Let denote copies of independently and identically distributed data, where denotes subject ’s outcome (BMI score), denotes the dichotomous exposure (breastfeeding and cesarean section), denotes the vector of potential confounders. Further, let denote subject *i*’s two potential outcomes for exposure and no exposure respectively. Let denote , the propensity score (PS). Let denote , the covariate-adjusted regression function. With an additive regression function , under the assumption of no unmeasured confounders and some regularity conditions, denotes the parameter of interest, the average treatment effect .

In covariate-adjusted regression, the outcome was regressed on the exposure variable and covariates to obtain point and interval estimates of .

To implement PS-based methods, a logistic regression model was first fitted on data to obtain estimated PSs .

In PS regression, the outcome was regressed on the exposure variable and the estimated PS . The coefficient for is the estimated average treatment effect. PSs may be adjusted for in the regression model in other functional forms, e.g., linear and quadratic terms, a categorical variable indicating which sample quantile range falls in with the sample quantiles calculated using .

In PS stratification, suppose we classify the study population into strata using PS sample quantiles ( with quintiles, with deciles). Let denote the number of subjects in strata , i.e, with . Further, let and denote the numbers of exposed and unexposed subjects in strata respectively. Then the average treatment effect estimator is the weighted average of the within-stratum mean difference between the exposed and unexposed subjects. Specifically,

with its variance estimator where and are the sample variance among the exposed and unexposed subjects in stratum respectively.

PS matching with replacement was implemented using the R package ‘Matching’.

In inverse-probability-weighting, a stabilized weight was first calculated for each subject . Then a weighted linear regression was fitted on data with subject-specific weight . The coefficient for is the inverse-probability-weighting estimator of the average treatment effect.

The robust, sandwich variance estimator was used as a conservative estimator of its variance. Note that the stabilized weight differs from the standard, un-stabilized weight only in the addition of the numerator for exposed subjects and for unexposed subjects. The addition of the numerator makes the finite-sample numeric performance of this estimator more stable and does not affect its other properties.

In DR estimation, both PS model and covariate-adjusted regression model are used. Let denote the estimated covariate-adjusted regression function . The DR estimator is defined below.

Its variance can be approximated by it sample variance