

Adjusting for selection bias in retrospective case control studies

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Retrospective case control studies are particularly prone to selection bias. This paper develops selection bias adjusted odds ratio estimators (SBOR) for these studies. Generally, selection bias comes about when the participant selection mechanism is associated to the exposure under investigation. Thus to adjust for selection bias, we first use directed acyclic graphs and conditional independence assumptions to identify a variable conditional on which the selection mechanism and the exposure are independent. We term this the bias breaking variable. Second, we find data on the BB that are representative of the population of interest (usually from a source other than the main study) and derive suitable SBORs based on the additional data. We show by means of a set of examples that such bias breaking variables are not uncommon in epidemiologic settings.

We use simulations to show that the SBORs we develop outperform standard estimates (based on a multivariable logistic regression) of the odds ratio (OR). For example, when there is no association between the exposure and the outcome variable, i.e. true OR=1, then in an extreme biasing situation, the standard estimate is 1.23 with 95% confidence intervals (CI):(0.63,2.37) while the adjusted estimate is 1.02, 95% CI:(0.45,2.30). When the true OR is 2.41 and the bias breaking variable is also a confounder of the association between the exposure and the outcome, the adjusted estimate is 2.73, 95% CI:(1.23,6.04) whilst the standard estimate is 3.28, 95% CI (1.85,4.93). We also consider a retrospective case control study investigating the association between Hypospadias (a congenital malformation) and life-style risk-factors, where socio economic status is assumed to be the bias breaking variable. Here the SBORs and standard estimates do not differ greatly confirming the validity of the study conclusions.