Appendix 1

Real Data Example 3

Korrick et al. (16) examined the relation of bone lead concentration to blood pressure among a subset of women in a cohort study. From the subset of subjects who lived in the Boston area, women were recruited who reported a history of hypertension or who had hypertension on examination (cases, n=89); in addition, control women were recruited who had no history of hypertension and who had normal blood pressure. The controls were divided into two groups: those whose self-reported blood pressure was low normal (n=122) and those whose self-reported blood pressure was high normal (n=73). Bone lead was also measured among those recruited. The original authors analyzed the data using ordinal logistic regression, with the 3 blood pressure groups as the outcome, and measured bone lead as the exposure. The proportion of eligible controls included in the study was not reported, and was not available to us. We reanalyzed their data with the Zhou et al. estimator, using measured systolic blood pressure as the outcome and bone lead concentration as the exposure. For subjects whose measured blood pressure did not agree with their reported blood pressure, we recoded the measured blood pressure so that it was consistent with the reported range. For example, for subjects who reported hypertension but whose measured systolic blood pressure was less than 140 mmHg, we recoded the systolic blood pressure as 140. We adjusted for age, body mass index, family history of hypertension, and dietary sodium. The results showed that for an increase in bone lead of two standard deviations, the systolic blood pressure increased by 2.4 mmHg (p = 0.008). By comparison, when the data were analyzed using ordinary least squares, the estimated effect of lead on blood pressure was twice as large, reflecting the bias incurred by failing to account for the design.
The example demonstrates that by using $\beta_Z$ an unbiased estimate of the relationship of lead to blood pressure as a continuous variable can be computed even when the base population has not been enumerated.