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Population Aging: How Should It Be Measured?

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In 1950 people aged 65+ represented about 1 in 12 of the US population. Today their share is around 1 in 7. While declining fertility formed the basis for this growth from the end of the 19th century until WWII, since the 1960s falling old-age mortality has been an additional driving force. This ‘population aging’ has worried policy makers because for every worker paying tax and social security there are more older ‘dependent’ citizens, with greater demands on social insurance, health and welfare systems and increasing prevalence of morbidity and disability [1-3].

The standard indicator of population aging is the old-age dependency ratio (OADR). It takes the number of those who have reached the state pension age and divides it by the number of ‘working age’ (16-64 years) adults to measure the dependent elderly population relative to those who pay for them. In the US the OADR went from 12.7 elderly per 100 of working age in 1950 to about 20 today, and may reach 35% by 2050. This has increased policy makers’ concern despite lower levels than in other high-income countries [4]. However, the OADR is not ‘fit for purpose’, as it counts neither the dependent elderly nor those who sustain them. It merely takes a cut-off point (the state pension age) and assigns adults to the two sides of the ratio accordingly. We propose several alternative measures that give a more accurate but different account.

Counting the dependent elderly

Paradoxically, the main process that causes population aging – declining old-age mortality – makes age a poor measure of its progress. When lifespans lengthen, any given age becomes a marker reached earlier along the life course. In 1950 mean period life expectancy for women in the US aged 65 was 15 years. Today this has risen to 21 years (resp. 13 and 18 years for men) (www.mortality.org). We can best capture this changing significance of age by realizing that the age of a population comprises two components: the *years lived* of its members (their ages) and their *years left* (their remaining life expectancies or RLE). In a period of lengthening lifespans, not only does the average age of the population increase, so too does the RLE associated with each age [5]. Its effects are substantial. At the end of the baby boom in the late 1960s the median age of the population was just under 28, but now it is 37. Yet over the course of the 20th century, life expectancy across all ages *also* increased. We thus have

the situation that for instance in 1950 the median age of 30 carried a RLE of an additional 42 years but 37 year olds in 2011 could expect to live another 43 years. In aggregate terms, the population of 2011, despite being 7 years ‘older’ as measured by *years lived*, was nevertheless one year ‘younger’ than that of 1950 in terms of *years left* for its members to enjoy. This is crucial, because many behaviors and attitudes (including those related to health) are more strongly linked to RLE than age [6-9]. Using both years lived and years left also helps remind us that populations and individuals are rather different things.

The OADR defines all people above the statutory pension age as ‘dependent’, regardless of their economic, social or medical circumstances. This overlooks the fact that rising RLEs render these elderly ‘younger’, healthier and fitter than their peers in earlier cohorts. Many have accumulated substantial assets, may still be working and many have valuable experience or specialist knowledge. Many do volunteer work vital to the ‘third sector’ or look after grandchildren. We know that most acute medical care costs occur in the final months of life, with little impact from the age at which these months occur [4 10]. At least some forms of disability are being postponed to later ages. Good data on population health by age is only available for the last decade, but RLE data is a robust substitute as it provides a more accurate picture of the extent of aging by taking account of falling old-age mortality. Therefore, following Sanderson and Scherbov and others [4 11-13] we use RLE of 15 years or less as the threshold of dependency, but do so for each sex separately [14].

Counting the ‘working’ population

The OADR assumes that everyone of ‘working age’ actually works. However the knowledge economy keeps youngsters in education for longer while many older workers choose or are obliged to retire early. Meanwhile, greater gender equality, dual career families and migration have added 44 million women workers over the last 50 years (vs. +31 million male workers). Using age to define the working population thus makes little sense. Indeed, if we count those not employed, for whatever reason, as ‘dependent’ we find that there are more ‘dependents’ of ‘working’ age (70 million) than non-working elderly (36 million). We thus use the number employed over all ages for the denominator of what we call the Real Elderly Dependency Ratio (REDR) [14], i.e.:

$$REDR = \frac{\# \text{ men and women in age groups with } RLE \leq 15 \text{ year}}{\# \text{ men and women employed}}$$

Results

If we define the dependent elderly population as those with ages at which RLE is 15 years or less, we find a very different trend than observed for standard measures of aging. For instance, in the 1950s the proportion of those with life expectancies of 15 years or less to live (Prop. RLE15–) was still higher than

those aged 65+ (Prop 65+). Early mortality improvements were concentrated on younger ages, for example through the defeat of child killing infectious diseases, but from the late 1970s improvements to old-age mortality kicked in. These reversed the rise in the proportion of the population with low life expectancies, as Figure 1 shows.

We can now add in the trend in employment, where later entry to employment, and earlier exit from it, has been more than offset by the dramatic rise in *mothers* employment, so that the proportion of the working-age population who are at work is higher now (66%) to what it was in 1960 (60%), although it is down from before the economic crisis (73% in 2000). Putting these two series together we have the Real Elderly Dependency Ratio (REDR). As Figure 2 shows, this has actually fallen by almost one third since 1960, while, the conventional OADR increased. Looking into the future, the OADR will rise while the REDR, much more dependent on the employed population, is set to remain stable until about 2020. Moreover, our projection is a conservative one: we assumed that age-specific labor force participation rates will slowly increase to levels observed before the economic crisis, but did not adjust for the gradual raising of the State Pension Age to 67 by 2027, disincentives to early retirement and further progress on gender equality.

International comparison

The increase in the OADR in recent decades is not unique to the US. On the contrary, due to the younger population and relatively high rates of immigration the OADR is lower than most other western countries (Figure 3). Similarly, the REDR has also declined in other industrialized countries, but whereby the US is in a more favorable position despite the fact that it has stabilized and is likely to increase gradually over the next couple of decades. For instance, in Germany and Italy, the REDR has been almost flat for two decades, owing to slower employment growth and lower birth rates than elsewhere in the developed world. One reason why immigration has played an important role in depressing many countries' REDR is by raising employment rates. Increased labor-force participation among women –who spend a significantly higher share of their lives in employment than they did 50 years ago, when most women withdrew from employment after marriage or childbirth –has also helped to lower REDRs. Of course, failure to support these trends has the opposite effect. Japan – where opposition to immigration and failure to embrace gender equality lead to a rapidly rising REDR –is a case in point. A low female-employment rate also raised India's REDR, albeit less drastically. Russia, too, has seen its REDR increase substantially, owing to post-communist economic dislocation. But the rest of the major emerging economies still enjoy relatively low REDRs.

Time to death

There is still room for improvement in the way population ageing is measured, including with regard to some of the recent alternatives that have been proposed [4 11 13 14], as RLE15- is a *population average* measurement and many persons in the corresponding age group may still live another 20 years while others die within two. Moreover, as the literature also shows, time to death (TTD) is a better indicator for health care expenditure [15]. We therefore propose to use the age obtained by RLE15- (as we are here interested in elderly but without a fixed age), but the population split into TTD. Figure 1 shows that in terms of elderly with acute health needs, measured by a TTD of <5 years, the burden has been stable since 1980 (4 per population of 100), also when dividing by the population who are actually in employment (REDR2 in Figure 2) rather than the total population (Prop RLE15-&TTD<5 in Figure 1). Only after 2020 will the REDR1 and REDR2 start to rise (and the latter indicator still very slowly), while the commonly used OADR has already been rising for close to a decade and especially since 2010.

Concluding remarks

The very different story of population aging told by our measure has several important implications for policy:

1. The OADR is a poor indicator. It gives a false picture of the both the level and trend in population aging because it takes no account of rising life expectancies. We have suggested several alternatives here.
2. It is wrong to assume that population aging itself will strain health and social care systems. Demand for services will rise, but will continue to be driven by other factors, chiefly progress in medical knowledge and technology. Moreover as others have suggested, the economic costs of old age dependency have typically been exaggerated and especially so in the US [16 17]. However this needs to be set against the insight that the last decades have been ones in which the population, far from 'aging' has in fact been getting younger, producing something of a 'demographic dividend'.
3. The relationship between 'old' and 'age' is changing as continued falls in mortality delay the typical onset of senescence and its associated morbidities [10 18 19] Indeed, TTD is a more important marker than age.
4. Urgent attention ought to be paid to the relationship between morbidity and RLE. Age specific disability rates appear to be falling [10 20-22], yet recently born generations have a worse risk factor profile than older generations. For instance, current obesity trends may have a major impact on public health as 'metabolic risk factor'-related diseases such as diabetes. Aging-related diseases like osteoarthritis are predicted to significantly increase and start at a younger age, increasing the risk of cardiovascular and other chronic diseases. It also suggests that the aging process can speed up as well as slow down, with obvious implications for public health policy.

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Fig 1. Proportion aged 65+ (Prop65+), in age groups with Remaining Life Expectancy ≤ 15 years (Prop.RLE15-) and where TTD < 5 years

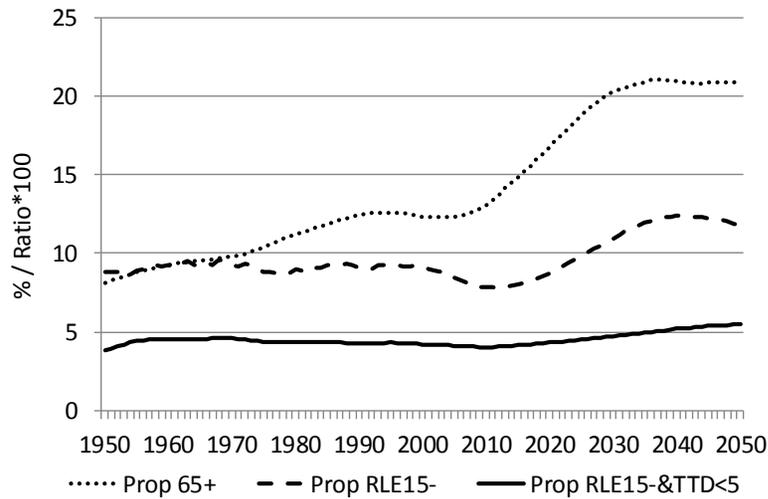


Fig 2. OADR and the Real Elderly Dependency Ratio with elderly in ages with RLE15- (REDR1) and with RLE15- and TTD < 5 years (REDR2).

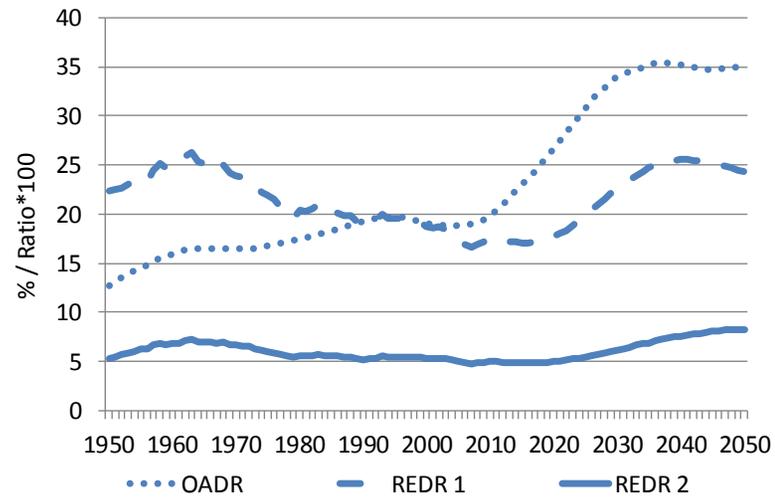
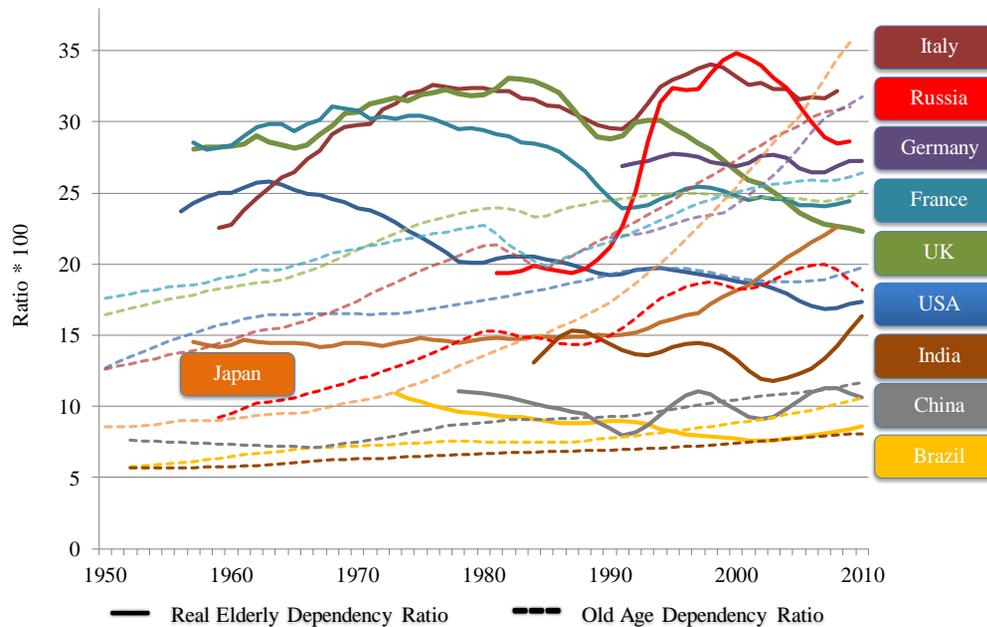


Fig. 3. Real Elderly Dependency Ratio and Old Age Dependency Ratio in select high-income countries and BRIC countries, 1950-2010



Sources: Human Mortality Database (www.mortality.org); www.oecd.org; US Census Bureau (www.census.org); International Labour Organization (www.ilo.org/) and National statistics offices. Authors' calculations.