**Data S1.** Model specifications for imputation by linear mixed effects model (LMM).

Let index the subjects and index the visits. There are measurements (visit 2, visit 3, and visit 4) for abdominal circumference, head circumference, and femur length, and measurements (visit 2, visit 3, visit 4, and at delivery) for the combined vector of estimated fetal weight and birth weight. The final selected models for each measured growth parameter are as follows:

Abdominal circumference:

Head circumference:

Femur length:

Estimated fetal weight and birth weight:

and (for each model)

where denotes gestational age of -th subject at -th visit, denotes the set of covariates (maternal age, pre-pregnancy BMI, infant sex, smoking, race, insurance, alcohol use, IVF, preeclampsia, parity) of th subject, and are fixed effect parameters in the mean model, is the random intercept and is the random slope with respect to time/visit for the th subject, and is the random error. We assumed that and are independent. Here is the joint variance-covariance matrix of the random effects and is the variance-covariance matrix of the errors. For abdominal circumference and head circumference, is chosen as a identity matrix to reflect independent error structure; for femur length and estimated fetal weight and birth weight, is unstructured correlation matrix. These selections of the variance-covariance structure were governed by the AIC.

The imputation was performed as follows, using abdominal circumference as an example. There are 897 subjects who have complete covariates and at least one abdominal circumference measurement. We created 50 data sets with imputed measurements for missing abdominal circumference. For each data set, missing gestational ages for time points where abdominal circumference were missing were randomly drawn from a normal distribution , where is the mean gestational age at visit and is the standard deviation of gestational age at visit . Parameters in the linear mixed-effects model of abdominal circumference were estimated by restricted maximum likelihood (REML). The imputed values are estimated by , where and are fixed effects estimates, and are best linear unbiased predictor (BLUP) of random effects of the th subject, and is estimated random error, which is sampled from , where is the standard error (SE) of residuals. Within the 50 imputed datasets, if the gestational age that was imputed for a missing measurement was after the gestational age at delivery, it was deleted from the imputed dataset. If the gestational age that was imputed for visit was after the observed gestational age for visit +1, it was deleted from the imputed dataset as well. This resulted in varying numbers of observations for subsequent statistical models that were fitted. The same procedure was performed for each of the other growth parameters.

Demographic, behavioral, and pregnancy information on study participants was included in both LMM and MICE imputations. These included the following maternal factors: age (in years, continuous); pre-pregnancy body mass index (BMI, in kg/m2, continuous); Race (White, Black, or Other); health insurance provider (public vs. private); tobacco and alcohol use during pregnancy (yes or no); and parity (continuous). We additionally included information on the pregnancy itself in the imputation calculations: *in vitro fertilization* (IVF, yes or no); presence of preeclampsia (yes or no); and infant sex (male or female). Finally, we included gestational age at the time of ultrasound measurement (or at delivery, for birth weight) for both approaches.