Cosmetologists and Reproductive Outcomes

Lisa Gallicchio, PhD, Susan Miller, ScD, Teresa Greene, Howard Zacur, MD, PhD, and Jodi A. Flaws, PhD

OBJECTIVE: To test the hypothesis that cosmetologists are at increased risk of poor pregnancy outcomes compared with women of the same age who are not cosmetologists.

METHODS: Participants were recruited through mass mailing of questionnaires. To be included in the study, respondents to the survey had to be aged between 21 and 55 years and not have had a hysterectomy or oophorectomy. This analysis focused on 350 cosmetologists and 397 women in other occupations who met these inclusion criteria and who reported five or fewer singleton pregnancies. The main outcome measures were miscarriage, stillbirth, the occurrence of maternal health conditions during pregnancy (preeclampsia, high blood pressure, diabetes), hospitalization or physician-ordered bed rest during pregnancy, preterm labor, and premature delivery (before 37 weeks at delivery).

RESULTS: There were no statistically significant associations between occupation and the pregnancy outcomes after adjustment for age, race, education, and smoking and alcohol use at the time of pregnancy. A statistically significant association was found between race and low birth weight such that nonwhite women were at increased risk of reporting a low birth weight neonate compared with white women (odds ratio [OR] 3.35, 95% confidence interval [CI] 1.53–7.26). Similarly, current smoking was found to be positively associated with miscarriage (OR 1.53, CI 1.09–2.16) and miscarriage or stillbirth (OR 1.64, 95% CI 1.18–2.28).

CONCLUSION: Risk of adverse pregnancy outcomes among cosmetologists is not increased compared with women of the same age working in other occupations.
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LEVEL OF EVIDENCE: II

Cosmetologists constitute a major occupational group of female workers who sustain chemical exposures during their reproductive lifespan.[1,2] In general, cosmetologists are exposed to a variety of chemicals on a daily basis, including phenylenediamine compounds (hair dyes), alcohols (hairsprays), methacrylate (acrylic nails), and phthalates (nail polishes, shampoos, and perfumes).[3–6] Many of these chemicals have been shown to cause reproductive abnormalities in animal models.[7,8]

Despite this knowledge, only a few studies have been designed specifically to examine reproductive function in cosmetologists,[9–13] and only one, to our knowledge, was conducted in the United States.[9] This study, conducted in New York, showed a statistically significant increased risk of having a low birth weight infant among cosmetologists compared with realtors (odds ratio [OR] 1.36, 95% confidence interval [CI] 1.09–1.70). Other studies have also shown increases in the risk of infertility or time-to-pregnancy of more than 12 months,[12,13] of spontaneous abortion,[12] of menstrual abnormalities,[11] and of having an infant with an adverse health outcome[12,14,15] among hairdressers compared with controls. Thus, the majority of the studies that have examined reproductive outcomes have, in general, reported results that are consistent with findings from the research conducted in animal models. Data are, however, limited, and the majority of studies that have been conducted have been registry-based (albeit of sample sizes more than 1,000 women), thus limiting the availability of important variables such as socioeconomic status, education, and smoking that may confound the examined associations.

Therefore, we conducted a large survey-based study among cosmetologists and women in other

From the Prevention and Research Center, the Weinberg Center for Women's Health & Medicine, Mercy Medical Center, Baltimore, Maryland; Department of Gynecology & Obstetrics, Johns Hopkins University School of Medicine, Baltimore, Maryland; and Department of Veterinary Biosciences, University of Illinois, Urbana, Illinois.

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Corresponding author: Dr. Jodi A. Flaws, Department of Veterinary Biosciences, University of Illinois, 2001 South Lincoln Avenue, Room 3223, Urbana, Illinois, 61802; e-mail: jflaws@illinois.edu.

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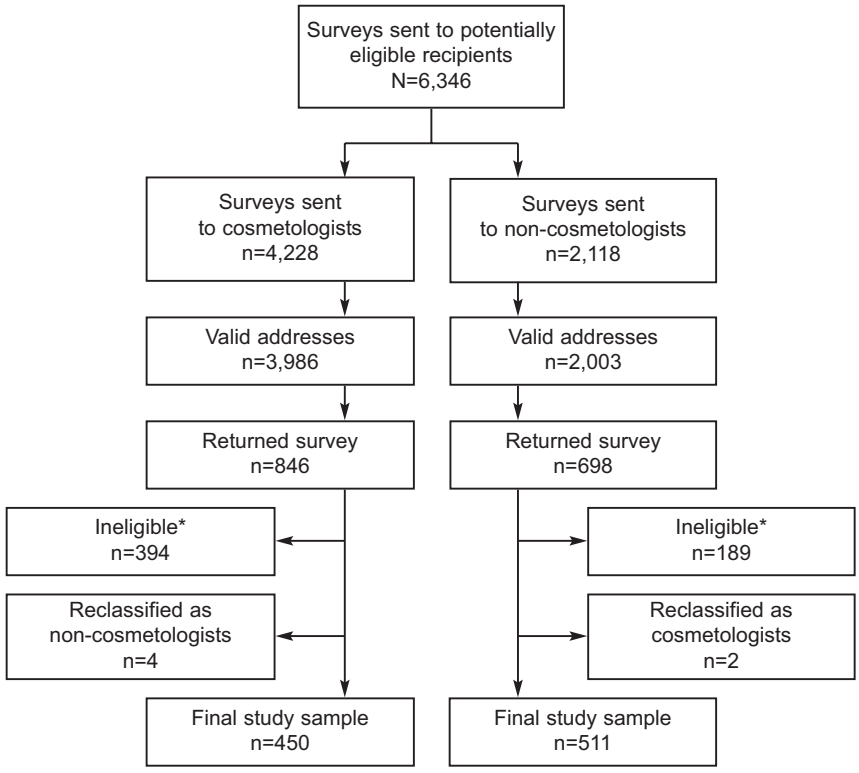

Fig. 1. Reproductive Outcomes in Salon Employees (ROSE) study flow chart.

Gallicchio. Cosmetologists and Reproductive Outcomes. Obstet Gynecol 2009.

professions in the Baltimore, Maryland Metropolitan region in the United States to test the hypothesis that cosmetologists are at increased risk of poor pregnancy outcomes compared with women who are not cosmetologists. Detailed data on occupational and pregnancy history as well as on health habits and demographics were collected and analyzed.

MATERIALS AND METHODS

The Reproductive Outcomes in Salon Employees (ROSE) study was approved by the institutional review boards at the University of Illinois Urbana-Champaign and Johns Hopkins University. To recruit participants for the study, the names and addresses of all registered female cosmetologists and noncosmetologists (eg, realtors, teachers, nurses, and retail sales clerks) who were aged between 21 and 50 years were obtained from a commercial mailing house. The target age range was selected because it represents adults who should be in their reproductive lifespan, and eliminates most women who are well into their menopausal years or retired and who may not accurately remember the exposures or outcomes of interest. The targeted noncosmetologist groups were selected because they are composed of occupational groups of women with similar educational levels, socioeconomic status, stress, and workplace environments to cosmetologists, but are not exposed to chemicals used in salons on a regular basis.

Each woman in the targeted age range and occupational group was mailed a recruitment packet, which included a letter explaining the study, a validated questionnaire, a $1.00 incentive, and a stamped, addressed return envelope. The $1.00 incentive was included because previous studies indicate that it significantly increases the response to mailed surveys.[16] To help avoid selective response and bias, the study was presented to potential participants as a study on women who work. Surveys were mailed in waves from September 2005 through October 2008.

To be included in the study, all respondents to the cross-sectional survey had to be aged between 21 and 55 years, not have had a hysterectomy or oophorectomy, and be working or have worked either in a cosmetology business or in selected occupations with similar salary and hours to that in the cosmetology business, but with limited or no chemical exposures (eg, retail sales, real estate sales, nursing, teaching). As shown in Figure 1, recruitment packets were mailed to 4,228 cosmetologists, and of these, 242 were returned due to bad addresses. Of the remaining 3,986 surveys that were mailed, 846 were mailed back to the study office; 394 of the surveys were mailed back

from women who did not meet the inclusion criteria or could not or did not want to participate in the study. Reasons for ineligibility/exclusion were not currently employed, n=7; hysterectomy or oophorectomy, n=136; aged older than 55 years, n=56; not interested in participating, n=153; deceased, n=2; not cosmetologists, n=10; male, n=1; more than 50% of the survey incomplete, n=9; and other (not specified), n=20. Therefore, 452 surveys were mailed back from the cosmetologists who met the eligibility criteria. Based on their job descriptions, four of these surveys were from women who were reclassified as noncosmetologists. Informed consent was implied by return of the questionnaire.

Similarly, recruitment packets were mailed to 2,118 women in occupations other than cosmetology, as described above (Fig. 1). Of these packets, 115 were returned due to bad addresses. Of the remaining 2,003 surveys, 698 were returned, of which 189 were mailed back from women who did not meet the inclusion criteria or could not or did not want to participate in the study. Specific reasons for exclusion were hysterectomy or oophorectomy, n=94; aged older than 55 years, n=27; not interested, n=55; deceased, n=1; not employed, n=4; more than 50% of the survey incomplete, n=1; other (not specified), n=7. Therefore, 509 surveys were mailed back from employed women from the noncosmetologists group who met the eligibility criteria. Based on their job descriptions, two of the surveys in this group were from women who were reclassified as cosmetologists. Thus, the study sample consisted of 450 cosmetologists and 511 women employed in other occupations.

The survey was constructed to collect data on a number of reproductive health topics, including infertility, pregnancy outcomes, and menstrual cycle history. For the purposes of obtaining data on pregnancy outcomes, each woman was asked to report the number of times she had been pregnant (including a current pregnancy, if applicable) and detailed data were collected on the woman's first five pregnancies. Because of the length of the survey, detailed data on subsequent pregnancies were not collected. Data obtained pertained to maternal age and weight gain at the time of the pregnancy; cigarette smoking and alcohol drinking habits at the time of the pregnancy; outcome of the pregnancy (termination, miscarriage [defined as spontaneous abortion at less than 20 weeks], stillbirth [defined as spontaneous abortion at 20 weeks or greater] or live birth); the occurrence of maternal health conditions during pregnancy (preeclampsia, high blood pressure, diabetes); hospitalization or physician-ordered bed rest during pregnancy; preterm labor or premature delivery (less than 37 weeks at delivery); and whether the child had any postdelivery health problems, including allergies, asthma, autism, learning disorders, Down syndrome, or birth defects. Of primary importance, the woman's occupation at the time of each pregnancy was queried, with participants asked to select from the following choices: homemaker; student; cosmetologist; technical or scientific; sales or administrative support; managerial or professional specialty; service, operator, fabricator and laborer; or other. Although initial plans entailed the comparison of cosmetologists at the time of each pregnancy to multiple "other" occupational groups, a cross-check of occupation at the time of survey completion by the selection at the time of each pregnancy showed variability in the choice made by individuals of a single occupation. For example, teachers chose "service" and "managerial, professional specialty" with equal frequency. Therefore, occupation at the time of pregnancy was analyzed as a dichotomous variable: "cosmetologist" and "other occupation."

In addition to pregnancy history, the survey collected detailed data pertaining to the woman at the time of enrollment; these data included marital status, education level, weight and height, race, personal and household income, type of health insurance, and time since last doctor visit. Data on history of hormone and oral contraceptive use as well as personal and family medical history were also collected.

Power and sample size calculations for this study were based on the outcome of infertility, which was not examined in this analysis. Under the assumption of an 8% prevalence of infertility in the noncosmetologist group, it was estimated that the recruitment of 500 women in the noncosmetologist group and 500 women in the cosmetologist group would provide 80% power to observe a minimum detectable difference of 5.7% (two-tailed test at alpha=0.05). The range of minimal detectable differences was calculated to be from 4.5% to 9.0%, based on different prevalence assumptions (4.0% to 50.0%) for the outcome measure in the noncosmetologist group.

Based on the pregnancy history data collected, five groups of women were identified: 1) women who had never been pregnant (n=96); 2) women who reported five or fewer singleton pregnancies and were not missing all of the data on one (or more) of the reported pregnancies (includes women who were currently pregnant and met these criteria) (n=747); 3) women who reported five or fewer singleton pregnancies and were missing all of the data on at least one of the reported pregnancies (includes women who were

Table 1. Characteristics of Cosmetologists and Women in Other Occupations

Characteristic	Cosmetologists (n=350)	Other Occupations (n=397)	*P*
Current occupation			
Teacher		176 (44.3)	
Medical (including nurses)		86 (21.7)	
Manager/professional		21 (5.3)	
Sales		35 (8.8)	
Other		79 (19.9)	
Age (y)	43.6±6.5	43.1±7.6	.3
Race			.5
White	302 (86.3)	345 (86.9)	
African American	34 (9.7)	38 (9.6)	
Other	6 (1.7)	12 (3.0)	
Education			<.001
Some high school	6 (1.7)	5 (1.3)	
High school/GED	99 (28.3)	33 (8.3)	
Some college/tech	125 (35.7)	83 (20.9)	
College/tech degree	92 (26.3)	99 (24.9)	
Some graduate school	8 (2.3)	43 (10.8)	
Graduate degree	11 (3.1)	131 (33.0)	
Marital status			.9
Single	21 (6.0)	20 (5.0)	
Married	267 (76.3)	309 (77.8)	
Widowed	4 (1.1)	4 (1.0)	
Divorced/separated	37 (10.6)	50 (12.6)	
Partners	12 (3.4)	12 (3.0)	
Household income ($)			<.001
Less than 20,000	21 (6.0)	9 (2.3)	
20,000–49,000	50 (14.3)	40 (10.1)	
50,000–99,000	174 (49.7)	172 (43.3)	
100,000 or greater	82 (23.4)	161 (40.6)	
Employment status			<.001
Full-time	178 (50.9)	308 (77.6)	
Part-time	159 (45.4)	78 (19.6)	
Student	1 (0.3)	3 (0.8)	
Medical leave	2 (0.6)	3 (0.8)	
Body mass index (kg/m^2)			.1
Less than 18.5	2 (0.6)	8 (2.0)	
18.5–24.9	139 (39.7)	142 (35.8)	
25.0–29.9	112 (32.0)	128 (32.2)	
30.0 or greater	80 (22.9)	111 (28.0)	
Cigarette smoking status			.001
Current	76 (21.7)	67 (16.9)	
Former	128 (36.6)	111 (28.0)	
Never	142 (40.6)	215 (54.2)	
Alcohol drinking status			.4
Current	226 (64.6)	237 (59.7)	
Former	104 (29.7)	135 (34.0)	
Never	18 (5.1)	23 (5.8)	
Health insurance			.03
None	24 (6.9)	11 (2.8)	
Medicare/Medicaid	8 (2.3)	5 (1.3)	
Conventional (PPO, POS)	202 (57.7)	246 (62.0)	
Managed care (HMO)	94 (26.9)	101 (25.4)	
Mixed/Other	19 (5.4)	33 (8.3)	
Visit to primary care doctor			.3
Never	5 (1.4)	2 (0.5)	
Less than 1 y ago	241 (68.9)	255 (64.2)	
1–2 y ago	68 (19.4)	92 (23.2)	
3–5 y ago	16 (4.6)	27 (6.8)	
Greater than 5 y ago	13 (3.7)	17 (4.3)	

GED, general equivalency degree; PPO, preferred provider organization; POS, point of service; HMO, health maintenance organization.
Data are n (%) or mean±standard deviation.
Some characteristics may not add up to 100% due to missing data.

Table 2. Health Habits and Pregnancy Outcomes by Individual Pregnancy: Comparison of Cosmetologists and Women in Other Occupations

	Pregnancy 1			Pregnancy 2		
	Cosmetologists (n=175)	Other Occupations (n=570)	*P*	Cosmetologists (n=155)	Other Occupations (n=456)	*P*
Age (y)	25.1±4.5	23.5±5.5	<.001	27.5±4.2	27.3±5	.7
Smoked during pregnancy	40 (22.9)	120 (21.1)	0.6	29 (18.7)	75 (16.4)	.5
Drank alcohol during pregnancy	23 (13.1)	59 (10.4)	0.4	15 (9.7)	34 (7.5)	.4
Current pregnancy	0 (0)	3 (0.5)	0.3	3 (1.9)	2 (0.4)	.1
Terminated pregnancy	14 (8)	118 (20.7)	<.001	5 (3.2)	37 (8.1)	.04
Pregnancy outcome*						
Miscarriage	25 (15.5)	61 (13.6)	.5	24 (16.3)	64 (15.3)	.8
Stillbirth	2 (1.2)	8 (1.8)	.7	1 (0.7)	5 (1.2)	.6
Live birth	132 (82)	380 (84.6)	.6	122 (83)	347 (83.2)	1
Unknown†	2 (1.2)	0 (0)	–	0 (0)	1 (0.2)	–
Live births, child health						
Premature birth	6 (4.5)	35 (9.2)	.1	8 (6.6)	35 (10.1)	.3
Low birth weight	8 (6.1)	22 (5.8)	.9	0 (0)	16 (4.6)	.02
Any child health problems	58 (43.9)	136 (35.8)	.1	42 (34.4)	131 (37.8)	.5
Live births, maternal health						
High blood pressure	6 (4.5)	40 (10.5)	.04	5 (4.1)	25 (7.2)	.2
Preeclampsia	2 (1.5)	27 (7.1)	.02	2 (1.6)	12 (3.5)	.3
Diabetes	8 (6.1)	14 (3.7)	.3	4 (3.3)	16 (4.6)	.6
Bed rest	16 (12.1)	50 (13.2)	.8	10 (8.2)	40 (11.5)	.3
Premature labor	7 (5.3)	42 (11.1)	.1	10 (8.2)	27 (7.8)	.9
Hospitalization	9 (6.8)	46 (12.1)	.1	12 (9.8)	31 (8.9)	.8

Data are mean±standard deviation or n (%).
* Among those pregnancies not terminated and not current.
† Respondent did not indicate outcome of pregnancy.

currently pregnant and met these criteria) (n=57); 4) women who reported five or fewer pregnancies and who reported that one of the pregnancies resulted in a multiple birth (eg, twins) (includes women who were currently pregnant and met these criteria) (n=21); and 5) women who reported more than five pregnancies (including those who reported that one of the pregnancies resulted in a multiple birth and those who were currently pregnant and met these criteria) (n=40). The current analysis focused on participants in group 2 (those who reported five or fewer singleton pregnancies and were not missing all of the data on one [or more] of the reported pregnancies, which includes women who were currently pregnant and met these criteria) (n=747).

Characteristics of the cosmetologists and the women in other occupations at the time of survey completion were compared using χ^2 tests for categorical variables and Student *t* tests for continuous variables. Similarly, data pertaining to health habits and maternal and child health outcomes for each pregnancy were compared among women who reported being a cosmetologist to women who reported having "other" occupations during that specific pregnancy. For each pregnancy that was not current or not terminated, the following pregnancy outcomes were analyzed: miscarriage, stillbirth, live birth. The following maternal and child health outcomes were analyzed among only those pregnancies resulting in live births: premature birth, low birth weight (less than 2,500 g), any health problem experienced by the child, maternal high blood pressure, preeclampsia, maternal diabetes, physician-directed bed rest, premature labor, and maternal hospitalization during pregnancy.

To examine the unadjusted and adjusted associations between occupation at the time of pregnancy and the outcome variables, taking into account the lack of independence among multiple pregnancies per mother, repeated-measures analyses of variance were performed using the SAS PROC GENMOD (SAS Institute Inc., Cary, NC) procedure. As described above, the independent variable, maternal occupation at the time of pregnancy, was dichotomized as cosmetologist or other. Age at pregnancy (continuous), maternal race (African-American or other), education level (high school degree, some college, college degree, or more), cigarette smoker at

Pregnancy 3			Pregnancy 4			Pregnancy 5		
Cosmetologists (n=81)	Other Occupations (n=245)	*P*	Cosmetologists (n=35)	Other Occupations (n=121)	*P*	Cosmetologists (n=7)	Other Occupations (n=37)	*P*
29.7±4.7	29.4±4.7	.8	31.3±4	31.3±4.5	.9	34.1±5.5	32.5±4.2	.4
16 (19.8)	41 (16.7)	.5	6 (17.1)	18 (14.9)	.8	0 (0)	9 (24.3)	.1
12 (14.8)	28 (11.4)	.4	4 (11.4)	10 (8.3)	.6	1 (14.3)	3 (8.1)	.6
0 (0)	2 (0.8)	.4	1 (2.9)	2 (1.7)	.7	0 (0)	1 (2.7)	.6
7 (8.6)	23 (9.4)	.8	4 (11.4)	9 (7.4)	.4	1 (14.3)	3 (8.1)	.6
15 (20.3)	42 (19.2)	.8	7 (23.3)	23 (20.9)	.9	1 (16.7)	3 (9.1)	.6
0 (0)	3 (1.4)	.3	1 (3.3)	1 (0.9)	.3	0 (0)	2 (6.1)	.5
59 (79.7)	175 (79.9)	1	22 (73.3)	85 (77.3)	0.7	5 (83.3)	28 (84.8)	.9
0 (0)	0 (0)	–	0 (0)	0 (0)	–	0 (0)	0 (0)	–
2 (3.4)	10 (5.7)	.5	1 (4.5)	4 (4.7)	1	0 (0)	5 (17.9)	.3
1 (1.7)	6 (3.4)	.5	0 (0)	1 (1.2)	.6	2 (40)	8 (28.6)	.6
25 (42.4)	67 (38.3)	.6	13 (59.1)	25 (29.4)	.01	0 (0)	1 (3.6)	.7
3 (5.1)	11 (6.3)	.7	2 (9.1)	6 (7.1)	.8	0 (0)	3 (10.7)	.4
2 (3.4)	6 (3.4)	1	1 (4.5)	4 (4.7)	1	0 (0)	0 (0)	–
4 (6.8)	11 (6.3)	.9	5 (22.7)	3 (3.5)	.002	2 (40)	2 (7.1)	.04
9 (15.3)	17 (9.7)	.2	3 (13.6)	14 (16.5)	.8	0 (0)	8 (28.6)	.2
7 (11.9)	16 (9.1)	.5	2 (9.1)	8 (9.4)	1	0 (0)	5 (17.9)	.3
5 (8.5)	14 (8)	.9	3 (13.6)	9 (10.6)	.7	1 (20)	3 (10.7)	.6

the time of pregnancy (yes or no) and alcohol drinker at the time of pregnancy (yes or no) were included as potential confounders in all models and were selected as potential confounders based on their associations with pregnancy outcomes in the literature. All analyses were conducted in SAS 9.1 (SAS Institute Inc.). A two-tailed $P<0.05$ was considered statistically significant.

RESULTS

The occupational composition of the comparison group at the time of survey completion is shown on Table 1. Teachers comprised approximately 44% of the comparison group, whereas women in the medical profession, including nurses, were 21.7% of the comparison group. All nurses were Licensed Practical Nurses, with the exception of one Registered Nurse. Compared with women in the noncosmetologist occupation group, cosmetologists were significantly less likely to have a college degree or some graduate schooling, to have a household income of $100,000 or greater, to be employed full-time, and to have health insurance. Conversely, the cosmetologists were significantly more likely to report that they were current smokers compared with women in the noncosmetologist occupation group. There were no statistically significantly differences between the two groups in terms of age, race, marital status, body mass index, alcohol drinking, and time since last visit to a primary care doctor.

In unadjusted analyses, there were no statistically significant differences in terms of pregnancy outcomes (miscarriage, stillbirth, or live birth) for each individual pregnancy between the cosmetologists and noncosmetologist comparison group (Table 2). For example, for pregnancy 1, among pregnancies that were not terminated, approximately 17% of the women who reported being a cosmetologist at the time of pregnancy reported either a miscarriage or a stillbirth compared with 15.8% of women who reported not being a cosmetologist ($P=.91$).

Among live births, compared with noncosmetologists, women who reported being cosmetologists at the time of pregnancy were significantly less likely to report a low birth weight child at pregnancy 2 (0.0% for cosmetologists compared with 4.6% for noncosmetologists; $P=.02$) and significantly more likely to report having a child with

health problems at pregnancy 4 (59.1% compared with 29.4%; $P=.01$). Similarly, among live births, cosmetologists were less likely than noncosmetologists to be diagnosed with high blood pressure or preeclampsia at pregnancy 1 (high blood pressure: 4.5% compared with 10.5%; $P=.04$; preeclampsia: 1.5% compared with 7.18%; $P=.02$). In contrast, cosmetologists were more likely to be diagnosed with gestational diabetes at pregnancies 4 and 5 compared with the noncosmetologists.

Results from the adjusted analysis taking into account the lack of independence among multiple pregnancies per mother are shown on Table 3. There were no statistically significant associations between occupation and the pregnancy outcomes or the child health outcomes after adjustment for age, race, education, smoking and alcohol use at the time of pregnancy. A statistically significant association was found between race and low birth weight such that nonwhite women were at increased risk of reporting a low birth weight neonate compared with white women (OR 3.35, 95% CI 1.53–7.26). Similarly, current smoking was found to be positively associated with miscarriage (OR 1.53, 95% CI 1.09–2.16) and miscarriage or stillbirth (OR 1.64, 95% CI 1.18–2.28). Age and education were not significantly associated with any of the pregnancy or child health outcomes.

DISCUSSION

Despite the large number of cosmetologists exposed to chemicals prioritized for study by the National Institutes of Occupational Safety and Health and the ability of such chemicals to cause reproductive toxicity in animal models, little is known about reproductive function in cosmetologists. Findings from this survey-based cross-sectional study indicate that cosmetologists are not at increased risk for poor pregnancy outcomes compared with similarly aged women in other occupations.

This study examines pregnancy outcomes among cosmetologists in the United States. Major strengths of this study are the collection of occupation and health habit (smoking and alcohol use) data for each individual pregnancy and the enrollment of an employed comparison group. The findings of statistically significant associations between cigarette smoking, race, and certain adverse pregnancy outcomes provide support for the internal validity of the study.

Despite the strengths of our study, it also had several inherent weaknesses. First, unlike some of the previously published studies for which at least part of the data were collected from large registries, all of the data collected in the present study were based on participant self-report. In some cases, participants

Table 3. The Associations Between Occupation at the Time of Pregnancy and Pregnancy Outcomes Taking Into Account the Lack of Independence for Multiple Pregnancies Per Mother

	Pregnancy Outcome			Child Health Outcome		
Variables*	Miscarriage (n=267)	Stillbirth (n=23)	Adverse Event† (n=290)	Premature Birth (n=106)	Low Birth Weight (n=55)	Child Health Problem (n=508)
Occupation						
Noncosmetologists	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Cosmetologists	1.11 (0.79–1.54)	0.53 (0.17–1.71)	1.03 (0.74–1.43)	0.64 (0.37–1.13)	0.61 (0.29–1.27)	1.27 (0.96–1.67)
Age (y, continuous)	1.02 (0.99–1.06)	0.96 (0.89–1.04)	1.02 (0.99–1.05)	1.01 (0.97–1.05)	0.99 (0.93–1.04)	0.98 (0.96–1.01)
Race						
White	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Nonwhite	1.33 (0.80–2.20)	1.44 (0.38–5.37)	1.37 (0.84–2.22)	1.74 (0.88–3.42)	3.35 (1.53–7.26)	0.84 (0.49–1.45)
Education						
College graduate	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Some college	1.24 (0.91–1.69)	1.63 (0.60–4.38)	1.26 (0.93–1.72)	1.07 (0.63–1.84)	1.72 (0.86–3.46)	1.02 (0.72–1.39)
High school degree	0.67 (0.44–1.02)	1.74 (0.62–4.86)	0.73 (0.50–1.08)	0.77 (0.40–1.84)	0.92 (0.39–2.20)	0.73 (0.51–1.07)
Cigarette smoking						
No	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Yes	1.53 (1.09–2.16)	2.20 (0.89–5.42)	1.64 (1.18–2.28)	0.95 (0.49–1.84)	1.23 (0.51–2.94)	1.04 (0.73–1.48)
Alcohol drinking						
No	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Yes	1.27 (0.78–2.05)	1.22 (0.48–3.08)	1.29 (0.83–2.02)	0.26 (0.07–0.98)	0.91 (0.30–2.76)	1.09 (0.67–1.78)

ref, referent.
Data are odds ratio (95% confidence interval).
Neither occupation nor the other confounders examined were associated with maternal health outcomes (data not shown).
* Reflect characteristics at the time of pregnancy.
† Miscarriage or stillbirth.

were asked to recall health habits and pregnancy outcomes that may have taken place greater than 20 years in the past. Therefore, there may have been some data misclassification. We think, however, that the accuracy of our data on potential confounding factors such as cigarette smoking and alcohol drinking during pregnancy is likely better than that of previous studies, because the majority of these past investigations collected data on these variables using birth certificates. Herdt-Losavio et al[9] noted that for variables such as smoking and drinking, there may be some underreporting of information on birth certificates because of the stigma associated with smoking and drinking, especially during pregnancy. In addition, other variables have a high rate of missing information when derived from birth certificates and medical records.[9]

Second, because of the nature of the study, we did not collect data on specific exposures at the time of each pregnancy for the cosmetologists or the noncosmetologist group. Work history and exposure data were only collected for the time pertaining to survey completion. Finally, sample size and power calculations for this study were based on the outcome of infertility and not for the adverse pregnancy outcomes analyzed in this study. Therefore, there is the possibility that this analysis lacked power to detect statistically significant differences between the groups in the outcomes presented. It should be noted, though, that most of the ORs calculated for the associations between cosmetologist occupation and the adverse outcomes were either below one (stillbirth, premature birth, low birth weight) or only slightly above one (miscarriage); these results suggest that, even in the absence of sufficient statistical power, cosmetologists are not at increased risk for these outcomes.

Despite the limitations of the research, our findings are similar to those reported in a recent publication by Zhu et al[17] that examined data from the Danish National Birth Cohort and found no statistically significant differences between hairdressers and shop assistants in terms of fetal loss (miscarriage and stillbirth), preterm birth, very preterm birth, small for gestational age, and malformations. As in our study, Zhu et al[17] selected the referent group (shop assistants) because they were of similar socioeconomic background to the hairdressers, and further, the researchers controlled for maternal age, smoking, and alcohol consumption in the analyses.

Other investigations have found increases in the risk of certain adverse pregnancy outcomes among cosmetologists compared with women in other occupations, although many of the other findings from these studies are also in concordance with ours. In an analysis of data from New York State occupational licensing and birth records from 1997 to 2003, Herdt-Losavio et al[9] showed that cosmetologists had a small but statistically significant increased risk of having a low birth weight neonate compared with realtors (OR 1.38, 95% CI 1.09–1.74) after adjustment for potential confounders, such as maternal age, race, smoking, prenatal care, and alcohol use. When stratified by race, this association was significant among only nonwhite women (OR 2.30, 95% CI 1.22–4.33) and was not present when the comparison group was the general population (OR 0.97, 95% CI 0.85–1.10). No significant associations were observed between occupation and preterm birth. Rylander et al[18] reported greater odds of small for gestational age birth (OR 1.20, 95% CI 1.06–1.36) among Swedish women who worked as hairdressers during early pregnancy compared with women who worked full-time in other occupations after adjustment for year of birth, maternal age, parity, and maternal smoking. These results were similar to those reported in a prior study by Rylander et al[15] that compared hairdressers in Sweden to women in the general population. These studies, based on data from the Swedish Medical Birth Register, found no statistically significant differences in the frequency of stillbirths and early neonatal deaths, preterm births, or malformations between the two groups. Finally, in a retrospective study from the Netherlands, Kersemaekers et al[12] showed that, compared with clothing sales clerks, hairdressers who conceived from 1986–1988 had an increased risk of spontaneous abortion and a low birth weight infant; however, similar increases were not observed in comparisons of hairdressers and sales clerks who conceived from 1991–1993. No data for the Kersemaekers et al[12] study were collected on health habits such as smoking at the time of pregnancy.

It should be noted that this study, while large and population-based, was a survey-based investigation in which participants were solicited through mailed recruitment packets. As with any survey-based study, especially when the response rate is low as it was in this study, the women who completed the questionnaire may differ from those who did not complete the questionnaire, limiting the generalizability of the results. It is possible that those women not completing the questionnaire had worse pregnancy outcomes, and if this was a reason for not participating for cosmetologists but not a reason for nonparticipation among other groups, the estimates could be biased toward the null.

In conclusion, our data indicate that there is not an increased risk of adverse pregnancy outcomes among cosmetologists compared with noncosmetologists working in the Baltimore, Maryland Metropolitan region. Ours findings are consistent with the majority of published data on this topic.

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