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The HRS around the world surveys—A review

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Aging is clearly one of the most shared current public policy issues around the world with rapid demographic aging and the joint goals of maintaining good health and adequate economic security with financially attainable public and private budgets. It is thus not surprising that the Behavioral and Social Research (BSR) unit of the National Institute on Aging (NIA) in the United States started a Health and Retirement Study in the United States in 1990, a national panel sample with a two-year periodicity of Americans over age 50. The American HRS has led to similar international aging surveys in more than 40 other countries around the world that share a common scientific and policy mission, with a mutual desire to *harmonize* their main survey content. The rationale behind it is simple: Perhaps more than other societal phenomena, aging is a multi-faceted process with determinants that often have very long lead times. Furthermore, identifying the relative role of such determinants may be difficult because in many instances all individuals in a cohort are exposed to the same macro-events (such as war, famine, socioeconomic policies, developments in medical technology, and better access to health insurance). It follows that aggregate data limited to one country and one dimension of behavior can limit what we can learn from them.

In contrast, a coherent network of harmonized data sets can help study the behavioral reactions to changes in public policy (e.g., changes in health care utilization and its implications for health status in the wake of health care reform; changes in the retirement age and the level of savings preceding a pension reform). In doing so, we can understand not only how individuals respond to their socioeconomic environment (including institutions and policy measures), but also how the aging process unfolds in different cultures, societies, and environments over time.

The rest of this paper is organized as follows. The next section graphically illustrates the sharp growth in the number of HRS surveys around the world over the last 30 years, while section 2 documents the growing number of observations and number of publications cumulatively produced by these HRS surveys to date. Section 3 highlights the rapidly expanding survey content in these surveys with special attention paid to adding life histories, measures of severe cognitive impairment (HCAP), and COVID-19. Section 4 illustrates some of the major current findings from these HRS surveys with a special emphasis on their implications for health outcomes all over the world as well as the United States. The final section contains the main conclusions of the paper.

Growth in HRS surveys around the world.

Figs. 1, 2, and 3 show the historical spread of the HRS aging surveys around the world at three points—1995, 2006, and 2019. In the first graph, in 1995, only three countries were in the network, which was also at best a very loose network: the American HRS (Sonnega et al., 2014), the Mexican Health and Aging Studies (MHAS) in Mexico (Wong et al., 2017), and the Indonesian Family Life Survey (IFLS) in Indonesia (Thomas et al., 2012). The publication success of HRS and the importance of aging around the world produced a significant growth in the subsequent decade.

By 2006, additional countries in the network included the English Longitudinal Survey of Aging (ELSA) in England (Steptoe et al., 2013); the Survey of Health Ageing and Retirement in Europe (SHARE); which initially included 13 continental countries (Börsch-Supan et al., 2013); the Irish Longitudinal Study of Ageing (TILDA) in Ireland (Kearney et al., 2011; Whelan and Savva, 2013); and three additional Asian surveys—the Chinese Health and Retirement Longitudinal Study (CHARLS) in China (Zhao et al., 2014), the Korean Longitudinal Study of Aging (KLoSA) in South Korea (Park et al., 2007), and the Japanese Study on Aging and Retirement (JSTAR) in Japan (Research Institute of Economy, Trade and Industry, 2018). As illustrated in the graphs, this expansion continued in the next decade with more recently implemented Longitudinal Aging Study in India (LASI) in India (Arokiasamy et al., 2012); the Brazilian Longitudinal Study of Aging (ELSI) in Brazil (Lima-Costa et al., 2018); Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) in South Africa (Gómez-Olivé et al., 2018); the Northern Ireland Cohort for the Longitudinal Study (NICOLA) in Northern Ireland; the Healthy Aging in Scotland (HAGIS) study in Scotland (Douglas et al., 2018); and the Malaysia Aging and Retirement Study (MARS) in Malaysia in 2019 (Mansor et al., 2019). In addition, over this time period the number of continental European countries in SHARE grew to 28 countries. SHARE would have a complete country count of 29 since it had a survey in Ireland, which was eventually discontinued with the start of a much larger TILDA in

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Fig. 1. HRS Global Coverage—1995.

Fig. 2. HRS Global Coverage—2006.

Ireland. Details about the individual surveys are contained in Appendix Table A1.[1]

Overall, HRS surveys around the world now consist of more than 40 countries on five continents—North America, Europe, Asia, South America, and Africa. These countries cover 71% of the world's population aged 61 or older. Moreover, additional countries may want to join the HRS around the world surveys, and initial conversations are taking place with people in Australia, New Zealand, Wales, Pakistan, Singapore, Thailand, Uruguay, Cuba, and Egypt. Thus, the HRS around the world surveys may grow in terms of number of countries in the future. However, the significant commitment cost of a long-term panel does mean that not all these countries will make it into the HRS group of surveys so that country growth will likely not mirror the past history. Similarly, the significant panel cost will lead some existing countries in the network to discontinue their future panel waves.

What accounts for this spectacular success in the HRS network of surveys? One reason of course is the universal trend toward significant population aging around most of the world. The world is steadily getting older, and new institutions and policies are needed to continue to provide income security and protection from increasing health risk and do so at sustainable budgets—a long way from the current political situation in most countries. Competence in execution certainly also played a

[1] Details about the separate surveys including variables, observations, waves, and home websites can be found on the Gateway to Global Aging website at https://g2aging.org/

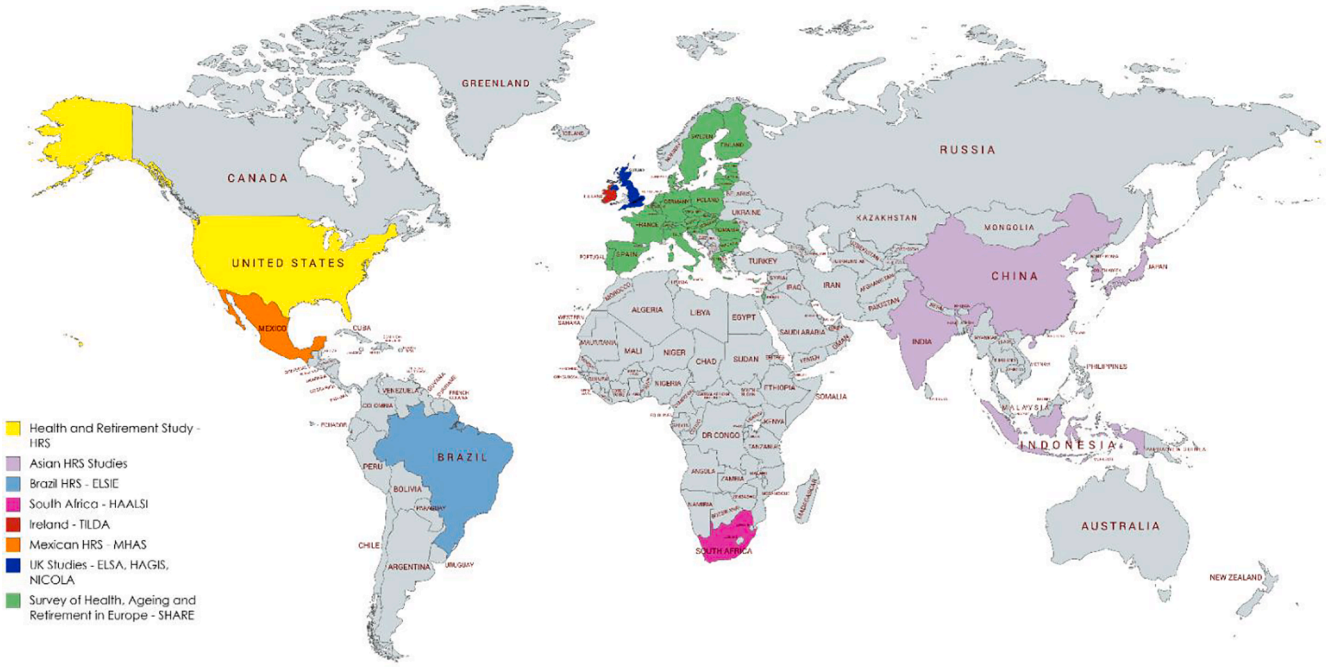

Fig. 3. HRS Global Coverage—2019.

Table 1
Observations in HRS around the World Surveys.

Country	Sample Size per Last Completed Wave (Year)	Total Sample Size All Waves
United States (HRS)	20,917 (2018)	252,742
Continental Europe (SHARE)	76,520 (2018)	369,649
China (CHARLS)	22,000 (2018)	76,000
Indonesia (IFLS)	43,500 (2015)	133,504
England (ELSA)	8445 (2018)	108,558
Mexico (MHAS)	18,465 (2019)	82,078
Brazil (ELSI)	9412 (2016)	9412
Ireland (TILDA)	5400 (2018)	27,163
S. Korea (KLOSA)	10,250 (2019)	43,000
South Africa (HAALSI)	5000 (2019)	5000
India (LASI)	72,250 (2019)	72,250
Malaysia (MARS)	5613 (2019)	5613
Northern Ireland (NICOLA)	8478 (2017)	14,988
Japan (JSTAR)	3800 (2015)	5000
Scotland (HAGIS)	1000 (2018)	1000
TOTAL	311,050	1,205,957

role, and the research teams leading these studies deserve a lot of credit. In the United States and most of HRS countries from high-income countries, the samples in the HRS surveys were those aged 50 and over. In many of the middle-income Asian countries, the age cutoff for participation in the survey was moved down five years, to age 45. The reason for this was two-fold: First, the transition into poorer health starts at younger ages in these countries than in Western Europe and the United States. Second, in some of these countries, such as China and South Korea, at least in the formal wage and government sectors, the rules for mandatory retirement are often imposed at younger ages than in Western Europe and the United States.

A central reason for its success is the network's model of inclusion and openness. Openness is reflected most directly by the public release of all data in the network of surveys to researchers both inside and outside the country where the data were collected. There is a very strict and non-negotiable rule in the HRS network of countries that surveys must make data available to all researchers around the world, not just all researchers in the host country. Another reason for the success of the HRS network was derivative of the mutual learning between the studies on how to maintain respondents in the panel. This largely involved being aware of current residence of panel migrants through the family members and neighbors of the original respondents who would know the new location of respondents who moved (Frankenberg et al., 2001).

Observations and productivity of HRS surveys

Table 1 presents observations available for analysis in the HRS around the world surveys both from using the most current wave of data available in 2019 in each country and from using all the data from all waves in the HRS around the world network up to any wave in 2019. In the most recent wave of data in 2019, there are almost 311,000 observations with about 21,000 of those from the American HRS. By far the largest single country sample is found in the Indian LASI survey (72,250 observations), a reflection of the government of India's desire to conduct analysis with enough sample at the state level where public policy is often made in India. The SHARE survey with 28 countries has about 76,000 observations in their last wave across all its countries for similar reasons—a desire by individual country funders to conduct some analysis at the country level. Most of the other countries sample sizes are in the standard 5000 to 20,000 range.

Most analyses now would use samples from all or most waves of the individual data comprising of more than 1.2 million observations across all HRS surveys. Four of the data sets now have more than one quarter million observations each: SHARE (369,649), United States of America (252,742), Indonesia (133,504), and England (108,558).

While there is legitimate uncertainty about country growth in this network in the future, the data available to researchers will certainly grow given the panel nature of the data. Given the per-wave sample size, also illustrated in the second column of Table 1, total sample size in the HRS network of surveys will pass 2 million observations in three more waves and add 1 million more observations every additional three years. Effective sample sizes will always be somewhat less than these numbers, implying that researchers must consider in their statistical analyses that both spouses are recruited into the data, so their data are correlated by unobserved factors between spouses. The observations are also correlated over time by unobserved time-related factors. These issues are

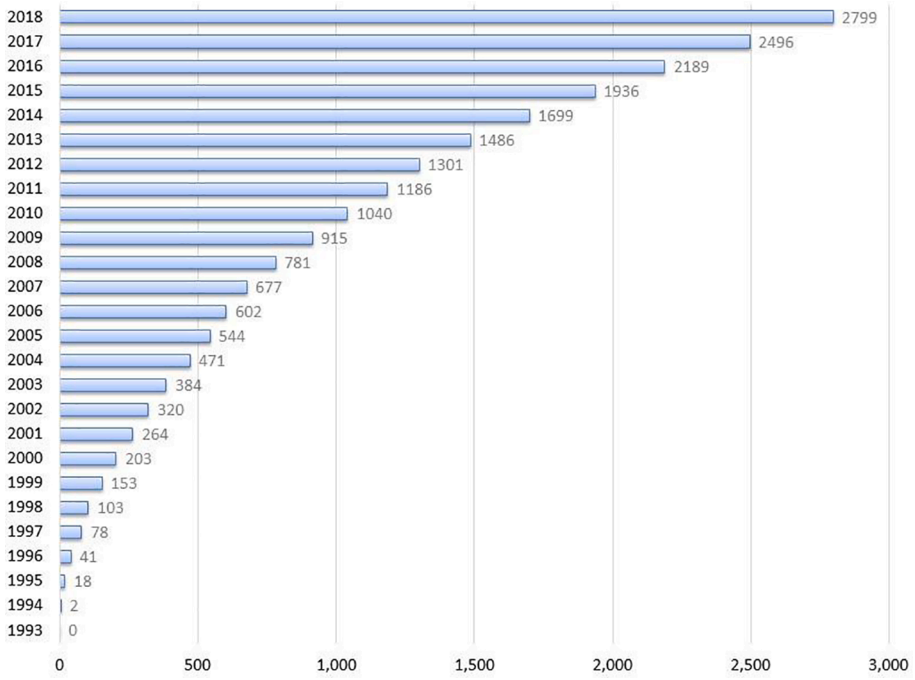

Fig. 4. Cumulative Journal Articles in United States.

Table 2
Number of Waves and English Language Publications.

Country	Survey	Year of 1st Wave	# of Waves	# of Publications
United States	HRS	1992	14	3094
Continental Europe	SHARE	2004	7	1733
China	CHARLS	2011	4	1253
Indonesia	IFLS	1993–4	5	877
England	ELSA	2002	9	712
Mexico	MHAS	2002	5	289
Ireland	TILDA	2010	4	253
S. Korea	KLoSA	2006	5	153
South Africa	HAALSI	2018	1	33
India	LASI	2018–19	1	31
Brazil	ELSI	2015–6	1	19
Northern Ireland	NICOLA	2018	1	7
Malaysia	MARS	2019	1	n/a
TOTAL				**8454**

easily offset because observed spousal and time-related variables are extremely important in individual decision making and can be included in the modeling.

Given the large number of waves in many HRS surveys around the world, there is a concern about long-run sustainability of this model. However, now BSR (NIA) pays only about one-fifth of the cost of global HRS studies excluding the American HRS. There is currently a big difference between HRS incumbents and new entrants into the network in terms of cost sharing for the surveys. New entrants into the HRS network are now expected to finance their infrastructure for data collection, and older HRS around the world studies are having the host country pay an increasing fraction of the costs of their data collection efforts. Sustainability will require both continued American NIA funding as well as continued within-country funding of these studies. I will show below that there is a significant payoff to American investment in data around the world in terms of scientific productivity and output.

Fig. 4 plots the research productivity of the American HRS survey over the years since its inception. This plot refers only to research papers published in journals. There has been an exceptionally large and steady growth in publications, and by the end of 2018, HRS publications had reached almost 2800 publications with no indication of this positive trend slowing down. These publications were across the board in that they included publications in both major health and social science journals.

This impressive growth in publications was not limited to the American HRS. Table 2 lists the number of cumulative HRS around the world publications listed by the HRS country and survey. The specific country or area of the world is listed in the first column, the data set in the second column, the year a survey began in the third column, the number of current waves of data in the fourth column, and the number of publications to date in the fifth and final column. These are actual English language publications as of 2019 and do not include working papers or dissertations, which clearly would make these numbers even much larger.

The publication record is impressive indeed. Across all HRS around the world surveys, there has been almost 8500 publications at this point. Currently with the introduction of another survey panel wave, the cumulative number of publications will grow at least by 1000 publications per year so we will soon have more than 10,000 publications in the HRS around the world studies with even faster growth in publications in the future.

The number of publications by data set is clearly related to the number of existing waves of data available or in most cases equivalently the length of time the data have been available to researchers. Not surprisingly, the American HRS is at the top of the list with more than 3000 publications to date. Next in line with 1733 publications is SHARE, which not only has an impressive life history among its accomplishments but also 29 separate and interesting individual countries to analyze within its own distinct network. The third HRS country with more than 1000 publications (1253) is China (CHARLS). That impressive number is no doubt due to the very large size of the research community in China and the fact that in the past data were not normally made easily available to Chinese researchers except for those who collected the data. The CHARLS count includes only English language papers. Both Indonesia and England have good records of publications to date. The remaining country surveys are in a much earlier stage of their own life histories, and as is normal with data their publications lie in the

future. For example, the Indian LASI DATA is being distribution to researchers around the world in Oct 2020. The normal periodicity of the HRS around the world surveys is every two years. Recently, the Mexican MHAS survey and the Chinese CHARLS survey switched to every three years to reduce the long-term cost of data collection. ELSI is also conducted every three years.

Evolving survey content in HRS around the world surveys

While the HRS international network has maintained its core original focus on the domains of health and economic status, its scientific scope has steadily expanded over time with significantly improved measurement in cognition, psychosocial risk factors, changes in the value of assets, and biomarker-based measures of health that aided in identification of timing of health disease onsets. These domains were seen not only as important in themselves for older populations around the world, but also central in understanding the critical health and economic decisions made by the older people.

To illustrate, a major ELSA innovation in the network was to take biological measures from venous blood in every second wave, which eventually convinced many other surveys in the network (including the HRS) to do the same. This attribute within the HRS network of allowing scientific innovation at the country level and having others within the network adopt the most successful innovations is one of the major gains from the network's close partnerships. These biological measures can be used not only to validate respondents' self-reports but also to monitor overall health. They can also provide information about pre-clinical levels of disease of which respondents may not have been aware and to which they have not yet been able to react behaviorally. For example, SHARE has drawn capillary blood samples, which are now being assayed.

A life histories

I will briefly discuss three other innovations that greatly expanded the content available in the HRS around the world surveys over time—life histories, severe cognitive impairment probabilities, and COVID-19. ELSA was the initiator with a life-history in its third wave (2006). Building on this, SHARE introduced its life history modules in its wave 3 in 2008 and then again in wave 7 (Börsch-Supan et al., 2011). The necessity of life histories in the HRS network stems from the basic reality that relevant health and economic life does not begin at age 50 even for the health changes observed after age 50. Thus, controlling for status at age 50 is simply not enough. Many other salient things happen in individuals' lives that matter a great deal in the evolution of their physical and mental health after age 50 (Goodman et al., 2011). These include the strong legacy of early family life events, especially during the childhood years, on later life health and economic outcomes. Similarly, early experiences will include the influence of earlier country-level effects on current outcomes.

These earlier events could include wars (Kesternich et al., 2014), economic cycles (Genoni, 2012), and severe events such as famines, earthquakes, and political upheavals. Socioeconomic circumstances during childhood are strong predictors of health even in old age. However, although childhood is an important period for effective intervention, it is not the only opportunity to prevent future problems. Negative socioeconomic circumstances such as childhood poverty can be compensated, for example by good education leading to more favorable living conditions in adulthood (Pakpahan et al., 2017). These findings were made possible especially by SHARE's collection of retrospective information, which allows for the analysis of life course developments across many countries.

A frequent objection to the addition of life histories is retrospective reporting bias. In my view, retrospective reporting bias in these life histories is an exaggerated problem for the objective facts of life (Smith, 2009). Table 3 demonstrates this by using the analysis in Smith (2009) that compares two retrospective histories of prevalence of childhood diseases in an HRS internet panel and in the Panel Study of Income Dynamics (PSID) sub-model with the actual prevalence of childhood diseases obtained from historical sources at the time. This table shows remarkably similar levels of specific childhood disease prevalence from all three sources. Similarly, Smith (2009) showed that the specific dates of the introduction of vaccines for measles and mumps led to a sharp drop in the retrospective reporting of measles and mumps at the same time in the PSID retrospective childhood health module. In conclusion, the data contained in this retrospective module demonstrated that the most salient health life events in people's lives can accurately be collected in self-reports and continue to influence economic and health pathways at older ages.

Table 3
Comparison of responses in childhood prevalence health histories of HRS Internet Panel to external sources and to PSID respondents aged 50+.

Diseases (%)	HRS Internet Panel	External Source	PSID Aged 50+
Very Common Diseases			
Measles	88.0	92.4	82.9
Mumps	65.5	64.6	67.3
Chicken Pox	83.5	83.9	80.0
Moderately Common Diseases			
Asthma	4.0	6.0	4.5
Respiratory Disorder	13.8	12.3	8.9
Speech Impediment	1.6	1.9	2.0
Allergic Condition	10.9	13.4	7.8
Heart Trouble	1.8	1.6	1.5
Chronic Ear Problem	9.9	6.9	6.5
Severe Headaches or Migraines	6.1	6.0	6.1
Stomach	4.8	3.1	3.1
Depression	2.2	2.1	2.1
Very Rare Diseases			
Childhood Diabetes	0.1	0.4	0.2
Hypertension	0.4	0.6	0.4
Epilepsy/Seizures	0.7	0.3	0.4
N	*3964*	*NA*	*7778*

The success of the SHARE life histories persuaded many other HRS surveys to add a life history module to their structure. These countries include Brazil (ELSI), China (CHARLS), and South Africa (HAALSI). The American HRS is adding its life histories in parts over time. Several other countries in the network are now planning to add a life history module, so life histories may soon become a common part of the HRS surveys around the world.

Cognitive impairment, dementia, and HCAP

As the world ages at a rapid rate, cognitive impairment in its various forms including dementia is increasingly becoming a major health concern among the elderly population in the United States and around the world that is very expensive to deal with (Hurd et al., 2013). In response to that concern, many HRS surveys around the world have or

Table 4
HCAP Status of HRS Partner Studies.

Country	Study	Applied	Funded	Begun	Completed
USA	HRS	✓	✓	✓	✓
Mexico	MHAS	✓	✓	✓	✓
England	ELSA	✓	✓	✓	✓
S. Africa	HAALSI	✓	✓	✓	✓
China	CHARLS	✓	✓	✓	✓
India	LASI	✓	✓	✓	✓
EU	SHARE	✓	✓	✓	
S. Korea	KLOSA	✓	✓	✓	
Ireland	TILDA	✓	✓		
N. Ireland	NICOLA	✓	✓		
Brazil	ELSI	✓			

will be adding the Harmonized Cognitive Assessment Protocol (HCAP) to their surveys. HCAP's goal is to collect more detailed measures of cognitive function that will enable researchers to estimate the probability of mild cognitive impairment (MCI) and more severe cognitive impairment including dementia and other serious cognitive impairments in the samples within the HRS around the world surveys. Already among the HRS around the world surveys, HCAP modules has been added in the following countries: United States (HRS), England (ELSA), Mexico (MHAS), China (CHARLS), India (LASI), and South Africa (HAALSI). In addition, HCAP modules will likely soon be added to SHARE (continental Europe), the two Irelands (TILDA and NICOLA), South Korea (KLOSA) and others will be sure to follow. The current plans of the different surveys are highlighted in Table 4.

A main goal of HCAP is to produce comparable diagnostic classifications of severe cognitive impairment and dementia and MCI in subsamples drawn from the HRS family of studies, thereby permitting combined longitudinal epidemiological studies in these subsamples. The cognitive questions administered in HCAP are meant to capture a set of key cognitive domains affected by cognitive aging (e.g., attention, memory, executive function, language, and video spatial function) in a manner that is harmonized across the HRS around the world samples (Langa et al., 2020). The first step involves one-hour in-person interviews on these cognitive domains for respondents aged 65+ with an additional 20-minute interview of a knowledgeable informant who reports about the respondents' cognitive ability and daily function. Informant interviews are a normal part of the clinical diagnosis of severe cognitive impairment. HCAP subsamples to estimate rules for assigning diagnostic classifications to full samples. The probability of falling into three cognitive groups (i.e., normal, MCI, and dementia) will be assessed for each respondent so that incidence and prevalence can be estimated. These harmonized international data will provide opportunities to better understand risk and protective factors for MCI, severe cognitive impairment, and full scope of dementia burden on individuals, families, and society. HCAP interviews will be administered in multiple waves of the HRS surveys at a periodicity that is not yet fully determined for all studies. Excellent examples of the implementation of HCAP in very different countries can be found in Banerjee et al. (2020), Mejia-Arango et al. (2020), and Meng et al. (2019).

COVID-19

The COVID-19 pandemic around the world illustrates the challenges but even more so the rewards of having an existing joint set of aging surveys around the world. As of August 2020, the COVID-19 pandemic has led to more than 5.6 million cases in America and 175,000 deaths. The currently reported world-wide numbers at the time of this writing are almost 23 million cases and more than 806,000 deaths. These numbers will certainly rise in the future. Elderly people, especially those with pre-existing conditions such as heart disease and diabetes, are known to be more affected by the pandemic. We also know the most serious consequences of the pandemic are both in health and economic outcomes with profoundly serious economic consequences already prevalent in many countries. We clearly need panel surveys with "before and after" conditions of an older population that contains high-quality scientific information on health and economic status of individuals and families. The HRS around the world surveys thus plays an important role in filling this gap of information on the effects of the pandemic on older populations.

The challenge that the COVID-19 pandemic has created for the HRS surveys is that conducting detailed in-person interviews often with biomarkers has become basically impossible. Consequently, many of the HRS surveys are skipping their normal full detailed 2020 in-person interviews. Instead, they are fielding surveys that focus on the reality and possible consequences of COVID-19. Continental Europe, China, Brazil, and India have already included or fielded a COVID-19-related surveys. To illustrate with just one example among many, the English ELSA survey has been funded to investigate the effects of the COVID-19 crisis on the older population in England. ELSA will collect data from more than 10,000 ELSA participants, all aged 50 years and over, asking them about their experiences of the COVID-19 crisis. Data collection will occur in two phases, with the first beginning in May 2020 and the second in September 2020, to examine changes in participants' experiences as the COVID-19 crisis evolves. We do not know yet the complete knowledge obtained about COVID-19 from the HRS around the world surveys, but it will surely be substantial. To illustrate, the initial results from TILDA, the Irish study, show that COVID-19 infection is less likely to occur among people with high levels of vitamin D (Rhodes et al., 2020).

Cumulative substantive findings

The surveys in the HRS studies around the world have produced new important knowledge, including about health-related outcomes and policy in the United States and the world. For example, one of the most important findings from using ELSA and HRS data was that, across virtually every disease in people over age 50, Americans were much sicker than the English (Banks et al., 2006; Zaninotto et al., 2020). The initial research using ELSA and HRS also showed that standard risk factors and prevalence of health insurance were reasonably similar in the two country analytical populations. The disease differences were due to much higher waist circumference among American women compared to British women. These differences were also linked to higher rates of diabetes among American women and to higher rates of childhood disease among Americans compared to the English (Banks et al., 2010, 2012). One lesson for American policy is that improving population health even for older Americans must start at a much younger age.

This type of comparative health research across countries was extended to continental European countries using SHARE data. Once again, the authors pointed out that the health status of older Americans was worse than that of continental Europeans in SHARE countries (Avendano et al., 2009), and that life expectancy in the United States has not kept up with that in higher-income countries in Europe. The health status of middle-aged and older Americans was particularly worse than that of the English and the Europeans among those in the lowest wealth tercile suggesting that it is the poorest Americans, in terms of wealth, who have the worst health outcomes compared to their European and English brothers and sisters.

Notably, the American health disadvantages started at very young ages. Death rates due to homicide, poisoning, and infections are particularly high in the United States. Lee and Smith (2018) did similar comparisons of Asian and Europeans to Americans and found that by far the largest difference in these health disparities was in the levels of and growth in obesity in America in comparison to the other countries. Smoking used to account for higher levels of mortality among Americans compared to Europeans, but that explanation has been replaced by obesity.

In more recent work on ELSA and HRS, Banks et al. (2010) showed that new disease incidence was higher in England than in the United States (the opposite of the prevalence comparison) and that mortality from new disease was higher in England than in the United States. Their interpretation was that English people are getting diagnosed with a disease at a later stage than Americans and that the medical treatment of those with a disease is not as good in England as it is in the USA—the opposite of the widely held popular view. Similarly, Marshall et al. (2016) showed that levels of controlled hypertension are higher in the United States than England, due to lower levels of undiagnosed hypertension in HRS than ELSA. The amount of uncontrolled hypertension is similar in the two countries, suggesting differences in diagnostic practices but not health care.

These health differences across countries apply to cognitive health as well. Using SHARE data, Mazzonna and Peracchi (2012) reported large differences in cognitive ability across European countries, with cognitive ability highest in Northern Europe and lowest in Southern Europe.

Cognitive ability varies significantly by education level, with the most educated having the best cognitive levels. Supporting the results obtained in Rohwedder and Willis (2010), they also report that retirement lead to declines in cognitive ability, most likely due to the loss of one source of stimulation in life. Similarly, Lei et al. (2014) supported the importance of non-biological factors influencing cognition by demonstrating that the female education deficit among older Chinese is the most important factor explaining the female cognition deficit. Similar findings for India are reported in Lee and Smith (2014). These findings point to the importance in future research of exploring the role that education plays in cognitive and dementia differences across countries and gender using the HCAP data from the HRS around the world surveys.

One limitation in learning from other countries about how to deal with aging of populations stems from the reliance on answers to subjective questions in the surveys. An excellent illustration of this problem concerns measuring physical activity and sleep, which are important reasons why health outcomes vary especially in older populations. To illustrate, Kapteyn et al. (2018) examined answers to subjective questions on the intensity of exercise and the quality of sleep by respondents in the United States, England, and the Netherlands. If we used the subjective questions alone, there would appear to be only minor differences across these countries in the amount of vigorous exercise and quality of sleep. In addition, there was virtually no age gradient in exercise or sleep in answers to the subjective questions. Fortunately, respondents in all three countries were given accelerometers to wear on their wrists. Accelerometers are a proven scientific method to objectively measure both vigorous exercise and the quality of sleep. When the objective measure is used instead of the subjective measure, the Dutch and English are much more physically active than the Americans and a steep age gradient in the reduction of physical exercise in all three countries becomes apparent. With subjective questions only, the negative importance of lack of exercise to American health is significantly understated. Because of this study, the HRS around the world studies will now add objective measures of exercise and sleep in their surveys.

Another important way the surveys could and did learn from each other is by developing methods for reducing attrition in the panel. The Indonesian IFLS showed that attrition was much lower if the names and addresses of nearby family members and friends are recorded so that respondents who moved can be located and retained in the panel.

The collection of around the world aging surveys has also aided in uncovering important policy results for an older population. To illustrate, Donoghue et al. (2016), using the Irish TILDA data in this network, found that a significant fraction of people over age 50 in the city of Dublin were significantly challenged by the timings of traffic lights and had insufficient time to cross the road at light-controlled pedestrian crossings. Specifically, the study found that 65% of people over age 50 had insufficient time to cross the road if carrying out a cognitive-based task (e.g., talking on a phone). Therefore, many older Irish people simply did not go out. Because of this study, the city of Dublin identified older persons' crossings and allowed longer periods of green lights.

Using TILDA data, Murphy et al. (2015) identified a significant proportion of older people who were unaware of hypertension (subjective versus objective blood pressure (BP) measures). Among those with hypertension, in the first wave of TILDA data, 45% of Irish respondents were not aware that they were hypertensive largely because they were never tested. Because of these findings, the Irish government introduced reimbursement to general practitioners (GPs) for ambulatory BP measurement, and the rates of undiagnosed hypertension subsequently fell significantly. Similarly, the sharp increase in prevalence of falls in middle-age, particularly among women, supports the notion that falls are not just a problem of old age, and that middle-age may be a critical life stage for preventive interventions.

The second IFLS wave followed the same sample four years later (in 1997–1998) and was fielded right before the Asian financial crisis. After the crisis, a 25% IFLS subsample was surveyed to provide data about distributional impacts of Indonesia's economic crisis. Combined with the full five waves, this survey became the main vehicle for understanding short- and long-run impacts of the financial meltdown in Indonesia (Frankenberg et al., 2003). Cohabitation, for instance, was an important behavioral response to the crisis. And while parental needs are important, research using IFLS data showed that cohabitation is influenced to a larger extent by the cost sharing and benefits of living with children.

Linking it further with the American HRS, MHAS also sampled migrants returned from the United States so that outgoing and return migrants can be studied with the two samples. One interesting finding from these data relates to the negative association between years spent in the United States and being (health) insured in Mexico upon returning home, which may affect migrant's health care access. The same cannot be said about pension benefits, due to the portability of the U.S. social security upon retirement in Mexico. In any case, the uncertainty created by the social security and health insurance status should make people save, but Naranjo and Gameren (2016) find that the public protection system, rather than precautionary savings, has a more prominent role in reducing financial vulnerability in old age. These examples show that the value of these aging studies is to first inform policy and knowledge in the host counties.

Conclusions

This paper describes the main highlights of the evolution of the Health and Retirement Aging Surveys around the world over the past 30 years. Most countries have been and will continue to age at a very rapid rate, signaling a need for a better understanding of how to provide good health and income security during older ages at sustainable public and private budgets. These HRS surveys, with a very harmonized content across the surveys, are now in 41 countries in five continents, a number that may grow in the future. The HRS surveys now cover greater than 70% of the world's population over age 60. The substantive content of the surveys includes many dimensions of physical and cognitive health outcomes including provision of health care, economic status, and family demographics.

The success of the HRS around the world surveys is due not only to the necessity of dealing with worldwide aging, but also to the remarkably high quality of the surveys themselves. With every new wave, more than 300,000 observations are added to this network with currently more than 1.2 million cumulative observations, which will exceed more than 2 million observations in just three more waves. The cost of this research network has been sustainable only due to joint funding of the countries involved. The BSR division of the National Institute of Aging now pays only 19% of the data infrastructure costs and needs to continue its commitment into the future. In addition, most of the other costs must be paid by the countries themselves, who receive a lot of the benefit to the individual country even when there is no unique benefit to America. In the future, these surveys could equally be called "WORLD AGING SURVEYS" as "HRS surveys around the world."

This network of world aging surveys has been very scientifically productive. There are more than 8000 publications to date in the network with more than 3000 publications coming from the American HRS. With every new wave every two years, the cumulative number of publications will grow by at least 1000 publications per year, so we will soon have more than 10,000 publications in the world aging studies with even faster growth in the future.

The world aging surveys have not remained scientifically static over time. First, they have engaged in a collective effort to improve the measurement of traditional content in aging panel surveys. This improved measurement includes the timing of new onsets of disease, the use of venous and capillary BLOOD-based biomarkers to measure disease severity, and changes in values of economic assets over time. This improvement in measurement has the additional critical benefit of making the surveys in the different countries more directly comparable

Table A1
The International Landscape in Comparable Data Collection.

A. Europe and North America
- HRS (Health and Retirement Survey)
  - original sample of 37,000+ people interviewed 1992 through 2018
  - started in 1992; finished 14 waves
  - last wave sample size is 20,917 (2018)
- MHAS (Mexican Health and Aging Study)
  - original sample of 15,000+ people
  - started in 2002; finished 5 waves (2002–2004; 2012–2013)
  - last wave sample size is 18,465 (2019)
- ELSA (English Longitudinal Study of Ageing)
  - original sample of 11,000+ people
  - started in 2002; finished 9 waves (2002; 2004; 2006; 2008; 2010; 2012; 2014, 2016, 2018)
  - last wave sample size is 8445 (2018)
- SHARE (Survey of Health, Ageing and Retirement in Europe)
  - sample of 31,000+ people (11 countries) in 2004; 58,000 + people (19 countries) in 2012
  - started in 2004; finished 8 waves (2004; 2006; 2008 – SHARELIFE; 2010; 2012; 2014)
  - comprehensive retrospective histories (SHARELIFE, 30,000 people)
  - last wave sample size is 76,520 (2018)
- TILDA (Irish Longitudinal Study of Aging)
  - original sample of 8000+ people
  - started in 2010–11; finished 4 waves
  - last wave sample size is 5400 (2018)
- NICOLA (Northern Ireland Cohort for the Longitudinal Study of Aging)
  - original sample of 8500+ people
  - started in 2015; finished 1 wave
  - last wave sample size is 8478 (2017)
- HAGIS (Healthy Aging in Scotland)
  - (pilot) sample of 10,000 people; started in 2015
  - last wave sample size is 1000 (2018)

B. Asia
- IFLS (Indonesian Family Life Survey)
  - original sample of 33,000+ people of all ages
  - started in 1993–1994; finished 5 waves
  - last wave sample size is 43,500 (2015)
- KLoSA (Korean Longitudinal Study of Aging - South Korea)
  - original sample of 6000+ people
  - started in 2006; finished 5 waves
  - last wave sample size is 10,250 (2019)
- JSTAR (Japanese Study of Aging and Retirement)
  - original sample of 8000 people in 5 cities in 2007; 9300 people in 10 cities in 2011
  - started in 2007; finished 4 waves
  - last wave sample size is 3800 (2015)
- LASI (Longitudinal Ageing Study in India)
  - original sample of 72,250 people (baseline) in all Indian states
  - started in spring 2017
  - last wave sample size is 72,250 (2019)
- CHARLS (China Health and Retirement Longitudinal Survey)
  - original sample of 10,000 + households (17,000 people)
  - started in 2011; finished 4 waves
  - last wave sample size is 22,000 (2018)
  - MARS- Malaysia Aging and Retirement Survey
  - original sample of 5613 people
  - started in 2019 one wave complete

C. South America
- ELSI (Brazilian Longitudinal Study of Aging)
  - original sample of almost 10,000 people
  - started in 2015; finished 1 wave- 2019-finished 90% of wave 2.
  - last wave sample size is 9412 (2016)

D. Africa
- HAALSI (Health and Aging in Africa): Longitudinal Studies of INDEPTH
  - sample of 5,000 adults 40+ in 2014
  - last wave sample size is 5000 (2019) started in 2014 (in Agincourt S.A.); finished 1 wave with follow-ups every 2–3 years

so that they can learn from each other.

Improvement in measurement also involved adding important new content to the surveys. Two examples are highlighted in this paper—the addition of life histories and the HCAP measurement of severe cognitive impairment. Life histories add critical personal and historical events before age 50 that shape the evolution of health status in older age. The childhood years have proven to be a critical span of life even for health events that happen after age 50. With regard to HCAP, many of the surveys around the world have or soon will add HCAP, a harmonized and validated method enabling measurement of the probability of mild and severe cognitive impairment for people over age 60. The addition of HCAP is too recent to know what the scientific impact will eventually be, but it promises to radically enhance our understanding of the reasons for the onset of dementia around the world and the identification of policies that can reduce cognitive impairment with aging in future aging cohorts all over the world.

Moreover, in the next decade these aging surveys will be one of our main sources of information about the COVID-19 pandemic within the most vulnerable aging population. This is because these surveys have the essential panel quality of before and after the pandemic. In addition, the surveys themselves have responded by including new content that will enable researchers to do high-quality studies of the reasons for the incidence of the disease but also its health and economic consequences on those who are affected and their families.

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Declaration of Competing Interest

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

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Appendix A

Table A1

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