To the editor and editorial board,

I am formally writing to point out the significant errors in the (Gibson 2024) paper, published in your journal. It is important both you and your readership are aware of its shortcomings before basing any decisions on the claims made. In particular, the paper asserts two claims:

- That claims of negative New Zealand mortality are underpinned by the "Our World In Data" projection graph using the method of [Karlinsky and Kobak (2021)][1].
- That Gibson's method, producing positive excess mortality, is more effective than Karlinsky & Kobak in determining excess mortality as it adjusts for immigration-based changes in the rate of population growth.

Neither of these claims are accurate.

The underpinning of New Zealand's mortality measurement

For centuries, it has been established practice among actuaries, demographers, and health researchers to measure mortality using age-adjusted death rates where such data is available (Price 1773). This method supersedes the use of Crude Mortality Rates[2] by acknowledging that different ages have different risks of death, so comparing age-based risk of death on a uniform basis. In New Zealand, tutorials on making mortality comparisons by using death rates by age and standardising to a reference population have been published since the 1890s (Didsbury et al. 1891).

Age Standardised Mortality directly adjusts for both population growth and aging, as it is based on the number of deaths of the current resident population divided by the current resident population, stratified by age group and time period. This directly measures the population change effects Gibson is trying to model.

While calculation of New Zealand's cumulative excess mortality for 2020-2022 can vary by a couple of percentage points depending on the exact method adopted, using an age-standardised death rates method the UK's Institute and Faculty of Actuaries finds New Zealand's excess mortality from week 10 2020 to the end of 2022 to be -4% (that there are 4% fewer deaths than would be expected based on pre-COVID-19 trends) (Institute and Faculty of Actuaries 2024).

The Our World in Data graph, and the Karlinsky and Kobak method that underlies it, is an approximation (if it is a better or worse approximation to Gibson's method will be discussed later). While recognising the Our World In Data graph is an approximation, there are still several practically useful implicit features about it:

[1] The analysis code for (Karlinsky and Kobak 2021) is available from https://github.com/dkobak/excess-mortality

[2] The Crude Mortality Rate (CMR) is a simple calculation of the total number of deaths in a population divided by that population. The CMR allows comparability of populations of different sizes, but does not make any allowance for differences in composition between populations

- Being based on trends of deaths, it enables a common, consistent basis comparison with countries that lack age stratified current population information. As Gibson notes, Karlinsky and Kobak were initially able to provide comparison data for 103 countries (later 127). By contrast the mortality.org has weekly death rates by age (suitable for age standard mortality comparisons) for 38 countries[3].
- It makes weekly comparisons available.
- It is able to be checked by any member of the public for the latest current worldwide information. This last is a function of Our World in Data presentation rather than the method, but it is still a practical benefit.

While the existence of centuries of mortality measurement (not mentioned in Gibson's article) does not directly address if New Zealand medical professionals are aware that best practice mortality calculations recognise that people of different ages die at different rates when using the publicly available Our World in Data graphs in media pieces, it does establish that there is an established methodology, not mentioned in Gibson's article, underpinning claims of New Zealand's negative excess, and that method has been used for centuries, world-wide, across multiple disciplines. We can check if New Zealand medical professionals are aware of this by asking them.

> "*…the key point being any comparisons both within country (over time) or between countries should be age standardised to provide the most accurate picture possible (and of course be based on high quality and complete underlying deaths data which we can say NZ's are!)*" (Bloomfield 2024)

Age Standardised Mortality Review

As Age Standardised Mortality is a standard across multiple disciplines, but is not raised in the Gibson paper, a brief review is in order.

Death rates for an age stratified group, for a time period in a given location, measure the rate at which that age group dies. These can be directly compared to death rates in other time periods and locations to measure if the group experience is more or less deadly. As it is a rate, it automatically adjusts for differences in the size of the age group.

While this enables direct comparisons of people of the same age, it does not enable total population comparisons (as total populations may have different age structures). Standardisation with a reference population addresses this by assessing the total population deaths on the basis of death rates by age if the places and times being compared had the same age structure.

The total of standardised deaths can optionally be divided by the standard population to make age standardised mortality rates.

[3] The count of 38 countries was obtained from counting the countries in the STMF metadata file https://mortality.org/File/GetDocument/Public/STMF/DOC/STMFmetadata.pdf

Some variation in calculated results can be caused by the choice of standard population, due to the variation of young and old within a population. However, pragmatically, variations arising from the choice of standard population are likely to be immaterial to the results. Using single year age death rates by sex to 94 then 95+, and a linear baseline from 2013-2019, a standard reference population of 2023 gives a cumulative excess of -2% for 2020 to 2022. Using a standard reference population of 2021 when the borders were restricted gives a cumulative excess of -2%. Using a pre-COVID-19 standard population of 2019 gives a cumulative excess of -2%. Using the standard population of 1961, used by Stats NZ to maintain long-term continuity, cumulative excess is -2%[4].

Excess mortality is the difference between actual mortality and what is expected. The expected value is an estimate based on certain underlying premises, so excess mortality calculations using any method are sensitive what is considered "normal": the baseline. For Age Standardised Mortality the regular process is to use a linear trend of preceding years, and where trying to measure the impact of a major multi-year event like a pandemic, the linear trend of pre-pandemic years.

As New Zealand, no different to most other advanced economies, has seen the rate of decrease in mortality slow over time, the length of the linear trend baseline period should be short enough not to be introducing error as a result of applying a straight line of best fit to curved data.

After thorough investigation of the data, the Australian Bureau of Statistics (ABS) considers 2013-2019 to give the best baseline for the pandemic period (Australian Bureau of Statistics 2023). New Zealand has seen a similar trend in mortality in this period to Australia, with the added limitation that using 2011, the year of the Christchurch Earthquake and the residents of the second largest city living in broken housing through the following winter, is an extremely poor choice to include in baselines as such an event is not a reoccurring annual one.

While many international studies use a 5 year baseline range to increase the number of countries for which weekly level data is available, in practice the results for New Zealand do not differ substantively between a 5 (2015-2019) and 7 (2013-2019) year baseline period. Using a 2022 standard population and a 2015-2019 baseline gives -2% excess mortality for 2020-2022, while using a 2013-2019 baseline gives -2%[5].

[4] NZ annual deaths are available from https://infoshare.stats.govt.nz in Population : Deaths - VSD : Deaths by age and sex (Annual-Dec). NZ mean annual population is available from Population : Population Estimates - DPE : Estimated Resident Population by Age and Sex (1991+) (Annual-Dec) : Mean year ended. The 1961 age standardised mortality rate figures are in Population: Death Rates - DMM : Standardised death rates (Maori and total population) (Annual-Dec). Raw data and analysis code at https://github.com/thoughtfulbloke/letter2ed in the support_files folder.

[5] Raw data and analysis code at https://github.com/thoughtfulbloke/letter2ed in the support_files folder.

Comparison of Gibson and Karlinsky & Kobak

To assess the accuracy of approximations of mortality, the difference of an approximation to age-standardised mortality methods can be measured. Earlier age-stratified methods give a cumulative excess mortality for 2020-2022 in the -2% to -4% range.

The Our World in Data cumulative excess (Projection based on Karlinsky & Kobak) gives cumulative excess mortality for 2020-2022 as 0%.

Gibson's model gives an excess mortality for 2020-2022 range of 1.7% to 5.3% with the central estimate rounding to 4%.

Though not mentioned in Gibson's paper, using total population (without aging) as a model term would normally be functionally equivalent to the commonly known Crude Mortality Rate (deaths among the total population / total living population). A 2015-2019 linear regression of the annual CMR gives an 2020-2022 cumulative excess of 0%[6].

Gibson's method produces results further from actuarial standard methods than the Karlinsky & Kobak method. The reason for Gibson's model performing so poorly compared to Karlinsky & Kobak lies in the age imbalance of death rates. Young people frequently migrate and infrequently die. Old people infrequently migrate and frequently die. Applying a correction based on the amount of migration to the mortality of the total population (dominated by people not migrating) introduces structural error.

Conversely, because the Karlinsky & Kobak method uses only death data, it implicitly limits itself to the population that dies. The population mainly dying are not migrating, so the model does not diverge as far from age standardised mortality as the Gibson method when border changes cause major fluctuations in migration.

If 2020 had the same single year of age death rates as 2019, and new migrant 2020 death rates were the same as the equivalently aged non-migratory population in 2019, then we can calculate the expected deaths from the 35,744 reduction in nett migration from 2019 to 2020. Using single age death rates, the youthful migrating population would be expected to result in 85 fewer deaths for the 35,744 reduction in total population[7].

Conversely, the expected increase in deaths due to aging can be calculated by aging the 2019 resident population by one year, and subtracting annual deaths of that age, and applying the single year death rates of 2019 (the same assumption as deaths expected from migration). For

[6] NZ crude death rates are available from https://infoshare.stats.govt.nz in Population : Death Rates - DMM Crude death rate (Maori and total population) (Annual-Dec). Raw data and analysis code at https://github.com/thoughtfulbloke/letter2ed in the support_files folder.

[7] NZ migration data available from https://infoshare.stats.govt.nz in Tourism : International Travel and Migration - ITM : Table: Estimated migration by direction, age group and sex, 12/16-month rule (Annual-Dec). NZ death data available in Population : Deaths - VSD : Deaths by age and sex (Annual-Dec). NZ population data available in Population : Population Estimates - DPE : Estimated Resident Population by Age and Sex (1991+) (Annual-Dec). Raw data and analysis code at https://github.com/thoughtfulbloke/letter2ed in the support_files folder.

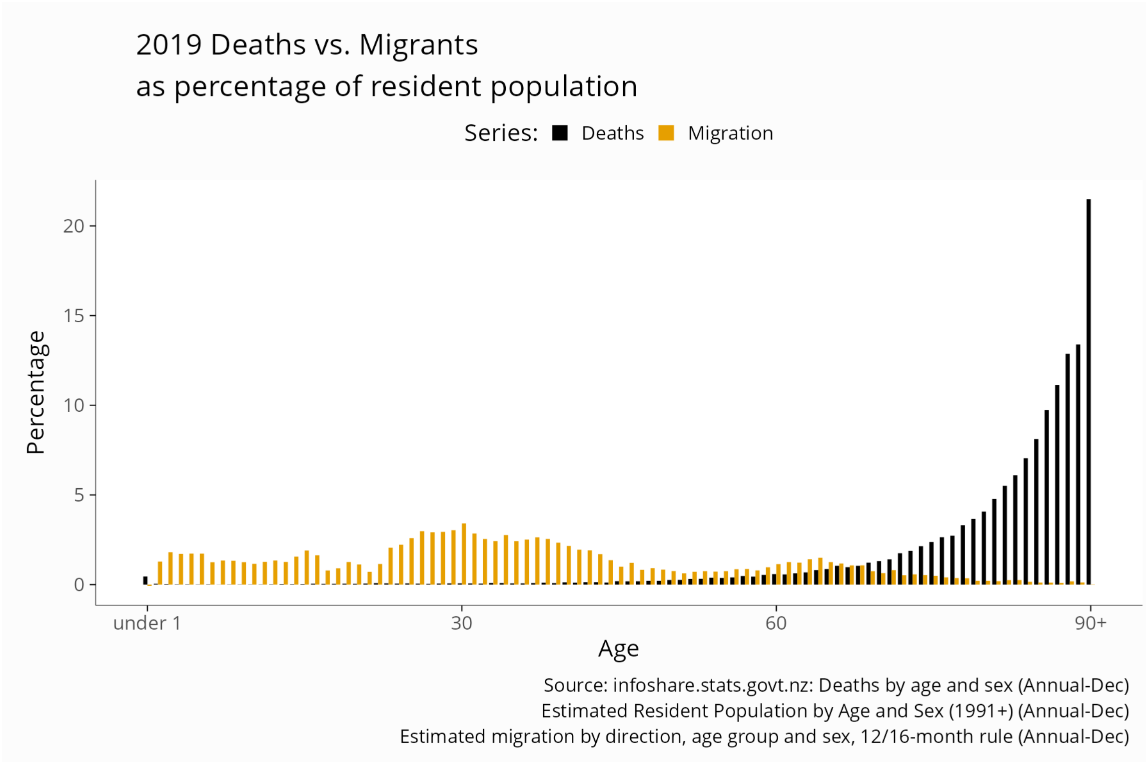


Figure 1: Figure 1: Ages of migration and ages of death have little overlap

the resident population, ecluding under one yer olds, there would be an expected rise of 837 deaths while the total population decreased by about 33,963[8].

Gibson's decision not to apply total population but not age to the model minimises an expected increase in deaths of an approximate order of magnitude greater than the effects of migration. But all these complexities are avoided by incorporating both migration and aging by using age standardised mortality.

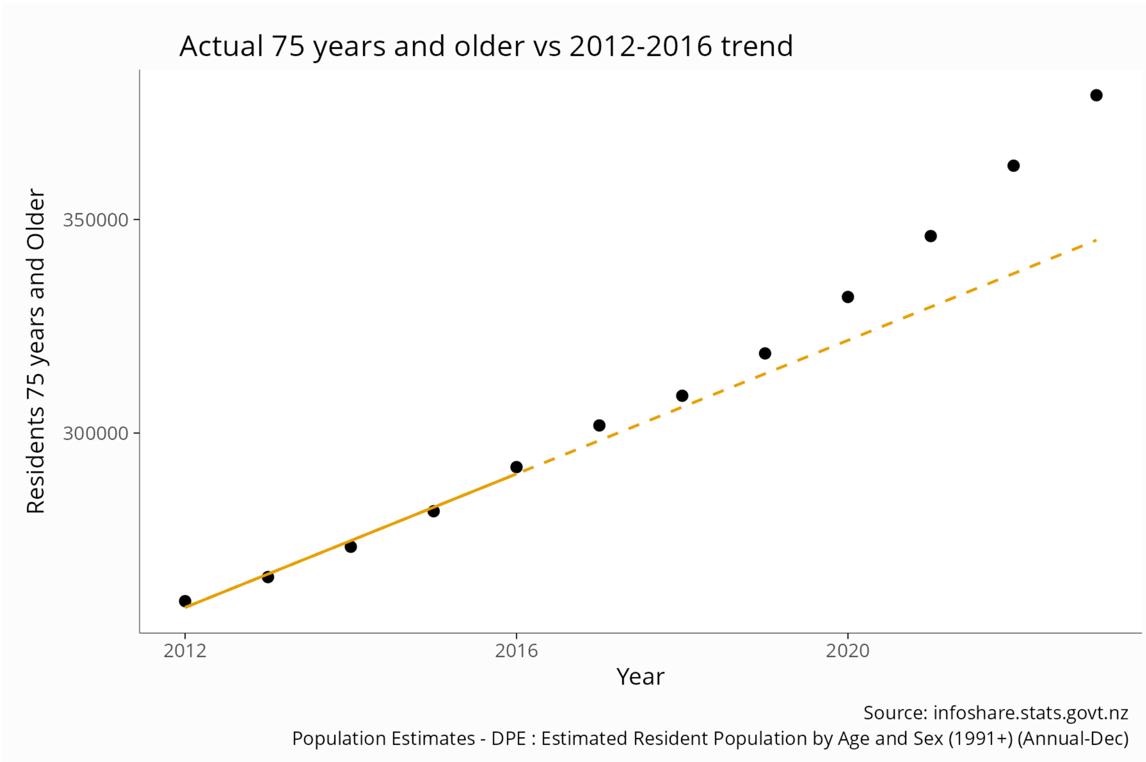
Gibson asserted that it was not important to incorporate aging:

> *If societal aging was a cause of the increased number of deaths, as Gabel and Knox (2023) put forward as a reason for the excess mortality in 2022, it should also show up prior to the COVID-19 era, given that societal aging is a long-term process.*

The assumption that aging is a long-term process so should show up as a long slow process only applies if there are no sudden demographic shifts among age groups that alter the risk

[8]NZ death data available from https://infoshare.stats.govt.nz in Population : Deaths - VSD : Deaths by age and sex (Annual-Dec). NZ population data available in Population : Population Estimates - DPE : Estimated Resident Population by Age and Sex (1991+) (Annual-Dec). Raw data and analysis code at https://github.com/thoughtfulbloke/letter2ed in the support_files folder.

of death. The number of 75 and older residents, when compared to the 2012-2016 trend, was also accelerating in 2019. This matches a "sudden" demographic shift of an acceleration in the age distribution that began decades earlier and naturally aged into ranges that play a more significant role in total deaths.



But the dramatic increase in elderly only contributes to mortality as one of other interacting factors, such as the age specific risk environment. A more direct measure of importance is the difference in outcome between the Crude Mortality Rate (ignoring age structure) and the Age Standardised Mortality Rate (based on age startified death rates). The difference in excess mortality between those two methods is exactly and only the difference caused by using age specific death rates.

Of more surprise is that Gibson's results for 2020-22 less well approximate the crude mortality rate than Karlinsky & Kobak, since the crude mortality rate is the normal method of comparing death rates while ignoring the effects of age. While there is not enough information in the paper to exactly replicate Gibson's method and achieve the same outcome, part of the reason for the difference seems likely to be the unusual step of treating population as an additive contributor to deaths in his modification of Karlinsky & Kobak. But, compared to the differences with methods acknowledging age, such problems are minor.

Karlinsky & Kobak also appears superior for comparisons between countries, as Gibson's results are a worse approximation with ASMR based methods calculated by other countries statistical authorities. The Australian Bureau of Statistic's age based mortality analysis has excess mortality of 3.4% across 2020-2022 (Australian Bureau of Statistics 2023). Karlinsky & Kobak's approximation of 4% is much closer to the ABS result than Gibson's result of -3%.

Specific methods are used to facilitate particular goals, such as breadth of comparison. Methods can righty be critiqued when applied to other goals, such as country specific accuracy. But in making such critiques, it is important to provide the existing best methods for that goal. And if making specific claims of improved accuracy, benchmarking each method against the most accurate establishes the relative worth of different methods.

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