

Supplementary Materials to: Assessment of variability in life expectancy in older men by use of new comorbidity indices. A nationwide population-based study

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Updated method for estimation of life expectancy

For the purpose of this study we updated our previously described method to estimate life expectancy based on age and comorbidity (1). This previously described method was based on the Charlson comorbidity index (CCI) as measure of comorbidity (2). The current update aimed to replace the CCI with a Multidimensional diagnosis-based comorbidity index (3) (MDCI) that was calculated at each index date based on data on discharge diagnoses in The National Patient Register (4). The MDCI has been shown to have superior performance compared to the CCI as a measure of comorbidity (3, 5).

This supplementary document contains details on how we updated the method and estimated the parameters of the simulation model that subsequently was used to obtain estimates of life expectancy. Both the previous and current model parameters were estimated using data on men without prostate cancer. Life expectancy in men with prostate cancer is then estimated given their age and comorbidity at date of diagnosis.

Population for model development

We used comparison men from Prostate Cancer data Base Sweden (PCBaSe) 5 to update our model parameters. Comparison men in PCBaSe are men without prostate cancer diagnosis matched to each man with prostate cancer at the date of diagnosis, based on birthyear and region of residence (6). The index date for a comparison man is the corresponding date of diagnosis of the man with prostate cancer. Comparison men with an index date between 2008 and 2020 were included (N = 645 328). Follow-up ended at date of death or 31 December 2020, whichever occurred first.

A drug comorbidity index (DCI) (7) was calculated based on filled prescriptions in The Prescribed Drug Register (8). Both the MDCI and DCI were calculated at each consecutive year from the index date until end of follow-up.

Methods

The updated version of the microsimulation model involved these steps at each year:

1. Has the man died according to the simulation? If yes, exit the update process, otherwise continue to step 2.
2. Will the man die in the next year according to the simulation? If yes, record the death and exit the update process, and else continue to step 3.

3. Will a change in MDCI and/or DCI occur during the next year according to the simulation? If no, record the old MDCI/DCI and go to step 5, and else go to step 4.
4. Determine the size and direction of change in MDCI/DCI and record the new MDCI/DCI.
5. Increase age by one and go to step 1 and repeat until all men are dead or of age = 105.

We used a combination of logistic regression models for each binary outcome (yes/no above) and the size of change in MDCI and DCI were modelled using Gamma regression. The models included natural cubic splines of each of the variables:

Age (knots at 55, 65, 70, 75, 85 years),

MDCI (knots at -0.3, -0.1, 0.5, 1, 1.5), and

DCI (knots at -0.1, 0.1, 1, 2, 4).

The knots were determined based on the distribution of the variables. The models also include all two-way interactions between the splines. The following outcomes were modelled in the order

1. **Death** – logistic regression
2. **MDCI change** (or no change) – logistic regression
3. **MDCI direction** (increase or decrease) – logistic regression
4. **MDCI increase size** – Gamma regression
5. **MDCI decrease size** – Gamma regression
6. **DCI change** – logistic regression
7. **DCI direction** – logistic regression
8. **DCI increase size** – Gamma regression
9. **DCI decrease size** – Gamma regression

The models of death and MDCI depended on the MDCI and DCI from the previous year. The models for DCI used the MDCI for the current year.

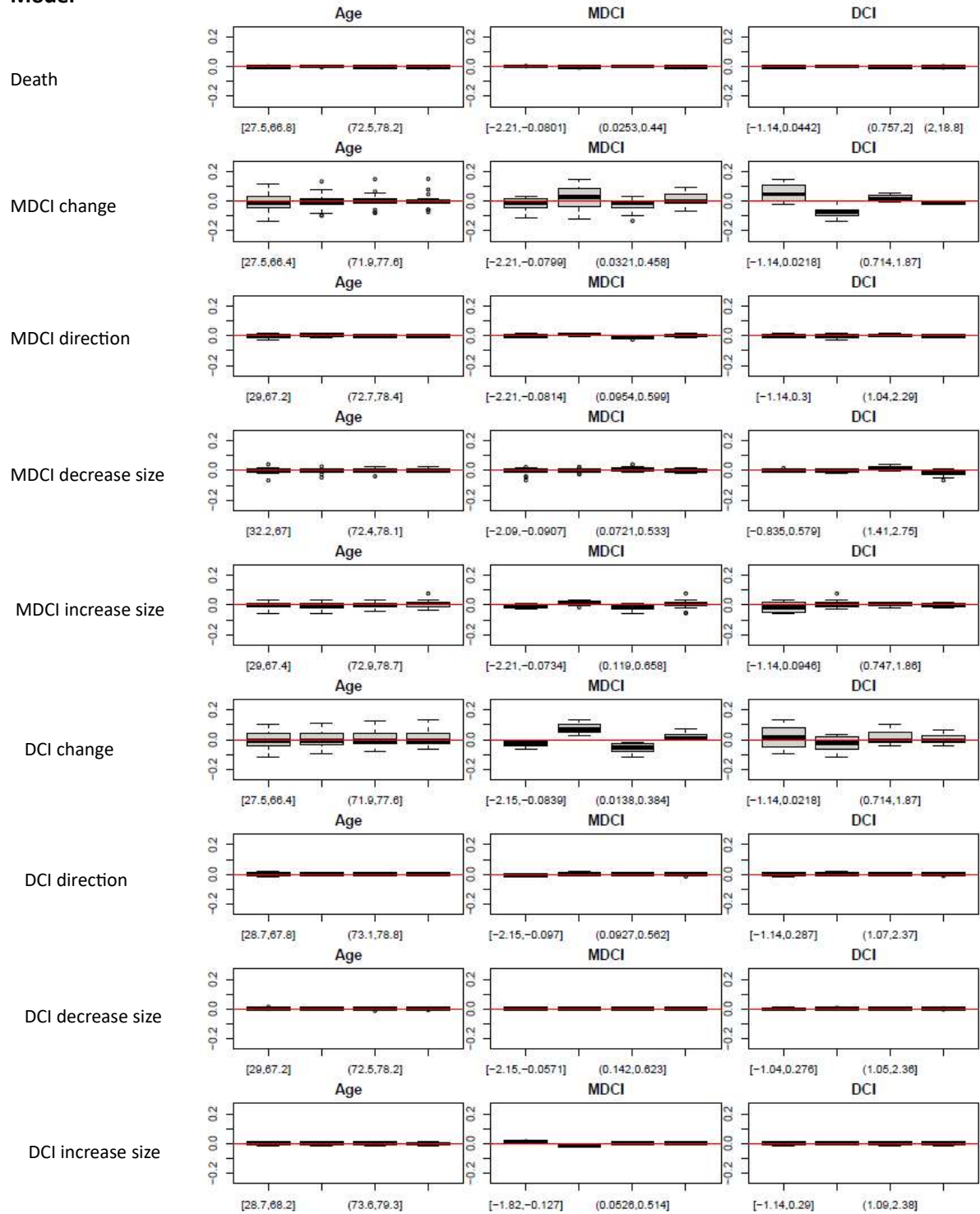
Model fit

Predicted probabilities of binary events and size of change in MDCI and DCI agreed well with observed proportions within age groups, MDCI and DCI (**Supplementary Figure S1**). The largest differences were observed in subgroups of MDCI and DCI for the models predicting a change in MDCI and DCI respectively.

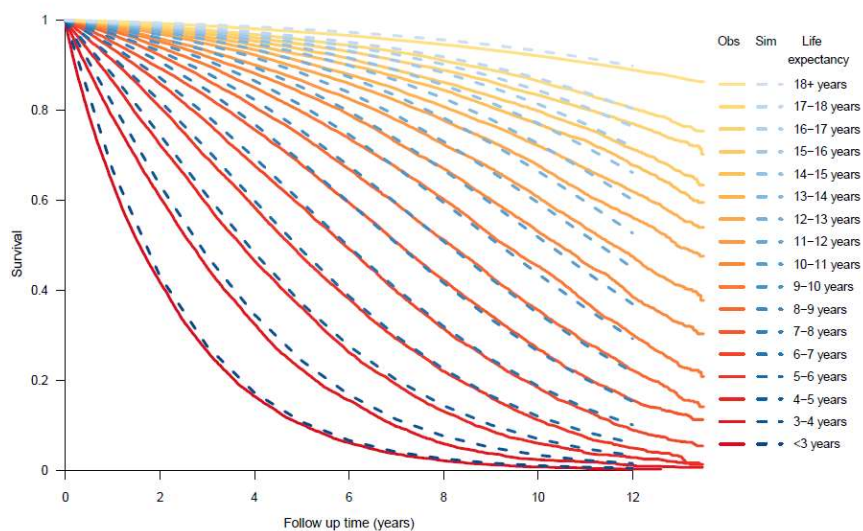
Life expectancy was estimated by simulating a survival time for each combination of age (50-100 years, step size 1 year), MDCI (from -0.75 to 13.5, step size 0.25) and DCI (from -1.5 to 7, step size 0.25) 640 000 times. For each combination, an estimate of life expectancy was obtained by averaging the simulated survival times. Simulated survival probability corresponded well with the observed survival according to groups of life expectancy (**Supplementary Figure S2**).

Application to men with prostate cancer

The estimates of life expectancy obtained from the simulations were subsequently applied to men with prostate cancer. In case the MDCI and/or DCI for a man was not exactly equal to one of the simulated values we used linear interpolation between the closest values.

Model

Supplementary Figure S1. Predicted probability minus observed proportion/size in change for each outcome.



Supplementary Figure S2. Estimated survival probability based on life expectancy in observed data and simulated data.

References

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