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Research Article

Differences in Vaginal Progesterone Provision among Racial and Socioeconomic Groups

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Abstract

Objective: Preterm birth is the leading cause of perinatal morbidity and mortality and has been increasing in the United States. Short cervical length is a treatable risk factor for preterm birth. Non-Hispanic black and Hispanic women have significantly higher rates of preterm birth and disparities exist in the obstetrical care of these populations. This study assesses the impact of race/ethnicity and socioeconomic status on the provision of vaginal progesterone among women without a history of preterm birth.

Methods: This was a retrospective cohort study assessing the impact of race/ethnicity and socioeconomic status on the prescription of vaginal progesterone for the treatment of incidentally diagnosed shortened cervix within an urban academic medical center. Women undergoing mid-trimester cervical length screening 2014-2019 were included. Demographics, cervical length, progesterone provision, and perinatal outcomes were recorded.

Results: 139 (1.7%) patients met inclusion criteria. Racial and ethnic groups differed significantly in maternal age, gravidity, body mass index and insurance. There were no significant differences in prescription of vaginal progesterone by race/ethnicity or insurance type. While adjusted odds ratios vaginal progesterone provision were all lower for Hispanic and non-Hispanic black women, and for those with public insurance, this did not reach statistical significance.

Conclusion: There was no difference in the provision of vaginal progesterone among women of differing race/ethnicity or socioeconomic status likely due to small numbers of patients meeting inclusion criteria with a shortened cervix. Further research should assess a larger number of patients to determine if our findings of a lack of disparity are confirmed.

Keywords: Cervical length; Disparities; Equitable care; Preterm birth; Shortened cervix; Vaginal progesterone

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Introduction

Preterm birth, which is defined as delivery between 20 weeks and 36 weeks and 6 days gestational age, has been increasing in the United States since 2014 and is the leading cause of perinatal morbidity and mortality [1,2]. Disparities in the incidence of preterm birth exist and present as a public health problem for managing obstetrics care in vulnerable populations. Specifically, non-Hispanic black women experience greater rates of preterm birth than women of other races and ethnicities. In 2019, preterm birth rates were around 50% higher in non-Hispanic black women (14.39%) than for non-Hispanic white women (9.26%) and Hispanic women (9.97%) [1].

One risk factor for preterm birth is short cervical length, which is defined as cervical length less than 2.5cm by transvaginal ultrasound [3-5]. Shortened cervix is prevalent in around 1% of pregnancies and is a treatable risk factor for preterm birth [6-8]. It is recommended that cervical length surveillance via transabdominal or transvaginal ultrasound begin around 16 weeks of gestation for patients at high risk of preterm delivery [9,10]. Despite this recommendation, non-Hispanic black and Hispanic women are more likely to have missed or present late to cervical length screening [11]. This is of particular concern given statistically shorter cervical lengths among these populations, [11] and serves as a significant health care disparity [11-15]. Importantly, using risk-based cervical length screening has been shown to miss 40% of cervical shortening and as such, the Society for Maternal-Fetal Medicine states that universal screening at the time of the mid-trimester anatomical survey is a reasonable practice for individuals without a prior history of preterm birth [16-18].

Vaginal progesterone, either as a 90 milligram (mg) gel or 200mg suppository, has been shown to decrease rates of preterm birth in patients without a history of preterm birth and a diagnosis of short cervix at less than 24 weeks gestation [18-21]. Vaginal progesterone is typically prescribed between 18-25 weeks and 6 days until 36-37 weeks of gestation [9]. Specifically, studies have established that vaginal progesterone prescribed between 20-22 weeks can decrease the rate of preterm birth before 33-34 weeks of gestation in patients with a short cervix [19,21]. Thus, the American College of Obstetrics and Gynecology recommends the prescription of vaginal progesterone for asymptomatic individuals with singleton pregnancy and without history of preterm birth for treatment of short cervix [9].

Prior to the PROLONG trial, [22] 17-alpha hydroxyprogesterone caproate (17OHP-C) was typically prescribed for patients with singleton gestations and prior preterm birth [18,23]. Studies have

established that disparities in the use of 17OHP-C exist between differing racial and ethnic groups [16,24]. Specifically, it has been established that non-Hispanic black women have an increased risk of non-adherence to 17OHP-C treatment [16]. However, no study has assessed whether disparities exist in the provision of vaginal progesterone among racial/ethnic groups or groups of differing socioeconomic status. This study aims to investigate the impact of race/ethnicity and socioeconomic status on the prescription of vaginal progesterone among women without a history of preterm birth and a diagnosis of an incidental shortened cervical length at time of mid-trimester anatomical survey.

Materials and Methods

This is a retrospective cohort study assessing the impact of race/ethnicity and socioeconomic status on the prescription of vaginal progesterone for the treatment of shortened cervix within two practices at a single academic institution. Women with no history of preterm birth undergoing routine mid-trimester cervical length screening at the time of anatomical survey between the years 2014 and 2019 were included. Patients with multiple gestations, uterine anomalies, or fetal anomalies were excluded. Patients without information on delivery within the electronic medical record were also excluded. All ultrasound examinations included in this study were conducted by registered diagnostic medical sonographers, and all examinations were interpreted by maternal-fetal medicine physicians.

The primary outcome was prescription of vaginal progesterone. Secondary outcomes included compliance with vaginal progesterone, gestational age at delivery, Preterm Premature Rupture of Membranes (PPROM), Neonatal Intensive Care Unit (NICU) admission, and neonatal mortality. Data was obtained from a database of patients treated at two practices, one of which treats exclusively patients on public insurance and the other primarily patients with private insurance in order to represent two populations with differing socioeconomic status within our institution. Remaining data was obtained from our institution's electronic medical record. Demographic data, cervical length and gestational age at time of diagnosis, gestational age at time of progesterone prescription, and obstetric outcomes were recorded. Compliance with vaginal progesterone was assessed via chart review of both ultrasound reports and provider notes. Insurance type (public versus private) was used as a proxy for socioeconomic status.

Data was analyzed using the Chi-square or Fisher Exact test for categorical variables and the T-Test, ANOVA Test, Wilcoxon Rank Sum Test, or Kruskal-Wallis Test for continuous variables, as applicable. Data was also analyzed using univariate linear and logistic regression, as well as multivariable linear and logistic regression adjusted for the following covariates: age at delivery, pre-gravid BMI, smoking status, and history of Loop Electrical Excision Procedure (LEEP) or cervical procedure. Data from the Electronic Medical Record (EMR) were abstracted and stored in a Research Electronic Data Capture (REDCap) database. De-identified data were then analyzed using SAS 9.4 (SAS Institute, Cary, NC). Two-sided p-values were considered statistically significant at the 0.05 level. Approval by the Institutional Review Board at our institution was obtained.

Results

Of 8,198 patients who underwent cervical length screening during the study timeframe, 139(1.7%) met inclusion criteria. Demographic and baseline characteristics are shown in table 1. Patients in this sample had a median age at delivery of 31 years, a median pre-pregnancy BMI of 25.9 kg/m^2, and a median gravida of 2. Fifty percent of patients had private health insurance, 88% of patients had never smoked, 44% had prior cervical instrumentation such as Loop Electrosurgical Excision Procedure (LEEP) or cone biopsy, and 16% had a history of uterine fibroids. Age at delivery ($p<0.01$), BMI at delivery ($p=0.02$), gravida ($p<0.01$), number of abortions/elective terminations ($p<0.01$), insurance type ($p<0.01$), diabetes mellitus prevalence ($p<0.01$), history of uterine or cervical polyps ($p=0.02$), and history of Loop Electrical Excision Procedure (LEEP) or cervical procedure ($p<0.01$) differed significantly across race/ethnicity (Table 1).

Patients had a median gestational age at diagnosis of shortened cervix of 21 weeks, a median cervical length at diagnosis of 1.8cm, and a mean gestational age when vaginal progesterone was prescribed of 21 weeks. As shown in table 2, prescription of vaginal progesterone based on differing race/ethnicity was 76.2% in Hispanic women, 81.6% in non-Hispanic black women, 81.8% in non-Hispanic white women, and 73.1% in other races. Of the 109 patients prescribed vaginal progesterone, 78% were always compliant, 7% were sometimes compliant, and 5% were not compliant. Four percent of women had a pessary intervention, 34% had a cerclage intervention, and 42% had an antepartum admission. Diagnosis and management of incidentally diagnosed short cervix did not differ significantly across race or ethnicity. Specifically, there were no statistically significant differences across race or ethnicity in regard to gestational age at diagnosis ($p=0.27$), cervical length at diagnosis ($p=0.23$), or gestational age at which vaginal progesterone was prescribed ($p=0.44$). Compliance with vaginal progesterone was lower in Hispanic (63%) and non-Hispanic black women (83%) when compared to white counterparts (90%) but this was not statistically significant ($p=0.19$) (Table 2).

Neonatal outcomes are shown in table 3. Patients in this sample had a median gestational age at delivery of 38 weeks, a median neonatal birthweight of 2945 grams, and median APGAR scores of 9 at both 1 and 5 minutes. Fifty-two percent of the neonates were male, 30% were admitted to the NICU, and 2% suffered neonatal death. Neonatal characteristics did not differ significantly across race/ethnicity (Table 3).

This study also assessed the impact of socioeconomic status on the prescription of vaginal progesterone among women in this sample. Age at delivery and race/ethnicity differed significantly across insurance type ($p<0.05$) (Table 4). However, diagnosis and management of incidentally diagnosed short cervix did not differ significantly across insurance type. Specifically, there were no statistical differences across insurance type in regard to gestational age at diagnosis ($p=0.73$), cervical length at diagnosis ($p=0.23$), or gestational age in weeks at which vaginal progesterone was prescribed ($p=0.25$) (Table 5). Neonatal outcomes also did not differ significantly across insurance type (Table 6).

In order to determine if race/ethnicity and socioeconomic factors may be predictive of vaginal progesterone provision, we assessed the impact of differing baseline characteristics, race/ethnicity, and socioeconomic status on provision of vaginal progesterone among patients without a history of preterm birth with incidentally diagnosed shortened cervix. As shown in table 7, when adjusting for age at delivery, pre-gravid BMI, smoking status, and history of LEEP/cervical procedures, none of the baseline, race/ethnicity, or socioeconomic status variables were significantly associated with vaginal progesterone provision. Of note, while the percentage of patients who received vaginal progesterone was lower among Hispanic women and non-Hispanic

	Hispanic (N=42)			Non-Hispanic Black (N=49)			Non-Hispanic White (N=22)			Other/More than One Race** (N=21)			
	N	Median (IQR)	Range	N	Median (IQR)	Range	N	Median (IQR)	Range	N	Median (IQR)	Range	P-Values
Age at delivery (years)	42	28.5 (23-34)	20-40	49	30 (26-34)	20-45	22	37 (31-38)	25-44	21	34 (29-37)	19-46	<0.01
BMI pre-gravid (kg/m²)	29	26.3 (24.7-30.7)	16-52.6	40	26.8 (23-33.2)	17.8-45.1	18	24.8 (23-28.1)	19.5-35.7	18	23.8 (20.0-28.7)	18.3-41.5	0.13
BMI at delivery (kg/m²)	37	32.2 (28.9-37.8)	19.1-56.7	45	30.9 (28.7-34.1)	21.6-42.7	22	27.4 (25.8-32.6)	24-44.3	19	27.8 (24-31.5)	21.3-39.3	0.02
Gravida	42	2 (1-4)	1-7	49	3 (2-4)	1-9	22	1.5 (1-2)	1-12	21	2 (1-3)	1-5	<0.01
Para: Term Deliveries*	42	0 (0-1)	0-2	49	0 (0-1)	0-4	22	0 (0-1)	0-10	21	0 (0-1)	0-1	0.59
Para: Preterm Deliveries*	42	0 (0-0)	0-0	49	0 (0-0)	0-1	22	0 (0-0)	0-0	21	0 (0-0)	0-0	0.63
Para: Miscarriages*	42	0 (0-1)	0-3	49	0 (0-1)	0-4	22	0 (0-0)	0-3	21	0 (0-1)	0-3	0.21
Para: Abortion/ Elective Terminations*	42	0 (0-1)	0-4	49	1 (0-2)	0-4	22	0 (0-0)	0-2	21	0 (0-0)	0-1	<0.01
Para: Living Children*	42	0 (0-1)	0-2	49	0 (0-0)	0-4	22	0 (0-1)	0-10	21	0 (0-1)	0-1	0.54
	No. / No. observed (%)			No. / No. observed (%)			No. / No. observed (%)			No. / No. observed (%)			
Insurance Type***													<0.01
Private	14 (33)			19 (39)			18 (82)			15 (71)			
Public	28 (67)			29 (59)			4 (18)			6 (29)			
Smoking Status***													0.95
Current/Former Smoker	4 (10)			6 (12)			3 (14)			3 (14)			
Never Smoker	37 (88)			43 (88)			19 (86)			18 (86)			
Prior Cervical Instrumentation													0.29
Yes	17 (40)			28 (57)			8 (36)			9 (43)			
No	25 (60)			21 (43)			14 (64)			12 (57)			
History/Current Uterine Fibroids													0.11
Yes	5 (12)			13 (26)			3 (14)			1 (5)			
No	37 (88)			36 (74)			19 (86)			20 (95)			
Other Comorbidities													
Chronic hypertension	1 (2)			6 (12)			0 (0)			2 (10)			0.14
Diabetes mellitus (type 1 or 2)	0 (0)			0 (0)			0 (0)			4 (19)			<0.01
Hx bariatric surgery	1 (2)			2 (4)			0 (0)			1 (5)			0.92
Autoimmune disease (Lupus, etc.)	0 (0)			0 (0)			1 (4)			0 (0)			0.32
Uterine or cervical polyps	0 (0)			0 (0)			0 (0)			2 (10)			0.02
Hx of uterine surgery (excl. C-section)	1 (2)			0 (0)			0 (0)			1 (5)			0.30
Hx of LEEP/cervical procedure	1 (2)			2 (4)			6 (27)			3 (14)			<0.01
Hypothyroidism	3 (7)			2 (4)			3 (14)			1 (5)			0.51

Hyperthyroidism	1 (2)	0 (0)	0 (0)	1 (5)	0.30
Polycystic Ovarian Syndrome (PCOS)	2 (5)	1 (2)	0 (0)	3 (14)	0.13

Table 1: Baseline characteristics for patients without history of preterm birth with incidentally diagnosed shortened cervix across Race/Ethnicity.

*All parity numbers exclude outcomes of current pregnancy.

**Other/More than one Race refers to patients with 'Asian', 'Native Hawaiian or Other Pacific Islander', 'More than One Race', or 'Other' selected as race. Patients with 'Unknown' race were excluded.

***N=1 patient was missing Insurance Type and Smoking Status.

	Hispanic (N=42)			**Non-Hispanic Black (N=49)**			**Non-Hispanic White (N=22)**			**Unknown/Other (N=26)**			
	N	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**P-Values**
GA at Diagnosis (weeks)	42	21 (19.6-23.4)	16-28	49	20.6 (20-21.7)	16-27.9	22	21.9 (20.6-23.6)	18.1-27.6	26	21.4 (20.1-24.9)	16.3-28	0.27
CL at Diagnosis (cm)	41	1.8 (1-2.3)	0-2.5	48	1.7 (1-2.2)	0-2.5	21	1.9 (1.7-2.3)	0.7-2.5	26	1.9 (1.4-2.1)	0-2.5	0.23
GA when VP prescribed (weeks)*	32	20.9 (19.4-22.8)	17-25.9	40	20.7 (20-22.3)	16.1-27.9	18	22.2 (20-22.9)	12-26.7	19	21.7 (20.1-24.9)	17.4-27	0.44
	No. / No. observed (%)			No. / No. observed (%)			No. / No. observed (%)			No. / No. observed (%)			
Compliance with VP*													0.19
Yes, always	20/32 (63)			33/40 (83)			16/18 (90)			16/19 (84)			
Yes, sometimes	5/32 (16)			2/40 (5)			0/18 (0)			1/19 (5)			
No	3/32 (9)			1/40 (2)			1/18 (5)			0/19 (0)			
Unknown	4/32 (12)			4/40 (8)			1/18 (5)			2/19 (11)			-
Pessary	2/42 (5)			1/49 (2)			0/22 (0)			1/26 (4)			0.83
Cerclage	16/42 (38)			20/49 (41)			4/22 (18)			7/26 (27)			0.22
Antepartum Admission	21/42 (50)			23/49 (47)			10/22 (45)			5/26 (19)			0.06

Table 2: Diagnosis/Management of incidentally diagnosed shortened cervix across Race/Ethnicity.

*These variables refer only to the N=109 patients who were prescribed VP. Thirty patients in this dataset were not prescribed VP.

	Hispanic (N=42)			**Non-Hispanic Black (N=49)**			**Non-Hispanic White (N=22)**			**Unknown/Other (N=26)**			
	N	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**P-Values**
GA at Delivery (weeks)	42	38.1 (35.4-39.6)	23.9-41.6	49	37.1 (34-39.3)	20-41.3	22	38.9 (37.3-40)	30-41.3	26	38.2 (35.7-39.1)	25-40.3	0.23
Neonatal Birthweight (grams)	42	2905 (2460-3300)	630-3920	48	2795 (2040-3382.5)	305-4345	22	3240 (2770-3500)	1190-4230	26	2900 (2330-3235)	670-4175	0.32
APGAR (1 min)	42	9 (8-9)	4-9	48	9 (8-9)	0-9	22	9 (8-9)	6-9	25	9 (8-9)	4-9	0.70
APGAR (5 min)	42	9 (9-9)	6-9	48	9 (9-9)	0-9	22	9 (9-9)	8-9	25	9 (9-9)	8-9	0.90
	No. / No. observed (%)			No. / No. observed (%)			No. / No. observed (%)			No. / No. observed (%)			
Gender													0.89
Male	22/42 (52)			27/49 (55)			10/22 (45)			13/26 (50)			
Female	20/42 (48)			22/49 (45)			12/22 (55)			13/26 (50)			
PPROM Prior to Delivery													0.61
Yes	5/42 (12)			10/49 (20)			2/22 (9)			4/26 (15)			
No	37/42 (88)			39/49 (80)			20/22 (91)			22/26 (85)			
NICU Admission													0.70
Yes	11/42 (26)			18/49 (37)			6/22 (27)			7/26 (27)			
No	31/42 (74)			31/49 (63)			16/22 (73)			19/26 (73)			

Reasons for NICU Admission					
Prematurity	10/42 (24)	17/49 (35)	3/22 (14)	6/26 (23)	0.29
Respiratory Distress Syndrome (RDS)	4/42 (10)	8/49 (16)	0/22 (0)	3/26 (12)	0.22
Transient Tachypnea of Newborn (TTN)	2/42 (5)	2/49 (4)	2/22 (9)	0/26 (0)	0.49
Hypoglycemia	0/42 (0)	2/49 (4)	1/22 (5)	0/26 (0)	0.43
Infection	0/42 (0)	4/49 (8)	1/22 (5)	2/26 (8)	0.20
Fetal Anomaly	0/42 (0)	0/49 (0)	0/22 (0)	0/26 (0)	-
Neonatal Death					0.22
Yes	0/42 (0)	3/49 (6.1)	0/22 (0)	0/26 (0)	
No	42/42 (100)	46/49 (93.9)	22/22 (100)	26/26 (100)	

Table 3: Neonatal characteristics for patients without history of preterm birth with incidentally diagnosed shortened cervix across Race/Ethnicity.

	Private Insurance (N=70)			**Public Insurance (N=68)**			
	N	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**P-values**
Age at delivery (years)	70	34 (30-38)	20-46	68	28 (23-32)	19-45	<0.01
BMI pre-gravid (kg/m²)	58	25.2 (21.5-29.7)	18.3-45.1	50	26.5 (23.6-31)	16-52.6	0.19
BMI at delivery (kg/m²)	61	30 (25.8-34.1)	21.3-45	65	30.9 (27-33.7)	19.1-56.7	0.61
Gravida	70	2 (1-3)	1-7	68	2.5 (1-4)	1-12	0.44
Para: Term Deliveries*	70	0 (0-1)	0-2	68	0 (0-1)	0-10	0.14
Para: Preterm Deliveries*	70	0 (0-0)	0-0	68	0 (0-0)	0-1	0.31
Para: Miscarriages*	70	0 (0-1)	0-4	68	0 (0-1)	0-4	0.92
Para: Abortion/Elective Terminations*	70	0 (0-1)	0-4	68	0 (0-1)	0-4	0.81
Para: Living Children*	70	0 (0-1)	0-3	68	0 (0-1)	0-10	0.21
	No. / No. observed (%)			No. / No. observed (%)			
Race/Ethnicity							<0.01
Hispanic	14/70 (20)			28/68 (41)			
Non-Hispanic Black	19/70 (27)			29/68 (43)			
Non-Hispanic White	18/70 (26)			4/68 (6)			
Unknown/Other	19/70 (27)			7/68 (10)			
Smoking Status							0.33
Current/Former Smoker	10/70 (14)			6/68 (9)			
Never Smoker	60/70 (86)			61/68 (89)			
Unknown	0/70 (0)			1/68 (2)			-
Prior Cervical Instrumentation							0.23
Yes	36/70 (51)			28/68 (41)			
No	34/70 (49)			40/68 (59)			
History/Current Uterine Fibroids							0.13
Yes	15/70 (21)			8/68 (12)			
No	55/70 (79)			60/68 (88)			
Other Comorbidities							
Chronic hypertension	3/70 (4)			6/68 (9)			0.32
Diabetes mellitus (type 1 or 2)	3/70 (4)			1/68 (2)			0.62
Hx bariatric surgery	2/70 (3)			2/68 (3)			>0.99
Autoimmune disease (Lupus, etc.)	1/70 (1)			0/68 (0)			>0.99
Uterine or cervical polyps	2/70 (3)			0/68 (0)			0.50

Hx of uterine surgery (excl. C-section)	2/70 (3)	0/68 (0)	0.50
Hypothyroidism	7/70 (10)	2/68 (3)	0.17
Hyperthyroidism	1/70 (1)	1/68 (2)	>0.99
Polycystic Ovarian Syndrome (PCOS)	3/70 (4)	3/68 (4)	>0.99

Table 4: Baseline characteristics for patients without history of preterm birth with incidentally diagnosed shortened cervix across insurance type.

*All parity numbers exclude outcomes of current pregnancy.

	Private Insurance (N=70)			**Public Insurance (N=68)**			
	N	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**P-values**
GA at Diagnosis (weeks)	70	21.1 (20.1-22.4)	16-28	68	20.9 (19.6-23.4)	16-28	0.73
CL at Diagnosis (cm)	67	1.9 (1.4-2.2)	0-2.5	68	1.7 (1-2.3)	0-2.5	0.23
GA when VP prescribed (weeks)*	58	21.6 (20.1-22.9)	12-27.4	51	20.6 (19.9-22.6)	16.1-27.9	0.25
	No. / No. observed (%)			No. / No. observed (%)			
Compliance with VP*							0.74
Yes, always	48/58 (83)			37/51 (72)			
Yes, sometimes	4/58 (7)			4/51 (8)			
No	2/58 (3)			3/51 (6)			
Unknown	4/58 (7)			7/51 (14)			-
Pessary	3/70 (4)			1/68 (2)			0.62
Cerclage	21/70 (30)			25/68 (37)			0.40
Antepartum Admission	26/70 (37)			32/68 (47)			0.24

Table 5: Diagnosis/ Management of incidentally diagnosed shortened cervix across insurance type.

*These variables refer only to the N=109 patients who were prescribed VP. Thirty patients in this dataset were not prescribed VP.

	Private Insurance (N=70)			**Public Insurance (N=68)**			
	N	**Median (IQR)**	**Range**	**N**	**Median (IQR)**	**Range**	**P-Values**
GA at Delivery (weeks)	70	38.1 (35-39.7)	20-41.3	68	38.1 (34.6-39.4)	21-41.6	0.63
Neonatal Birthweight (g)	70	2940 (2445-3450)	305-4345	67	2985 (2180-3300)	510-3950	0.17
APGAR (1 min)	68	9 (8-9)	4-9	68	9 (8-9)	0-9	0.70
APGAR (5 min)	68	9 (9-9)	5-9	68	9 (9-9)	0-9	0.81
	No. / No. observed (%)			No. / No. observed (%)			
Gender							0.49
Male	34/70 (49)			37/68 (54)			
Female	36/70 (51)			31/68 (46)			
PPROM Prior to Delivery							0.58
Yes	9/70 (13)			11/68 (16)			
No	61/70 (87)			57/68 (84)			
NICU Admission							0.77
Yes	20/70 (29)			21/68 (31)			
No	50/70 (71)			47/68 (69)			
Reasons for NICU Admission							
Prematurity	16/70 (23)			19/68 (28)			0.49
Respiratory Distress Syndrome (RDS)	4/70 (6)			11/68 (16)			0.06
Transient Tachypnea of Newborn (TTN)	4/70 (6)			2/68 (3)			0.69
Hypoglycemia	2/70 (3)			1/68 (2)			>0.99
Infection	3/70 (4)			4/68 (6)			0.72
Fetal Anomaly	0/70 (0)			0/68 (0)			-
Other	2/70 (3)			1/68 (2)			>0.99
Neonatal Death	1/70 (1)			2/68 (3)			0.62

Table 6: Neonatal characteristics for patients without history of preterm birth with incidentally diagnosed shortened cervix across insurance type.

	VP Prescribed (N=109)			VP Not Prescribed (N=30)			VP Prescribed Vs. Not Prescribed Unadjusted Regression		VP Prescribed Vs. Not Prescribed Adjusted Regression+	
	N	Median (IQR)	Range	N	Median (IQR)	Range	OR (95% CI)	P-Values	OR (95% CI)	P-Values
Baseline Characteristics										
Age at delivery (years)	109	32 (26-36)	19.0-44.0	30	30 (23-37)	20.0-46.0	1.0 (1.0-1.1)	0.38	1.1 (1.0-1.2)	0.08
BMI (pre-gravid)	86	26.1 (23-30.7)	17.8-52.6	22	24.9 (21.9-29.6)	16.0-40.6	1.0 (1.0-1.1)	0.38	1.0 (0.9-1.2)	0.57
BMI (delivery)	98	30.1 (26.8-33.4)	21.3-56.7	29	30.9 (24.9-37.8)	19.1-45.0	1.0 (0.9-1.0)	0.45	1.0 (0.9-1.0)	0.29
Gravida	109	2 (2-4)	1.0-9.0	30	1.5 (1-3)	1.0-12.0	1.1 (0.9-1.5)	0.38	1.2 (0.8-1.8)	0.31
Para: Term Deliveries*	109	0 (0-1)	0.0-4.0	30	0 (0-1)	0.0-10.0	0.8 (0.6-1.2)	0.32	1.3 (0.4-4.1)	0.61
Para: Preterm Deliveries*	109	0 (0-0)	0.0-1.0	30	0 (0-0)	0.0-0.0	1.0 (1.0-1.0)	0.99	1.0 (1.0-1.0)	>0.99
Para: Miscarriages*	109	0 (0-1)	0.0-4.0	30	0 (0-1)	0.0-3.0	1.1 (0.7-1.7)	0.67	1.0 (0.5-1.7)	0.93
Para: Abortion/Elective Terminations*	109	0 (0-1)	0.0-4.0	30	0 (0-0)	0.0-4.0	1.8 (1.0-3.1)	0.04	1.4 (0.8-2.5)	0.27
Para: Living Children*	109	0 (0-1)	0.0-4.0	30	0 (0-1)	0.0-10.0	0.9 (0.6-1.2)	0.34	1.3 (0.4-3.7)	0.66
GA at Diagnosis	109	21 (20-22.4)	16.1-27.9	30	20.8 (19.3-24.3)	16.0-28.0	1.0 (0.9-1.1)	0.88	1.1 (0.9-1.3)	0.49
CL at Diagnosis	108	1.8 (1.2-2.2)	0.0-2.5	28	2 (1-2.3)	0.0-2.5	1.0 (0.5-1.8)	0.90	1.0 (0.5-2.1)	0.96
	No. / No. observed (%)			No. / No. observed (%)			OR (95% CI)	P-Values	OR (95% CI)	P-Values
Race/Ethnicity**								0.76		0.37
Hispanic	32 (29)			10 (33)			0.7 (0.2-2.6)		0.4 (0.1-3.1)	
Non-Hispanic Black	40 (37)			9 (30)			1.0 (0.3-3.6)		0.4 (0.1-3.3)	
Non-Hispanic White	18 (17)			4 (13)			Ref		Ref	
Other/More than One Race	15 (14)			6 (20)			0.6 (0.1-2.3)		0.2 (0.1-1.4)	
Insurance Type++								0.26		0.15
Private	58 (53)			12 (40)			Ref.		Ref	
Public	51 (47)			17 (57)			0.6 (0.3-1.4)		0.4 (0.1-1.4)	

Table 7: Logistic regression analysis of Vaginal Progesterone (Vp) provision among patients without history of preterm birth with incidentally diagnosed shortened cervix across Race/Ethnicity and socio-economic status.

*All parity numbers exclude outcomes of current pregnancy.

**Other/More than one Race refers to patients with 'Asian', 'Native Hawaiian or Other Pacific Islander', 'More than One Race', or 'Other' selected as race. Patients with 'Unknown' race were excluded.

+Estimates are adjusted for age at delivery, BMI pre-gravid, smoking status, and history of LEEP/cervical procedure.

++N=1 patient was missing Insurance Type

black women compared to non-Hispanic white women, this did not reach statistically significance (p=0.37). Additionally, the percentage of patients who received vaginal progesterone was lower among those with public insurance (75%) than those with private insurance (82.9%), but this difference was not statistically significant (p=0.15).

Discussion

The provision of vaginal progesterone for women with short cervix without a history of preterm birth has been established as standard treatment for prevention of preterm delivery [18,19]. Although unclear, it is thought that vaginal progesterone acts to pharmacologically correct the body's deficiency of progesterone and thus is used as treatment for shortened cervix [25,26]. This study aimed to determine whether race/ethnic and socioeconomic disparities exist in the provision of vaginal progesterone for treatment of incidental short cervix among those without a history of preterm birth. At our urban academic medical center, there was no difference in the provision of vaginal progesterone for shortened cervix among women of differing race/ethnicity or socioeconomic status who were diagnosed at mid-trimester screening. Nor did we find a difference in vaginal progesterone provision using multivariable logistic regression adjusting for possible confounders.

The prescription of and adherence to vaginal progesterone requires a multifaceted process for both the provider and patient. Our study did not find statistically significant differences in regard to provision of vaginal progesterone across differing race/ethnicity or socioeconomic status. This finding is similar to study findings by Yee et al. in the counseling about and administration of 17OHC-P for preterm birth prevention [16]. The authors found that there were no statistically significant differences in the counseling or receipt of 17OHC-P across race/ethnicity [16].

Importantly, for utilization of vaginal progesterone, a patient needs access not only to surveillance ultrasounds but also requires compliance with vaginal progesterone. Unlike a physical method such as cervical cerclage or pessary, pharmacologic treatment with vaginal progesterone requires daily adherence. In one study assessing the effects of vaginal versus intramuscular progesterone for treatment of short cervix in women with a history of preterm birth, compliance between the two methods did not differ [27]. In prospective clinical

studies assessing the effect of vaginal progesterone as a prevention of preterm birth, overall compliance of vaginal progesterone has been reported to be between 69% [28] and 88.5% [19]. Our study reported a compliance rate of 78%, which is similar to previous reports. Compliance of vaginal progesterone was lower in Hispanic (63%) and non-Hispanic black women (83%) when compared to white counterparts (90%), but this finding did not reach statistical significance (p=0.19). Our finding that compliance with vaginal progesterone does not significantly differ among race/ethnicity is in contrast to studies assessing adherence to treatment with weekly injections of intramuscular 17OHP-C for prophylaxis of preterm birth. Specifically, Yee et al., found that non-Hispanic black women are at a significantly greater risk of nonadherence when compared to non-Hispanic white patients [16]. Similarly, Timofeev et al., found that non-Hispanic black women were more likely to start 17OHP-C later and stop treatment earlier when compared to non-Hispanic white patients [24]. It is possible that since vaginal progesterone is a self-administered treatment that can occur outside of the office, unlike intramuscular 17OHP-C, compliance may be more similar among racial/ethnic groups and women with differing socioeconomic status.

Importantly, while this study did not find that disparities among provision of vaginal progesterone exist to a statistically significant degree, disparities in the incidence of preterm birth and perinatal outcomes do exist. Non-Hispanic black women and Hispanic women have been reported to have statistically shorter cervical lengths and have been reported to have missed more screenings for cervical length than non-Hispanic white women [11]. Additionally, these populations have a significantly increased risk of preterm birth. Studies have assessed the different socioeconomic, psychosocial, and physiological risk factors that may contribute to these outcomes including neighborhood, education level, and interpregnancy interval that contribute to disparities in perinatal outcomes [29]. These findings suggest that great care must be paid to vulnerable populations in obstetrical care.

Strengths of our study include the routine use of transvaginal ultrasound in the midtrimester at time of anatomical survey for universal cervical length assessment. The techniques for cervical length measurement were standardized among our cohort allowing for accurate diagnosis. Limitations of this study include its retrospective nature which may lead to unrecognized confounding factors. Baseline differences among the different race/ethnicity groups existed as non-Hispanic white women were more likely to be older, of a lower pre-gravid BMI and have private insurance, however these demographic differences have been previously described. We are also limited by the small number of patients who fit eligibility criteria. Differences between provider practice may have contributed to the small number of patients included in this analysis. Furthermore, there is possible selection bias considering this population of patients had access to prenatal care and ultrasound screening in the second trimester.

While we did not demonstrate a statistically significant difference between race/ethnicity and prescription of vaginal progesterone for treatment of short cervix, this may be secondary to the relatively small sample size in our study. Further research should assessa larger number of patients at multiple institutions to determine if our findings of a lack of disparity are confirmed and can be generalizable to a larger population. Additionally, further research should determine whether psychosocial factors such as job status, education level, and neighborhood may affect provision of and compliance with vaginal progesterone for treatment of shortened cervix.

Conclusion

In summary, this study did not find statistically significant differences in the provision of vaginal progesterone based on race/ethnicity or socioeconomic status of patients. There was a lower percentage of vaginal progesterone provision in Hispanic (OR 0.4, 95% CI 0.1-3.1) and non-Hispanic black women (OR 0.4, 95% CI 0.1-3.3) and those with public insurance (OR 0.4, 95% CI 0.1-1.4) that did not reach statistical significance and should be further investigated with larger numbers across multiple institutions. A deeper exploration of how treatment with vaginal progesterone for shortened cervix may contribute to the larger disparities that exist in the outcomes of preterm birth across race and socioeconomic status is necessary.

Disclosures

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