OBSTETRICS

# An ultrasound-based fetal weight reference for twins

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**OBJECTIVE:** The objective of the study was to construct an ultrasound-based estimated fetal weight-for-gestational-age reference for twin fetuses, stratified by chorionicity.

**STUDY DESIGN:** We performed a retrospective cohort study of live-born nonanomalous twins delivered longer than 34 weeks at the Royal Victoria Hospital (Montreal, Canada). Fetal weight was estimated using ultrasound biometric measurements combined using Hadlock's formula. Multilevel linear regression models were used to adjust for clustering by twin pregnancy and to account for the serial ultrasound measurements taken on each fetus. Based on this model, smoothed estimates of fetal weight were made for the third, 10th, 50th, 90th, and 97th percentiles of the fetal weight distribution. Fetal weight references were stratified by fetal chorionicity.

**RESULTS:** A total of 642 twin fetuses with a total of 3078 ultrasound observations were included. Sixteen percent of the cohort was monochorionic. Fetal growth accelerated in the second trimester and continued in a linear pattern in the third trimester until term. As expected, the median weight for monochorionic twins was lighter than the median weight for dichorionic twins throughout pregnancy.

**CONCLUSION:** The reference values created in this study address serious methodological limitations of existing reference charts and thus provide an improved tool for assessing fetal growth in twin pregnancies. Importantly, dichorionic twins deviated from singleton reference charts at approximately 32 weeks, whereas monochorionic twins deviated at 28 weeks.

**Key words:** chorionicity, estimated fetal weight, fetal growth, reference chart, twin gestation

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The rate of multiple pregnancies rose steadily in North America until it plateaued in 2009.[1] In 2012, 1 in every 30 babies born in the United States was a twin.[2] Twin pregnancies are at significantly increased risk for perinatal death, largely because of prematurity and fetal growth restriction. The identification of growth-restricted fetuses is a major emphasis of prenatal care in twin pregnancies.

Optimal fetal growth in twins remains inadequately defined.[3,4] The median birthweight of twins is significantly lower than singletons beginning around week 30–32.[5] Thus, if the growth trajectory of twins is followed on a singleton curve, the normal deceleration of growth in twins may be interpreted as pathological slowing if singleton curves are used. Moreover, there is evidence that optimal birthweights are lower for twins than for singletons, supporting the use of different reference charts to assess the growth of twins.[6]

A number of population-based birthweight references have been generated for twins that chart birthweight for each completed week of gestation.[5,7-14] Reference charts based on the weights of live births are known to have considerable bias, especially at lower gestational ages.[15] Infants born at lower gestational ages are smaller, and less healthy, than their counterparts that remain in utero.

Given the limitations of birthweight reference standards, a number of ultrasound-based fetal weight standards have been constructed and adopted for the assessment of fetal growth in singletons.[16-18] Few standards, however, have been developed for twins and those that have been published have significant methodological limitations.[19-21] Published estimated fetal weight charts for twin pregnancies suffer from small sample sizes and inappropriate statistical modeling that fails to account for the correlation in fetal weight measurement between twins. Additionally, only a single

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TABLE 1
**Maternal and fetal characteristics of twin pregnancies at the Royal Victoria Hospital, Montreal, Canada, 1996–2006**

| Pregnancy characteristics | Mean ± SD or n, % |
|---|---|
| Maternal age, y | 33 ± 5.1 |
| Nulliparous | 165 (51.4) |
| Smoking during pregnancy | 13 (4.0) |
| Pregnancy conceived through ART | 112 (34.9) |
| Prepregnancy body mass index, kg/m$^2$[a] | 24.2 ± 4.8 |
| Diabetes during pregnancy | 45 (14.0) |
| Hypertensive disorders during pregnancy | 39 (12.2) |
| Birthweight, g | 2638 ± 408 |
| Gestational age, wks plus d[b] | 37 ± 1 (36 ± 2, 37 ± 6) |
| Delivery <37 wks | 276 (43.0) |
| Female fetuses | 334 (52.0) |
| Monochorionicity | 102 (15.9) |

*ART*, assisted reproductive technology.

[a] In 273 pregnancies with available body mass index data; [b] Median with interquartile range.

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study has differentiated growth patterns by chorionicity.[19]

In this study, our objective was to construct an ultrasound-estimated fetal weight-for-gestational-age reference for twin fetuses, stratified by chorionicity that addressed the methodological concerns of previous studies.

## Materials and Methods

### Study population

We conducted a retrospective cohort study based on data from the Royal Victoria Hospital, a McGill University tertiary care teaching hospital in Montreal, Canada. Data from the hospital's obstetrical ultrasound department were linked with maternal and newborn outcome data in the McGill Obstetrical and Neonatal Database, a quality-controlled electronic database that contains abstracted prenatal and postnatal clinical information on all women delivering at the Royal Victoria Hospital and their infants since 1978.

Data entry during the study period was performed by a single individual, contributing to the consistency of coding methods and data entry. Cases of uncertainty are referred for clarification to a staff obstetrician or neonatologist, who also remained constant during the study period. All women delivering live-born twins at the Royal Victoria Hospital between 1996 and 2006 were eligible for inclusion. Data for the periods between April 1, 1997, and March 31, 1998, and between April 1, 2000, and March 31, 2001, were missing because of a period of system upgrades during which no database entry occurred. Pregnancies in which at least 1 fetus had a congenital anomaly, had twin-twin transfusion syndrome, underwent spontaneous or iatrogenic fetal reduction, or lacked valid estimated fetal weight measurements (some obstetricians delivering at the Royal Victoria Hospital have ultrasounds performed elsewhere) were excluded from further analysis. Pregnancies delivering before 34 weeks or lacking an ultrasound-based estimate of gestational age were also excluded.

The study was approved by the McGill University Research Ethics Board.

### Biometric measurements

Ultrasounds were performed by certified ultrasound technologists with subspecialty training in obstetrical ultrasound or physicians in maternal and fetal medicine with fellowship training in obstetrical ultrasound. Estimated fetal weight was calculated using Hadlock's formulae.[16]

For each fetus, we randomly sampled 1 estimated fetal weight measurement per month. This was done to avoid over-inclusion of data from higher-risk pregnancies that had undergone a greater number of scans. In monochorionic twins, estimated fetal weights were sampled from each 2-week period to reflect the scanning frequency in uncomplicated monochorionic twin pregnancies. We did not include birthweight because it was unclear to what extent the fetus identified on ultrasound (ie, twin A vs twin B) would correspond with the birth order at delivery.

### Gestational age

Gestational age in days at the time of ultrasound was calculated using last menstrual period confirmed or revised with early ultrasound. At the Royal Victoria Hospital, the last normal menstrual period estimate is used as long as it is in agreement within 10 days of the ultrasound estimate of gestational age.

### Chorionicity

As per the recommendations of the Society of Obstetricians and Gynecologists of Canada, determination of chorionicity is ideally done by ultrasound between 10 and 14 weeks of gestation.[22] The presence of a single placental mass in the absence of a lambda sign at the intertwin membrane-placental junction as seen on ultrasound is interpreted as indicative of monochorionicity, whereas twins are classified as dichorionic if a single placental mass is viewed on ultrasound and the lambda sign is also present.[23] The determination of chorionicity was conducted according to these guidelines during the study period.

### Statistical analysis

Our data set was hierarchical in nature, with repeated measurements of estimated fetal weight (EFW) for each fetus and clustering of twins born to the same mother. We accounted for these correlations when modeling the relationship