

A joint application of disease risk score and propensity score to control for confounding: A clinical example

M. Sanni Ali^{1,2}; Ian J. Douglas¹; Elizabeth Williamson¹; Daniel Prieto-Alhambra^{2,3}; Liam Smeeth¹

1 London School of Hygiene and Tropical Medicine, London, UK;

2 University of Oxford, Oxford, UK; 3 Universitat Autònoma de Barcelona and Instituto de Salud Carlos III, Barcelona, Spain

Background

Propensity scores (PS) and disease risk scores (DRS, also called prognostic scores) are two commonly used methods to deal with observed confounding in observation studies of treatment effects. Although clinical disease risk scores such as CHA₂DS₂-VASc score are often included in the PS modelling, combined empirical applications of DRS and PS have been limited to simulations which showed better performance compared with individual DRS or PS applications in terms of bias and precision.

Objectives: To illustrate a joint application of DRS and PS to control for confounding using clinical example.

Methods

We used the United Kingdom Clinical Practice Record Datalink (CPRD) data to evaluate the association between bariatric surgery (BS) on the risk of type 2 diabetes mellitus (T2DM) as an example. We followed patients from index date until T2DM, death, loss to follow-up, or end of study (December 31, 2014), whichever came first. We fitted DRS in the patient groups without the exposure (bariatric surgery) and predicted the baseline risk for T2DM for the entire cohort using logistic regression. We then applied 1:1 PSM with caliper width of 0.20 standard deviation on the logit of the PS including the DRS as quintiles in the PS model. We also used only the PSM without the DRS included as a reference. We evaluated covariate balance using absolute standardized mean difference (ASMD) in the combined PS_DRS matched dataset as well as PSM dataset. We estimated hazard ratios and 95% confidence intervals (95% CI) using Cox proportional hazard models.

Results

After PSM, we had 5132 patients with 406 having T2DM events during follow-up. Both PS_DRS combined matching and PSM improved covariate balance, ASMD all below 10%. Bariatric surgery reduced the risk of T2DM, HRs [95% CI], 0.57 [0.47, 0.70] in the full matched cohort. The risk was similar when we use PSM without the DRS HR [95% CI], 0.65 [0.53, 0.79].

Conclusions

Joint application of DRS and PS has improved covariate balance and could be a preferred application of covariate summary score in high dimensional data. Further studies are needed to evaluate in the performance of this approach in the presence of effect modification and multiple exposures.