

Behavioral Risk Factors Before and During Pregnancy

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PUBLIC HEALTH IMPORTANCE

Infant mortality and low birth weight continue to pose important public health problems in the United States. Although U.S. infant mortality has decreased steadily in recent decades, the rate of decrease slowed from an annual average of 5% in the 1970s to an annual average of 3% in the 1980s. Between 1989 and 1990, U.S. infant mortality decreased by 6%, from 9.8 to 9.2 infant deaths per 1,000 live births. Despite this encouraging statistic, infant mortality remains higher in the United States than in many other developed countries (1). Low birth weight, which contributes heavily to U.S. infant mortality and morbidity, has declined very little in the last two decades. In 1970, 7.9% of all U.S. live births were classified as low birth weight, whereas in 1989 the percentage remained at 7.1% (2).

Studies have suggested that women's behavior during the periconceptional and prenatal periods are related to infant mortality and low birth weight. Types of behavior just before and during pregnancy that have been determined to be associated with infant mortality and morbidity include delayed or no prenatal care and use of cigarettes, alcohol, and illicit drugs. In addition, researchers are interested in other behavior thought to be related to pregnancy outcome, such as weight gain, planning status of pregnancy, physical activity before and during pregnancy, and psychosocial stress. Of all known behavioral risk factors, smoking and alcohol use before and during pregnancy have received the most attention because of the availability of data and their recognized associations with preg-

nancy outcome (3,4) (for additional information about related topics and surveillance activities, see the Contraception, Prenatal Care, Pregnancy-Related Nutrition, Infant Mortality, and Fetal Alcohol Syndrome chapters).

HISTORY OF DATA COLLECTION

The effects of women's behavior on pregnancy outcome and infant health has stimulated researchers' interest in obtaining data to examine this complex relationship. Three principal sources of data have been used for this purpose: vital records, periodic cross-sectional surveys, and ongoing surveillance systems (Table 1). Vital records have been the primary tool for surveillance of maternal status during pregnancy and the condition of infants at birth. Additions of items

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TABLE 1. Data sources on maternal risk behavior during the periconceptional and prenatal periods

Data source	Population	Survey years	Behavioral risk factors	
			Just before pregnancy	During pregnancy
Birth certificates	All U.S. live births	Annual	NA	Smoking and alcohol use; weight gain
National Natality Surveys (NNS)	Stratified sample of U.S. live births to married women only	1963, 1964–1966, 1967–1969, 1972, 1980	Smoking and alcohol use, by amount; intendedness of pregnancy (1980 NNS)	Smoking and alcohol use, by amount; weight gain (1980 NNS)
National Maternal and Infant Health Survey (NMIHS)	Stratified sample of U.S. live births, infant deaths, and fetal deaths	1988–1991	Smoking, alcohol and illicit drug use, by amount; physical activity; intendedness of pregnancy	Smoking, alcohol and illicit drug use, by amount; physical activity; weight gain; use of prenatal care
Pregnancy Risk Assessment Monitoring System* (PRAMS)	Stratified sample of live births in state	Ongoing; cycles beginning in 1987 and 1990	Smoking, alcohol use, by amount; intendedness of pregnancy	Smoking, alcohol use, by amount; stressful events; weight gain; use of prenatal care

* Participants include Alabama, Alaska, California, District of Columbia, Florida, Georgia, Indiana, Maine, Michigan, New York, Oklahoma, South Carolina, Washington, and West Virginia.

to the birth certificate and format changes introduced in 1989 have increased the information that birth certificates provide. Nevertheless, they provide limited data on maternal behavior during pregnancy and no information on women’s behavior before conception.

Cross-sectional surveys conducted by CDC’s National Center for Health Statistics (NCHS), such as the National Survey of Family Growth (NSFG) and the National Maternal and Infant Health Survey (NMIHS), have obtained nationally representative information regarding the health aspects of pregnancy and childbirth. In addition, the NMIHS has been designed to complement data available from vital records with more detailed information regarding women’s behavior before and during pregnancy. The NSFG and the NMIHS provide unique sources of nationally representative data; however,

they are conducted intermittently and both are of limited use for analysis at state and local levels.

To provide a state-specific supplement to vital records, CDC’s National Center for Chronic Disease Prevention and Health Promotion initiated a cooperative agreement in 1987 with the District of Columbia and five states to design and establish the Pregnancy Risk Assessment Monitoring System (PRAMS). Since then, eight additional states have started participating in PRAMS. PRAMS participants include Alabama, Alaska, California, District of Columbia, Florida, Georgia, Indiana, Maine, Michigan, New York (excluding New York City), Oklahoma, South Carolina, Washington, and West Virginia. CDC provides these states with financial and technical support for developing, conducting, and maintaining their PRAMS projects.

PRAMS is an ongoing, population-based surveillance system that obtains self-reported behavioral information from new mothers. This information is linked to birth certificate data for analysis. PRAMS is designed to generate state-specific data and it allows comparisons between states through the use of standardized data collection methods. PRAMS data have been used to estimate the prevalence of behavioral risk factors, to assess the effects of behavioral risk factors on infant mortality and birth weight, and to target intervention programs. Currently, PRAMS surveillance covers about one third of U.S. births.

In addition to the population-based surveillance systems and surveys covered in this chapter, a variety of other data collection mechanisms obtain behavioral risk information from subgroups of women. For example, CDC's Pregnancy Nutrition Surveillance System (PNSS) has monitored behavioral and nutritional risk factors among low-income women in selected states since 1979. PNSS collects prospective data on alcohol use, smoking, and weight gain during pregnancy from women who receive prenatal care in a public health setting (see the Pregnancy-Related Nutrition chapter).

CDC SURVEILLANCE ACTIVITIES

Vital records constitute the only perinatal database for the U.S. population. Revisions in the U.S. Standard Birth Certificate in 1989 were designed to improve surveillance of pregnancy outcome and related factors (5). The 1989 revisions added several new items and replaced open-ended questions with a check-box format designed to make data collection more uniform and complete. Before 1989, behavioral risk information was recorded on birth certificates in open-ended comment boxes captioned **complications of pregnancy** and **concurrent illnesses or conditions affecting the pregnancy**. The responses to these questions were not included on NCHS's computerized national natality files. These items have now been replaced by check-boxes that collect categorical information on cigarette smoking, use of alcohol, and weight gain during pregnancy. These data are now available on national natality files.

Although the revised birth certificate is a useful surveillance tool to determine trends in pregnancy outcome, the scope of prenatal behavioral information it collects is limited. Smoking and alcohol use questions are restricted to use at any time during pregnancy, and average amount consumed per week over the entire pregnancy. The data therefore fail to account for changing patterns of the use of these substances during pregnancy. Changing use patterns are particularly important in regards to alcohol use, which poses the greatest risk for anatomic anomalies when consumed heavily during the periconceptional period. Because of the lack of specificity in question design and the lack of uniformity in the way birth certificate information is collected, birth certificates may underestimate the prevalence of some risk behaviors during pregnancy (6).

Despite these limitations, the birth certificate is a useful source of clinically reported birth outcome information, and it furnishes an excellent sampling frame for surveys such as the NMIHS and surveillance systems such as PRAMS. Additionally, vital records include variables that can be used to identify groups of special interest for which oversampling might be indicated.

To obtain additional data that could be linked to birth outcome information in vital records, NCHS has conducted the NMIHS and related earlier surveys such as the National Natality Surveys (NNS). These surveys are based on national samples drawn from vital records of live births, infant deaths, and late fetal deaths (7).

The NMIHS is primarily a mail survey; only non-respondents are contacted for a personal or telephone interview. Collected data are linked to data in birth certificates and health-care provider records. NMIHS data are collected from mothers 6–30 months after the birth of the child to assess their behavior before and during pregnancy, their health, the pregnancy outcome, and the infant's health. Known and potential risk factors covered on the NMIHS questionnaire include weight gain during pregnancy, physical activity, and the use of cigarettes, alcohol, and illicit drugs just before and during pregnancy. The 1988 NMIHS was the first in the series to collect information from all women regardless of their marital status; pre-

vious NNS cycles collected data only from married women. The survey design oversamples high-risk groups in the natality component, including low- and very-low-birth-weight infants, African-American infants, and in Texas only, Hispanic infants.

The NNS and NMIHS contributed the first nationally representative estimates of the prevalence of behavioral risk factors before and during pregnancy among women who recently gave birth. These surveys continue to provide important supplements to vital records data. In addition, the NMIHS follow-up surveys, in which respondents are recontacted after 2–3 years, are an important source of longitudinal data that allow us to examine maternal risk behavior from the periconceptional period through early childhood.

Like the NMIHS, PRAMS also samples from birth certificates. The sampling frame consists of all live births occurring during a specified period in a given state. The system's primary data collection method consists of statewide mail surveillance with telephone follow-up for nonrespondents (8). Every month, each PRAMS state draws a stratified systematic sample of 100–200 births from recently processed birth certificates. Unlike the NMIHS, which must wait for the states to send their records to NCHS before sampling, PRAMS's monthly samples for mail surveillance require only that the birth certificate has been logged into the state vital statistics registry system. This allows PRAMS projects to contact a new mother within 2–6 months after the delivery.

Although stratification variables differ among PRAMS states, all states oversample births in subpopulations with an increased risk of poor birth outcomes (Table 2). PRAMS data are entered at the state health agency. CDC then weights the data on the basis of sample design, nonresponse, and omissions from the sampling frame.

The PRAMS questionnaire is structured into two parts: a core portion that is identical for all states, and a state-specific portion. Core questions related to maternal behavior and birth outcomes include focus on the use of cigarettes and alcohol before and during pregnancy, intendedness of pregnancy, and stressful events during pregnancy.

State-specific questions related to maternal behavior before and during pregnancy address such topics as mental health and social support, occupation and physical activity, drug use, and physical abuse.

Data collection by mail with telephone follow-up for nonrespondents has worked well in most PRAMS states. However, in states with large urban populations in which response rates by mail tend to be low, mail surveillance is supplemented with hospital-based surveillance in defined geographical areas with telephone follow-up for nonrespondents. Births in subpopulations with traditionally low-response rates by mail are sampled from the delivery logs of targeted hospitals. Reaching new mothers while they are still in the hospital after delivery has provided a feasible and effective method for collecting data from women who are less likely to respond by mail.

GENERAL FINDINGS

Birth Certificates

Analyses of national data from the revised 1989 birth certificate regarding behavioral risks during pregnancy have focused on smoking, use of alcohol, and weight gain during pregnancy (9,10). Here are some selected findings on these topics:

- Nineteen percent of women who gave birth in 1989 reported smoking during pregnancy. Smoking varied according to the mother's level of education and adequacy of prenatal care. Mothers with 9–11 years of education were about eight times as likely to smoke (42%) as were college graduates (5%). Mothers whose care was inadequate were twice as likely to have smoked during pregnancy (32%) as were those with adequate care (16%).
- Controlling for race, adequacy of prenatal care, and mother's educational level, babies born to mothers who smoked during pregnancy were at a greater risk of having a low birth weight. Whereas 6% of babies born to nonsmoking mothers had a low birth weight, 11.4% babies born to mothers

TABLE 2. Stratification variables and stratum-specific response rates for the Pregnancy Risk Assessment Monitoring System, by state, 1990–1991*

State	Stratification variables	Stratum	No.†	Response rate	
Alaska	Maternal race, adequacy of prenatal care	Inadequate prenatal care	Native Alaskan	503	68.4
		Adequate prenatal care	Native Alaskan	540	74.9
		Inadequate prenatal care	non-Native Alaskan	541	72.0
		Adequate prenatal care	non-Native Alaskan	727	82.9
Maine	Birth weight	<2,500 g		259	75.0
		≥2,500 g		381	73.7
Michigan	Maternal race, birth weight	Black (mail)	<2,500 g	348	49.7
		Black (hospital)	<2,500 g	186	78.5
		Other races	<2,500 g	367	73.8
		Black (mail)	≥2,500 g	354	58.5
		Black (hospital)	≥2,500 g	233	83.3
		Other races	≥2,500 g	414	84.3
Oklahoma	Birth weight	<1,500 g		228	65.9
		1,500–2,499 g		195	59.3
		2,500–3,999 g		260	70.3
		≥4,000 g		293	79.6
West Virginia	Adequacy of prenatal care, birth weight	Inadequate prenatal care	<2,500 g	201	62.2
		Adequate prenatal care	<2,500 g	250	74.4
		Inadequate prenatal care	≥2,500 g	218	75.4
		Adequate prenatal care	≥2,500 g	204	82.6

* Includes only states with 1 year or more of weighted PRAMS data. States initiating PRAMS in 1990 began data collection in spring 1993 and therefore are not included.

† No. = number of women; all data were collected during 1990–1991, but the number of months' worth of data vary.

who reported smoking during pregnancy had a low birth weight.

- Four percent of women who gave birth in 1989 reported using alcohol during pregnancy. Among women who reported drinking during pregnancy, 61% reported consuming one drink or less per week, and 21% said they consumed three or more drinks per week.
- Among women who reported having three or more drinks per week, 15–20% of their babies had a low birth weight compared with 7% of mothers who did not drink.
- Approximately 17% of white mothers and 27% of African-American mothers with gestations of >40 weeks gained <20 lbs. during pregnancy. This is below the 1990 National Institute of Medicine's recommended weight gain of 25–35 lbs. for an average-sized woman. Women most at risk for insufficient weight gain included those with less than a high school education, unmarried women, and women whose attendant at birth was not a physician or midwife. Differences found by racial group may be attributable to economic, social, or other factors.

States have used birth certificates to look at such topics as the relationship between smoking during pregnancy and conditions such as low birth weight, sudden infant death syndrome (SIDS), and other complications of pregnancy (11–14). States have also used birth certificates to describe patterns of smoking during pregnancy among subgroups of women (15).

National Maternal and Infant Health Survey and National Natality Survey

Numerous analyses of NMIHS and NNS data have addressed behavioral risk factors such as tobacco, alcohol, and drug use before and during pregnancy; weight gain during pregnancy; physical activity and stress during pregnancy; and unintended or unwanted pregnancy:

- Results from the 1988 NMIHS indicate that age, race, marital status, and depression (but

not occupation) were significantly related to alcohol consumption just before and during pregnancy (16).

- Among mothers with live births included in the 1988 NMIHS, women who drank more during pregnancy also smoked more, were younger and less educated, and gave birth to babies whose gestational age was less than the gestational age of babies born to women who drank at lower levels or not at all (17).
- 1988 NMIHS data revealed that both intrauterine and passive exposure to cigarette smoke were associated with an increased risk of SIDS (18).
- An analysis of live births from the 1988 NMIHS indicated that African-American women were significantly less likely to receive prenatal advice on smoking and alcohol cessation than were white women (19).
- A study of data from the 1967 and 1980 NNS revealed that among married mothers, level of education was strongly associated with the decrease in prevalence of smoking during pregnancy. Between 1967 and 1980, whereas prevalence of smoking during pregnancy decreased from 48% to 43% among mothers with <12 years of education, it decreased from 34% to 11% among mothers with >12 years of education (20).
- Results from the 1980 NNS revealed an association between whether the pregnancy was wanted and the likelihood that a smoker would stop smoking after her pregnancy is confirmed. Wanting the birth to have occurred earlier or at that time was associated with a 23% decrease in the probability that the woman would quit smoking (21).

Pregnancy Risk Assessment Monitoring System

CDC's major areas of PRAMS analysis—conducted with combined data sets for four participating states—have addressed smoking and alcohol use during pregnancy:

- The prevalence of smoking before, during, and after pregnancy among women receiving publicly funded prenatal care was 2.3 to 3.4 times the comparable prevalence among women who received care from private providers.
- Although many smokers reduced or quit smoking while they were pregnant, most resumed or increased their smoking to nearly prepregnancy levels within 3–6 months after delivery (Table 3) (3).
- The prevalence of drinking during the last 3 months of pregnancy is relatively low: 11.7% of mothers reported light drinking (one to six drinks per week), 0.2% reported moderate drinking (seven to 13 drinks per week), and 0.03% reported heavy drinking (14 drinks or more per week) (Table 4) (4).
- The prevalence of drinking during the 3 months before conception was much higher, with 31.9%–53.8% of mothers reporting light drinking; 1.6%–3.0% reporting moderate drinking; and 0.6%–1.3% reporting heavy drinking (4).
- Between 66% and 75% of PRAMS respondents received prenatal counseling about alcohol’s effects. Heavy drinkers were more likely than light drinkers to receive such counseling (4).
- A comparison of PRAMS data with information from birth certificates indicates that

the reporting of alcohol use during pregnancy is significantly higher on the self-reported PRAMS questionnaire than on the birth certificate (4).

State-Specific Findings from PRAMS

OKLAHOMA

Oklahoma publishes PRAMS findings in a quarterly newsletter, the *Oklahoma PRAMS-GRAM*, which is distributed to public and private health care providers; university faculty in medicine, nursing, and public health; legislators; state maternal and child health directors; and professional organizations (22). Oklahoma has also published its PRAMS findings in *Morbidity and Mortality Weekly Report* (23). These data focus on topics such as the prevalence of alcohol and cigarette consumption during pregnancy as well as unintended pregnancy:

- One in 10 Oklahoma mothers reported consuming alcohol during the last 3 months of pregnancy, with <1% consuming seven drinks or more per week during the last trimester.
- One in seven mothers (14.6%) reported that they were not asked by their prenatal care provider if they drank alcohol.
- Mothers who smoked during pregnancy were found to be 2.3 times more likely to deliver a low-birth-weight infant than were mothers who did not smoke.

TABLE 3. Percent distribution of cigarette consumption (in relation to prepregnancy amount) during the last 3 months of pregnancy and 3–6 months postpartum among 2,473 women who smoked before pregnancy — Maine, Michigan, Oklahoma, and West Virginia, 1988–1989

Timing	Cigarette consumption					
	Quit		Reduced		Smoked same or more	
	%	(SE)*	%	(SE)*	%	(SE)*
Last 3 months of pregnancy	29.4	(2.1)	39.1	(2.3)	31.5	(2.2)
3–6 months postpartum	13.4	(1.5)	18.4	(1.7)	68.2	(2.1)

*SE, standard error.

Source: Adams MM, Brogan DJ, Kendrick JS, et al. (3).

TABLE 4. Percent distribution of alcohol consumption 3 months before and during the last 3 months of pregnancy among 6,319 women — Maine, Michigan, Oklahoma, and West Virginia, 1988–1989

Timing	Alcohol consumption									
	None		Light <7 drinks/week		Moderate 7–13 drinks/week		Heavy ≥14 drinks/week		Unknown	
	%	(SE)*	%	(SE)*	%	(SE)*	%	(SE)*	%	(SE)*
3 months before pregnancy	47.4	(1.4)	44.2	(1.4)	2.4	(0.05)	1.0	(0.3)	4.9	(0.5)
Last 3 months of pregnancy	85.3	(1.0)	11.7	(0.9)	0.2	(0.1)	0.03	(0.02)	2.8	(0.4)

*SE, standard error.

Source: Bruce FC, Adams MM, Shulman HB, et al. (4).

- One in five mothers reported that they smoked cigarettes during the last 3 months of pregnancy.
- About 44% of respondents reported that their most recent pregnancy was unintended.
- More than two thirds (69.4%) of respondents <20 years of age reported that their most recent pregnancy was unintended, and 14% of infants were delivered to females <20 years of age.

MAINE

Maine has published a report describing its PRAMS research methodology and providing general findings from the first four years of surveillance to state government agencies, public and private health agencies, and professional associations (24). These findings relate to the use of alcohol and cigarettes during pregnancy:

- About 40% of respondents reported consuming alcohol during the last trimester of pregnancy.
- Similar to Oklahoma, Maine found that <1% of women reported consuming seven drinks or more a week during the last 3 months of pregnancy.

- Approximately 25% of respondents who gave birth in 1991 reported smoking during the last trimester of pregnancy.
- One in 10 women reported smoking at least one pack of cigarettes a day during the last trimester of pregnancy.
- About half of WIC recipients reported smoking during their most recent pregnancy.

WEST VIRGINIA

West Virginia’s analyses of PRAMS data have focused on smoking because the prevalence of smoking among West Virginia women of reproductive age is comparatively high. Results have been presented at numerous state conferences and have been regularly distributed to state agencies and other organizations:

- About 39% of women who received Medicaid smoked during pregnancy compared with 21% of women not on Medicaid (25).
- After controlling for age, PRAMS officials found that recipients of Medicaid were still 1.8 times more likely to smoke during pregnancy than were women not on Medicaid.

- Medicaid recipients who smoked gave birth to infants who at term weighed, on average, about 306 g (11 oz) less than infants born to nonsmoking, non-Medicaid recipients.

INTERPRETATION ISSUES

Currently we have no national reporting system to provide detailed, prospectively collected information about women's behavior during pregnancy. Despite the 1989 expansions in the scope and specificity of information collected on the birth certificate, vital records do not provide the level of detailed behavioral information necessary to study important aspects of women's behaviors, such as the timing of tobacco and alcohol consumption during pregnancy, and their relationship to birth outcome.

The NMIHS and PRAMS provide estimates of the prevalence of women's pregnancy-related behaviors that may be associated with poor outcome. NMIHS data provide important information regarding national trends in women's risk behavior before and during pregnancy. PRAMS collects data about women's behavior that can be used by state health departments to inform program decision makers. PRAMS also offers states the opportunity to participate in sampling design, data collection, and questionnaire development, thus strengthening their ability to make program decisions based on state-specific scientific information.

Despite their differences, the NMIHS and PRAMS face comparable methodologic considerations because of similarities in data collection. The NMIHS and PRAMS data are both designed to supplement birth certificate information. Both data collection systems use birth certificates as a sampling frame, which has several advantages. Sampling from birth certificates allows the NMIHS to obtain a nationally representative sample. For PRAMS, the sample drawn from each participating state's birth certificates is representative of the state population; therefore, findings can be generalized to the state. Vital records also allow both data collection systems to oversample populations of special interest.

A disadvantage of using birth certificates is that data must be collected retrospectively, increasing the chance of recall bias or inability to contact the selected woman. In addition, the extent to which pregnancy outcome may influence a woman's recall and reporting of behavior is unknown. Retrospective data collection means that sensitivity and predictive value of a positive test are difficult to determine.

For both the NMIHS and PRAMS, a final birth certificate file is necessary to assess sample bias and weight the data. Reliance on vital records means that both the NMIHS and PRAMS are dependent on varying state time frames for recording and finalizing birth certificate files. Delays in vital records processing at the state level hinder the timeliness of data collection and production of weighted data sets.

Because the NMIHS and PRAMS questionnaires are primarily self-administered and collected by mail, they may provide a more accurate report of risky behaviors such as smoking and alcohol use during pregnancy than would be obtained in face-to-face interviews. Some research indicates that respondents are less likely to report high-risk behavior directly to a clinician or interviewer (26–28). Even though confidentiality is stressed during interviews women may be self-conscious about the possible adverse effects of their behavior and therefore not report honestly.

Self-administered questionnaires have the advantage of not introducing bias resulting from the presence of an interviewer. However, they are limited in their ability to obtain complex medical information, which would require lengthier, more difficult questions. Further, because interpretation of a question is left to the respondent, ensuring uniform interpretation is difficult. In contrast, an interviewer-administered questionnaire allows for probing when the respondent fails to understand a question or provide an appropriate response.

The greatest challenge presented by mail questionnaires is low response, particularly among highly mobile or disadvantaged subpopulations. Both the NMIHS and PRAMS send two mailings before contact is attempted by phone or, in the

case of the NMIHS, by personal interview. The total response rate to the mail component of the 1988 NMIHS was 30.3%, excluding follow-up attempts for nonresponders. Response to the mail component of PRAMS has been better, ranging from about 33.6% in Washington, D.C., to approximately 77.1% in West Virginia (8). To boost overall response rates, the NMIHS used census interviewers to conduct home visits for face-to-face data collection. PRAMS has developed and established hospital surveillance, which has increased overall response rates. However, the addition of both home interviews and hospital surveillance has increased the labor intensity and cost of conducting the NMIHS and PRAMS.

EXAMPLES OF USING DATA

Dissemination of findings is an essential component of any survey or surveillance system. Birth certificate and national survey data have been used to describe national trends and set national goals for improving the health of women and children. Baseline data used to determine national year 2000 objectives for women and children's health are derived from birth certificate and national survey information (29). These data have also been the basis of a large body of scientific research concerning maternal behavior and its influence on birth outcomes. Many findings from these studies have enhanced our understanding of how behavior and birth outcome are linked and have influenced women and children's health programs.

The addition of behavioral risk information to the birth certificate will provide states with ready estimates of the overall prevalence of smoking and alcohol use during pregnancy. States are already using such information to target public health resources. In Georgia, a study of prenatal smoking information from birth certificates was instrumental in expanding Georgia Medicaid to cover smoking cessation programs for pregnant women (Rochat R, unpublished data, 1993).

States participating in PRAMS have found that PRAMS data can provide the basis for state-specific research. Using PRAMS data, states have documented the need to strengthen women and children's health services; monitored their progress toward meeting public health goals;

and informed health-care providers and the public about the prevalences of certain types of behavior during pregnancy. They have used PRAMS data to measure progress toward meeting year 2000 objectives in the areas of prenatal weight gain, maternal smoking, breast-feeding, births among teenagers, and alcohol consumption. Below are brief descriptions of some ways PRAMS findings have helped shape policies and programs.

Maine's commissioner of health has developed a series of plans calling for expansion of women and children's health services for young mothers. PRAMS data have been incorporated into a working document titled *Teen and Young Adult Health: Annual Action Plan, FY '90-'91*, which documents the need for improved pregnancy management services for teens and young mothers (30). Using data on smoking behavior, Maine is also producing a brochure for health care providers designed to reinforce the importance of counseling pregnant women about the effects of smoking.

The *Oklahoma PRAMS-GRAM* reaches a wide spectrum of public health providers, policy makers, and the general public (22). On the basis of research findings, the *PRAMS-GRAM* makes program recommendations aimed at achieving year 2000 goals for improved women and children's health. PRAMS data regarding alcohol consumption during pregnancy was instrumental in the establishment of a state fetal alcohol syndrome (FAS) prevention center, which will help communities establish FAS prevention projects and work with state community leaders to improve policies aimed at preventing FAS. In addition, the governor and the commissioner of health have used PRAMS data to develop public health policies and strategies regarding women and children's health (*Oklahoma State Department of Health, unpublished data, 1993*).

FUTURE ISSUES

Meaningful data systems are necessary if the United States is to monitor its progress toward improved public health. National and state public health organizations are under increasing pressure to inform health-care providers, policy makers, and the public about the status of infant

health and to translate data into improved health services for women and children. In recognition of this fact, goals for improved public health surveillance systems form an integral part of the national health objectives in *Healthy People 2000* (29).

Meeting these challenges will require the continuation of periodic national surveys. In 1991, a follow-up survey of women interviewed for the 1988 NMIHS was conducted to obtain longitudinal data on the progress of their children. In addition, a new cycle of the NMIHS is being planned for 1996 or 1997, with subsequent follow-up at 2-year intervals. The cohort will be followed at least until the children reach 6 years of age.

State health departments will also be required to enhance their capacity to collect and analyze state-specific data on women and children's health. PRAMS responds to these needs directly by building data collection and analytic capacity within state health departments. PRAMS states are developing analysis projects in collaboration with university faculty, private health promotion organizations, and CDC. Such collaborative relationships will enhance the quality and timeliness of new PRAMS analyses. In addition, PRAMS data will help states monitor their progress toward attaining national public health goals by providing state-specific data addressing 16 of the year 2000 objectives for women and children's health and family planning.

As new research findings modify our understanding of factors that affect infant health, data collection systems must evolve as well. Future evaluation needs include 1) regular assessment of response rates by mode of contact, 2) periodic evaluation of data collection and sampling methodology, and 3) periodic revision of information collected in questionnaires. The revision of information obtained in questionnaires will be particularly important as our knowledge of behavioral risk factors increases. PRAMS is designed to be an ongoing surveillance activity of state health departments in the area of infant health, with PRAMS states functioning more independently over time. Given the availability of resources, CDC hopes to extend PRAMS to every state, thus providing them with access to

a unique source of information about how periconceptional and perinatal behavior are linked to infant health. The participation of all states will also provide us with a new source of national data and strengthen our ability to conduct comparisons between states.

Several changes under way will help to improve the efficiency of longitudinal studies and surveillance systems like the NMIHS and PRAMS. More timely registration of vital records through the Electronic Birth Certificate System will reduce the time between the mother's delivery and her receipt of the survey. Improvements in the birth certificate registry will help NCHS and PRAMS states to quickly release data that are needed by health professionals and agencies to measure their progress and target resources. For new PRAMS states, greater standardization of PRAMS methodology will streamline the start-up process and ease operation of the surveillance system.

The global goal of data collection systems like the NMIHS and PRAMS is to provide a quantitative basis for improved policies and programs that reduce infant mortality and morbidity. In regard to behavioral risk factors during the periconceptional and perinatal periods, the information these data systems collect can improve our understanding of women's behavior and our knowledge of how to reduce the prevalence of behavioral risk factors. In the future, improved data systems and prompt dissemination of findings will continue to strengthen the link between surveillance and improvements in women and children's health policies and services.

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