

MEMORANDUM

DATE July 17, 1996

TO Jim Collins

FROM Rob Schnatter

Jim,

Attached is the section of my dissertation which addresses the comparison population for SFR's (i.e., the national population). If you have any questions, please call.

A handwritten signature in cursive script, appearing to read "Rob/len", written in dark ink.

Rob

ARS:lm
Attachment

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The stillbirth rate (SBR), or late fetal mortality rate is:

$$\text{SBR} = \frac{\text{number of fetal deaths 28 weeks or more}}{\text{total births}}$$

The latter measure includes stillbirths in the denominator, while the former does not.

f. Calculation of confidence intervals

Confidence intervals for the above measures were calculated to assess the precision of each measure. The confidence intervals assume that the number of cases with the outcome of interest follows a binomial distribution with the probability of success equal to the adverse outcome percent. A slight reformulation for the sex ratio is necessary, in that the number of male births over the total number of births is the binomial parameter (rather than the ratio of males to females). It is straight forward to convert the upper and lower confidence limits for the male birth proportions back to corresponding sex ratios. The confidence intervals were calculated according to the exact binomial formula using the TRUE EPISTAT software package.

g. Standardized Fertility Ratios

Standardized fertility ratios (SFR's), are calculated as:

$$\text{SFR} = \frac{\text{Observed births}}{\text{Expected births}}$$

where,

Observed births -	Births identified through the ERIS ¹ database
Expected births -	U.S. Birth probabilities times the woman-years at risk for pregnancy adjusted for parity of the employee, age of the female employee or spouse of male employee, and time of birth of the offspring.

¹ ERIS is an acronym for Exxon's Employee Relations Information System

The SFR or Standardized Birth Ratio (SBR) statistic has been discussed extensively in the literature (Wong et al., 1979, Levine et al., 1980, Harber, 1981, Levine et al., 1981, Starr and Levine, 1983, Wong et al., 1985, Starr et al., 1986, Wong, 1986). These authors have raised the following issues regarding the calculation and interpretation of the SFR/SBR: (a) the correct terminology, (b) additive accumulation of expected births versus a multiplicative approach for each parity/year combination, (c) the adjustment of the post-employment (or post-exposure) observed/expected birth ratio by the pre-employment (pre-exposure) observed to expected ratio, (d) the inclusion of married employees only, (e) the inclusion of married woman-years only, (f) the inclusion of all parity levels versus only parity 1+, (g) the inclusion of surgically sterilized employees, (h) the inclusion of adopted/step-children in incrementing parity, (i) the inclusion of woman years directly after childbirth.

This project takes the following tacks on these issues: (a) the SFR terminology is used rather than SBR, since fertility rates are specific to 15 - 49 year olds, while birth rates are specific to the whole population. The method uses the reproductive experience of women 15 to 49 years of age, so corresponds more closely to a fertility rate rather than a birth rate; (b) expected births are accumulated additively, since Starr and Levine (1983) showed that the multiplicative procedure was biased; (c) no adjustment of the post-employment observed and expected birth ratios are made by the pre-employment observed/expected ratio. This is not done since the pre-employment period is necessarily characterized by younger ages, lower

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parities, and earlier time periods, all of which generally result in more expected births. In addition, many (male) employees delay childbearing until employment; (d) ever-married and never married employees are included, since they are both present in the national fertility rate tables, however, they are analyzed separately; (e) all woman years are included, as in the national fertility rate tables; (f) all parity levels are included, since they are present in the national fertility rate tables; (g) surgically sterilized employees are included since they are included in the national fertility rate tables; (h) adopted and step children are not used to increment parity, since this is not done in the national fertility rate tables; and (i) woman years directly after childbirth are included, since they are included in the national fertility rate tables.

The U.S. birth probabilities for single years through 1985 were obtained through the National Center for Health Statistics (NCHS, 1988). The 1985 rates were used to calculate expected births for the 1986-88 time period.

Expected births were calculated after the date first employed plus nine months for all employees. Observed births were enumerated over the similar interval. Age and parity were treated as dynamic variables, while birth cohort (year of birth) was constant. Expected births specific to age (or wife's age), parity and birth cohort were calculated for each employee and totalled. Indirect standardization methods were used to weight the expected births calculation to the woman years at risk distribution in the study population, according to age, parity, and calendar time period. The software program used to

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calculate SFR's was developed by Levine and colleagues at CIIT and was pretested extensively. These investigators have used the program in several publications. Methods for testing the accuracy of ERIS data will be described in a following section of this chapter. Ninety-five percent confidence intervals were computed for the SFR's according to the formula of Byar, cited in Rothman and Boice (1979).

h. Participant/non-participant SFR's

SFR calculations (using ERIS data) were performed separately for participants and non-participants. This analysis provides insight on whether there is response bias relative to fertility in questionnaire respondents. Response bias is indicated if SFR's between participants and non-participants differ significantly (i.e. the SFR confidence intervals do not overlap). This analysis differs slightly from the assessment of the coefficient for parity in logistic analyses described above. This assessment is a direct measure of birth spacing differences in respondents versus non-respondents, while the parity coefficient does not account for birth spacing.

4. Workplace medical records

The final method of investigating possible response bias used an independent database to investigate certain outcome measures. This analysis was not budgeted in the initial proposal, but was possible due to a simultaneous record abstraction in these workers for a separate mortality study. Workplace medical records were blindly abstracted for a sample of participants and non-participants. Documentation of miscarriages and infertility were abstracted from these records. This analysis was restricted to these two outcomes for the following

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