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ORIGINAL ARTICLE

Age discrimination, the right to life, and COVID-19 vaccination in countries with limited resources

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Abstract

This paper seeks to develop and apply a simple yardstick based on remaining life expectancy to assess whether specific health policies unfairly discriminate against people on the basis of their age. This reveals that the COVID-19 vaccine prioritization policies of several countries have discriminated against older people. Conversely, the exclusion of older people from COVID-19 vaccine testing is shown to be non-discriminatory, as is some degree of age prioritization for limited acute COVID-19 care. Age discrimination in vaccine prioritization is shown to be embedded in wider ageist attitudes in health policy, which give the lives of older people a lower social value than the lives of people at younger ages.

INTRODUCTION

On February 6, 2021, the Director General of WHO stated: "There is a disturbing narrative in some countries that it's OK if older people die. It's not OK… It is important that everywhere older people are prioritized for vaccination. Those most at risk of severe disease and death from COVID-19, including health workers and older people, must come first. And they must come first everywhere." (Ghebreyesus, 2021).

Why was such a statement considered necessary? As national vaccination programmes started to gear up, it became clear that not all countries were giving older people a high priority. For example, in Bulgaria, people aged 65 and over were given a lower status than several other large groups, including teachers and many categories of civil servants (Kassova, 2021b). Also, in late

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April 2021, it was claimed that most people aged over 80 were being denied hospital admission in order to prioritize treatment for younger people (Kassova, 2021a).

This paper explores the ethical nature of these policy decisions, and whether or not they represent substantive discrimination against older people. We set out a simple criterion for establishing an operationalizable yardstick of fairness. We briefly assess the usefulness of this yardstick with reference to a range of global health issues. We then interrogate COVID-19 vaccination policies in greater detail, with a particular focus on a set of countries whose health care resources are more limited than in high-income country settings: Brazil, Bulgaria, India, and South Africa.

ESTABLISHING A YARDSTICK OF AGEISM IN HEALTH POLICY: THE RIGHT TO LIFE VERSUS THE RIGHT TO HEALTH

The World Health Organisation's conceptualization of ageism, distinguishes between stereotyping, prejudice and discrimination (WHO, 2021a). Ageism is relevant to all age groups, including younger people, and intersects with other forms of prejudice, such as racism and sexism. This paper focuses on health policy discrimination against older people, reflecting the specific vulnerabilities of this age group to COVID-19. The paper also interrogates explanations or justifications provided by policy-makers, establishing links between discrimination, stereotyping and prejudicial attitudes.

It would seem logical that the right to health would be the most appropriate yardstick for assessing fairness in health policy, be it with reference to older people or a different dimension. Good health for all is recognized as a universal human right (United Nations High Commissioner for Human Rights and World Health Organisation, 2008) and one of the Sustainable Development Goals (SDGs). Specifically, it refers to "the right to the highest attainable standard of physical and mental health"[1]. This, however, raises the difficult issues of what "the highest attainable state of health" actually is, and what conditions any threshold should be bounded by. Individual age, societal wealth, and other factors may apply, and all have complex effects on what we could consider to be reasonably attainable. This vagueness reduces the usefulness of the right to health as a workable basis for assessing potential discrimination against specific groups, especially people at very old ages.

Although good health refers to a much more comprehensive and complex set of attributes than mere survival, the right to life is a relatively simple and operationalizable starting point for identifying discrimination. Moreover, the right to life is the most fundamental human right and Article 3 of the United Nations Universal Declaration of Human Rights (United Nations, 1948). Since life is not potentially infinite, a meaningful application of the right to life has to recognize limits to reasonable expectations of life expectancy and survival for people at given ages. Also, in allocating finite resources, there will be a forced trade-off between one person's right to life and another's. This trade-off has been apparent in rationing access to acute COVID-19 treatment on the basis of age, in a context of resource scarcity and a need for brutal pragmatism. All things being equal, people at older ages are less likely to respond positively to treatment and, therefore, a degree of age rationing may have maximized the total number of lives saved. Nevertheless, some practices may have gone beyond what is ethically acceptable: a study in India found the median age of people admitted to a tertiary level hospital for COVID-19 was just 33.5 years (Suri et al., 2021).

[1] Health is defined very holistically by the World Health Organisation as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (ibid).

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A further challenge in operationalizing the right to life is whether all years of life being lived should have an equal value, regardless of age. Since the 1990s, the disability adjusted life years (DALY) has been the primary metric used by the World Health Organisation, the World Bank, and national health agencies to allocate a metric to human health. Until it was reformed in 2010, the DALY gave a lower value to every year a person lived beyond age 69 compared to ones lived as a younger adult. The co-developer of the DALY justified this on the grounds that: "… the elderly, depend on the rest of society for physical, emotional and financial support. Given different roles and changing levels of dependency with age, it may be appropriate to consider valuing the time lived at a particular age unequally" (Murray, 1994, p.434). The empirical and ethical bases for this justification are both unsubstantiated: instead, it reflects a general set of ageist attitudes permeating global health policymaking (Lloyd-Sherlock et al., 2016).

A more challenging issue is whether a year of life lived with a high degree of suffering should be seen to have the same value as a year lived with a good quality of life. This is often a critical ethical consideration in decision-making at the clinical level (Back et al., 2003). Similarly, a senior scientific adviser on the UK government COVID-19 policy observed: "many frail old people might see COVID-19 infection as a relatively peaceful end compared with, say, several years of dementia or some cancers." However, it should not be assumed that the subjective quality of life experienced by, say, a frail older person with limited function is inherently worse than that experienced by a fully fit and healthy person (Efklides et al., 2003). As such, in this paper we place an equal value to all years of life lived, regardless of age or any other individual circumstances.

Years of life lost (YLLs) are a different metric to DALYs. They are calculated as the sum of each death observed at each specific age for a given cause in a certain year multiplied by years lost for deaths at a given age and sex (Martinez et al., 2019). Years of life lost are sometimes derived from global life tables that predict average life expectancy at birth (currently 86 for both women and men) (WHO, 2013). More sophisticated studies derive YLLs from national age-specific life expectancy data (Pifarré et al., 2021). For example, in Mexico, in 2020 average remaining life expectancy was 21.25 years for a person aged 60 and 8.82 years at the age of 80 (World Data Atlas, 2021). Accordingly, the death of a Mexican aged 80 would be given a value of 41.5% of that for a Mexican aged 60. YLLs have been applied to gauge the impact of common health conditions, such as cardiovascular disease, across different age groups and countries (Martinez et al., 2020). A key strength of using YLLs is that all lives saved have some value, regardless of an individual's age, since even a person aged 100 has some potential remaining life expectancy. This contrasts with one of the main global health targets. Sustainable Development Goal 3.4 is to reduce premature mortality from non-communicable diseases by a third between 2016 and 2030. "Premature mortality" is defined by WHO as deaths occurring between the ages of 15 and 70 (WHO, 2021b). Averting the death of a person aged 70 or more makes no contribution towards meeting this target, and therefore SDG 3.4 incentivises resource allocation away from older people (Lloyd-Sherlock et al., 2016). The adoption of this explicitly ageist United Nations target demonstrates the extent to which ageism has permeated global health agendas. WHO's justification for this is that: "Premature deaths from NCDs result in loss of productivity and have an impact on the economy" (WHO, 2021b), the implication being that people aged 70 and over are unproductive and hence have no value[2].

[2] This approach is clearly at odds with the WHO's own report on ageism (WHO, 2021a), which reveals the need for more consistency across different parts of this organisation and a need to mainstream awareness of ageism beyond groups whose primary focus is on older people.

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At the start of the COVID-19 pandemic, older people living in low and middle-income countries were identified as a key risk group. As well as a tragedy, the huge wave of mortality, mainly at older ages, was seen as an opportunity to challenge deeply entrenched ageism in health policy (Lloyd-Sherlock et al., 2020). The following sections assess how much changed, with particular reference to COVID-10 vaccination policies.

THE EXCLUSION OF OLDER PEOPLE FROM COVID-19 VACCINATION TRIALS

Several early trials for COVID-19 vaccines included only minimal numbers of people at older ages or none at all. For example, Sinovac trials in China were only conducted on adults aged under 60 (Zhang et al., 2021). No initial COVID-19 vaccination trials included people with pre-existing health conditions, which further reduced their validity for many older people. This led to a seemingly absurd outcome that vaccines were not trialed on the very people who needed them most.

At first sight, this would appear to be a self-evident example of age discrimination, with harmful consequences for older people. Some national governments, such as Indonesia's, initially opted against including older people in its roll-out of the Sinovac vaccine due to a lack of data on the safety or efficacy of vaccines for people at these ages (Lloyd-Sherlock et al., 2021a; Lloyd-Sherlock et al., 2021b). In the case of the Oxford AstraZeneca vaccine, the small numbers of older people included in early trials initially prompted several European countries to ban its use for people aged over 55 (Boytchev, 2021).

Nevertheless, there may be grounds to justify the limited involvement of older people in these trials, on the basis of maximizing YLLs. Including people at very old ages or with other health conditions would have added considerable complexity to the trial process (Carroll & Zajicek, 2011; Getz et al., 2015). Consequently, had these people been fully represented in early trials, the approval of vaccines would almost certainly have been substantially delayed. These delays would have led to many additional deaths of people of all ages, especially among older people. The least-worst option was therefore judged to be proceeding with vaccination of groups at high-risk of COVID-19 mortality, despite an element of risk (Andrew & McElhaney, 2020). At the time these decisions were made, it was not possible to assess the number of deaths of older adults this might cause. This concern rapidly disappeared, as data on the safety and efficacy of different vaccines were compiled from the real-world application of vaccines. (Lopez Bernal et al., 2021).

It can therefore be argued that the limited inclusion of older people in drug trials was not intrinsically unjust, according to our YLLs yardstick. That does not mean that these decisions were not influenced by ageist mindsets which have been identified by other studies (Kanik et al., 2022). For example, in justifying excluding older people, Indonesia's Sinovac clinical trial leader, said, "Why do we target people of a productive age? Because these people can work hard, so the country will not have a deficit" (BBC News Indonesia, 2020).

It must be stressed that the case of COVID-19 vaccination development has been highly exceptional, given the urgent need to protect many millions of lives at risk. Similar arguments do not necessarily apply to the exclusion of older people from trials and evaluations of other drugs and procedures, which do not conform to the "race against time" pandemic scenario. Excluding older people from trials is a widespread problem, affecting many conditions for which treatments have been developed over many decades. For example, there is evidence that the involvement of older people in trials for conditions such as influenza vaccines and cancer treatments is often minimal

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(Osterholm et al., 2012; Sedrak et al., 2020; Shenoy & Harugeri, 2015). Applying a YLL yardstick to these cases may well reveal ageist practices.

AGE PRIORITISATION IN COVID-19 VACCINATION

Globally, there are some broad similarities in national approaches to vaccine prioritization. Most countries have established a hierarchy of priority categories, whereby vaccination of a higher priority group should be completed before moving on to a lower priority one. Almost all countries have placed health workers who are at particular risk of COVID-19 infection as part of their professional role in the highest category. Most countries included people at older ages as a second priority group. This is also true of Indonesia, once vaccines whose trials included older people became available. However, there have also been substantial variations within this approach.

Table 1 summarizes priority groups and how they related to vaccination roll-out for selected countries[3]. In all the cases presented, older people receive a relatively high priority status. Brazil takes a disaggregated approach, starting with people aged 90 and over and then progressively extending coverage to younger 5-year age groups. The other three countries place all older people in a single category. Brazil's population aged 60 or more is 30 million, of whom 1.8 million are aged 85 or more. Had the country applied a 60+ category, only one in 17 vaccinations for that category would have been provided to people aged 85 or more, considerably slowing the extension of protection to this highly vulnerable group.

In Brazil, people aged 60 or more shared their priority status with other groups, such as indigenous people and people with disabilities living in long-term care facilities. However, these other groups are relatively small, accounting for less than 1.5 million people. In the other three countries, older people shared their priority status with a wider set of groups who account for a much higher share of their populations. For example, South Africa established a single category for all people aged 60 or more, as well as all people aged 18 or more living with HIV, tuberculosis, diabetics, chronic lung disease, cardiovascular disease, renal disease, or obesity. Together these accounted for around 13 million people, of whom only 420,000 were aged 80 or more (Department of Health of South Africa, 2021a).

All four countries in Table 1 included specific occupational categories in their COVID-19 vaccination prioritization. In some cases, these groups are given the same priority as older people, and, in the cases of "front-line workers" in India and mink farm workers in Bulgaria, a higher one. The precise definitions of some of these categories lack specificity, especially for those referred to variously as "front-line", "key" or "essential workers." Again, it can be seen that Brazil applied more specific occupational categories and placed these below older people.

In the context of limited supplies of COVID-19 vaccines and limited capacity to administer them to large populations, large gaps between theoretical entitlements in Table 1 and actual coverage are to be expected. The clearest example of this was Bulgaria, which in the face of limited uptake in the initial phase of roll-out, removed all prioritization criteria. As a result, it was reported that older people were required to compete with people of all ages in lengthy vaccine queues (France 24, 2021).

[3] The selection of case study countries was mainly opportunistic, reflecting availability of comparable data.

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TABLE 1 COVID-19 vaccine priority groups, selected countries

Brazil	Bulgaria	India	South Africa
February 2021: People 60+ or with disabilities in long-term care facilities. **Cascading priorities**: Indigenous people; health workers; people aged 90+; people aged 85–89 (followed by next oldest 5-year age groups down to 60–64); people 18–59 with comorbidities; people with disabilities; education workers; security forces; transport workers; other key workers.	**January 2021**: Medical personnel, pharmacists and dentists; staff and customers of social institutions, pedagogical specialists, people working on mink farms; people who are in charge of guaranteeing that activities essential for public life are able to take place **February 2021**: People 65+; people 18+ with comorbidities. **Mid-February 2021**: All citizens.	**January 2021**: Health professionals; "frontline workers." **March 2021**: People 60+; people 45+ with comorbidities. **April 2021**: All people 45+. **May 2021**: All people 18+ (those 18–44 paid until June 21st).	**February 2021**: "Front line health care workers". **May 2021**: People 60+; "essential workers"; people in congregate settings; people 18+ with co-morbidities. **August 2021**: All people 18+.

Note: The data of Brazil was retrieved from NOTA TÉCNICA No 155/2021-CGPNI/DEIDT/SVS/MS by Ministry of Health of Brazil (2021). The data of South Africa was retrieved from COVID-19 Vaccine Rollout Strategy by the National Institute for Communicable Diseases Of South Africa (2022). Data from India was retrieved from Pandemic lessons from India: inappropriate prioritization for vaccination by Lloyd-Sherlock et al. (2021). Data from Bulgaria was retrieved from Bulgaria scraps vaccine priority lists after low take-up by France 24 (2021).

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JUSTIFICATIONS FOR VACCINE PRIORITISATION POLICIES

There are clear and robust justifications for the high priority given to front-line health workers. These groups are more exposed to infection in their work environments. Failing to vaccinate them may undermine health care systems, due to staff absenteeism through illness or fear of infection (Tujjar & Simonelli, 2020). As well as reducing YLLs by providing services related to COVID-19(not least administering vaccines), sustaining health services saves YLLs resulting from other causes. Indeed, there is a strong argument that the high priority given to health workers should have been widely extended to people engaged in providing social care to older people on either a paid or unpaid basis (Dunn et al., 2021).

The different approaches taken to prioritizing people at older ages have less coherent justifications. In the early months of 2021, as discussed above, some countries justified the exclusion of older people from vaccination on the grounds of insufficient specific data on drug safety and efficacy for these age groups. This rationale quickly lost validity as substantial data was generated for other countries which did apply these vaccines to older people.

In those countries that established broader categories of older people, no specific justifications were given for eschewing a disaggregated approach, and the issue does not appear to have been recognized as important. Implicitly, however, some arguments were deployed to challenge the need to focus on those at the very oldest ages. For example, it has been claimed that the very old are less exposed to infection than younger adults, on the purported grounds that they have fewer social contacts related to work environments and other social settings (Jentsch et al., 2021; Persad et al., 2020; Russel & Greenwood, 2020). The validity of these claims in high-income countries is open to question, since the oldest old make considerable use of health and social care, which increases their risk of both becoming infected and spreading infection. Also, older people are immunologically more susceptible to infection than people at younger ages and less likely to experience asymptomatic COVID-19, which is less infectious to others (Davies et al., 2020). Additionally, in LMIC settings, many older people are obliged to remain in work due to limited pension coverage and inhabit crowded multi-generational housing (Lloyd-Sherlock et al., 2020).

A broader set of arguments and justifications for prioritization relate to a perceived trade-off between preventing deaths and limiting the wider economic and social harms caused by the pandemic (Yang et al., 2021). This dilemma has been identified as relevant to vaccination policies for a range of health conditions and is particularly acute in the case of COVID-19 (Hardt et al., 2016). It is evident in the World Health Organisation's global guidance for COVID-19 vaccine prioritization, which states:

> The overarching goals of protecting individuals and public health, while recognizing the need to minimize impact on societies and economies, should drive the allocation process of health products across different countries (WHO, 2020).

Academics involved in the development of this WHO guidance advised there should be an initial phase in vaccine roll-out exclusively guided by potential YLLs saved, followed at some unspecified point by a different set of criteria based on social and economic issues (Herzog et al., 2021). This approach is broadly compatible with Brazil's prioritization strategy, but less clearly with the other countries in Table 1, where categories are broad and sometimes have the same status as older people.

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Relatedly, it is assumed that older people do not perform essential or even valuable roles. This is evident in a recent World Bank study that warns:

> The pandemic has killed large numbers of people who are of working age, many of whom were their families' breadwinners (Demombynes et al., 2021a, p14).

This links to productivity and human capital arguments used to justify ageism more generally in public health, as discussed above. On April 12, 2021, with reference to the Philippines' COVID-19 vaccination programme, President Duterte, stated:

> Let's prioritize those who, once they get a vaccine, there's a chance that he would live and live productively. Most of the senior citizens are no longer that productive.' As it happens, the large majority of the ten million adults aged 60 or more in the Philippines do not have a pension. Consequently, many have no alternative to remaining productive for as long as they possibly can (AFP - Agence France Presse, 2021).

Similarly, it is sometimes claimed that few older people have a care-giving role (Persad et al., 2020). Yet a high share of family social care, especially caring for older spouses, is provided by older people (Carers UK & Age UK, 2015). As such, any perceived trade-off between socio-economic and epidemiological priorities has sometimes been misleadingly equated to one between older people and younger adults.

All of the above considerations and justifications play out within highly charged political arenas. Recognizing this, the OECD recommends that:

> In stratifying populations governments must ensure they manage public expectations and explain not only why it is fair but also why prioritizing specific population groups is both efficient and essential to bringing the acute phase of the pandemic under control (Organisation for Economic Co-operation and Development, 2021).

In countries such as Bulgaria, India, and South Africa, the political strategy has, instead, been one of minimizing stratification by applying broad inclusion criteria. This may have reflected limited public support for a more targeted approach prioritizing the oldest and most vulnerable. For example, a survey of public health stakeholders in South Korea found the dominant opinion was that maintaining the healthcare system and critical infrastructure should take priority over saving lives (Choi et al., 2021). Limited public support for a focus on the oldest ages has also reflected a general perception that these people have little remaining life expectancy and a poor quality of life (Vos et al., 2018).

CONSEQUENCES OF COVID-19 VACCINATION PRIORITISATION

It should not be assumed that the official priorities and related entitlements described in the previous section will directly match actual patterns of coverage across different groups. Depending on how vaccines are provided in practice, some groups may have more difficulty than others in mobilizing their entitlements. For example, older people have limited personal mobility to reach vaccination centers and are less likely to have access to or be familiar with digital technology, which has been central to the logistics of vaccination roll-out in most countries. Without specific

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strategies to overcome these barriers, gaps between entitlements and realities will be especially large for them, especially in rural areas (Konovalov, 2021).

Data on COVID-19 vaccination cover for specific age groups are not publicly available for many countries, preventing systematic comparisons. This is part of a wider lack of disaggregated data on COVID-19 cases and mortality for older people (Lloyd-Sherlock et al., 2020). With reference to the countries included in Table 1, there are large variations in overall levels of coverage and also in the ratio of coverage between older people and younger adults. In Brazil, two doses had been provided to 86.0% of people aged 70 or more, compared to 20.8% for people aged between 60 and 64 and lower levels for younger ages (Vidale, 2021). In South Africa, the difference between older and younger ages has been much smaller: by October 31, 2021 54.7% of people aged 60 or more had fully been vaccinated, compared to 48.8% for people aged 50–59(Department of Health of South Africa, 2021b). The same applies in India, where, by 27 h October 2021, 47% of people aged 60 or more had been fully vaccinated, compared to 28% of those aged 18 to 59 (Ministry of Health and Family Welfare of India, 2021). In Bulgaria, people at the oldest ages were less likely to be vaccinated than other age groups. By October 26, 2021, 21.0% of people aged 80 or more had been fully vaccinated, compared to 31% of people aged between 60 and 69 and 19.7% of those aged 25 to 49 (Our World in Data, 2022).

Data disaggregating coverage within older populations are largely absent, preventing analysis of these intersectional effects. Nevertheless, there are indications that coverage at all ages is strongly associated with advantaged status. In India, for example, coverage is generally lower among poorer, rural residents than urban ones. This reflects the logistical challenges of reaching more dispersed populations, as well as the frequent need to pay for vaccines. There is consistent evidence across countries that coverage is lower for men than for women of all ages, despite strong associations between male sex and COVID-19 case fatality (Dehingia & Raj, 2021). In Brazil, it has been claimed that vaccination has discriminated against afro-descendent groups (Coalizão Negra por Direitos, 2021).

For high-income countries, there is overwhelming evidence that the risk of dying from COVID-19 if infected (the case fatality rate, CFR) is vastly higher for people at very old ages than for any other population group. For example, data from Italy show a CFR of 34.6% for people aged 80 and over, compared to 0.9% for people aged 40 to 49 (Signorelli & Odone, 2020). Limited access to COVID-19 testing, especially in poorer countries, prevents robust data on age-specific infection rates and hence on CFR (Lloyd-Sherlock et al., 2020). Although it is likely that there will be some variation in the strength of this association due to other mediating effects, the available evidence indicates that it is broadly consistent (Laxminarayan et al., 2020). Whether variations in CFR translate into variations in numbers of deaths at different ages will be affected by any age differences in rates of infection. As discussed above, claims that older people have lower infection risk have sometimes been used to justify a lower vaccine priority. However, in the absence of robust data on infection rates by age in different settings, it should be assumed there is no differential.

There is emerging evidence from high-income countries that COVID-19 vaccination has averted large numbers of deaths. For example, it has been estimated that around 140,000 deaths were averted in the USA by early May 2021, the great majority of older people (Gupta et al., 2021). Assuming that associations between age and both risk of infection and CFR in other countries are broadly similar, different approaches to vaccine prioritization are likely to produce large differences in overall COVID-19 mortality. Estimating the size of these effects is complicated, since it requires comparisons between actual data and counterfactuals, based on various assumptions. Also, age disaggregated COVID-19 mortality data are not available for some countries and have

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TABLE 2 Average life expectancy at ages 40, 60, and 80, selected countries 2019

	Life expectancy age 40 (years)	Life expectancy age 60 (years)	Life expectancy age 80 (years)
Brazil	39.0	21.9	9.4
Bulgaria	36.5	19.8	6.8
India	34.4	18.2	6.8
South Africa	30.3	19.1	5.5

Note: Data on Population was retrieved from The Global Health Observatory. Life expectancy at age 60 by WHO (2022) and World population prospects 2019 by UN DESA (2019).

been shown to be unreliable for others (Demombynes et al., 2021a). In the case of Brazil, where mortality data are relatively robust, it has been possible to compare deaths attributed to COVID-19 deaths for different age groups over time. This estimates that, had levels of mortality for people aged 60 or more remained unchanged before and after the vaccination campaign, an estimated 43,802 additional COVID-related deaths would have occurred over a 3-month period.

How total deaths averted by different vaccination strategies translates into YLLs averted largely depends on the age distribution of these deaths and the expected years of remaining life expectancy at these ages. Table 2 presents this data for people aged 40, 60, and 80 for the four case study countries. A number of additional factors must also be considered, including the reproduction rate[4], the speed of vaccination roll-out and the effect of vaccination coverage on case fatality at different ages. The only published study that attempts this analysis finds that vaccinating the oldest old against COVID-19 in the USA maximizes both overall deaths prevented and YLLs prevented (Goldstein et al., 2021).

In sum, the YLL effects of different national COVID-19 vaccination age prioritization strategies depend on a number of factors. The most important of these are the extent to which policy priorities are reflected in actual patterns of coverage, age-specific case fatality, and remaining years of life expectancy at different ages. Available data do not permit robust measurements of these effects. However, the considerable association between case fatality and very old age, coupled with non-negligible remaining life expectancy at these ages, means that failing to prioritize these age groups will have led to many more YLLs. Consequently, with the exception of front-line health workers, failing to vaccinate people in reverse age order represents an egregious form of age discrimination, according to our YLL yardstick.

CONCLUDING COMMENTS

This paper applies a relatively simple approach to establish whether specific health policies can be considered as discriminating against older people. Few other studies take a comparable approach to combining epidemiological metrics and ethical frameworks to assess fairness in health policy (Ebrahim et al., 2020). Somewhat counter-intuitively, the paper suggests that the exclusion of older people from early COVID-19 trials was not discriminatory, based on what policy-makers knew at the time. This is because the additional length of time needed to complete trials and provide vax to older people and others would have generated more YLLs than a more expedited

[4] Commonly known as the R rate, this is the average number of people one person with an infectious disease is likely to infect.

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trial process. We also suggest that a limited degree of age-based rationing of acute COVID-19 care may have been justifiable in some circumstances, although the practice of some hospitals appears to have exceeded these limits. We show that giving a relatively low priority to people at the oldest ages in COVID-19 vaccination programmes has been highly discriminatory. This is far from an abstract issue, given the large differences between the four case study countries. Brazil's high prioritization of older people and relative success in putting this into practice shows what the other case study countries might have been able to achieve. All the case study countries have had access to sufficient vaccine to cover their older population and other key risk groups (Lloyd-Sherlock, 2021).

YLLs have a number of important limitations as a metric of fairness, since they only take mortality and expected life expectancy into account, ignoring other key elements of health and quality of life. Some studies argue that YLLs intrinsically discriminate against people at younger ages, on a number of grounds. These include an argument that, although quality of life is not entirely determined by age, there is a broad relationship between the two and that this should be included in measures of fairness. Also, the "fair innings" argument, postulates giving all life years the same value may unfairly deny younger people the opportunity to live through different stages of life (Harris, 1985).

Conversely, some geriatricians argue that YLLs are unfair on people at older ages on the grounds that relationships between chronological age and potential remaining life expectancy are very elastic, even at very old ages (Farrell et al., 2020a, 2020b). They argue for individualized assessments of potential life expectancy based on personal health status. However, such an approach is not feasible for decision-making in vaccine prioritization in terms of its operational complexity. Also, applying this individually-tailored approach would discriminate against less-advantaged social groups, since personal health status and potential life expectancy are socially determined. For example, in countries like South Africa, life expectancy at age 60 is lower for blacks than for whites (Lloyd-Sherlock, 2018).

As well as ignoring variations in life expectancy across people at the same age, our YLL approach overlooks variations in the risk of infection and case fatality. There is evidence from many countries that less advantaged social groups face higher exposure to infection and enjoy less access to effective COVID-19 treatment (Marmot & Allen, 2020).

Additionally, age-specific case fatality for men is significantly higher than it is for women. Whether prioritizing vaccination for less advantaged groups, or for men, would save more or fewer overall YLLs would be balance between their relative risk of dying and their age-specific life expectancy (which tends to be lower for men than for women). This is essentially a theoretical concern: the complexity of making and implementing such a calculus would be unfeasible in the real world of vaccine roll-out.

Though it may lack the sophistication of more holistic health metrics, applying YLLs to evaluate fairness is by no means simple, as demonstrated by our analysis of vaccine prioritization. Moreover, a robust application of the YLL yardstick requires reliable data which are not always available in poorer countries. This hinders the generation of precise YLL estimates and leaves a large margin of potential error.

Although applying YLLs is not unproblematic, no other metrics or strategies have been applied to assess age discrimination of different health polices across different countries. Indeed, this is the first published paper to do so. In theory, a similar approach could be applied to averting YLLs at the global level. Each dose given to a younger person in a rich country means one less for a more vulnerable person in a poor one. In May 2021, the Director General of WHO commented:

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> In a handful of rich countries, which bought up the majority of the supply, lower-risk groups are now being vaccinated…I understand why some countries want to vaccinate their children and adolescents, but right now I urge them to reconsider and to instead donate vaccines to Covax (The Guardian, 2021).

For example, in the first 2 weeks of September 2021 the USA provided around 4.5 million COVID-19 vaccine doses to people aged under 40 (CDC, 2020); a number roughly equivalent to the total number of people aged 70 or more living in Vietnam.

In the process of analyzing cases of discrimination against older people in COVID-19 vaccination, we find justifications are often based on ageist stereotypes and attitudes that place an inherently lower value on older people than on people at other ages. These include flawed arguments that older people uniformly represent an economic and social burden (Lytle & Levy, 2022). These views and discourses correspond with those made to justify ageist global health policies before the COVID-19 pandemic. Strikingly, older people remain a marginal concern of most global agencies whose priorities still reflect dated demographic and epidemiological scenarios[5]. A World Bank publication in October 2021 draws attention to COVID-19 mortality among younger adults and bears the unfortunate title "Too young to die", implying the same is not true for older people (Demombynes et al., 2021b). Rather than lessen ageism in global health, the COVID-19 pandemic has simply made the issue more apparent, along with the structures that enable it.

The paper raises a wide range of implications for future policy, both with specific reference to COVID-19 and health policy more generally.

First, in terms of participation in vaccine trials, there is an evident need for global protocols to balance needs for expediency and representation. This complex issue is not specific to older people. For example, initial trials of Zika vaccines excluded pregnant women, due to potential harm to their fetuses, even though these fetuses were the most at-risk group (WHO, 2019).

Second, the varied approaches to prioritization taken by the case study countries reflect wider patterns of inclusion and exclusion in their respective heath systems. Since the 1990s, Brazil has increased public health expenditure and established a unified, universal health system. By contrast, in India, a large part of the older population has little if any access to basic health services. Bulgaria's universal health care entitlements have been increasingly notional over time, and South Africa's health system is yet to overcome the double legacies of apartheid and HIV/AIDS.

Third, and most fundamentally, there is an evident need to increase national and global policymaker awareness of their own potentially ageist attitudes, values, and assumptions. As population ageing accelerates and pressures on public resources intensify, the need for transparent and ethical frameworks to resolve dilemmas and trade-offs between the interests of different age groups will be compelling.

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[5] Many examples of this marginal status can be provided. For example, the Lancet has over 50 Commissions on global health priorities, funded by donors such as the Gates Foundation. Of these, none refers specifically to older people. In 2019, WHO disbanded its only department exclusively focussed on the health of older people.

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