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CLINICAL ARTICLE

Patterns of fetal growth in an Asian Indian cohort in the USA☆

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ABSTRACT

Objective: To determine whether a greater proportion of fetuses in an Asian Indian cohort are classified as small for gestational age than would be expected from a normally distributed population. *Methods:* A retrospective analysis of fetal growth pattern and neonatal outcome was conducted among Asian Indian women who were referred to a maternal–fetal medicine center in Park Ridge, IL, USA, for evaluation of fetal growth between January 1, 2012, and December 31, 2013. The primary outcome was an abdominal circumference or estimated weight of lower than the 10th percentile for gestational age according to the Hadlock formula. *Results:* Overall, 207 women and 210 fetuses were included. Forty-eight (22.9%) fetuses had an abdominal circumference lower than the 10th percentile. The total number of neonates classified as small for gestational age at delivery was 22 (10.5%), a value indicative of a normally distributed population. *Conclusion:* Fetal size was smaller than expected among the present Asian Indian cohort, but most neonates were classified as appropriate for gestational age at birth. Population specific growth curves are needed to improve assessment of fetal growth.

1. Introduction

Research into the developmental origins of health and disease has highlighted fetal development as a determinant of future health [1]. Size and body proportions at birth predict both short- and long-term outcomes. These outcomes range from infant mortality, childhood growth, and cognitive ability [1] to the onset of conditions in adulthood, such as cardiovascular disease and type 2 diabetes mellitus [2,3].

Newborns in India are among the smallest in the world, with an average full-term birth weight of 2.6–2.9 kg compared with 3.5–3.7 kg for white populations in high-income countries [4]. Asian Indian women—both those who have migrated from India and those born in the USA—are frequently referred to the Division of Maternal-Fetal Medicine at Advocate Lutheran General Hospital, Park Ridge, IL, USA, to evaluate their fetuses for possible growth restriction. Fetal growth restriction is often associated with a small fetal abdominal circumference (AC) among this population. A smaller-than-expected fetal AC frequently necessitates serial ultrasonography to assess fetal growth, and also results in increased prenatal surveillance of the fetus [4]. Nonstress testing and biophysical profiles can produce false-positive results, which in turn can lead to preterm delivery and iatrogenic prematurity [5,6].

The objective of the present study was to evaluate fetal growth patterns among a cohort of Asian Indian women using standardized fetal growth curves for the general population that were developed by Hadlock et al. in 1984 [7]. It was hypothesized that a greater proportion of fetuses would be classified as growth restricted or small for gestational age (SGA) than might be expected from a normally distributed population. Additionally, the outcomes of neonates who had been designated as growth restricted during fetal development were reviewed to identify any associated neonatal morbidity. Finally, the standardized fetal growth curves [7] were compared with fetal biometric data from a rural Indian cohort [4]. The aim of this comparison was to determine whether there was a better correlation between the fetal biometry of the rural Indian cohort and neonatal outcome than with the Hadlock curves that are currently used.

2. Materials and methods

A retrospective study was conducted of Asian Indian women referred to the Division of Maternal-Fetal Medicine at Advocate Lutheran General Hospital, Park Ridge, IL, for evaluation of fetal growth between January 1, 2012, and December 31, 2013. The present study was approved by the institutional review board of Advocate Health Care,

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Downers Grove, IL. Consent was not necessary owing to the retrospective design.

The ultrasonography database (Digisonics, Houston, TX, USA) was searched for women of Asian Indian ethnic origin. However, because this demographic information was not reliably recorded, the names and (if needed) photographic identification of all patients referred to the Division of Maternal-Fetal Medicine by two obstetricians who primarily care for the Asian Indian population in Park Ridge were reviewed for possible inclusion.

Fetal biometric data were derived from the obstetric ultrasonography reports, which were viewed directly from the ultrasonography database. Neonatal outcome data were obtained from the newborn's electronic medical record, which was linked to the mother's electronic medical record. Data collected included maternal age, gravity, parity, indication for ultrasonography, all the individual ultrasonography parameters, estimated fetal weight (EFW), and the corresponding percentiles. Neonatal data included gestational age at delivery, birth weight, birth length, head circumference, and AC if available. Admission to the neonatal intensive care unit, indication, and length of stay were also recorded.

The primary fetal outcome was SGA, which was defined as an AC or EFW of lower than the 10th percentile for the gestational age, according to the Hadlock formula [6]. Growth percentiles were then compared between fetuses attaining the primary outcome and those generated with data from the Pune study [7], which reported fetal biometry in a large Indian cohort in rural India. The Pune study of 653 singleton pregnancies reported the 10th, 50th, and 90th percentiles for 20, 28, and 36 weeks of gestation [4]. Assuming that the growth data exhibited the same pattern as the Hadlock standard [7], all the data points from the Pune study should be superimposable on the same modified curve as the Hadlock curve for that measurement. However, the Pune study data did not fall on the same curves as the Hadlock measurements (Fig. 1), suggesting a different pattern of growth.

Because the data points did not fall on the same modified curves, this approach could not be used to fill in other points for the Pune data. Therefore, spline curves were generated using the Pune data (Fig. 2). Initial 12-week values from Table 3 of Hadlock et al. [7] were included for reference. A spline curve is a numeric function that is defined by multiple polynomial functions. It possesses a sufficiently high degree of smoothness where the polynomial pieces connect the data points [8]. Spline interpolation is often preferred to polynomial interpolation because the results are similar to those obtained interpolating with higher degree polynomials, but instability is avoided [9]. The spline fit used in the present study was cubic (i.e. to the order of three). The spline curves fit the Pune data well and so were used to generate fetal growth reference tables at 1-week gestational intervals.

Data were analyzed using Excel version 2007 (Microsoft, Redmond, WA, USA) and SPSS version 22 (IBM, Armonk, NY, USA). Descriptive statistics for continuous data (mean ± standard deviation; range) and categorical data (number; percentage) were calculated for all patient characteristics. Statistical significance was defined as $P < 0.05$. Spline

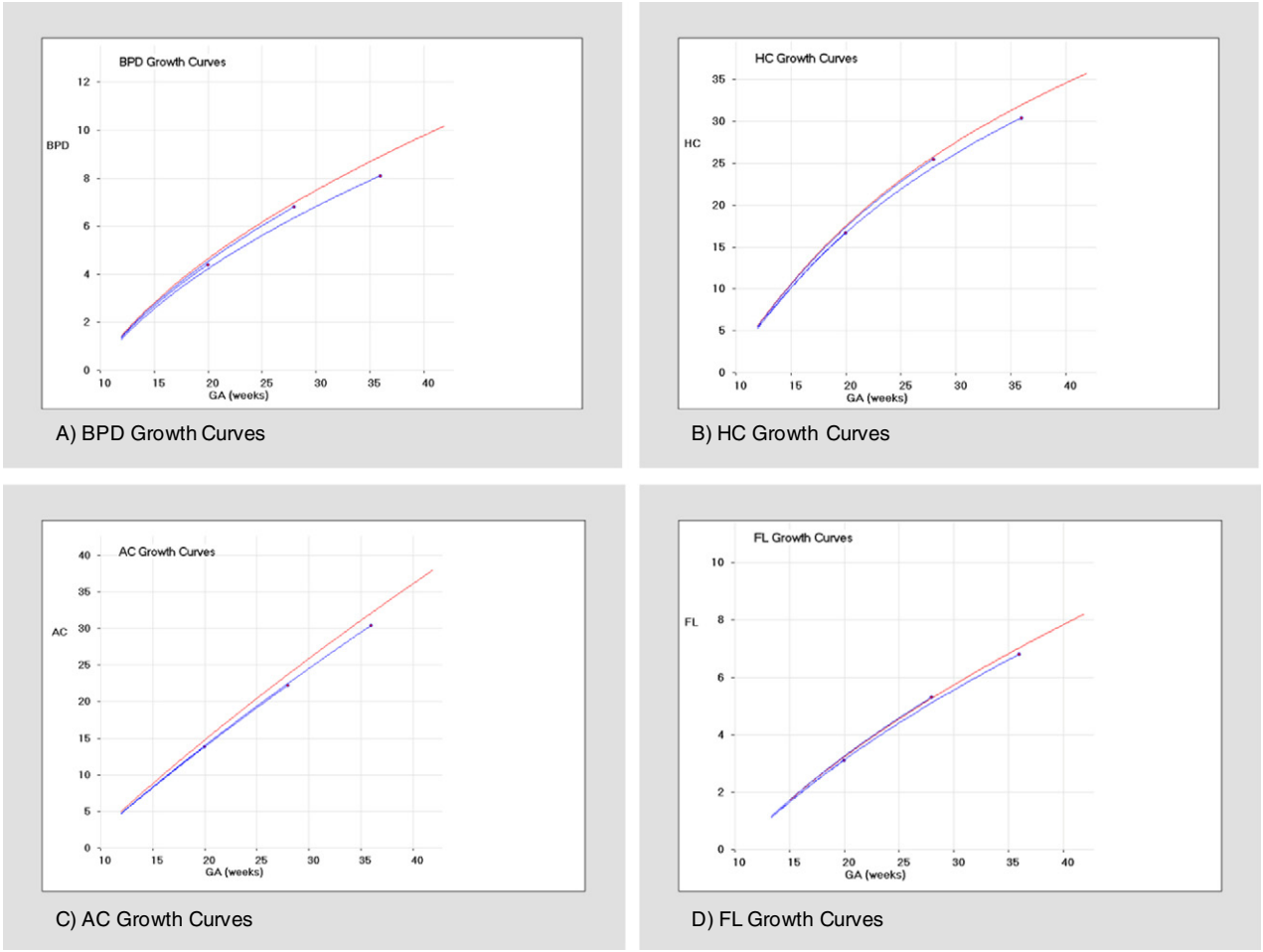

Fig. 1. Comparison of the fetal growth curves. BPD, HC, AC, and FL are given in cm. The blue lines represent the 10th and 90th percentiles for the Hadlock curves; the pink line represents the Pune study data. Abbreviations: BPD, biparietal diameter; GA, gestational age; HC, head circumference; AC, abdominal circumference; FL, femur length.