Gynecology & Obstetrics
ISSN: 2161-0932
OPEN ACCESS Freely available online
Research Article

Length of Fetal Radio in the Analysis of Ultrasound in the Week 11-13+6 of Gestational Age

Jose Luis Duque[1], Lina Maria Echeverri[2], Astrid Milena Rueda[2], Camilo Torres[1], Jose L. Perez-Olivo[3], Jose L. Perez-Olivo[4], Arcminson F. Solano Montero[3], Mauricio Gomez Bossa [3] , Abelardo Motta- Murcia [1], Saulo Molina-Giraldo[3,4,5,6*]

[1]Medicina Perinatal Ltda., Bogotá, Colombia; [2]Department of Radiology, Universidad de la Sabana, Bogotá, Colombia, [3]Fetal therapy and Surgery Network - FetoNetwork, Colombia,[4]Section of Fetal Therapy and Fetal Surgery Unit, Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology Hospital de San José and Department of Obstetrics and Gynecology Fundación Universitaria de Ciencias de la Salud - FUCS, Bogotá, Colombia; [5]Section of Fetal Therapy and Fetal Surgery Unit, Division of Maternal-Fetal Medicin Department of Obstetrics and Gynecology, Clínica Colsubsidio 94, Bogotá, Colombia, [6]Department of Obstetrics and Gynecology, Faculty of Medicine, Universidad Nacional de Colombia, Bogota, Colombia.

ABSTRACT

Objective: Describe the behaviour of the length of fetal radio in order to include it in the analysis of ultrasound in the week 11-13+6 of gestational age, because it is associated with multiple genetic syndromes.

Methods: An observational descriptive study was carried out on the measurement of the fetal radius in healthy patients with a single pregnancy who attended a screening ultrasound in weeks 11-13+6.

Results: 334 radio measurements of the fetus with Cranio caudal length (LCC) between 45 and 84 mm. Mothers were on average 30.8 years old. The LCC average was 64.2 mm and the average proximal radius was 5.9 mm. The percentiles by gestational age of the length of the proximal radius were to percentile 5% and 95 % at 11 weeks, 1.4 mm and 5.88 mm, for 12 weeks was 2.94 mm and 7.5 mm, for the 13 weeks was 4.66 mm and 9.91 mm and 13+6 week was 6.5 mm and 11.07 mm respectively. A positive correlation between radial length and other fetal biometry was found.

Conclusions: The Assessment of the Fetal Radio Should be Routinely Done in the Ultrasound of the 11 to the 13+6 Week Because Of It Is Associated With Fetal Abnormalities Of Chromosomal Origin, For This Reason, It Is Important To Study The Behavior Of The Radius Length To Determine Fetal Values Extrapolated To Our Population.

Keywords: Fetal radio; Genetic screening Ultrasound; Ultrasound week 11 to the 13+6; Long bones

INTRODUCTION

Early screening of fetal aneuploidies has been an essential part of prenatal assessment for several decades. Recently, the concept of the inversion of the Diagnostic Pyramid has been introduced, in which the fetal ultrasound assessment, at week 11 to 13+6, is intended to determine major abnormalities and categorize risk [1]. Genetic screening fetal ultrasound has evolved from the measurement of nuchal translucency to extended anatomical evaluation[1-3].

Within the spectrum of anatomical structures to be assessed in fetal biometry are the long bones, which are likely to measure from the 11th week of gestation. The measurement of femur length is the most studied and used measure in the routine search for anatomical abnormalities and fetal growth [4], however, the radius is not part of the routine of ultrasound examination, despite the multiple associations to numerous pathologies due to chromosomal causes (Table 1) [5-15].

So far, only some authors describe curves of normal values for this bone with studies that include data obtained in gestational

Correspondence to: Saulo Molina Giraldo, M.D., MSc ,Calle 91c #21-17, 4º piso Clinica de la Mujer - Unidad de Medicina Materno Fetal Fetoscopia, Bogotá, Colombia, Teléfono 6161799, Extensión 169, E-mail:molina.saulo@urosario.edu.co smolina@clinicadelamujer.com.co, smolina@fucsalud.edu.co

Received: 02-Apr-2022, Manuscript No. GOCR-22-18561, **Editor assigned**: 05-Apr-2022, PreQC No. GOCR-22-18561 (PQ); **Reviewed**: 18-Apr-2022, QC No. GOCR-22-18561; **Revised**: 25-Apr-2022, Manuscript No. GOCR-22-18561 (R); **Published**: 30-Apr-2022, DOI: 10.35248/2161-0932.22.12.592.

Citation: Giraldo SM, Echeverri LM, Rueda AM, Torres C, Montero AFS, Bossa MG, et al. (2022) Length of Fetal Radio in the Analysis of Ultrasound in the Week 11-13+6 of Gestational Age. Gyno & Obstet. 12.592.

ages greater than week 12 and come from patients with different sociodemographic characteristics from ours 16, therefore, the fetal radius should be investigated to include it systematically in the fetal evaluation in an early stage.

The purpose of this study is to achieve an objectification of the length of the radial bone in fetuses with gestational age between weeks 11 to 13+6 and to determine the longitudinal radial in terms of percentiles.

MATERIALS AND METHODS

An observational descriptive study was carried out on fetal radius measurement in healthy patients with a single pregnancy who attended a screening ultrasound from weeks 11 to 13+6 at the Centro de Medicina Perinatal LTDA and Clínica Colsubsidio from June 2013 to June 2014; they were defined as healthy fetuses because the result of the ultrasound study and the concept issued by neonatology in the review of the postpartum medical history indicated this. Written informed consents were obtained for the study as a part of the consent for first-trimester screening.

The measurements of the fetal radio were obtained by three doctors who specialized in advanced maternal-fetal ultrasound, certified and with more than 20 years of experience, using the Expert Voluson 730 ultrasound system (GE Medical Systems, Kretz Ultrasound, Zipf, Austria) equipped with RIC 5-9H vaginal and RAB 4-8L abdominal transducers. For the evaluation of the radius, the technique described by O Brien and Queenan 17 (Figure 1) was used employing a screen freeze when the upper limb proximal to the transducer was fully visualized, specifically, the forearm in the longitudinal axis, and when the bone disposition was found Perpendicular to the ultrasound beam, the measurement was made from the greater trochanter to the most distal ossified end, excluding the epiphyseal portions. Later, the same repair points were used to measure the radius distal to the transducer.

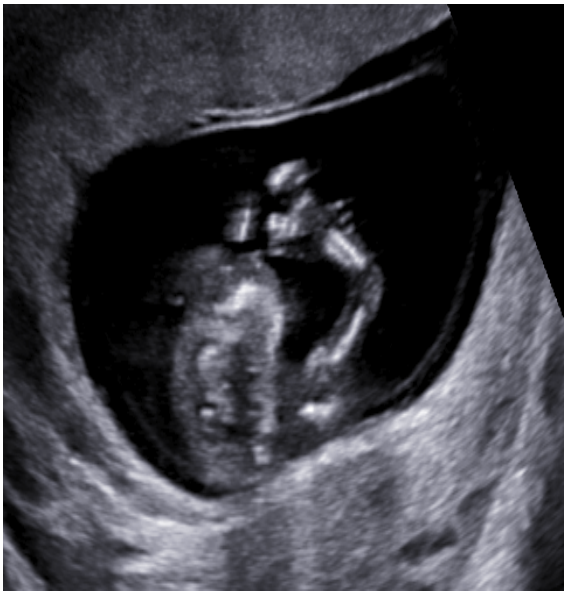

Figure 1: Ultrasound image of the fetal radius.

The reproducibility of the measurements has been evaluated in previous studies where at least two independent observers evaluated the fetal parameters. While one of the observers performed two serial measurements to evaluate intraobserver reproducibility, the other obtained the same measurements to evaluate interobserver reproducibility, achieving a maximum inter- and intra-observer variability of 2 mm and limits of agreement of 95% according to the technique proposed by Balt and Altman [5, 16-19].

A convenience sample was obtained consecutively. All patients underwent screening ultrasound from weeks 11 to 13+6 according to the international protocol [3]. The information was collected at the time of the ultrasound, feeding an EXCEL 2011 file (version

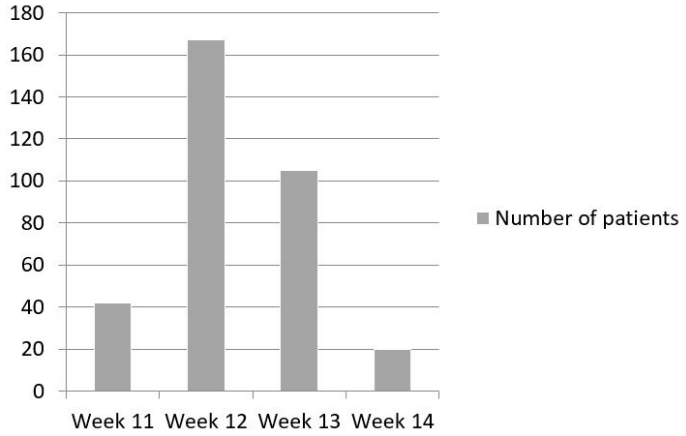

Figure 2: Representation of the number of patients included in relation to gestational age.

Table 1. Syndromes associated with malformations of the fetal radius

Syndrome	FREQUENT		OCCASIONAL
Thrombocytopenia-radius absent syndrome			
ABSCENCE			HYPOPLASIA
Holt-Oram syndrome	Bilateral	NA	NA
Sirenomelia syndrome	NA		
Nager syndrome	NA	NA	Dysgenesis
Roberts syndrome	X	X	Hypoplasia and abscence
Morh syndrome	X	X	
Club-hand deformity	X	X	
Nail-patella síndrome	NA	NA	Congenital radial head dislocation
Fanconni Anemia	X	X	
Ellis–van Creveld	NA	NA	Hypoplasia
Rothmund-Thomson síndrome	NA	NA	Hypoplasia
Trisomy 18 syndrome	NA	NA	Hypoplasia
Baller-Gerold syndrome	X	X	NA
VACTERL síndrome	X	X	NA

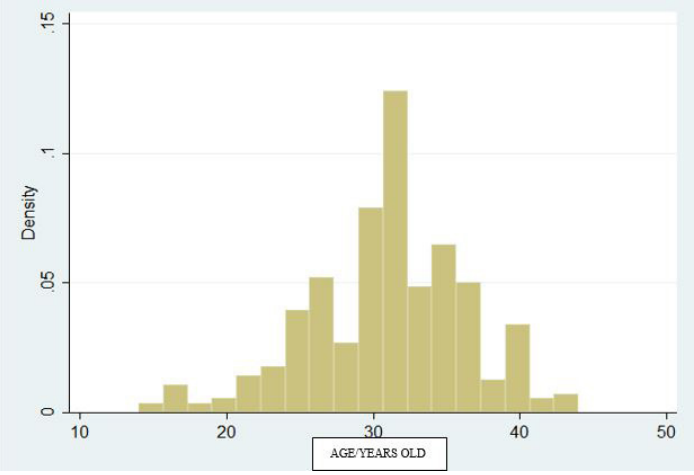

Figure 3: Histogram of maternal age expressed in years.

Table 2: Description of the morphological characteristics of the fetuses.

	N	Average	S.D	Min	Max
CRL	334	64.27	9.34	46	84
BPD	334	20.53	3.08	13	26.8
HC	334	64.46	15.45	33.6	96.9
AC	332	62.03	9.1	41.2	87
HL	334	8.04	5.12	1.9	13.4
Pr	334	5.91	1.96	0.8	11.1

14.1.0) where the patient's identification data was tabulated, including name, unique identification number, maternal age, gestational age, crown-rump length (CRL), radial length (RL), abdominal circumference (AC), head circumference (HC), humeral length (HL), femoral length (FL), thumb visibility, proximal radius (Pr) and distal radius (Dr). The construction of the percentile table was carried out from the measurement of the proximal radius due to the refraction and attenuation phenomena of the ultrasound beam on the distal radius.

Descriptive statistics were applied and the frequency of the patients according to their gestational age was calculated by CRL. The mean, median, standard deviation, minimum and maximum of the variables proximal radius (Pr), distal radius (Dr), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femoral length (FL), and age in years of the patients with the STATA 10.1 software with a significant p less than 0.005. For the proximal fetal radius, the 5%, 10%, 25%, 50%, 75%, 90%, and 95% percentiles were calculated and the graph of the percentiles curve by gestational age was made.

Dispersion graphs were obtained between the proximal radius and the variables BPD, HC, AC, FL, HL, and Dr Spearman's rank correlation coefficient was applied for each comparison.

RESULTS

A total of 334 patients were studied, all of whom met the inclusion criteria of having 11 to 13+6 weeks of gestation, at week 11 (n=42), at week 12 (n=167), at week 13 (n=105), and week 13+6 (n=20) (Figure 2).

The mothers were on average 30.8 years old with a median of 31 years and an SD of 5.4 years, with a minimum of 14 years and a maximum of 44 years (Figure 3).

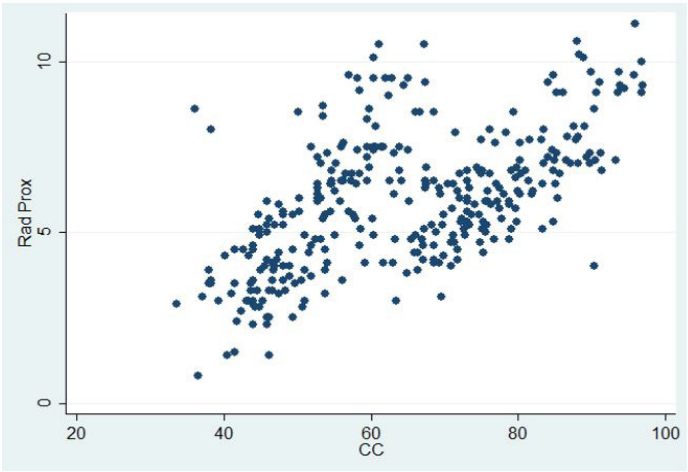

Figure 4: Scatter plot between the proximal radius and CC (head circumference).

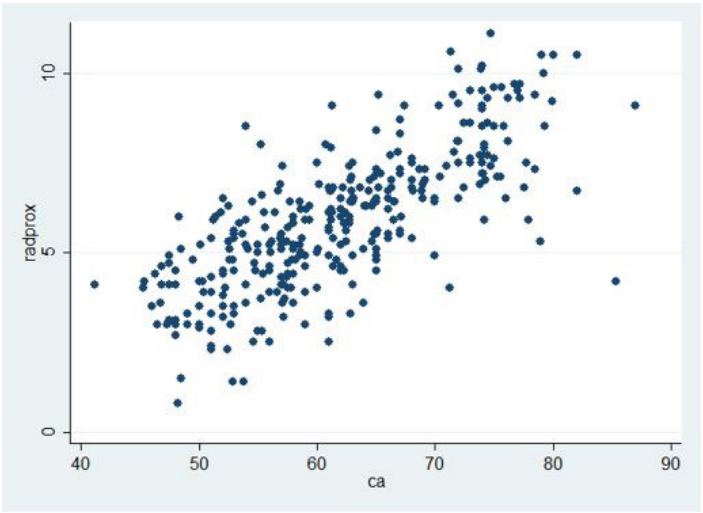

Figure 5: Scatter plot between the proximal radius and AC (abdominal circumference)

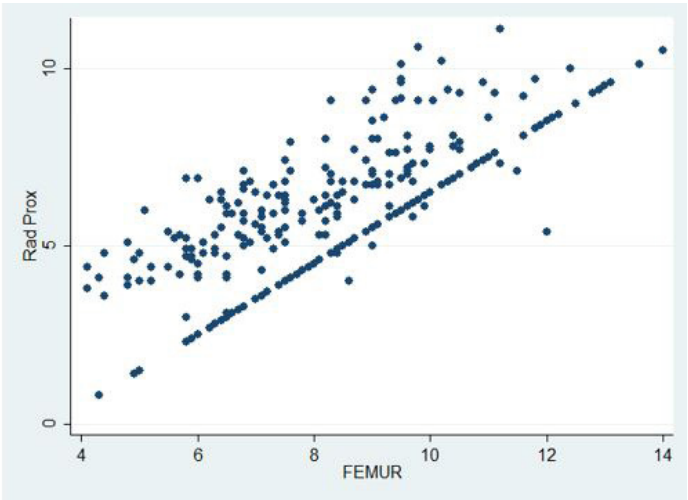

Figure 6: Scatter plot between the proximal radius of the fetal femur.

The CRL had a minimum of 46 with a maximum of 84 and an average of 64.2 with an SD of 9.35. The Dr had a minimum of 0.29 with a maximum of 10.7 and an average of 5.21 with SD 1.7. The HL had a minimum of 1.9 with a maximum of 13.9 and an average of 7.7 with SD 2.14. The FL had a minimum of 4.1 with a maximum of 14 and an average of 8.35 with SD 1.97. The AC had a minimum of 13.7 with a maximum of 87 and an average of 61.5

with SD 9.7. The Pr had a minimum of 0.8 with a maximum of 11.1 and an average of 5.9 with SD 1.9. The HC had a minimum of 96.9 with a maximum of 33.6 and an average of 64.4 with SD 15. The BPD had a minimum of 13 with a maximum of 26 and an average of 20.5 with SD 13. Table 1 describes the morphological characteristics of the studied fetuses, the average CRL was 64.2 mm and the average proximal radius was 5.9 mm (Table 2).

The correlation coefficient for BPD was 0.79, for HC it was 0.58, for AC it was 0.76, for HL it was 0.87, for FL it was 0.77 and for Dr it was 0.955 (Table 3 - Figures 4 to 9).

According to the box and whisker plot (Figure 10), the 50th percentile for week 11 of the Pr is 3.9 mm, for week 12 it is 5.2 mm, for week 13 it is 7.2 mm and for week 14 is 8.8 mm.

In the graph of percentiles by gestational age of the proximal radius length, the 5% and 95% percentiles for week 11 were 1.4 and 5.88 mm, for week 12 it was 2.94 and 7.5 mm; for week 13 it was 4.66 and 9.91mm and for week 14 it was 6,515 and 11.07 mm

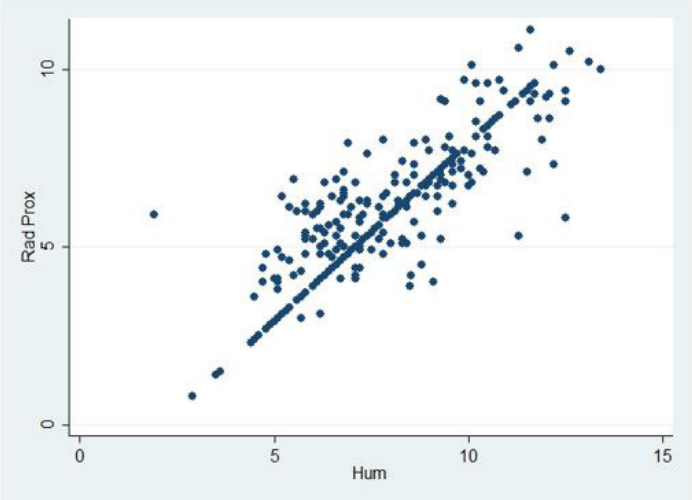

Figure 7: Scatter plot between proximal radius and hum (humeral length)

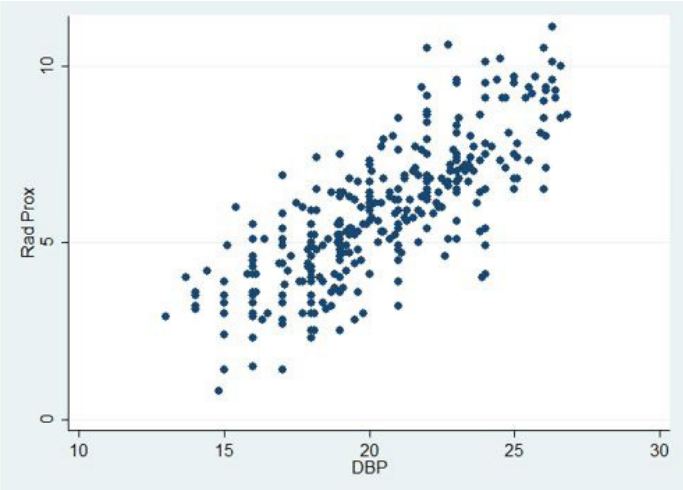

Figure 8: Scatter plot between the proximal radius and DBP (biparietal diameter)

respectively (Table 4).

DISCUSSION

The ultrasound evaluation of fetal long bones is a useful, precise, practical, and repeatable method that allows an approach, together with other biometric variables, to precision in the calculation of gestational age 18.

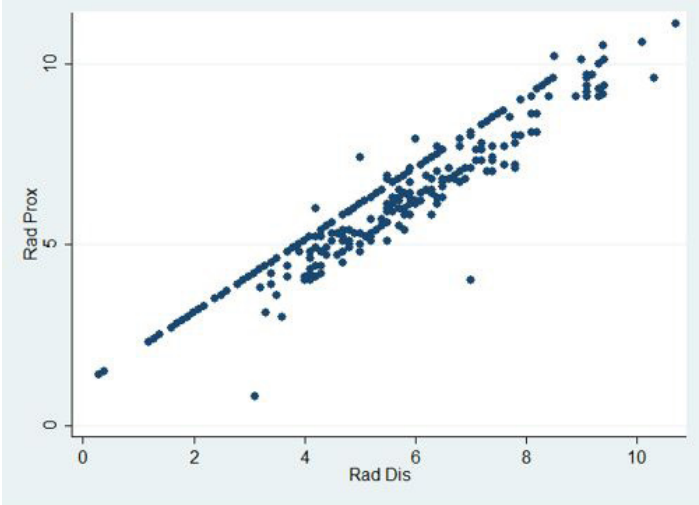

Figure 9: Scatter plot between proximal radius and radius of (distal radius)

Table 3. Spearman's correlation coefficients of the proximal radius with the different variables.

	Coefficient	p-value
HC	0,58	<0.0001
BPD	0,79	<0.0001
AC	0,76	<0.0001
HL	0,80	<0.0001
FL	0,77	<0.0001
Dr	0,95	<0.0001

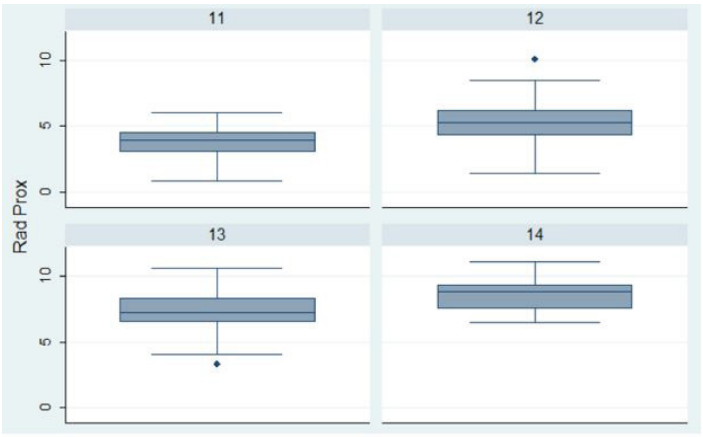

Figure 10: Box plot. Proximal radius in relation to gestational age in weeks.

Table 4: Table of percentiles of fetal radius length (mm) by a week of gestational age

Rp percentiles by weeks	5%	10%	25%	50%	75%	90%	95%
11 weeks	1,41	2,3	3	3,9	4,525	5,2	5,88
12 weeks	2,94	3,3	4,2	5,2	6,2	6,82	7,5
13 weeks	4,66	5,46	6,5	7,2	8,4	9,54	9,91
14 weeks	6,515	6,85	7,5	8,8	9,375	10,5	11,07

Recently, the importance of fetal anatomical evaluation in the early stages of development has increased as part of the genetic diagnostic ultrasound performed between weeks 11 and 13 + 6 of gestational age, so it is important to know what the behaviour of the length of the fetal long bones in this period and thus make an approach to pathologies in utero. Considering that radius has a high association with different clinical syndromes, it is justified to include its characterization in the ultrasound screening assessment. The World Health Organization (WHO) agrees with the construction of local values that allow a better clinical approach to the evaluation of fetal growth behaviour [18-21].

Curves of normal behaviour have been established for the length of the fetal radius in previous studies in the European population, however, they do not include measurements at week 11 of gestation with sample sizes for the period of interest lower than those obtained in our study. Due to ethnic differences, data cannot be extrapolated to the Latin American population. To our knowledge, there are no reports of reference values in the obstetric ultrasound of fetal long bones from week 11 to week 13+6 in the Latin population18. Chitty et al. in 2002 carried out a cross-sectional study measuring the bone length of different extremities including 30 measurements of the radial bone in fetuses of European origin from week 12 to week 14 of gestation; These authors reported normality tables in the 10th, 50th, and 90th percentiles with values of 3.3, 5.5 and 7.8 for week 12; 5.9, 8.2 and 10.5 for week 13 and 8.7, 11.0 and 13.4 for week 14 respectively4. Exacoustos et al. in an Italian study, in 1991, analyzed 2317 pregnant women who underwent routine ultrasounds from week 13 to the 40th week of gestation; Measurements were made in 2186 fetal radius, reporting normality curves for these, however, the minimum gestational age for the evaluation of the fetal radius was 15 weeks, a gestational age that exceeds our study objective [5].

Concerning previous studies that report radial length for week 12 to week 13+6, our study managed to collect a significantly higher sample than that of the published literature and include measurements at the 11th week of gestation, where we found that the behaviour of the distribution in 10th, 50th and 90th percentiles are similar to the findings previously reported for weeks 12 and 13, however, we observed an increase in the radial length of previous studies at week 13+6 compared to our study, probably due to the mentioned ethnic differences, in addition to observing an increase in radial length as gestational age advances [4, 5].

The sample size of our study is considered a weakness to determine a normal distribution pattern at the population level, however, the description of the behaviour of the length of the fetal radius of our population provides valuable information for medical knowledge and possible future studies because of the lack of information in the literature that includes the evaluation of the fetal radius in early stages of pregnancy with a sample like ours. On the other hand, the greatest strength of the study is based on the fact that this information was obtained from the Latin American population.

Establishing the distribution values of the fetal radius length in the early gestation period will serve as a precedent for subsequent studies that increase the number of the sample and thus be able to determine a normal distribution pattern of the behaviour of the fetal radius length as a tool for ultrasound screening, useful information that anticipates the patient's medical and emotional needs of their social environment that serves as the basis for antenatal counselling for treating doctors and relatives of fetuses with abnormalities detected in utero.

References

1. Nicolaides K. Turning the Pyramid of the Prenatal Care. Fetal Diagn Ther 2011; 29:183-96.
2. Chitayad D, Langlois S, Wilson RD. Prenatal screening for fetal aneuploidy in singleton pregnancies. J Obstet Gynaecol Can 2011; 7: 736-50.
3. Salomón LJ, Alfirevic Z, Bilardo CM. ISUOG practice guidelines: performance of first-trimester fetal ultrasound scan. Ultrasound Obstet Gynecol 2013;41(1):102-13.
4. Chitty LS, Altman DG, Chitty L, Douglas G. Charts of fetal size: limb bones. BJOG 2002; 109(8): 919-29.
5. Azpilcueta J, Dominguez LP, Rivera-Hoyos AM, Tellez SE. Sindrome de Rothmund Thompson (Poiquilodermia atrófica congénita) en mujeres gestantes. Clin Invest Ginecol Obstet 2011; 38: 244-55.
6. Avina JA, Colonnelli G. Sindrome de Holt-Oram asociado con anomalías faciales, Informe de un caso. Rev Med Int Mex Seguro Soc 2010: 48 (6): 657-65.
7. Boute O, Depret-Mosser S, Vinatier D, Manouvrier S, de Lassale EM, Farriaux JP. Prenatal Diagnosis of Thrombocytopenia Absent Radius Syndrome. Fetal Diagn Ther 1996; 11: 224–30.
8. Tongsong T, Sirichotiyakuy S, Champrapaph P. Prenatal diagnosis of thrombocytopenia absent radius syndrome. Ultrasound Obstetrics and Gynecology. 2000; 15 (3): 256-8.
9. Salomon BD. VACTERL/VATER Association. Orphanet J Rare Dis. 2011; 6: 56.
10. Avína-Fierro JA, Colonnelli-Barba G. Síndrome de Holt Oram asociado con anomalías faciales. Informe de un caso. Rev Med Int Mex Seguro Soc 2010; 48 (6): 657-9.
11. Dugoff L, Thieme G, Hobbins JC. First-trimester prenatal diagnosis of chondroectodermal dysplasia (Ellis–van Creveld syndrome) with ultrasound. Ultrasound Obstet Gynecol 2001; 17: 86–8
12. Witters I, Claerhout P, Fryns P. Increased nuchal translucency thickness in thrombocytopenia-absent-radius syndrome. Ultrasound Obstet Gynecol 2005; 26 (5): 581-2.
13. Sorolla JP. Anomalías craneofaciales. Rev Med Clin Condes 2010; 21(1): 5-15.
14. Sepúlveda W, Be C, Youlton R, Gutierrez J, Carstens E, Sanchez J. Trisomía 18: diagnóstico Citogenético prenatal y hallazgos ultrasonográficos. Rev Chil Ultrason 1999; 2 (2): 48-54
15. Sanchez-Segura M, Marsán-Suarez V, Macías-Abraham C, et al. Síndrome de Roberts asociado con inmunodeficiencia. Rev Cubana Hematol Inmunol Hemoter 2012; 28(2): 185-91.
16. Exacoustos C, Rosati P, Rizzo G, Arduini D. Ultrasound measurements of fetal limb bones. Ultrasound Obstet Gynecol 1991; 1(5): 325-30.
17. Queenan JT, O'Brien GD, Campbell S. Ultrasound measurement of fetal limb bones. Am J Obstet Gynecol 1980; 138(3): 297-302.
18. Molina S, Romero N, Franco A. Valores de referencia de la biometría en los huesos largos fetales entre las semanas 18 y 39 de gestación en la población colombiana. Rev Colomb Obstet Ginecol 2012; 63 (1): 11-6.
19. Bland JM, Altman DG. Applying the right statistics: analyses of measurement studies. Ultrasound Obstet Gynecol 2003; 22: 85-93.
20. Ministerio de Salud de Colombia. Resolución No 008430 de 4 de

Octubre de 1993: 1- 12.

21. Borghi E, de Onis M, Garza C. For the WHO Multicentre Growth Reference Study Group. Construction of the World Health Organization child growth standards: selection of methods for attained growth curves. Stadistics Medicine 2006; 25: 247-65.