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Original Article

Role of Early Ultrasound Parameters in Predicting First-Trimester Pregnancy Outcomes

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ABSTRACT

Background: Early ultrasound examination plays an important role in assessing pregnancy viability during the first trimester. Sonographic parameters such as gestational sac diameter (GSD), yolk sac diameter (YSD) and embryonic heart rate (EHR) provide valuable structural and functional information about early embryonic development. Abnormalities in these parameters have been associated with an increased risk of early pregnancy loss. This study was conducted to evaluate the role of early ultrasound parameters in predicting first-trimester pregnancy outcomes.

Materials and Methods: A descriptive observational study was conducted over one year (December 2016 to December 2017) in the Department of Obstetrics and Gynaecology at Santokba Durlabhji Memorial Hospital, Jaipur. A total of 140 pregnant women between 6–9 weeks of gestation with singleton pregnancies were included. All participants underwent transvaginal ultrasonography, and parameters including GSD, YSD, EHR and crown–rump length (CRL) were recorded. Participants were followed until 13 weeks of gestation to determine pregnancy outcome. Statistical analysis included Chi-square test and calculation of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy.

Results: Among the ultrasound parameters studied, YSD and EHR showed a significant association with pregnancy outcome ($p < 0.001$ and $p = 0.002$ respectively) while GSD did not show a statistically significant association ($p = 0.431$). The abortion rate was highest in pregnancies with a small yolk sac (<2 mm) where 90.91% resulted in miscarriage. Diagnostic test analysis showed that YSD had the highest sensitivity (77.36%) while EHR demonstrated the highest specificity (91.95%) and diagnostic accuracy (80%). When ultrasound parameters were combined, specificity increased to 97.70% and PPV to 88.24% although sensitivity decreased to 28.30%.

Conclusion: Yolk sac characteristics and embryonic heart rate are strong predictors of first-trimester pregnancy outcome, whereas gestational sac diameter alone has limited predictive value. Combined evaluation of ultrasound parameters improves specificity and may help identify pregnancies at risk of early loss.

Keywords: *First trimester pregnancy, Transvaginal ultrasonography, Yolk sac diameter (YSD), Embryonic heart rate (EHR), Early pregnancy loss prediction.*

INTRODUCTION

First trimester ultrasound examination plays a very important role in modern obstetric care. In the past, ultrasound in early pregnancy was mainly used to confirm the presence of pregnancy. However, with improvements in ultrasound technology, it has now become an important diagnostic tool that can help predict pregnancy outcomes at a very early stage. Transvaginal sonography is considered the standard method for evaluating early pregnancy because it provides better image resolution and allows the uterus and developing embryo to be seen more clearly. Since the ultrasound probe is placed closer to the uterus, transvaginal sonography can detect important early pregnancy structures earlier than transabdominal ultrasound [1].

One of the earliest ultrasound signs of an intrauterine pregnancy is the gestational sac. The gestational sac is a fluid filled structure that forms inside the uterus and surrounds the developing embryo. It can usually be identified on ultrasound as early as 4 weeks and 3 days of gestation [2]. Measurement of the gestational sac is commonly done by calculating the mean gestational sac diameter (GSD). This measurement is helpful for estimating gestational age during very early pregnancy. It also provides useful information about pregnancy development. When the gestational sac grows at a normal rate and contains the expected embryonic structures, it is usually a sign of a healthy pregnancy. However, if the gestational sac does not grow properly or remains empty beyond a certain size, it may indicate that the pregnancy is not viable [2,3].

After the gestational sac appears, the next important structure that becomes visible on ultrasound is the yolk sac. The yolk sac is usually the first clear embryonic structure seen inside the gestational sac. It typically becomes visible around 5 weeks of gestation when the GSD is greater than 8 mm [4]. Although the yolk sac exists only during the early stages of pregnancy, it plays a very important role in early embryonic development. It helps provide nutrients to the developing embryo before the placenta is fully formed. It is also involved in early blood cell formation, metabolism, immune function, and the development of primordial germ cells [5].

On ultrasound, a normal yolk sac usually appears as a round structure with a clear center and a smooth outer wall. This appearance generally indicates normal early embryonic development. However, abnormalities in yolk sac size or shape may suggest problems in pregnancy development. For example, a yolk sac that is very large, very small, or irregular in shape has been associated with a higher risk of miscarriage in several studies. In particular, a yolk sac diameter (YSD) greater than 6 mm has been linked with a higher chance of first trimester pregnancy loss. Similarly, abnormal yolk sac shapes such as irregular, calcified, or echogenic structures may indicate abnormal embryonic development [4–6]. Because of these associations, the yolk sac is often considered an important indicator of early embryonic health.

Another important parameter used to assess early pregnancy viability is embryonic cardiac activity. The presence of a heartbeat is considered the most reliable sign of a living embryo. Embryonic cardiac activity can usually be detected using M mode transvaginal ultrasound between 5 and 6 weeks of gestation [7]. Once cardiac activity is seen, the embryonic heart rate (EHR) can be measured.

EHR provides more information than simply confirming that the embryo is alive. It also helps predict the future outcome of the pregnancy. Studies have shown that a slow EHR during early pregnancy may indicate a higher risk of miscarriage. For example, an EHR of less than 90 beats per minute at 6.0 to 6.2 weeks of gestation, or less than 110 beats per minute at 6.3 to 7.0 weeks, has been associated with an increased risk of pregnancy loss [8,9]. Therefore, EHR serves as a functional indicator that reflects the physiological condition of the developing embryo.

Although GSD, yolk sac characteristics, and EHR are all important in early pregnancy assessment, each parameter reflects a different aspect of early development. Gestational sac measurements provide structural information about the pregnancy environment, yolk sac features reflect early embryonic support functions, and EHR indicates the functional development of the embryo. Therefore, evaluating these parameters together may improve the accuracy of predicting pregnancy outcomes.

Recent studies have increasingly focused on combining multiple ultrasound parameters rather than relying on a single measurement. This integrated approach can improve the prediction of pregnancy viability, support early clinical decision making, reduce the need for repeated scans, and help provide better counselling to patients. Based on this concept, the present study was conducted to evaluate the role of early ultrasound parameters in predicting first trimester pregnancy outcomes.

MATERIALS AND METHODS

Study Design: This study was a descriptive observational study conducted to evaluate the role of yolk sac measurements, gestational sac measurements and EHR in determining the outcome of pregnancy in the first trimester.

Study Duration: The study was conducted over a period of one year from December 2016 to December 2017.

Study Area: The study was carried out in the Department of Obstetrics and Gynaecology at Santokba Durlabhji Memorial Hospital, Jaipur. Pregnant females attending both the inpatient and outpatient departments were included in the study.

Study Population: The study population consisted of pregnant females between 6 and 9 weeks of gestation who attended the study centre and fulfilled the inclusion criteria.

Inclusion Criteria:

- Pregnant females between 6–9 weeks of gestation
- Pregnant females aged 18–35 years
- Pregnant females with singleton pregnancy
- Pregnant females with spontaneous conception

- Pregnant females having abnormal ultrasound parameters such as GSD, YSD or EHR

Exclusion Criteria:
- Pregnant females with pre-existing medical diseases
- Pregnant females with bad obstetric history
- Multiple pregnancies
- Infertile females who conceived after treatment

Sample Size: A total of 140 patients were enrolled during the study period.

Sampling Methodology: A purposive sampling technique was employed, where all eligible patients meeting the inclusion criteria during the study period were enrolled.

Data Collection and Procedure:
Patients fulfilling the inclusion criteria who attended the study centre during the study period were approached by the investigator and informed about the nature and purpose of the study. Written informed consent was obtained from all participants before inclusion.

A detailed history including socio-demographic characteristics was recorded and a complete clinical and obstetric examination was performed.

Routine laboratory investigations including blood group, complete blood count (CBC), random blood sugar, urine routine microscopy, and thyroid function test were conducted for all participants.

All subjects underwent transvaginal sonography using a WIPRO-GE Voluson 730 PRO ultrasound machine performed by a single experienced sonologist and the following parameters were recorded including YSD and its characteristics, GSD and its characteristics, EHR, and crown-rump length (CRL).

Participants were followed up at 13 weeks of gestation, when abdominal ultrasonography was performed to determine pregnancy outcome, where normal outcome was defined as continuation of pregnancy beyond 13 weeks with an intact gestational sac and a live intrauterine foetus, while abnormal outcome was defined as abortion before 13 weeks or a non-viable pregnancy on follow-up scan.

Data Analysis:
- Data were entered into Microsoft Excel and analysed using MedCalc software (version 16.4).
- Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were presented as frequencies and percentages.
- Chi-square test were used for categorical variables. Sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and diagnostic accuracy were calculated.
- A p-value of <0.05 was considered statistically significant.

Ethical Considerations:
- Ethical approval was obtained from the Institutional Ethics Committee before commencement of the study.
- The study adhered to ethical principles outlined in the Declaration of Helsinki.
- Written informed consent was obtained from all participants.
- Patient confidentiality was maintained by anonymising all collected data.

RESULTS
In present study, 140 first trimester pregnant cases were included as per criteria and data collected. The outcome of the study was evaluated in terms of miscarriage or normal continuation of pregnancy at the end of the 13th week. The descriptive analysis showed that the study population consisted of women in the reproductive age group, with mean values calculated for maternal age, gestational sac size, yolk sac size, embryonic heart rate, gestational age, and CRL (Table 1).

Analysis of maternal and ultrasound parameters (Table 2) in relation to pregnancy outcome showed that maternal age and gravidity did not have a statistically significant association with pregnancy outcome. YSD demonstrated a statistically significant association with pregnancy outcome, with abnormal yolk sac sizes showing a higher proportion of pregnancy loss compared with normal YSD. The appearance of the yolk sac was also significantly associated with pregnancy outcome, with abnormal yolk sac morphology being more frequently observed in cases that resulted in abortion. GSD did not show a statistically significant association with pregnancy outcome. EHR showed a statistically significant association with pregnancy outcome, indicating that abnormal heart rate values were related to an increased likelihood of pregnancy loss.

For YSD analysis, the total number of observations was 129 because 8 patients had two yolk sacs (5.71%), while 3 patients (2.14%) had no visible yolk sac on ultrasound examination. Similarly, for EHR analysis, the total number of observations was 76, as cardiac activity was absent in 64 patients (45.71%) during the ultrasound examination.

The diagnostic test analysis showed that YSD demonstrated the highest sensitivity among the individual ultrasound parameters for predicting pregnancy outcome (Table 3). GSD showed relatively lower sensitivity and specificity compared with the other parameters. EHR demonstrated high specificity and good diagnostic accuracy in predicting pregnancy outcome. Among the individual parameters, EHR and YSD showed better predictive performance compared with GSD. When the ultrasound parameters were evaluated in combination, the specificity and PPV increased considerably, indicating a stronger ability to correctly identify pregnancies that would continue beyond the first trimester. However, the combined parameters showed relatively lower sensitivity.

Table 1: Descriptive Statistics of Study Parameters

Parameter	Mean ± SD (Min–Max)
Age (years)	26.73 ± 3.91 (18–35)
Gestational sac size (mm)	26.76 ± 13.03 (3.8–71.3)
Yolk sac size (mm)	3.66 ± 2.57 (0.5–20.8)
Embryonic heart rate (bpm)	131.96 ± 48.10 (62–212)
Gestational age (weeks)	7.74 ± 1.05 (6–9)
Crown-rump length (mm)	10.43 ± 7.46 (1.0–25.4)

Table 2: Association of Maternal and Ultrasound Parameters with Pregnancy Outcome

Parameter	Category	Abortions n (%)	Survived n (%)	Total n (%)	p-value
Age (years)	18-20	2 (50)	2 (50)	4 (2.86)	**0.866**
	21-30	69 (62.16)	42 (37.84)	111 (79.28)	
	31-35	16 (64)	9 (36)	25 (17.86)	
Gravidity	Primigravida	29 (55.77)	23 (44.23)	52 (37.14)	**0.310**
	Multigravida	58 (65.91)	30 (34.09)	88 (62.86)	
Yolk Sac Diameter	Small (<2 mm)	30 (90.91)	3 (9.09)	33 (25.58)	**<0.001***
	Normal (2–5 mm)	30 (42.25)	41 (57.75)	71 (55.04)	
	Large (>5 mm)	17 (68.00)	8 (32.00)	25 (19.38)	
Appearance of Yolk Sac	Abnormal	60 (83.33)	12 (16.67)	72 (51.43)	**<0.001***
	Normal	27 (39.71)	41 (60.29)	68 (48.57)	
Gestational Sac Diameter	Abnormal	35 (67.31)	17 (32.69)	52 (37.14)	**0.431**
	Normal	52 (59.09)	36 (40.91)	88 (62.86)	
Embryonic Heart Rate (bpm)	<100	20 (54.05)	17 (45.95)	37 (48.68)	**0.002***
	100–180	5 (29.41)	12 (70.59)	17 (22.37)	
	>180	2 (9.09)	20 (90.91)	22 (28.95)	

Table 3: Diagnostic Test Parameters for Prediction of Pregnancy Outcome Using Ultrasound Parameters

Diagnostic Test Parameter	Gestational Sac Diameter	Embryonic Heart Rate (100–180 bpm)	Yolk Sac Diameter (2–5 mm)	Combined Parameters
Sensitivity (%)	67.92	60.38	77.36	28.30
Specificity (%)	40.23	91.95	66.67	97.70
Positive Predictive Value (%)	40.91	82.05	57.75	88.24
Negative Predictive Value (%)	67.31	79.21	82.61	69.11
Diagnostic Accuracy (%)	50.71	80.00	70.00	71.43

DISCUSSION

The present study evaluated the role of early ultrasound parameters in predicting first-trimester pregnancy outcomes. A total of 140 patients were included in the final analysis. Unlike several previous studies that evaluated randomly selected early antenatal cases, this study specifically included pregnancies in which at least one ultrasound parameter that is GSD, YSD or EHR was abnormal. This study design allowed a more focused assessment of the prognostic value of these parameters in pregnancies that were already considered to be at potential risk.

Most of the participants in the present study were between 26 and 35 years of age. Maternal age did not show a statistically significant association with pregnancy outcome. Similar observations have been reported in previous studies by Varelas et al. [10] and Moraden and Forouzeshfar [11]. However, Falco et al. [12] reported that increasing maternal age may be

associated with a higher risk of miscarriage. Gravidity also did not show a statistically significant influence on pregnancy outcome in our study. Comparable results were reported by Adiga et al. [13] and Manchanda et al. [14]. However, Makrydimas et al. [15] suggested that factors such as previous pregnancy loss and increasing maternal age may negatively affect future pregnancy outcomes. These findings indicate that while maternal characteristics may contribute to pregnancy outcomes, they may not always show a strong independent association in small clinical cohorts.

The findings of the present study show that YSD and embryonic heart rate are strong and independent predictors of first-trimester pregnancy outcome. Both of these parameters performed better than GSD when used alone. Among all the parameters studied, YSD emerged as one of the most important indicators of pregnancy viability.

In this study, a YSD outside the normal range of 2–5 mm was strongly associated with spontaneous abortion. The abortion rate was extremely high in the small yolk sac group (<2 mm), reaching more than 90%, while pregnancies with a large yolk sac (>5 mm) also showed a high abortion rate. The yolk sac plays a very important role in early embryonic development. According to embryological studies, the yolk sac is responsible for early nutrition, haematopoiesis, and the production of primordial germ cells before the placental circulation becomes fully functional [16]. Because of these important functions, abnormalities in the yolk sac may reflect underlying developmental problems. A very small yolk sac may not be able to provide adequate nutritional support to the embryo, whereas an enlarged or irregular yolk sac may indicate degeneration or abnormal embryonic development.

The importance of YSD has also been highlighted in several recent studies. A 2024 study by Namratha and Sowmya [6] identified YSD as a key prognostic factor and reported that deviations from the normal range are strongly associated with poor pregnancy outcomes. Similarly, a 2022 study by Doubilet et al. [17] found that the simple visualization of a yolk sac inside the gestational sac significantly improves the chances of a successful first-trimester pregnancy outcome. The study reported that pregnancies in which a yolk sac was visualized had almost four times higher odds of continuing normally compared with pregnancies in which the yolk sac was not seen.

The strong association between YSD and pregnancy outcome observed in our study is also consistent with earlier research. Studies by Varelas et al. [10], Bae and Karnitis [18], and Adiga et al. [13] reported that pregnancies with YSD within the normal range tend to have significantly better survival rates compared with those with abnormal yolk sac measurements. The slightly higher miscarriage rates observed in the present study may be explained by the study design. Unlike many previous studies that included randomly selected early pregnancies, this study specifically included pregnancies with at least one abnormal ultrasound parameter. Therefore, even when the YSD was normal, other abnormal parameters such as GSD or EHR could still affect the final pregnancy outcome.

In addition to yolk sac size, yolk sac appearance was also found to be important. In the present study, abnormal yolk sac morphology was associated with a higher rate of miscarriage compared with pregnancies that had a normal yolk sac appearance. Similar findings were reported by Moraden and Forouzeshfar [11], who also observed higher miscarriage rates in pregnancies with abnormal yolk sac morphology. The exact cause of these abnormalities is still not fully understood. It is not clear whether they arise due to primary defects in yolk sac development or occur secondary to abnormalities in embryonic development. Since the yolk sac acts as an important structure for nutrient exchange between the embryo and the maternal environment, structural abnormalities may indicate dysfunction of this early transport system and may therefore be associated with adverse pregnancy outcomes.

The present study also confirmed the strong prognostic value of embryonic heart rate. A clear relationship was observed between EHR and pregnancy survival. An EHR within the normal range of 100–180 beats per minute (bpm) was strongly associated with successful pregnancy continuation, whereas heart rates outside this range showed a much higher risk of pregnancy loss. In particular, slow embryonic heart rates below 100 bpm were associated with a significantly higher rate of miscarriage. These findings are supported by Choudhary et al. [7], who reported that a slow EHR at 6–7 weeks of gestation is strongly associated with first-trimester pregnancy loss.

The diagnostic performance of EHR in our study was also very strong. The normal EHR range showed very high specificity and PPV, which means that when a normal heart rate is detected, it is highly likely that the pregnancy will continue normally. Similar conclusions were reported in a large 2024 study by Doubilet and Guo [19], which analysed more than 6,500 first-trimester ultrasound examinations. The authors reported that once a normal EHR is observed, many other traditional risk factors become much less important in predicting pregnancy outcome.

The association between slow EHR and miscarriage may be related to early developmental physiology. During early gestation, the embryonic cardiac conduction system, particularly the sinoatrial node, is still developing. As a result, abnormal or slow heart rhythms may reflect delayed cardiac maturation or underlying developmental abnormalities.

In contrast to YSD and embryonic heart rate, GSD alone did not show a statistically significant association with pregnancy outcome in the present study. This finding suggests that gestational sac size may not be a reliable independent predictor of pregnancy viability. The gestational sac provides the initial environment for the developing embryo, but its size alone may

not directly reflect the health of the embryo itself. Therefore, gestational sac measurements are more meaningful when interpreted together with other ultrasound findings.

The diagnostic test analysis in our study also showed interesting results when the three ultrasound parameters were combined. When GSD, YSD, and EHR were all considered together, the specificity and PPV were very high. This means that when all three parameters are normal, there is a very high probability that the pregnancy will continue normally. However, the sensitivity of the combined parameters was relatively low. This indicates that the absence of normal findings in all three parameters does not necessarily confirm that the pregnancy will fail.

This observation highlights an important clinical point. A single abnormal ultrasound finding should not immediately lead to a diagnosis of pregnancy failure, especially if other parameters appear normal. Current clinical guidelines recommend strict criteria for diagnosing early pregnancy loss in order to avoid incorrectly diagnosing a viable pregnancy as non-viable. For example, the absence of cardiac activity in an embryo with a CRL of 7 mm or more is considered a definitive sign of pregnancy failure [3].

The clinical importance of early ultrasound evaluation has increased significantly with the widespread availability of transvaginal sonography and highly sensitive pregnancy tests. These technologies allow pregnancies to be detected at much earlier stages than before. As a result, ultrasound plays a crucial role in early pregnancy assessment and clinical decision-making.

Early identification of abnormal ultrasound markers allows clinicians to provide appropriate counselling, closer monitoring, and individualized management for patients who may be at risk of early pregnancy loss. At the same time, ultrasound findings must always be interpreted carefully and in combination with clinical information to avoid misdiagnosis.

CONCLUSION

The results of the present study reinforce the importance of yolk sac morphology and EHR as key sonographic markers for evaluating first-trimester pregnancy viability. Abnormal yolk sac size, abnormal yolk sac appearance, and slow EHR were strongly associated with pregnancy loss. In comparison, GSD alone showed limited predictive value. These findings support the growing evidence that dynamic embryonic indicators such as yolk sac characteristics and embryonic heart activity provide more reliable information about early pregnancy viability than gestational sac measurements alone.

Annexure 1: Measurement of Ultrasound Parameters

Gestational Sac Diameter (GSD)

- On ultrasound imaging, the gestational sac appears as a thick echogenic ring surrounding a sonolucent centre, which represents the fluid-filled chorionic sac. The mean gestational sac diameter (GSD) was calculated by measuring the inner sac wall in three perpendicular planes and calculating the average of these measurements. The appearance of the gestational sac was evaluated using the Nyberg criteria.
- Major criteria included large sac (≥25 mm mean sac diameter without an embryo or ≥20 mm mean sac diameter without a yolk sac) and distorted shape of the gestational sac. Minor criteria included thin decidual reaction (<2 mm), irregular contour of the gestational sac, absent double decidual sign, weak decidual amplitude, and low position of the sac. GSD values were automatically generated using Rempen's software integrated in the WIPRO-GE Voluson 730 PRO ultrasound equipment.

Yolk Sac Diameter (YSD)

- The yolk sac is the first extraembryonic structure visualised within the gestational sac on ultrasound. The YSD was measured by placing callipers on the inner limits of the longest diameter. Additional characteristics assessed included shape, number of yolk sacs, echogenicity of the rim and centre, and degenerative changes such as calcification. A yolk sac was considered normal when it had a diameter between 2–5 mm, round shape, number equal to the embryos, echogenic rim with hypoechoic centre, and absence of degenerative changes.

Embryonic Heart Rate (EHR)

- Embryonic heart rate was measured using M-mode sonography. Heart rates less than 100 beats per minute (bpm) or greater than 180 bpm were considered abnormal.

Crown-Rump Length (CRL)

- CRL was used as a reference parameter for estimating gestational age in the first trimester and was correlated with the last menstrual period (LMP). CRL was measured by obtaining a true unflexed longitudinal section of the embryo with clearly defined crown and rump endpoints, and placing callipers at these points. CRL values were automatically generated using Hadlock's software integrated in the WIPRO-GE Voluson 730 PRO ultrasound equipment.
- The values of GSD, YSD, EHR, CRL and LMP were correlated to identify abnormal findings using the reference values provided in table below. Gestational sac diameter was also classified as small, normal or large by comparing

gestational age calculated by LMP and CRL, and a difference of seven or more days between these measurements was considered abnormal.

- Relationship between gestational age and embryonic CRL, EHR, mean GSD and mean YSD is as follows:

Gestation Days	CRL (mm)			HR (bpm)			GSD (mm)			YSD (mm)		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	50th	5th	95th
40	2.4	1.1	4.1	105	90	121	12.9	8.0	18.9	3.2	2.4	4.1
41	2.9	1.4	4.8	108	92	124	13.8	8.7	19.9	3.3	2.5	4.2
42	3.4	1.9	5.5	111	95	127	14.7	9.4	21.0	3.4	2.6	4.3
43	4.1	2.3	6.3	114	98	131	15.6	10.2	22.1	3.4	2.6	4.4
44	4.7	2.8	7.1	117	101	134	16.5	10.9	23.2	3.5	2.7	4.4
45	5.4	3.1	7.9	120	101	138	17.4	11.7	24.3	3.6	2.7	4.5
46	6.1	3.9	8.8	124	107	141	18.4	12.5	25.4	3.6	2.8	4.6
47	6.9	4.5	9.7	127	111	145	19.3	13.3	26.6	3.7	2.9	4.7
48	7.7	5.2	10.6	131	114	149	20.3	14.1	27.7	3.8	2.9	4.7
49	8.5	5.9	11.6	135	117	153	21.3	14.9	28.8	3.8	3.0	4.8
50	9.4	6.6	12.6	138	121	157	22.3	15.7	30.0	3.9	3.0	4.9
51	10.2	7.3	13.6	142	124	161	23.3	16.6	31.1	4.0	3.1	5.0
52	11.2	8.1	14.7	146	128	165	24.3	17.4	32.3	4.0	3.1	5.0
53	12.1	8.9	15.7	149	131	168	25.3	18.3	33.4	4.1	3.2	5.1
54	13.0	9.7	16.8	153	134	172	26.3	19.1	34.6	4.2	3.3	5.2
55	14.0	10.6	17.9	156	137	176	27.3	20.0	35.8	4.2	3.3	5.2
56	15.0	11.4	19.1	159	140	179	28.3	20.8	36.9	4.3	3.4	5.3
57	16.0	12.3	20.2	162	143	182	29.3	21.7	38.1	4.3	3.4	5.4
58	17.1	13.2	21.4	165	146	185	30.3	22.6	39.2	4.4	3.5	5.4
59	18.1	14.2	22.5	167	148	188	31.3	23.4	40.4	4.5	3.5	5.5
60	19.1	15.1	23.7	169	150	190	32.3	24.3	41.5	4.5	3.6	5.6
61	20.2	16.0	24.9	171	152	192	33.3	25.2	42.6	4.6	3.6	5.6
62	21.3	17.0	26.1	173	153	193	34.3	26.0	43.7	4.6	3.7	5.7
63	22.4	18.0	27.3	174	154	194	35.3	26.9	44.9	4.7	3.7	5.8
64	23.5	18.9	28.5	174	154	195	36.3	27.8	46.0	4.7	3.8	5.8
65	24.6	19.9	29.7	174	154	195	37.3	28.6	47.1	4.8	3.8	5.9
66	25.7	20.9	30.9	174	154	195	38.2	29.5	48.2	4.8	3.9	5.9
67	26.8	21.9	32.1	173	153	194	39.2	30.3	49.2	4.9	3.9	6.0
68	27.9	22.9	33.3	171	152	192	40.2	31.2	50.3	4.9	4.0	6.0
69	29.0	23.9	34.5	169	150	190	41.1	32.0	51.4	5.0	4.0	6.1
70	30.1	24.9	35.7	167	147	187	42.0	32.8	52.4	5.0	4.0	6.2
71	31.2	25.9	36.9	163	141	183	43.0	33.6	53.4	5.1	4.1	6.2
72	32.3	26.9	38.1	159	141	179	43.9	34.4	54.4	5.1	4.1	6.3
73	33.3	27.9	39.3	155	136	174	44.8	35.2	55.4	5.2	4.2	6.3
74	34.4	28.9	40.4	150	131	169	45.6	36.0	56.4	5.2	4.2	6.4
75	35.5	29.9	41.6	144	126	163	46.5	36.8	57.4	5.3	4.2	6.4

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