

SPECIAL ARTICLE

OUTCOMES OF PREGNANCY IN A NATIONAL SAMPLE OF RESIDENT PHYSICIANS

MARK A. KLEBANOFF, M.D., M.P.H., PATRICIA H. SHIONO, PH.D., AND GEORGE G. RHOADS, M.D., M.P.H.

Abstract Background. Physically demanding, highly stressful work during pregnancy has been reported to cause a variety of adverse outcomes. It has been difficult, however, to separate the effects of work from those of socioeconomic status.

Methods. By means of a national questionnaire-based survey, we studied the outcomes of pregnancy during residency for 4412 women who graduated from medical school in 1985 and for the wives of 4236 of their male classmates, who served as controls.

Results. The rate of response to our survey was 87 percent (4412 of 5079) for the women residents and 85 percent (4236 of 4968) for the wives of the male residents. There were no significant differences in the proportion of pregnancies ending in miscarriage (13.8 percent for residents vs. 11.8 percent for their classmates' wives, $P = 0.12$), ectopic gestations (0.5 percent vs. 0.8 percent, $P = 0.69$), and stillbirths (0.2 percent vs. 0.5 percent, $P = 0.20$). There were 989 women residents and 1238 residents' wives whose first pregnancy during residency resulted in the live birth of a singleton infant. Although during each trimester the women residents worked many more hours than the wives of the male residents, the fre-

quency of preterm births (<37 weeks' gestation) was similar: 6.5 percent for residents and 6.0 percent for residents' wives (odds ratio = 1.1; 95 percent confidence interval, 0.7 to 1.5). Infants who were small for gestational age (with birth weights less than the 10th percentile for gestational age) were born to 5.3 percent of the residents and 5.8 percent of the residents' wives (odds ratio = 0.9; 95 percent confidence interval, 0.6 to 1.3). Adjustment for factors that differed between the women residents and the wives of male residents resulted in odds ratios of 1.2 (95 percent confidence interval, 0.8 to 1.7) for preterm delivery and 0.9 (95 percent confidence interval, 0.6 to 1.3) for the delivery of an infant who was small for gestational age. However, the women residents more frequently reported having had preterm labor (11 percent vs. 6 percent), but not preterm delivery (6.5 percent vs. 6.0 percent); preeclampsia was also more common among the women residents (8.8 percent vs. 3.5 percent).

Conclusions. These results suggest that working long hours in a stressful occupation has little effect on the outcome of pregnancy in an otherwise healthy population of high socioeconomic status. (*N Engl J Med* 1990; 323: 1040-5.)

PHYSICALLY strenuous occupations have long been suspected of causing adverse pregnancy outcomes. Occupational factors such as long working hours,^{1,2} night work,¹ and lengthy periods of standing^{1,3} have been associated with an increased risk of preterm delivery. Prolonged standing at work has also been associated with reduced intrauterine growth.⁴ A common criticism of these reports is that women with physically demanding occupations are likely to be of lower socioeconomic status than women with less demanding occupations.⁵ To address this issue, it is necessary to separate the effects of occupational physical stress and socioeconomic status.

Residency training provides a unique opportunity to make this separation. Medical residents are highly educated, yet they spend long hours during both day and night in work that includes prolonged standing and great emotional stress. Although residency occurs at an age when many women want to have children, most residency programs have no specific policies re-

garding maternity leave,^{6,7} and many pregnant residents perceive resentment of the pregnancy on the part of other house officers and faculty members.⁶

It is commonly believed that pregnant residents are at high risk for a variety of adverse outcomes. Pregnant physicians have been reported to have an increased risk of preterm delivery,⁸ intrauterine growth retardation,⁹ placental abruption,¹⁰ and pregnancy-induced hypertension.¹¹ However, not one of the previous studies of pregnancy among residents has used a broad sample of residents and had a response rate sufficient to ensure the validity of the results. The present study is the largest to date that has evaluated the outcomes of pregnancy among women residents.

METHODS

We surveyed women physicians who graduated from medical school in 1985 ($n = 5096$) and a random sample of 5000 of the 12,306 male physicians who graduated in 1985. Names and addresses for the physicians were obtained from the American Medical Association (AMA) Physicians' Master File. Physicians were sent a questionnaire, along with a covering letter and a letter of endorsement from the American College of Obstetricians and Gynecologists. Male physicians were instructed to give the questionnaires to their wives for completion, or to complete the questionnaire themselves if giving it to their wives was not possible. Nonrespondents were sent a postcard reminder and subsequently received a second copy of the questionnaire. Those who still had not responded were then contacted by telephone, at which time the questionnaire was completed by professional interviewers if possible.

The questionnaire covered the outcome of each pregnancy, demographic information, and the woman's weight and height. The remainder of the questions concerned the first pregnancy that began during the residency (index pregnancy) and included items on the type of residency (or other work in the case of the wives),

From the Division of Prevention Research, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Md. (M.A.K.); the Center for the Future of Children, David and Lucile Packard Foundation, Los Altos, Calif. (P.H.S.); and the Department of Environmental and Community Medicine, Robert Wood Johnson Medical School, University of Medicine and Dentistry of New Jersey, Piscataway (G.G.R.). Address reprint requests to Dr. Klebanoff at the Division of Prevention Research, National Institute of Child Health and Human Development, National Institutes of Health, EPN 640, Bethesda, MD 20892.

Supported by a contract (N01-HD-9-2923) with the National Institutes of Health.

Presented at the annual meeting of the Society for Pediatric Epidemiologic Research, Snowbird, Utah, June 12, 1990.

the number of hours worked, the amount of time off from work, and the attitudes of the woman's colleagues toward the pregnancy. The analyses in the present report are based on these index pregnancies.

The outcomes of interest, reported by the respondents, were preterm delivery, defined as the delivery of a live-born infant before 37 weeks of gestation, and the delivery of an infant who was small for his or her gestational age, defined as a live-born infant with a birth weight less than the 10th percentile for gestational age.¹² The association between the outcome of pregnancy and exposure status was expressed in terms of odds ratios and 95 percent confidence limits.¹³ A variety of factors known to influence the outcome of pregnancy were compared for women physicians and the wives of male physicians by chi-square tests and t-tests, as appropriate. The odds ratios for adverse pregnancy outcomes according to exposure status were adjusted for age at delivery, parity, height, prepregnancy weight, and race or ethnic group with use of multiple logistic regression.¹⁴

RESULTS

The study population initially consisted of 5096 female and 5000 male physicians. Because of errors in the listing of sex in the AMA Master File, the final population we surveyed comprised 5094 women and 5002 men. Physicians who had died, did not enter residency, or had a mailing address outside the United States and its territories (15 women and 34 men) were regarded as ineligible, leaving 5079 women and 4968 men to whom we mailed questionnaires.

The overall rate of response to the survey was 86.1 percent. The response rate was 86.9 percent (4412 of 5079) for female physicians and 85.3 percent (4236 of 4968) for the wives of male physicians; 1.3 percent of the female and 1.5 percent of the male physicians declined to participate, and the remainder of those not included did not respond. Respondents who returned the mailed questionnaire were more likely than respondents contacted by telephone ever to have had a pregnancy. Among those who had been pregnant, however, the frequency of preterm delivery and delivery of an infant who was small for gestational age did not differ between postal and telephone respondents. Among male physicians' wives who had ever been pregnant ($n = 2119$), 231 were themselves either physicians or medical students. These wives were considered to have been exposed to the same conditions as the women residents and were therefore excluded from further analysis.

The outcomes of pregnancy in the two groups are shown in Table 1. There were 1293 residents and 1494 wives who became pregnant during residency; the final study population consisted of the 989 residents and 1239 spouses who gave birth to live-born singleton infants as a result of the first pregnancy that began during the residency. As shown in Table 1, there were no statistically significant differences between residents and residents' wives in terms of the proportion of pregnancies that ended in miscarriage (13.8 percent vs. 11.8 percent, respectively; $P = 0.12$), ectopic gestation (0.5 percent vs. 0.8 percent, $P = 0.69$), or stillbirth (0.2 percent vs. 0.5 percent, $P = 0.20$). The difference in the percentage of pregnancies ending in live birth was a result of a threefold higher rate of voluntary terminations of pregnancy among the women res-

Table 1. Outcome of the First Pregnancy That Began during Residency.

OUTCOME	WOMEN RESIDENTS	WIVES OF MALE RESIDENTS*	P VALUE
	number (percent)		
Voluntary termination	103 (8.0)	41 (2.7)	<0.001
Miscarriage	178 (13.8)	176 (11.8)	0.12
Ectopic pregnancy	7 (0.5)	12 (0.8)	0.41
Stillbirth	3 (0.2)	8 (0.5)	0.20
Multiple pregnancy	13 (1.0)	18 (1.2)	0.61
Single live birth	989 (76.5)	1239 (82.9)	<0.001
Total	1293 (100)	1494 (100)	—

*Because of rounding, percentages do not total 100.

idents (8.0 percent vs. 2.7 percent). Sixty-nine percent of the terminations elected by women residents took place before nine weeks' gestation, making it unlikely that they were due to fetal anomalies.

Selected characteristics of the women residents and the wives of male residents are presented in Table 2. The women residents were slightly older and more likely to be black than the wives of male residents; they were also more likely than the wives to be primiparous. The women residents were approximately 2.4 kg heavier. There were no significant differences in

Table 2. Characteristics of Women Residents and Wives of Male Residents.

CHARACTERISTIC	WOMEN RESIDENTS*	WIVES OF MALE RESIDENTS*	P VALUE
Age at delivery (yr) — no. (%)			<0.001
<25	0 (0)	79 (6.5)	
25–29	540 (54.8)	726 (59.5)	
30–34	378 (38.3)	348 (28.5)	
≥35	68 (6.9)	67 (5.5)	
Race or ethnic group — no. (%)			<0.001
Asian	39 (3.9)	47 (3.8)	
Black	45 (4.6)	19 (1.5)	
White	892 (90.3)	1152 (93.1)	
Other	12 (1.2)	20 (1.6)	
Parity — no. (%)			<0.001
1	796 (80.5)	827 (66.7)	
≥2	193 (19.5)	412 (33.3)	
Smoking during pregnancy — no. (%)			0.95
No	949 (96.6)	1191 (96.6)	
Yes	33 (3.4)	42 (3.4)	
Mean height (cm)	165.6	165.1	0.10
Mean prepregnancy weight (kg)	58.7	56.3	<0.001
Mean weight gain during pregnancy (kg)	14.2	14.0	0.24
Mean hours employed per week†			
First trimester	73.5	37.6	<0.001
Second trimester	71.7	36.9	<0.001
Third trimester	64.4	34.9	<0.001
Mean attitude score‡			
Other residents, coworkers	2.0	1.4	<0.001
Faculty, supervisors	2.3	1.7	<0.001

*Among the women residents, data on age were missing for 3 women, data on race or ethnic group for 1, and data on smoking for 7. Among the wives of male residents, data on age were missing for 19, data on race or ethnic group for 1, and data on smoking for 6. Percentages were calculated on the basis of the number for whom data were available. Because of rounding, percentages do not always total 100.

†Employed women only (76 percent of the wives of male residents were employed).

‡Rated by the women on a five-point scale, with 1 indicating "supportive" and 5 "antagonistic."

height or weight gain during pregnancy; smoking during pregnancy was uncommon in both groups. Twenty-three percent of the employed wives of the male residents were registered nurses, 11 percent were teachers, 5 percent were secretaries, and 3 percent were accountants. The remainder worked in 113 different occupations. The women residents reported working nearly twice as many hours per week throughout the entire pregnancy as did the wives of the male residents. Since the data on hours worked refer only to employed women, the actual differences between residents and spouses in the mean number of hours employed are even greater than those shown in Table 2. The women residents quit work on average 12 days before delivery, as compared with 35 days for the wives ($P < 0.001$). Among the residents, 52 percent worked until the day of the delivery or the day before, as compared with 26 percent of the wives. The women residents perceived significantly less support from both coworkers and supervisors during their pregnancy than did the wives of male residents. Results of the comparisons of hours worked and colleagues' attitudes were not changed when the questionnaires completed by male residents for their wives ($n = 416$) were eliminated from the analyses.

Despite major occupational differences, neither preterm delivery nor delivery of an infant who was small for his or her gestational age was significantly more common among the women residents than among the wives of male residents. The overall frequency of preterm delivery was 6.5 percent for women residents and 6.0 percent for wives ($P = 0.64$); the corresponding figures for infants small for gestational age were 5.3 percent and 5.8 percent ($P = 0.56$). The mean birth weight of the children born to the women residents was 3396 g, as compared with 3428 g for the children born to the wives of male residents ($P = 0.19$). The proportion of infants who weighed less than 2500 g at birth was 4.3 percent for the residents and 3.0 percent for the wives ($P = 0.12$); the proportion weighing less than 1500 g was 0.4 percent for the residents and 0.6 percent for the wives ($P = 0.58$).

The associations between the characteristics of the women and the incidence of preterm delivery are presented in Table 3. Corresponding data for the delivery of infants who were small for their gestational age are presented in Table 4. Preterm delivery was significantly more common among the wives of male residents who were less than 25 or more than 35 years of age; a similar but not statistically significant trend was observed among the women residents. Smaller weight gain was significantly associated with preterm delivery in both groups. None of the other factors shown in Table 3 were significantly associated with preterm delivery. The frequency of delivering infants small for gestational age differed significantly according to race or ethnic group among both groups of women. The delivery of infants small for gestational age was more common among primiparous, shorter, and lighter women, and among women who gained less weight

Table 3. Characteristics Associated with Preterm Delivery among Women Residents and Wives of Male Residents.*

CHARACTERISTIC	WOMEN RESIDENTS		WIVES OF MALE RESIDENTS	
	% PRETERM		% PRETERM	
Age at delivery (yr)				
<25	—		10.1	
25–29	6.1		4.3	
30–34	6.6		7.5	
≥35	8.8		10.6	
Race or ethnic group				
Asian	2.3		12.8	
Black	6.7		0	
White	6.7		5.9	
Other	0		0	
Parity				
1	6.7		5.7	
≥2	5.7		6.6	
Smoking during pregnancy				
No	6.6		6.2	
Yes	6.1		0	
			PRETERM	TERM
Mean height (cm)	165.1	165.6	165.6	165.1
Mean prepregnancy weight (kg)	58.0	58.7	55.6	56.3
Mean weight gain (kg)	12.9	14.3	12.5	14.2

*Preterm delivery was defined as delivery at less than 37 weeks' gestation.

during pregnancy. None of the other factors shown in Table 4 were significantly associated with the delivery of an infant who was small for his or her gestational age.

The crude and adjusted odds ratios for preterm delivery and delivery of infants small for gestational age are presented in Table 5. Odds ratios were adjusted for factors that differed significantly between residents and wives and were associated with either preterm delivery or delivery of an infant small for gestational age; these variables included age, race or ethnic group, parity, height, and prepregnancy weight. This adjustment had a limited effect on the odds ratios; none of the crude or adjusted odds ratios for preterm delivery or delivery of an infant small for gestational age among the women residents were statistically or clinically different from those for the residents' wives. When male residents completed the questionnaire, their wives' mean reported height was 0.8 cm greater ($P = 0.08$) and their mean weight was 1.1 kg less ($P = 0.02$) than the height and weight of the wives who completed the questionnaire themselves. Elimination of data from questionnaires completed by male residents resulted in odds ratios of 1.2 for preterm delivery and 1.0 for delivery of an infant small for gestational age. The vast majority of the women (76 percent of wives and 100 percent of residents) worked at some time during their pregnancy. To account for the possibility that unemployed wives might bias the results (because health problems might have prevented their employment), we excluded unemployed wives from the analysis. The resulting odds ratios were 1.1 for preterm delivery and 1.0 for the delivery of an infant small for gestational age.

Table 4. Characteristics Associated with the Delivery of Infants Who Were Small for Their Gestational Age among Women Residents and Wives of Male Residents.*

CHARACTERISTIC	WOMEN RESIDENTS		WIVES OF MALE RESIDENTS	
	% SMALL FOR GESTATIONAL AGE		% SMALL FOR GESTATIONAL AGE	
Age at delivery				
<25	—		7.7	
25–29	5.6		4.1	
30–34	4.8		9.0	
≥35	5.9		4.6	
Race or ethnic group				
Asian	12.8		14.9	
Black	13.3		0	
White	4.5		5.7	
Other	8.3		0	
Parity				
1	6.6		7.0	
≥2	1.0		3.5	
Smoking during pregnancy				
No	5.2		5.8	
Yes	9.1		7.1	
	SMALL FOR GESTATIONAL AGE	NOT SMALL FOR GESTATIONAL AGE	SMALL FOR GESTATIONAL AGE	NOT SMALL FOR GESTATIONAL AGE
Mean height (cm)	162.1	165.6	162.1	165.1
Mean prepregnancy weight (kg)	55.4	58.9	52.3	56.5
Mean weight gain (kg)	11.7	14.4	11.8	14.2

*Infants who were small for gestational age had birth weights less than the 10th percentile for gestational age.

We investigated the possibility that working longer hours and more nights was related to the incidence of preterm delivery or the delivery of an infant small for gestational age. This analysis was limited to women residents, because of the variety of occupations held by the wives and the large difference in hours worked between women residents and the wives of male residents. The 143 residents who worked 100 hours or more per week during the first trimester of pregnancy had a 9.8 percent risk of preterm delivery, as compared with 4.6 percent for the 818 residents who worked less than 100 hours per week ($P = 0.012$). The corresponding figures for the second trimester were 8.8 percent and 4.9 percent, respectively ($P = 0.07$). There was no indication that increasing numbers of hours worked up to 100 per week were associated with preterm delivery. Working 100 or more hours per week was not associated with the delivery of an infant who was small for gestational age. Residents who did not work during the third trimester ($n = 53$) had a 77 percent incidence of pregnancy complications; the rate of preterm delivery among such women was correspondingly elevated. After we excluded the 53 women who did not work, the residents who worked 100 hours or more per week during the third trimester were found to be at increased risk of preterm delivery (10.3 percent) as compared with those who worked less than 100 hours (4.8 percent, $P = 0.04$). The average number of nights on call per month ranged from six to seven and did not differ in any trimester between the residents who delivered preterm infants and those

whose infants were delivered at term or between those who delivered infants small for gestational age and those who delivered infants who were not small for gestational age.

Women in surgical specialties (surgeons and obstetrician–gynecologists) reported working the most hours during each trimester; it is likely that they spent more time standing than other residents. The mean weight of the infants born to the residents in surgical specialties was 3334 g, as compared with 3408 g for the infants born to the other residents ($P = 0.13$). The odds ratios for the delivery of preterm infants, infants who were small for their gestational age, and low-birth-weight infants were 1.6 ($P = 0.12$), 0.8 ($P = 0.63$), and 0.8 ($P = 0.72$) for surgeons and obstetrician–gynecologists as compared with the other residents. This suggests that employment in these particularly strenuous specialties has only a modest effect on the outcome of pregnancy.

Among women whose residency normally lasts three years (those in pediatrics, internal medicine, and family practice), the rates of preterm delivery for women in postgraduate years 1, 2, and 3 were 8.4 percent, 3.2 percent, and 5.6 percent, respectively ($P = 0.46$ for the trend). The corresponding rates of delivery of infants small for gestational age were 4.2 percent, 5.7 percent, and 6.1 percent ($P = 0.53$). Because the number of hours worked and the number of nights on call usually decrease as training in these three specialties progresses, these data provide additional evidence against a strong effect of workload on pregnancy outcome.

The incidence of pregnancy complications among the women residents and the wives of male residents is presented in Table 6. In spite of the lack of difference in the rate of preterm delivery, premature labor requiring bed rest or hospitalization was nearly twice as common among the women residents as among the residents' wives. Preeclampsia or eclampsia was more than twice as common among the residents; this association did not change after adjustment for parity. Placental abruption was less likely to occur among the

Table 5. Odds Ratios for Preterm Delivery and Delivery of Infants Who Were Small for Their Gestational Age among Women Residents as Compared with Wives of Male Residents.*

OUTCOME†	WOMEN RESIDENTS OR (95% CI)
Preterm delivery	
Crude odds ratio	1.1 (0.7–1.5)
Adjusted odds ratio	1.2 (0.8–1.7)
Infants small for gestational age	
Crude odds ratio	0.9 (0.6–1.3)
Adjusted odds ratio	0.9 (0.6–1.3)

*The odds ratios for these outcomes among the wives of male residents were all 1.0. Preterm delivery was defined as delivery at less than 37 weeks' gestation. Infants who were small for gestational age had birth weights less than the 10th percentile for gestational age. OR denotes odds ratio, and CI confidence interval.

†Adjusted odds ratios have been adjusted for age, parity, race or ethnic group, height, and prepregnancy weight.

Table 6. Frequency of Complications of Pregnancy among Women Residents and Wives of Male Residents.

COMPLICATION	WOMEN RESIDENTS	WIVES OF MALE	P VALUE
	(N = 984)	RESIDENTS (N = 1218)	
	<i>percent</i>		
Premature labor requiring bed rest or hospitalization	11.3	6.0	<0.001
Rupture of membranes ≥ 4 hours before labor	6.4	6.7	0.82
Preeclampsia or eclampsia	8.8	3.5	<0.001
Placental abruption	0.4	1.2	0.054
Placenta previa	0.8	0.7	0.67
Other bleeding	7.8	5.9	0.08

residents ($P = 0.054$). None of the other complications differed in incidence between the two groups.

DISCUSSION

Medical residency provides a unique opportunity to study occupationally related physical activity and pregnancy outcome without the confounding effect of socioeconomic status. It would be difficult to assemble a cohort of women who work longer hours, suffer more sleep deprivation, and are under more stress than residents. As most residency programs have no specific contingency plans for pregnancy leave, the majority of pregnant residents take no time off before the birth of their babies.⁶ However, in spite of their physically demanding occupation, residents are usually of high socioeconomic status.

The choice of the wives of male residents as controls for this unique population has several advantages. Such women are similar in socioeconomic status and age to the women residents. The wives of male residents are likely to receive prenatal care from the same sources as the women residents. In addition, the wives in this study were employed in a variety of occupations, so that any adverse effect of one particular occupation would be minimized. Many of the wives of male residents had medical backgrounds, and those who did not had ready access to medical consultation — a factor that could be expected to increase greatly the reliability of the self-reported pregnancy outcomes.

We found no significant differences in the rates of miscarriage, ectopic gestation, and stillbirth, or in either fetal growth or duration of pregnancy between the women residents and the wives of male residents. Moreover, both groups of women had rates of delivery of low-birth-weight infants that were lower than that in the general U.S. population and similar to that in women of comparable education.¹⁵ These findings cast doubt on previously reported associations between employment in physically demanding occupations and an increased risk of adverse pregnancy outcomes.¹⁻⁴ In addition, our results do not support the widely held belief that women residents are at high risk for adverse outcomes of pregnancy.¹⁶ The use of a nationally representative sample of recent medical graduates and the high response rate (more

than 85 percent for both study groups) increase the validity of the conclusions.

Preterm labor was significantly more common among women residents than among the residents' wives, although preterm delivery was not. This finding is in agreement with those of some other studies,^{8,17} but it suggests that attending obstetricians may have a lower threshold for diagnosing early labor in a group of women who are known to work extremely long hours and are widely believed to be at high risk,^{8-10,16} or that pregnant physicians may be more likely to report symptoms to their obstetricians. Alternatively, preterm labor triggered by work-related stress could be more reversible than that due to other causes.

The excess risk of reported preeclampsia among the residents could also be due to a difference in diagnostic vigilance. Major adverse effects of preeclampsia are the delivery of infants who are small for gestational age, preterm delivery, and stillbirth. Among women in whom preeclampsia developed, 24 percent of the residents and 41 percent of the wives had one or more of these outcomes ($P = 0.048$). This suggests that the residents had milder cases of preeclampsia than the wives, that medical management was more effective among the residents, or that obstetricians were more vigilant in diagnosing preeclampsia among women residents.

Our results differ from those of Miller et al.,⁸ who noted that 60 women physicians who received care in a university group practice were 2.3 times more likely to deliver preterm infants than a group of control women who had at least 16 years of education. Grunebaum et al.⁹ reported that the delivery of low-birth-weight infants was 3 to 4 times more common, and the delivery of infants small for gestational age was 7.5 times more common, in pregnancies among obstetrical residents than in pregnancies among the same women before or after their residencies. Neither of these studies used a large, scientifically selected sample of physicians; moreover, Grunebaum et al. reported a response rate under 50 percent, raising the issue of biased response. Our results are in general agreement with those of several small¹⁷ and uncontrolled^{10,11} surveys, which found women physicians to be at low risk of delivering preterm infants, infants who are small for gestational age, or low-birth-weight infants.

These results call into question the association between stressful occupations requiring long hours of physical activity and the incidence of preterm delivery. Several studies have found occupational factors — such as high number of working hours per week,^{1,2} night work,¹ and long periods of standing^{1,3} — to be associated with an increased risk of preterm delivery. "Preventive rest periods" for fatigue in the absence of specific obstetrical disorders were shown in one study to result in a reduced occurrence of preterm delivery.¹⁸ The degree to which unmeasured socioeconomic factors account for these results has been unclear, since women with physically demanding occupations are

usually of lower socioeconomic status than those with less demanding occupations. We found that pregnant residents, who worked long hours and were likely to work until delivery, did not have significantly higher rates of most adverse outcomes than a control group of women of similar socioeconomic status but with jobs that demanded fewer hours of work. Among women residents, a larger number of hours worked per week and a larger number of nights on call were not strongly associated with adverse pregnancy outcomes; only extremely long workweeks appeared hazardous. Therefore, the previously reported associations between occupational stress and adverse pregnancy outcome may be attributable to unmeasured socioeconomic factors.

In spite of working longer hours, working later in their pregnancies, and working with reportedly less supportive coworkers and supervisors, women residents have a risk of adverse pregnancy outcome that is similar to that for the wives of male residents. However, residents who work more than 100 hours per week (15 percent during the first trimester, decreasing to 8 percent during the third) may be at increased risk for preterm delivery. This increase suggests that the New York State law limiting residents to 80 hours of work per week¹⁹ is well advised with respect to pregnant residents. That pregnant residents as a group are at low risk of adverse outcome does not mean that residency programs should not make appropriate provisions for pregnant residents (the extent to which such provisions existed in this study is unknown). Nor would it be appropriate to conclude that jobs involving other types of strenuous physical labor might not affect pregnancy outcome. With the possible exception of those with extremely long workweeks, however, our findings refute the belief that pregnant residents are a high-risk group in terms of pregnancy outcome, and they call into question the relation of occupational stress and fatigue to outcome in otherwise healthy women of high socioeconomic status.

We are indebted to Rita Stone and Robin Krug of Westat, Inc., for their exceptional work in carrying out the survey; to the American College of Obstetricians and Gynecologists for their endorsement; and, most of all, to the medical school class of 1985 and their families for participating in the survey.

REFERENCES

1. Mamelie N, Laumon B, Lazar P. Prematurity and occupational activity during pregnancy. *Am J Epidemiol* 1984; 119:309-22.
2. McDonald AD, McDonald JC, Armstrong B, Cherry NM, Nolin AD, Robert D. Prematurity and work in pregnancy. *Br J Ind Med* 1988; 45:56-62.
3. Saurel-Cubizolles MJ, Kaminski M, Llado-Arkhipoff J, et al. Pregnancy and its outcome among hospital personnel according to occupation and working conditions. *J Epidemiol Community Health* 1985; 39:129-34.
4. Naeye RL, Peters EC. Working during pregnancy: effects on the fetus. *Pediatrics* 1982; 69:724-7.
5. Fabro S. Pregnant women at work. *Reprod Toxicol* 1986; 5:1-4.
6. Sayres M, Wyshak G, Denterlein G, Apfel R, Shore E, Federman D. Pregnancy during residency. *N Engl J Med* 1986; 314:418-23.
7. Sinal S, Weavil P, Camp MG. Survey of women physicians on issues relating to pregnancy during a medical career. *J Med Educ* 1988; 63:531-8.
8. Miller NH, Katz VL, Cefalo RC. Pregnancies among physicians: a historical cohort study. *J Reprod Med* 1989; 34:790-6.
9. Grunebaum A, Minkoff H, Blake D. Pregnancy among obstetricians: a comparison of births before, during, and after residency. *Am J Obstet Gynecol* 1987; 157:79-83.
10. Schwartz RW. Pregnancy in physicians: characteristics and complications. *Obstet Gynecol* 1985; 66:672-6.
11. Phelan ST. Pregnancy during residency: II. Obstetric complications. *Obstet Gynecol* 1988; 72:431-6.
12. Williams RL, Creasy RK, Cunningham GC, Hawes WE, Norris FD, Tashiro M. Fetal growth and perinatal viability in California. *Obstet Gynecol* 1982; 59:624-32.
13. Woolf B. On estimating the relation between blood group and disease. *Ann Hum Genet* 1955; 19:251-3.
14. Kleinbaum DG, Kupper LL, Morgenstern H. *Epidemiologic research: principles and quantitative methods*. Belmont, Calif.: Lifetime Learning Publications, 1982.
15. Kleinman JC, Madans JH. The effects of maternal smoking, physical stature, and educational attainment on the incidence of low birth weight. *Am J Epidemiol* 1985; 121:843-55.
16. Katz VL, Miller NH, Bowes WA Jr. Pregnancy complications of physicians. *West J Med* 1988; 149:704-7.
17. Osborn LM, Harris DL, Reading JC, Prather MB. Female residents not at increased risk for adverse pregnancy outcome. *Proc Annu Conf Res Med Educ* 1988; 27:120-6.
18. Mamelie N, Bertucat I, Munoz F. Pregnant women at work: rest periods to prevent preterm birth? *Pediatr Perinat Epidemiol* 1989; 3:19-28.
19. Bergman AB, DeAngelis CD, Feigin RD, Stockman JA. Regulation of working hours for pediatric residents. *J Pediatr* 1990; 116:478-83.