Population-Based Surveillance and Etiological Research of Adverse Reproductive Outcomes and Toxic Wastes

PHASE I

ASSEMBLING INFORMATION ON ADVERSE REPRODUCTIVE OUTCOMES

NEW JERSEY DEPARTMENT OF HEALTH
A BETTER STATE OF HEALTH

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POPULATION-BASED SURVEILLANCE AND ETIOLOGICAL
RESEARCH OF ADVERSE REPRODUCTIVE OUTCOMES AND TOXIC WASTES

REPORT ON PHASE I: ASSEMBLING INFORMATION ON ADVERSE REPRODUCTIVE OUTCOMES

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March, 1992

New Jersey Department of Health

This report was supported in part by funds from the Comprehensive Environmental Response, Compensation, and Liability Act trust fund through a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

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ACKNOWLEDGMENTS

The principal authors wish to express gratitude to many people for enabling the completion of this multi-year project and its five reports.

We were very fortunate to have a dedicated staff who contributed to the project over a long period of time: many of these individuals continue to work at the Department, continuing to contribute toward the project's objectives:

> Jorge Esmart, Ellen Dufficy, Marian McElroy, Kay Knoblauch, Barbara Guidici, Debra Dragnosky-Embert, Suzanne Tschachler, and Donna France conducted interviews of the cases and controls; Jorge Esmart, Ellen Dufficy and Mary Knapp compiled, completed, and cleaned the birth outcomes data.
>
> Carmen Pedroza and Jeanette Corbin contributed their secretarial and data entry skills.

Numerous Departmental personnel supported the project through its many phases:

> Elizabeth Shapiro, Pamela Costa and Barbara Kern supported the project through their work on the Birth Defects Registry. Jonathan Savrin assisted in the completion of the reports. Perry Cohn, William Coniglio and Jerald Fagliano contributed technical insights. George Halpin, Susan Lenox-Goldman, Jerald Fagliano, Kathleen Cunningham, Diana Kiel, James Brownlee, Rebecca Zagraniski, and Leah Ziskin provided management support and technical reviews.

This project depended for its success on cooperation and contributions by many individuals outside the Department of Health:

> Barker Hamill and his staff in the Bureau of Safe Drinking Water made it possible to conduct the exposure assessment for the drinking water studies. Robert Tucker and Leslie McGeorge of the Division of Science and Research coordinated the technical reviews and communications within Department of Environmental Protection and Energy. Our able Peer Review Panel was composed of Drs. Howard Kipen, Dirk Moore, Nigel Paneth, and Sherry Selevan. We thank the water companies of northern New Jersey for their consistent cooperation. We are indebted to the hundreds of New Jersey women who shared their time and life experiences with us.

Lastly, this project succeeded because of the constant and creative support of our project officer, Larry Edmonds of the Centers for Disease Control.

EXECUTIVE SUMMARY

This report constitutes the first phase of the cooperative agreement of the New Jersey Department of Health and the Centers for Disease Control: Population-Based Surveillance and Etiologic Research of Adverse Reproductive Outcomes and Toxic Wastes. Phase I of the project was intended to both enhance and evaluate the operation and data collection of the New Jersey Birth Defects Registry (BDR) and present rates of adverse reproductive outcomes of the state and its subdivisions including comparisons with other such registries. Under this phase, outcome rates for the state, its 21 counties, and 567 municipalities were generated for perinatal mortality (fetal and infant mortality), low birth weight, and congenital anomalies (total and categories). In addition, New Jersey's municipalities were characterized with respect to demographic and health related variables derived from the U.S. Census and vital records databases.

The report incorporates data on live births, fetal deaths (stillbirths) and records in the BDR for the years 1985 through 1987. The means by which the BDR has been implemented and its quality control are described in the Phase I report and other reports previously generated by the Department. The BDR is a modified passive system; reporting of congenital anomalies to the Department of Health by hospitals and physicians are required by statute. Follow-up to ensure completeness of reporting is conducted annually and continually by the registry staff.

Rates of all and selected categories of congenital anomalies were computed by state, county and municipality based on anomalies reported to the BDR up to age one. Comparisons were then made between these rates and rates generated by other birth defects surveillance programs in this country. Most New Jersey rates fell between those of "passive" and "active" systems elsewhere. However, some categories of birth outcomes appeared to show more complete ascertainment due to improved methods used in New Jersey; e.g. central nervous system defects for which fetal death and infant death certificates were combined with BDR data. In addition, rates of low birthweight, fetal deaths and infant mortality for the 1985-1987 birth cohorts were computed by municipality.

The municipality-based rates of birth outcomes were also examined in relation to each other and in relation to aggregate sociodemographic characteristics which were extracted from the U.S. Census and from vital records databases. Most notably, rates based upon vital records, especially low birthweight due to both prematurity and small for gestational age, are largely predicted by sociodemographic variables while birth defect rates appear to be unrelated to these independent factors. Correlations between birth outcome categories and between birth outcomes and some of these sociodemographic variables are presented in the report and its appendices. The rates of both the outcomes and the demographic variables also comprised the essential input to the Phase III ecological analyses.

The activities undertaken under this phase of the overall project have served to:

(1) enhance the data quality, completeness, and applications of the birth defects registry,

(2) facilitate the identification and avoidance of duplicate records among birth certificate, fetal death, infant death, and birth defects registries,

(3) identify demographic factors statistically correlated with rates of adverse birth outcomes,

(4) identify adverse birth outcomes that have rates correlated with other, outcomes rates,

(5) enable comparison rates of specific birth defects in New Jersey with other registries in this country, and

(6) facilitate the accomplishment of the other phases of the project, particularly Phase III.

Notably, merging of data from birth certificates, death certificates, fetal death certificates, and the Birth Defects Registry has improved the completeness and quality of adverse reproductive outcomes rates and other data. In particular, reporting of central nervous system defects and chromosomal anomalies were thereby improved over those derived from the BDR alone.

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I. INTRODUCTION

In 1986, the New Jersey Department of Health (NJDOH) entered into a five-year cooperative agreement with the U.S. Centers for Disease Control (CDC). The goal of the project was to develop and apply appropriate methodology to assess relationships between adverse reproductive outcomes (AROs) and population exposures to environmental pollutants, particularly toxic waste site contamination. It was anticipated that the results of the project would be useful for the prevention of adverse reproductive outcomes.

Listed below are the four main objectives of the project.

(1) To enhance the Department of Health's capability to conduct surveillance and etiological research of AROs, including birth defects, low birthweight, fetal deaths and infant mortality.

(2) To evaluate the appropriateness of available data on environmental pollution for estimating exposures to populations.

(3) To perform ecological (correlational) analyses at the municipality level of fetal and infant mortality, birth defects and low birthweight and estimated population exposure to environmental pollutants (using appropriate environmental databases).

(4) To conduct etiological studies of selected adverse reproductive outcomes and exposures to environmental pollutants.

The project was divided into four "phases" corresponding to these four objectives. Separate reports have been prepared for each of the four phases.

This report describes the activities undertaken in Phase I of the project as outlined in the research protocol (Fulcomer et al., 1987) and greatly expands on an earlier report (Fulcomer et al., 1986) that highlighted the development of New Jersey's new Birth Defects Registry (BDR). [Recently, BDR staff prepared a report (NJDOH, 1991) that provides much more up-to-date results from the Registry.] As a first step in assessing relationships

between adverse reproductive outcomes and exposures to environmental pollutants, the current report presents information on the methods used to assemble the necessary data on ARO cases so that stable rates could be generated for small geographic areas. The report focuses on our work in the three areas listed below and may be of special interest to others collecting such data as part of routine surveillance programs.

(1) Characterizing the State's municipalities in terms of U.S. Census and other demographic and health-related variables.

(2) Assembling individual data on adverse reproductive outcomes, including a description of the activities undertaken to gather information on a range of specific congenital anomalies.

(3) Establishing outcome rates for the municipalities and for the entire State and describing some of their statistical characteristics.

The analyses included in this report are based on data from the 327,015 live births and 3,548 fetal deaths (stillbirths) that occurred to New Jersey residents from 1985 to 1987. By combining information from this large group of births with that on exposures to environmental pollutants from the project's second phase (Bove, 1992) and on other sociodemographic attributes available on the selected geographic areas, subsequent correlational analyses in the project's third phase (Fulcomer et al., 1992a) overcame many of the confounding and conceptual difficulties encountered in smaller-scale studies. Similarly, enhancing the ascertainment of birth defects and other AROs through the efforts described here improved the statistical power and generalizability of the etiological studies in the project's fourth phase (Bove et al., 1992a and 1992b).

II. SOCIODEMOGRAPHIC AND HEALTH VARIABLES TO CHARACTERIZE NEW JERSEY'S MUNICIPALITIES

This chapter briefly describes the selection of U.S. Census and six other health variables that were used as sociodemographic indicators to summarize the entire State and its 567 municipalities. Other health variables described are either AROs themselves or play an important role in explaining outcome rates for both this report and the later correlational analyses. The next chapter addresses the acquisition of those AROs involving congenital anomalies.

New Jersey possesses several characteristics which make it suitable as a location for the population-based surveillance of toxic waste effects on reproductive outcomes. With a population of 7.36 million people living within an area of 7,496 square miles according to the 1980 U.S. Census (NJDOL, 1984), it is the most densely populated state in the nation, yet it has great internal hetereogeneity and contrasts. The northern portion of the State is highly industrialized and heavily populated while the southern portion has large rural, forested areas, many of which have been used for waste disposal. Because of the State's central location in the Northeast Corridor, New Jersey is also a major conduit for the transport of industrial and chemical products. Finally, because of the large population, the number of live births has grown to well over 100,000 per year over the past decade.

Given the diversity within the State, it is not surprising that municipalities often differ widely with respect to the number of births and other indices of reproductive risks. For example, in 1985, the number of births in specific municipalities ranged from 0 to 5,643, reflecting the extreme dispersion of the birthing population throughout New Jersey. Therefore, for ecologic (or correlational) analyses that are based on geographic areas such as municipalities, it is important to assess the variability of births among geographic locations and to consider how to "weight" the geographically-aggregated events (e.g., by the number of births by area) so that the occurrence of spurious, "size-related" associations would be minimized.

A. SELECTION OF U.S. CENSUS VARIABLES

Assembling the U.S. Census variables to characterize New Jersey's municipalities was among the first activities undertaken as part of the cooperative agreement and was completed by the end of 1987. The selection of the characteristics to be included was based on the following:

(1) Access to 1980 U.S. Census tapes provided through the State Data Center of the New Jersey Department of Labor.

(2) Published tables from the 1980 Census (NJDOL, 1982a; NJDOL, 1982b; NJDOL, 1982c; NJDOL, 1982d; NJDOL, 1982e).

(3) Historical data on the State's population since 1790 (NJDOL, 1984).

Four broad categories of demographic attributes were selected for use in the project. A total of 38 original and 16 calculated variables (54 altogether) were categorized as follows:

(1) Land area, 1970/1980 census, and urban/rural distribution of population (7 original; 4 calculated).

(2) Income and education (10 original; 3 calculated).

(3) Housing characteristics (6 original; 4 calculated).

(4) Selected characteristics of individuals (15 original; 5 calculated).

For these census variables, some details such as codebooks have been listed in the project's technical documentation (Fulcomer et al., 1992b) and, therefore, are not presented as part of this report.

Several steps were taken to ensure the accuracy of the census variables.

(1) Values of original variables were verified against available, published sources (e.g., the published tables available from the State Data Center mentioned above).

(2) Descriptive statistics calculated for the original variables (e.g., population totals) were also compared to published summary statistics provided by the State Data Center.

(3) Results found in the calculations of new variables were carefully evaluated, including the checking of computations of values as well as inspecting sums, minima, and maxima.

The inclusion of three distinct types of numerical location codes for the municipalities (commonly referred to as "geocodes") permitted flexible linkage of files of census characteristics to other information for comparable areas (e.g., health outcomes data for the municipalities). Two of these codes (i.e., the federal FIPS codes for county and minor civil divisions and the official state codes for municipalities) are listed in a readily available publication (NJDOL, 1983). The third set of geocodes, used by NJDOH's Bureau of Vital Statistics, are unique identifiers needed to link outcome information derived from vital records.

In addition to the three types of geocodes, a subset of 21 (9 original; 12 calculated) of the census variables was chosen for this project's analyses of New Jersey municipalities, based on an approach presented in an earlier study (Fulcomer et al., 1981). These variables have already been used for several other NJDOH projects (Fulcomer et al., 1988 and Fulcomer and Ziskin, 1989).

In order to facilitate the analyses of communities of vastly different sizes, preference in forming this subset was given to the most readily-comparable version of a variable (e.g., figures expressed as percents rather than as actual numbers). Furthermore, to avoid complications of collinearity (i.e., linear predictability from other variables) within groups of related

items in subsequent regression analyses, an attempt was made to eliminate highly-redundant items (except for the retention of the five separate income variables to explore the possible influences of outliers). Finally, the six municipalities having no births in one or more years during the period from 1983 to 1986 were deleted from further consideration. The removal of the six municipalities eliminated all missing values found among the census variables and is described in the next section. For the remaining 561 county/ municipality units included in the file, Table 1 lists some descriptive statistics (means, standard deviations, minima, and maxima) for the selected census variables.

Based on "covariates" often reported in the literature on adverse reproductive outcomes (e.g., see Myrianthopoulos, 1985, Janerich and Bracken, 1986, and Kallen, 1988), a final set of six demographic variables derived from the U.S. Census characteristics were incorporated into the project's correlational and regression analyses to control for some aspects of socioeconomic status (SES) as follows:

- Per capita income (in dollars).
- Mostly rural (a dichotomous variable indicating if more than 50% of a community's population resided in rural areas).
- Population density (number of persons per square mile in a municipality).
- Percent of housing units with 1.01 or more persons per room ("% crowded housing").
- Percent of housing units built before 1960 ("% old housing").
- Percent of female-headed households with related children under six years of age living below poverty status ("% female-headed poverty").

These six census-based variables remained after a "backward elimination" method (e.g., see Kerlinger and Pedhazur, 1973, Draper and Smith, 1981, and Cohen and Cohen, 1983) was applied to earlier regression analyses using the full set of 21 sociodemographic variables with preliminary data for the outcomes. Because the regression algorithm permitted the inspection of

traditional diagnostic statistics (e.g., regression coefficients, standard errors, coefficients of determination, etc.) for several dependent variables simultaneously along with some measures of redundancy within the independent variable set related to principal components (e.g., collinearity measured by the percent of each independent variable's variance accounted for by the remaining explanatory variables), it was possible to exclude 15 of the 21 census variables which did not explain significant portions of the outcomes' variances but which were highly correlated with other independent variables.

TABLE 1

DESCRIPTIVE STATISTICS FOR DEMOGRAPHIC VARIABLES INCLUDED IN CORRELATIONAL STUDIES OF NEW JERSEY'S COUNTY/MUNICIPALITY UNITS*

NEW JERSEY DEPARTMENT OF HEALTH

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
AREA IN SQUARE MILES	13.26	18.50	0.09	113.40
1980 POPULATION	13127.17	22371.67	192	329248
POPULATION DENSITY	3239.33	4568.48	7.53	43548.89
1970 POPULATION	12809.88	24756.52	204	381930
% CHANGE: 1970-1980	14.77	41.87	-89.86	465.43
% IN RURAL AREAS	28.82	42.44	0.00	100.00
MEDIAN HOUSEHOLD INCOME	22082.31	6806.77	9285	49484
MEDIAN FAMILY INCOME	24622.96	6833.60	10010	51101
MEAN HOUSEHOLD INCOME	25266.25	8813.96	11756	78956
MEAN FAMILY INCOME	27823.94	9158.04	11792	77812
PER CAPITA INCOME	8651.39	2683.50	3692	25185
% HIGH SCHOOL GRADUATES OR GREATER	72.29	10.87	25.57	94.37
% HOUSING UNITS BUILT BEFORE 1960	62.57	19.53	4.22	100.00
% OCCUPIED HOUSING UNITS	94.10	6.96	32.68	100.00
% OWNER OCCUPIED HOUSING UNITS	72.39	17.52	12.89	96.73
% CROWDED HOUSING UNITS (1.01 OR MORE PERSONS PER ROOM)	2.23	1.81	0.00	12.32
% FEMALES	51.47	2.60	24.29	57.25
% NON-WHITES	8.12	12.42	0.00	98.65
% POPULATION UNDER FIVE YEARS OF AGE	6.05	1.72	0.46	19.30
% FAMILIES WITH YOUNG CHILDREN (UNDER 6) LIVING BELOW POVERTY	0.96	1.26	0.00	10.82
% FEMALE-HEADED FAMILIES WITH YOUNG CHILDREN BELOW POVERTY	0.53	.84	0.00	5.15

*** Except for 1970 POPULATION, data are based on the 1980 U.S. Census.**

In addition to the census variables, another set of six sociodemographic variables were created by aggregating birth-certificate information for each municipality and used as independent variables in later regression analyses. [Fetal death certificate information could not be aggregated because many of the variables appeared on the certificates but were not available on computerized records.] These six aggregated variables were:

- Average age of mothers at the time of birth ("mother's age").
- Percent of mothers over age 35 at the time of birth ("% mothers > 35").
- Percent of mothers who did not have at least a high school education ("% mothers < H.S.").
- Percent of primiparous mothers ("% primiparous").
- Percent of white mothers ("% white").
- Percent of births with "inadequate" prenatal care ("% inadequate prenatal care").

Because New Jersey has undergone tremendous growth and changes in the dispersion of its population since the 1970's, these additional background variables from birth certificates were used to obtain more recent information than the 1980 Census for maternal age, education, race, and parity. The percent of mothers over age 35 at the time of birth was selected to explore some possible non-linear effects, particularly recent increases in maternal ages and Down Syndrome among births to women in that age-category (e.g., see Fulcomer et al., 1988). An earlier algorithm (NAS, 1973) was employed to calculate values for the prenatal care adequacy variable. The algorithm accounts for the month prenatal care began, the number of prenatal visits, and the gestational age at birth. Characteristics of this algorithm when applied to New Jersey births (e.g., handling of missing information on gestational ages) are described in the cross-sectional report (Bove et al., 1992a), which introduced this approach to the project. [Work on the cross-sectional report also provided the percent of small-for-gestational age births mentioned in the next section.]

The final six census-based variables and the six items aggregated from birth certificates were selected for inclusion as independent variables in the

project's correlational and regression analyses. [Results of some of these analyses are included in this document, although the majority of the work on exposure-outcome relationships is presented in the report on the project's third phase (Fulcomer et al., 1992a).]

B. SELECTION OF HEALTH VARIABLES BASED ON VITAL RECORDS

Information on selected health variables comprise the second set of geocoded information used to characterize the State's municipalities. These health variables were derived from three types of state vital records (birth certificates, death certificates, and fetal death certificates maintained by NJDOH's Bureau of Vital Statistics, or BVS) for the years 1985 to 1987. These vital records served as population-based sources for some of the adverse reproductive outcomes of interest (e.g., very low and low birthweight) and provided denominators for some outcome rates (e.g., rates per 1,000 live births) and several other important background variables employed in later analyses (e.g., inadequate prenatal care). [It should be noted that, despite being perhaps the most well-known source of data on health outcomes, vital records are sometimes affected by accuracy and ascertainment problems (e.g., Minton and Seegmiller, 1986, and Greb et al., 1987).] Listed below are the health variables created from each type of certificate.

(1) Variables created from birth certificate records:

- (a) Number of births with very low birthweights (< 1500 grams).
- (b) Number of births with low birthweights (< 2500 grams).
- (c) Number of births with unknown birthweights.
- (d) Total number of infants born.
- (e) Rate of births with very low birthweights.
- (f) Rate of births with low birthweights.
- (g) Rate of births with unknown birthweights.
- (h) Percent of preterm births (gestational age less than 38 weeks).
- (i) Percent of small-for-gestational age births (birthweights below the 10th percentile for each week of gestation).

(2) Variables created from death certificate records:

(a) Number of neonatal deaths (up to 28 days after birth).

(b) Number of post-neonatal deaths (28 days to one year).

(c) Total number of infant deaths (up to one year of age).

(d) Rate of neonatal deaths.

(e) Rate of post-neonatal deaths.

(f) Rate of infant deaths.

(3) Variables from fetal death certificate records:

(a) Number of fetal deaths (20 weeks or more gestational age).

(b) Rate of fetal deaths.

With the assistance of NJDOH's Maternal and Child Health Services (MCHS), separate data files of these health variables by municipality were constructed for each birth-year cohort from 1983 through 1988, although only the years from 1985 through 1987 were used in the analyses found in this report. These data formed the basis for a project-based presentation on trend statistics (Fulcomer, 1988). Codebooks for each birth-year's file, including formulae used to create various rates, are available in the project's technical documentation (Fulcomer et al., 1992b).

For each of the three types of certificates, cross-tabulations of the health events by municipality were prepared by MCHS on a mainframe computer and downloaded to a microcomputer for editing and calculating rates. MCHS's processing of vital records information on a mainframe computer is based on tapes of data files initially prepared by BVS and then published by NJDOH's Center for Health Statistics (CHS) in comprehensive statistical reports. The reports for 1985, 1986, and 1987 are available (NJDOH, 1987; NJDOH, 1988; and NJDOH, 1989).

By taking advantage of the availability of certificate-based information within NJDOH for the years from 1983 through 1988, MCHS has developed special, birth-year cohort files to monitor infant and fetal mortality rates and other pregnancy outcomes observed in New Jersey facilities, including the matched linkage of birth and death certificates. In large part, MCHS's treatments of infant birth, infant death, and fetal death records correct errors in the

recording and the entry of data (e.g., in birthweights and in the coding of municipalities) and data omissions or oversights (e.g., inadequately stated causes of deaths). These special files also include other items found on the certificates but not entered by BVS, notably additional diagnoses and other factors possibly related to the causes of infants' deaths, and are constructed to facilitate the analysis of matched birth-death data from the birth-year cohort perspective (vs. the death-year cohorts as published in CHS's statistical reports).

In their special files, MCHS generally edits only those records for in-state resident infant and fetal deaths, largely because of their interest in the delivery of services provided within New Jersey and because of difficulties in the receipt and completeness for out-of-state events for New Jersey residents. Therefore, only events both occurring in-state and involving residents of New Jersey are uniformly captured. Furthermore, except for a few changes in some critical items found in the matched birth-death files, the remainder of the computer records are not edited.

For each individual year and the total of the three years from 1985 to 1987, Table 2 lists the number of New Jersey births, infant deaths, and fetal deaths using the special files of the NJDOH's vital records prepared by MCHS. [Rates and other descriptive results for these outcomes are given in the fourth chapter of this report.] By accounting for New Jersey resident births in unspecified locations, the MCHS figures for birth are identical to those reported by CHS (NJDOH, 1987; NJDOH, 1988; and NJDOH, 1989). However, as mentioned above, the MCHS figures for infant deaths are given by birth-year cohort, in contrast to the calendar year of death as provided by CHS. Other important enhancements to the CHS figures are the removal of induced abortions from the reporting of all fetal deaths.

Table 2 also summarizes the exclusion of outcome information found on vital records due to the removal of records from locations not included in this project. Locations for which records were deleted were: state institutions; military posts; unspecified residences; and the six municipalities removed because no births occurred in one or more years during the period from 1983 to 1986. The most important exclusion of information

TABLE 2

FREQUENCIES OF NEW JERSEY RESIDENT LIVE BIRTHS, NEONATAL AND POST-NEONATAL INFANT DEATHS, AND FETAL DEATHS FOR 1985, 1986, AND 1987

OUTCOME DERIVED FROM VITAL RECORDS	1985	1986	1987	TOTAL
BIRTHS				
Resident Live Births	105,329	108,446	113,240	327,015
Locations Removed:				
State Institutions	7	9	1	17
Military Posts	343	225	190	758
Unspecified	0	2	6	8
Six Municipalities Deleted	6	10	6	22
Total For Later Analyses	104,973	108,200	113,037	326,210
INFANT DEATHS BY BIRTH-YEAR COHORT				
Resident Neonatal Deaths	775	710	722	2,207
Locations Removed:				
State Institutions	0	0	0	0
Military Posts	6	3	4	13
Unspecified	2	2	1	5
Six Municipalities Deleted	0	0	0	0
Total For Later Analyses	767	705	717	2,189
Resident Post-Neonatal Deaths	359	350	339	1,048
Locations Removed:				
State Institutions	0	0	0	0
Military Posts	3	0	1	4
Unspecified	1	1	0	2
Six Municipalities Deleted	0	0	0	0
Total For Later Analyses	355	349	338	1,042
Total Infant Deaths	1,134	1,060	1,061	3,255
Locations Removed:				
State Institutions	0	0	0	0
Military Posts	9	3	5	17
Unspecified	3	3	1	7
Six Municipalities Deleted	0	0	0	0
Total For Later Analyses	1,122	1,054	1,055	3,231
FETAL DEATHS				
Resident Fetal Deaths: Total	1,119	1,166	1,263	3,548
With Induced Abortions Removed	787	851	912	2,550
Locations Removed:				
State Institutions	0	0	0	0
Military Posts	2	1	7	10
Unspecified	2	0	1	3
Six Municipalities Deleted	1	0	0	1
Total For Later Analyses	782	850	904	2,536

represented in Table 2 is the birth certificate data for the large number of residents of military posts, for which census figures on population are not comparable to those for the rest of the State. The removal of the six municipalities resulted in the loss of only 22 births (0.0067% of the State's births) and one fetal death for the three-year period from 1985 through 1987. Thus, compiling the complete data file for municipalities in this project (i.e., with no missing information for both outcome and census variables) was accomplished with a minimal loss of outcome-related information.

III. ADVERSE REPRODUCTIVE OUTCOMES INVOLVING CONGENITAL ANOMALIES

This chapter discusses the acquisition of data on individuals born with congenital anomalies (or birth defects) using NJDOH's individual-based reporting systems. First, the chapter briefly highlights some of the activities undertaken to collect individual data for this report, covering the 327,015 live births and 3,548 fetal deaths (stillbirths) that occurred to New Jersey residents in the three years from 1985 to 1987. The second section provides rates of selected congenital anomalies for the 8,843 cases having one or more congenital anomalies. These cases were reported principally through the Birth Defects Registry (BDR).

A. COLLECTING INDIVIDUAL-BASED DATA ON CONGENITAL ANOMALIES

Like much of the material presented in the previous chapter on acquiring U.S. Census and routine vital statistics data, the collection of individual-based information on congenital anomalies began as soon as the cooperative agreement commenced in the summer of 1986. Much of this work has continued to the present, thereby extending the project's data acquisition efforts far beyond what was initially envisioned, and reflecting the commitment of NJDOH to the first objective of enhancing its surveillance and research capabilities in the area of AROs. The BDR became population-based in 1985, despite a history of providing services on an as-needed basis through the Crippled Children's Program that began in the 1920's.

Because the population-based BDR had been operating for only a short time when the project began, the first few quarters of the cooperative agreement were devoted to enhancing the operations of the Registry to meet the goals of the project. Activities undertaken included staffing the project, obtaining microcomputer hardware and software, preparing and implementing record-handling procedures, and clarifying diagnoses.

By 1988 several statistical analyses involving BDR data were in progress. These analytic efforts included the completion of a study of the occurrence of chromosomal defects (Fulcomer et al., 1988), an early assessment of the

reporting of birth defects by maternity hospitals to assist in the design of the BDR's quality assurance program, and a first attempt to use ARO data to identify areas to be included in a case-control study for the project's fourth phase. These activities revealed some data quality problems that were later resolved by project staff, especially the handling of duplicate registrations received from multiple reporting sources.

By the summer of 1989, three large 80386 microcomputers were purchased by the project, one for use by the BDR and the remaining two for large-scale applications by the project's research scientists. The system devoted to the BDR enabled the entire set of registrations received since 1985 to reside in a single database, which facilitated further analyses and helped to avoid the entry of duplicate records. A computer program was developed to augment BDR records with selected recodings of diagnostic variables and other values. The new records created by this program grouped congenital anomalies into 32 specific categories, based on work reported on by CDC (CDC, 1988). For each case, the program also formed six broader summary indicators (neural tube defects; eye defects; selected severe cardiac defects; oral clefts; reduction deformities; and chromosomal anomalies) and counted the the total numbers of congenital anomalies (up to eight such diagnoses were possible for each record) and the 32 specific categories that occurred. Through simple reformatting of fields in input records, this program could also be applied to fetal and infant death certificate files.

Beginning in 1990, the arrival of new staff members enabled the BDR to expand its efforts to improve the quality of reports of congenital anomalies submitted to it. About the same time, project staff of the cooperative agreement were able to obtain additional information on congenital anomalies from the three other types of ARO data sources, including fetal death (F.D.) certificates, infant death (I.D.) certificates, and the matching of birth certificates with records from the BDR. Earlier, in the summer of 1989, the process of selecting subjects with congenital anomalies for the case-control study of the project's fourth phase (Bove et al., 1992b) had utilized the fetal and infant death certificates. Later in 1990, the project's cross-sectional study (Bove et al., 1992a) relied heavily on the matching of birth certificates to registrations with the BDR, in addition to information on

congenital anomalies ascertained through the fetal and infant death certificates.

B. FREQUENCIES AND RATES OF CONGENITAL ANOMALIES

Table 3 lists the frequencies of reported congenital anomalies by the source of ascertainment for New Jersey infants born in 1985 to 1987 and fetal deaths that occurred to residents of the State in that period. The diagnoses reported here are the specific conditions within the twenty major categories designated as congenital anomalies (ICD-9 codes 740 to 759). For each specific diagnosis having at least one report of an affected infant or fetal death, Table 3 indicates the number (simple frequency) of cases obtained from each ascertainment source [i.e., the Birth Defects Registry (BDR), the infant death (I.D.) certificates, and the fetal death (F.D.) certificates]. Also found in Table 3 are the total number of cases for each diagnosis and total rate per 1000 live births for the years from 1985 through 1987.

For live births, the frequencies in Table 3 refer only to those diagnoses made up to age one. Because some reports of birth defects present at or soon after birth are not submitted to the Registry by the child's first birthday, all registrations received up to age two with at least one diagnosis in the 740 to 759 range were checked to determine if such conditions were present before a child's first birthday (i.e., a "true" congenital anomaly vs. an acquired condition or development problem that became apparent later).

Table 3 is quite similar to the corresponding table in the first report on the Registry (Fulcomer et al., 1986) except for being based on more complete ascertainment procedures (e.g., incorporating cases found through matched birth-death and fetal death records and a somewhat longer reporting interval). Further, given the recent steps taken to remove duplicate records from the BDR, the rate of live births with one or more defects (26.14 per 1000 live births) is quite comparable to the earlier value reported (27.00). Although the infant death and fetal death certificates account for only a small fraction of the records in the entire analytic file for this report, these two sources of ascertainment still have an important impact on the

TABLE 3

OUTCOME FREQUENCIES BY SOURCE OF ASCERTAINMENT AND TOTAL RATES PER 1000 LIVE BIRTHS OF CONGENITAL ANOMALIES IN NEW JERSEY FROM 1985 TO 1987: UNDUPLICATED CASES FOUND THROUGH THE BIRTH DEFECTS REGISTRY (B.D.R.), INFANT DEATHS (I.D.), AND FETAL DEATHS (F.D.)

		CODES AND DESCRIPTIONS FOR DIAGNOSTIC CATEGORIES	FREQUENCIES BY SOURCE				
740	CODES	ANENCEPHALUS AND SIMILAR ANOMALIES	B.D.R.	I.D.	F.D.	TOTAL	RATE
	740.0	Anencephalus	34	22	45	101	0.31
741	CODES	SPINA BIFIDA	B.D.R.	I.D.	F.D.	TOTAL	RATE
	741.0	With hydrocephalus	43	1	2	46	0.14
	741.9	Without mention of hydrocephalus	109	1	8	118	0.36
742	CODES	OTHER CONGENITAL ANOMALIES OF NERVOUS SYSTEM	B.D.R.	I.D.	F.D.	TOTAL	RATE
	742.0	Encephalocele	28	3	4	35	0.11
	742.1	Microcephalus	159	3	1	163	0.50
	742.2	Reduction deformities of brain	32	3	0	35	0.11
	742.3	Congenital hydrocephalus	229	12	18	259	0.79
	742.4	Other specified anomalies of brain	43	0	0	43	0.13
	742.5	Other specified anomalies of spinal cord	4	0	0	4	0.01
	742.8	Other specified anomalies of nervous system	7	0	0	7	0.02
	742.9	Unspecified anomaly of brain, spinal cord, and nervous system	26	2	5	33	0.10
743	CODES	CONGENITAL ANOMALIES OF EYE	B.D.R.	I.D.	F.D.	TOTAL	RATE
	743.0	Anophthalmos	7	0	0	7	0.02
	743.1	Microphthalmos	16	0	0	16	0.05
	743.2	Buphthalmos	14	0	0	14	0.04
	743.3	Congenital cataract and lens anomalies	42	0	0	42	0.13
	743.4	Coloboma and other anomalies of anterior segment	25	0	0	25	0.08
	743.5	Congenital anomalies of posterior segment	7	0	0	7	0.02
	743.6	Congenital anomalies of eyelids, lacrimal system, and orbit	28	0	0	28	0.09
	743.8	Other specified anomalies of eye	12	0	0	12	0.04
	743.9	Unspecified anomaly of eye	7	0	0	7	0.02
744	CODES	CONGENITAL ANOMALIES OF EAR, FACE, AND NECK	B.D.R.	I.D.	F.D.	TOTAL	RATE
	744.0	Anomalies of ear causing impairment of hearing	18	0	0	18	0.06
	744.1	Accessory auricle	414	1	0	415	1.27
	744.2	Other specified anomalies of ear	91	0	0	91	0.28
	744.3	Unspecified anomaly of ear	27	0	0	27	0.08
	744.4	Branchial cleft cyst or fistula; preauricular sinus	42	0	0	42	0.13
	744.5	Webbing of neck	5	0	0	5	0.02
	744.8	Other specified anomalies of face and neck	8	0	1	9	0.03
	744.9	Unspecified anomalies of face and neck	12	0	0	12	0.04

TABLE 3 (continued)

		CODES AND DESCRIPTIONS FOR DIAGNOSTIC CATEGORIES	FREQUENCIES BY SOURCE				
745	CODES	BULBUS CORDIS ANOMALIES AND ANOMALIES OF CARDIAC SEPTAL CLOSURE	B.D.R.	I.D.	F.D.	TOTAL	RATE
	745.0	Common truncus	11	1	0	12	0.04
	745.1	Transposition of great vessels	95	4	0	99	0.30
	745.2	Tetralogy of Fallot	70	3	0	73	0.22
	745.3	Common ventricle	16	1	1	18	0.06
	745.4	Ventricular septal defect	504	9	0	513	1.57
	745.5	Ostium secundum type atrial septal defect	134	9	4	147	0.45
	745.6	Endocardial cushion defects	48	2	0	50	0.15
	745.7	Cor biloculare	0	0	1	1	0.00
	745.8	Other	2	0	1	3	0.01
	745.9	Unspecified defect of septal closure	4	0	0	4	0.01
746	CODES	OTHER CONGENITAL ANOMALIES OF HEART	B.D.R.	I.D.	F.D.	TOTAL	RATE
	746.0	Anomalies of pulmonary valve	48	0	0	48	0.15
	746.1	Tricuspid atresia and stenosis, congenital	27	0	0	27	0.08
	746.2	Ebstein's anomaly	11	0	0	11	0.03
	746.3	Congenital stenosis of aortic valve	9	0	0	9	0.03
	746.4	Congenital insufficiency of aortic valve	4	0	0	4	0.01
	746.5	Congenital mitral stenosis	2	0	0	2	0.01
	746.6	Congenital mitral insufficiency	5	0	0	5	0.02
	746.7	Hypoplastic left heart syndrome	52	9	1	62	0.19
	746.8	Other specified anomalies of heart	86	1	4	91	0.28
	746.9	Unspecified anomaly of heart	288	14	6	308	0.94
747	CODES	OTHER CONGENITAL ANOMALIES OF CIRCULATORY SYSTEM	B.D.R.	I.D.	F.D.	TOTAL	RATE
	747.0	Patent ductus arteriosus	413	11	0	424	1.30
	747.1	Coarctation of aorta	62	2	0	64	0.20
	747.2	Other anomalies of aorta	19	0	0	19	0.06
	747.3	Anomalies of pulmonary artery	83	1	0	84	0.26
	747.4	Anomalies of great veins	16	1	0	17	0.05
	747.5	Absence or hypoplasia of umbilical artery	100	0	0	100	0.31
	747.6	Other anomalies of peripheral vascular system	6	0	0	6	0.02
	747.8	Other specified anomalies of circulatory system	5	1	1	7	0.02
	747.9	Unspecified anomaly of circulatory system	104	14	0	118	0.36
748	CODES	CONGENITAL ANOMALIES OF RESPIRATORY SYSTEM	B.D.R.	I.D.	F.D.	TOTAL	RATE
	748.0	Choanal atresia	19	0	0	19	0.06
	748.1	Other anomalies of nose	17	0	0	17	0.05
	748.2	Web of larynx	3	0	0	3	0.01
	748.3	Other anomalies of larynx, trachea, and bronchus	49	1	0	50	0.15
	748.4	Congenital cystic lung	4	0	1	5	0.02
	748.5	Agenesis, hypoplasia, and dysplasia of lung	76	49	8	133	0.41
	748.6	Other anomalies of lung	8	1	0	9	0.03
	748.8	Other specified anomalies of respiratory system	3	0	0	3	0.01
	748.9	Unspecified anomaly of respiratory system	0	1	0	1	0.00

TABLE 3 (continued)

		CODES AND DESCRIPTIONS FOR DIAGNOSTIC CATEGORIES	FREQUENCIES BY SOURCE				
749	CODES	CLEFT PALATE AND CLEFT LIP	B.D.R.	I.D.	F.D.	TOTAL	RATE
	749.0	Cleft palate	171	0	1	172	0.53
	749.1	Cleft lip	82	0	0	82	0.25
	749.2	Cleft palate with cleft lip	160	1	1	162	0.50
750	CODES	OTHER CONGENITAL ANOMALIES OF UPPER ALIMENTARY TRACT	B.D.R.	I.D.	F.D.	TOTAL	RATE
	750.0	Tongue tie	26	0	0	26	0.08
	750.1	Other anomalies of tongue	13	1	0	14	0.04
	750.2	Other specified anomalies of mouth and pharynx	11	0	0	11	0.03
	750.3	Tracheoesophageal fistula, esophageal atresia and stenosis	66	3	0	69	0.21
	750.4	Other specified anomalies of esophagus	4	0	0	4	0.01
	750.5	Congenital hypertrophic pyloric stenosis	25	1	0	26	0.08
	750.6	Congenital hiatus hernia	2	0	0	2	0.01
	750.7	Other specified anomalies of stomach	1	0	0	1	0.00
	750.8	Other specified anomalies of upper alimentary tract	18	0	0	18	0.06
	750.9	Unspecified anomaly of upper alimentary tract	6	0	0	6	0.02
751	CODES	OTHER CONGENITAL ANOMALIES OF DIGESTIVE SYSTEM	B.D.R.	I.D.	F.D.	TOTAL	RATE
	751.0	Meckel's diverticulum	4	1	0	5	0.02
	751.1	Atresia and stenosis of small intestine	62	0	2	64	0.20
	751.2	Atresia and stenosis of large intestine, rectum, and anal canal	96	4	0	100	0.31
	751.3	Hirschsprung's disease and other congenital functional disorders of colon	25	0	0	25	0.08
	751.4	Anomalies of intestinal fixation	25	1	1	27	0.08
	751.5	Other anomalies of intestine	37	2	0	39	0.12
	751.6	Anomalies of gallbladder, bile ducts, and liver	23	2	1	26	0.08
	751.7	Anomalies of pancreas	5	0	0	5	0.02
	751.8	Other specified anomalies of digestive system	8	0	0	8	0.02
	751.9	Unspecified anomaly of digestive system	2	0	0	2	0.01
752	CODES	CONGENITAL ANOMALIES OF GENITAL ORGANS	B.D.R.	I.D.	F.D.	TOTAL	RATE
	752.0	Anomalies of ovaries	1	0	0	1	0.00
	752.1	Anomalies of fallopian tubes and broad ligaments	2	0	0	2	0.01
	752.3	Other anomalies of uterus	0	0	2	2	0.01
	752.4	Anomalies of cervix, vagina, and external female genitalia	41	0	0	41	0.13
	752.5	Undescended testicle	327	0	0	327	1.00
	752.6	Hypospadias and epispadias	650	0	0	650	1.99
	752.7	Indeterminate sex and pseudohermaphroditism	37	1	0	38	0.12
	752.8	Other specified anomalies of genital organs	57	1	0	58	0.18
	752.9	Unspecified anomaly of genital organs	10	0	0	10	0.03
	753.0	Renal agenesis and dysgenesis	38	14	9	61	0.19
	753.1	Cystic kidney disease	41	6	1	48	0.15

TABLE 3 (continued)

		CODES AND DESCRIPTIONS FOR DIAGNOSTIC CATEGORIES	FREQUENCIES BY SOURCE				
753	CODES	CONGENITAL ANOMALIES OF URINARY SYSTEM	B.D.R.	I.D.	F.D.	TOTAL	RATE
	753.2	Obstructive defects of renal pelvis and ureter	91	1	0	92	0.28
	753.3	Other specified anomalies of kidney	19	0	1	20	0.06
	753.4	Other specified anomalies of ureter	12	0	0	12	0.04
	753.5	Exstrophy of urinary bladder	5	0	0	5	0.02
	753.6	Atresia and stenosis of urethra and bladder neck	12	1	0	13	0.04
	753.7	Anomalies of urachus	5	0	0	5	0.02
	753.8	Other specified anomalies of bladder and urethra	15	1	0	16	0.05
	753.9	Unspecified anomaly of urinary system	8	1	3	12	0.04
754	CODES	CERTAIN CONGENITAL MUSCULOSKELETAL DEFORMITIES	B.D.R.	I.D.	F.D.	TOTAL	RATE
	754.0	Of skull, face, and jaw	17	1	0	18	0.06
	754.1	Of sternocleidomastoid muscle	9	0	0	9	0.03
	754.2	Of spine	2	0	0	2	0.01
	754.3	Congenital dislocation of hip	454	0	0	454	1.39
	754.4	Congenital genu recurvatum and bowing of long bones of leg	22	0	0	22	0.07
	754.5	Varus deformities of feet	287	0	0	287	0.88
	754.6	Valgus deformities of feet	108	0	0	108	0.33
	754.7	Other deformities of feet	271	1	0	272	0.83
	754.8	Other specified nonteratogenic anomalies	21	0	0	21	0.06
755	CODES	OTHER CONGENITAL ANOMALIES OF LIMBS	B.D.R.	I.D.	F.D.	TOTAL	RATE
	755.0	Polydactyly	724	0	0	724	2.21
	755.1	Syndactyly	275	0	0	275	0.84
	755.2	Reduction deformities of upper limb	98	0	0	98	0.30
	755.3	Reduction deformities of lower limb	44	0	1	45	0.14
	755.4	Reduction deformities, unspecified limb	10	1	1	12	0.04
	755.5	Other anomalies of upper limb, including shoulder girdle	71	0	0	71	0.22
	755.6	Other anomalies of lower limb, including pelvic girdle	301	1	0	302	0.92
	755.8	Other specified anomalies of unspecified limb	2	0	0	2	0.01
	755.9	Unspecified anomaly of unspecified limb	1	1	1	3	0.01
756	CODES	OTHER CONGENITAL MUSCULOSKELETAL ANOMALIES	B.D.R.	I.D.	F.D.	TOTAL	RATE
	756.0	Anomalies of skull and face bones	107	0	1	108	0.33
	756.1	Anomalies of spine	29	1	0	30	0.09
	756.3	Other anomalies of ribs and sternum	12	0	0	12	0.04
	756.4	Chondrodystrophy	12	1	1	14	0.04
	756.5	Osteodystrophies	18	0	0	18	0.06
	756.6	Anomalies of diaphragm	27	16	1	44	0.13
	756.7	Anomalies of abdominal wall	35	2	1	38	0.12
	756.8	Other specified anomalies of muscle, tendon, fascia, and connective tissue	19	0	0	19	0.06
	756.9	Other and unspecified anomalies of musculoskeletal system	8	0	1	9	0.03

TABLE 3 (continued)

		CODES AND DESCRIPTIONS FOR DIAGNOSTIC CATEGORIES	FREQUENCIES BY SOURCE				
757	CODES	CONGENITAL ANOMALIES OF THE INTEGUMENT	B.D.R.	I.D.	F.D.	TOTAL	RATE
	757.0	Hereditary edema of legs	4	0	0	4	0.01
	757.1	Ichthyosis congenita	6	0	0	6	0.02
	757.2	Dermatoglyphic anomalies	6	0	0	6	0.02
	757.3	Other specified anomalies of skin	773	0	0	773	2.36
	757.4	Specified anomalies of hair	1	0	0	1	0.00
	757.5	Specified anomalies of nails	8	0	0	8	0.02
	757.6	Specified anomalies of breast	54	0	0	54	0.17
	757.8	Other specified anomalies of the integument	15	0	0	15	0.05
	757.9	Unspecified anomaly of the integument	4	0	0	4	0.01
758	CODES	CHROMOSOMAL ANOMALIES	B.D.R.	I.D.	F.D.	TOTAL	RATE
	758.0	Down syndrome	352	5	30	387	1.18
	758.1	Patau's syndrome	24	0	7	31	0.09
	758.2	Edward's syndrome	46	6	17	69	0.21
	758.3	Autosomal deletion syndromes	11	1	1	13	0.04
	758.5	Other conditions due to autosomal anomalies	27	0	1	28	0.09
	758.6	Gonadal dysgenesis	15	0	2	17	0.05
	758.7	Klinefelter's syndrome	8	2	4	14	0.04
	758.8	Other conditions due to sex chromosome anomalies	10	0	1	11	0.03
	758.9	Conditions due to anomaly of unspecified chromosome	8	1	18	27	0.08
759	CODES	OTHER AND UNSPECIFIED CONGENITAL ANOMALIES	B.D.R.	I.D.	F.D.	TOTAL	RATE
	759.0	Anomalies of spleen	3	0	0	3	0.01
	759.1	Anomalies of adrenal gland	2	1	0	3	0.01
	759.2	Anomalies of other endocrine glands	1	0	0	1	0.00
	759.3	Situs inversus	5	0	0	5	0.02
	759.4	Conjoined twins	4	2	1	7	0.02
	759.5	Tuberous sclerosis	5	0	0	5	0.02
	759.6	Other hamartoses, not elsewhere classified	4	0	0	4	0.01
	759.7	Multiple congenital anomalies, so described	49	35	64	148	0.45
	759.8	Other specified anomalies	118	3	4	125	0.38
	759.9	Congenital anomaly, unspecified	30	4	30	64	0.20

rates of some specific conditions. Most importantly and as would be expected, the infant and fetal deaths contribute especially heavily to the total rate of anencephalus, greatly improving the ascertainment of one of the central nervous system defects included in the case-control and cross-sectional studies of the project's fourth phase. The infant deaths, and to a lesser extent the fetal deaths as well, also have disproportionate influences on the rates of diagnostic codes 748.5 (agenesis, hypoplasia, and dysplasia of lung) and 753.0 (renal agenesis and dysgenesis). Finally, a large proportion of the fetal deaths involve chromosomal anomalies, especially Down (758.0), Patau's (758.1), and Edward's (758.2) Syndromes. Although there is undoubtedly room for enhancing the reporting of congenital anomalies in New Jersey, particularly through improving the diagnostic information on infant death and fetal death certificates, these initial results of a multiple-source case-finding approach presented in Table 3 are clinically reasonable and encourage future attempts to achieve more complete ascertainment.

Table 4 presents rates of 32 selected groupings of congenital anomalies drawn from readily available, published results provided by six different birth defects monitoring programs, including New Jersey's BDR. For New Jersey, much more current rates from the BDR alone are provided in the Registry's recent report (NJDOH, 1991). Three of the systems external to New Jersey (BDMP/CPHA; BDMP/MDHIS; and MACDP) coordinate their reporting through CDC and are described in a recent publication (CDC, 1988), while the remaining two refer to statewide systems in Iowa (Hanson et al., 1989) and California (CBDMP, 1988). Two of the systems presented in the CDC publication (BDMP/CPHA and BDMP/MDHIS) involve "passive" reporting from hospitals throughout the United States. The first of these birth defects monitoring programs (BDMP/CPHA) is based on information sent to CDC by the Commission on Professional and Hospital Activities and covered 3,096,375 live births (21% of the country's total) from 1982 to 1985. A second system sending reports to CDC is the McDonnell Douglas Health Information System (BDMP/MDHIS), formerly known as "McAuto", which provided data on 2,150,970 live births (14.6% of the U.S. total) from 1982 to 1985. For each of these passive systems, Table 4 displays separate rates for the Northeast (which includes New Jersey) and for the entire United States. The third external source of rates listed in the CDC publication is from the Metropolitan Atlanta Congenital Defects Program

(MACDP), an "active" system jointly directed by CDC, the Georgia Mental Health Institute, and the Emory University School of Medicine. For 1982 to 1985, MACDP rates were derived from information on 116,038 live births. Published reports from two other "active" systems also provide some of the rates found in Table 4. The first of these covers 165,537 live births in Iowa for the years from 1983 to 1986. The California Birth Defects Monitoring Program (CBDMP), now a statewide program, is the second program and reported on congenital anomalies found among 165,854 live births in the five-county San Francisco Bay Area for 1983 and 1984.

In general, New Jersey's rates in Table 4 tend to fall between those of the two "passive" and the three "active" systems. However, two general groups of conditions show the expected improvement from the inclusion of congenital anomalies based on the more active surveillance of infant and fetal death certificates. The first group is the broad category of diagnoses affecting the central nervous systems, especially anencephalus. Secondly, because of the tremendous case ascertainment that accompanied the studies in Vernon Township (Fulcomer et al., 1988; Fulcomer and Ziskin, 1989), it is not surprising that New Jersey's rates for ascertaining chromosomal defects, particularly of Down Syndrome, equal or exceed those from all of the other reporting systems. Some other conditions for which New Jersey's rates are lower than the other values, most notably patent ductus arteriosus and club feet without CNS, may reflect the inclusion of only more clinically significant cases in the State, especially those for which the county-based case managers of Special Child Health Services may need to help coordinate services.

TABLE 4

RATES PER 1000 LIVE BIRTHS OF SELECTED CONGENITAL ANOMALIES AS REPORTED BY DIFFERENT BIRTH DEFECTS REPORTING SYSTEMS

	REPORTING SYSTEMS							
	BDMP - CPHA* 1982 - 1985		BDMP - MDHIS 1982 - 1985		Atlanta* (MACDP)	Iowa* BDMP	Calif.* (CBDMP)	New* Jersey
DIAGNOSTIC DESCRIPTION	Northeast	Total	Northeast	Total	1982-1985	1983-1986	1983-1984	1985-1987
Central Nervous System:								
Anencephalus	.28	.29	.19	.20	.33	.39	.30	.31
Spina Bifida without Anencephalus	.47	.48	.47	.44	.65	.54	.58	.50
Encephalocele	.10	.11	.06	.09	.22	.08	.15	.11
Microcephalus	.28	.25	.28	.28	.53	.60	1.21	.50
Hydrocephalus without Spina Bifida	.62	.58	.46	.52	.77	.72	.57	.79
Eyes:								
Anophthalmos/Microphthalmos	.09	.08	.07	.07	.37	.24	.36	.07
Congenital cataract/lens anomalies	.13	.11	.12	.09	.17	.30	.22	.13
Cardiovascular:								
Common Truncus	.02	.03	.02	.02	.07	.07	.13	.04
Transposition of Great Arteries	.12	.11	.11	.08	.47	.43	.54	.30
Tetralogy of Fallot	.12	.11	.15	.10	.32	.26	.36	.22
Ventricular Septal Defects	2.25	1.71	1.78	1.42	1.84	3.56	na	1.57
Atrial Septal Defect	.20	.21	.10	.16	1.53	1.29	na	.45
Endocardial Cushion Defect	.09	.08	.08	.07	.37	.36	na	.15
Pulmonary Valve Stenosis and Atresia	.27	.19	.08	.14	.39	.39	na	.15
Tricuspid Valve Stenosis and Atresia	.02	.03	.02	.02	.17	.31	na	.08
Aortic Valve Stenosis and Atresia	.06	.06	.05	.04	.30	.39	na	.04
Hypoplastic Left Heart Syndrome	.09	.08	.07	.07	.33	.38	.30	.19
Patent Ductus Arteriosus	3.04	2.96	2.11	2.39	6.16	3.64	na	1.30
Coarctation of Aorta	.09	.07	.09	.08	.34	.41	na	.20
Pulmonary Artery Anomaly	.16	.20	.15	.15	.56	.69	na	.26

TABLE 4 (continued)

RATES PER 1000 LIVE BIRTHS OF SELECTED CONGENITAL ANOMALIES AS REPORTED BY DIFFERENT BIRTH DEFECTS REPORTING SYSTEMS

	REPORTING SYSTEMS							
	BDMP - CPHA* 1982 - 1985		BDMP - MDHIS 1982 - 1985		Atlanta* (MACDP)	Iowa* BDMP	Calif.* (CBDMP)	New* Jersey
DIAGNOSTIC DESCRIPTION	Northeast	Total	Northeast	Total	1982-1985	1983-1986	1983-1984	1985-1987
Respiratory:								
Lung Agenesis and Hypoplasia	.51	.32	.31	.25	.55	.65	.57	.41
Craniofacial:								
Cleft Palate without Cleft Lip	.55	.56	.54	.53	.42	.45	.77	.53
Cleft Lip with or without Cleft Palate	.85	.91	.88	.86	1.08	1.22	1.11	.75
Gastrointestinal:								
Tracheo-Esophageal Anomalies	.24	.21	.27	.20	.23	.22	.27	.21
Rectal/Intestinal Atresia & Stenosis	.37	.35	.34	.36	.37	.50	.46	.31
Genitourinary:								
Renal Agenesis	.23	.18	.14	.15	.33	.46	.42	.19
Musculoskeletal:								
Club Foot without CNS	2.76	2.61	2.17	2.39	2.51	3.30	na	.34
Reduction Defect of Upper Limbs	.16	.16	.17	.15	.43	.51	na	.30
Reduction Defect of Lower Limbs	.08	.09	.10	.09	.16	.33	na	.14
Chromosomal:								
Down Syndrome/Trisomy 21	.87	.85	1.11	.87	.97	1.00	.97	1.18
Patau's Syndrome/Trisomy 13	.06	.08	.04	.06	.10	.07	.10	.09
Edwards' Syndrome/Trisomy 18	.12	.10	.12	.09	.20	.21	.16	.21

* Reporting system includes case-information on live births up to one year of age and on stillborn infants above 20 weeks gestation.

na = Not Available

IV. CORRELATIONS AND OTHER DESCRIPTIVE RESULTS FOR SELECTED VARIABLES

This chapter presents some simple correlations and other descriptive statistics for the subset of the variables gathered as part of Phase I and selected for inclusion in the ecologic (i.e., correlational) analyses of the project's third phase (Fulcomer et al., 1992a). These variables included the twelve sociodemographic characteristics treated as independent variables (described in Section A of Chapter II) and two subsets of information on AROs to serve as outcomes (i.e., dependent variables) in the multiple and partial regression analyses of Phase III. The dependent variables consisted of 8 outcome rates based on vital records (described in Section B of Chapter II) and the rates of 13 categories of congenital anomalies derived from the BDR (using output of the program described in Section A of Chapter III).

A. METHODS

As a first step in approaching the regression analyses of the AROs, some univariate descriptive statistics (means, standard deviations, etc.) and simple bivariate correlations (i.e., unadjusted for any covariates) were calculated. For all of the variables described in this section, results are presented in juxtaposition for four weighting schemes intended to address wide variations in the number of births among the 561 municipalities retained in the analytic file. The four schemes ranged from unweighted (i.e., treating each municipality as having an equal number of births) to fully-weighted (i.e., proportional to the number of births in a community) and are explained more fully in Chapter II of the the Phase III report. Two intermediate approaches (common logarithms and square roots) were calculated by applying these simple transformations to the number of live births in a municipality. Similar methods for weighting observations by frequency-related information are also available in standard statistical packages such as BMDP (Dixon et al., 1988, p. 529), SAS (SAS, 1985), and SPSS (SPSS, 1988). These approaches to the weighting of the geographic units in this project have the added advantages of applicability to all of the AROs simultaneously and ease of interpretation.

The linking of records of aggregated results for the municipalities from the various sources of variables was accomplished using several of the MADMANager Utility Programs (Fulcomer and Kriska, 1989). In order to base the later regression analyses on stored results of sufficient statistics rather than requiring cumbersome recalculation with the entire set of records, MAD03C of the MADSTAT Statistics Programs (Fulcomer and Kriska, 1992) was employed to calculate univariate (means and standard deviations) and bivariate statistics (correlations) for all variables included in the final linked data file. Four sets of parameter estimates were prepared as input into the MADSTAT regression algorithm, one for each of the four weighting schemes.

B. DESCRIPTIVE STATISTICS FOR THE SOCIODEMOGRAPHIC (INDEPENDENT) VARIABLES

Using MADSTAT program MAD03C, univariate descriptive statistics and simple bivariate correlations were calculated for twelve of the sociodemographic variables serving as independent variables in the later regression analyses (listed in Appendices A and B, respectively). All of these variables have already been described in the second chapter, with six drawn from the set summarizing the 1980 U.S. Census and the remaining six aggregated from the birth certificates to serve as risk factors. Given the ecologic nature of the municipality-based correlations, the substantial magnitudes of the correlations in Appendix B are not surprising, including many of the relationships involving poor prenatal care. Appendix A also lists some summary regression statistics for each variable treated as a dependent variable to be explained from the remaining eleven independent variables that are also utilized in the Phase III regression analyses: the original mean; the intercept term; the original standard deviation; the standard error of prediction; the multiple R; R^2 expressed as a percent of variance accounted for (i.e., the coefficient of determination x 100.00%); the adjusted, or "shrunken" R^2 as a percent to estimate the population R^2 [= $1-(1-R^2)((N-1)/(N-p-1))$], where p is the number of independent variables] originally due to Wherry (1931); and the F-ratio for R^2. The high levels of the R^2 for many of the independent variables (e.g., 97% of the variance of mother's average age is explained by the regression of the other eleven independent variables obtained under the fully-weighted scheme) illustrate that the intercorrelation matrices are nearly singular (i.e., the independent variables are almost collinear).

C. DESCRIPTIVE STATISTICS FOR THE OUTCOME (DEPENDENT) VARIABLES

Following the format described above for Appendix A, Tables 5 and 6 present some univariate descriptive statistics for two distinct groupings of 21 AROs retained for the correlational and regression analyses of the project's third phase (Fulcomer et al., 1992a). These tables also contain regression-related results for explaining the outcomes from the twelve sociodemographic variables; these results are more fully described in the Phase III report, where these two tables are presented again (as Tables 4 and 5, respectively in that document).

As shown in Table 5, the first grouping consists of eight ARO variables derived from the vital records information described in the second chapter. Except for the two variables calculated from gestational age information as part of the work on the project's cross-sectional study (Bove et al., 1992a), the other six variables are generally considered traditional AROs based on data found on birth and death certificates.

The second grouping of outcomes, shown in Table 6, covers 13 overlapping categories of congenital anomalies, all formed from the 32 diagnostic categories reported on by CDC (CDC, 1988) and described in the third chapter. In order to overcome the problems associated with "rare" outcomes, these birth defects variables were selected by combining some of the more important groupings of congenital anomalies into a small, meaningful set. Six of these outcomes (neural tube defects, eye defects, selected severe cardiac defects, oral clefts, reduction deformities, and chromosomal anomalies) were already available as broad summary indicators from the computer program that grouped the diagnostic information, while another set of six (chromosomal anomalies, congenital anomalies, major anomalies, minor anomalies, central nervous system defects, and musculoskeletal defects) were derived using simple transformations of the resulting output records. Down Syndrome was the only one of the specific diagnostic categories retained for the correlational analyses and was included because of ongoing interest in its occurrence among births to New Jersey residents (e.g., Fulcomer et al., 1988).

TABLE 5

Descriptive Statistics For Each Vital Records Outcome, Including Regression Results From The Independent Variables

VARIABLE	TYPE OF WEIGHTING	MEAN	INTERCEPT VALUE	STANDARD DEVIATION	STANDARD ERROR	MULTIPLE R	MULTIPLE R-SQUARE PER CENT	ADJUSTED R-SQUARE PER CENT	F-RATIO FOR R-SQUARE
Preterm births percent	Unweighted	8.1143	48.9888	3.5011	2.6924	.6491	42.1275	40.8602	33.2424**
	Log(10)	8.2004	35.4795	3.2682	2.3447	.7045	49.6332	48.5302	45.0015**
	Square Root	8.6243	37.9345	3.3543	1.9024	.8278	68.5236	67.8343	99.4154**
	Fully-wgtd.	9.8792	21.4097	3.8870	1.4188	.9325	86.9623	86.6768	304.5994**
Small-for-gestational age percent	Unweighted	10.1453	20.5737	3.0433	2.7763	.4309	18.5632	16.7799	10.4095**
	Log(10)	10.2555	14.8874	2.7489	2.4534	.4695	22.0465	20.3395	12.9153**
	Square Root	10.5095	15.8276	2.4428	2.0478	.5589	31.2332	29.7273	20.7413**
	Fully-wgtd.	11.1511	5.4554	2.1896	1.5283	.7234	52.3282	51.2842	50.1271**
Very low birthweight rate	Unweighted	10.7042	13.4926	11.4321	10.8973	.3329	11.0838	9.1368	5.6926**
	Log(10)	10.6736	20.5956	9.8858	9.2746	.3724	13.8695	11.9835	7.3537**
	Square Root	11.1457	31.1709	8.4368	7.3261	.5120	26.2132	24.5974	16.2233**
	Fully-wgtd.	12.9099	38.9659	7.5325	4.9153	.7637	58.3314	57.4189	63.9282**
Low birthweight rate	Unweighted	55.9390	201.7679	25.8503	22.2059	.5272	27.7895	26.2082	17.5743**
	Log(10)	56.8128	170.6982	24.1056	19.4861	.6005	36.0548	34.6545	25.7486**
	Square Root	59.8551	205.6308	23.9894	15.8368	.7573	57.3532	56.4193	61.4144**
	Fully-wgtd.	68.7379	147.8255	27.2254	11.2055	.9134	83.4231	83.0601	229.8175**
Neonatal death rate	Unweighted	5.8728	31.1302	7.2140	7.0876	.2354	5.5426	3.4742	2.6797**
	Log(10)	5.9073	22.2913	6.3972	6.2427	.2610	6.8115	4.7709	3.3379**
	Square Root	6.0906	26.4334	5.3089	5.0336	.3468	12.0292	10.1028	6.2445**
	Fully-wgtd.	6.7102	23.8850	4.0735	3.4528	.5449	29.6955	28.1560	19.2889**
Post-neonatal death rate	Unweighted	2.4211	-10.1002	5.1187	4.9490	.2920	8.5244	6.5213	4.2556**
	Log(10)	2.4278	-3.2981	4.1843	4.0032	.3229	10.4295	8.4681	5.3174**
	Square Root	2.6201	1.5431	3.3843	3.1166	.4124	17.0099	15.1926	9.3600**
	Fully-wgtd.	3.1936	5.1492	2.6631	2.0421	.6516	42.4627	41.2027	33.7021**
Total infant death rate	Unweighted	8.2941	21.0260	8.7649	8.3771	.3258	10.6120	8.6546	5.4215**
	Log(10)	8.3353	18.9866	7.6934	7.2352	.3668	13.4518	11.5566	7.0978**
	Square Root	8.7111	27.9574	6.5688	5.8318	.4782	22.8679	21.1789	13.5391**
	Fully-wgtd.	9.9046	28.9950	5.5765	4.0205	.7010	49.1335	48.0196	44.1108**
Fetal mortality rate	Unweighted	6.9253	22.7398	7.9773	7.8918	.2057	4.2301	2.1329	2.0171*
	Log(10)	6.9347	8.9757	7.0011	6.9073	.2179	4.7472	2.6614	2.2760**
	Square Root	7.0895	1.0189	5.7390	5.5512	.2905	8.4414	6.4364	4.2103**
	Fully-wgtd.	7.6948	1.5630	4.3227	3.8105	.4895	23.9576	22.2924	14.3875**

* significant at $p < .05$.

** significant at $p < .01$.

TABLE 6

Descriptive Statistics For Each Birth Defects Registry Outcome, Including Regression Results From The Independent Variables

VARIABLE	TYPE OF WEIGHTING	MEAN	INTERCEPT VALUE	STANDARD DEVIATION	STANDARD ERROR	MULTIPLE R	MULTIPLE R-SQUARE PER CENT	ADJUSTED R-SQUARE PER CENT	F-RATIO FOR R-SQUARE
Down syndrome	Unweighted	1.4198	-13.5659	4.3478	4.3460	.1491	2.2244	.0834	1.0389
	Log(10)	1.3475	-5.9486	3.3598	3.3618	.1423	2.0247	.0000	.9437
	Square Root	1.2845	-1.1152	2.5351	2.5384	.1374	1.8877	.0000	.8786
	Fully-wgtd.	1.1862	3.1069	1.6153	1.6062	.1799	3.2374	1.1185	1.5279
Neural tube defects	Unweighted	1.9911	8.3697	3.9144	3.8730	.2050	4.2020	2.1042	2.0031*
	Log(10)	1.9959	9.4255	3.5353	3.5004	.2016	4.0632	1.9624	1.9341*
	Square Root	1.9924	14.7112	2.9092	2.8821	.1988	3.9539	1.8507	1.8800*
	Fully-wgtd.	2.0478	11.7121	2.0457	2.0044	.2461	6.0547	3.9975	2.9432**
Eye defects	Unweighted	.2121	-.9528	1.0125	1.0193	.0906	.8212	.0000	.3781
	Log(10)	.2162	-.8148	.9732	.9790	.0978	.9557	.0000	.4407
	Square Root	.2101	-.4525	.8539	.8579	.1111	1.2340	.0000	.5705
	Fully-wgtd.	.1963	.7381	.6362	.6359	.1497	2.2422	.1015	1.0474
Selected severe cardiac defects	Unweighted	1.3779	-6.9161	3.1674	3.1617	.1580	2.4955	.3604	1.1688
	Log(10)	1.3511	-5.2168	2.8293	2.8305	.1433	2.0541	.0000	.9577
	Square Root	1.3095	-2.6914	2.2953	2.3024	.1240	1.5364	.0000	.7126
	Fully-wgtd.	1.2872	3.0891	1.5705	1.5671	.1601	2.5636	.4300	1.2015
Oral clefts	Unweighted	1.3450	-4.4956	2.8932	2.8977	.1356	1.8392	.0000	.8556
	Log(10)	1.3401	-4.1310	2.6216	2.6273	.1309	1.7139	.0000	.7963
	Square Root	1.3101	-3.5220	2.1769	2.1845	.1206	1.4553	.0000	.6744
	Fully-wgtd.	1.2599	-.2964	1.5526	1.5590	.1154	1.3312	.0000	.6161
Reduction deformities	Unweighted	.4378	.6883	1.4981	1.5042	.1159	1.3444	.0000	.6223
	Log(10)	.4438	.9969	1.4048	1.4101	.1185	1.4045	.0000	.6505
	Square Root	.4358	2.0165	1.2041	1.2089	.1170	1.3699	.0000	.6343
	Fully-wgtd.	.4204	1.7536	.8806	.8834	.1232	1.5167	.0000	.7033
Chromosomal anomalies	Unweighted	2.0124	-17.1261	4.7591	4.7617	.1427	2.0359	.0000	.9490
	Log(10)	1.9567	-8.8550	3.8296	3.8384	.1300	1.6907	.0000	.7853
	Square Root	1.9091	-4.1499	2.9935	3.0047	.1187	1.4099	.0000	.6531
	Fully-wgtd.	1.8273	1.5649	2.0039	2.0039	.1463	2.1415	.0000	.9994
Congenital anomalies	Unweighted	28.2671	53.1675	25.0865	24.5347	.2530	6.4010	4.3514	3.1230**
	Log(10)	27.7806	68.2228	21.9362	21.5775	.2306	5.3165	3.2432	2.5642**
	Square Root	27.2878	145.1566	18.2189	17.9741	.2181	4.7555	2.6698	2.2801**
	Fully-wgtd.	27.0898	175.9276	13.5644	13.2885	.2467	6.0842	4.0277	2.9585**
Major anomalies	Unweighted	21.8319	2.1828	19.7944	19.1366	.2922	8.5387	6.5359	4.2634**
	Log(10)	21.4571	22.6626	17.7063	17.2166	.2735	7.4810	5.4550	3.6926**
	Square Root	20.9822	72.5735	14.8180	14.5105	.2482	6.1626	4.1078	2.9991**
	Fully-wgtd.	20.6488	96.4496	10.9744	10.7530	.2460	6.0516	3.9943	2.9416**

TABLE 6 (continued) CONTINUED

Descriptive Statistics For Each Birth Defects Registry Outcome, Including Regression Results From The Independent Variables

VARIABLE	TYPE OF WEIGHTING	MEAN	INTERCEPT VALUE	STANDARD DEVIATION	STANDARD ERROR	MULTIPLE R	MULTIPLE R-SQUARE PER CENT	ADJUSTED R-SQUARE PER CENT	F-RATIO FOR R-SQUARE
Minor anomalies	Unweighted	6.4351	50.9895	10.2648	10.1834	.1921	3.6884	1.5794	1.7489
	Log(10)	6.3234	45.5652	8.3933	8.3853	.1526	2.3291	.1903	1.0890
	Square Root	6.3056	72.5879	6.7436	6.6844	.1963	3.8540	1.7486	1.8305*
	Fully-wgtd.	6.4408	79.4781	4.9560	4.7627	.3103	9.6280	7.6490	4.8652**
Central nervous system defects	Unweighted	2.3125	7.4071	4.1813	4.1468	.1936	3.7498	1.6422	1.7791*
	Log(10)	2.3112	8.9093	3.7842	3.7544	.1919	3.6824	1.5732	1.7459
	Square Root	2.2870	14.8164	3.1154	3.0927	.1888	3.5662	1.4545	1.6888
	Fully-wgtd.	2.3118	12.6967	2.1840	2.1490	.2292	5.2544	3.1796	2.5326**
Heart defects	Unweighted	4.9757	9.5225	6.1269	6.0975	.1755	3.0798	.9575	1.4511
	Log(10)	5.0704	11.8802	5.7063	5.6820	.1725	2.9762	.8516	1.4008
	Square Root	5.1780	23.7546	4.9666	4.9306	.1886	3.5587	1.4468	1.6851
	Fully-wgtd.	5.3954	28.3944	3.8619	3.7692	.2605	6.7845	4.7433	3.3237**
Musculoskeletal defects	Unweighted	7.8740	-9.1620	9.4364	9.2270	.2538	6.4389	4.3902	3.1428**
	Log(10)	7.7790	-3.5389	8.3248	8.1751	.2373	5.6308	3.5643	2.7248**
	Square Root	7.8220	12.5166	7.0767	6.9336	.2462	6.0624	4.0053	2.9471**
	Fully-wgtd.	8.1600	32.3502	5.5455	5.2970	.3274	10.7168	8.7617	5.4814**

* significant at $p < .05$.

** significant at $p < .01$.

Simple bivariate correlations within the subsets of outcome variables were also derived from vital records and the BDR using MADSTAT program MAD03C and are displayed in Appendices C and D, respectively. Correlations between the two subsets are found in Appendix E. The correlations between the sociodemographic (independent) variables and the two subsets of adverse reproductive outcome (dependent) variables play an important role in the calculation of regression coefficients and are described later in this chapter.

Correlations Within Vital Records Variables. The substantial levels of correlation among the variables within the subset of items derived from vital records are readily apparent from an inspection of Appendix C. Of the 112 off-diagonal correlations (28 for each of 4 weighting schemes), 93 exceed the critical value for significance at $p<.01$ (i.e., $|r|\geq.115$), while 9 of the remaining values are significant at $p<.05$ (i.e., $.088\leq|r|<.115$). The remaining ten correlations that are not significant involve five relationships of outcome variables with the rate of post-neonatal deaths and five associations of other vital-record outcomes with the rate of fetal deaths. Beyond levels of significance, the sizes and directions (all of the significant values are positive) indicate considerable "concurrent" and "predictive" validity (Cronbach, 1960). While it makes good clinical sense that the percents of preterm and small-for-gestational infants are positively correlated with the rate of neonatal deaths, the high magnitudes of the relationships, most notably for the fully-weighted scheme, are somewhat surprising. Although there have been a few studies of more specific adverse reproductive outcomes in smaller geographic areas such as census tracts (Fulcomer et al., 1981), many of the reports in the literature have been at a cruder level of geographic aggregation, mostly counties, and over shorter time intervals, leading to the likely attenuation of associations. In the present study, the inclusion of three year's worth of data and the use of alternative weighting schemes partially offset the problem of small sample sizes that often plagues research into relatively rare outcomes.

Correlations Within Birth Defects Registry Variables. The correlations among the variables derived from the Birth Defects Registry are listed in Appendix D. Of the 312 off-diagonal correlations (78 for each of 4 weighting

schemes), 174 exceed the critical value for significance at $p<.01$ (i.e., $|r|\geq.115$), while 29 of the remaining values are significant at the 5 percent level (i.e., $.088\leq|r|<.115$). However, despite the substantial levels of some correlations in this table, it is important to point out that values for several of the pairings of variables are inflated because of "part-whole" (or "autocorrelated") relationships that occur when items are also included in linear combinations (i.e., as part of weighted composite measures involving two or more constituent variables). Among the pairings of variables in this subset that are inflated in this manner are the following: Down Syndrome-chromosomal defects; neural tube defects-central nervous system defects; cardiac-heart; reduction deformities-musculoskeletal; congenital anomalies-major defects; and congenital anomalies-minor defects.

Correlations Between Vital Record And Birth Defects Registry Variables. The correlations between the eight vital records variables and the thirteen rates derived from the Birth Defects Registry are presented in Appendix E and represent one of the first attempts to bring together adverse reproductive outcome variables from more than two data sources (i.e., typically matched birth-deaths in contrast to the four sources of information represented in these two subsets of dependent variables). Of the 416 correlations (8x13 = 104 for each of 4 weighting schemes), 104 exceed the critical value for significance at $p<.01$ (i.e., $|r|\geq.115$), while 34 of the remaining values are significant at $p<.05$ (i.e., $.088\leq|r|<.115$). Although the magnitudes of the correlations are lower than the levels generally evident in the within-subset matrices, there are still a substantial proportion of significant values.

Correlations Between The Sociodemographic (Independent) And Vital Records Variables. The correlations between the twelve independent variables and the subset of eight dependent variables based on information obtained from vital records are presented in Appendix F. Of the 384 correlations (12x8 = 96 for each of 4 weighting schemes), 300 exceed the critical value for significance at $p<.01$ (i.e., $|r_{xy}|\geq.115$); 19 of the remaining values are significant at the 5 percent level (i.e., $.088\leq|r_{xy}|<.115$). In addition, the directions of the significant relationships are all consistent with "risk factors" reported in the literature (e.g., see Myrianthopoulos, 1985, Janerich and Bracken, 1986, and Kallen, 1988) and the magnitudes of the associations are substantial, even

for the unweighted scheme. Therefore, even these unadjusted correlations provide evidence of considerable potential for concurrent and predictive validity of the explanatory variables with respect to these outcomes. The lack of significant values is concentrated in the two with the most tenuous status as "risk factors" (i.e., mostly rural and percent of primiparous mothers).

Correlations Between The Sociodemographic (Independent) And Birth Defects Registry Variables. The correlations between the twelve independent variables and the subset of thirteen rate variables derived from the Birth Defects Registry are listed in Appendix G. Of the 624 correlations (12x13 = 156 for each of 4 weighting schemes), 72 exceed the critical value for significance at $p<.01$ (i.e., $|r_{xy}|\geq.115$); 57 of the remaining values are significant at the 5 percent level (i.e., $.088\leq|r_{xy}|<.115$). The number of significant simple correlations provides an initial indication of possible associations between the risk factors and the rates of selected birth defects for future investigations. However, the results in Appendix G are much less dramatic than their counterparts for the dependent variables based on vital records information. Besides a much lower proportion of significant values and generally lower magnitudes, the directions of the relationships do not follow the same consistent pattern of positive correlations noted in Appendix F.

V. SUMMARY

This report has described the activities undertaken in the first phase of a cooperative agreement between the New Jersey Department of Health (NJDOH) and the U.S. Centers for Disease Control (CDC). The overall goal of the project was to develop and apply appropriate methodology to assess relationships between adverse reproductive outcomes (ARO) and population exposures to environmental pollutants, particularly toxic waste site contamination. With the objective of enhancing NJDOH's capability to conduct surveillance and etiological research of birth defects, low birthweight, fetal and infant mortality, work in this phase concentrated on assembling information on AROs so that stable rates of their occurrence could be established.

The second chapter has described the selection of six variables from the U.S. Census and six other health variables derived from vital records to serve as sociodemographic indicators to summarize the entire State and its 567 municipalities. Health variables incorporated in the correlational and etiological studies of the project's third and fourth phases were also introduced in the second chapter. Many of these sociodemographic and other health variables have also been employed in other NJDOH studies and project staff have been actively involved in obtaining comparable data from the 1990 U.S. Census and with updating health outcome data to account for the new modifications of vital records introduced in 1989 as part of the national effort spearheaded by the National Center for Health Statistics (NCHS).

The third chapter described the collection of data on individuals with AROs involving congenital anomalies. Much of this work has continued to the present, thereby extending the project's data acquisition efforts far beyond what was initially envisioned, and reflecting the commitment of NJDOH to the first objective of enhancing its surveillance and research capabilities in the area of AROs. In particular, NJDOH's future efforts in analysis and evaluation of ARO information should benefit from the improvements in data quality, integration of historical data, and merging of AROs from multiple sources made possible by the cooperative agreement. A table displaying the frequencies and rates of specific diagnostic categories for the 8843 affected

cases has shown that the acquisition of information from infant and fetal death certificates improves the reporting of some congenital anomalies. Specifically, another table comparing New Jersey rates to those from five other birth defects monitoring programs has demonstrated that the reporting of central nervous system defects and chromosomal anomalies were improved over those derived from the Birth Defects Registry (BDR) alone.

Finally, simple correlations and other descriptive statistics for all of the AROs incorporated into this report have been listed in the fourth chapter, covering 327,015 live births and 3,548 fetal deaths (stillbirths) that occurred in New Jersey residents in the three years from 1985 to 1987. Some of these correlational results have provided encouraging evidence of potential validity of the ARO information gathered as part of the project's first phase. Combined with the evaluation of databases and assembling of information on environmental exposures in Phase II, the success of the project's efforts to acquire reliable and reasonably complete information on AROs will facilitate future ecological and etiological studies, particularly by improving the statistical power and generalizability of the studies involving potentially "weak" associations with environmental exposures.

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APPENDIX A

Summary Descriptive Statistics, Including Regression Results Treating Each Sociodemographic (Independent) Variable As Dependent

VARIABLE	TYPE OF WEIGHTING	MEAN	INTERCEPT VALUE	STANDARD DEVIATION	STANDARD ERROR	MULTIPLE R	MULTIPLE R-SQUARE PER CENT	ADJUSTED R-SQUARE PER CENT	F-RATIO FOR R-SQUARE
Mother's age	Unweighted	28.0119	27.0930	1.8732	.5327	.9595	92.0706	91.9117	579.5112
	Log(10)	27.9539	26.6521	1.8779	.5113	.9630	92.7318	92.5862	636.7713
	Square Root	27.7352	26.8376	1.9151	.3964	.9788	95.7993	95.7151	1138.2014
	Fully-wgtd.	27.1230	26.0403	2.0595	.3570	.9852	97.0549	96.9959	1644.7661
% Mothers > 35	Unweighted	10.6993	-86.9354	5.9073	2.6285	.8977	80.5902	80.2013	207.2239
	Log(10)	10.5091	-78.9762	5.5818	2.3417	.9096	82.7457	82.3999	239.3460
	Square Root	10.0395	-88.7517	5.1359	1.8552	.9339	87.2082	86.9519	340.2549
	Fully-wgtd.	9.0458	-71.1823	4.4322	1.4615	.9452	89.3396	89.1260	418.2629
% Mothers < H.S.	Unweighted	9.7631	98.4995	8.9053	3.5489	.9189	84.4306	84.1187	270.6507
	Log(10)	10.1437	95.3007	9.3080	3.4445	.9305	86.5744	86.3054	321.8364
	Square Root	11.7082	127.7592	10.8378	3.1439	.9579	91.7504	91.5851	555.0811
	Fully-wgtd.	16.2884	134.7967	13.7065	3.0558	.9753	95.1272	95.0296	974.3292
Per capita income	Unweighted	8651.3922	-9741.8109	2683.5033	1607.5692	.8051	64.8181	64.1132	91.9510
	Log(10)	8569.3256	-9239.7823	2553.0353	1454.1563	.8258	68.1952	67.5579	107.0140
	Square Root	8328.1426	-14220.0458	2388.7302	1225.3600	.8614	74.2025	73.6856	143.5558
	Fully-wgtd.	7707.3145	-12584.0567	2241.4851	902.2320	.9171	84.1164	83.7981	264.3086
Mostly rural	Unweighted	.2799	-1.4249	.4493	.3848	.5300	28.0915	26.6507	19.4973
	Log(10)	.2403	-1.3982	.4274	.3734	.5017	25.1668	23.6674	16.7846
	Square Root	.1784	-1.5534	.3828	.3438	.4578	20.9547	19.3710	13.2308
	Fully-wgtd.	.1003	-.9239	.3004	.2765	.4110	16.8941	15.2290	10.1457
Population density	Unweighted	3239.3344	-43962.3497	4568.4837	3325.6380	.6932	48.0495	47.0086	46.1613
	Log(10)	3587.8796	-47281.1157	4984.2766	3514.8884	.7159	51.2468	50.2700	52.4618
	Square Root	4493.3101	-78389.3356	5943.2729	3870.7599	.7643	58.4161	57.5829	70.1111
	Fully-wgtd.	6529.8812	-95495.8156	7169.7743	4416.0349	.7925	62.8090	62.0638	84.2875
% Crowded housing	Unweighted	2.2329	6.7456	1.8138	.9988	.8383	70.2751	69.6795	117.9942
	Log(10)	2.3372	4.1664	1.9319	.9795	.8649	74.7991	74.2942	148.1357
	Square Root	2.7547	-.1277	2.4308	1.0219	.9093	82.6749	82.3278	238.1650
	Fully-wgtd.	4.0010	-7.4888	3.4276	1.1045	.9477	89.8202	89.6163	440.3678
% Old housing	Unweighted	62.5674	48.8733	19.5312	17.8681	.4237	17.9494	16.3054	10.9181
	Log(10)	62.2500	51.9899	19.9676	17.9969	.4512	20.3610	18.7653	12.7600
	Square Root	62.5222	69.6903	20.7734	17.9889	.5146	26.4839	25.0109	17.9796
	Fully-wgtd.	65.1010	35.2067	21.5207	16.7579	.6368	40.5561	39.3651	34.0509
% Female-headed poverty	Unweighted	.5321	2.3036	.8441	.6030	.7069	49.9678	48.9653	49.8448
	Log(10)	.5818	2.1076	.9012	.5926	.7590	57.6020	56.7525	67.8065
	Square Root	.7634	2.5577	1.1227	.5858	.8562	73.3079	72.7731	137.0717
	Fully-wgtd.	1.3058	3.7807	1.5736	.5766	.9319	86.8379	86.5741	329.2778

APPENDIX A (continued)

Summary Descriptive Statistics, Including Regression Results Treating Each Sociodemographic (Independent) Variable As Dependent

VARIABLE	TYPE OF WEIGHTING	MEAN	INTERCEPT VALUE	STANDARD DEVIATION	STANDARD ERROR	MULTIPLE R	MULTIPLE R-SQUARE PER CENT	ADJUSTED R-SQUARE PER CENT	F-RATIO FOR R-SQUARE
% Primiparous	Unweighted	44.3046	117.8316	6.4356	5.5619	.5175	26.7774	25.3103	18.2517
	Log(10)	44.4598	98.3784	5.8124	4.9858	.5279	27.8653	26.4200	19.2797
	Square Root	44.6993	115.9713	5.2162	4.2365	.5944	35.3312	34.0355	27.2674
	Fully-wgtd.	44.8525	88.3378	4.5810	3.3626	.6869	47.1790	46.1207	44.5781
% White	Unweighted	90.7091	-1.7042	13.3401	9.8523	.6821	46.5259	45.4545	43.4241
	Log(10)	89.6922	-18.7124	14.3440	10.2119	.7093	50.3115	49.3159	50.5349
	Square Root	86.5512	-110.4766	17.4785	11.2471	.7708	59.4066	58.5933	73.0398
	Fully-wgtd.	78.7489	-263.6616	22.5721	12.3552	.8404	70.6277	70.0391	120.0096
% Inadequate prenatal care	Unweighted	23.3982	157.5497	13.1936	7.6266	.8200	67.2416	66.5853	102.4461
	Log(10)	23.4316	153.8991	13.0821	7.1985	.8386	70.3168	69.7221	118.2301
	Square Root	24.4733	211.5040	13.5306	6.5912	.8760	76.7361	76.2699	164.6251
	Fully-wgtd.	27.9343	221.8850	14.6626	6.5112	.8982	80.6677	80.2804	208.2554

APPENDIX B

Correlations Within The Subset Of Sociodemographic (Independent) Variables

VARIABLE	WEIGHTING	% Moms >35	% Moms <HS	Per cap. Income	MstlyRur	Pop. Density	% Crowd. Housing	% Old Housing	% Fem.hd Poverty	% Primipr.	% White	% Inadq. Prenatal
Mother's Age	Unweighted	.8418	-.8281	.7589	-.0077	-.1637	-.6751	-.0646	-.5524	-.0568	.4731	-.7363
	Log(10)	.8515	-.8338	.7775	.0190	-.1919	-.6797	-.0818	-.5961	-.0298	.4998	-.7670
	Square Root	.8568	-.8631	.8167	.0783	-.2894	-.7180	-.1652	-.6927	.0168	.5806	-.8194
	Fully-wgtd.	.8546	-.9021	.8779	.1600	-.4299	-.7847	-.3468	-.8069	.1307	.7058	-.8555
% Mothers > 35	Unweighted		-.5692	.7316	.0315	-.1162	-.4745	-.0271	-.3680	-.1550	.2203	-.4935
	Log(10)		-.5792	.7595	.0352	-.1201	-.4719	-.0205	-.3952	-.1482	.2402	-.5392
	Square Root		-.5841	.7884	.0587	-.1511	-.4658	-.0414	-.4383	-.1155	.2936	-.5848
	Fully-wgtd.		-.6271	.8217	.0981	-.2263	-.5110	-.1394	-.5313	-.0175	.4088	-.6428
% Mothers < H.S.	Unweighted			-.5996	.0289	.3024	.7576	.1612	.6439	-.1388	-.5421	.7504
	Log(10)			-.6183	-.0092	.3590	.7931	.1980	.7085	-.1420	-.5747	.7704
	Square Root			-.6708	-.0880	.4831	.8514	.3038	.8170	-.1660	-.6566	.8036
	Fully-wgtd.			-.7851	-.1770	.6026	.8993	.4871	.9023	-.2271	-.7438	.8377
Per capita Income	Unweighted				-.0979	-.1267	-.5650	-.0001	-.4125	.0016	.2565	-.5555
	Log(10)				-.0713	-.1537	-.5741	-.0119	-.4483	.0203	.2799	-.5874
	Square Root				-.0181	-.2478	-.6119	-.0722	-.5412	.0683	.3655	-.6455
	Fully-wgtd.				.0673	-.4173	-.7252	-.2509	-.7102	.1706	.5367	-.7330
Mostly rural	Unweighted					-.3809	-.0265	-.2409	-.1543	-.2249	.1551	.1721
	Log(10)					-.3558	-.0534	-.2528	-.1538	-.2305	.1661	.1274
	Square Root					-.3195	-.1174	-.2720	-.1720	-.2253	.1918	.0423
	Fully-wgtd.					-.2857	-.1818	-.3027	-.1996	-.1854	.2177	-.0766
Population density	Unweighted						.4561	.3802	.3830	.2241	-.2670	.0326
	Log(10)						.5135	.4038	.4214	.2187	-.3086	.0790
	Square Root						.6175	.4589	.5204	.1832	-.4066	.1970
	Fully-wgtd.						.6940	.5601	.6101	.1210	-.5076	.3497
% Crowded housing	Unweighted							.1649	.6131	.0349	-.5745	.5405
	Log(10)							.2068	.6751	.0245	-.6059	.5768
	Square Root							.3169	.8020	-.0071	-.6782	.6347
	Fully-wgtd.							.4890	.8972	-.0477	-.7429	.6907
% Old housing	Unweighted								.1617	.0841	-.0828	-.0180
	Log(10)								.1998	.0893	-.1270	.0089
	Square Root								.3014	.0820	-.2438	.1037
	Fully-wgtd.								.4696	.0477	-.4210	.2983
% Female-headed poverty	Unweighted									-.0288	-.5082	.4635
	Log(10)									-.0554	-.5601	.5277
	Square Root									-.1032	-.6722	.6301
	Fully-wgtd.									-.1691	-.7709	.7198

APPENDIX B (continued)

Correlations Within The Subset Of Sociodemographic (Independent) Variables

VARIABLE	WEIGHTING	% Moms >35	% Moms <HS	Per cap. Income	MstlyRur	Pop. Density	% Crowd. Housing	% Old Housing	% Fem.hd Poverty	% Primipr.	% White	% Inadq. Prenatal
% Primiparous	Unweighted										.0239	-.1921
	Log(10)										.0092	-.2021
	Square Root										.0032	-.2457
	Fully-wgtd.										.0354	-.3396
% White	Unweighted											-.4402
	Log(10)											-.4747
	Square Root											-.5448
	Fully-wgtd.											-.6191

APPENDIX C

Correlations Within The Subset Of Vital Records Outcome Variables

VARIABLE	WEIGHTING	S.G.A. percent	Very low B.W.rate	Low B.W.rate	Neonatal Dth.rate	Post-n. Dth.rate	Tot.Inf. Dth.rate	Fetal M. rate
Preterm births percent	Unweighted	.2122**	.2672**	.5616**	.1810**	.1426**	.2323**	.0907*
	Log(10)	.2513**	.3359**	.6093**	.2185**	.2011**	.2911**	.1177**
	Square Root	.3594**	.4770**	.7395**	.3114**	.3308**	.4222**	.2155**
	Fully-wgtd.	.5716**	.7290**	.8934**	.5174**	.6067**	.6678**	.4340**
Small-for-gestational age percent	Unweighted		.1780**	.4543**	.2211**	.0677	.2216**	.0070
	Log(10)		.2018**	.4792**	.2079**	.0896*	.2216**	.0182
	Square Root		.2564**	.5321**	.2192**	.1629**	.2611**	.0706
	Fully-wgtd.		.4347**	.6637**	.3216**	.3907**	.4216**	.2351**
Very low birthweight rate	Unweighted			.5340**	.5677**	.0479	.4953**	.1055*
	Log(10)			.5531**	.5691**	.1045*	.5301**	.1246**
	Square Root			.6272**	.5775**	.2248**	.5826**	.1825**
	Fully-wgtd.			.7994**	.6533**	.5264**	.7287**	.3782**
Low birthweight rate	Unweighted				.4077**	.0296	.3529**	.0940*
	Log(10)				.4074**	.1048*	.3958**	.1145*
	Square Root				.4324**	.2576**	.4823**	.2034**
	Fully-wgtd.				.5560**	.5732**	.6800**	.4233**
Neonatal death rate	Unweighted					-.0193	.8118**	.1489**
	Log(10)					.0141	.8392**	.1474**
	Square Root					.0976*	.8585**	.1741**
	Fully-wgtd.					.3415**	.8936**	.3059**
Post-neonatal death rate	Unweighted						.5682**	.0426
	Log(10)						.5556**	.0623
	Square Root						.5941**	.1108*
	Fully-wgtd.						.7270**	.2969**
Total infant death rate	Unweighted							.1475**
	Log(10)							.1565**
	Square Root							.1978**
	Fully-wgtd.							.3653**
Fetal mortality rate	Unweighted							
	Log(10)							
	Square Root							
	Fully-wgtd.							

* significant at $p < .05$, two-tailed.

** significant at $p < .01$, two-tailed.

APPENDIX D

Correlations Within The Subset Of Birth Defects Registry Outcome Variables

VARIABLE	WEIGHTING	NTDs	Eyes	Cardiacs	Clefts	Reductn.	Chromo.	Con. An.	Major D.	Minor D.	CNS	Heart D.	Musculo.
Down syndrome	Unweighted	.0327	-.0045	-.0075	.0184	.0032	.9344**	.1873**	.2338**	.0068	.0519	.0629	-.0386
	Log(10)	.0457	.0046	.0090	.0429	.0157	.9095**	.2061**	.2408**	.0306	.0694	.0994*	-.0149
	Square Root	.0494	.0231	.0345	.0776	.0316	.8900**	.2368**	.2659**	.0555	.0757	.1398**	.0175
	Fully-wgtd.	.0432	.0602	.0817	.1420**	.0495	.8662**	.2810**	.3108**	.0809	.0728	.1998**	.0534
Neural tube defects	Unweighted		.0241	.2299**	-.0041	.0244	.0417	.4149**	.4353**	.1747**	.9451**	.3186**	.2040**
	Log(10)		.0321	.2218**	.0076	.0324	.0529	.4230**	.4361**	.1855**	.9429**	.2965**	.2218**
	Square Root		.0505	.2163**	.0294	.0457	.0564	.4145**	.4279**	.1797**	.9414**	.2762**	.2292**
	Fully-wgtd.		.0906*	.2172**	.0695	.0707	.0564	.3853**	.4076**	.1522**	.9412**	.2538**	.2231**
Eye defects	Unweighted			.0624	-.0138	-.0016	.0405	.0986*	.1023*	.0437	.0809	.0804	.0329
	Log(10)			.0626	-.0094	.0003	.0586	.1144*	.1161**	.0542	.0868	.0819	.0431
	Square Root			.0604	.0030	.0053	.0829	.1327**	.1334**	.0653	.0988*	.0819	.0585
	Fully-wgtd.			.0536	.0314	.0123	.1187*	.1564**	.1558**	.0830	.1250**	.0713	.0838
Selected severe cardiac defects	Unweighted				.1276**	-.0102	.0081	.3639**	.4081**	.1024*	.2271**	.6117**	.1108*
	Log(10)				.1118*	-.0039	.0259	.3648**	.3980**	.1137*	.2225**	.5962**	.1251**
	Square Root				.1068*	.0074	.0493	.3586**	.3864**	.1198**	.2231**	.5784**	.1389**
	Fully-wgtd.				.1157**	.0301	.0861	.3546**	.3779**	.1337**	.2357**	.5629**	.1591**
Oral clefts	Unweighted					.1112*	.0619	.2584**	.3279**	-.0010	-.0165	.1551**	.1238**
	Log(10)					.1112*	.0907*	.2772**	.3344**	.0190	-.0055	.1627**	.1496**
	Square Root					.1061*	.1263**	.3010**	.3472**	.0503	.0166	.1873**	.1758**
	Fully-wgtd.					.0870	.1900**	.3469**	.3769**	.1149*	.0591	.2365**	.2077**
Reduction deformities	Unweighted						.0059	.1879**	.2042**	.0655	.1074*	.0922*	.2693**
	Log(10)						.0188	.1978**	.2133**	.0669	.1041*	.0925*	.2879**
	Square Root						.0360	.2000**	.2192**	.0588	.1023*	.0933*	.2917**
	Fully-wgtd.						.0582	.2000**	.2244**	.0506	.1066*	.0934*	.2810**
Chromosomal anomalies	Unweighted							.2093**	.2627**	.0049	.0612	.1010*	-.0310
	Log(10)							.2352**	.2777**	.0288	.0767	.1393**	.0014
	Square Root							.2771**	.3148**	.0571	.0830	.1815**	.0491
	Fully-wgtd.							.3430**	.3812**	.0946*	.0858	.2428**	.1144*
Congenital anomalies	Unweighted								.9221**	.6658**	.4514**	.5652**	.6914**
	Log(10)								.9323**	.6467**	.4628**	.6008**	.6892**
	Square Root								.9372**	.6423**	.4573**	.6334**	.7027**
	Fully-wgtd.								.9400**	.6554**	.4348**	.6750**	.7355**
Major anomalies	Unweighted									.3252**	.4677**	.6128**	.6299**
	Log(10)									.3271**	.4712**	.6339**	.6380**
	Square Root									.3346**	.4668**	.6594**	.6536**
	Fully-wgtd.									.3585**	.4554**	.6928**	.6836**
Minor anomalies	Unweighted										.2013**	.1995**	.4751**
	Log(10)										.2154**	.2328**	.4555**
	Square Root										.2095**	.2622**	.4622**
	Fully-wgtd.										.1815**	.3134**	.4992**

Correlations Within The Subset Of Birth Defects Registry Outcome Variables

VARIABLE	WEIGHTING	NTDs	Eyes	Cardiacs	Clefts	Reductn.	Chromo.	Con. An.	Major D.	Minor D.	CNS	Heart D.	Musculo.
Central nervous system defects	Unweighted											.3298**	.2464**
	Log(10)											.3106**	.2633**
	Square Root											.2967**	.2669**
	Fully-wgtd.											.2867**	.2583**
Heart defects	Unweighted												.2170**
	Log(10)												.2556**
	Square Root												.3013**
	Fully-wgtd.												.3633**
Musculoskeletal defects	Unweighted												
	Log(10)												
	Square Root												
	Fully-wgtd.												

* significant at p < .05, two-tailed.

** significant at p < .01, two-tailed.

APPENDIX E

Correlations Between The Subsets Of Vital Records (Columns) And Birth Defects Registry (Rows) Outcome Variables

VARIABLE	WEIGHTING	Preterm percent	S.G.A. percent	Very low B.W.rate	Low B.W.rate	Neonatal Dth.rate	Post-n. Dth.rate	Tot.Inf. Dth.rate	Fetal M. rate
Down syndrome	Unweighted	.0235	.0056	.0222	-.0266	.0450	.5326**	.3481**	-.0222
	Log(10)	.0133	.0049	.0486	-.0001	.0686	.3764**	.2617**	-.0146
	Square Root	-.0180	-.0057	.0481	-.0086	.0727	.2483**	.1867**	-.0171
	Fully-wgtd.	-.0929*	-.0454	-.0212	-.0748	.0330	.0410	.0436	-.0492
Neural tube defects	Unweighted	.0599	.0699	.0935*	.1465**	.1276**	-.0331	.0857	.0412
	Log(10)	.0752	.0692	.1018*	.1551**	.1346**	-.0226	.0996*	.0322
	Square Root	.0978*	.0820	.1124*	.1606**	.1451**	.0042	.1194**	.0324
	Fully-wgtd.	.1665**	.1530**	.1545**	.1971**	.1748**	.0954*	.1732**	.0723
Eye defects	Unweighted	-.0414	.0079	-.0011	-.0324	.0108	-.0297	-.0084	.1414**
	Log(10)	-.0380	.0054	.0031	-.0337	.0171	-.0278	-.0009	.1513**
	Square Root	-.0263	.0059	.0087	-.0286	.0279	-.0159	.0144	.1573**
	Fully-wgtd.	-.0027	.0155	.0196	-.0097	.0498	.0207	.0463	.1525**
Selected severe cardiac defects	Unweighted	-.0346	.0111	.0862	-.0196	.1700**	-.0440	.1142*	.1034*
	Log(10)	-.0344	.0002	.0808	-.0200	.1482**	-.0362	.1036*	.1024*
	Square Root	-.0300	-.0065	.0657	-.0112	.1144*	-.0196	.0824	.1032*
	Fully-wgtd.	.0007	.0120	.0624	.0323	.0721	.0284	.0661	.1170**
Oral clefts	Unweighted	.0135	.0291	-.0368	.0500	-.0105	.0241	.0054	-.0577
	Log(10)	.0174	.0207	-.0233	.0436	-.0097	.0381	.0126	-.0457
	Square Root	.0134	.0092	-.0070	.0285	-.0065	.0468	.0188	-.0146
	Fully-wgtd.	.0031	-.0162	.0044	.0026	-.0033	.0507	.0218	.0502
Reduction deformities	Unweighted	.0278	-.0283	-.0343	-.0355	-.0450	.0131	-.0294	-.0212
	Log(10)	.0414	-.0300	-.0298	-.0276	-.0409	.0274	-.0191	-.0120
	Square Root	.0540	-.0238	-.0176	-.0082	-.0292	.0471	.0006	.0051
	Fully-wgtd.	.0729	-.0041	.0210	.0297	.0031	.0849	.0428	.0351
Chromosomal anomalies	Unweighted	.0202	.0018	.0138	-.0466	.0319	.4975**	.3168**	-.0144
	Log(10)	.0118	-.0041	.0370	-.0251	.0515	.3492**	.2327**	-.0055
	Square Root	-.0107	-.0192	.0391	-.0271	.0603	.2384**	.1715**	-.0039
	Fully-wgtd.	-.0655	-.0619	-.0122	-.0710	.0455	.0692	.0663	-.0242
Congenital anomalies	Unweighted	.0599	.0834	.0493	-.0149	.1274**	.0531	.1359**	.0551
	Log(10)	.0835	.0523	.0880*	.0295	.1448**	.0476	.1463**	.0759
	Square Root	.1119*	.0371	.1291**	.0765	.1666**	.0682	.1698**	.1073*
	Fully-wgtd.	.1564**	.0322	.1964**	.1405**	.2149**	.1328**	.2203**	.1861**
Major anomalies	Unweighted	.0565	.0777	.0624	.0125	.1456**	.0737	.1629**	.0498
	Log(10)	.0758	.0571	.0975*	.0430	.1603**	.0546	.1629**	.0683
	Square Root	.0936*	.0451	.1307**	.0723	.1790**	.0652	.1783**	.0989*
	Fully-wgtd.	.1210**	.0443	.1758**	.1126*	.2130**	.1110*	.2086**	.1717**
Minor anomalies	Unweighted	.0376	.0540	.0000	-.0605	.0306	-.0124	.0180	.0388
	Log(10)	.0584	.0161	.0243	-.0136	.0403	.0094	.0387	.0545
	Square Root	.0965*	.0009	.0615	.0478	.0569	.0410	.0671	.0727
	Fully-wgtd.	.1600**	-.0099	.1483**	.1351**	.1164**	.1175**	.1411**	.1291**

Correlations Between The Subsets Of Vital Records (Columns) And Birth Defects Registry (Rows) Outcome Variables

VARIABLE	WEIGHTING	Preterm percent	S.G.A. percent	Very low B.W.rate	Low B.W.rate	Neonatal Dth.rate	Post-n. Dth.rate	Tot.Inf. Dth.rate	Fetal M. rate
Central nervous system defects	Unweighted	.0503	.0689	.1053*	.1454**	.1428**	-.0196	.1061*	.0663
	Log(10)	.0665	.0673	.1164**	.1537**	.1502**	-.0060	.1216**	.0585
	Square Root	.0903*	.0780	.1270**	.1569**	.1593**	.0204	.1393**	.0561
	Fully-wgtd.	.1570**	.1409**	.1632**	.1877**	.1849**	.1035*	.1845**	.0862
Heart defects	Unweighted	.0003	.0410	.0945*	.0156	.1131*	-.0338	.0733	.0718
	Log(10)	.0203	.0335	.1072*	.0275	.1075*	-.0136	.0820	.0683
	Square Root	.0574	.0422	.1265**	.0652	.1094*	.0217	.0996*	.0791
	Fully-wgtd.	.1233**	.0847	.1792**	.1456**	.1381**	.1006*	.1490**	.1340**
Musculoskeletal defects	Unweighted	.0816	.0755	.0280	.0386	.1049*	-.0013	.0856	.0207
	Log(10)	.1180**	.0571	.0669	.0883	.1229**	.0326	.1199**	.0559
	Square Root	.1824**	.0614	.1329**	.1567**	.1586**	.0849	.1720**	.1180**
	Fully-wgtd.	.2823**	.0963*	.2696**	.2579**	.2513**	.2037**	.2809**	.2596**

* significant at $p < .05$, two-tailed.

** significant at $p < .01$, two-tailed.

APPENDIX F

Correlations Between The Sociodemographic (Rows) And Vital Records Outcome (Columns) Variables

VARIABLE	WEIGHTING	Preterm percent	S.G.A. percent	Very low B.W.rate	Low B.W.rate	Neonatal Dth.rate	Post-n. Dth.rate	Tot.Inf. Dth.rate	Fetal M. rate
Mother's age	UNWEIGHTED	-.4793**	-.3688**	-.1859**	-.3910**	-.1503**	-.1878**	-.2334**	-.1200**
	LOG(10)	-.5498**	-.4036**	-.2373**	-.4598**	-.1836**	-.2259**	-.2756**	-.1344**
	SQUARE ROOT	-.6765**	-.4945**	-.3740**	-.6074**	-.2752**	-.3224**	-.3886**	-.2124**
	FULLY-WGTD.	-.8102**	-.6515**	-.6263**	-.7849**	-.4720**	-.5502**	-.6076**	-.4106**
% Mothers > 35	UNWEIGHTED	-.2120**	-.2872**	-.1344**	-.2034**	-.0933*	-.1506**	-.1647**	-.0760
	LOG(10)	-.3076**	-.3282**	-.1623**	-.2681**	-.1255**	-.1684**	-.1960**	-.0884*
	SQUARE ROOT	-.4055**	-.3892**	-.2441**	-.3667**	-.1912**	-.2153**	-.2655**	-.1343**
	FULLY-WGTD.	-.5318**	-.5064**	-.4222**	-.5156**	-.3440**	-.3609**	-.4237**	-.2706**
% Mothers < H.S.	UNWEIGHTED	.5015**	.3625**	.2129**	.4272**	.1453**	.2355**	.2571**	.1266**
	LOG(10)	.5895**	.4027**	.2607**	.5060**	.1789**	.2689**	.2951**	.1530**
	SQUARE ROOT	.7260**	.4990**	.3955**	.6592**	.2670**	.3619**	.4023**	.2403**
	FULLY-WGTD.	.8554**	.6814**	.6376**	.8263**	.4580**	.5905**	.6167**	.4386**
Per capita income	UNWEIGHTED	-.3060**	-.2638**	-.1453**	-.3056**	-.1560**	-.1324**	-.2057**	-.0312
	LOG(10)	-.3664**	-.3068**	-.1758**	-.3438**	-.1735**	-.1605**	-.2316**	-.0488
	SQUARE ROOT	-.4844**	-.3933**	-.2749**	-.4532**	-.2315**	-.2351**	-.3083**	-.1149*
	FULLY-WGTD.	-.6681**	-.5763**	-.5071**	-.6505**	-.3946**	-.4517**	-.5041**	-.3016**
Mostly rural	UNWEIGHTED	-.0311	-.1260**	.0589	-.0743	.0322	.0294	.0437	.0800
	LOG(10)	-.0721	-.1474**	.0317	-.1114*	.0186	-.0036	.0135	.0636
	SQUARE ROOT	-.1330**	-.1981**	-.0233	-.1701**	-.0173	-.0570	-.0434	.0174
	FULLY-WGTD.	-.2010**	-.2682**	-.1276**	-.2301**	-.0964*	-.1512**	-.1427**	-.0800
Population density	UNWEIGHTED	.1821**	.1434**	.0420	.1801**	.0336	.0485	.0561	.0089
	LOG(10)	.2406**	.1664**	.0809	.2281**	.0526	.0801	.0874	.0355
	SQUARE ROOT	.3721**	.2457**	.1877**	.3570**	.1061*	.1518*	.1640**	.1090*
	FULLY-WGTD.	.5241**	.3970**	.3819**	.5198**	.2284**	.3110**	.3155**	.2658**
% Crowded housing	UNWEIGHTED	.4341**	.2930**	.1494**	.3775**	.1008*	.1609**	.1770**	.0718
	LOG(10)	.5235**	.3355**	.2083**	.4544**	.1344**	.2041**	.2228**	.1010*
	SQUARE ROOT	.6667**	.4440**	.3531**	.6177**	.2168**	.3017**	.3307**	.2009**
	FULLY-WGTD.	.7940**	.6380**	.5977**	.7938**	.3953**	.5261**	.5402**	.4103**
% Old housing	UNWEIGHTED	.0540	.0846	.1210**	.1405**	.1023*	.0650	.1221**	.0495
	LOG(10)	.1054*	.1047*	.1396**	.1837**	.1242**	.0852	.1496**	.0728
	SQUARE ROOT	.2195**	.1550**	.2062**	.2833**	.1725**	.1519**	.2177**	.1338**
	FULLY-WGTD.	.4284**	.3202**	.3822**	.4709**	.3036**	.3361**	.3823**	.2966**

Correlations Between The Sociodemographic (Rows) And Vital Records Outcome (Columns) Variables

VARIABLE	WEIGHTING	Preterm percent	S.G.A. percent	Very low B.W.rate	Low B.W.rate	Neonatal Dth.rate	Post-n. Dth.rate	Tot.Inf. Dth.rate	Fetal M. rate
% Female-headed	UNWEIGHTED	.3948**	.2683**	.1535**	.3857**	.1191**	.1008*	.1569**	.0797
poverty	LOG(10)	.4965**	.3116**	.2245**	.4689**	.1550**	.1681**	.2204**	.1112*
	SQUARE ROOT	.6709**	.4321**	.3883**	.6485**	.2447**	.3107**	.3580**	.2078**
	FULLY-WGTD.	.8287**	.6443**	.6562**	.8385**	.4391**	.5836**	.5995**	.4144**
% Primiparous	UNWEIGHTED	.0107	.0651	-.0909*	.0075	-.0370	-.0969*	-.0870	-.0006
	LOG(10)	-.0134	.0838	-.0534	.0092	-.0241	-.1017*	-.0753	.0039
	SQUARE ROOT	-.0523	.0609	-.0388	-.0135	-.0277	-.1195**	-.0840	.0045
	FULLY-WGTD.	-.1319**	-.0372	-.0626	-.0771	-.0632	-.1778**	-.1311**	-.0116
% White	UNWEIGHTED	-.5415**	-.1353**	-.2532**	-.4243**	-.1342**	-.1853**	-.2187**	-.1149*
	LOG(10)	-.6247**	-.1745**	-.3145**	-.5072**	-.1691**	-.2424**	-.2725**	-.1348**
	SQUARE ROOT	-.7607**	-.2875**	-.4713**	-.6826**	-.2704**	-.3509**	-.3994**	-.2246**
	FULLY-WGTD.	-.8807**	-.4756**	-.7352**	-.8582**	-.4859**	-.5905**	-.6371**	-.4276**
% Inadequate	UNWEIGHTED	.4387**	.2372**	.1926**	.3352**	.1192**	.2149**	.2236**	.1054*
prenatal care	LOG(10)	.5085**	.2839**	.2221**	.4013**	.1565**	.2441**	.2629**	.1333**
	SQUARE ROOT	.6217**	.3838**	.3311**	.5360**	.2360**	.3208**	.3560**	.2135**
	FULLY-WGTD.	.7291**	.5725**	.5270**	.6837**	.3918**	.5013**	.5257**	.3940**

* significant at p < .05, two-tailed.

** significant at p < .01, two-tailed.

APPENDIX G

Correlations Between The Sociodemographic (Rows) And And Birth Defects Registry Outcome (Columns) Variables

VARIABLE	WEIGHTING	Down S.	NTDs	Eyes	Cardiacs	Clefts	Reductn.	Chromo.	Con. An.	Major D.	Minor D.	CNS	Heart D.	Musculo.
Mother's age	Unweighted	.0223	-.0688	-.0372	-.0223	-.0359	.0069	.0331	-.0335	-.0519	.0181	-.0439	-.0683	-.0816
	Log(10)	.0358	-.0804	-.0366	-.0189	-.0370	.0034	.0463	-.0694	-.0771	-.0187	-.0546	-.0859	-.1213**
	Square Root	.0545	-.1094*	-.0385	-.0185	-.0365	-.0010	.0601	-.1158**	-.1133*	-.0639	-.0837	-.1214*	-.1829**
	Fully-wgtd.	.1032*	-.1883**	-.0500	-.0431	-.0311	-.0133	.0946*	-.1792**	-.1647**	-.1256**	-.1624**	-.1850**	-.2759**
% Mothers > 35	Unweighted	.0152	-.0368	-.0398	-.0409	-.0421	.0133	.0196	.0143	-.0161	.0659	-.0092	-.0842	-.0204
	Log(10)	.0343	-.0477	-.0391	-.0394	-.0482	.0148	.0395	-.0280	-.0474	.0269	-.0174	-.0993*	-.0665
	Square Root	.0566	-.0720	-.0391	-.0385	-.0530	.0175	.0600	-.0749	-.0874	-.0103	-.0401	-.1262**	-.1200**
	Fully-wgtd.	.1015*	-.1423*	-.0489	-.0573	-.0588	.0157	.0943*	-.1501**	-.1550**	-.0675	-.1095*	-.1803**	-.2104**
% Mothers < H.S.	Unweighted	-.0067	.0492	.0440	.0148	.0242	-.0230	-.0108	.0218	.0346	-.0135	.0317	.0299	.0792
	Log(10)	-.0307	.0606	.0430	.0090	.0220	-.0151	-.0332	.0471	.0504	.0167	.0437	.0418	.1170**
	Square Root	-.0516	.0923*	.0423	.0051	.0153	-.0036	-.0505	.0771	.0724	.0492	.0761	.0705	.1672**
	Fully-wgtd.	-.0984*	.1796**	.0517	.0280	.0079	.0179	-.0888*	.1220**	.1103*	.0898*	.1610**	.1313**	.2380**
Per capita income	Unweighted	.0097	-.0276	-.0425	-.0189	-.0371	-.0396	.0176	.0060	-.0486	.1083	-.0179	-.0498	-.0485
	Log(10)	.0185	-.0432	-.0411	-.0180	-.0442	-.0390	.0283	-.0490	-.0804	.0416	-.0301	-.0732	-.0995*
	Square Root	.0348	-.0773	-.0389	-.0223	-.0507	-.0367	.0436	-.0989*	-.1157**	-.0130	-.0593	-.1154**	-.1516**
	Fully-wgtd.	.0823	-.1633**	-.0416	-.0514	-.0513	-.0370	.0834	-.1634**	-.1643**	-.0835	-.1374**	-.1879**	-.2311**
Mostly rural	Unweighted	.0024	-.0766	.0307	-.0065	.0126	-.0095	-.0007	-.0423	-.0090	-.0859	-.0450	-.0919*	-.0139
	Log(10)	-.0230	-.0632	.0330	-.0003	.0044	-.0122	-.0218	-.0487	-.0185	-.0881*	-.0311	-.0864	-.0165
	Square Root	-.0316	-.0428	.0321	.0117	-.0095	-.0132	-.0278	-.0573	-.0278	-.0938*	-.0131	-.0782	-.0306
	Fully-wgtd.	-.0239	-.0198	.0254	.0318	-.0342	-.0085	-.0192	-.0723	-.0422	-.1044*	.0019	-.0673	-.0606
Population density	Unweighted	.0122	.0572	-.0125	.0086	.0215	.0157	.0098	.0224	.0138	.0282	.0494	.0204	.0159
	Log(10)	.0178	.0460	-.0170	.0029	.0143	.0142	.0100	.0243	.0089	.0447	.0393	.0151	.0236
	Square Root	.0034	.0378	-.0205	-.0062	.0004	.0107	-.0118	.0251	.0010	.0658	.0333	.0169	.0517
	Fully-wgtd.	-.0408	.0584	-.0197	-.0094	-.0166	.0098	-.0670	.0445	.0066	.1073*	.0555	.0450	.1174**
% Crowded housing	Unweighted	-.0015	.0886*	.0344	.0033	.0305	.0179	-.0128	.0389	.0473	.0039	.0725	.0451	.0826
	Log(10)	-.0071	.0892*	.0288	.0047	.0289	.0197	-.0195	.0576	.0574	.0293	.0737	.0600	.1052*
	Square Root	-.0284	.0984*	.0172	.0126	.0165	.0166	-.0374	.0733	.0644	.0564	.0844	.0940*	.1412**
	Fully-wgtd.	-.0912*	.1525**	.0092	.0525	-.0011	.0190	-.0925*	.1013*	.0808	.0984*	.1370**	.1667**	.1978**

APPENDIX G (continued)

Correlations Between The Sociodemographic (Rows) And And Birth Defects Registry Outcome (Columns) Variables

VARIABLE	WEIGHTING	Down S.	NTDs	Eyes	Cardiacs	Clefts	Reductn.	Chromo.	Con. An.	Major D.	Minor D.	CNS	Heart D.	Musculo.
% Old housing	Unweighted	.0724	.1076*	.0224	.0329	.0498	.0069	.0708	.1265**	.1309**	.0568	.1137*	.0289	.0802
	Log(10)	.0622	.1104*	.0318	.0359	.0476	.0049	.0608	.1215**	.1233**	.0576	.1155**	.0289	.0825
	Square Root	.0320	.1144*	.0437	.0394	.0322	.0063	.0318	.1047*	.1038*	.0549	.1179**	.0294	.0907*
	Fully-wgtd.	-.0461	.1451**	.0586	.0503	-.0017	.0238	-.0394	.0923*	.0861	.0620	.1453**	.0493	.1379**
% Female-headed poverty	Unweighted	-.0391	.1072*	.0121	.0882*	.0644	-.0259	-.0549	.1055*	.1319**	.0035	.0924*	.0945*	.1396**
	Log(10)	-.0365	.1051*	.0119	.0695	.0509	-.0208	-.0536	.1036*	.1186**	.0206	.0901*	.0847	.1464**
	Square Root	-.0435	.1122*	.0133	.0427	.0278	-.0077	-.0560	.0975*	.0995*	.0448	.0972*	.0845	.1685**
	Fully-wgtd.	-.0849	.1771**	.0224	.0553	.0086	.0206	-.0878	.1220**	.1111*	.0878	.1605**	.1349**	.2218**
% Primiparous	Unweighted	-.0025	.0524	.0085	.0496	.0470	.0554	.0121	.0679	.0928*	-.0131	.0466	.0484	.1033*
	Log(10)	.0151	.0399	.0028	.0395	.0471	.0536	.0274	.0636	.0808	-.0044	.0329	.0415	.0843
	Square Root	.0054	.0074	-.0137	.0233	.0338	.0427	.0133	.0363	.0439	.0016	.0015	.0261	.0502
	Fully-wgtd.	-.0458	-.0634	-.0467	.0144	.0061	.0172	-.0379	-.0044	-.0150	.0210	-.0622	.0179	.0107
% White	Unweighted	.0515	-.0045	.0155	.0445	.0306	.0055	.0592	.0369	.0606	-.0266	.0031	.0177	-.0578
	Log(10)	.0486	-.0126	.0193	.0406	.0298	.0022	.0548	.0083	.0401	-.0630	-.0057	.0023	-.0953*
	Square Root	.0566	-.0356	.0201	.0295	.0303	-.0054	.0552	-.0382	.0051	-.1144*	-.0300	-.0379	-.1650**
	Fully-wgtd.	.1068*	-.0989*	.0106	-.0094	.0335	-.0306	.0886*	-.1182**	-.0551	-.2013**	-.0951*	-.1200**	-.2799**
% Inadequate prenatal care	Unweighted	.0393	.0477	.0131	.0169	.0459	-.0115	.0152	.0495	.0677	-.0097	.0396	.0082	.1266**
	Log(10)	.0158	.0634	.0162	.0146	.0446	-.0060	-.0068	.0654	.0780	.0063	.0544	.0324	.1443**
	Square Root	-.0082	.0916*	.0208	.0068	.0410	-.0029	-.0223	.0909*	.0988*	.0284	.0800	.0715	.1805**
	Fully-wgtd.	-.0426	.1620**	.0316	.0014	.0292	.0011	-.0416	.1203**	.1316**	.0380	.1432**	.1286**	.2356**

* significant at p < .05, two-tailed.

** significant at p < .01, two-tailed.