dependency over ten years in the very old: results from the Newcastle 85+ Study (Kingston, Andrew et al.) email: andrew.kingston@newcastle.ac.uk

Objectives and background: As age increases, the ability to manage activities of daily living (ADL) weakens and increases the likelihood of becoming dependent upon health and social care services. Previous research has tended to use an aggregate measure of lost capacity in ADL to assess levels of dependency; however, this fails to capture the frequency or intensity of care needs. In addition, determinants that operate to shape levels of dependency are not the same across the population. For some, transitions to dependent states are swift and the duration spent in them longer; governed by person specific risk factors related to disease, socioeconomics and/or lifestyle. In order for governments to plan health and social care strategies to help people maintain independence and/or stabilise decline, evidence is required to show how risk factors shape transitions to dependency in older people.

Methods: Using 10-year data from the Newcastle 85+ Study (a longitudinal cohort study of people born in 1921 in Newcastle upon Tyne and North Tyneside, UK) we constructed a measure of dependency using the Interval of Need (IoN) which conditions individuals on the lapsed time between periods when

help is needed with basic and instrumental activities of daily living [(I)ADL], urinary continence and cognition. Four categories comprise the interval: (i) independent people (ii) low dependency: people who require help less often than daily (iii) medium dependency: people who require help at regular times of the day and (iv) high dependency: people who require 24-hour care. We explore how eight disease groups, multimorbidity and impairments associate with transitions in dependency and death over ten years (age 85-95) using multistate modelling.

Results: Suffering a stroke (men HR: 1.6, 95% CI: 1.1-2.2; women HR: 2.4, 95% CI: 1.5-3.7) or a diagnosis of diabetes (men HR: 2.0, 95% CI: 1.1-3.5; women HR: 1.9, 95% CI: 1.2-3.0) increases the risk of shifting from independent to low-level dependency. Having three or more diseases compared to none increased the risk of incident substantial (medium or high) dependency (men HR: 2.3, 95% CI: 2.0- 2.7; women HR: 3.5, 95% CI:

2.6-4.7). A similar pattern was observed for those who had three or more falls (men HR: 2.0, 95% CI: 1.1-3.7; women HR: 2.2, 95% CI: 1.3-3.5). The fuller results of the analysis will be discussed.

Conclusions: There should be a focus on prevention of, and appropriate and efficient service provision for those with complex multi-morbidity and specific attention on stroke and diabetes. Falls prevention strategies may also provide benefits in terms of preventing transitions to substantially dependent states. By understanding how risk factors operate to shape dependency, health care plans can be optimised to reduce transitions and interventions targeted more efficiently to stabilise or reverse decline.

Keywords: Dependency, ADL, ageing, disability

Inequalities in frailty free life expectancies by socioeconomic status across generations. (Matthews, Fiona et al.) email: Fiona.Matthews@newcastle.ac.uk

Objectives: To investigate the impact of deprivation on frailty free life expectancy across populations over time.

Methods: The Cognitive Function and Ageing Studies (CFAS I and CFAS II) are population-based longitudinal studies that examine risk factors and health outcomes in the UK population aged 65 and over. The first CFAS study began in 1989 and CFAS II started recruiting in 2008, nearly 20 years after CFAS I. A current measure of socioeconomic status (SES) available for each individual is area level deprivation. The CFAS Frailty Index is composed of 30 items -or deficits- which include morbidities and risk factors, as well as subjective measures of disability. Each deficit within the Frailty Index is weighted equally and is scored based on its presence or absence. A two year follow-up interview and notification of deaths over 5 years is available within each cohort. Life expectancy in frail and non- frail states for each cohort were estimated using IMaCh.

Results: Between CFAS I and CFAS II there has been increase in inequality by SES with a sharp increase in the life expectancy differentials between SES groups. The amount of remaining time spent with frailty has decreased substantially over time, however the most advantaged have benefited the greatest (40% to 22%) in contrast to the least advantaged (40% to 32%) as a proportion of their remaining life.

Conclusions: Whilst there has been an overall decrease in the amount of time spent with frailty over time there has been a substantial increase in inequality. This has implications for the health of some of the most vulnerable members of the population.

Keywords: Frailty, life-expectancy, inequality, time trends

Socio-Economic Correlates of Life Expected in Degrees of Frailty. (Zimmer, Zachary et al.) email: zachary.zimmer@msvu.ca

Objectives: Our objective in this paper is to examine transitions in frailty and compute life expected across degrees of frailty by socio-demographic characteristics commonly found to distinguish healthy aging. Frailty, defined as the extent to which multidimensional physiological systems are in decline, is an indicator of vulnerability to adverse health outcomes and subsequently predicts healthy aging. Differences in frailty exist by age and sex 1,2 , and a modest literature suggests disparities across social determinants. 3,4 While estimates of life lived in degrees of frailty by demographic and social characteristics can provide information about quality of life for distinct population subgroups, there are very few such studies 5,6 and virtually none that consider a sample generalizable to the U.S. This paper addresses this gap.

Methods: Data are from waves 5 to 12 of the Health and Retirement Study 2000 to 2014. N=26,515 aged 55+ are monitored across more than 107,935 biannual transitions. A 59-item frailty index is constructed using the deficit accumulation approach. 7 Individuals are categorized into three degrees of frailty at baseline (non-frail defined as a health deficit in fewer than 10% of items; vulnerable 10% to 25%; frail 25% or greater). Individuals are categorized in one these degrees plus deceased at follow-up. IMaCh .99r computes life expected in degrees of frailty by age, sex, marital status, ethnicity, place of residence, level of education, and wealth.

Results: Preliminary findings indicate transitions from any baseline to follow-up degree of frailty is possible, with remaining in the baseline state being most likely (70.6%) and the transition from frail to non-frail being infrequent (0.2%). Total life expectancy at age 55 for men is 24.5, divided into 7.9 years of life non-frail, 11.4 vulnerable, and 5.2 frail. For women, life expectancy is 27.6 years, divided into 7.6, 12.0, and 8.0 respectively. More years of life in a higher degree of frailty among women is consistent with other research. Findings presented at REVES will further show transition probabilities and life lived in degrees of frailty by age and the socio-demographic characteristics listed above.

Conclusion: Given population aging and increasing longevity, estimations of life expectancy in degrees of frailty is critical for evaluating the current and assessing the future state of public health and establishing who is more and less vulnerable in later life.

Keywords: frailty, health expectancy, social determinants, United States

SESSION 11: Trends in Health Prevalences

Health Status among older Europeans: A study of 5 birth cohorts (Gómez-León, Madelin et al.) email: madelin.gomez@upf.edu

Objectives: While mortality has shown a postponement towards older ages over the past decades, previous studies on gender differences in health in later life have found mixed evidence. We examine how trends in gender differences in health in the period 2004-2015 in 9 European countries using data from the Survey of Health, Ageing and Retirement in Europe (SHARE) have changed in magnitude.

Methods: We restricted our analyses to women and men aged 50 to 90 years of aged and we have followed up three age cohorts over time (2004 to 2015) selected according to the age at the baseline (wave 1): Cohort 1: 50 to 59; Cohort 2: 60 to 69, and Cohort 3: 70 to 79. First, descriptive analysis shows the prevalence of two health indicators for men and women in three age cohorts. Secondly, logistic regressions indicate the likelihood of having a health problem by gender controlling for socio-demographic indicators and other health conditions.

Preliminary results: Our results for Europe show that the older the cohort studied the larger the percentage of bad health-perceived is found and also there is a health gap between generations. For ADL limitations, there is barely any gender differences in the first two age cohorts studied; however, in the oldest age cohort gender differences are significant. Particularly, up to a third of women between 81 to 90 years of age present limitations with at least one ADL. Further analyses of these cohorts will examine regional variations in the health gap to identify how health patterns changes across cohorts and regions with different public social policies and welfare regimes.

Keywords: gender health gaps, Europe, SHARE

Estimate of the Needs of the Elderly Care in China (Qiao, Xiaochun) email: qxchcn@aliyun.com

As effective population control and lower fertilities for over 25 years, China is facing aging take-off. The purpose of the research is to estimate the needs of long-term care of Chinese elderly in the coming future.

We use mid-term census data conducted in 2015 to project the future population, including the number and proportion of the age-specific aged population. Combining with the result of population projection, we use nationally representative repeated cross-sectional data conducted in 1987, 1992, 2000, 2006, 2010 and 2015, respectively, to estimate the former changes of self-care health expectancy, as well as the proportion of age-specific self-care of Chinese elderly so as to make projection on the needs of long-term cares of the elderly from now to 2050.

We found that China reached standard of aging society, 7 percent of elderly population aged 65 and over, in 2000 based on UN definition, and will reach to 13.0% in 2020. The proportion has increased 6 percentage point for the 20 years. China will be an aged society in 2023 when the proportion of the elderly aged 65 and over increased to 14.2%, and be super-aged society in 2032 when the proportion reached to 20%. Until year 2040, this proportion will jump to 25.7%. It means, within next 20 years from 2020 to 2040, the proportion will increase 12.7 percentage point, which is doubled comparing with the prior 20 years.

Even though the high speed of population aging will increase the need of elderly care, combining with the increasing needs of care in each age group, the total number of elderly who needs to be taken care increased substantially. Comparing the amount of care needs in 2005, the increased needs will increase to 3 times in 2030, 4.4 times in 2040 and 5.7 times in 2050. There was only 33.48 million elderly population being taken care in 2015, it will increase to 99.10 million in 2030 and 144.38 million in 2040. If one care-giver would take care of 5 elderly, it needed 6.7 million care-givers in China in 2015. This number will be 10.4 million in 2020, 19.8 million in 2030, 28.9 million in 2040, and 38.2 million in 2050. However, now there are only 0.3 million formal care-givers in China, which means that there are huge shortage of the care-givers in the coming future. China will face a strong pressure on the elderly care in the future as the fast population aging caused by both the effective family planning program and the fast longevity.

SESSION 12: Human Longevity and Lifespan Dispersion

Beyond a mortality pleateau: a fresh inquiry into the adult longevity and the force of old-age mortality (Cheung, Siu Lan Karen et al.) email: cslk@hku.hk

Background: Recent debates about a fixed limit to human lifespan and extreme age mortality plateaus drew a flurry of attention. Instead of investigating the occurrence of a mortality plateau to uncover whether a limit to human lifespan exists or not, the study of old-age mortality compression with the adult modal length of life (M) (M- approach) is relevant to unfold this riddle.

Methods: Raw data on the number of deaths and exposure at risk by age, sex and single year were obtained from the Human Mortality Database (HMD) for 19 European countries, as well as from Australia, Canada, Japan and the United States of America (U.S.A.) and pooled together for six different groups. A total of 1,760 period life tables by sex are constructed and the distributions of deaths are fitted by P-Spline method to estimate M and its derivatives.

Results: Our analysis shows that the force of mortality at M ($\mu(M)$) for the 23 low-mortality countries started to increase earlier for females since the 1950s, ranging 0.09 to 0.13. For males, the increase in $\mu(M)$ is 20 years lagging behind. We contend that the effect of $\mu(M)$ rise on the mean length of life after M ($e(M)$) and the effect of compression of mortality above M on $e(M)$ are distinguishable. Using Kitagawa's decomposition method, our results show that the fall in $e(M)$ is two-thirds due to the effect of change in $\mu(M)$. Since an increase in $\mu(M)$ is far from negligible at any rate to cause a decrease in $e(M)$, we also examine the steepening of the slope of mortality curve between $\mu(M)$ and the highest attained age the mortality function about 0.5 ($\mu(\omega)$), closely intact with the presumable mortality plateau. Our findings reveal that the occurrence of the compression above M concurrently with a $\mu(M)$ rise suggests that there is "a seemingly unstoppable limit" for extending human life, but it is still distant. (315 words).

The Jeanne Calment affair – can fake news change the truth? (Robine, Jean-Marie)
email: robinejm@gmail.com

Background: In December 2018 Jeanne Calment (JC)'s record of longevity (122 years) was rejected by two Russians, the gerontologist Valery Novoselev in an interview published at a Russian internet site, and the mathematician Nikolay Zak in a report on the internet medium ResearchGate. They concluded that JC's daughter usurped her mother's identity after her death in 1934 in order to avoid paying inheritance tax. Nikolay Zak's report was later published in a revised form in Rejuvenation Research (RR) with the same conclusion based on approximately the same arguments and results.

Methods: Analysis of the effects of first the internet documents in the social medias and the press worldwide, since the boosting effects of the article in RR. Discussion of the authors arguments and results, and our finding of new evidences of JC's record.

Results: The whole affair went on from 4 December 2018 (interview with Novoselov) to the 30 January 2019 (publication of Zak's article). In that period not only the family was seriously accused as frauds and liars in world-wide medias, but also the French researchers who documented JC's longevity record and the city of Arles. We will demonstrate how all the authors arguments can either be refuted or at least strongly questioned. We will stress the unacceptability of publishing an article with such an unfounded accusation, and the unethical demand of exhumations based on what can indeed be called "fake news".

Low American life expectancy: Separating longstanding differences from mortality trends 1970-2014. (Van Raalte, Alyson A. et al.) email: vanraalte@demogr.mpg.de

Objectives: Americans have low life expectancy and an outlying age structure of mortality—high early adult mortality and low old age mortality—when compared to other developed countries. Whether recent health challenges have exacerbated or minimized this outlying pattern in an internationally comparative perspective has not been investigated. By taking a long-term perspective, we aim to track the origin and development of the outlying American age pattern of mortality to provide insight into the drivers of mortality decline.

Methods: We decomposed the 2010-14 gap in life expectancy between the United States and a composite of 17 other high income counties into contributions from initial differences in age-specific mortality (1970-74) and contributions from differences in age-specific mortality trends (1970-74 to 2010-14) using contour decomposition methods. Decompositions were also performed for each decade of progress, against each individual country, and for mortality in the absence of smoking. For a limited subset of countries having a harmonized time series of cause of death data, we further decomposed these differences by major cause of death.

Results: Increases in the gap in life expectancy between the USA and other western developed countries from 1970-74 to 2010-14 were driven primarily by mortality over infancy and at ages 60+ (see below). For men, the trend component in mortality below age 60 (apart from infancy) was actually favourable for the USA, leading to life

expectancy convergence. The USA advantage at older ages declined substantially, particularly among women. Results by cause of death will be presented at REVES.

Conclusion: The exceptionally high young adult mortality is longstanding in the USA, and up until very recently, US mortality was converging to international levels over these ages. Explanations for the shortfall in US life expectancy must look beyond recent trends for theories that can account for these longstanding differences in the age pattern of mortality.

Keywords: life expectancy, decomposition, age patterns of mortality, USA

A decomposition of life expectancy and lifespan dispersion: Comparison between Hong Kong and Japan (Zheng, Yan et al.) email: u3005433@connect.hku.hk

Objectives: The aims are to identify the common drivers that make the two Asian societies the world leaders in life expectancy, and given that both societies have achieved similar levels of longevity, unravel to what extent the life disparity in Hong Kong and Japan resembles or differs from each other.

Methods: Decomposition analyses were conducted to evaluate the age-specific contributions to the changes in life expectancy and disparity for each of the societies and their comparisons were performed over the period of 1977-2016.

Results: The results show that reduction in mortality of the adult and the old age groups contribute most for the increase in life expectancy. Hong Kong has higher disparity than Japan, but due to great improvement in reducing premature deaths, the gap has been narrowing. However, in recent years, further reduction in mortality of the oldest elderly in Hong Kong has actually played a significant role to enlarge its disparity, thus widening its gap with Japan again.

Conclusions: Increasing dominant influence in “saving life at late ages” is very likely to cause reemergence of life disparity in these two long-lived societies.

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