Immortal time bias in standardized mortality ratios in patients with diseases associated with high mortality

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Immortal time bias in standardized mortality ratios, in patients with high mortality diseases

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Objectives

Standardized Mortality Ratios (SMR) is used to prioritize funding in healthcare. It is important to clarify whether SMR is biased. We suspect the bias is affected by the severeness of the disease.

Methods

SMRs were calculated with different time window sizes (Figure 1) and different diseases of varying severeness (Figure 2). SMRs were compared using visual inspection and bias calculations from Suissa and Liang (data not shown).

Heuristics

A time window of a shorter length produces a larger SMR:

$$SMR = \frac{N_{\textit{actually dead}}}{N_{\textit{expected dead}}}$$

where,

$$N_{\textit{expected dead}} = MR_{Background} \cdot N_{\textit{alive}}$$

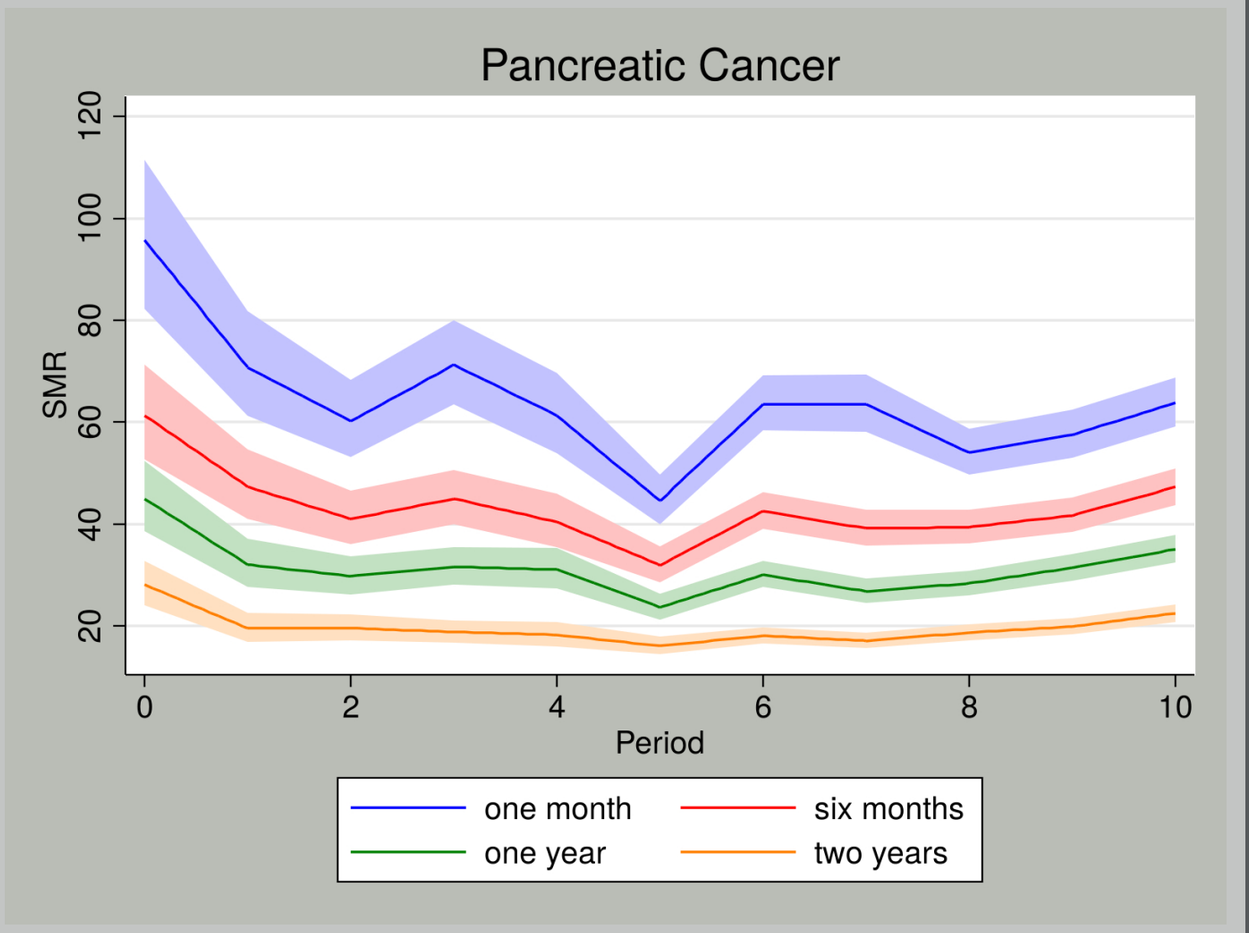
If we consider a period of two years, and aggregate SMR from one month time frames we see that

$$N_{\textit{alive, 2 years}} = \max\left\{N^i_{\textit{alive, 1 month}}\right\}, \quad i \in (1,2,...,24)$$

thus $N_{\textit{alive, 2 years}} \geq N^i_{\textit{alive, 1 month}} \forall i \in (1,2,...,24)$ and

$$SMR^{2\ \textit{years}}_{2\ \textit{years}} \leq SMR^{1\ \textit{month}}_{2\ \textit{years}}$$

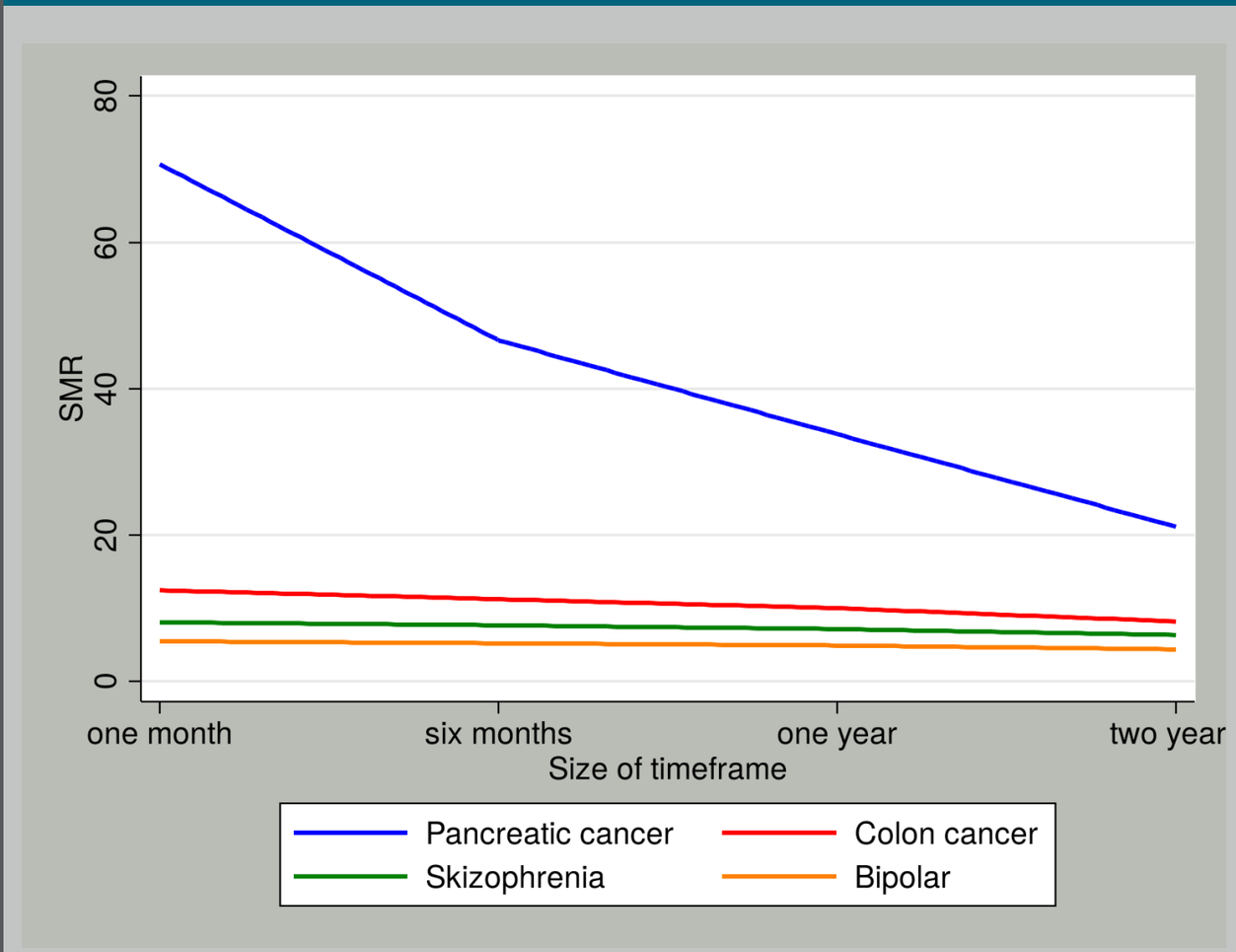
Results: Figure 1



Results

Figure 1: The time window sizes affect the SMRs for pancreatic cancer; hence a larger time window produces smaller SMRs.
Figure 2: The magnitude of the time window size bias is predominantly seen in pancreatic cancer.

Results: Figure 2



Conclusion

The time window size produces bias, which worsens as the severity of a disease increases. This bias can be reduced by shortening the time window.
These results are preliminary, and calculated on faulty data, we await access to the full dataset.
We continue this project by expanding our data, to make it possible to calculate SMR based on a time window of 1-2 weeks.
We are also conducting a review of previous published material to determine whether SMR has been used inappropriately.

References

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