

Estimates of US Children Exposed to Alcohol Abuse and Dependence in the Family

ABSTRACT

Bridget F. Grant, PhD, PhD

Objectives. This study sought to provide direct estimates of the number of US children younger than 18 years who are exposed to alcohol abuse or alcohol dependence in the family.

Methods. Data were derived from the National Longitudinal Alcohol Epidemiologic Survey.

Results. Approximately 1 in 4 children younger than 18 years in the United States is exposed to alcohol abuse or alcohol dependence in the family.

Conclusions. There is a need for approaches that integrate systems of services to enhance the lives of these children. (*Am J Public Health*. 2000; 90:112–115)

Alcohol abuse and alcohol dependence are the two most prevalent and deleterious psychiatric disorders not only in the United States but in the world.¹ In 1992, an estimated 14 million adults in the United States abused alcohol or were dependent on it.² Beyond the enormous, devastating effects on both these individuals and society, immediate family members, particularly children, suffer the burdens inflicted by such disorders.

There is considerable evidence that both genetic exposure and environmental exposure to alcoholism predispose children to become alcoholics themselves. Evidence of familial aggregation of alcoholism has been strongly supported by family, twin, and adoption studies.^{3–5} Despite a number of methodological shortcomings,⁶ there is also abundant evidence from studies of environmental exposure that children of alcoholic parents are at risk. Children of alcoholics are often subjected to an extremely disorganized milieu, negligent and abusive rearing, economic hardship, and social isolation that accompanies attempts to hide the disorder from friends, relatives, and others.^{7,8}

Studies using self-report or behavioral observations have shown that alcoholic families, relative to nonalcoholic families, are characterized by higher levels of conflict, lower levels of cohesion, more impaired problem solving, and more hostile communications.^{6–9} Many studies have shown as well that parental alcoholism is associated with a range of psychopathology and other behavioral and medical problems in offspring, including conduct disorder and delinquency,^{10–12} use and abuse of alcohol and other drugs in adolescence,^{13–15} anxiety disorders,⁶ and impaired physical health.¹⁶

Because of the important consequences of exposure to alcohol in the family, this study was conducted to provide estimates of the number of children (i.e., younger than 18 years) who are exposed to alcohol abuse and/or dependence in the family environment. This study provides, for the first time, a direct estimate of the number of children living with at least one adult classified with alcohol abuse or dependence, considering both past-year and lifetime diagnoses.

The present study represents a significant advance over previous estimates of the number of children of alcoholics in the

United States, which have ranged from 5 to 6 million.^{17–19} These previous estimates were based on extrapolating the ratio of children to adults from the general population to subpopulations of alcoholics.^{17–19} Other studies have questioned adults about exposure in their childhoods.²⁰

This study avoids several limitations of previous research, including exclusion of certain subpopulations, absence of standardized definitions of alcohol abuse and dependence, recall bias, and the untenable assumptions that alcoholism is randomly distributed in the general population and that the ratios of children in alcoholic families are consistent with those in the general population. Unlike previous research, the present study provides a description of children at risk by virtue of exposure to alcohol in the family in terms of sex, race, and age.

Methods

Sample

This study was based on the 1992 National Longitudinal Alcohol Epidemiologic Survey, sponsored by the National Institute on Alcohol Abuse and Alcoholism.²¹ Data were collected via personal interviews conducted in respondents' homes by US Bureau of the Census interviewers. The survey sample consisted of adults 18 years or older who were selected at random from a nationally representative sample of households. The multistage sampling design featured the selection of primary sampling units via probability-proportional-to-size techniques, oversampling of segments with high proportions of Black residents, and oversampling of young adults (i.e., those aged 18 to 29 years) at the household level. The household response rate was 92%, and the individual response rate was 97%, yielding a total sample size of 42 862.

Requests for reprints should be sent to Bridget F. Grant, PhD, PhD, Division of Biometry and Epidemiology, Suite 514, National Institute on Alcohol Abuse and Alcoholism, MSC 7003, Bethesda, MD 20892-7003 (e-mail: bgrant@willco.niaaa.nih.gov).

This brief was accepted July 27, 1999.

Diagnostic Assessment

Diagnoses of alcohol use disorders, as classified in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)*,²² were derived from the Alcohol Use Disorders and Associated Disabilities Interview Schedule, a fully structured psychiatric interview designed to be administered by trained lay interviewers.²³ The interview schedule included an extensive list of symptom items that operationalized the *DSM-IV* criteria for alcohol abuse and dependence.

Respondents were classified with past-year dependence if they met at least 3 of the 7 *DSM-IV* criteria for dependence within the 1-year period preceding the interview: tolerance; withdrawal or avoidance of withdrawal; desire or attempts to cut down or stop drinking; much time spent on drinking, obtaining alcohol, or recovering from its effects; reduction/cessation of important activities in favor of drinking; impaired control; and continued drinking despite physical or psychological problems caused or exacerbated by drinking. Respondents were classified with past-year alcohol abuse if they met at least 1 of the 4 *DSM-IV* criteria for abuse in the 1-year period preceding the interview: alcohol-related legal problems, continued drinking despite interpersonal problems, neglect of role responsibilities as a result of drinking, and drinking in hazardous situations.

The Alcohol Use Disorders and Associated Disabilities Interview Schedule diagnoses of past-year alcohol abuse and dependence also satisfied the clustering and duration criteria of the *DSM-IV* definitions. The criteria of the *DSM-IV* included clustering of symptoms for each diagnosis within the 1-year period preceding the interview, along with associating duration qualifiers with certain abuse and dependence criteria. Duration qualifiers are defined in *DSM-IV* as the repetitiveness with which symptoms must occur to be classified as positive toward a diagnosis. They are represented by the terms *recurrent*, *often*, and *persistent* appearing in the description of the diagnostic criteria.

Lifetime diagnoses were also measured as syndromes, or the clustering of the number of simultaneous symptoms required for a diagnosis of abuse or dependence. Respondents classified with a lifetime diagnosis encompassed all who had experienced an episode of abuse or dependence at any point in their lives. The reliabilities of past-year and lifetime *DSM-IV* alcohol abuse and dependence diagnoses were 0.73 and 0.76, as ascertained from an independent test-retest study conducted in the general population.²⁴

Statistical Analyses

SUDAAN,²⁵ a software program that uses Taylor series linearization to adjust for sample design characteristics in complex sample surveys, was used in conducting all of the analyses presented here to take into account the complex sample design of the National Longitudinal Alcohol Epidemiologic Survey. Two estimates of the number of children living with at least 1 adult classified with alcohol abuse or dependence were derived from the study data: (1) the number of children living in households with 1 or more adults classified with past-year alcohol abuse and/or dependence, and (2) the number of children living in households with 1 or more adults classified with a diagnosis of alcohol abuse, alcohol dependence, or both, at any point during their lives.

The number of children living in households with 1 or more adults who abused or were dependent on alcohol in the past year was estimated by multiplying the total estimated number of adults 18 years and older who met *DSM-IV* criteria for past-year abuse and/or dependence by the average number of children from birth to 17 years of age living in their households. This average number of children was obtained by linking National Longitudinal Alcohol Epidemiologic Survey respondents' files with those of all other individuals in the same household, by taking a count of children based on the ages of each other household member, and then calculating the weighted mean of this count for adults who were classified with past-year abuse and/or dependence.

The weight factor for each adult sample member included a multiplier to account for all other adults in the household represented by the sample member. Thus, weighting the number of children in the household by the weight factor for this sample member accounted for the probability that at least one of the adults in the household abused or was dependent on alcohol. The same procedure was used to estimate the number of children living in households with one or more adults classified with a diagnosis of alcohol abuse or dependence on a lifetime basis; the total number of adults classified with a past-year diagnosis of abuse or dependence was replaced with the estimated number of adults classified with a lifetime diagnosis.

The first estimate of children living in households with at least one abusing/dependent adult represents an underestimation of the number of exposed children. The reason is that this estimate does not account for adults who were not abusing or dependent on alcohol during the year preceding the interview but had been at some earlier time that

TABLE 1—Numbers of Children Living in Households With 1 or More Adults Who Abused or Were Dependent on Alcohol in the Previous Year: National Longitudinal Alcohol Epidemiologic Survey, 1992

Characteristic	No.
Sex	
Male	4 740 904
Female	4 926 569
Race/ethnicity	
Black	1 146 485
Non-Black	8 520 988
Age, y	
0–2	1 842 237
3–5	1 668 656
6–8	1 741 220
9–11	1 512 953
12–14	1 408 891
15–17	1 493 516
Total	9 667 473

may have coincided with the time the child was living in the household.

In contrast, the estimate based on adults with lifetime diagnoses represents an overestimation of the number of exposed children to the extent that an unknown proportion of these adults had not abused or been dependent on alcohol during a period that coincided with the time the child was living in the household. Both estimates are also overrepresentations to the extent that households with multiple alcoholics increase the probability that children will be categorized as living in an alcoholic household.

Results

Approximately 7.4% (13 760 000) of US adults were classified with a past-year diagnosis of *DSM-IV* alcohol abuse or dependence. Of these individuals, 9 806 000 were men and 3 954 000 were women. An estimated 9 667 473 children were living in households with 1 or more adults classified with a past-year diagnosis of alcohol abuse or dependence (Table 1). Approximately 49.0% of these children were male, 11.9% were Black, and 88.1% were non-Black. Slightly more than one third (36.3%) of the children were 5 years or younger, 33.7% were aged 6 to 11 years, and 30% were aged 12 to 17 years.

Most of the children were identified as biological, foster, or adopted children or stepchildren (70.4%); 11.6% were siblings of the adults classified with a past-year diag-

TABLE 2—Numbers of Children Living in Households With 1 or More Adults Who Had Abused or Been Dependent on Alcohol at Some Time in Their Lives: National Longitudinal Alcohol Epidemiologic Survey, 1992

Characteristic	No.
Sex	
Male	14 327 666
Female	13 718 592
Race/ethnicity	
Black	2 359 344
Non-Black	25 686 914
Age, y	
0–2	5 252 965
3–5	5 064 018
6–8	4 983 415
9–11	4 556 563
12–14	4 276 707
15–17	3 912 590
Total	28 046 258

noses of *DSM-IV* alcohol abuse and/or dependence. The remainder (8.8%) were classified as other biological relatives (e.g., cousins, grandchildren, nieces, nephews), non-relatives with or without their own relatives in the household (6.3%), and children with an unspecified relationship to the adult classified with past-year abuse or dependence (2.9%).

Approximately 18.2% (n = 33 761 710) of the adults were classified with a lifetime diagnosis of *DSM-IV* alcohol abuse or dependence. An estimated 28 046 258 children were living in households with 1 or more adults classified as having such a diagnosis (Table 2). Among these children, 51.1% were male, 8.4% were Black, and 91.6% were non-Black. Again, slightly more than one third (36.8%) were 5 years or younger; 34% were aged 6 to 8 years, and 29.2% were aged 12 to 17 years.

Most of the children were the biological, foster, or adopted children or stepchildren (82.5%) of the adults classified with lifetime abuse or dependence. The remaining children were identified as siblings (5.1%), other biological relatives (5.6%), nonrelatives living in the household (4.2%), and children with an unspecified relationship to the adult with an abuse and/or dependence diagnosis (2.6%).

Discussion

In 1992, an estimated 9 667 473 children, representing approximately 15% of the 66 million US children 17 years or younger,

were living in households with 1 or more adults who were abusing or dependent on alcohol. Nearly 43% (n = 28 046 258) of US children were members of households with 1 or more adults who, at some time in their lives, had abused or were dependent on alcohol. The true estimate of the number of children exposed to alcohol abuse or dependence lies somewhere between these two figures.

Given the more conservative estimate involving past-year diagnoses, about 1 in every 6.6 children in the United States is exposed to alcohol abuse or dependence in the family. Assuming the less conservative estimate involving lifetime diagnoses, 1 in every 2.3 children is exposed to alcohol abuse or dependence in the family. Consider that neither estimate includes children's exposure to biological and nonbiological family and friends who do not reside in the household. Also, assume that 50% of the 18 378 785 children living with 1 or more adults with diagnoses of abuse and/or dependence only prior to the past-year are indeed affected before the age of 18 years by that adult's abuse and/or dependence. With these considerations, it can conservatively be estimated that approximately 1 in every 4 (28.6%) children in the United States is exposed to alcohol abuse or dependence in the family. Such figures represent underestimations to the extent that they do not include children who are homeless and otherwise not residing in households.

As is the case with most research, this study raises a number of critical questions and issues. Foremost, all of the children exposed to alcohol abuse or dependence in the family are at risk of adverse developmental, social, and health outcomes, but not all exposed children will manifest the effects of these threats to their health, well-being, and ability to achieve their full potential in life. More research is necessary to explore the resiliency found in some children who manage to cope positively despite their exposure to alcohol abuse and dependence in the family and an environment that can, at best, be characterized as stressful, chaotic, and frightening. More needs to be known about these individual differences and the impact of mediating factors (e.g., sex of child and affected adult, personality features, comorbidity, social support) on the development and outcomes of children exposed to alcohol abuse or dependence in the family.

The extraordinary number of children in this country who are exposed to alcohol abuse and dependence defines one of today's major public health problems and demands a comprehensive public policy directed toward prevention and intervention. Extant social health and treatment services designed to improve

the lives of children from a variety of types of dysfunctional families have ignored the wide-ranging problems experienced by children exposed to alcohol abuse and dependence in the family. There are simply too many of these children at risk to rely on existing fragmented, incomplete, and compartmentalized health, social, and treatment services.

What is urgently needed is a comprehensive strategy that integrates all systems oriented toward the provision of health, social, and treatment services, designed to improve the lives of children at risk from their exposure to alcohol abuse and dependence in the family. Such a strategy must include a broadening of an array of services targeted to the needs of these children at every developmental stage, coupled with aggressive interventions to enhance their lives and protect their safety.

Children exposed, through no fault of their own, to alcohol abuse and dependence during their critical developmental years are thrust into families and environments that pose extraordinary risks to their immediate and future well-being and that threaten the achievement of their fullest potential. Unless comprehensive and intensive interventions are provided to address the full range of needs of children exposed to abuse and dependence, along with the needs of their families, the potential costs to human services, health, education, social services, and correctional systems will quickly become overwhelming. □

References

1. Murray CJL, Lopez AD. *The Global Burden of Disease*. Boston, Mass: Harvard School of Public Health; 1996.
2. Grant BF, Harford TC, Dawson DA, Chou PS, Dufour M, Pickering RP. Prevalence of DSM-IV alcohol abuse and dependence: United States, 1992. *Alcohol Health Res World*. 1994; 18:243–248.
3. Cotton NS. The familial incidence of alcoholism: a review. *J Stud Alcohol*. 1979;40:89–116.
4. Cloninger CR, Bohman M, Sigvardsson S. Inheritance of alcohol abuse. *Arch Gen Psychiatry*. 1981;38:861–868.
5. Kaprio J, Koshenvuo M, Langinvainio H, et al. Genetic influences on use and abuse of alcohol: a study of 5,638 adult Finnish twin brothers. *Alcoholism*. 1987;11:349–356.
6. Jacob T, Seilhamer RA. Alcoholism and family interaction. In: Jacob T, ed. *Family Interaction and Psychopathology: Theories, Methods and Findings*. New York, NY: Plenum Press; 1987: 535–580.
7. Black C. *"It Will Never Happen to Me!"* New York, NY: Ballantine Books; 1981.
8. Fillmore KM. Prevalence, incidence and chronicity of drinking patterns and problems among men as a function of age: a longitudinal and cohort analysis. *Br J Addict*. 1987;82: 77–83.

9. Sher K. *Children of Alcoholics*. Chicago, Ill: University of Chicago Press; 1991.
10. Reich W, Earls F, Frankel O, Shayka JJ. Psychopathology in children of alcoholics. *J Am Acad Child Adolesc Psychiatry*. 1993;32:995-1002.
11. Steinhausen HC, Gobel D, Nester V. Psychopathology in the offspring of alcoholic parents. *J Am Acad Child Adolesc Psychiatry*. 1984;23:465-471.
12. West MO, Prinz RJ. Parental alcoholism and childhood psychopathology. *Psychol Bull*. 1987;102:204-218.
13. Johnson S, Leonard KE, Jacob T. Drinking, drinking styles, and drug use in children of alcoholics, depressives, and controls. *J Stud Alcohol*. 1989;50:427-431.
14. Merikangas KR, Weissman MM, Prusoff BA, Pauls DL, Leckman JF. Depressives with secondary alcoholism-psychiatric disorders in offspring. *J Stud Alcohol*. 1985;46:199-204.
15. Rydelius PA. Alcohol abusing teenage boys—testing a hypothesis on the relationship between alcohol abuse and social background factors, criminality and personality in teenage boys. *Acta Psychiatr Scand*. 1983;97:153-167.
16. Roberts K, Brent E. Physician utilization and illness patterns in families of alcoholics. *J Stud Alcohol*. 1982;43:119-128.
17. *An Assessment of the Needs of and Resources for Children of Alcoholic Parents*. Springfield, Va: National Technical Information Service; 1974.
18. Clark WB, Midanik L. Alcohol use and alcohol problems among U.S. adults: results of the 1979 national survey. In: *Alcohol Consumption and Related Problems*. Washington, DC: US Dept of Health and Human Services; 1982:76-94. DHHS publication ADM 82-1190.
19. Russell M, Henderson C, Blume S. *Children of Alcoholics: A Review of the Literature*. New York, NY: Children of Alcoholics Foundation; 1985.
20. Schoenborn CA. Exposure to alcoholism in the family: United States, 1988. In: *Adv Data Vital Health Stat*. 205. Washington, DC: US Dept of Health and Human Services; 1991. DHHS publication PHS 91-1250.
21. Grant BF, Peterson A, Dawson DS, Chou SP. *Source and Accuracy Statement for the National Longitudinal Alcohol Epidemiologic Survey*. Rockville, Md: National Institute on Alcohol Abuse and Alcoholism; 1994.
22. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*. Washington, DC: American Psychiatric Association; 1994.
23. Grant BF, Hasin DS. *The Alcohol Use Disorders and Associated Disabilities Interview Schedule*. Rockville, Md: National Institute on Alcohol Abuse and Alcoholism; 1992.
24. Grant BF, Harford TC, Dawson DA, Chou PS, Pickering RP. The Alcohol Use Disorders and Associated Disabilities Interview Schedule (AUDADIS): reliability of alcohol and drug modules in a general population sample. *Drug Alcohol Depend*. 1995;39:37-44.
25. *Software for Survey Data Analysis (SUDAAN), Version 6.00*. Research Triangle Park, NC: Research Triangle Institute; 1996.

Continued Risky Behavior in HIV-Infected Youth

Catherine Diamond, MD, MPH, and Susan Buskin, PhD, MPH

ABSTRACT

Objectives. The purpose of this study was to describe and compare risky behaviors in HIV-infected youths and adults.

Methods. Records of HIV-infected outpatients were reviewed for the period January 1990 to February 1998. Youths (younger than 22 years at HIV diagnosis and younger than 25 years at study entry, n = 139) were compared with adults (22 years or older at HIV diagnosis or 25 years or older at study entry, n = 2880). Risky behaviors occurring after HIV diagnosis included unsafe sex and needle sharing.

Results. Female and male youths were more than twice as likely as adults to engage in risky behavior (adjusted odds ratios of 2.6 and 2.3, respectively).

Conclusions. Both youths and adults continue to engage in risky behaviors after HIV diagnosis. Prospective studies are needed, along with targeted public health campaigns, for youths with HIV and for those at risk of infection. (*Am J Public Health*. 1999; 90:115-118)

Many cases of HIV infection and AIDS diagnosed in adults were acquired during adolescence. As of December 1998, 3423 AIDS cases among youths aged 13 to 19 years and 24 437 cases among youths aged 20 to 24 years had been reported to the Centers for Disease Control and Prevention (CDC).¹ Because HIV infection frequently occurs more than a decade before the onset of AIDS,² these figures underestimate the extent of HIV infection in youths. Individuals aged 13 to 24 years currently account for 18% of reported HIV cases.¹ We sought to describe and compare risky behaviors of HIV-infected youths and adults to help prevent the spread of HIV infection.

Methods

Analyses were performed on data obtained from the Seattle-King County Adult/Adolescent Spectrum of HIV-Related Diseases Study³; these data were collected between January 1990 and February 1998. Seattle, Wash, is one of 11 municipal areas in the United States tracking HIV-AIDS trends via medical record review in this CDC-sponsored study. Abstraction was performed by trained staff using standardized instruments

at 9 diverse King County sites; men of ethnic minority backgrounds and women were oversampled. Records were abstracted for a 1-year retrospective period beginning with a patient's initial visit to a participating site and semiannually thereafter until death or loss to follow-up.

Subjects were divided into 2 groups: youths (diagnosed with HIV before 22 years of age and younger than 25 years at study entry) and adults (22 years or older at HIV diagnosis or 25 years or older at study entry). Among the adults, 99% had been diagnosed with HIV when 22 years or older, and 1% had been diagnosed before 22 years but were 25 years or older at study entry. We used this definition of youths to ensure that these individuals were truly infected as youths and observed for behavioral risks while still

The authors are with the University of Washington School of Public Health and the Seattle-King County Department of Public Health, Seattle.

Requests for reprints should be sent to Susan Buskin, PhD, MPH, Seattle-King County Department of Public Health, 3rd Floor Yesler Bldg, 400 Yesler Way, Seattle, WA 98104 (e-mail: sbuskin@u.washington.edu).

This brief was accepted June 15, 1999.

young adults. Persons without follow-up visits were excluded.

We defined continued risky behavior as that occurring more than 6 months after the first known date of HIV infection. Such behaviors included unsafe sex (e.g., unprotected anal, genital, or oral sex), exchange of sex for money or drugs, needle sharing without bleach, and other unsafe practices (e.g., fecal-oral contact). Women who became pregnant and individuals who contracted a sexually transmitted disease (STD) were considered as engaging in risky behavior as well.

Using SPSS 7.5 (SPSS Inc, Chicago, Ill), we performed multivariate logistic regression analyses to determine the odds of continued risky behavior after adjusting for potential confounders in the association between risky behaviors and youths. Potential confounders were included in the models if adding the confounding variable changed the odds ratio for continued risky behavior in youths by more than 5%.⁴ The use of highly active antiretroviral therapy was not examined, because such therapy was not available during the first 6 years of the study. All adjusted models included illicit use of noninjection drugs, CD4 cell count, CDC HIV classification,⁵ and number of outpatient visits. For women, adjusted models also included psychiatric disorders and alcohol abuse.

Results

Median ages at HIV diagnosis and study entry, respectively, were 20 and 21 years in 139 youths and 32 and 34 years in 2880 adults. The median ages at study entry and HIV diagnosis were lower in young women than in young men ($P < .001$ and $P = .03$, t test). Sixty-eight percent of youths were male, compared with 90% of adults.

Youths had higher CD4 cell counts at study entry than adults ($P < .01$, Mann-Whitney test) (Table 1) and were more likely to be asymptomatic ($P < .001$, χ^2 test). Median numbers of outpatient visits were 19 in youths and 23 in adults (significant difference at $P = .04$, Mann-Whitney test). Median follow-up times were 2.4 years and 2.3 years in young women and adult women, respectively; the corresponding medians in young men and adult men were 1.9 years and 2.0 years.

Fifty-six percent of adults and 48% of youths had a psychiatric disorder (anxiety, depression, or psychosis). Young women had fewer psychiatric disorders than young men (34% vs 55%; $P = .04$, χ^2 test). Nine percent of youths evidenced suicidal ideation, in comparison with 13% of adults. Youths were more likely than adults to engage in illicit use of noninjection drugs ($P = .05$, χ^2 test).

TABLE 1—Characteristics and Behaviors of HIV-Infected Male and Female Youths and Adults: Seattle-King County, 1990–1998

Characteristic—Behavior	Young Men (n = 95)	Adult Men (n = 2578)	Young Women (n = 44)	Adult Women (n = 302)
Median age at HIV diagnosis, y (range)	20 (14–21)	32 (16–69)	19 (11–21)	31 (17–81)
Median age at study entry, y (range)	21 (15–24)	34 (22–75)	20 (15–24)	32 (22–82)
Race/ethnicity, ^a %				
White	64	74	68	54
Black	16	13	11	33
Latino	9	9	2	6
Asian	6	2	2	2
American Indian/Alaska Native	4	2	16	5
HIV exposure category, ^a %				
Men having sex with men	67	66	...	...
Injection drug use	6	9	34	43
Injection drug use & sex with men	22	20	...	...
Blood transfusion/hemophilia	2	1	...	1
Heterosexual sex	1	2	48	38
No identified risk	1	2	18 ^b	18
King County resident, %	86	90	70	73
Enrollment site, ^a %				
Community clinic	21	24	5	5
Emergency department	31	24	14	13
Private physician	4	11	0	0
HIV specialty clinic	44	42	82	82
Median CD4 cells/mm ³ (range)	482 (0–1050)	291 (0–2952)	570 (47–1089)	383 (0–1616)
Initial CDC HIV classification, ^a %				
Asymptomatic (A)	66	45	84	62
Symptomatic (B)	17	19	7	15
Clinical AIDS (C)	16	36	9	23
Psychiatric disorder, %	55	57	34	53
Suicidal Ideation, %	12	13	5	11
Illicit drug use (noninjection), %	28	20	27	30
Alcohol abuse, %	27	27	41	28
Risky behavior ^c (overall), %	23	14	61	39
Unsafe sex with anonymous partner	3	<1	2	3
Unsafe heterosexual sex ^d	0	6	61	38
Unsafe homosexual sex	22	12	...	...
Unsafe sex with HIV-negative partner	3	1	9	4
Exchange of sex for money or drugs ^e	0	<1	5	3
Sharing needles ^e	0	1	0	5
Other unsafe practices	0	<1	0	1
Acute STD ^f (overall), %	15	4	18	14
Chlamydia	2	<1	7	3
Gonorrhea	13	3	5	1
Nongonococcal urethritis in men	3	<1	...	...
Trichomonas	0	<1	11	11
Pregnancy in known HIV-positive women, %	...	...	36	19
Total continued risky behavior ^g , %	28	16	66	46

^aColumn total may not equal 100% because of rounding.

^bWomen likely to have been infected heterosexually but unable to identify a source partner (e.g., who cannot recall a partner who used injection drugs or a partner with known HIV infection) were classified as having no identified risk.

^cNoted by medical provider at least 6 months after HIV diagnosis.

^dIn women and men other than those with sex with men as HIV exposure category.

^eIn individuals with injection drug use as an HIV exposure category.

^fAcute STDs are any of the following diagnosed 6 months or more after HIV diagnosis: chlamydia, gonorrhea, nongonococcal urethritis, and trichomonas.

^gAny of the above-listed risky behaviors along with pregnancy and STDs.

TABLE 2—Adjusted Odds Ratios for Continued Risky Behaviors in HIV-Infected Male and Female Subjects: Seattle-King County, 1990–1998

Characteristic	Male Subjects		Female Subjects	
	Odds Ratio	P	Odds Ratio	P
Youth ^{a,b}	2.3	.001	2.6	.03
Race/ethnicity				
White	1.0	Reference ^c	1.0	Reference ^c
Black	1.4	.07	1.2	.59
Latino	1.5	.03	1.5	.46
Asian	1.4	.37	1.9	.45
American Indian/Alaska Native	1.8	.10	3.4	.05
HIV exposure category				
Men having sex with men	1.0	Reference ^c	...	...
Injection drug use	0.5	<.01	1.0	Reference ^c
Injection drug use and sex with men	1.0	.87	...	...
Heterosexual/other	0.7	.40	1.0	.90
King County resident	1.5	.11	1.0	.91
Enrollment site				
Community clinic	1.0	Reference ^c	1.0	Reference ^c
Emergency department	1.0	.90	1.4	.63
Private physician	0.4	<.001	...	...
HIV specialty clinic	1.1	.33	1.1	.90
CD4 cells/mm ³ at study entry ^{a,b}				
>500	2.3	<.001	1.6	.40
200–499	1.5	.03	1.4	.52
<200	1.0	Reference ^c	1.0	Reference ^c
Initial CDC HIV classification ^{a,b}				
Asymptomatic (A)	1.8	<.01	3.2	.03
Symptomatic (B)	1.4	.09	1.8	.21
Clinical AIDS (C)	1.0	Reference ^c	1.0	Reference ^c
No. of outpatient visits ^{a,b}				
<5	1.0	Reference ^c	1.0	Reference ^c
6–20	2.3	.001	4.2	<.01
21–45	5.1	<.001	9.7	<.001
>45	6.8	<.001	7.7	<.001
Psychiatric disorder or suicidal ideation ^b	1.4	.01	1.0	.93
Alcohol abuse ^b	1.3	.03	1.5	.23
Illicit drug use (noninjection) ^{a,b}	1.9	<.001	2.4	<.01

^aFactors in the adjusted logistic regression models for male subjects.

^bFactors in the adjusted logistic regression models for female subjects.

^cCategory against which the other categories were compared.

^dNo women were enrolled at private physician sites.

Sixty-six percent of young women exhibited evidence of risky behaviors after HIV infection, as compared with 46% of adult women (significant difference at $P = .02$, χ^2 test) (Table 1). When pregnant women were excluded, 46% of young women and 34% of adult women exhibited evidence of risky behaviors. Twenty-eight percent of young men with HIV infection, in comparison with 16% of infected adult men, exhibited evidence of risky behaviors (significant difference at $P < .01$, χ^2 test). In adults, continued risky behavior was associated with psychiatric disorders, suicidal ideation, alcohol abuse, and illicit use of noninjection drugs ($P < .001$, χ^2 test); in youths, however, these associations were not statistically significant.

Youths were significantly more likely than adults to be diagnosed with at least one

episode of an acute STD (chlamydia, gonorrhea, trichomonas, or nongonococcal urethritis; $P < .001$, χ^2 test) (Table 1). Gonorrhea and nongonococcal urethritis were both significantly more common in male youths than in adults ($P < .001$, χ^2 test). Sixteen (36%) of 44 young women became pregnant, as compared with 53 (19%) of 283 adult women younger than 46 years (significant difference at $P = .01$, χ^2 test).

Multivariate analyses showed that the adjusted odds of continued risky behaviors were 2.6 ($P = .03$) among female youths and 2.3 ($P = .001$) among male youths (Table 2). In male subjects, psychiatric disorders, alcohol abuse, and injection drug use all increased the odds of continued risky behavior. Male subjects who had been evaluated by a private physician were less

likely to have documented risky behaviors. The odds of continued risky behavior were higher in male subjects with CD4 cell counts above 200 mm³. The odds of continued risky behavior were higher among subjects who engaged in the use of illicit noninjection drugs than in nonusers. Individuals with asymptomatic HIV infection were more likely to engage in risky behaviors than those with clinical AIDS, and the odds of continued risky behavior increased with increasing numbers of physician visits.

Discussion

Both male and female youths were more than twice as likely as adults to continue engaging in risky behaviors after HIV infection. Excess risks for young women are further evidenced by national data showing that AIDS incidence is increasing rapidly in heterosexual women in their 20s.^{6,7} Although women had more documented risky behavior than men, this may have been due to more frequent STD screening and inclusion of pregnancy as evidence of risky behavior. STDs have been shown to increase HIV transmission; thus, the increased number of STDs among youths has implications for the spread of HIV.^{8,9}

The present study was limited because risk data was collected from medical record review. We obtained information only on youths receiving medical care; thus, our findings may represent an underestimate of the extent of risky behaviors in HIV-infected youths. However, medical record abstraction provided us with a picture of what young people are telling their providers about their risky behaviors over time; such information may be more reliable than data obtained in a single survey. Measurement of STDs and pregnancies helps in assessing the true extent of risky behavior.^{9,10} Less apparent markers of risky behavior may not have been routinely ascertained owing to differences in provider or patient recall or social desirability bias.

Targeted public health campaigns, school-based interventions, clinician attention to risk assessment and counseling at all medical visits, and treatment for substance abuse and mental illness are interventions that might benefit young people with HIV infection and those at risk for infection. Prospective studies of possible increases in risky behavior with the advent of highly active antiretroviral therapy are needed.^{11,12} □

Contributors

C. Diamond and S. Buskin analyzed the data and cowrote the paper.

Acknowledgments

We obtained approval from the Institutional Review Board of the University of Washington before the initiation of this study.

We wish to thank Drs Tom Becker, Russ Alexander, Jim Farrow, Sharon Hopkins, Ann Do, and Mark Dworkin for their manuscript reviews and Beth Sohlberg for her invaluable technical assistance.

References

1. *HIV/AIDS Surveillance Report*. Vol 10. Atlanta, Ga: Centers for Disease Control and Prevention; 1998:16–17.
2. Kaplan JE, Spira TJ, Fishbein DB, Lynn HS. Ten-year follow-up of HIV-infected homosexual men with lymphadenopathy syndrome: evidence for continuing risk of developing AIDS. *J Acquir Immune Defic Syndr*. 1992;5:565–570.

3. Farizo KM, Buehler JW, Chamberland ME, et al. Spectrum of disease in persons with human immunodeficiency virus infection in the United States. *JAMA*. 1992;267:1798–1805.
4. Rothman KJ, Greenland S. *Modern Epidemiology*. Philadelphia, Pa: Lippincott-Raven; 1998: 255–257.
5. Centers for Disease Control. 1993 revised classification system for HIV infection and expanded surveillance case definition for AIDS among youths and adults. *MMWR Morb Mortal Wkly Rep*. 1992;41(RR-17):1–19.
6. Rosenberg PS, Biggar RJ. Trends in HIV incidence among young adults in the United States. *JAMA*. 1998;279:1894–1899.
7. Wortley PM, Fleming PL. AIDS in women in the United States. *JAMA*. 1997;278:911–916.
8. Belongia EA, Danila RN, Angamuthu V, et al. A population-based study of sexually transmitted disease incidence and risk factors in human immunodeficiency virus-infected people. *Sex Transm Dis*. 1997;24:251–256.
9. Quinn TC. Association of sexually transmitted diseases and infection with the human immunodeficiency virus: biological cofactors and markers of behavioral interventions. *Int J STD AIDS*. 1996;7(suppl 2):17–24.
10. Berman SM, Gunn RA, Aral SO. Abstinence and safer sex among adolescents [letter]. *JAMA*. 1999;281:1485.
11. Kelly JA, Hoffmann RG, Rompa D, Gray M. Protease inhibitor combination therapies and perceptions of gay men regarding AIDS severity and the need to maintain safer sex. *AIDS*. 1998;12:F91–F95.
12. Centers for Disease Control and Prevention. Increases in unsafe sex and rectal gonorrhea among men who have sex with men—San Francisco, California, 1994–1997. *MMWR Morb Mortal Wkly Rep*. 1999;48:45–48.

Sources of Prenatal Care Data and Their Association With Birth Outcomes of HIV-Infected Women

ABSTRACT

Objectives. Different sources of prenatal care data were used to examine the association between birth outcomes of HIV-infected women and the Adequacy of Prenatal Care Utilization (APNCU) index.

Methods. Adjusted odds ratios of birth outcomes for 1858 HIV-positive mothers were calculated for APNCU indexes on the basis of birth certificate data or 3 types of physician visits on Medicaid claims.

Results. Claims- and birth certificate-based APNCU indexes agreed poorly ($\kappa < 0.3$). Only the broadest claims-based APNCU index had lower adjusted odds ratios for low birth-weight (0.64; 95% confidence interval [CI]=0.49, 0.84) and preterm birth (0.70; 95% CI=0.54, 0.91). The birth certificate-based index had a reduced adjusted odds ratio (0.73; 95% CI=0.56, 0.95) only for preterm birth.

Conclusions. The association of birth outcomes and adequacy of prenatal care in this HIV-infected cohort differed significantly depending on the source of prenatal care data. (*Am J Public Health*. 2000;90:118–121)

Barbara J. Turner, MD, MEd, James Cocroft, MA, Craig J. Newschaffer, PhD, Walter W. Hauck, PhD, Thomas R. Fanning, PhD, and Michelle Berlin, MD

The impact of prenatal care on birth outcomes has been an area of substantial controversy in the public health field.¹ A number of indexes, notably Kotelchuck's Adequacy of Prenatal Care Utilization (APNCU) index, have been developed to study this issue.^{2–4} Less attention, however, has been directed to evaluating the type of data used to calculate measures of the use of prenatal care.

Although vital statistics data are often used as a source of information on prenatal care,^{5–7} birth certificate records reflect the mother's recollection of her prenatal care history and her understanding of what constitutes a prenatal care visit. Administrative data provide an alternative source of such information. These data offer the advantages of eliminating patient recall as a potential source of error and permitting specification of the types of providers who deliver prenatal care. Care from diverse types of primary and specialty providers during pregnancy may have distinct benefits for women with chronic diseases such as HIV infection, who have an increased risk of adverse birth outcomes.⁸

In this retrospective cohort study, we computed APNCU indexes from birth certificate data and Medicaid claims for a cohort of

HIV-infected pregnant women. For the claims-derived assessment, we computed APNCU indexes for 3 progressively broad definitions of the types of providers who contribute to prenatal care. We hypothesized that of the 4 data inputs into the index, the one based on Medicaid claims for the most com-

Barbara J. Turner, James Cocroft, and Craig J. Newschaffer are with the Center for Research in Medical Education and Health Care, Biostatistics Section, and Walter W. Hauck is with the Division of Clinical Pharmacology, Jefferson Medical College of Thomas Jefferson University, Philadelphia, Pa. Dr Turner is also with the Division of General Internal Medicine, Jefferson Medical College of Thomas Jefferson University. Thomas R. Fanning is with the New York State Department of Health, Albany. Michelle Berlin is with the Department of Obstetrics and Gynecology, University of Pennsylvania, Philadelphia.

Requests for reprints should be sent to Barbara J. Turner, MD, MEd, 12th Floor, Blockley Hall, 423 Guardian Dr, 19107-6021 (e-mail: barbara.turner@mail.tju.edu).

This brief was accepted August 20, 1999.

Note. The authors' opinions do not necessarily reflect those of the New York State Department of Health.

TABLE 1—Proportion of HIV-Infected Medicaid Recipients (n = 1858) With Adequate Prenatal Care,^a as Assessed From Birth Certificate Data and From Medicaid Claims: New York State, 1993–1995

Data Source	% With Adequate Prenatal Care	κ^b			
		Birth Certificates	Claims (OB-GYN)	Claims (OB-GYN + Selected Primary Care ^c)	Claims (OB-GYN + Any Primary Care + HIV Specialty Care)
Birth certificates	52.8	1.0	0.29	0.26	0.23
Claims (OB-GYN)	52.9	...	1.0	0.82	0.65
Claims (OB-GYN + selected primary care ^c)	58.3	...	...	1.0	0.67
Claims (OB-GYN + any primary care + HIV specialty care ^d)	68.1	...	...	...	1.0

Note. OB-GYN = obstetric-gynecologic care.

^aAdequacy of prenatal care is based on the Kotelchuck index,^{2,3} dichotomized with Kotelchuck's original "inadequate" level vs all other categories.

^bA κ statistic between 0 and 0.39 indicates poor agreement; κ between 0.40 and 0.74, adequate agreement; κ of 0.75 or more, good agreement.

^cSelected primary care providers are general internists, family medicine practitioners, and generalists.

^dHIV-related specialties include infectious disease, allergy/immunology, hematology, and oncology.

prehensive set of providers would be most strongly associated with low birthweight and preterm birth.

Methods

Data

We studied 1858 Medicaid recipients in New York State who delivered live-born singleton children between 1993 and 1995, who were identified by a tested case-finding screen as HIV infected, and who had claims data linked to vital statistics records (92% of mothers). For mothers with multiple deliveries in the study period, one delivery was randomly selected. The study population also reflects the prior exclusion of 14 mothers who participated in programs that paid a global fee for prenatal care, since we could not determine the number or type of their visits.

Birth outcomes served as the criteria for our analyses. Low birthweight was specified as less than 2500 g, and preterm birth was defined as a gestational age of less than 37 weeks, based on the physician's estimate or, when the physician's estimate was unavailable (3.7% of cases), the mother's estimate of her last menses.

The APNCU index was calculated in 4 ways. First, we used data on prenatal care visits from vital statistics records. Then we determined the number and timing of visits from Medicaid claims for (1) obstetrics-gynecology visits only; (2) obstetrics-gynecology, family practice, or general medicine services; and (3) obstetrics-gyne-

cology, any primary care, and HIV-related specialty care (HIV-related specialties include infectious disease, allergy/immunology, hematology, and oncology). To simplify the analysis, inadequate prenatal care was compared with all other levels (i.e., adequate plus, adequate, and intermediate) combined.

To control for possible confounders, we included several other maternal characteristics in our multivariate analyses. Lacking viral load and CD4 T-lymphocyte data, we evaluated maternal HIV stage from diagnoses previously reported to be predictive of maternal-child HIV transmission, including history of clinical AIDS, pneumonia, or anemia during pregnancy.⁹ Chronic medical conditions including hypertension, asthma, and diabetes were also determined from diagnoses on claims. Illicit drug use was measured by an approach that, in previous validation studies of claims data, identified 85% of subjects with illicit drug use noted on charts.¹⁰ Other demographic and behavioral covariates included age, race/ethnicity, marital status, nativity (US, including Puerto Rican, vs foreign), New York City residence, parity, year of delivery, educational attainment, and smoking and alcohol use during pregnancy.

Analysis

Simple κ coefficients¹¹ were computed to assess the chance-corrected agreement among the different measures of adequate prenatal care. These are interpreted in the same way as intraclass correlation coefficients. To evaluate the relative strength of the

association between the variously specified APNCU indexes and birth outcomes, we compared 4 logistic regression models for each outcome. Each model included the same covariates with 1 of the 4 APNCU indexes (there were no significant interaction terms), and the adjusted odds ratio and 95% confidence interval were contrasted.

Results

In 17% of the deliveries, the infants were low-birthweight; a similar proportion were preterm. The proportion of mothers with adequate prenatal care utilization varied from one half for the APNCU index derived from vital statistics to two thirds for the index based on visits to the most comprehensive set of providers (Table 1). As shown by the κ statistic, we observed poor agreement between each of the 3 claims-based APNCU indexes of prenatal care and the birth certificate-based APNCU index. Agreement among the claims-based measures was considerably better.

The adjusted odds ratios for the 4 types of data source did not differ dramatically for either birth outcome (Table 2). However, the APNCU measure based on visits to the most comprehensive set of providers—primary care, obstetrics-gynecology, and HIV specialists—consistently showed the strongest association, with a 30% to 35% reduction in the adjusted odds of either birth outcome. The other indexes showed 15% to 20% reductions in the odds of low birthweight. However, the birth certificate-derived measure showed a 25% reduction in the adjusted odds

TABLE 2—Adjusted Odds Ratios^a for Low Birthweight and Preterm Birth, by Adequacy of Prenatal Care^b as Assessed From Birth Certificate Data and From Medicaid Claims: New York State, 1993–1995

Data Source	Low Birthweight (<2500 g)			Preterm Birth (<37 weeks)		
	Women With Adequate Care, %	Women With Inadequate Care, %	AOR (95% CI)	Women With Adequate Care, %	Women With Inadequate Care, %	AOR (95% CI)
Birth certificates	11.1	19.5	0.80 (0.61, 1.05)	11.0	18.6	0.73 (0.56, 0.95)
Claims (OB-GYN)	13.5	20.2	0.86 (0.67, 1.13)	14.4	19.8	0.90 (0.69, 1.17)
Claims (OB-GYN + selected primary care ^c)	13.5	21.0	0.78 (0.60, 1.02)	14.7	20.2	0.88 (0.67, 1.14)
Claims (OB-GYN + any primary care + HIV specialty care ^d)	13.6	23.0	0.64 (0.49, 0.84)	14.4	22.2	0.70 (0.54, 0.91)

Note. AOR = adjusted odds ratio; CI = confidence interval; OB-GYN = obstetric-gynecologic care.

^aOdds ratios are adjusted for mother's age, race/ethnicity, education, marital status, nativity, New York City residence, chronic comorbid conditions, and smoking and substance use during pregnancy.

^bAdequacy of prenatal care is based on the Kotelchuck index,^{2,3} dichotomized with Kotelchuck's original "inadequate" level vs all other categories.

^cSelected primary care providers are general internists, family medicine practitioners, and generalists.

^dHIV-related specialties include infectious disease, allergy/immunology, hematology, and oncology.

of preterm birth, a reduction comparable to that of the broadest claims-based measure.

Discussion

The assessment of adequacy of prenatal care utilization based on birth certificate data showed little agreement with that based on claims. Previous studies of the concordance of prenatal care information from birth certificates and from other data sources have shown similar poor agreement.^{12–16} Of our 4 study measures, we found that the most comprehensive claims-based APNCU index had the strongest association with both low birthweight and preterm birth.

The APNCU measure developed by Kotelchuck was not intended to take into account care by providers other than those directly involved in delivering obstetric and gynecologic services.² In considering visits to other providers, such as internists and HIV specialists, in a measure of adequacy of prenatal care, we may have classified some women as having adequate prenatal care when they actually had fewer obstetric visits than recommended. However, we hypothesize that visits to these other providers facilitated detection and treatment of conditions that could have had an adverse effect on birth outcomes (e.g., serious infections, hypertension, severe anemia, asthma, or poor nutrition). We cannot say whether a study of healthy women or women with diseases other than HIV infection would show a similar advantage to considering care during pregnancy delivered by providers other than obstetricians.

Our findings should prompt researchers to consider the value of administrative data in the examination of prenatal care adequacy. They should also lead researchers to reconsider the types of visits that should be included in an evaluation of prenatal care utilization or, more accurately, an evaluation of care during pregnancy. For women with chronic diseases, treatment from a broader set of providers may contribute to improved birth outcomes. □

Contributors

B. J. Turner, C. J. Newschaffer, W. W. Hauck, and M. Berlin conceptualized the project. T. R. Fanning helped develop the data sources of the project. J. Cocroft performed the data analyses and wrote the paper with B. J. Turner, C. J. Newschaffer, and M. Berlin. W. W. Hauck and C. J. Newschaffer advised on the statistical analyses. All of the authors reviewed and commented on the paper. T. R. Fanning obtained comments from other policymakers in the New York State Department of Health.

Acknowledgments

This work was supported by the National Institute on Drug Abuse (R01 DA07906).

This research was presented at the 1998 Annual Meeting of the American Public Health Association, Washington, DC, November 15–19, 1998.

We wish to thank Sondra G. Druker, BA, CRA/C, Clinical Research Coordinator, for her technical and editing assistance.

References

1. Goldenberg RL, Rouse DJ. Medical progress: prevention of premature birth. *N Engl J Med.* 1998;339:313–318.

2. Kotelchuck M. An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed Adequacy of Prenatal Care Utilization index. *Am J Public Health.* 1994;84:1414–1420.
3. Kotelchuck M. The Adequacy of Prenatal Care Utilization Index: its US distribution and association with low birthweight. *Am J Public Health.* 1994;84:1486–1489.
4. Kessner DM. *Infant Death: An Analysis by Maternal Risk and Health Care.* Washington, DC: National Academy Press; 1973.
5. Oleske DM, Branca ML, Schmidt JB, Ferguson R, Linn ES. A comparison of capitated and fee-for-service Medicaid reimbursement methods on pregnancy outcomes. *Health Serv Res.* 1998; 33:55–73.
6. Fraser AM, Brockert JE, Ward RH. Association of young maternal age with adverse reproductive outcomes. *N Engl J Med.* 1995;332: 1113–1117.
7. Kogan MD, Martin JA, Alexander GR, Kotelchuck M, Ventura SJ, Frigoletto FD. The changing pattern of prenatal care utilization in the United States, 1981–1995, using different prenatal care indices. *JAMA.* 1998;279: 1623–1628.
8. Markson LE, Turner BJ, Houchens R, Silverman NS, Cosler L, Takyi BK. Association of maternal HIV infection with low birth weight. *J Acquir Immune Defic Syndr Hum Retrovirol.* 1996;13:227–234.
9. Turner BJ, Hauck WW, Fanning TR, Markson LE. Cigarette smoking and maternal-child HIV transmission. *J Acquir Immune Defic Syndr Hum Retrovirol.* 1997;14:327–337.
10. Fanning TR, Turner BJ, Cosler LE, et al. Quality of Medicaid data for HIV/AIDS research: examination of a statewide database. *AIDS Public Policy J.* 1995;10:39–47.
11. Fleiss JL. *Statistical Methods for Rates and Proportions.* New York, NY: John Wiley & Sons Inc; 1981.
12. Clark K, Fu C-M, Burnett C. Accuracy of birth certificate data regarding the amount, timing,

- and adequacy of prenatal care using prenatal clinic medical records as referents. *Am J Epidemiol.* 1997;145:68–71.
13. McDermott J, Drews C, Green D, Berg C. Evaluation of prenatal care information on birth certificates. *Paediatr Perinat Epidemiol.* 1997;11:105–121.
 14. Kirby RS. The quality of vital prenatal statistics data, with special reference to prenatal care. *Paediatr Perinat Epidemiol.* 1997;11:122–128.
 15. Piper JM, Mitchel EF, Snowden M, Hall C, Adams M, Taylor P. Validation of 1989 Tennessee birth certificates using maternal and newborn hospital records. *Am J Epidemiol.* 1993;137:758–768.
 16. Schoendorf KC, Parker JD, Batkhan LZ, Kiely JL. Comparability of the birth certificate and 1988 Maternal and Infant Health Survey. *Vital Health Stat—Series 2: Data Evaluation & Methods Research.* 1993;116:1–19.

Factors Predicting Completion of a Home Visitation Program by High-Risk Pregnant Women: The North Carolina Maternal Outreach Worker Program

Maryam Navaie-Waliser, DrPH, Sandra L. Martin, PhD, Marci K. Campbell, PhD, RD, Irene Tessaro, RN, DrPH, Milton Kotelchuck, PhD, MPH, and Alan W. Cross, MD

ABSTRACT

Objectives. This study sought to identify characteristics of high-risk pregnant women that predicted long-term participation in a home visitation program.

Methods. Data regarding sociodemographic characteristics, perceived needs, psychological functioning, substance use, and informal social support were collected prospectively from 152 short-term and 221 long-term program participants.

Results. In comparison with short-term participants, long-term participants were more likely to have been African American, married, nonsmokers, and enrolled in the program during their second trimester of pregnancy, and they were more likely to have had emotional and instrumental support needs.

Conclusions. Women with greater social support needs and healthier behaviors were more receptive to long-term home visitation than other women. (*Am J Public Health.* 2000;90:121–124)

Past studies of maternal home visitation programs have reported attrition rates ranging from 5% to 60%.^{1–4} Although the primary goal of most home visitation studies is to measure programmatic effects on infant morbidity and mortality, investigators often face difficulties estimating program benefits when a substantial proportion of women drop out earlier than expected.

To date, relatively few studies have focused on examining the characteristics of women who drop out of prevention programs prematurely.^{5–11} None of these studies have focused on pregnant women at risk for poor psychosocial functioning, and none are specific to maternal home visitation programs. Given the dearth of information concerning the characteristics of program dropouts and completers and the applicability of this knowledge to program planning, the present study examined associations between women's sociodemographic characteristics, perceived needs, psychological functioning, substance use, and informal social support networks and their duration of participation in a North Carolina maternal home visitation program.

Methods

Study Design and Sample

This study was part of a comprehensive evaluation of the North Carolina Maternal Outreach Worker Program.^{12,13} As described elsewhere,¹⁴ a quasi-experimental design

was used to select 373 women who were enrolled in the program and met the following criteria: (1) receipt of maternity care coordination services, (2) less than 28 weeks pregnant, and (3) presence of at least one of several risk factors (i.e., noncompliance in regard to care, previous poor birth outcome, adolescent pregnancy, transportation difficulties, inadequate social support, high medical risk, physical abuse, substance abuse, mental illness, lack of housing, or other stressful family situations).

Study subjects were classified as short-term participants if they dropped out of the program before 10 months after delivery (n = 152). They were classified as long-term participants if they remained in the program for at least 10 months after delivery (n = 221).

At the time of the study, Maryam Navaie-Waliser was with the Department of Maternal and Child Health, University of North Carolina at Chapel Hill, and Irene Tessaro was with the Center for Health Promotion and Disease Prevention, University of North Carolina at Chapel Hill. Sandra L. Martin and Milton Kotelchuck are with the Department of Maternal and Child Health, Marci K. Campbell is with the Department of Nutrition, and Alan W. Cross is with the Center for Health Promotion and Disease Prevention, University of North Carolina at Chapel Hill.

Requests for reprints should be sent to Maryam Navaie-Waliser, DrPH, Center for Home Care Policy and Research, Visiting Nurse Service of New York, 5 Penn Plaza, 18th Floor, New York, NY 10001-1810 (e-mail: mnavaie@vnsny.org).

This brief was accepted July 20, 1999.

TABLE 1—Sociodemographic Characteristics of Short-Term (n = 152) and Long-Term (n = 221) Participants: The North Carolina Maternal Outreach Worker Program, 1992–1995

Characteristic	Short Term, No. (%)	Long Term, No. (%)	Crude Odds Ratio (95% Confidence Interval)	P
Age, y				
12–17	72 (46)	85 (54)	1.3 (0.8, 2.1)	.223
18–19	26 (34)	51 (66)	1.7 (0.9, 2.9)	.078
≥20	54 (39)	85 (61)	Referent	
Race/ethnicity				
African American	70 (33)	142 (67)	2.3 (1.4, 3.5)	.001 ^a
Other	13 (43)	17 (57)	1.5 (0.7, 3.2)	.358
White	69 (53)	62 (47)	Referent	
Education ^b				
Less than high school	102 (39)	161 (61)	1.4 (0.6, 3.6)	.459
High school	40 (45)	49 (55)	1.1 (0.4, 3.0)	.847
More than high school	9 (47)	10 (53)	Referent	
Marital status				
Married	13 (30)	30 (70)	1.7 (0.8, 3.3)	.136
Unmarried	139 (42)	191 (58)	Referent	
Employment status (part or full time) ^b				
Employed	18 (44)	23 (56)	0.9 (0.4, 1.6)	.642
Unemployed	132 (40)	197 (60)	Referent	
Monthly family income, \$ ^b				
<1000	20 (40)	30 (60)	1.0 (0.5, 1.8)	.957
≥1000	99 (40)	146 (60)	Referent	
Gestational age at program entry, wk ^b				
1–13	17 (43)	23 (57)	1.2 (0.6, 2.5)	.601
14–26	81 (37)	138 (63)	1.5 (1.0, 2.4)	.070
≥27	53 (47)	59 (53)	Referent	

^a $P \leq .001$ denotes statistical significance (Cochran Mantel–Haenszel χ^2 test).

^bResults reported on available data; some participant data missing.

Data Collection and Assessment

Between 1992 and 1995, interviews were conducted with study participants in their homes at the time of their entry into the Maternal Outreach Worker Program. These interviews were designed to collect a wide range of information, including sociodemographic characteristics; perceived needs (e.g., social support related, violence [physical abuse] related, and pregnancy related); psychological functioning specific to self-esteem, perceived stress, and depression (through the use of previously validated instruments^{15–17}); substance use during pregnancy; and structural (i.e., sources and frequency) and functional (i.e., type) components¹⁸ of informal social support networks (i.e., support from relatives and friends).

Statistical Analysis

SAS^{19,20} was used in examining descriptive statistics, conducting bivariate analyses, and applying logistic regression techniques. Five multivariate models were used to examine long-term Maternal Outreach Worker Program participation as a function of (1) sociodemographic charac-

teristics, (2) perceived needs, (3) psychological functioning, (4) substance use, and (5) informal social support networks. Each model (except the sociodemographic model) was adjusted for the effects of age, race, and marital status. Stratified analyses were used to examine potential interactions between predictor variables. In addition, adjusted odds ratios (ORs), 95% confidence intervals (CIs), and P values were computed.

Results

Long-term and short-term program participants did not differ greatly in terms of sociodemographic characteristics (Table 1). Race was the only sociodemographic variable found to be significantly associated with duration of program participation, suggesting that long-term participants were more likely to have been African American than White.

Additional crude (unadjusted) analyses revealed that the 2 groups did not differ in (1) perceived needs in the areas of social support, violence, and pregnancy; (2) self-esteem, perceived stress, and depression levels; or (3) source, frequency, and type of

informal social support. However, a significant relationship was found between the women's use of substances and their duration of program participation, with long-term participants more likely than short-term participants to have been nondrinkers (OR = 1.8, 95% CI = 1.2, 2.9; $P = .006$) and nonsmokers (OR = 2.4, 95% CI = 1.5, 3.7; $P = .001$) during pregnancy.

Of the 5 multivariate models used to examine long-term program participation, those pertaining to the women's psychological functioning and informal social support networks revealed no significant associations. However, several characteristics were found to be associated with the women's duration of program participation in the 3 remaining models (Table 2). The sociodemographic model revealed that long-term participants were more likely than short-term participants to have been African American, married, and enrolled in the program during their second trimester of pregnancy. After adjustment for potential confounders, the perceived needs and substance use models revealed that long-term participants were more likely than short-term participants to have had emotional and instrumental social support needs and to have been nonsmokers during pregnancy.

TABLE 2—Results from Logistic Regression Models of Characteristics Associated With Long-Term Participation: The North Carolina Maternal Outreach Worker Program, 1992–1995

Predictor	Adjusted Odds Ratio	95% Confidence Interval	P
Sociodemographic characteristics (n = 366) ^a			
Age	1.0	0.92, 1.01	.124
African American	2.7	1.71, 4.31	.0001 ^b
Married	3.4	1.54, 7.43	.002 ^b
Employed	1.1	0.54, 2.20	.800
Education level			
Less than high school	1.2	0.40, 3.37	.765
High school	1.0	0.35, 2.98	.949
Gestational age at program entry, wk			
1–13	1.4	0.64, 3.13	.380
14–26	1.6	1.01, 2.46	.043 ^c
Perceived needs (n = 373) ^d			
Social support related			
Emotional support	1.7	1.01, 2.85	.048 ^c
Instrumental support	1.6	1.00, 2.61	.052 ^c
Informational support	0.9	0.52, 1.63	.910
Pregnancy related	1.2	0.64, 2.26	.433
Violence related	0.8	0.38, 1.65	.542
Substance use during pregnancy (n = 373) ^d			
No alcohol use	1.5	0.94, 2.39	.085
No tobacco use	1.8	1.11, 2.89	.015 ^b

Note. The following variable coding schemes were used: duration of program participation, 1 = long-term, 0 = short-term; age, continuous variable; education, 2 indicator variables with more than high school as referent; employment status, 0 = unemployed, 1 = employed; race/ethnicity, 0 = non-African American, 1 = African American; marital status, 0 = unmarried, 1 = married; gestational age at program entry, 2 indicator variables with 27 weeks or more as the referent; social support needs, 0 = no, 1 = yes for emotional, instrumental, or informational support; pregnancy-related needs, 0 = no, 1 = yes; violence-related needs, 0 = no, 1 = yes; alcohol use, 0 = yes, 1 = no; tobacco use, 0 = yes, 1 = no.

^aMonthly family income excluded because of large numbers of missing data.

^b $P \leq .002$ denotes statistical significance.

^c $P \leq .05$ denotes statistical significance.

^dAdjusted for age, race/ethnicity, and marital status.

Discussion

The majority of our findings specific to sociodemographic characteristics, psychological functioning, substance use, and social support networks are consistent with those previously reported in studies of attrition in prevention programs.^{5–11} However, past studies also have reported associations between other sociodemographic factors, such as age,^{6,8,10,11} employment status,⁶ income,¹¹ and education level,¹¹ and duration of program participation, findings that were not supported by our data. These inconsistencies are probably related to differences in the composition of the study samples, the sampling schemes, and the type of program under investigation.

Our findings regarding gestational age could signify that women bonded better with their home visitors given the additional length of time they were enrolled in the program. Moreover, our observations regarding substance use suggest that there may be a

need to enhance tobacco prevention initiatives in the Maternal Outreach Worker Program. However, it also is possible that the needs of women who use tobacco during pregnancy exceed the services that can be provided to them by home visitors.

In terms of social support, the observation that emotional and instrumental types of support may be more important components of home visitation programs than informational support does not imply that the latter was not valuable to participants. Rather, it may be that the women's informational support needs were being met by sources other than home visitors (e.g., other publicly funded programs).

Our study must be viewed in light of its limitations. All of the data were obtained from personal interviews and were subject to biases associated with self-reported information.²¹ Furthermore, we were unable to measure possible program-related factors that may have contributed to the observed attrition, such as scheduling conflicts between

participants and home visitors or smokers being less receptive to the program's anti-smoking messages. Finally, it should be noted that the odds ratios generated in this study pertained to an outcome that was not a rare event; therefore, odds ratios would tend to be larger than relative risk estimates.

Despite its limitations, this study suggests that certain groups of women, such as those with greater social support needs and healthier behaviors, appear to be more receptive than other groups to long-term maternal home visitation services. Future Maternal Outreach Worker Program efforts should focus on strategic planning that aims at retaining groups of women, such as smokers, who are more likely to drop out of the program. □

Contributors

M. Navaie-Waliser developed the conceptual framework of this study, performed data analyses, and wrote the paper. S. L. Martin contributed to the conceptual and analytic frameworks of the paper and assisted with the writing. M. K. Campbell, I. Tessaro, and A. W. Cross planned the study, designed the questionnaire, and supervised data collection. M. Kotelchuck contributed to the conceptual and analytic frameworks of this study.

Acknowledgments

This research was supported in part by the Association for the Schools of Public Health, in collaboration with the Centers for Disease Control and Prevention, under grant 32-1065 and by the North Carolina Governor's Institute on Alcohol and Substance Abuse, Inc.

An earlier version of this article was presented at the 125th Annual Meeting of the American Public Health Association, November 1997, Indianapolis, Ind. Approval for this research was obtained from the Institutional Review Board of the School of Public Health, University of North Carolina at Chapel Hill, and from study participants via informed consent.

We thank Drs Pierre Buekens (Department of Maternal and Child Health), Andrea K. Biddle (Department of Health Policy and Administration), and David A. Savitz (Department of Epidemiology), all from the School of Public Health, University of North Carolina at Chapel Hill, for their constructive comments and suggestions on earlier versions of this article.

References

- Perkocha VA, Novotny TE, Bradley JC, Swanson J. The efficacy of two comprehensive perinatal programs on reducing adverse perinatal health outcomes. *Am J Prev Med.* 1995;11:21–29.
- Gjerdingen DK, Froberg DG, Fontaine P. The effects of social support on women's health during pregnancy, labor and delivery, and the postpartum period. *Fam Med.* 1991;23:370–375.
- Chapman J, Siegel E, Cross A. Home visitors and child health: analysis of selected programs. *Pediatrics.* 1990;85:1059–1068.

4. Navaie-Waliser M, Gordon SK, Hibberd ME. The Mentoring Mothers Program: a community empowering approach to reducing infant mortality. *J Perinat Educ.* 1996;5(4):47–58.
5. Chan LS, Wingert WA, Wachsmen L, Schuetz S, Rogers C. Differences between dropouts and active participants in a pediatric clinic for substance abuse mothers. *Am J Drug Alcohol Abuse.* 1986;12:89–99.
6. Noel NE, McCrady BS, Stout RL, Fisher-Nelson H. Predictors of attrition from an outpatient alcoholism treatment program for couples. *J Stud Alcohol.* 1987;48:229–235.
7. Irvine AA, Mitchell CM. Impact of community-based diabetes education on program attenders and nonattenders. *Diabetes Educator.* 1992;18:29–33.
8. Danoff NL, Kemper KJ, Sherry BL. Risk factors for dropping out of a parenting education program. *Child Abuse Negl.* 1994;18:599–606.
9. Blouin J, Schnarre K, Carter J, Blouin A, Tener C, Barlow J. Factors affecting dropout rate from cognitive-behavioral group treatment for bulimia nervosa. *Int J Eat Disord.* 1995;17:323–329.
10. Agosti V, Nunes E, Ocepeck-Welikson K. Patient factors related to early attrition from an outpatient cocaine research clinic. *Am J Drug Alcohol Abuse.* 1996;22:29–39.
11. Strogatz DS, Earp JL. The determinants of dropping out of care among hypertensive patients receiving a behavioral intervention. *Med Care.* 1983;21:970–980.
12. Tessaro I, Campbell M, O'Meara C, et al. State health department and university evaluation of North Carolina's Maternal Outreach Worker Program. *Am J Prev Med.* 1997;13(suppl 2):38–44.
13. State Center for Health Statistics, Department of Environment, Health, and Natural Resources, and Center for Health Promotion and Disease Prevention, University of North Carolina at Chapel Hill. *The North Carolina Baby Love Maternal Outreach Worker Program: Final Evaluation Report.* Chapel Hill, NC: University of North Carolina; 1996:1–87.
14. Navaie-Waliser M. *An Evaluation of the Participants, Impacts, and Cost-Effectiveness of the North Carolina Baby Love Maternal Outreach Worker Program.* Chapel Hill, NC: University of North Carolina; 1999:67–90.
15. Rosenberg M. The self concept: social products and social forces. In: Rosenberg M, Turner RH, eds. *Social Psychology: Sociological Perspectives.* New York, NY: Basic Books; 1981:593–624.
16. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* 1983;24:385–396.
17. Radloff LS. The CES-D Scale: a self-report depression scale for research in general populations. *Appl Psychol Meas.* 1977;1:385–401.
18. Pierce GR, Sarason BR, Sarason IG, Joseph HJ, Henderson CA. Conceptualizing and assessing social support in the context of the family. In: Pierce GR, Sarason BR, Sarason IG, eds. *Handbook of Social Support and the Family.* New York, NY: Plenum Press; 1996:3–23.
19. Stokes ME, Davis CS, Koch GG. *Categorical Data Analysis Using the SAS System.* Cary, NC: SAS Institute Inc; 1995.
20. *Statistical Analysis System, Version 6.12.* Cary, NC: SAS Institute Inc; 1996.
21. Rothman KJ. *Modern Epidemiology.* Boston, Mass: Little Brown & Co Inc; 1986.

A Time to Be Born

Marlene Anderka, MPH, Eugene R. Declercq, PhD, and Wendy Smith, MD, MPH

ABSTRACT

Objectives. This study used a large, population-based data set ($n = 619,455$) to establish reference standards of the timing of spontaneous vaginal births.

Methods. Low-risk births in Massachusetts from 1989 to 1995 were studied. This group comprised 242,276 births that met the following criteria: singleton, vertex, vaginal births with a birthweight of between 2500 and 4000 g; gestation between 37 and 42 weeks; a 5-minute Apgar score greater than 6, and no induction or stimulation.

Results. Low-risk births displayed a mild circadian pattern, with a peak between 11:00 AM and 1:00 PM and a trough between 11:00 PM and 1:00 AM. Subgroup analysis showed no clear differences except for parity.

Conclusions. Reference standards should be developed and used as comparative norms for hospital and practice-based perinatal studies of diurnal patterns of birthing. (*Am J Public Health.* 2000;90:124–126)

Is there a natural pattern to the timing of birth? This question has been the subject of a variety of research efforts, with empirical studies dating back to at least 1848.¹ Past research has generally been divided between studies examining the time of birth and those documenting the time of the onset of labor. Combining both would be ideal and would permit examination of the length of labor.² The difficulty in reliably defining the onset of labor in a large data set, however, has resulted in a preponderance of studies focusing on time of birth. This study, based on all births in Massachusetts between 1989 and 1995, represents a broader cross section of births than most studies. The large data set reduces both the random variation characteristic of smaller data sets divided into 24-hour periods and biases from peculiarities of local populations and practices.

Examination of these circadian rhythms is relevant for 3 types of perinatal health research: first, research seeking physiologic mechanisms for onset and length of labor as well as specific outcomes, including stillbirth and neonatal death,³ preterm birth,⁴ and premature rupture of the membranes^{5,6}; second, research gauging the impact of

exogenous factors, such as induction and stimulation of labor and cesarean deliveries,⁷ “physician convenience,”^{8,9} the number of hours of sunlight, and seasons of the year,¹⁰ on the timing of birth; and third, research considering opportunities for maternity staffing patterns to be better linked to birth timing.¹¹ This brief will provide reference data for research examining underlying physiologic patterns, the potential for better staffing plans, or the influence of exogenous factors on the timing of birth.

Marlene Anderka is with the Office of Statistics and Evaluation, Bureau of Family and Community Health, Massachusetts Department of Public Health, Boston. Eugene R. Declercq is with the Maternal and Child Health Department, Boston University School of Public Health, Boston, Mass. Wendy Smith is with the Department of Obstetrics and Gynecology, Boston University School of Medicine, Boston, Mass.

Requests for reprints should be sent to Marlene Anderka, MPH, Office of Statistics and Evaluation, Bureau of Family and Community Health, Massachusetts Department of Public Health, 250 Washington St, Boston, MA 02108-4619 (e-mail: marlene.anderka@state.ma.us).

This brief was accepted July 15, 1999.

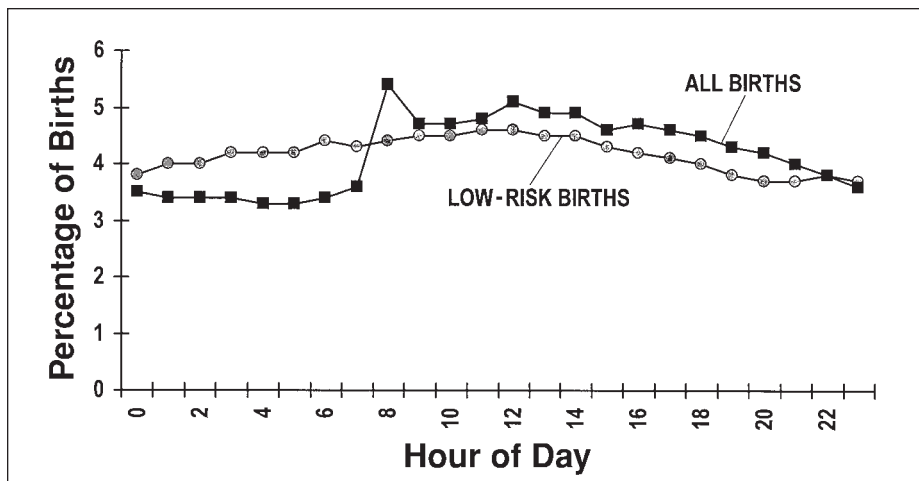


FIGURE 1—Percentage of births in Massachusetts from 1989 to 1995 by hour of day: all births vs low-risk births.

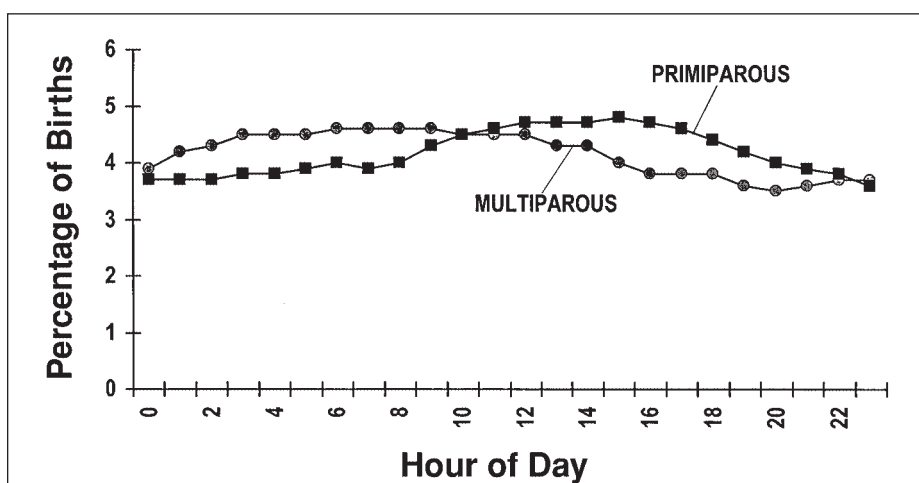


FIGURE 2—Percentage of low-risk births in Massachusetts from 1989 to 1995 by hour of day: primiparous vs multiparous women.

Methods

We chose to establish a reference group of low-risk, spontaneous vaginal births that were least likely to involve interventions that would alter natural birth timing. Our reference group consisted of births that met the following criteria: singleton, vertex, vaginal births with a birthweight of between 2500 and 4000 g; gestation of between 37 and 42 weeks; a 5-minute Apgar score greater than 6; and no induction or stimulation. We also removed women who were diabetic or had complications of labor and delivery from the low-risk group. The resulting data set contained 242 276 cases, which were examined overall and by subgroup.

We plotted the data to identify overlap in subgroup trends. The intensity of the cyclic patterns was quantified by a technique developed by Edwards.¹²

Results

Figure 1 presents the timing of spontaneous vaginal births and of all births in Massachusetts from 1989 to 1995. For all births, there was a clustering around times associated with planned cesarean births (i.e., 7:00 AM to 9:00 AM) and there were fewer births in the late-night and early-morning hours. Interestingly, the births involving less intervention were not distributed evenly or in a random fashion. There was a slight increase in these births between 9:00 AM and 3:00 PM, with a peak between 11:00 AM and 1:00 PM. These births were least common between 7:00 PM and 1:00 AM. Low-intervention births between 11:00 AM and 1:00 PM were 1.23 times more common than births around 11:00 PM to 1:00 AM.

Was the timing of birth related to traits (age, race/ethnicity, parity), background (education), or prenatal behavior (adequacy of care

as measured by the Kessner index,^{13,14} smoking) of the mother? Only in the case of parity—specifically, primiparas vs multiparas—did different patterns emerge. Figure 2 presents these parity-specific patterns. The peak for primiparas was shifted about 8 hours to the right of the curve for multiparas; that is, the birth time for primiparas peaked between noon and 4:00 PM, while births to multiparas showed a steady peak between 3:00 AM and 9:00 AM. Given the crossover of parity-specific patterns, parity-specific reference standards are clearly preferable to one overall standard.

The ratios obtained when we applied the Edwards method to the Massachusetts birth data confirmed the relative intensity of the patterns (reference = 1.208, all births = 1.501). The ratios for the primiparous and multiparous women in the low-risk group were 1.300 and 1.287, respectively. These ratios can be compared via assessment of differences between study subgroups and between reference and study groups.

Other analyses not shown here examined time of birth by season and by day of the week. Patterns for both parity groups were consistent over the seasons. Analysis by day of the week revealed a lower proportion of births on weekend days than on weekdays; this was true for both primiparous and multiparous women. Time-of-birth patterns varied between weekend days and weekdays for both parity groups. For primiparous women, the time of birth was about 3 hours earlier on the weekend than on weekdays; for multiparous women, the time of birth was about 4 hours earlier on the weekend and the cyclic pattern was more intense than during the week.

Discussion

These findings present the results of the first population-based US study of birth timing and provide a reference group for future analyses of circadian patterns of birth. Birth certificates are a logical source from which to derive standards, because they meet criteria for ideal reference data.¹⁵ Research on the quality of birth certificate data following the 1989 standard certificate revision has focused primarily on the early years after the changes and has found variable reporting on some items (e.g., alcohol use and medical history), although we found no study that examined time of birth.^{16,17} Massachusetts birth certificates do not contain measures of onset or length of labor; therefore, they cannot help to establish patterns for these occurrences. Also, they do not currently include a category for labor medications beyond the identification of births involving induction or stimulation.

The distribution of low-risk, spontaneous vaginal births displayed a circadian pattern, with the most common time period from 9:00 AM to 3:00 PM and a trough between 7:00 PM and 1:00 AM. There were also distinctly different patterns for primiparas and multiparas. These findings differ from those of other major studies, such as that of Kaiser and Halberg, who in 1962 summarized the results of 10 different studies of the hour of birth covering a 112-year period and more than 600 000 cases.¹ They reported an overall early-morning (2:00 AM–4:00 AM) peak in spontaneous births, although the 3 most recent studies they cited, all from the United States, showed a pattern more similar to ours than their overall findings. Glatte and Bjerkedal's 1983 examination of 617 306 Norwegian births¹⁸ also found an early-morning peak (4:00 AM–6:00 AM). They also found a greater midday peak for primiparas and a greater early-morning peak for multiparas, similar to what we found. Older studies could contain a higher proportion of multiparous births, which would account for the earlier peak observed in these studies. Research has suggested little difference in the time of onset of labor for primiparas and multiparas¹⁰ and a generally shorter labor for multiparas,¹⁹ which may account for some of the differences in time of birth.

Possible social and physiologic mechanisms for different weekday vs weekend patterns have been discussed in the literature.^{1,20–22} Alternatively, these findings by day of the week could indicate that our reference group contains residual effects of interventions.

Reference standards such as those developed here should be used as comparative norms for hospital and practice-based studies of temporal patterns of birthing. Separate

standards should be used for primiparous and multiparous women to avoid the masking of effects. □

Contributors

M. Anderka was involved in the conception and design of the study, data analysis and interpretation, and writing of the paper. E. Declercq was involved in the conception and design of the study and writing of the paper. W. Smith provided clinical expertise and data analysis and interpretation.

References

1. Kaiser IH, Halberg F. Circadian periodic aspects of birth. *Ann NY Acad Sci.* 1962;98:1056–1068.
2. Nesheim BI. Duration of labor: an analysis of influencing factors. *Acta Obstet Gynecol Scand.* 1988;67:121–124.
3. DePorte JV. The prevalent hour of stillbirth. *Am J Obstet Gynecol.* 1932;23:31–37.
4. Cooperstock M, England JE, Wolfe RA. Circadian incidence of labor onset hour in preterm birth and chorioamnionitis. *Obstet Gynecol.* 1987;70:852–855.
5. Cooperstock M, England JE, Wolfe RA. Circadian incidence of premature rupture of the membranes in term and preterm births. *Obstet Gynecol.* 1987;69:936–941.
6. Shettles LB. Hourly variation in onset of labor and rupture of membranes. *Am J Obstet Gynecol.* 1960;79:177–179.
7. Heres MHB, Pel M, Borkent-Polet M, Mirmiran M. The timing of birth: association of obstetric intervention with the circadian and circaseptan rhythms of the moment of birth. In: Pel M, Heres MHB, eds. *OBINT: A Study of Obstetrical Interventions.* Amsterdam, the Netherlands: Thesis Publishers; 1995:120–162.
8. Evans M, Richardson D, Sholl J, Johnson B. Cesarean section: assessment of the convenience factor. *J Reprod Med.* 1984;29:670–676.
9. Fraser W, Usher R, McLean F, et al. Temporal variation in rates of cesarean section for dystocia: does “convenience” play a role? *Am J Obstet Gynecol.* 1987;156:300–304.
10. Cagnacci A, Soldani R, Melis GB, Volpe A. Diurnal rhythms of labor and delivery in women: modulation by parity and seasons. *Am J Obstet Gynecol.* 1998;178:140–145.
11. Charles E. The hour of birth. *Br J Prev Soc Med.* 1953;7:43–59.
12. Edwards JH. The recognition and estimation of cyclic trends. *Ann Hum Genet (London).* 1961;25:83–87.
13. Kessner D, Singer J, Kalk C, Schesinger E. *Infant Death: An Analysis by Maternal Risk and Health Care.* Washington, DC: Institute of Medicine; 1973.
14. Kotelchuck M. An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed adequacy of prenatal care utilization index. *Am J Public Health.* 1994;84:1414–1420.
15. Gibson RS. *Principles of Nutritional Assessment.* New York, NY: Oxford University Press; 1990:209–246.
16. Bueschler PA, Taylor KP, Davis MH, Bowling M. The quality of the new birth certificate data: a validation study in North Carolina. *Am J Public Health.* 1993;83:1163–1165.
17. Parrish KM, Holt VL, Connell FA, Williams B, LoGerfo JP. Variations in the accuracy of obstetric procedures and diagnoses on birth records in Washington State, 1989. *Am J Epidemiol.* 1993;138:119–127.
18. Glatte E, Bjerkedal T. The 24-hour rhythmicity of birth. *Acta Obstet Gynecol Scand.* 1983;62:31–36.
19. Albers L, Schiff M, Gorwoda J. The length of active labor in normal pregnancies. *Obstet Gynecol.* 1996;87:355–359.
20. Macfarlane A. Variations in number of births and perinatal mortality by day of week in England and Wales. *Br Med J.* 1978;2:1670–1673.
21. Ruffieux C, Marazzi A, Paccaud F. The circadian rhythm of the perinatal mortality rate in Switzerland. *Am J Epidemiol.* 1992;135:936–951.
22. Paccaud F, Martin-Berran B, Gutzwiller F. Hour of birth as a prognostic factor for perinatal death. *Lancet.* 1988;8581:340–343.