Standardised crude probabilities of death to improve understanding of national and international cancer survival comparisons

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Stockholm, Sweden, 26-28 August 2019
Association of the Nordic Cancer Registries meeting 2019
How do we measure cancer survival?

- We usually present age-standardized net/relative survival.
- This has a complicated interpretation.

Survival in the **hypothetical** situation where
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Survival in the **hypothetical** situation where

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2. the age distribution was not as it is observed, but as that in a reference population.
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Survival in the *hypothetical* situation where

1. it is not possible to die from causes other than the cancer.
2. the age distribution was not as it is observed, but as that in a reference population.

- Many examples of the media, politicians, clinicians, patients and scientists interpreting incorrectly.
When comparing population subgroups we are interested in whether there are differences in cancer mortality rates.

For Fair Comparisons differences between population groups should not depend on,
Fair Comparisons?

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When comparing population subgroups we are interested in whether there are differences in cancer mortality rates.

For Fair Comparisons differences between population groups should not depend on,

1. differences in the age distribution,
2. differences in other cause mortality rates.
(1) Net Probability of Death (1 - Net Survival)

Probability of death in hypothetical world where not possible to die from causes other than the cancer under study.
Probabilities of Death

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(2) All-cause probability of death
Probability of death from any cause (cancer and other causes) in real world.

Age standardization for (1), (2) & (3) removes age differences. However, (2) and (3) depend on other cause mortality.
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Making all-cause and crude survival comparable

- All-cause and crude probabilities are easier to interpret, but are not comparable between populations.
- Can we make them comparable?
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Can we make them comparable?

Expected Mortality

\[\text{Net Probability}\]
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Diagram:
- Expected Mortality
  - Net Probability
  - All-cause/Crude Probability
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![Diagram](Expected Mortality -> Net Probability] [Net Probability] [All-cause/Crude Probability]
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Expected Mortality

Net Probability

All-cause/Crude Probability

Expected Mortality

Net Probability

All-cause/Crude Probability

Reference Expected Mortality
Making all-cause and crude survival comparable

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![Diagram showing the relationship between expected mortality, net probability, all-cause/crude probability, and reference expected mortality.](image-url)
Example

- Men diagnosed in England with Melanoma.
- Compare those who live in most deprived areas with least deprived areas.

![Graph showing mortality rate by age for least deprived, most deprived, and reference groups.](image-url)

- Least Deprived
- Most Deprived
- Reference
Example

- Men diagnosed in England with Melanoma.
- Compare those who live in most deprived areas with least deprived areas.

![Graph showing mortality rates by age and deprivation status.](image-url)
Net Probability of Survival

![Graph showing net probability of survival over years from diagnosis for Least Deprived and Most Deprived groups. The graph plots net/relative survival against years from diagnosis, with different lines indicating the survival probability over time.]
Net Probability of Death

Age Standardization:

Fair Comparison:

Least Deprived

Most Deprived

Years from diagnosis

Net Probability of Death

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Paul C Lambert
Crude Probabilities
28 August 2019
Net Probability of Death

Age Standardization: Internal
Fair Comparison: ×
Net Probability of Death

Age Standardization: ICSS
Fair Comparison: ✓
All-cause Probability of Death

Age Standardization: Internal
Expected Rates: Separate
Fair Comparison: ×
All-cause Probability of Death

Age Standardization: ICSS
Expected Rates: Separate
Fair Comparison: X
All-cause Probability of Death

Age Standardization: ICSS
Expected Rates: Reference
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Crude Probability of Death

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Age Standardization: ICSS
Expected Rates: Separate
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Crude Probability of Death

Age Standardization: ICSS
Expected Rates: Reference
Fair Comparison: ✓
Choice of Hypotheticals

Net Probability of Death

1. Age distribution is that of reference.
2. Only possible to die from cancer under study.

All-cause/Crude Probability of Death

1. Age distribution is that of reference.
2. Mortality rate due to other causes is that of reference.

In some situations it is useful to make one group non-hypothetical.

- Standardize to age distribution of particular group.
- Use expected mortality rates of particular group.
Crude Probability of Death

![Graph showing crude probabilities with years from diagnosis on the x-axis and crude probability of death on the y-axis. Two lines represent Least Deprived and Most Deprived categories.]

- Age Standardization: Most Deprived
- Expected Rates: Most Deprived
- Fair Comparison: ✅
Possible to make fair comparisons using all-cause or crude probabilities.
  ▶ Need to age standardize
  ▶ Need to use reference expected mortality rates.
Useful alternative/compliment to net survival/mortality.
Possible using modelling or life tables.
Need to think about which age distribution to standardize over.
Need to think which reference expected rates to use.
Stacked Plots

Least Deprived

Most Deprived

Reference Adjusted All-Cause Survival
Reference Adjusted Crude Probability of Death
Stacked Plots

- Reference Adjusted All-Cause Survival
- Reference Adjusted Crude Probability of Death