Adjusting Covid-19 expectations to the age profile of deaths

The impact of Covid-19 is likely to vary with a country's demographics, and this understanding can inform policy choices, writes Neil Monnery

The coronavirus disease (Covid-19) originated in Wuhan, China in late 2019. By early April 2020, this infectious respiratory disease had been identified in over one million people worldwide, with nearly 60,000 attributed deaths, and with an expectation that millions will eventually die from the disease. Coverage of the resultant pandemic has focused on three main measures: the number of people who have tested positive for currently having the virus, the number of deaths, and the case mortality rate (which is the number of deaths as a percentage of those testing positive). For some groups the calculated case mortality rate has been very high, and some commentators have misunderstood that this number is not the same as the percentage risk of death for someone in a group.

These three common measures have some limitations. Very different testing strategies have been adopted around the world producing very different proportions of positive test. Some countries have done widespread testing, producing lower levels of positive results. Others have tested only hospital admissions, showing much higher ratios of positive results. Almost all testing detects whether you actively have covid-19; we await the anti-body tests which will determine if you have had the virus but are no longer actively infected. We know that results are affected by the fact that only a minority of randomly selected people test positive, and that of those who are currently infected 50% show no symptoms, with the majority of the rest having only mild symptoms. Given that different testing strategies produce very different levels of positive tests, the case mortality rate is of limited use in comparisons. In addition, most people are more interested in the overall chances of dying from the disease rather than the chances of dying having tested positive.

The crude measure of the number of deaths is also of limited use, despite graphs showing the number of deaths for many countries being widespread, including in government presentations. Plotting the number of deaths in the US (population 327 million) alongside Singapore (population 6 million) or Korea (population 51 million) has obvious problems. Obviously, epidemiologists adjust for this and it would be helpful for broader public discussion if, at a minimum, we considered, say, deaths per million of population.

There are issues with measuring deaths, including whether deaths occur from or with Covid-19, that deaths are later in the clinical pathway thereby reducing the number of data points, differences in measurement (for example whether it is hospital or all deaths), and most importantly whether the

deaths are excess deaths or deaths some of which would have occurred in any case. Nonetheless, the death rate (and for now the expected death rate) is perhaps the key measure to use to examine alternative strategies. Evaluating those strategies will need to adjust for factors that are fixed and not driven by policy decisions in order to get to a true picture of how policy affected outcomes.

One of the most important factors affecting death rates is the age profile of different populations. Where we have age structure data and the size of the underlying population group, around 80% of deaths to date have been in the 70+ age group, and 92% have been in the 60+ age group. There is no obvious reason to expect that distribution to change as countries suffer more losses. Table 1 shows age data for deaths, using United Nations data for the size of population cohorts. Table 2 shows the same for countries that record different age bands but it shows a similar pattern. [*Data as of 31 March 2020 for France, 31 March for Belgium, 2 April for England.*]

Table 1. Deaths and underlying populations (ten-year age groups)

	AGE	0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80+	TOTAL	
DIAMOND PRINCESS	Deaths	0	0	0	0	0	0	1	7	4	**12**	a
	Population	16	23	347	428	334	398	923	1015	216	**3700**	
	Deaths per million pop	0	0	0	0	0	0	1083	6897	18519	**3243**	
SOUTH KOREA	Deaths	0	0	0	1	1	10	21	45	80	**158**	a
	Population (000)	4154	4753	6716	7080	8219	8477	6454	3561	1856	**51270**	
	Deaths per million pop	0	0	0	0	0	1	3	13	43	**3**	
ITALY	Deaths	0	0	2	20	89	369	1162	3456	4923	**10021**	b
	Population (000)	4995	5733	6103	6998	9022	9567	7485	6029	4529	**60461**	
	Deaths per million pop	0	0	0	3	10	39	155	573	1087	**166**	
SPAIN	Deaths	1	1	6	13	43	99	295	914	1965	**3337**	b
	Population (000)	4234	4736	4618	5902	7938	7046	5341	4015	2924	**46755**	
	Deaths per million pop	0	0	1	2	5	14	55	228	672	**71**	
GERMANY	Deaths						48	72	200	550	**870**	c
	Population (000)	7881	7931	9377	10872	10243	13488	10644	7471	5876	**83784**	
	Deaths per million pop						4	7	27	94	**10**	
CHINA	Deaths	0	1	7	18	38	130	309	312	208	**1023**	d
	Population (000)	222	596	1264	1852	1802	1908	1544	1389	1423	**12000**	
	Deaths per million pop	0	2	6	10	21	68	200	225	146	**85**	
NETHERLANDS	Deaths	0	0	0	1	5	29	151	512	953	**1651**	e
	Population (000)	1753	1954	2097	2098	2151	2524	2130	1592	837	**17135**	
	Deaths per million pop	0	0	0	0	2	11	71	322	1139	**96**	
NEW YORK	Deaths	0	2	22	76	158	377	663	942	1323	**3563**	e
	Population (000)	2770	2578	2791	2533	2819	2656	1839	1062	783	**19831**	
	Deaths per million pop	0	1	8	30	56	142	361	887	1690	**180**	
TOTAL	**Deaths**	**1**	**4**	**37**	**129**	**334**	**1062**	**2674**	**6388**	**10006**	**20635**	
	Population (000)	**26025**	**28303**	**33313**	**37763**	**42529**	**46065**	**36359**	**26134**	**18443**	**294936**	
	Deaths per million pop	**0**	**0**	**1**	**3**	**8**	**23**	**74**	**244**	**543**	**70**	

a As at 30 March 2020
b As of 31 March
c As of 2 April. No breakdown in <60 years old
d Assumed 12 million population for Wuhan, with average China age profile
e As of 4 April

Source: Japan CDC, Wikipedia, Korea CDC (KCDC), www.epicentro.iss.it, www.mscbs.gob.es, China CDC, Riou J. et al 'Adjusted age-specific fatality ratio during the Covid-19 epidemic in Hubei' (www.medrxiv.org), Robert Koch Institute, Rijksinstitut voor Volksgezondheid en Milieu, CDC (US), NY State, UN Population Estimate

Table 2. Deaths and underlying populations (noted age groups)

	ENGLAND				BELGIUM			FRANCE		
	Deaths	Population (000)	Deaths per million pop		Deaths	Population (000)	Deaths per million pop	Deaths	Population (000)	Deaths per million pop
80+	533	2439	219	75+	534	1042	512	1444	6231	232
60-79	261	9394	28	65-74	119	1190	100	320	7315	44
40-59	271	14161	19	45-64	45	3102	15	151	16991	9
20-39	66	14304	5	18-44	5	3642	1	16	19325	1
0-19	1	6290	0	0-17	1	2615	0	0	15411	0

Source: Epistat, www.rtbf.be, Sante public France, NHS England, PHE, United Nations

Given that we are in the midst of the pandemic, it is too early to draw final conclusions (although Diamond Princess, China and South Korea deaths may have plateaued) but we can see the very strong role played by age structures. And we can see the relative death rates for, say, those in their 60s versus 80s. With the odd exception of China, death rates for those aged 80+ are around three times those in their 70s. We can also see some boundary conditions emerging with Diamond Princess representing the worst outcome to date and Korea the best. One adjusted measure would be the risk of a person in their 70s dying. The deaths per million of population for this group vary from 13/million in South Korea to 573/million in Italy (as of end March), and at the extreme 6897/million on the Diamond Princess cruise ship.

Gender also plays a role. For these groups, where we have the data, 11,857 males and 8,276 females died (59% vs 41%). The drivers of gender differences will need further explanation. However, in cross country comparisons it is unlikely that gender mix is a key driver of different outcomes because the gender mix is broadly stable across countries (see Table 3).

Table 3: Gender ratios for >70 year-olds (various countries)

millions	Males > 70 years old	Females > 70 years old	% of > 70 y.o. who are male
USA	16.2	21.0	44%
UK	4.2	5.1	45%
France	4.1	5.7	42%
Italy	4.5	6.1	42%
Spain	2.9	4.0	42%
Japan	11.6	15.7	42%
Korea	2.2	3.2	41%

Source: United Nations World Population Prospects (2019)

We also know that we will need to adjust for comorbidity which will require data that identifies the causal link between the comorbidities and Covid-19. For example, in the US the proportion of adults with diabetes is very age dependent: 3% of 18-44 year olds, 14% 45-64, 23% 65-74, 21% 75+. Given the age profile we have seen it is no surprise that many of those dying of Covid-19 also have other age-related diseases. But there is limited analysis to date on how much these comorbidities increase risk in a population group. Other factors, which also have had very partial data availability, such as smoking, will also need to be examined as structural factors established prior to policy choices made.

When we come to evaluate the success of different policies we will have to adjust for other structural factors including intergenerational mixing, etiquette and social tactileness (kissing vs bowing), contacts per day, workplace characteristics, local transportation methods (crowded undergrounds

versus personal cars). With a good measure, and a clear normalisation for structural factors, alternative policies for social distancing, quarantines, testing, travel limitations, hospital capacity etc can be properly assessed.

If the age profile holds broadly constant as the pandemic spreads, then it will differentially affect the challenge faced by countries. There are approximately 460 million people in the world over 70 years old. Of these, 341 million (70%) live in 20 countries: a mix of populous and richer countries. Table 4 shows these countries, indicating where Covid-19 might have the most extensive impact. Italy and Japan lead the list with the highest percentage of older people. China, India and the United States have the largest absolute older populations. If there is any good news at all, it is perhaps that, in general, poorer countries will have less of a pandemic shock than larger/richer ones.

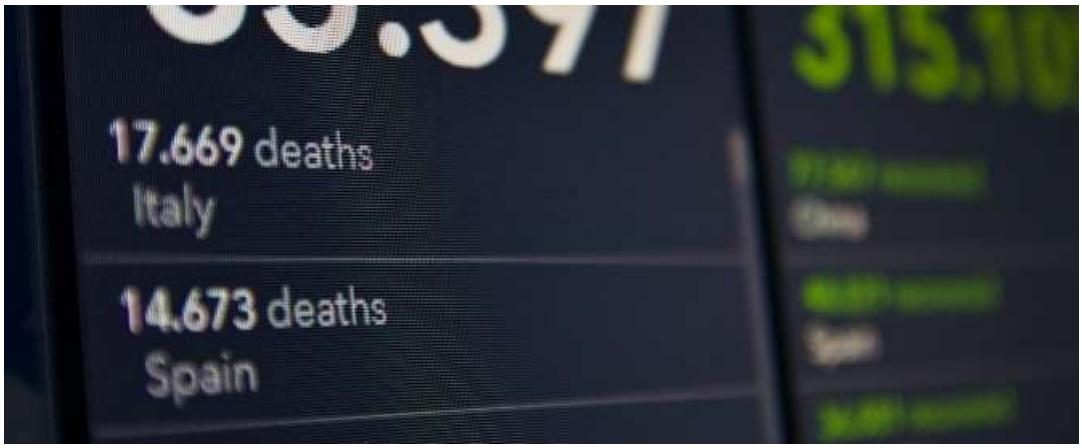
Table 4. Number of >70 year-olds and percentage of population

	People >70 years old (millions)	% Population > 70 years old
China	98.1	7%
India	52.5	4%
United States of America	37.2	11%
Japan	27.5	22%
Russian Federation	14.2	10%
Germany	13.3	16%
Brazil	13.0	6%
Italy	10.6	17%
Indonesia	10.0	4%
France	9.8	15%
United Kingdom	9.3	14%
Spain	6.9	15%
Mexico	6.2	5%
Pakistan	6.0	3%
Bangladesh	5.8	4%
Thailand	5.8	4%
Republic of Korea	5.4	11%
Turkey	4.8	6%
Ukraine	4.8	11%

Source: United Nations World Population Prospects (2019)

The age profile of Covid-19 deaths is very pronounced, making it important that demographics is included in evaluating disease progression and assessing policy responses. Without an understanding of these, and other, structural factors, cross-country comparison is of limited value. The impact of Covid-19 is likely to vary with country's demographics, and this understanding can help policy choices such as required capacity levels. When the time comes to conduct cost-benefit analyses of the policy choices made, the age profile will have a profound effect on the evaluation of years of life saved. On a more immediate point, careful consideration is necessary as to what measures are most useful for the very broad communication beyond experts that has become common during this pandemic. The risk of unrepresentative measures is that there is confusion amongst the wide range of people whose behaviour is important as part of the solution to this pandemic.

Also by Neil Monnery:



How we count the number of Covid-19 deaths matters

The number of Covid-19 deaths by country is widely used by governments and the media as a vital measure of the pandemic. A typical example is the slide below used for many weeks at the daily UK government briefings. Figure 1. Global death comparison (UK government's cabinet office briefing rooms chart) Notes: Countries are aligned by stage of the outbreak. Day … Continue reading

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Neil Monnery studied at Exeter College, Oxford, and at the Harvard Business School. Between 1983 and 2004, he worked at The Boston Consulting Group as a director and senior vice president. He was group strategy director of WH Smith between 2004 and 2014 and chairman of Smiths News. He is a director at Ashridge Strategic Management Centre and author of *Safe As Houses? A Historical Analysis of Property Prices* (2011) and *Architect of Prosperity: Sir John Cowperthwaite and the Making of Hong Kong* (2017).

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