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ORIGINAL PAPER

Indicators of Acculturation Related to Somali Refugee Women's Birth Outcomes in Minnesota

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Abstract We investigated the effect of indicators of acculturation among Somali refugee women's birth outcomes. Data were extracted from medical records of 584 Somali women delivering infants at a Midwestern hospital between 1993 and 2006. Bivariate analyses measured relationships between independent factors and the dependent variables of gestational age and birthweight. Structural equation modeling (SEM) determined the fit between factors hypothesized to reflect acculturation and the data. Significant increases noted over time were substance use/exposure, interpreter use, body mass index, hemoglobin levels, gestational diabetes and preterm birth. Bivariate analyses showed significance between prenatal care utilization and both preterm birth and gestational age. SEM results indicated a moderate to good fit between the hypothesized model and available data. Factors hypothesized to reflect acculturation and effect birth outcomes among Somali women are increasing but did not account for increased preterm birth. Further investigation is warranted to identify and truncate further disparate birth outcomes.

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Keywords Preterm birth · Acculturation · Somali prenatal · Gestational diabetes · Birth outcomes

Background

The percentage of infants born preterm in the United States increased from 9.5 to 12.5% [1] between 1981 and 2004 with non-Hispanic African-American women experiencing the highest preterm birth rate (17.8% in 2003) [1]. Among factors associated with increased risk of preterm birth is low socioeconomic status (SES) [1, 2]. Yet despite lower SES, foreign-born Mexican women and U.S.-born Latinas who retain Mexican cultural behaviors exhibit preterm birth rates similar to those of non-Hispanic white women [3–5]. This so-called "Latina paradox" is well documented and describes a protective effect of foreign birth for preterm and low birthweight (LBW) infants born in industrialized countries [4–9]. However, the protective effect diminishes over time and across generations [5, 7, 10] with acculturation, or adopting a more "Western" lifestyle hypothesized for this decreasing perinatal advantage. Less acculturated Mexican women retain protective factors such as the maintenance of traditional dietary practices; a low level of tobacco, alcohol and drug use; strong family support networks; positive attitudes towards childbearing and childrearing; and strong religious beliefs and practices [4].

This study examined whether a similar phenomenon is occurring among Somali refugee women. Refugees began leaving Somalia in 1993 due to civil war and while some evidence exists indicating that Somali women have fewer preterm births compared to women in their receiving countries [11, 12], no studies explore whether acculturation has affected Somali women's birth outcomes over time. Inquiry for this study was initiated because unadjusted

preliminary data from a Midwestern academic medical center indicated that Somali women had fewer preterm births than all other women delivering infants between 1997 and 2004 (8.5% vs. 12.3%), despite presenting with numerous physical and socioeconomic risk factors. These risk factors included a higher incidence of anemia (30% vs. 15%), gestational diabetes (11% vs. 5.3%) and hyperemesis (7% vs. 2%) compared to all other women.

Half of all causes of preterm birth (<37 weeks gestational age) remain unknown [1]. Preterm and LBW infants (<2500 g) are at high risk of morbidity and mortality [1, 4, 5, 8, 10, 13–17]. Known causes of preterm birth and low birthweight include genetic [18], biological [18], psychosocial [19–22] and environmental factors [1, 23]. Several studies seek to explain the effects of acculturation on birth outcomes. The complexity of inter-playing factors presents challenges on how acculturation should be described and measured. Commonly used proxies for acculturation include time residing in the U.S., age at immigration, preferred language or language spoken in the home [24] and preference of ethnic or Western food. Health behaviors include substance use (tobacco and alcohol), initiation of prenatal care, use of prenatal vitamins and diet quality [25]. Time in the U.S. has been shown to effect immigrants' health outcomes in increments of 5 year periods [5]. However, acculturation is a complex process and is thought to be influenced by both physiological and psychological factors and manifests across a range of indicators. This study considered acculturation a latent, or inferred, variable influenced by factors hypothesized to effect birth outcomes.

Methods

Conceptual Framework

The social ecological framework (Fig. 1) [26] illustrates multiple levels of influence that have the potential to influence birth outcomes. The theory of how social networks impact health includes the social-structural conditions, social network factors, psychosocial mechanisms and pathways that effect health [26]. Social networks influence health-promoting, but also health-damaging behaviors such as alcohol and tobacco use both shown to effect birth outcomes. Social networks are also hypothesized to produce stressors linked to physiologic responses. For example, several studies have noted variations to cortisol, epinephrine and norepinephrine production due to social isolation [26]. While strong social support networks and active stress reduction during pregnancy have been associated with fewer preterm births in Californian women who maintain their Mexican cultural heritage, the mechanism of this "selective biculturalism" is unclear [27]. This study tested a unique conceptual model (Fig. 2) that includes

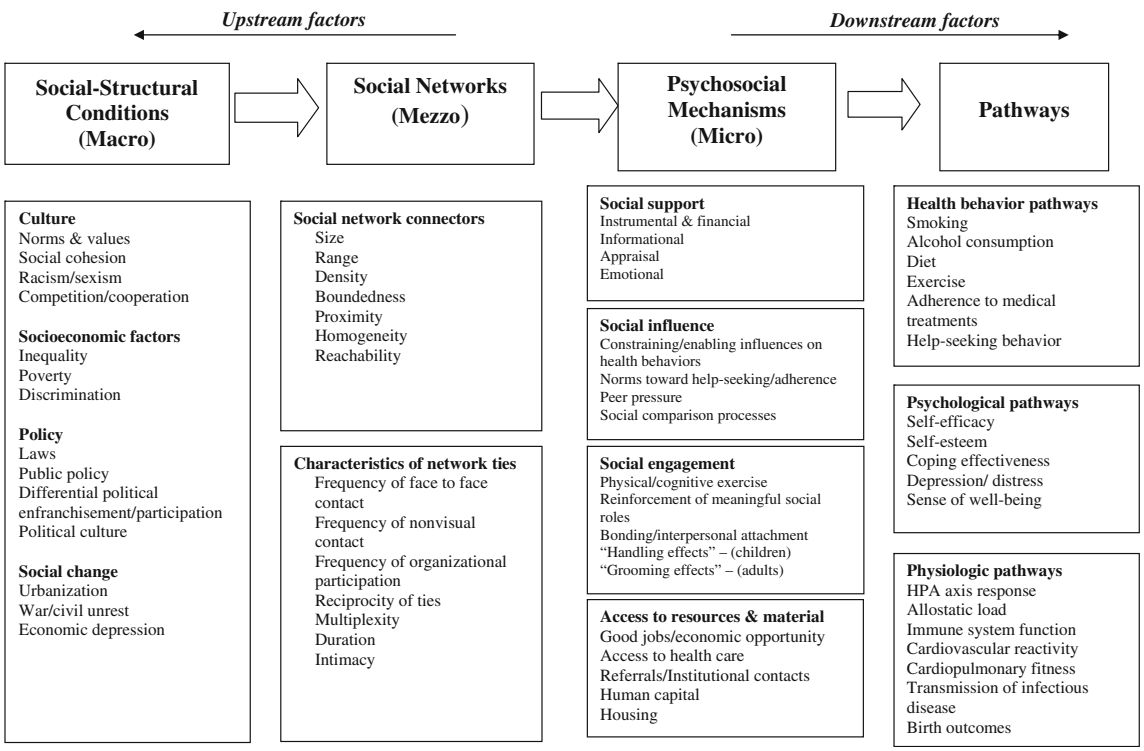

Fig. 1 Conceptual model of how social networks impact health (adapted from Berkman and Kawachi [26, p. 143])

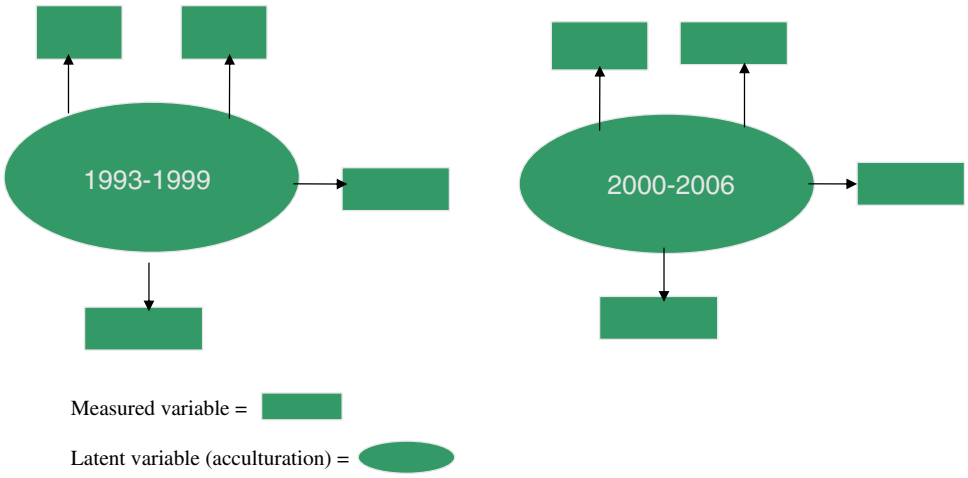

Fig. 2 Conceptual model comparing the effects of acculturation on Somali women's birth outcomes between 1993–1999 (Group 1) and 2000–2006 (Group 2)

factors supported by the existing literature and informed by the socio-ecologic framework. Acculturation reflects several psychosocial mechanisms hypothesized to effect physiologic causal pathways influencing infant gestational age and birthweight and are operative at the psychosocial and behavioral levels of the social ecological model [26].

Hypotheses tested consistent with past research but untested in Somali refugee women were that acculturation will increase over time, acculturation will be predictive of gestational age and birthweight, and more acculturated women will have poorer birth outcomes than less acculturated women. Because evidence indicates that acculturation can effect health outcomes in as few as five year increments, convenience samples consisting of women delivering within two 7 year periods were established with the earliest period (1993–1999) serving as the baseline for analysis.

Participants

All Somali refugee women delivering infants at our hospital between 1993 and 2006 were eligible for study inclusion. The initial sample of 661 Somali women was reduced to 584 cases after exclusions due to refusal to participate in research (45), twin births (2), women under age 18 (11), non-refugee (16), and stillbirths due to fetal anomaly (3). Approximately 75% of Somali women in our area are known to deliver infants at our hospital due to the perception that we have the technology to avert cesarean sections [28].

Data Collection

Data were extracted from medical records. Some records did not include all variables but all cases included the dependent variables of birthweight and gestational age. Missing fields are due to women receiving late or no prenatal care, or the field was not required for the provision of prenatal care (e.g., year of immigration). Sample size (N) is included for each variable in the data tables or narrative, as appropriate.

Measures

Dependent variables were gestational age measured in weeks from last menstrual period [LMP] and infant birthweight in grams. Consistent with our conceptual framework, independent variables were grouped into categories described as *maternal factors* (age in years, parity and gravidity), *health behavior*s (substance use or exposure including current use of alcohol, tobacco or second hand smoke exposure, weight gained during pregnancy in pounds; and body mass index [BMI]), *complications of pregnancy* (gestational diabetes [GDM] determined by laboratory test at 28 weeks gestation, hemoglobin levels and anemia diagnosis [<11 g/dl] as indicated by lab test), *maternal prenatal care history* (the Kotelchuck Index or "adequacy of prenatal care utilization" [APNCU] includes 4 categories: 1 = adequate plus, 2 = adequate, 3 = intermediate and 4 = inadequate). *Acculturation* is a latent variable that included several measured variables (age at immigration, years lived in the U.S., proportion of life lived in the U.S., and whether an interpreter was used at prenatal care appointments). These factors were adapted from several acculturation scales developed for non-Somalis and have not previously been shown to be associated with acculturation in Somalis. Existing acculturation measurement, in general, is hindered by the lack of appropriate or extensive psychometric analyses, or the use of one sociodemographic characteristics used to measure only one aspects of acculturation.

Analysis

Descriptive data was reported for the full sample and comparisons of women delivering infants in two consecutive

chronological periods (Group 1 = 1993–1999 and Group 2 = 2000–2006). Bivariate analysis of independent variables in both the full sample and each chronological period were compared to the dependent variables of gestational age and birthweight. Between group differences were calculated using chi-square and Fisher's exact tests for categorical independent variables, and two-sample *t*-tests for continuous independent variables. Structural equation modeling (SEM) using AMOS computer software tested the hypothesized model [29].

Table 1 Descriptions and comparisons of Somali women delivering infants at a Midwestern hospital between 1993–1999 (Group 1) and 2000–2006 (Group 2)

Variable	Group 1: 1993–1999			Group 2: 2000–2006			Group comparisons F, χ^2, or t (*P*-value)
	N	n (%)	Mean (CI)	N	n (%)	Mean (CI)	
Maternal age in years	138		27.4 (26.4, 28.3)	443		29.3 (28.5, 30.1)	3.37 (.0668)
18–19		10	7.2%		18	4.1%	
20–24		38	27.5%		112	25.3%	
25–29		43	31.2%		124	28.0%	
30–34		31	22.5%		122	27.5%	
35+		16	11.6%		67	15.1%	
Parity	138		2.1 (1.8, 2.5)	445		2.4 (2.2, 2.6)	1.6 (.2069)
Para = 0		35 (25.4)			91 (20.5)		1.5 (.2215)
Para = 1+		103 (74.6)			354 (79.5)		
Gravidity	138		3.5 (3.1, 3.9)	446		3.9 (3.6, 4.1)	2.9 (.0918)
APCNU	137			421			5.65 (.1302)
1 = Adequate+		34 (24.8)			77 (18.3)		
2 = Adequate		35 (25.5)			126 (29.9)		
3 = Intermediate		46 (35.6)			169 (40.1)		
4 = Inadequate		32 (16.1)			49 (11.6)		
Interpreter required	135	88 (65.2)		421	210 (49.9)		9.47 (.0021*)
Years in US	135		2.7 yrs (2.4, 3.1)	409		4.8 yrs (4.5, 5.1)	57.3 (<.0001*)
Age at immigration	135		24.7 yrs (23.6, 25.8)	406		23.7 yrs (23.1, 24.3)	2.67 (.1027)
Prop life in US	135		11 (.09, .12)	406		.17 (.16, .18)	38.8 (<.0001*)
BMI	110		26.4 (25.3, 27.4)	386		27.1 (26.5, 27.7)	1.2 (.2753)
<18.5		8 (7.3)			18 (4.7)		4.19 (.0406*)
≥18.5–25		36 (32.7)			138 (35.7)		
>25–30		43 (39.1)			111 (28.8)		
>30		23 (20.9)			119 (30.8)		
Substance use/exp.	112	7 (6.2)		400	57 (14.2)		4.83 (.0280*)
Weight gain (lbs)	137		17.3 (15.2, 19.5)	444		16.8 (15.8, 17.9)	.19 (.6653)
Hemoglobin	129		11.6 (11.4, 11.8)	427		12.0 (11.9, 12.1)	6.96 (.0086*)
Anemia							3.6 (.0569)
No		99 (76.7)			359 (84.1)		
Yes		30 (23.3)			68 (15.9)		
GDM	97			152			
No		92 (94.8)			292 (84.9)		6.0 (.0140*)
Yes		5 (5.2)			52 (15.1)		
Gestational age	138		39.6 (39.2, 40.0)	446		39.0 (38.8, 39.2)	-2.49 (.0133*)
<37 weeks		6 (4.3)			44 (9.9)		3.87 (.0491*)
≥37 weeks		132 (95.7)			402 (90.1)		
Birthweight in grams	138		3423.1 (3323.2, 3525.1)	446		3310.8 (3252.6, 3368.5)	
<2500 g		4 (2.9)			32 (7.2)		3.11 (.0779)
≥2500 g		134 (97.1)			414 (92.8)		

* $P < .05$

IRB approval and participant consent was received from all authors' participating institutions, and confidentiality assured for all data used in this study.

Results

Descriptive Statistics

As reported in Table 1, no statistically significant differences in *maternal and fertility history factors* were observed between groups. *Prenatal care history and acculturation factors* indicated statistically significant differences between groups for "years lived in the U.S." with an associated increase in "proportion of life lived in the U.S." A between group significant difference was noted in interpreter use with fewer women in Group 2 using an interpreter for prenatal care appointments compared to Group 1. *Health behavior factors* showed a significant BMI increase of 68% in "obese" women occurring between groups. Substance use/exposure was significant between groups with most cases identified as a husband or partner's smoking. *Complications of pregnancy* including hemoglobin levels significantly increased between groups although the actual decrease in anemia was not statistically significant. Gestational diabetes was diagnosed using 3 h oral glucose tolerance testing at 24–28 weeks gestation. Gestational diabetes nearly tripled and was significant between Group 1 (5.2%) and Group 2 (15.1%). A significant increase in *birth outcomes* (preterm birth) was noted between groups. While an increase in the proportion of LBW infants was also observed, the difference was not statistically significant.

Bivariate Analysis

Total Sample

A significant relationship was realized between parity as a continuous variable and preterm birth, but not LBW. Preterm birth decreased with increasing parity ($\chi^2 = 4.12$, $P = .04$, OR = 1.18). Significant differences were found between both preterm birth and LBW for interpreter use, weight gain, GDM and APNCU. Of those women delivering preterm infants, almost twice as many did not use interpreters (29 or 11.24%) compared with those using an interpreter (18 or 6.04%). Of those women delivering LBW infants, 21 (8.14%) used interpreters compared to 12 (4.03%) not using an interpreter ($\chi^2 = 4.03$, $P = .04$). Women with increased weight gain were less likely to have a preterm ($\chi^2 = 9.19$, $P = .0024$) or LBW infant ($\chi^2 = 10.74$, $P = .001$). Likewise, women with GDM were less likely to have a preterm ($\chi^2 = 9.41$, $P = .002$) or LBW infant ($\chi^2 = 7.6$, $P = .006$).

Logistic regression was used to determine significance between APNCU categories, coding APNCU 1, 2 and 3 as dummy variables (0, 1) and using APNCU 4 as the referent category. Significant differences were found between APNCU categories 1 and 4 ($\chi^2 = 11.76$, $P = .006$) categories 2 and 4 ($\chi^2 = 22.79$, $P < .0001$) and 3 and 4 ($\chi^2 = 30.24$, $P < .0001$) relative to preterm birth. Similarly, significant differences were found between APNCU categories 1 and 4 ($\chi^2 = 10.36$, $P = .0013$) 2 and 4 ($\chi^2 = 18.91$, $P < .0001$) and 3 and 4 ($\chi^2 = 21.20$, $P < .0001$) for LBW.

Bivariate Analysis by Year Group: Group 1 (1993–1999)

Comparisons between APNCU categories yielded a significant difference for APNCU 1 and 4 (referent group) within Group 1 ($\chi^2 = 4.01$, $P = .0453$). However, several cells had counts fewer than 5 making the results suspect. A statistically significant difference was observed between hemoglobin and LBW ($\chi^2 = 4.23$, $P = .0398$) only for Group 1.

Bivariate Analysis by Year Group: Group 2 (2000–2006)

Statistically significant differences were noted between both LBW and preterm birth for weight gain and gestational diabetes. Increased weight gain was associated with fewer LBW ($\chi^2 = 14.12$, $P = .0002$) and preterm infants ($\chi^2 = 17.05$, $P = < .0001$). Women with gestational diabetes were less likely to have either a preterm ($\chi^2 = 6.67$, $P = .0098$) or LBW infant ($\chi^2 = 8.75$, $P = .0031$). Logistic regression of APNCU and preterm birth showed significant differences between APNCU 1 and 4 ($\chi^2 = 7.71$, $P = .0055$), APNCU 2 and 4 ($\chi^2 = 18.23$, $P < .0001$) and APCNU 3 and 4 ($\chi^2 = 25.61$, $P < .0001$). A statistically significant difference was noted between APNCU 3 and 4 ($\chi^2 = 8.44$, $P = .0037$) only for LBW.

Structural Equation Modeling Analysis

SEM was conducted with variables achieving significance in bivariate analysis. These included interpreter use, parity as a continuous variable, weight gain, APNCU and GDM. Birthweight in pounds and gestational age were included as continuous variables. The model was constructed with covariances identified between weight gain, APNCU and GDM. Results (Fig. 3) indicated that the structural and measurement models were significantly different ($\chi^2 = 14.4$, 4 degrees of freedom, $P = .006$). Statistically significant relationships within the measurement model were noted between acculturation and weight gain ($P < .0001$), GDM ($P = .008$), gestational age ($P = .014$), interpreter use ($P < .0001$) and birthweight ($P = .028$).

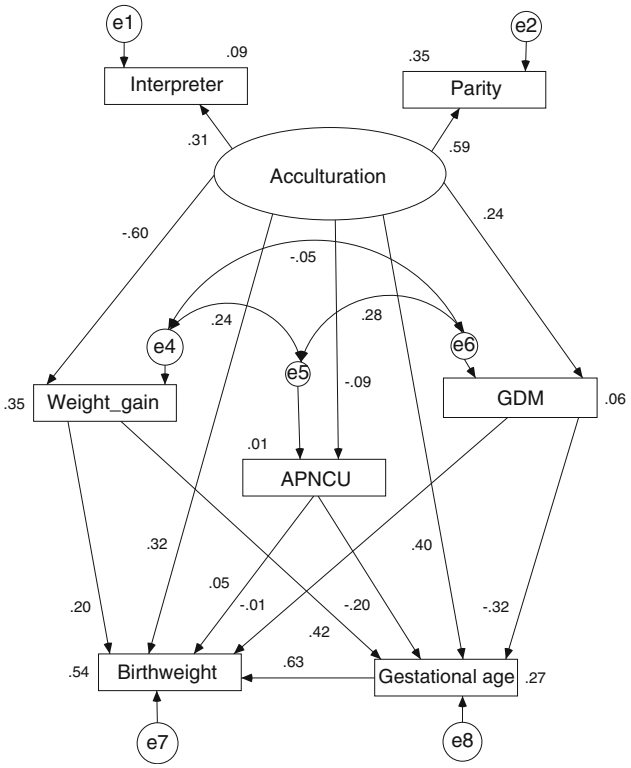

Fig. 3 Structural equation modeling (SEM) standardized regression weights of the hypothesized effect of acculturation on Somali women's birth outcomes

The CFI was .985, NFI was .979, and RMSEA was .067. Comparisons between time periods (Group 1 and Group 2) showed no differences between groups (CFI = .996, NFI = .909, RMSEA = .016).

Discussion

A key finding of this study was that preterm birth increased between chronologically defined baseline and follow-up groups indicating that preterm birth is increasing in Somali women delivering infants at our hospital. However, the hypothesized factors reflecting acculturation expected to account for this change were not significantly related to preterm birth between groups using structural equation modeling. Despite this outcome, further attention to between group comparisons are warranted. All variables selected to reflect acculturation (age at immigration, years lived in the U.S., proportion of life lived in the U.S. and interpreter used) were statistically significant between women delivering infants in Groups 1 and 2. These time-related factors had the expected associations of decreased interpreter use between groups over time. Interpreter use was a proxy for English competence, and while not an ideal measurement, ability to speak English was the most robust measure of acculturation in several studies [30, 31]. While the overall study sample showed significant differences between interpreter use and both preterm birth and LBW infants, these differences were not observed between groups. Expected results were partially realized in that comparisons for the total sample indicated poorer birth outcomes as interpreter use decreased. It was also expected that women in Group 2 would have poorer birth outcomes if they did not use an interpreter, indicating a greater degree of acculturation. These results suggested that factors other than language are stronger predictors of preterm birth, multiple factors reflecting acculturation measured together are necessary to impact birth outcomes, interpreter use is a questionable proxy for language competency, or actual use of interpreters introduced a confounding factor not corrected for in this study.

While mean weight gain during pregnancy decreased slightly between groups with time, there was a significant increase in women entering pregnancy as "obese" based on BMI. The proportion of women with gestational diabetes almost tripled between groups and an inverse relationship was noted between gestational diabetes and both preterm and LBW infants in the total sample and for Group 2. Significant inverse relationships were observed for both weight gain and gestational diabetes between preterm birth and LBW for the total sample and Group 2. However, gestational diabetes may confound other factors predisposing women to deliver preterm and LBW infants since women with GDM tend to deliver heavier infants. These results, while posing no immediate risks inherent to LBW or preterm infants, should be considered when evaluating potential long range health outcomes of Somalis. Because of the long term health consequences of GDM for both mother and infant, increased attention to the prevention of GDM should be prioritized for this population. Although there is a national trend toward obesity with associated comorbidities, the short period of time that Somali women have made this transition suggests that dramatic changes in lifestyle may be responsible. It should be noted that larger body size and health have positive associations in many African cultures, and therefore increasing BMI may reflect a cultural norm among Somalis. Because of diet composition, structured eating habits and daily exercise, Somali women did not previously experience deleterious health effects associated with the Western-based categories of overweight and obesity.

Substance use and exposure showed a significant increase between groups although most cases indicated "substance exposure" associated with either a husband or partner smoking. The accuracy of these data are suspect as tobacco use is forbidden among Muslims and women are unlikely to admit substance use. Within the context of the beneficial "healthy immigrant effect", as women move

away from cultural norms of healthy diets, low rates of substance use, and familial support, poorer health outcomes result.

Earlier initiation and increased utilization of prenatal care have been noted among other immigrant groups as they adopt to Western cultural norms [32]. The Kotelchuck Index (APNCU) [33] provides a composite measurement based on the month prenatal care was initiated and the number of recommended clinical visits and was used to indicate use of health care services. No significant differences in prenatal care utilization patterns were noted between groups although bivariate analysis confirmed the relationship between inadequate prenatal care and LBW for women in Group 2. While not demonstrating a variance in acculturation, this outcome reinforces the relationship between adequate prenatal care provision and preterm birth reduction and indicates the need to increase access to early and adequate prenatal care to Somali women of reproductive age.

While factors selected to reflect acculturation showed significant differences in the expected directions over time, they were not significantly associated with either preterm birth or LBW infants. While these factors were supported in the literature related to Latinas [34–36], they may not apply to Somalis. The difference of only 2.1 mean years lived in the U.S. between groups was a surprising finding and this short period should be critically considered when viewing results. Health outcome changes attributed to acculturation have not been measured in increments less than 5 years in other populations [10] and, therefore, this study may have shown different results if conducted over a longer time period. But given the small difference between mean years lived in the U.S., the statistically significant differences between factors known to affect birth outcomes are even more alarming.

Strengths and Limitations of the Study

This study tested hypotheses as a first step in understanding the effects of acculturation on Somali refugee women's birth outcomes. Strengths are inclusion of the majority of eligible cases over a 14 year period using data from a consistent source with the same diagnostic procedures. Limitations were use of retrospective data with missing fields which limited utilization of valid analysis. Factors reflecting acculturation were confined to medical record entries reducing the breadth of information available. Numerous factors are related to preterm birth and LBW, and only those related to acculturation in previous studies were included in this study. Additional limitations include no referent group, limited information on whether Somali women desire acculturating to Western norms and systematic identification of factors reflecting acculturation in Somalis prior to measuring these factors related to health outcomes.

New Contribution to the Literature

To our knowledge, this study is the first to examine health outcomes related to the acculturation of Somali refugees to life in the United States. Factors selected to reflect acculturation did not yield statistically significant relationships with preterm and LBW infants in this study. However, the magnitude of observed increases in risk factors contributing to poor birth outcomes are of concern in Somali refugee women, and the value of early and regular prenatal care was confirmed. Suggested interventions include policies supporting programs focused on strengthening factors outlined in the socio-ecological model such as positive health behaviors. Focused clinical care could include offering culturally appropriate nutritional and exercise counseling for Somali women patients with high BMIs and gestational diabetes.

As Somali women have resided in the U.S. for a relatively short period of time, continued research to identify and validate factors reflecting acculturation is needed to improve knowledge of cultural strengths and weaknesses of both Somali and Western societies related to birth outcomes. This course of inquiry may shed light on the many unknown factors related to preterm and LBW infants and associated long-term consequences.

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