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Original Research

Finding the best formulas to estimate fetal weight based on ultrasound for the Turkish population: a comparison of 24 formulas

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Background: Although prenatal diagnosis of fetal weight is a very important parameter that guides the clinician, the margin of error in fetal weight is still very high. *Aims*: The aim of this study is to identify the most accurate sonographic formulas for fetal weight estimation in general and specific gender subgroups of the Turkish population. *Method*: This study is a prospective study conducted with the term 160 pregnant women who had cesarean indication and hospitalized to give birth by a cesarean section. The actual birth weight of newborn babies and the estimated fetal weights obtained with 24 formulas were compared. Additionally, the data obtained were separated according to the gender of the newborns and the most appropriate formulas for fetal gender were tried to be determined separately. *Results*: The lowest Root Mean Square Error (RMSE) values which are the best indicator of success to predict were obtained as 301.8 gr, 284.9 gr and 304.4 gr with the formula of Schild *et al.* Male for all, the formula of Schild *et al.* Female for male fetuses and the formula of Campbell and Wilkinfor female fetuses, respectively. *Conclusion*: The formulas of Schild *et al.* Male , Schild *et al.* Female, and Campbell and Wilkin were selected as the best formulas for all fetuses, male fetuses and female fetuses, respectively, for estimating fetal weights in Turkish population.

Keywords

Fetal weight estimation; Birth weight; Fetal weight formulas; Foetal weight; Prenatal ultrasonography; Obstetric ultrasound

1. Introduction

The accurate estimating of fetal weight at the prenatal period is very important because of the fact that the fetal weight can indicate the level of intrauterine well-being and the probability of survival of the fetus. Detection of small for gestational age (SGA) or large for gestational age (LGA) fetuses in the prenatal period helps obstetricians to decide about the patient. In this way, mortality and morbidity can be reduced [1–5].

From this viewpoint, the fetal weight estimation that is closest to the real is a very crucial subject in order that physicians can make the right decisions and select the right management option. Therefore, researchers have proposed numerous formulas based on the ultrasonography parameters in the literature from the 1970s to the present. The most part of these Fetal Weight Estimation Formulas in the literature generally depends on one, a few or all of the ultrasonographic parameters that are named as abdominal circumference (AC), biparietal diameter (BPD), femur length (FL), head circumference (HC) and transverse abdominal diameter (TAD). Some formulas developed between the years of 1975 and 1993 can be given as Campbell and Wilkin [6], Warsof *et al.* [7], Higginbottom *et al.* [8], Shepard *et al.* [9], Thurnau *et al.* [10], Hadlock V [11], Hadlock VI [11], Hadlock I [12], Hadlock II [12], Hadlock III [12], Hadlock IV [12], Weiner I [13], Weiner II [13], Woo *et al.* [14], Ott *et al.* [15], Rose and McCallum [16], Vintzileos *et al.* [17], Merz I [18], Merz II [18] and Combs [19]. Also, some formulas proposed between the years of 2004 and 2019 can be given as Schild *et al.*—Female [20], Schild *et al.*—Male [20], Hart *et al.* [21], Munim *et al.* [22], Esinler *et al.* [23], Chen *et al.* [24], Lima *et al.* [25] and Hiwale *et al.* [26].

Furthermore, there are also many studies that aim to find the best formula for any country or region by comparing different formulas in the literature. Some of these studies are Siemer *et al.* [27], Hasenoehrl *et al.* [4], Hoopmann *et al.* [28], Campell *et al.* [6], Esinler *et al.* [29], Hiwale *et al.* [3].

Siemer *et al.* [27], Hasenoehrl *et al.* [4], and Esinler *et al.* [29] were compared some formulas for both fetuses with birth weight (BW) less than 2500 and more than 4000 gr. Hoopmann [28] compared the formulas of macrosomic fetuses. Some of the studies are population-based.

Siemer *et al.* [27], Hasenoehrl *et al.* [4] and Hoopmann *et al.* [28] studied at Germany population, Campell *et al.* [6] for the Australian population, Esinler *et al.* [29] for Turkish population, Hiwale *et al.* [3] for the Indian population, etc.

The aim of this study is to find the most accurate formula for the Turkish population based on gender. We compared the 24 formulas for this purpose. 24 compared formulas are given in Table 1 (Ref. [6–13, 15–21, 23, 26]).

Table 1. 24 FEW formulas compared in this Study.

Articles	Parameters	Formulas
Schild *et al.*—Male [20]	AC, BPD, FL, HC	$43576.579 + 1913.853 \times \log_{10}(0.1 \times \mathrm{BPD}) + 0.00001323 \times \mathrm{HC}^3 + 0.55532\times$ $\mathrm{AC}^2 + 13602.664 \times \sqrt{0.1 \times \mathrm{AC}} - 0.000721 \times \mathrm{AC}^3 + 0.00231 \times \mathrm{FL}^3(\mathrm{gr,mm})$
Campbell and Wilkin [6]	AC	$1000 * e^{-4.564+0.0282\times\mathrm{AC}-0.0000331\times\mathrm{AC}^2}(\mathrm{gr,mm})$
Schild *et al.*—Female [20]	AC, BPD, FL	$-4035.275 + 0.001143 \times BPD^3 + 1159.878 \times \sqrt{0.1 \times AC} + 0.010079 \times FL^3-$ $0.81277 \times FL^2(\mathrm{gr,mm})$
Esinler *et al.* [23]	AC, FL	$-1073.4 + 0.016 \times AC^2 + 0.371 \times FL + 20.187 * \left(\frac{AC}{FL}\right)^2$
Hadlock III [12]	AC, BPD, FL	$10^{1.335-0.000034\times AC\times FL+0.00316\times BPD+0.0457\times AC+0.0163\times FL}(\mathrm{gr,mm})$
Hadlock II [12]	AC, FL	$10^{1.304+0.00004\times AC\times FL+0.005281\times AC+0.01938*FL}(\mathrm{gr,mm})$
Hadlock I [12]	AC, BPD, FL, HC	$10^{1.3596+0.00064\times HC+0.00424\times AC+0.0174\times FL+0.0000061\times BPD\times AC-0.0000386\times AC\times FL}(\mathrm{gr,mm})$
Hadlock VI [11]	AC	$e^{2.695+0.0253\times AC-0.0000275\times AC^2}(\mathrm{gr,mm})$
Hadlock IV [11]	AC, FL, HC	$10^{1.326-0.0000326\times AC\times FL+0.00107\times HC+0.0438\times AC+0.0158\times FL}(\mathrm{gr,mm})$
Ott *et al.* [15]	AC, FL, HC	$10^{0.9337+1.2594\times\frac{FL}{AC}+0.004355\times AC+0.005394\times AC-0.000008582\times HC\times AC}(\mathrm{gr,mm})$
Combs *et al.* [19]		$0.00023718 \times AC^2 \times FL + 0.00003312 \times HC^3(\mathrm{gr,mm})$
Merz II [18]	AC, BPD	$-3200.40479 + 15.707186 \times AC + 0.1590391 \times BPD(\mathrm{gr.mm})$
Rose and McCallum [16]	TAD, BPD, FL	$e^{4.198+0.0143\times(BPD+TAD+FL)}(\mathrm{gr,mm})$
Warsof *et al.* [7]	AC, BPD	$10^{1.401+0.0144\times BPD+0.0032\times AC-0.000000111\times AC\times BPD^2}(\mathrm{gr,mm})$
Higginbottom [8]	AC	$0.0000816 \times AC^3(\mathrm{gr,mm})$
Hadlock V [12]	HC, AC, FL	$1000 \times (1.5622 - 0.00108 \times HC + 0.00468 \times AC + 0.0171 \times FL + 0.00000\times$ $HC^2 - 0.00003685 \times AC \times FL)(\mathrm{gr,mm})$
Shepard *et al.* [9]	AC, BPD	$10^{-1.7492+0.0166\times BPD+0.0046\times AC-0.00002546\times AC\times BPD}(\mathrm{gr,mm})$
Vintzileos *et al.* [17]	AC, BPD	$10^{1.879+0.0084\times BPD+0.0026\times AC}(\mathrm{gr,mm})$
Hivale *et al.* [26]	AC, FL, HC	$10^{2.78437+0.000004197\times HC\times AC+0.000008545\times AC\times FL}(\mathrm{gr,mm})$
Weiner II [13]	AC, FL, HC	$10^{1.6961+0.002253\times HC+0.001645\times AC+0.006439\times FL}(\mathrm{gr,mm})$
Thurnau *et al.* [10]	AC, BPD	$-229.076 + 0.09337 \times AC \times BPD(\mathrm{gr,mm})$
Weiner I [13]	AC, HC	$10^{1.6575+0.004035\times HC+0.001285\times AC}(\mathrm{gr,mm})$
Merz I [18]	AC	$0.0001 \times AC^3(\mathrm{gr,mm})$
Hart *et al.* [21]	MW, HC, AC, FL	$e^{7.638+0.000295\times MW(kg)+0.0000395\times HC+0.0000524\times AC+0.000487\times FL}(\mathrm{gr,mm})$

AC, Abdominal circumference; BPD, Biparietal diameter; FL, Femur length; HC, Head circumference (HC); TAD, Transverse abdominal diameter.

2. Materials and methods

This study was planned prospectively in a tertiary hospital between 1 April 2019 and 1 October 2019. 160 pregnant women who were term pregnant and had a cesarean indication hospitalized to give birth by cesarean included in the study. All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Hitit University (approval number: 069). This study included pregnant women with a single pregnancy, between 38 and 40 weeks, without a known fetal anomaly, without communication problems, and who wanted to participate in the study. After obtaining informed consent from the pregnant women, the sociodemographic information was recorded on the prepared form. Afterward, Hitachi HI Vision Preirus ultrasound system with Convex probe (8–4 Mhz) was performed using ultrasound and AC (Abdominal circumference), BPD (Biparietal diameter), FL (Femur length), HC (Head circumference) and TAD (Transverse abdominal diameter) measurements were taken. In addition, the location of the placenta, placental dimensions in 3 planes, and umbilical cord thickness were recorded. BPD was measured at the section of cavum septum pellucidum and falx cerebri plane and the cursors were placed outside to inside. HC was measured from the outside of the cranial bones in the same plane as the BPD. AC and TAD were measured at the level of where the umbilical vein passed through the liver and symmetrical rib images seen. FL was measured vertically from metaphysis to metaphysis.

All of the patients gave birth by cesarean on the day of the ultrasound examination. The newborns were weighted with an electronic machine immediately after the delivery. The baby's birth weight is recorded in the patient file.

In this study, the main accuracy measurement was determined as the root mean square error (RMSE). Therefore, the formulas that could calculate fetal weight estimations with the lowest RMSE values were selected as the best FWE (fetal weight estimation) formulas. In addition, the lowest mean error (ME), the lowest mean percentage error (MPE), the lowest average percentage error (MPE), the highest Pearson correlation (r), and deviations from ABW (Actual birth weight) ±5%, ±10%, and ±15% were used to find the best formulas. Calculations were made by Using Matlab, SPSS, and Excel. Formulations of RMSE, ME, MPE, and MAPE

Table 2. Demographics and ultrasound characteristics of the studied sample (n = 160).

Variable	Mean ± SD
Maternal age (yr)	29.96 ± 4.87
Gestational age (wk)	38.56 ± 1.23
Biparietal diameter (cm)	9.29 ± 0.36
Abdominal circumference (cm)	33.98 ± 1.82
Head circumference (cm)	33.04 ± 1.28
Femur length (cm)	7.35 ± 0.30
Actual birth weight (gr)	3327.13 ± 401.62
Interval between ultrasound scan and delivery (dy)	0.00 ± 0.00

are given below, respectively.

$$\mathrm{RMSE} = \sum_{i=1}^{n} \frac{(\mathrm{FWE_i} - \mathrm{ABW_i})^2}{n} \tag{1}$$

$$\mathrm{ME} = \sum_{i=1}^{n} \frac{(\mathrm{FWE_i} - \mathrm{ABW_i})}{n} \tag{2}$$

$$\mathrm{MPE} = \sum_{i=1}^{n} \left(\frac{\mathrm{FWE_i} - \mathrm{ABW_i}}{\mathrm{ABW_i}} \right) \times 100 \tag{3}$$

$$\mathrm{MAPE} = \sum_{i=1}^{n} \left| \frac{\mathrm{FWE_i} - \mathrm{ABW_i}}{\mathrm{ABW_i}} \right| \times 100 \tag{4}$$

Eqns. 1,2,3,4, $\mathrm{FWE_i}$, $\mathrm{ABW_i}$, and $|.|$ indicate fetal weight estimation of i^{th} baby, actual birth weight of i^{th} baby and the absolute value, respectively.

3. Results

Some of the demographic information of patients and some values of ultrasound parameters are given in Table 2.

For all fetuses in this study, statistics of RMSE, MAPE, MPE, and Pearson's r are given in Table 3 (Ref. [6–13, 15–21, 23, 26]) and the 5%, 10%, and 15% deviations from actual birth weight are given in Table 4 (Ref. [6–13, 15–21, 23, 26]) respectively. In Table 3, the formula of Schild *et al.*—Male [20] was the best formula in estimating fetal weight for all fetuses based on having the lowest RMSE. Furthermore, estimations obtained from the formula of Schild *et al.*—Male [20] had the lowest RMSE with the value of 301.8 gr, the lowest MAPE with the value of 7.2% ± 5.8 and the highest percentages of estimations within the 5% and the 10% ranges of ABW with the values of 43.1% and 76.9%, respectively, as shown in Table 3 and Table 4. Furthermore, estimations obtained from the formula of Schild *et al.*—Male [20] had a great percentage of estimations within the 15% range of ABW and pretty small values for each of MPE% and ME. The charts of FWE calculated by using the formula of Schild *et al.*—Male [20] and ABW were comparatively given in Fig. 1 for all fetuses. It can be shown in Fig. 1 that estimations obtained by using the formula of Schild *et al.*—Male [20] were quite close to ABW values.

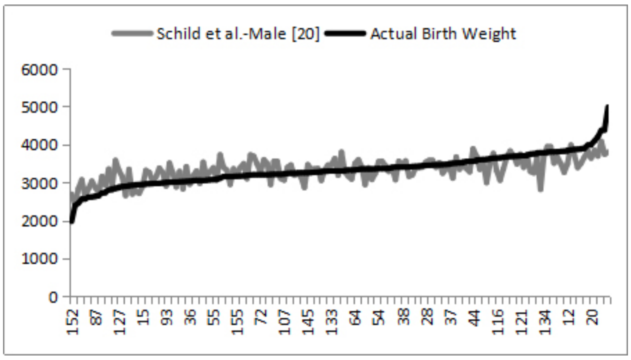

Fig. 1. The graphs of FWE of Shild *et al.*—Male [20] and ABW for all fetuses.

In Table 3 and Table 4, formulas of Campel and Wilkin [6], Schild *et al.*—Female [20], Esinler *et al.* [23], Hadlock III [12], Hadlock II [12], Hadlock I [12], Hadlock VI [11], Hadlock IV [11], Ott *et al.* [15] and Combs *et al.* [19] were ranked as the sufficient formulas in estimating fetal weight based on having the low RMSE. Among these formulas, the formula of Esinler *et al.* [23] had the lowest MAPE with the value of 7.2% ± 5.6%, the formula of Hadlock I [12] had the lowest MPE with the value of 0.3% ± 9.8% and the lowest ME with the value of -4.5 gr ± 320.7 gr, the formula of Schild *et al.*—Female [20] had the highest percentage of estimations within the 15% range of ABW with the value of 91.9% and Pearson's r value between estimations obtained from the formula of Hadlock III [12] and ABW had the highest correlation with the value of 0.701.

Additionally, insufficient formulas in estimating fetal weight could be seen in Table 3 and Table 4. The formulas of Thurnau *et al.* [10], Weiner I [13], Merz I [18], and Hart *et al.* [21] were classified as very insufficient formulas in estimating fetal weight for Turkish population.

For male fetuses in this study, statistics of RMSE, MAPE, MPE, and Pearson's r are given in Table 5 (Ref. [6–13, 15–21, 23, 26]) and the deviations 5%, 10%, and 15% deviations from actual birth weight are given in Table 6 (Ref. [6–13, 15–21, 23, 26]), respectively. In Table 5, the formula of

Table 3. The values of RMSE, MAPE, MPE, ME and Pearson's r of the formulas for all fetuses (n = 160).

	Formulas	RMSE	MAPE (%)	MAPE (CI%)	MPE (%)	MPE (CI%)	ME	ME (CI)	r
The Best	Schild *et al.*–Male [20]	**301.8**	**7.2 ± 5.8**	**6.4–8.1**	−0.9 ± 9.2	(−0.5)–2.4	6.6 ± 302.7	(−40.6)–53.9	0.665
Sufficient	Campbell and Wilkin [6]	306.6	7.3 ± 5.7	6.4–8.1	−0.5 ± 9.2	(−1.9)–1.0	−37.6 ± 305.2	(−85.3)–10.0	0.668
	Schild *et al.*–Female [20]	306.6	7.3 ± 5.7	6.4–8.1	−1.3 ± 9.1	(−2.7)–0.2	−62.6 ± 301.1	(−109.6)–(−15.6)	0.670
	Esinler *et al.* [23]	312.6	**7.2 ± 5.6**	**6.3–8.1**	−2.7 ± 8.7	(−4.0)–(−1.3)	−109.2 ± 293.9**	(−155.1)–(−63.3)	0.691
	Hadlock III [12]	316.1	7.7 ± 6.0	6.7–8.6	1.6 ± 9.6	0.1–3.2	39.6 ± 314.6	(−9.5)–88.7	**0.701**
	Hadlock II [12]	316.1	7.5 ± 6.2	6.5–8.4	1.3 ± 9.6	(−0.2)–2.8	28.9 ± 315.8	(−20.4)–78.2	0.694
	Hadlock I [12]	319.8	7.7 ± 6.0	6.8–8.7	**0.3 ± 9.8**	**(−1.2)–1.9**	**−4.5 ± 320.7**	**(−54.5)–45.6**	0.689
	Hadlock VI [11]	322.1	7.6 ± 6.3	6.6–8.6	1.0 ± 9.8	(−0.6)–2.5	15.7 ± 322.8**	(−34.7)–66.1	0.680
	Hadlock IV [11]	325.6	7.8 ± 6.0	6.9–8.8	−0.7 ± 9.9	(−2.2)–0.9	−37.0 ± 324.5	(−87.6)–13.7	0.677
	Ott *et al.* [15]	325.6	7.9 ± 6.1	6.9–8.8	−0.7 ± 9.9	(−2.2)–0.9	−40.4 ± 324.1	(−91.0)–10.2	0.663
	Combs *et al.* [19]	333.9	8.0 ± 6.0	7.0–8.9	−2.6 ± 9.6	(−4.1)–(−1.1)	−106.4 ± 317.5**	(−155.9)–(−56.8)	0.660
Insufficient	Merz II [18]	355.4	8.9 ± 7.5	7.7–10.1	6.2 ± 9.9	4.7–7.7	183.0 ± 305.7	135.2–230.7	0.679
	Rose and McCallum [16]	372.0	10.7 ± 6.7	8.0–10.1	2.6 ± 11.0	0.9–4.4	78.3 ± 364.8**	21.4–135.3	0.689
	Warsof *et al.* [7]	372.2	8.8 ± 6.8	7.7–9.8	−3.9 ± 10.4	(−5.5)–(−2.3)	−142.5 ± 344.9**	(−196.4)–(−88.6)	0.665
	Higginbottom [8]	402.8	9.6 ± 7.2	8.5–10.7	−2.8 ± 11.7	(−4.6)–(−1.0)	−98.4 ± 391.9**	(−159.6)–(−37.2)	0.669
	Hadlock V [12]	406.1	10.4 ± 9.5	8.9–11.9	6.7 ± 12.4	4.8–8.7	175.6 ± 367.4**	118.3–233.0	0.675
	Shepard *et al.* [9]	466.0	11.5 ± 8.9	10.2–12.9	8.3 ± 12.0	6.5–10.2	264.4 ± 385.0**	204.3–324.5	0.664
	Vintzileos *et al.* [17]	469.8	11.1 ± 8.9	9.8–12.5	6.3 ± 12.8	4.3–8.3	203.6 ± 424.7**	137.2–269.9	0.669
	Hivale *et al.* [26]	478.0	11.8 ± 7.2	10.7–12.9	−10.3 ± 9.2	(−11.7)–(−8.8)	−355.9 ± 320.1**	(−405.9)–(−305.9)	0.664
	Weiner II [13]	487.8	11.9 ± 7.8	10.7–13.2	−9.5 ± 10.6	(−11.2)–(−7.9)	−327.9 ± 362.3**	(−384.4)–(−271.3)	0.638
Very Insufficient	Thurnau *et al.* [10]	677.5	17.8 ± 7.2	16.7–19.0	−17.6 ± 7.8	(−18.8)–(−16.4)	−607.0 ± 301.9**	(−654.1)–(−559.8)	0.663
	Weiner I [13]	736.4	19.1 ± 9.9	17.5–20.6	−18.2 ± 11.4	(−20.0)–(−16.5)	−619.5 ± 399.4**	(−681.9)–(−557.2)	0.542
	Merz I [18]	788.9	19.9 ± 13.3	17.8–22.0	19.1 ± 14.4	16.9–21.4	629.7 ± 476.7**	555.24–704.12	0.669
	Hart *et al.* [21]	1128.1	31.0 ± 7.9	29.7–32.2	−30.75 ± 8.63	(−32.1)–(−29.4)	−1056.6 ± 396.6**	(−1118.5)–(−994.7)	0.478

CI, confidence interval; MAPE, mean absolute percentage error; MPE, mean percentage error; ME, Mean error.

** significant at 0.01 significance level (Null Hipotesis is ME = 0 and Alternative Hipotesis is $ME \neq 0$).

Schild *et al.*—Female [20] was the best formula in estimating fetal weight for male fetuses based on having the lowest RMSE. Estimations obtained from the formula of Schild *et al.*—Female [20] had the lowest RMSE with the value of 284.8 gr, the lowest MAPE with the value of 6.6% ± 5.0%, the highest percentages of estimations within the 5%, 10%, and 15% ranges of the actual birth weight with the values of 50.6%, 79.0%, 96.3%, respectively, as shown in Table 5 and Table 6. Furthermore, estimations obtained from the formula of Schild *et al.* Female [20] had pretty small values for each of MPE% and ME. The charts of FWE calculated by using the formula of Schild *et al.* Female [20] and ABW were comparatively given in Fig. 2 for male fetuses. It can be shown in Fig. 2 that estimations obtained by using the formula of Schild *et al.* Female [20] are quite close values to ABW values for male fetuses.

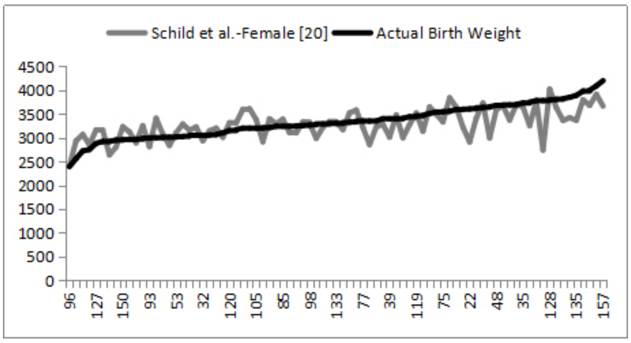

Fig. 2. The graphs of FWE of Shild *et al.*—Female [20] and ABW for boy fetuses.

In Table 5 and Table 6, the formulas of Schild *et al.*—Male [20], Hadlock III [12], Hadlock I [12], Ott *et al.* [15], Campel and Wilkin [6], Esinler *et al.* [23], Hadlock IV [11], Hadlock II [12], Combs *et al.* [19], Hadlock VI [11], Rose and McCallum [16], Warsof *et al.* [7] and Merz II were ranked as the sufficient formulas in estimating fetal weight for male fetuses based on having the low RMSE. Among these formulas, the formula of Hadlock I [12] had the lowest MPE with the value of 0.2% ± 9.0% and the lowest ME with the value of -5.6 ± 305.9 and Pearson's r value between estimations obtained from the formula of Rose and McCallum [16] and ABW had the highest correlation with the value of 0.663.

Additionally, insufficient formulas in estimating fetal weight could be seen in Table 5 and Table 6. Also, the formulas of Thurnau *et al.* [10], Weiner I [13], Merz I [18], and Hart *et al.* [21] were classified as very insufficient formulas in estimating the fetal weight of male fetuses for the Turkish population.

For female fetuses in this study, statistics of RMSE, MAPE, MPE, and Pearson's r are given in Table 7 (Ref. [6–13, 15–21, 23, 26]) and the deviations 5%, 10%, and 15% deviations from actual birth weight are given in Table 8 (Ref.

Table 4. Frequency distributions of EFW within a certain range of ABW for all fetuses (n = 160).

	Deviations of EFW from ABW					
	±5% deviation from ABW		±10% deviation from ABW		±15% deviation from ABW	
Formulas	Frequency	Percent	Frequency	Percent	Frequency	Percent
Schild *et al.*—Male [20]	69	43.1	123	76.9	142	88.8
Campbell and Wilkin [6]	67	41.9	118	73.8	146	91.3
Schild *et al.*—Female [20]	67	41.9	119	74.4	147	91.9
Esinler *et al.* [23]	67	41.9	117	73.1	146	91.3
Hadlock III [12]	59	36.9	114	71.3	145	90.6
Hadlock II [12]	66	41.2	113	70.6	144	90.0
Hadlock I [12]	61	38.1	113	70.6	142	88.8
Hadlock VI [11]	64	40.0	115	71.9	143	89.4
Hadlock IV [11]	62	38.8	110	68.8	142	88.8
Ott *et al.* [15]	57	35.6	111	69.4	142	88.8
Combs *et al.* [19]	63	39.4	107	66.9	140	87.5
Merz II [18]	59	36.9	105	65.6	131	81.9
Rose and McCallum [16]	50	31.3	104	65.0	132	82.5
Warsof *et al.* [7]	57	35.6	104	65.0	133	83.1
Higginbottom [8]	55	34.4	92	57.5	127	79.4
Hadlock V [12]	50	31.3	99	61.9	122	76.3
Shepard *et al.* [9]	40	25.0	82	51.3	114	71.3
Vintzileos *et al.* [17]	47	29.4	88	55.0	115	71.9
Hivale et. al. [26]	36	22.5	69	43.1	103	64.4
Weiner II [13]	41	25.6	78	48.8	100	62.5
Thurnau *et al.* [10]	8	5.0	26	16.3	54	33.8
Weiner I [13]	11	6.9	35	21.9	58	36.3
Merz I [18]	20	12.5	43	26.9	59	36.9
Hart *et al.* [21]	0	0.0	2	1.3	8	5.0

EFW, Estimated Fetal Weight; ABW, Actual Birth Weight.

[6–13, 15–21, 23, 26]), respectively. The formula of Campbell and Wilkin [6] was the best formula in estimating fetal weight for female fetuses based on having the lowest RMSE. Estimations obtained from the formula of Campbell and Wilkin [6] had the lowest RMSE with the value of 304.4 gr, the lowest MAPE with the value of 7.3% ± 5.5%, the lowest MPE with the value of -0.3% ± 9.3% and the highest percentage of estimations within the 15% range of ABW with the value of 89.9% as shown in Table 7 and Table 8. Estimations obtained from the formula of Campbell and Wilkin [6] had quite small values for each of MPE% and ME. The charts of FWE calculated by using the formula of Campbell and Wilkin [6] and ABW were comparatively given in Fig. 3 for male fetuses. It can be seen in Fig. 3 that estimations obtained by using the formula of Campbell and Wilkin [6] are quite close values to ABW values for female fetuses.

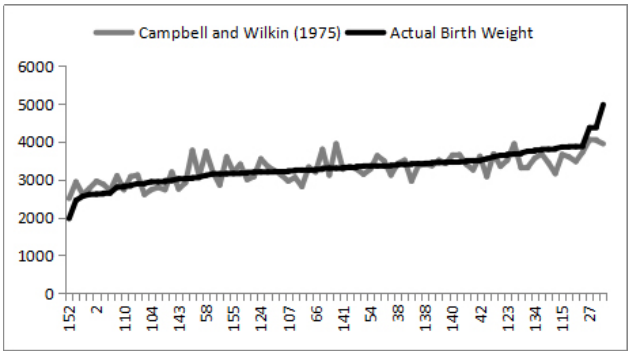

Fig. 3. The graphs of FWE of Shild *et al.*—Female [20] and ABW for boy fetuses.

The formulas of Campel and Wilkin [6], Esinler *et al.* [23], Schild *et al.*—Male [20], Hadlock VI [11], Hadlock II [12], Schild *et al.*—Female [20], Hadlock III [12], Hadlock I [12], Hadlock IV [11] and Ott *et al.* [15] were ranked as the sufficient formulas in estimating fetal weight for female fetuses based on having the low RMSE. Among these formulas, the formula of Schild *et al.* Male [20] had the lowest ME with the value of 0.8 ± 320.0, the formula of Hadlock II [12] had the highest percentages of estimations within the 5% and 15% ranges of ABW with the values of 41.8% and 89.9%, respectively, the formula of Hadlock VI [11] the highest percentage of estimations within the 10% range of ABW with the value of 77.2% and Pearson's r value between estimations obtained from the formula of Hadlock II [12] and ABW had the highest correlation with the value of 0.740.

Insufficient formulas in estimating fetal weight could be seen in Table 7 and Table 8. The formulas of Weiner II [13], Thurnau *et al.* [10], Weiner I [13], Merz I [18], and Hart *et al.* [21] were classified as very insufficient formulas in estimating the fetal weight of girl fetuses for the Turkish population.

Table 5. The values of RMSE, MAPE, MPE, ME and Pearson's r of the formulas for male fetuses (n = 81).

	FORMULAS	RMSE	MAPE (%)	MAPE (CI%)	MPE (%)	MPE (CI%)	ME	ME (CI)	r
The Best	Schild *et al.*—Female [20]	**284.9**	**6.6 ± 5.0**	**5.5–7.7**	−1.3 ± 8.2	(−3.2)–0.5	−60.2 ± 280.2	(−122.2)–1.8	0.653
Sufficient	Schild *et al.*—Male [20]	285.2	6.8 ± 5.2	5.7–7–8.0	0.9 ± 8.6	(−1.0)–2.8	−12.3 ± 286.8	(−51.1)–75.7	0.624
	Hadlock III [12]	303.1	7.3 ± 5.4	6.1–8.5	1.5 ± 9.0	(−0.5)–3.5	36.8 ± 302.7	(−30.2)–103.7	0.653
	Hadlock I [12]	304.1	7.2 ± 5.4	6.0–8.4	**0.2 ± 9.0**	**(−1.8)–2.2**	**−5.6 ± 305.9**	**(−73.3)–62.0**	0.645
	Ott *et al.* [15]	307.7	7.1 ± 5.6	5.9–8.4	−0.8 ± 9.1	(−2.8)–1.2	−40.6 ± 306.9	(−108.4)–27.3	0.622
	Campbell and Wilkin [6]	308.6	7.2 ± 5.7	5.9–8.5	−0.7 ± 9.20	(−2.7)–1.3	−42.6 ± 307.6	(−110.6)–25.4	0.569
	Esinler *et al.* [23]	308.8	7.0 ± 5.4	5.8–8.2	−3.1 ± 8.3	(−5.0)–(−1.3)	−121.0 ± 85.9	(−184.2)–(−57.8)**	0.631
	Hadlock IV [11]	312.2	7.3 ± 5.6	6.0–8.5	−0.8 ± 9.2	(−2.9)–1.2	−40.7 ± 311.431	(−109.5)–28.2	0.631
	Hadlock II [12]	312.5	7.3 ± 5.8	6.0–8.6	0.9 ± 9.3	(−1.2)–3.0	15.9 ± 314.0	(−53.5)–85.4	0.630
	Combs *et al.* [19]	315.8	7.2 ± 5.7	5.9–8.4	−2.7 ± 8.6	(−4.7)–(−0.8)	−106.1 ± 299.2	(−172.3)–(−39.9)**	0.620
	Hadlock VI [11]	325.0	7.7 ± 6.1	6.3–9.0	0.8 ± 9.8	(−1.4)–2.9	8.8 ± 326.9	(−63.5)–81.1	0.572
	Rose and McCallum [16]	346.6	8.5 ± 5.7	7.3–9.8	2.7 ± 9.9	0.5–4.9	84.1 ± 338.4	9.3–158.9*	**0.663**
	Warsof *et al.* [7]	347.2	7.9 ± 6.2	6.5–9.2	−3.6 ± 9.4	(−5.7)–(−1.5)	−131.9 ± 323.2	(−203.3)–(−60.4)**	0.618
	Merz II [18]	349.4	8.9 ± 6.6	7.4–10.3	6.2 ± 9.2	4.1–8.2	186.2 ± 297.5	120.4–252.0**	0.610
Insufficient	Hadlock V [12]	363.6	9.6 ± 7.5	8.0–11.3	6.0 ± 10.7	3.7–8.4	164.0 ± 326.6	91.8–236.2**	0.624
	Higginbottom [8]	400.7	9.5 ± 7.0	8.0–11.0	−3.1 ± 11.4	(−5.6)–(−0.6)	−111.6 ± 387.2	(−197.2)–(−26.0)*	0.576
	Vintzileos *et al.* [17]	442.6	10.9 ± 7.6	9.2–12.6	6.7 ± 11.5	4.2–9.2	215.9 ± 388.8	130.0–301.9**	0.622
	Shepard *et al.* [9]	452.6	11.4 ± 7.8	9.7–13.2	8.7 ± 10.8	6.3–11.1	279.3 ± 358.3	200.1–358.6**	0.617
	Weiner II [13]	463.7	10.9 ± 7.9	9.2–12.6	−9.5 ± 9.6	(−11.6)–(−7.4)	−324.5 ± 333.3	(−398.2)–(−250.8)**	0.618
	Hivale *et al.* [26]	468.1	11.1 ± 7.4	9.5–12.8	−10.4 ± 8.4	(−12.3)–(−8.5)	−359.3 ± 301.9	(−426.0)–(−292.5)**	0.618
Very Insufficient	Thurnau *et al.* [10]	655.5	17.6 ± 7.0	16.0–19.1	−17.6 ± 7.0	(−19.1)–(−16.0)	−604.6 ± 279.9	(−666.5)–(−542.7)**	0.616
	Weiner I [13]	703.2	18.1 ± 9.5	15.9–20.2	−17.9 ± 9.9	(−20.0)–(−15.7)	−606.3 ± 358.3	(−685.5)–(−527.1)**	0.523
	Merz I [18]	769.0	19.9 ± 12.2	17.2–22.6	18.8 ± 14.0	15.7–21.9	616.6 ± 462.6	514.3–718.9**	0.576
	Hart *et al.* [21]	1125.4	31.3 ± 7.4	29.6–32.9	−31.3 ± 7.4	(−33.0)–(−29.6)	−1070.0 ± 350.9	(−1147.6)–(−992.4)**	0.451

CI, Confidence interval; MAPE, mean absolute percentage error; MPE, mean percentage error; ME, Mean error.

** significant at 0.01 significance level (Null Hipotesis is ME = 0 and Alternative Hipotesis is ME $\neq$ 0); * significant at 0.05 significance level (Null Hipotesis is ME = 0 and Alternative Hipotesis is ME $\neq$ 0).

4. Discussion

In this study, the accuracy performances of formulas in the literature were compared, and then the best formulas were found for the Turkish population. As a result of comparisons, Formulas in the literature were classified as the best, sufficient, insufficient, and very insufficient for each gender not specific, male fetuses and female fetuses in Table 4, Table 6, and Table 8, respectively. The main accuracy criteria of this study were the lowest RMSE value. In according to this main criteria, the formulas of Schild *et al.* Male [20], Schild *et al.* Female [20] and Campbell and Wilkin [6] were found as the best formulas for all fetuses, male fetuses, and female fetuses, respectively, in estimating of the fetal weights for Turkish population. Also, as a result of all applications in this study, each of formulas of Schild *et al.* Male [20], Schild *et al.* Female [20], Campbell and Wilkin [6], Hadlock I [12], Hadlock II [12], Hadlock III [12], Hadlock VI [11], Esinler *et al.* [23] and Rose and McCallum [16] had the best accuracy performance depending on at least one criteria that is one of minimum RMSE, minimum MAPE, minimum MPE, minimum ME, maximum r, maximum percents of ±5%, ±10% and ±15% deviations from ABW. On the other hand, the formulas of Higginbottom [8], Shepard *et al.* [9], Hadlock V [12], Vintzileos *et al.* [17] and Hiwale *et al.* [26] were insufficient formulas and the formulas Thurnau *et al.* [10], Weiner I [13], Merz I [18] and Hart *et al.* [21] were the worst formulas in estimating all fetuses, male fetuses and female fetuses for Turkish population.

The idea of developing different formulas for both male and female fetuses was proposed by Schild *et al.* [20] in the literature. In the article of Schild *et al.* [20], MAPE value, the percent of ±10% deviation from ABW, and the percent of ±15% deviation from ABW had been calculated as 6.9%, 79.3%, and 90.5%, respectively, by using the formula Schild *et al.*—Female [20] for female fetuses. These values in this study were found as 7.3%, 75.9%, and 89.9%, respectively, by using the formula of Campbell and Wilkin [6] for female fetuses. According to these results, accuracy performances in the article of Schild *et al.* [20] were a little better than the accuracy performances of this study in estimating weight for female fetuses. However, in the article by Schild *et al.* [20], MAPE value, the percent of ±10% deviation from ABW, and the percent of ±15% deviation from ABW had been calculated as 7.0%, 73.3%, and 91.1%, respectively, by using the formula Schild *et al.*—Male [20] for male fetuses. These values in this study were found as 6.6%, 79.0%, and 96.3%, respectively, by using the formula of Schild *et al.*—Female [20]. According to these results, the accuracy performances of this study were a little better than the accuracy performances in the article by Schild *et al.* [20] in estimating weight for male fetuses. For this reason, it could be said that the values of accuracy per-

Table 6. Frequency distributions of EFW within a certain range of ABW for male fetuses (n = 81).

	Deviations of EFW from ABW					
	±5% deviation from ABW		±10% deviation from ABW		±15% deviation from ABW	
Formulas	Frequency	Percent	Frequency	Percent	Frequency	Percent
Schild *et al.*—Female [20]	40	50.6	64	79.0	78	96.3
Schild *et al.*—Male [20]	37	45.7	63	77.8	72	88.9
Hadlock III [12]	32	39.5	59	72.8	74	91.4
Hadlock I [12]	32	39.5	59	72.8	73	90.1
Ott *et al.* [15]	32	39.5	69	85.2	73	90.1
Campbell and Wilkin [6]	35	43.2	58	71.6	75	92.6
Esinler *et al.* [23]	35	43.2	59	72.8	76	93.8
Hadlock IV [11]	34	42.0	60	74.1	73	90.1
Hadlock II [12]	33	40.7	57	70.4	73	90.1
Combs *et al.* [19]	38	46.9	57	70.4	72	88.9
Hadlock VI [11]	33	40.7	54	66.7	73	90.1
Rose and McCallum [16]	26	32.1	54	66.7	71	87.7
Warsof *et al.* [7]	31	38.3	57	70.4	73	90.1
Merz II [18]	28	34.6	50	61.7	66	81.5
Hadlock V [12]	25	30.9	49	60.5	64	79.0
Higginbottom [8]	27	33.3	50	61.7	64	79.0
Vintzileos *et al.* [17]	25	30.9	41	50.6	57	70.4
Shepard *et al.* [9]	21	25.9	38	46.9	55	67.9
Weiner II [13]	24	29.6	47	58.0	57	70.4
Hivale *et al.* [26]	17	21.0	39	48.1	56	69.1
Thurnau *et al.* [10]	2	2.5	13	16.0	31	38.3
Weiner I [13]	9	11.1	17	21.0	31	38.3
Merz I [18]	10	12.3	19	23.5	28	34.6
Hart *et al.* [21]	0	0.0	1	1.2	2	2.5

EFW, Estimated Fetal Weight; ABW, Actual Birth Weight.

formances in this study are similar to the values of accuracy performances in the article of Schild *et al.* [20] for both male and female fetuses. And so, it could be thought that selecting different formulas is a logical way of estimating fetal weights.

Esinler *et al.* [29] found that the best formulas are Hadlock I [12], Ott *et al.* [15], and Comps *et al.* [19] in all fetuses, in fetuses >4000 gr and in fetuses <2500 gr, respectively, for Turkish population. Indeed, the formulas of Hadlock I [12], Ott *et al.* [15], and Comps *et al.* [19] were generally sufficient formulas in our study. However, in this study, Schild *et al.*—Male [20], Schild *et al.*—Female [20], and Campel and Wilkin [6] were the best formulas in estimating fetal weights for the Turkish population. Further, accuracy performances in our study were better than the accuracy performances in Esinler *et al.* [29]. For example, 7.2%, 6.6%, and 7.4 that are MAPE values calculated in our study were lower than 7.7%, 7.3%, and 10.3 in the article of Esinler *et al.* [29]. So, the reason why different formulas can be chosen as the best formulas for Turkish populations might be because of the fact that the interval range between ultrasound scan and delivery day. It was zero in our study while the interval range between ultrasound scan and delivery was <7 days in the study of Esinler *et al.* [29].

Hiwale *et al.* [26] developed a new formula for an Indian population. But, the formula of Hiwale *et al.* [26] was insufficient FWE formula with the RMSE value of 478.0 gr. Similarly, Hiwale *et al.* [3] found that the Woo *et al.* [30] formula's is the best formula for the Indian population. However, the formula of Campbell and Wilkin [6] was found as insufficient for the Indian population in the study of Hiwale *et al.* [3]. Despite the formula of Campbell and Wilkin [6] was a considerable sufficient formula in this study. As another comparison, the formula of Hart *et al.* [21] was the best formula for the Germany population despite the formula of Hart *et al.* [21] was the worst formula for the Turkish population in this study. For another example, the formula of Hadlock IV [11] was the best formula in estimation fetal weights for the Mexican population in the study of Blue *et al.* [31] despite the formula of Hadlock IV [11] was a little sufficient formula in our study. These findings show that the efficacy of the formulas for countries might differ from each other. Therefore, in this study, it could be thought that finding the best formulas for a Turkish population will contribute to researchers that will plan to study interested in FWE in the future.

The advantages of this study can be given as follows.

Comparisons were made for a gender non-specific and gender-specific. All fetuses (n = 160), male fetuses (n = 81) and female fetuses (n = 79) in Turkish people included randomly. The approach in this study is similar to the approach of Schild *et al.* [20] that proposed 2 different formulas for

Table 7. The values of RMSE, MAPE, MPE, ME and Pearson's r of the formulas for female fetuses (n = 79).

	FORMULAS	RMSE	MAPE (%)	MAPE (CI%)	MPE (%)	MPE (CI%)	ME	ME (CI)	r
The Best	Campbell and Wilkin [6]	**304.4**	**7.3 ± 5.7**	**6.0–8.6**	**−0.3 ± 9.3**	**(−2.4)–1.81**	−32.5 ± 304.6	(−100.7)–35.7	0.735
Sufficient	Esinler *et al.* [23]	317.0	7.4 ± 5.8	6.1–8.7	−2.2 ± 9.1	(−4.2)–(−0.1)	−97.1 ± 303.1	(−165.0)–(−29.2)**	0.735
	Schild *et al.*—Male [20]	317.9	7.7 ± 6.2	6.3–9.1	0.9 ± 9.9	(−1.3)–3.1	**0.8 ± 320.0**	(−70.9)–72.5	0.698
	Hadlock VI [11]	319.1	7.5 ± 6.6	6.0–9.0	1.2 ± 9.9	(−1.0)–3.4	22.7 ± 320.4	(−49.1)–94.4	0.735
	Hadlock II [12]	319.8	7.6 ± 6.5	6.1–9.0	1.8 ± 9.9	(−0.4)–4.0	42.3 ± 319.0	(−29.2)–113.7	**0.740**
	Schild *et al.*—Female [20]	327.3	8.0 ± 6.2	6.6–9.3	−1.2 ± 10.1	(−3.4)–1.1	−65.1 ± 322.8	(−137.4)–7.2	0.700
	Hadlock III [12]	328.8	8.0 ± 6.6	6.6–9.5	1.8 ± 10.3	(−0.5)–4.1	42.5 ± 328.1	(−31.0)–116.0	0.732
	Hadlock I [12]	335.1	8.2 ± 6.5	6.8–9.7	0.4 ± 10.5	(−1.9)–2.8	−3.3 ± 337.2	(−78.8)–72.3	0.718
	Hadlock IV [11]	338.8	8.4 ± 6.3	7.0–9.8	−0.5 ± 10.5	(−2.8)–1.9	−33.2 ± 339.3	(−109.1)–42.8	0.709
	Ott *et al.* [15]	343.0	8.6 ± 6.5	7.1–10.0	−0.6 ± 10.8	(−3.0)–1.8	−40.3 ± 342.8	(−117.0)–36.5	0.690
Insufficient	Combs *et al.* [19]	351.5	8.8 ± 6.2	7.4–10.2	−2.5 ± 10.5	(−4.9)–(−0.2)	−106.6 ± 337.1	(−182.1)–(−31.1)**	0.686
	Merz II [18]	361.6	8.9 ± 8.4	7.1–10.8	6.2 ± 10.6	3.9–8.6	179.7 ± 315.8	108.9–250.4**	0.723
	Rose and McCallum [16]	396.2	9.6 ± 7.6	7.9–11.3	2.5 ± 12.0	(−0.2)–5.2	72.4 ± 392.0	(−15.4)–160.2	0.707
	Warsof *et al.* [7]	396.2	9.7 ± 7.3	8.1–11.3	−4.2 ± 11.4	(−6.8)–(−1.7)	−153.4 ± 367.7	(−235.8)–(−71.1)**	0.695
	Higginbottom [8]	405.0	9.7 ± 7.5	8.0–11.4	−2.5 ± 12.1	(−5.2)–0.2	−84.9 ± 398.6	(−174.1)–4.4	0.730
	Hadlock V [12]	445.5	11.2 ± 11.2	8.7–13.7	7.4 ± 14.0	4.3–10.6	187.6 ± 406.7	96.5–278.7**	0.711
	Shepard *et al.* [9]	479.4	11.6 ± 9.9	9.4–13.9	8.0 ± 13.1	5.0–10.9	249.0 ± 412.3	156.7–341.4**	0.693
	Hivale et. al. [26]	487.9	11.0 ± 6.8	11.0–14.0	−10.2 ± 10.0	(−12.4)–(−7.9)	−352.4 ± 339.6	(−428.5)–(−276.4)**	0.694
	Vintzileos *et al.* [17]	496.1	11.4 ± 10.1	9.2–13.7	6.0 ± 4.0	2.8–9.1	190.8 ± 460.9	87.6–294.1**	0.699
Very Insufficient	Weiner II [13]	511.3	13.0 ± 7.6	11.3–14.7	−9.6 ± 11.7	(−12.2)–(−7.0)	−331.3 ± 391.9	(−419.1)–(−243.6)**	0.650
	Thurnau *et al.* [10]	689.5	18.1 ± 7.6	16.4–19.8	−17.6 ± 8.7	(−19.6)–(−15.7)	−609.4 ± 324.7	(−682.1)– (−536.7)**	0.692
	Merz I [18]	808.7	19.8 ± 14.4	16.6–23.0	19.5 ± 14.8	16.2–22.8	643.1 ± 493.4	532.6–753.6**	0.730
	Weiner I [13]	769.0	20.2 ± 10.2	17.9–22.4	−18.6 ± 12.8	(−21.5)–(−15.8)	−633.1 ± 439.4	(−731.5)–(−534.7)**	0.553
	Hart *et al.* [21]	1130.9	30.6 ± 8.5	28.7–32.5	−30.2 ± 9.8	(−32.4)–(−28.0)	−1042.8 ± 440.5	(−1141.5)–(−944.2)**	0.496

CI, Confidence interval; MAPE, mean absolute percentage error; MPE, mean percentage error; ME, Mean error.

** significant at 0.01 significance level (Null Hipotesis is ME = 0 and Alternative Hipotesis is ME $\neq$ 0).

each male and female. The best formulas have been determined for all fetuses, fetuses with BW less than 2500 gr and fetuses with BW bigger than 4000 in the literature. To the best of our knowledge, there is no study to compare males and females in the literature. For this reason, this study is the first one comparing these two.

- In the literature, most of the studies of the fetal weight estimation (FWE) are the retrospective studies, that interval range between ultrasound scan and delivery is <14 days. This situation may cause a measurement error. However, the interval range between ultrasound scan and delivery was zero in this study.
- In the literature, many different doctors have scanned fetuses to estimate the fetal weight. It is known that interobserver variability is high in ultrasonographic evaluation. In this study, one senior doctor scanned all fetuses. Therefore, interobserver variability completely eliminated.
- In the literature, many different ultrasound devices may be used during scanning. This situation may cause to make measurement errors since measurement sensitivities of ultrasound devices may differ from each other. In this study, one ultrasound device was used to be scan for all fetuses.

Author contributions

ÖK designed the research study. ÖK performed the research. CK analyzed the data. ÖK and CK wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Hitit University (approval number: 069).

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Conflict of interest

The authors declare no conflict of interest.

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Table 8. Frequency distributions of EFW within a certain range of ABW for female fetuses (n = 79).

	Deviations of EFW from ABW					
	±5% deviation from ABW		±10% deviation from ABW		±15% deviation from ABW	
Formulas	Frequency	Percent	Frequency	Percent	Frequency	Percent
Campbell and Wilkin [6]	32	40.5	60	75.9	71	89.9
Esinler *et al.* [23]	32	40.5	58	73.4	70	88.6
Schild *et al.*—Male [20]	32	40.5	60	75.9	70	88.6
Hadlock VI [11]	31	39.2	61	77.2	70	88.6
Hadlock II [12]	33	41.8	56	70.9	71	89.9
Schild *et al.*—Female [20]	27	34.2	55	69.6	69	87.3
Hadlock III [12]	27	34.2	55	69.6	71	89.9
Hadlock I [12]	29	36.7	54	68.4	69	87.3
Hadlock IV [11]	28	35.4	50	63.3	69	87.3
Ott *et al.* [15]	25	31.6	53	67.1	69	87.3
Combs *et al.* [19]	25	31.6	50	63.3	68	86.1
Merz II [18]	31	39.2	55	69.6	65	82.3
Rose and McCallum [16]	24	30.4	50	63.3	61	77.2
Warsof *et al.* [7]	26	32.9	47	59.5	60	75.9
Higginbottom [8]	28	35.4	42	53.2	63	79.7
Hadlock V [12]	25	31.6	50	63.3	58	73.4
Shepard *et al.* [9]	19	24.1	44	55.7	59	74.7
Hivale *et al.* [26]	19	24.1	30	38.0	47	59.5
Vintzileos *et al.* [17]	22	27.8	47	59.5	58	73.4
Weiner II [13]	17	21.2	31	39.2	43	54.4
Thurnau *et al.* [10]	6	7.6	13	16.5	23	29.1
Merz I [18]	10	12.7	24	30.4	31	39.2
Weiner I [13]	8	10.1	18	22.8	27	34.2
Hart *et al.* [21]	0	0.0	1	1.3	6	7.6

EFW, Estimated Fetal Weight; ABW, Actual Birth Weight.

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