Estimating restricted mean survival time and expected life-years lost in the presence of competing risks within flexible parametric survival models

Sarwar Islam Mozumder
University of Leicester

Paul Lambert
University of Leicester College of Medicine Biological Sciences and Psychology

Mark Rutherford
University of Leicester College of Medicine Biological Sciences and Psychology

DOI:

10.21203/rs.2.23839/v1

SUBJECT AREAS

Health Economics & Outcomes Research

KEYWORDS

competing risks, restricted mean survival time, restricted mean life 1 time, flexible parametric model, life-years lost, survival analysis

Abstract

We present various measures, specifically the expected life-years list due to a cause of death, that can be predicted for a specific covariate pattern. These can also be summarised at the population-level using standardisation to obtain marginal measures. The restricted mean survival time (RMST) measure can be obtained in the presence of competing risks using Royston-Parmar flexible parametric survival models (FPMs). Royston-Parmar FPMs can be fitted on either the cause-specific hazards or cumulative incidence scale in the presence of competing risks. An advantage of modelling within this framework for competing risks data is the ease at which other alternative predictions to the (cause-specific or subdistribution) hazard ratio can be obtained. The RMST estimate is one such measure. This has an attractive interpretation, especially when the proportionality assumption is violated. In addition to this, compared to similar measures, fewer assumptions are required and it does not require extrapolation. Furthermore, one can easily obtain the expected number of life-years lost, or gained, due to a particular cause of death, which is a further useful prognostic measure. We describe estimation of RMST after fitting a FPM on either the log-cumulative subdistribution, or cause-specific hazards scale. As an illustration of reporting such measures to facilitate interpretation of a competing risks analysis, models are fitted to English colorectal data.

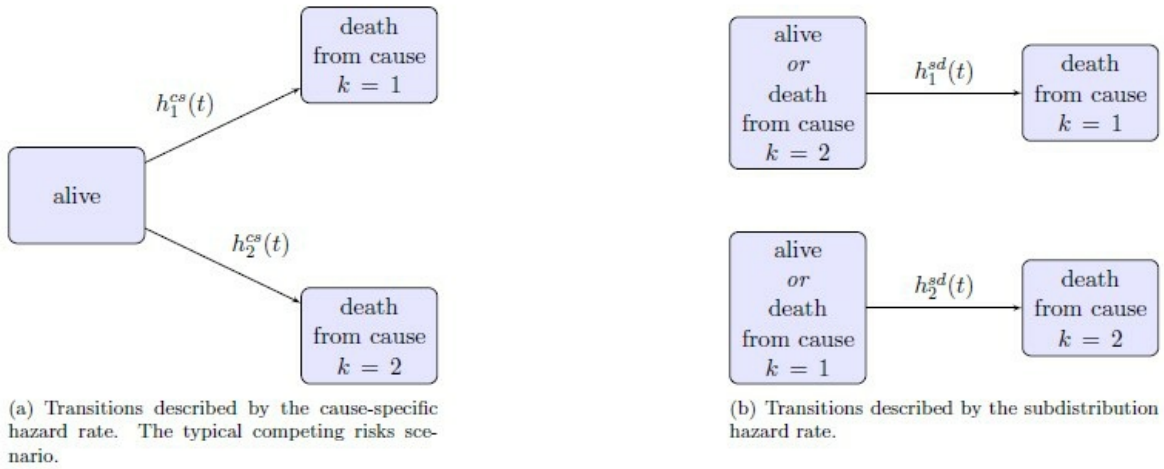
Full-text

Figures

Figure 1

(a) Transitions described by the cause- specic hazard rate. The typical competing risks scenario. (b) Transitions described by the subdistribu- tion hazard rate. Schematics of transitions from an initial state to one of K = 2 absorbing states that correspond to a particular cause of death in the presence of competing risks.

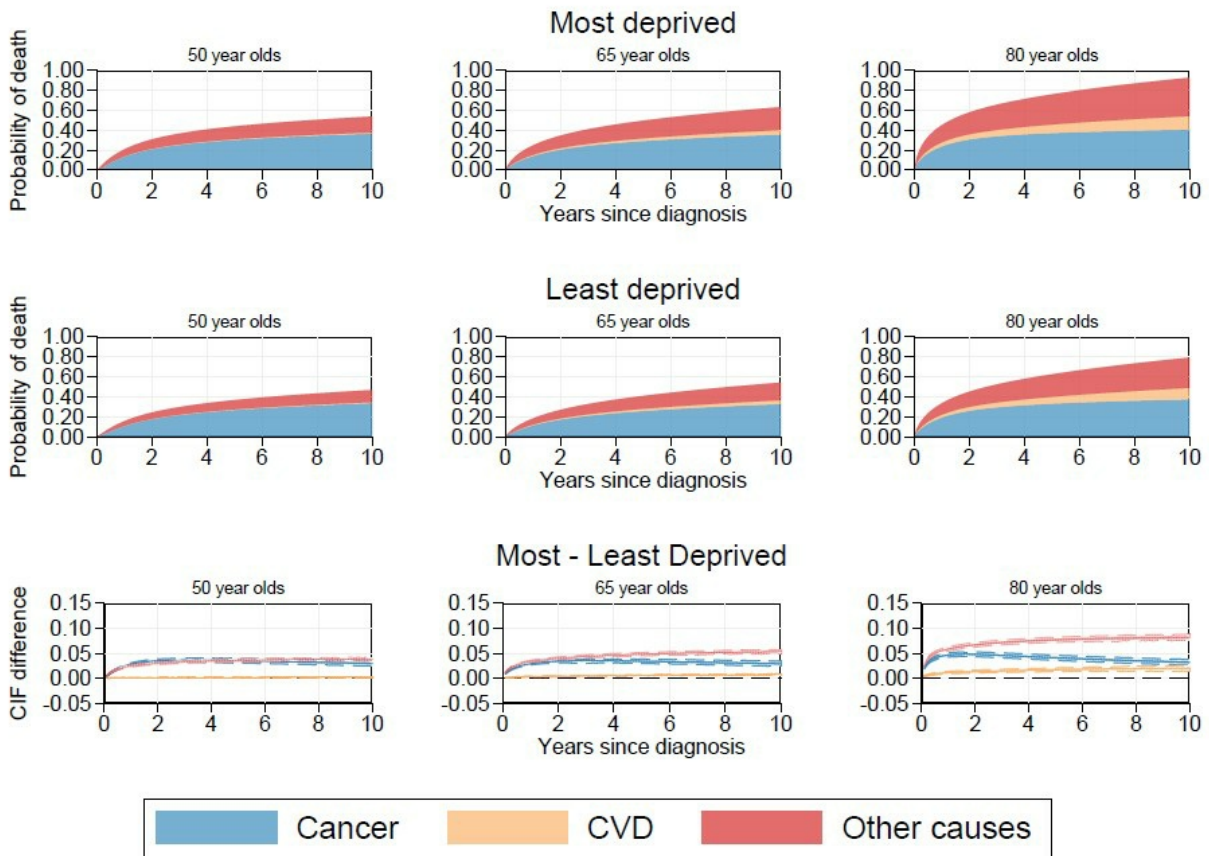



Figure 2

Stacked cause-specic cumulative incidence functions (CIFs) for the most (top row) and least (middle row) deprived groups for male patients at 50, 65 and 80 years old at diagnosis. CIF dierences (most - least deprived) are presented on the bottom row with associated 95% condence intervals (region enclosed by dashed lines).

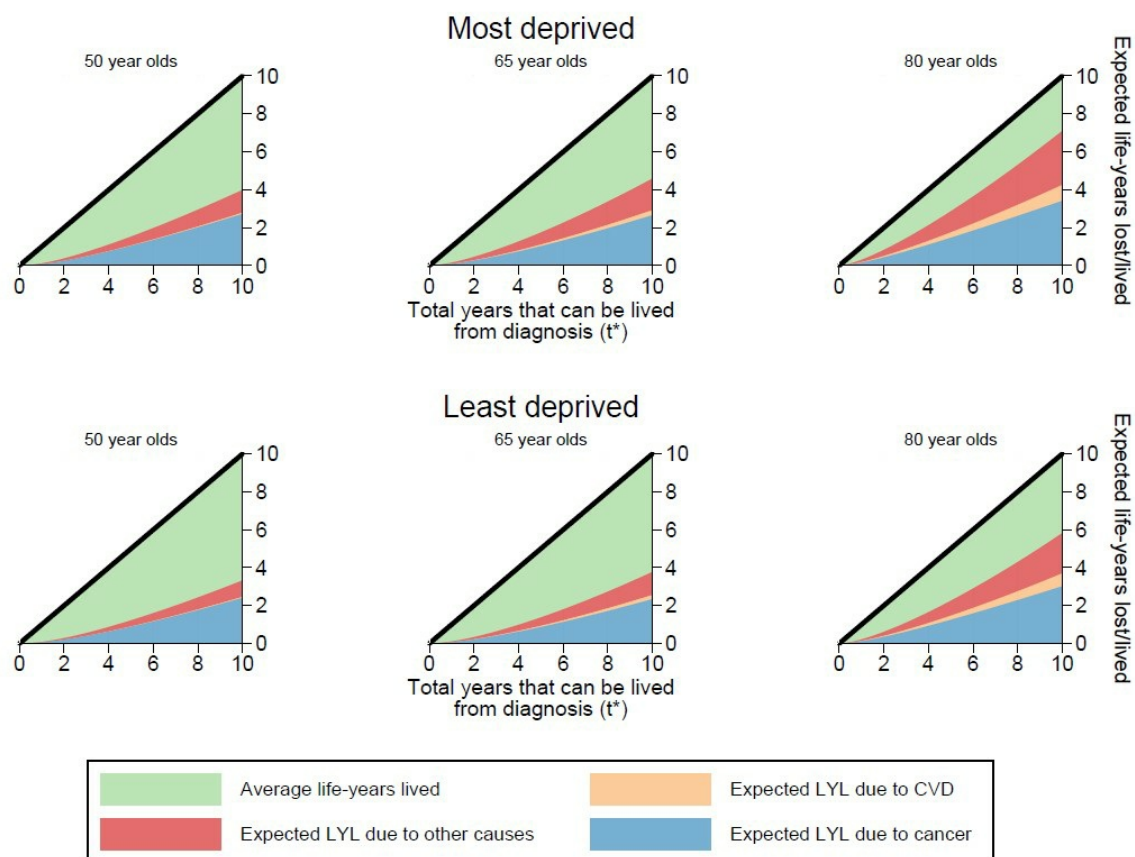



Figure 3

Stacked plots of expected life-years lost partitioned by each cause of death and total life-years lived for the most deprived (top row) and least deprived (bottom row) for male patients aged 50, 65 and 80 years old at diagnosis. These are presented at different years from diagnosis, t*.

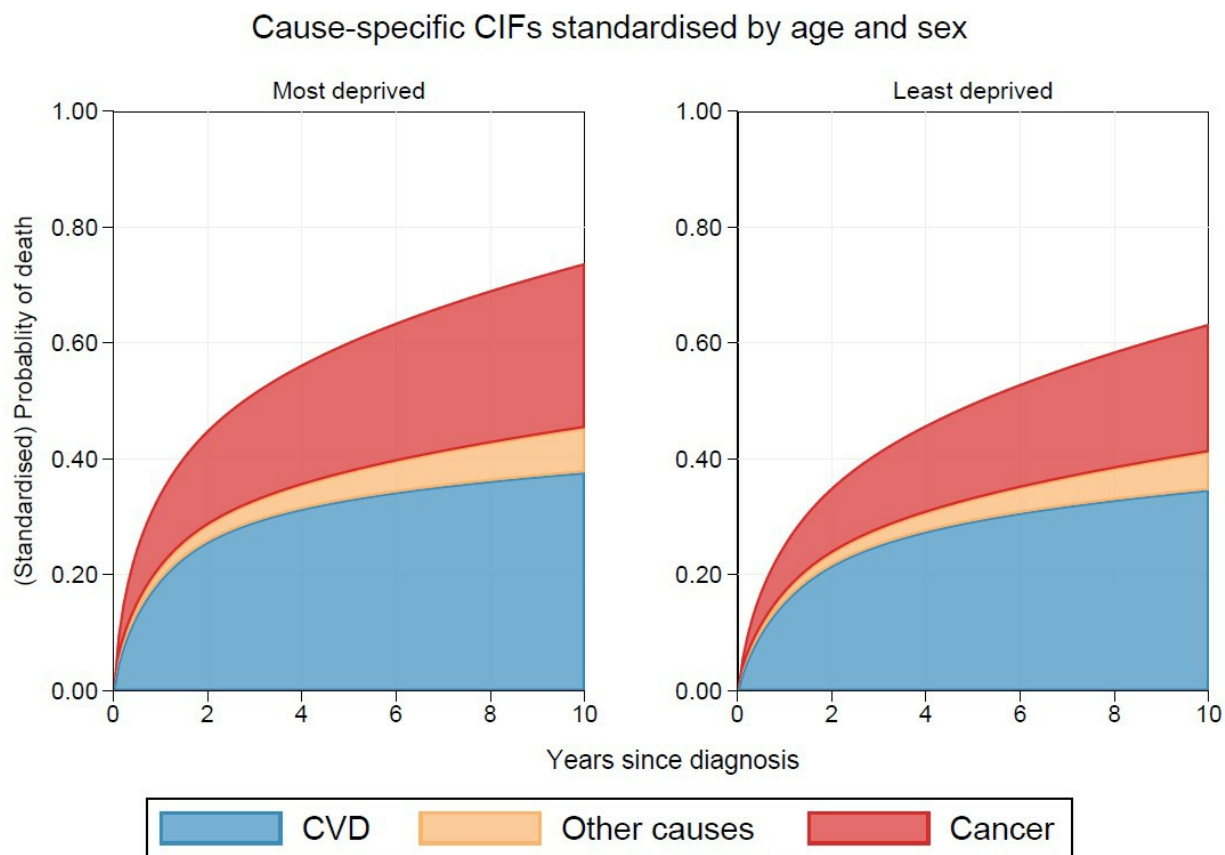



Figure 4

Estimated cause-specic cumulative incidence functions (CIFs) stacked for each cause of death. Predictions are standardised by age and sex and obtained for the most (left) and least (right) deprived.

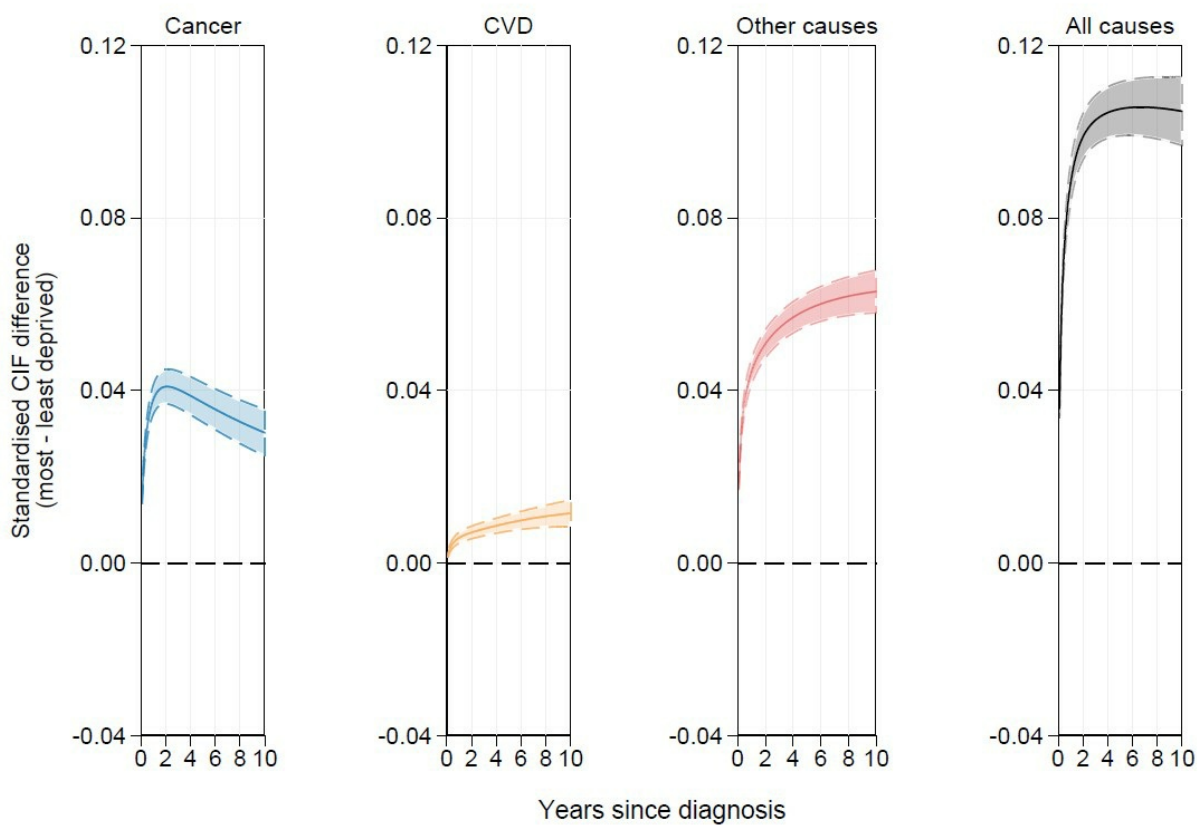



Figure 5

Predicted differences in cause-specic cumulative inci- dence functions (CIF) between the

most and least deprived patients with associated 95% condence intervals (dashed lines).

Estimates are standardised by age and sex.

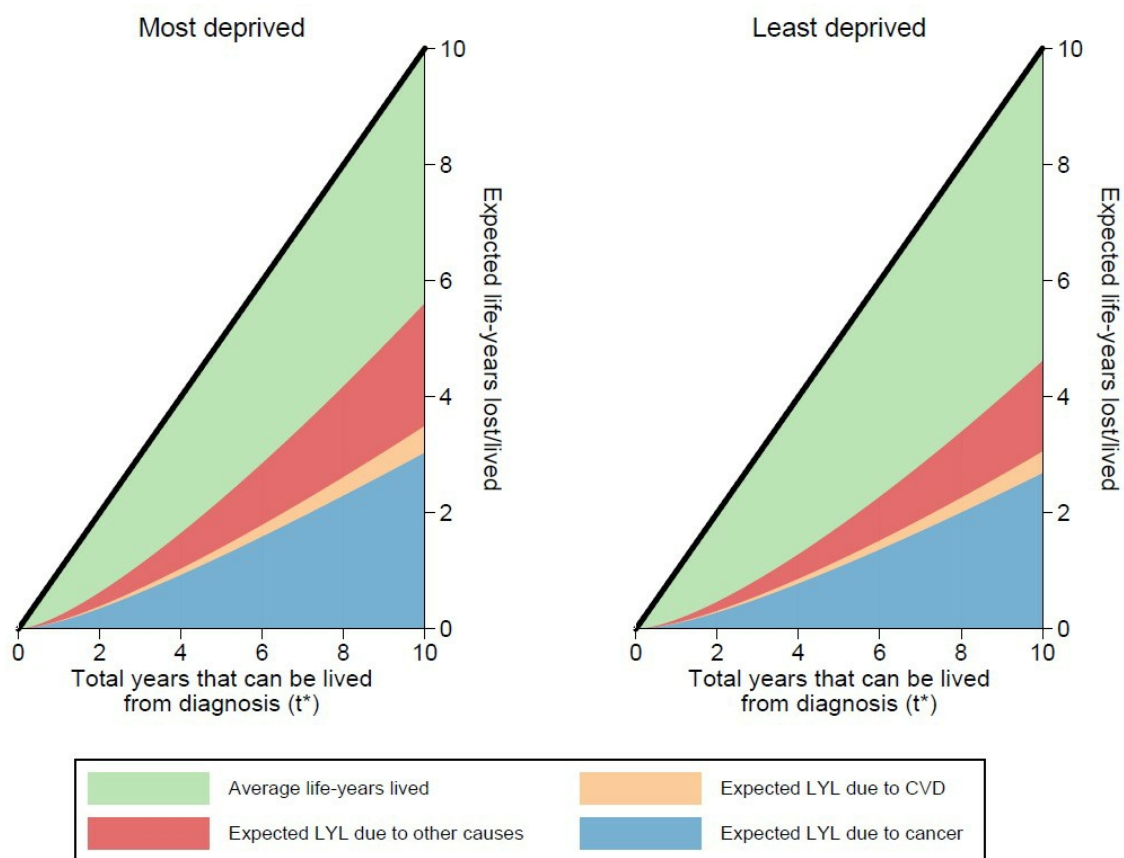



Figure 6

Stacked plots of expected life-years lost partitioned by each cause of death and total life-years lived for the most deprived (left) and least deprived (right) patients standardised by age and sex. These are presented for different years from diagnosis, t*.