3rd NATIONAL MATERNAL FETAL MEDICINE CONFERENCE 2019

'From Strategy to Action"

15-17th March

Venue: Convention Hall, Gambang Resort City

الجامعة الإسلامية العالمية ماليزيا

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

يونيرسيتي إسلام انتارابغسا ملسيا

(Company No. 101067-P)

Garden of Knowledge and Virtue

PREMIER INTERNATIONAL ISLAMIC RESEARCH UNIVERSITY

Ultrasound Biometry
&
Fetal Growth Abnormalities

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Head, MOG Conjoint Board

Still birth & Perinatal Death Rates in Malaysia

statista.com

Confidential Enquiries

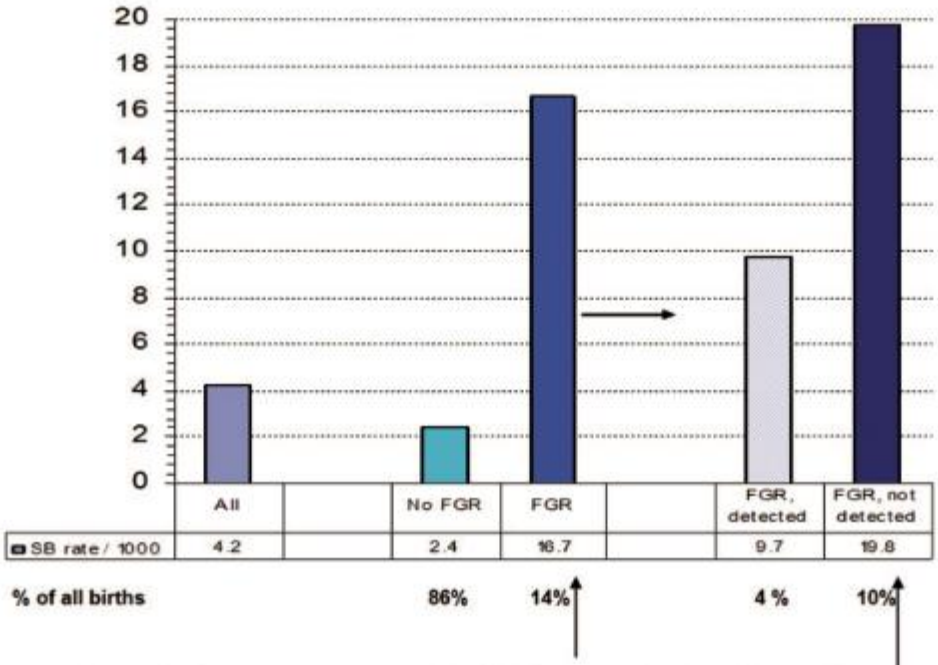
- Most stillbirth were due to Intrauterine Growth Restriction (IUGR) or Fetal Growth Restriction (FGR)
- Associated with suboptimal care
- Potentially avoidable

approximately 5.4 stillbirths per one thousand

Epidemiological analysis:
Significant reduction can be achieved through antenatal detection of pregnancies at risk

• Malaysia: perinatal mortality rates 2017 | Statistic
https://www.statista.com/statistics/641974/malaysia-perinatal-mortality-rates/

Still Birth Risk of FGR



Gestational age at birth, of cases without vs. with A/N detection:

280 days

↓

270 days

➔ Pregnancies with FGR have 7 fold higher risk of stillbirth

➔ Undetected FGR increases the stillbirth risk even further

➔ Detection results on average in delivery only 10 days earlier, and mostly at term

Figure 1. Stillbirth risk in pregnancies with and without antenatal (A/N) detection of fetal growth restriction (FGR), defined as < 10th customised centile. Illustration based on data in Gardosi et al.[5]

Fetal Growth and Perinatal Death

- Key components to reduce perinatal death :
  - Detect growth abnormalities (restriction / excessive growth)
- Methods of Prediction
  - Uterine Artery Doppler
- Methods of detection
  - Uterine enlargement – Serial Symphysio-Fundal-Height (SFH)
  - Fetal growth – Serial ultrasound Biometry
- Chart on Growth Chart
  - Which Chart that will not missed Growth Abnormalities

Ultrasound Biometry

Appropriate Dating :
Crown Rump Length (CRL) or LMP

- TAS 9^{+0} to 13^{+6} weeks from the first day of the LMP
- Gestational age by LMP
  - Regular menses 25-31 days
  - No hormonal contraception
  - No breastfeeding
- Gestational age by CRL
  - Gestational age based on CRL is within 7 days of that calculated by LMP for LMP to be reliable

INCORRECT:

The section is not mid-sagittal
Magnification is poor

The section is not mid-sagittal
The fetus is flexed (not in a neutral position)
(It is also a twin pregnancy!)

The inters
and rump

The section is not mid-sagittal:
You can see the spine in the middle - this is a coronal section

Risk Assesment at Booking: Screening and Surveillance of Fetal Growth

GAP algo

Low Risk
☐ No known risk factors

Increased Risk: one or more of the following:

Maternal Risk Factors
☐ Maternal age >40 years
☐ Smoker (any)
☐ Drug misuse

Previous Pregnancy History
☐ Previous SGA baby (<10th cust. centile)
☐ Previous stillbirth

Maternal Medical History
☐ Chronic hypertension
☐ Diabetes
☐ Renal impairment
☐ Antiphospholipid syndrome

Unsuitable for monitoring by fundal height- e.g.
☐ Large fibroids
☐ BMI >35

Current Pregnancy Complications

Early Pregnancy
☐ PAPP-A <0.415 MoM
☐ Fetal echogenic bowel

Late Pregnancy
☐ Severe pregnancy induced hypertension or pre-eclampsia (=PIH and proteinuria)
☐ Unexplained antepartum haemorrhage

Table 1. Prevalence of risk factors requiring serial ultrasound assessment of fetal growth according to new NHS England algorithm; West Midlands, N = 146,774

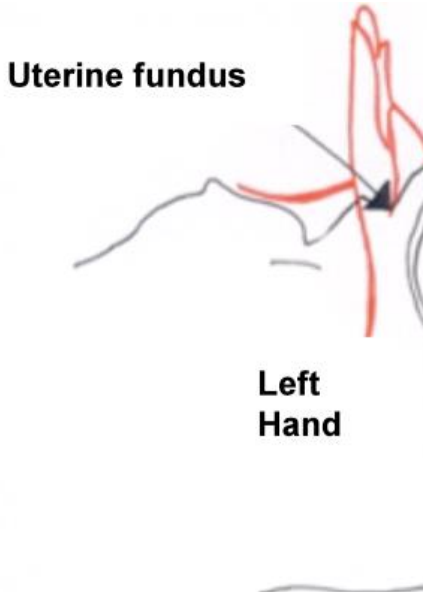
Risk factor	Prevalence (%)	Cumulative (%)
Previous stillbirth	0.3	0.3
Previous SGA baby	6.3	6.5
Pre-existing hypertension	6.2	12.4
Pre-existing diabetes	0.7	13.1
Maternal age 40+	3.2	15.6
Body mass index 35+	8.1	21.8
Drug misuse	1.1	22.6
Smoker 10 + cigarettes/day	9.6	29.5
Smoker 1–9 cigarettes/day	8.7	**36.2**

Reproduced from Francis et al.,[11] with permission.
SGA: small for gestational age.

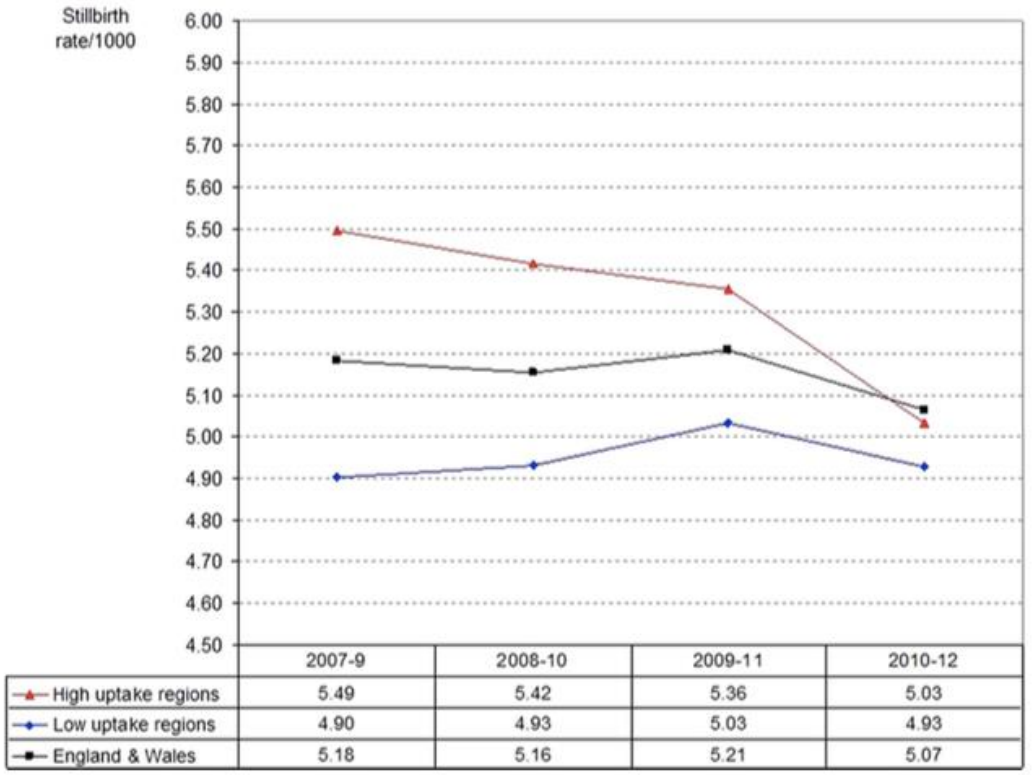
Figure 2. The growth assessment protocol (GAP) algorithm for fetal growth surveillance. Adapted from NHS England.[7]

Fetal Growth : Clinical Biometry

Symphysis Fundal Height Measurement



Previous standard at City Hospital	Cu
Variable practice in assessment of fetal growth: - abdominal palpation - tape measures, various techniques, variable frequency of assessment	Sta me - ta m
Variable documentation, common practice '= to dates'	Fu eve
3-4 cm range of normal	Ab
Plotting on population based chart only done when concerned	Fu customised chart printed after the dating scan
Individual scan measurements plotted on population charts	Referral for scan or admission as a result of referral guidelines
Referral to consultant	Direct referral for scan

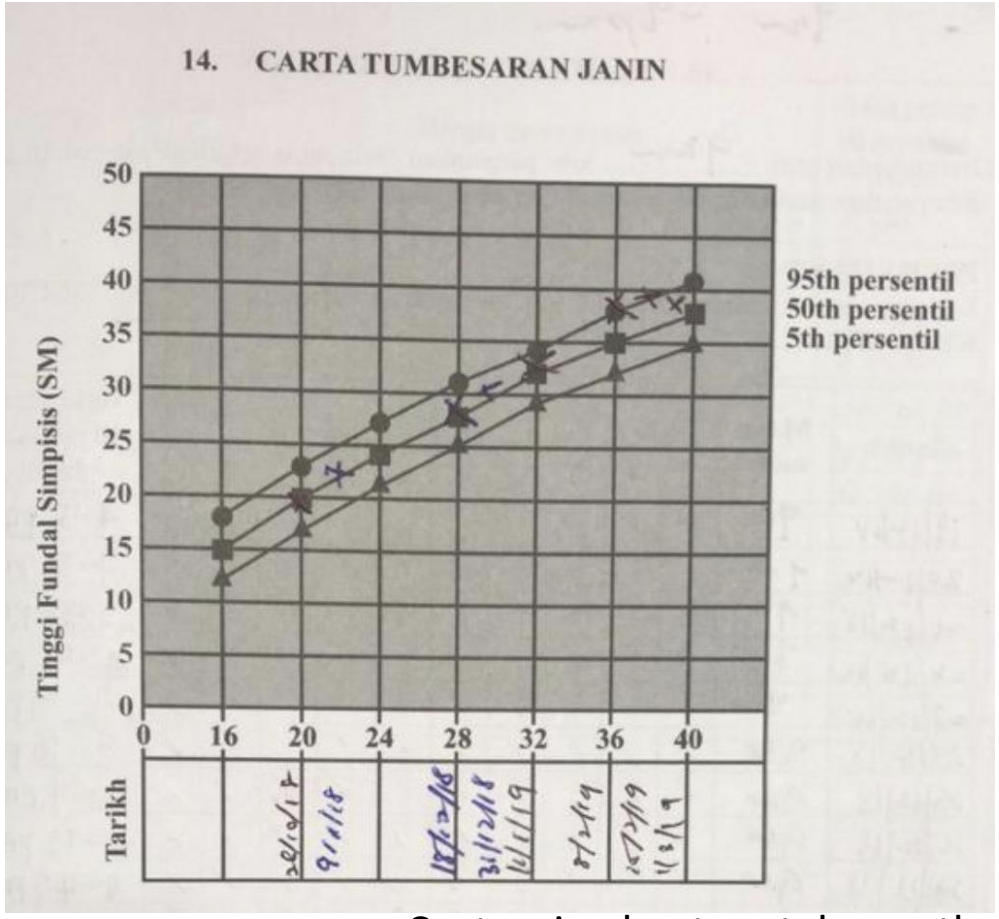


	2007-9	2008-10	2009-11	2010-12
High uptake regions	5.49	5.42	5.36	5.03
Low uptake regions	4.90	4.93	5.03	4.93
England & Wales	5.18	5.16	5.21	5.07

Figure 5 Stillbirth rates in high and low uptake regions and England and Wales, 2007–2012 (3-year moving average).

Gardosi et l 2003

Antenatal Growth Chart



Serial fundal height measurements are recommended by NIH 2003

Populations standards
When use to assess fetal growth at 3rd trimester will miss most SGA
Population standard grouped all women together and predict they will have the same size baby at term

Customised antenatal growth charts :
recommended by RCOG 2003

(a)

GROW-App UK

Helpdesk | Hello, sue.turner | Log off

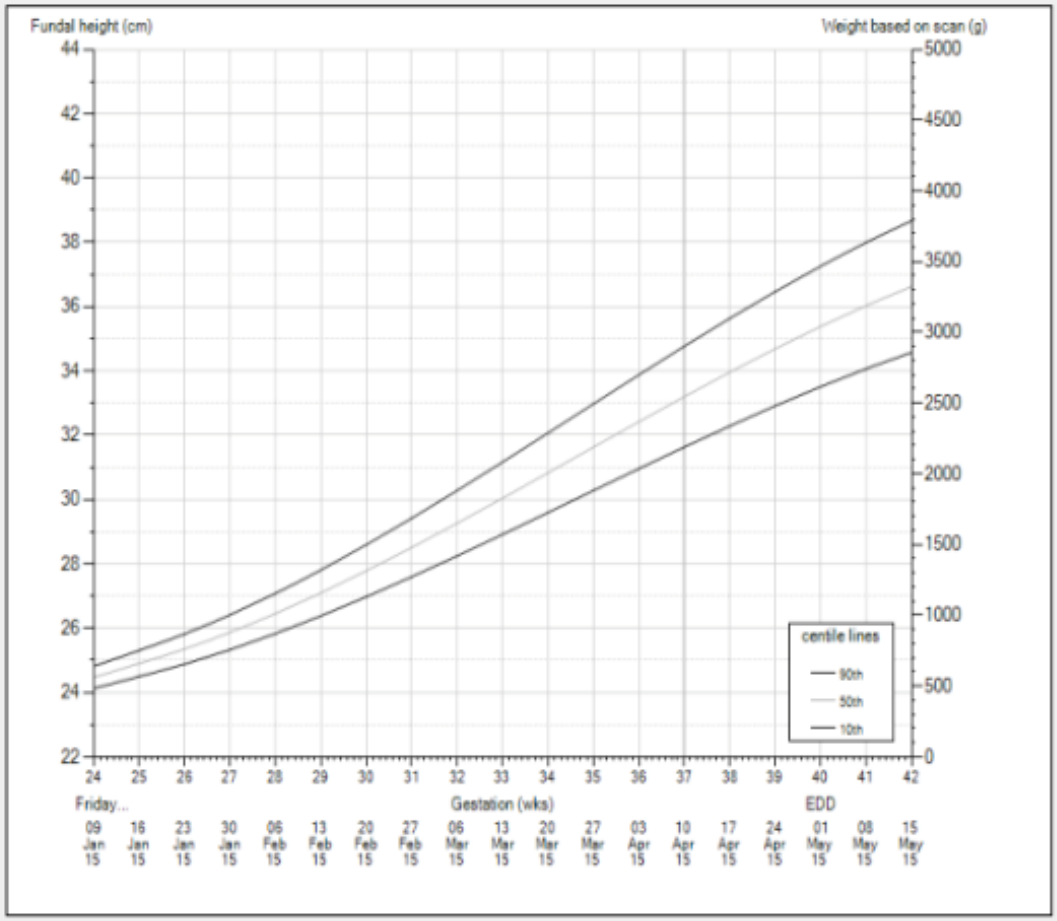
Chart | Centile | Reports | Help | Users

Mother Ref.	123456
First Name	Manjit
Last Name	Small
Date of Birth	31/10/1988
Ethnic Origin	Indian
Parity	0
Height	157 cm / 5ft 2ins
Weight	45 kg / 7st 1lbs
BMI	18.3 Low
TOW (g)	3042

EDD known 01/05/2015

Calculate EDD

Generate Chart



Greyscale

Show 5th/95th centiles

Gridlines by weight

Print

Clear


GROW-App UK
Helpdesk
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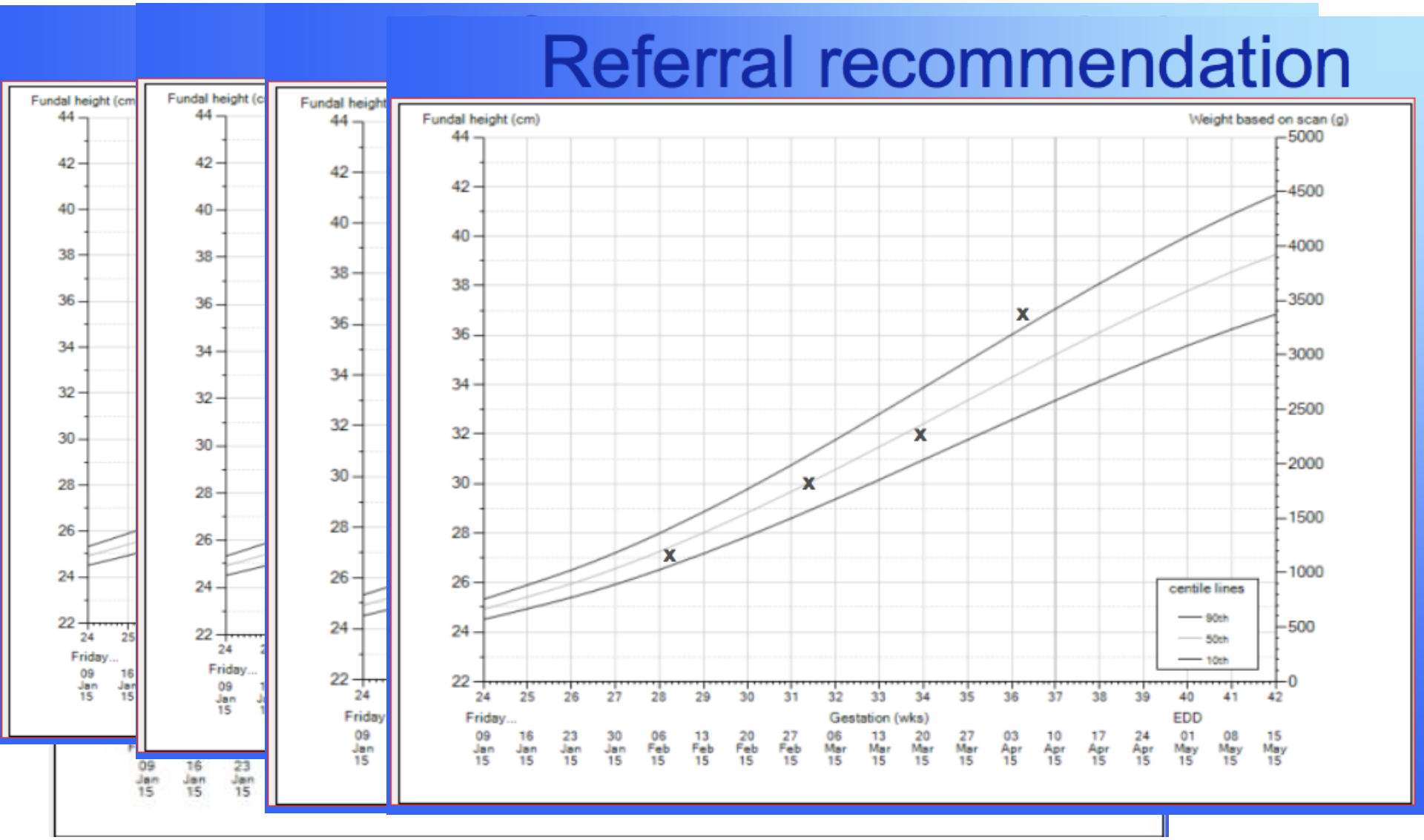
Log off
Chart
Centile
Reports
Help
Users
Mother Ref.
45684
First Name
Anna
Last Name
Sample
Date of Birth
01/01/1990
Ethnic Origin
British European
Parity
0
Height
163 cm
5ft 4ins
Weight
64 kg
10st 1lbs
BMI
24.1
TOW (g)
3429
EDD known
02/10/2015
Calculate EDD
Generate Chart
Fundal height (cm)
Weight based on scan (g)
centile lines
Gestation (wks)
EDD
Greyscale
Show 5th/95th centiles
Gridlines by weight
Print
Clear

Antenatal Growth Chart



Antenatal Growth Chart

Table 1 **- SGA Detection Rates***

	Population group n = 300	**Customised group n = 298**
SGA* n	62 (20.6%)	58 (19%)
Detected	10 (16.1%)	21 (36.2%)

*<10th birth weight centile at delivery

Adherence to the referral guidelines may have led to antenatal detection of SGA in 12 additional cases i.e. 12 + 21 = 33 of 58 SGA could have been detected = **56.9%**

Table 2 **- LGA Detection Rates***

	Population group n = 300	**Customised group n = 298**
LGA* n	26 (8.6%)	17 (5.7%)
Detected	3 (11.5%)	9 (52.9%)

* > 90th birth weight centile at delivery

Adherence to the referral guidelines may have led to antenatal detection of LGA in 6 additional cases i.e. 9 + 6 of 17 LGA could have been detected **= 88.2 %**

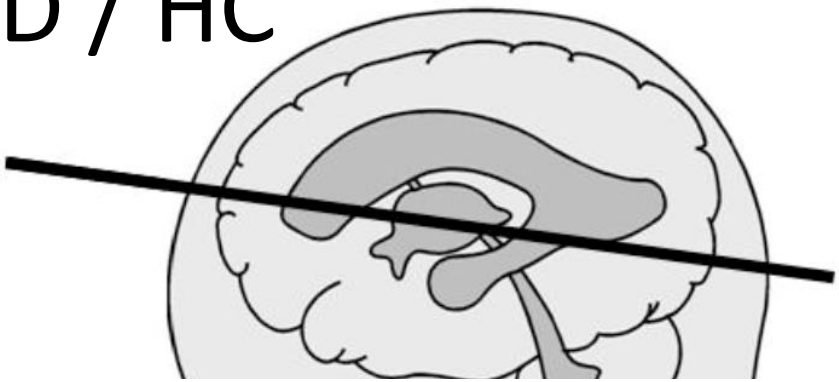
Fetal Growth and Perinatal Death

- Key components to reduce perinatal death :
  - Detect growth abnormalities (restriction / excessive growth)
- Dating of Gestational Age
  - Crown Rump Length / LMP
- Methods of Prediction
  - Uterine Artery Doppler
- Methods of detection / identifying growth abnormalities
  - Uterine enlargement – Serial Symphysio-Fundal-Height (SFH)
  - **Fetal growth – Serial ultrasound Biometry**
- Chart on Growth Chart
  - Which Chart that will not missed Growth Abnormalities

Identifying Fetal Growth : **2. Ultrasound Biometry**

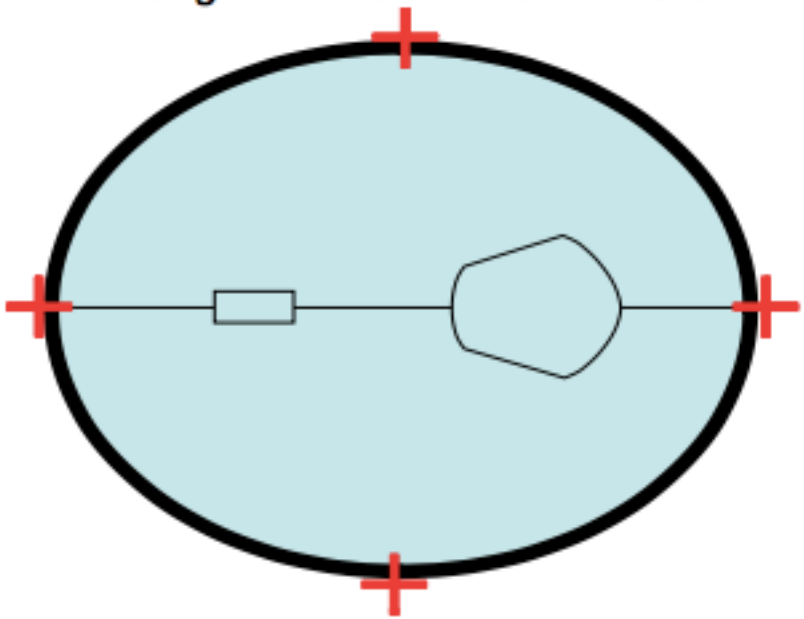
- Important clinical tool for :
  - Identification
  - Monitoring
  - Management of FGR/IUGR or Macrosomia
- CRL / BPD / HC / AC / FL

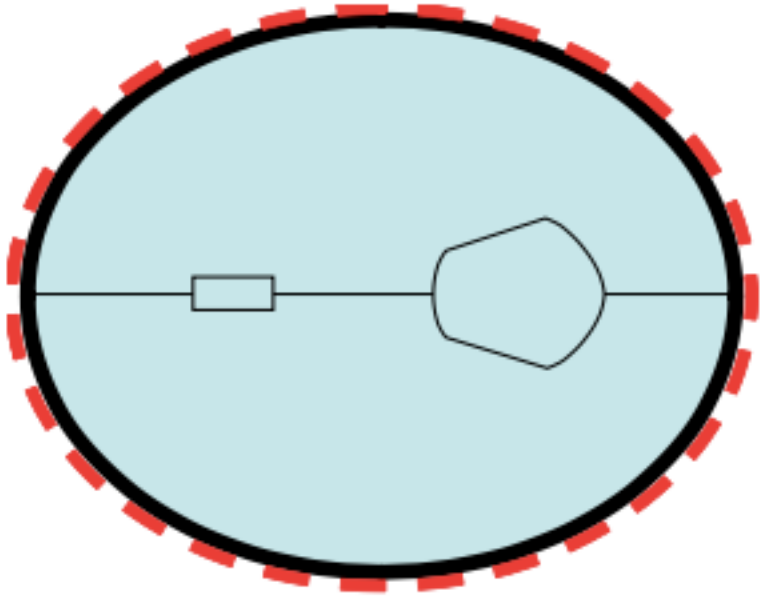
BPD / HC

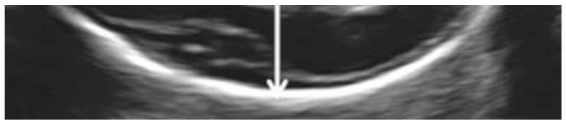


The level of the cross-section through the fetal head for correct measurement.

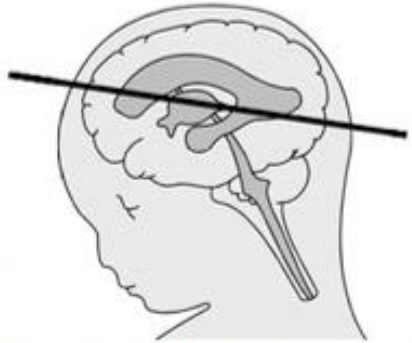
Callipers should be placed so that the intersection of the callipers is on the outer border of the bones ('OUTER TO OUTER').When using the ellipse facility this should run along the outer border of the skull.



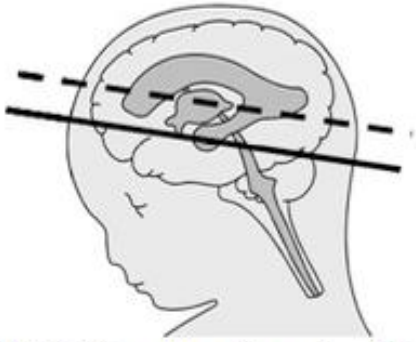




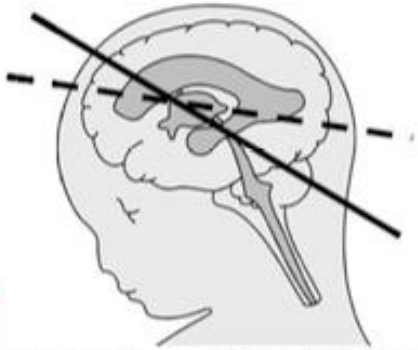
COMMON ERRORS:



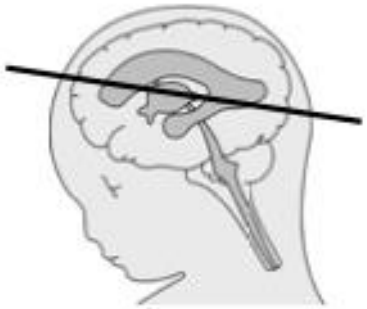
***CORRECT**: the main anatomic landmarks (1: thalami; 2: cavum sept are displayed.*



***INCORRECT**: the wings of the sphenoid bone (3) and cerebral pedu demonstrated: this section is too low in the fetal head*



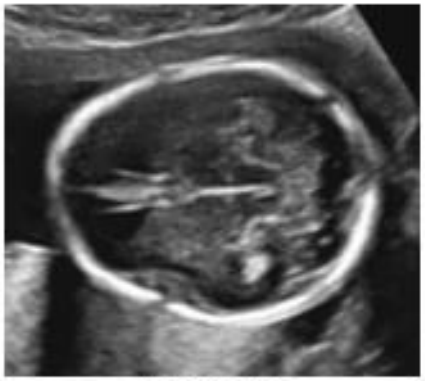
***INCORRECT**: the cerebellum (5) is demonstrated: this section is obt suboccipitobregmatic plane and does not allow proper measurement occipitofrontal diameter.*



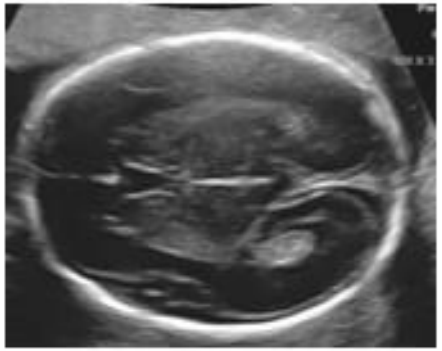
The main anatomic landmarks can be easily recognized between 14 weeks and term gestation.

Remember:

- **Level of the thalami**
- **Horizontal plane**
- **Oval shape**
- **Symmetrical**
- **Central position of falx cerebri**
- **Cavum septum pellucidum in anterior third**
- **Magnification**
- **Correct calliper placement**



15 weeks



22 weeks

32 weeks

AC

CORRECT:

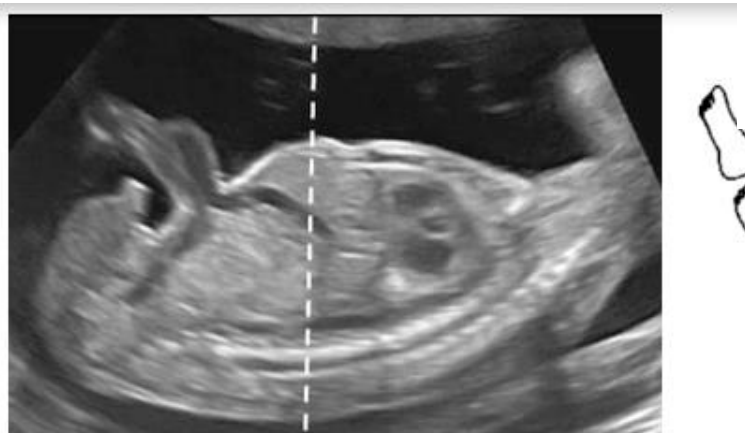
-The image is well magnified

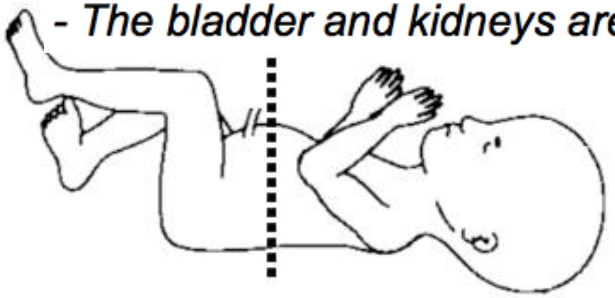
-The section is circular.

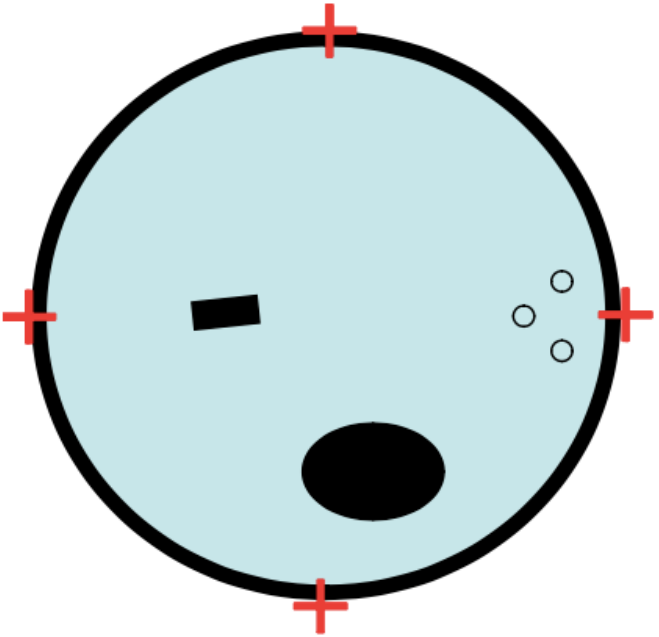
-The landmarks are seen:

1. *Short segment of umbilical vein in the anterior third.*
2. *Stomach bubble visible.*
3. *Spine.*

- The bladder and kidneys are not visible

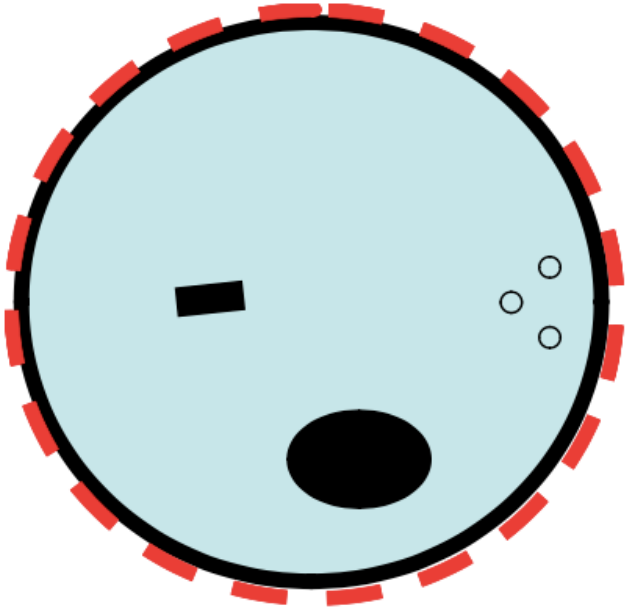




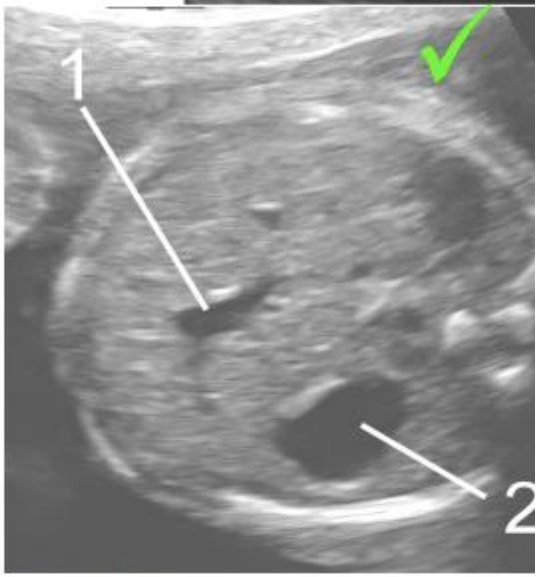


The callipers are positioned correctly, outer to outer.

When using the ellipse facility this should run along the outer border of the abdomen.



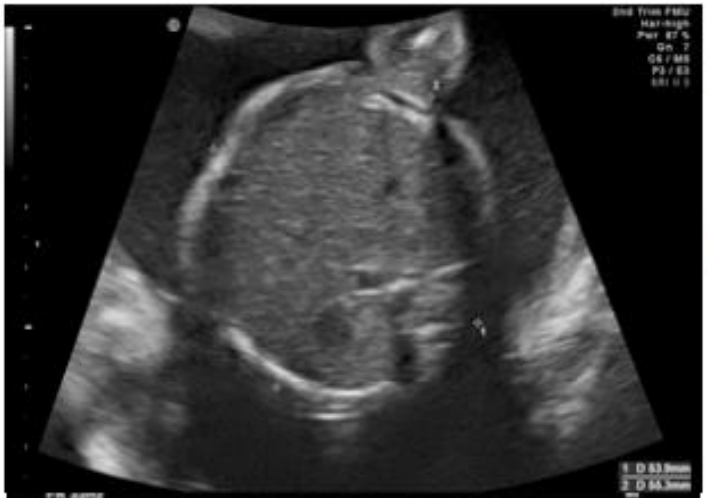
COMMON ERRORS:



CORRECT:

-There is a short segment of umbilical ve
vein in the anterior third (1), and the stor
is visible (2)

COMMON ERRORS:



INCORRECT

- The stomach is NOT visible
- The umbilical vein is NOT visible.

INCORRECT

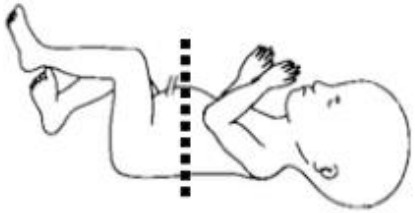
The umbilical vein is:
- not in the anterior third
- not a short segment

Like in the example above, the plane is too angled.
- Also, the stomach is not clearly visible

INCORRECT

- The magnification is very poor
- The umbilical vein may be correct but is not visible as the image is too small.

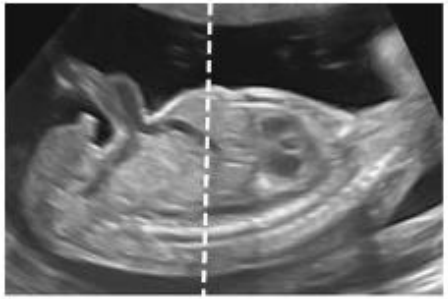
SUMMARY



The main anatomic landmarks can be easily recognized between 14 weeks and term gestation.

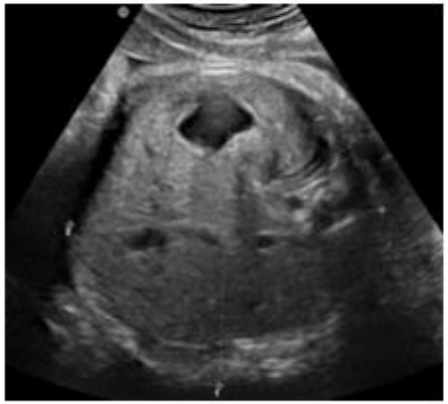
Remember:

- As circular as possible
- Short umbilical vein in anterior third
- Stomach bubble visible
- Kidneys and bladder NOT visible
- Magnification
- Correct calliper placement



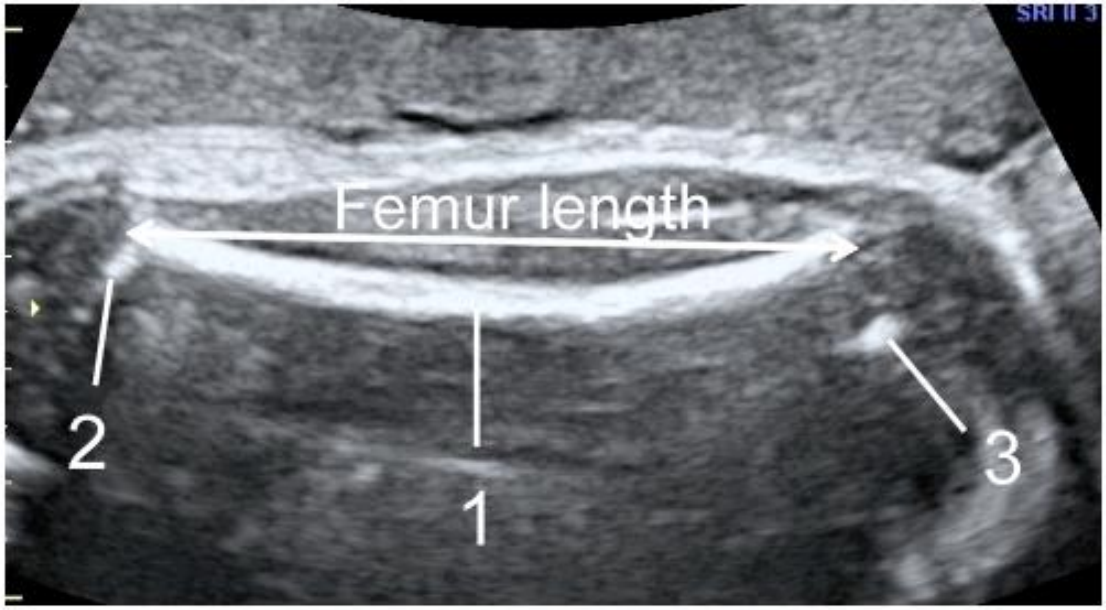
14 weeks

22 weeks



40 weeks

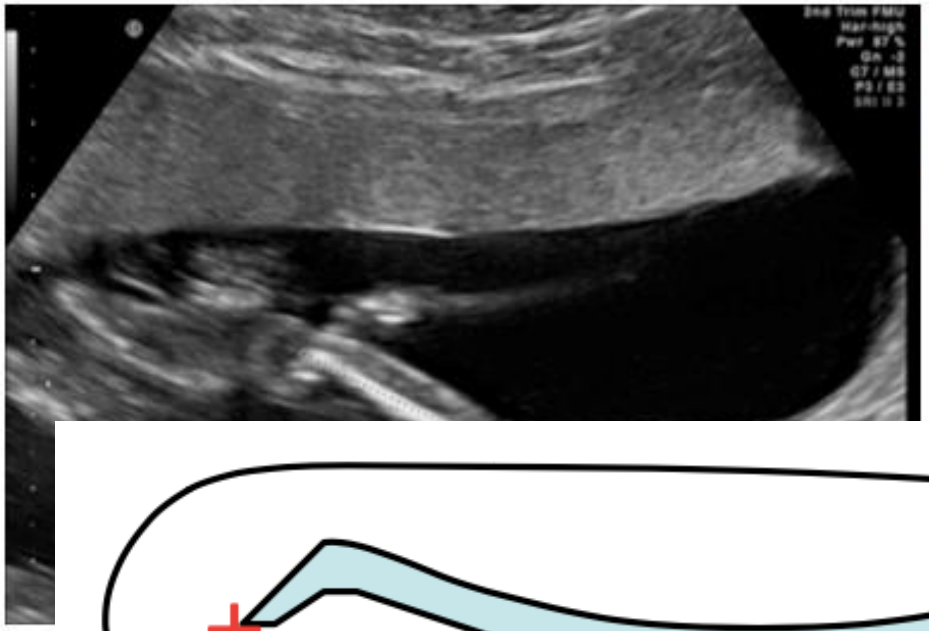
FL



In the second trimester only the ossified diaphysis (1) of the femur can be demonstrated; in the third trimester the greater trochanter (2) and distal ossification center (3) can be seen and this allows one to orientate the section plane better.

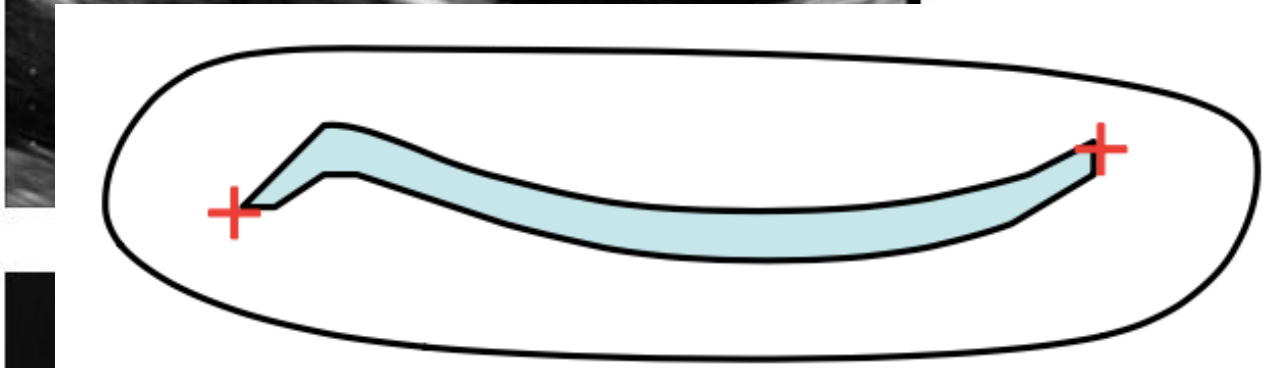
The greater trochanter should be avoided in measuring the femur length as this results in an excessive measurement (red X)

COMMON ERRORS:



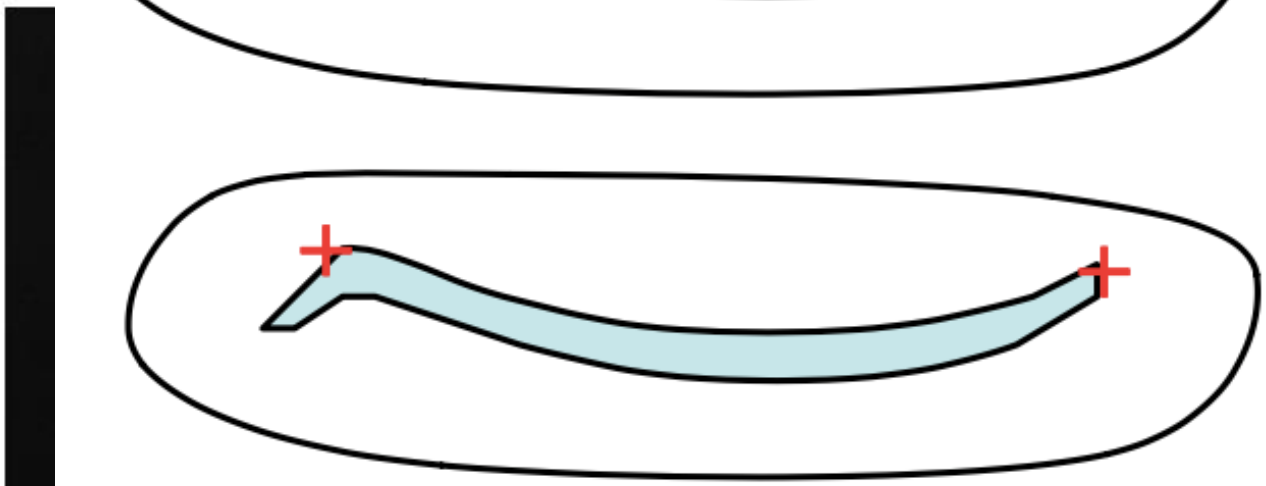
INCORRECT

The two edges of the femur are not clear. The main reason for this is poor magnification



INCORRECT

The greater troc should not be in femur length



CORRECT

SUMMARY:

The femur can be easily recognized between 14 weeks and term gestation

Remember:

Horizontal as possible

Measure the bone closest to the probe.

See the full length of the bone

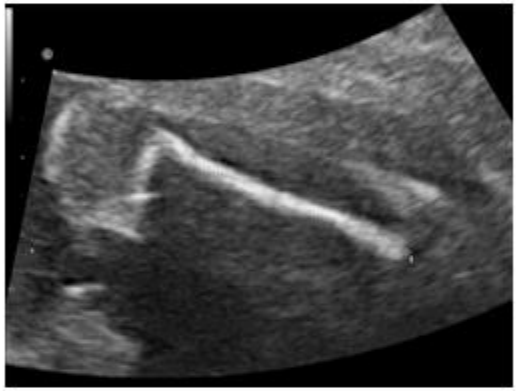
The bone is not obscured by shadows

Magnification

Correct calliper placement

Do not include greater trochanter

15 weeks

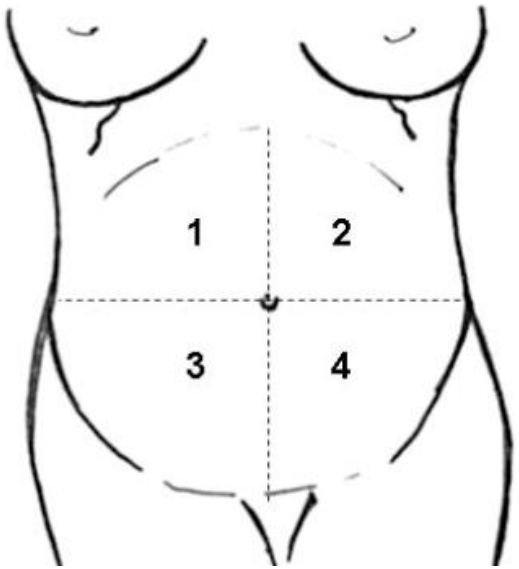


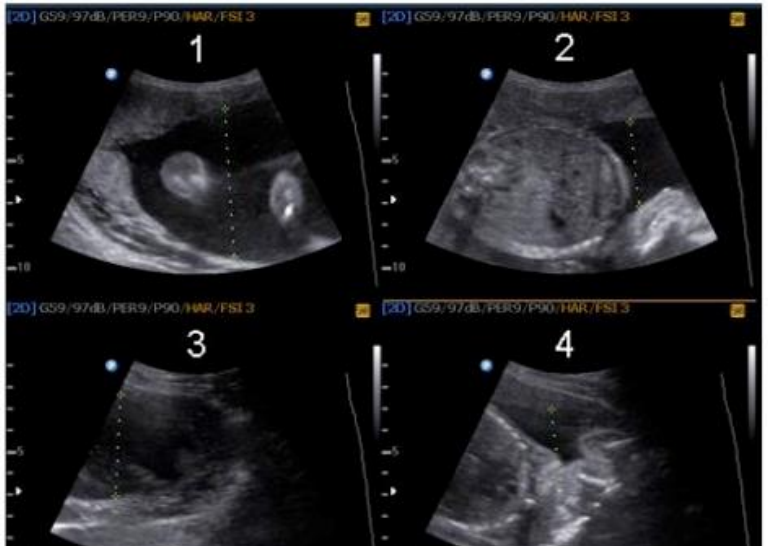
26 weeks

38 weeks

Amniotic Fluid Index

- Divide the uterus into 4 quadrants using the umbilicus as a reference (below 20 weeks the uterus is divided into 4 quadrants using the midline)



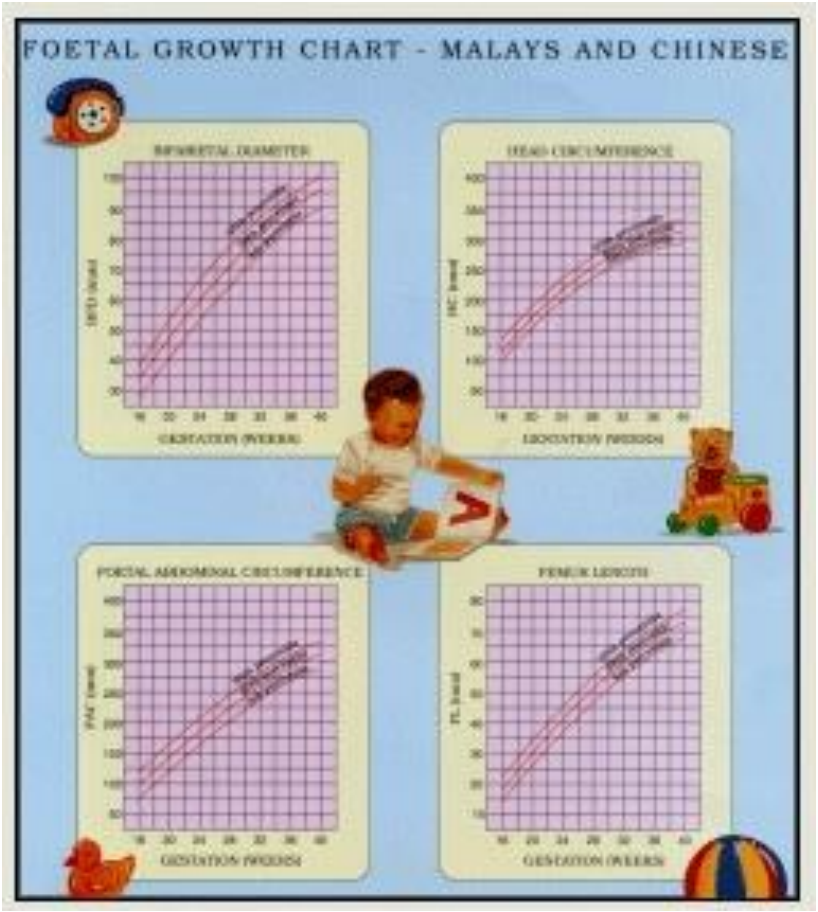


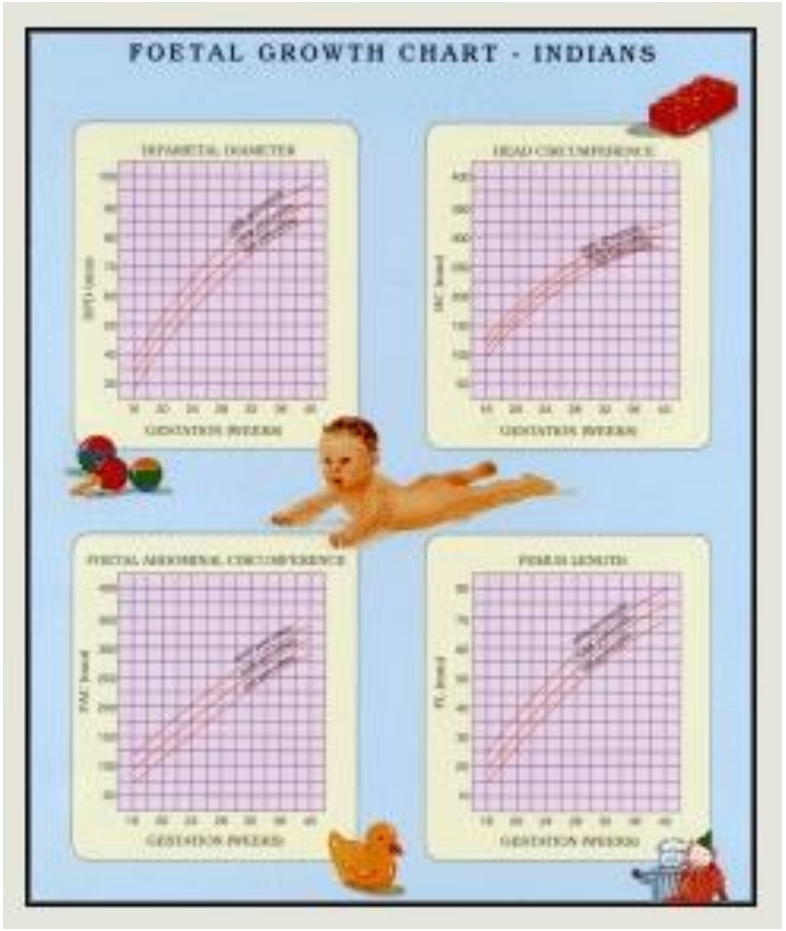
- Hold the probe LONGITUDINALLY to the mother
- Hold the probe at 90^0 to the floor
- Measure the deepest VERTICAL pool in each quadrant which contains no fetal parts or umbilical cord.
- Always measure the 4 quadrants in the sequence (1,2,3,4) shown above.

Which Growth Chart?

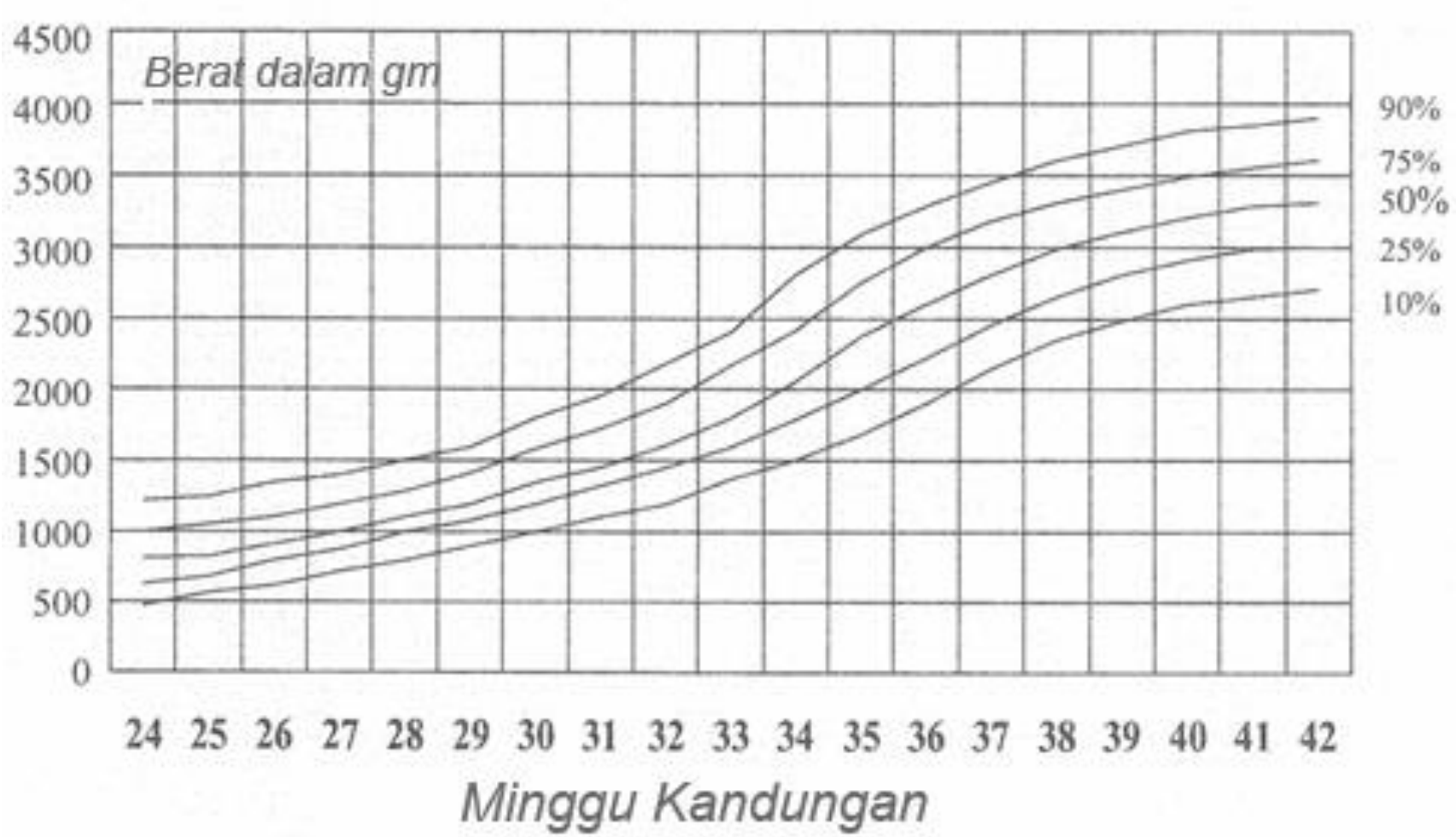
- Population Based Growth Chart
- WHO Growth Chart
- Intergrowth 21st Growth Chart
- Customised Growth Chart

Population Growth Chart – Malaysian Population





Urban



2. WHO Fetal Growth Chart

FIGURE 1
World Health Organization fetal growth chart: estimated fetal weight percentiles

FIGURE 3
World Health Organi… sex-specific growth percentiles for estimated fetal weight

Estimated Fetal Weight (g)

Neutral Chart

1387 low = risk pregnant women

10 countries

Argentina, Brazil, Democratic Republic of Congo, Den… , France, Germany, India, Norway, Thailand - Multipopulation

Participants

Median age 28 years, 58% nulliparous, norm… ocioeconomic or nutritional constraints (median caloric intake, 1840 calories/day) …nd ultrasound sessions, essentially urban populations

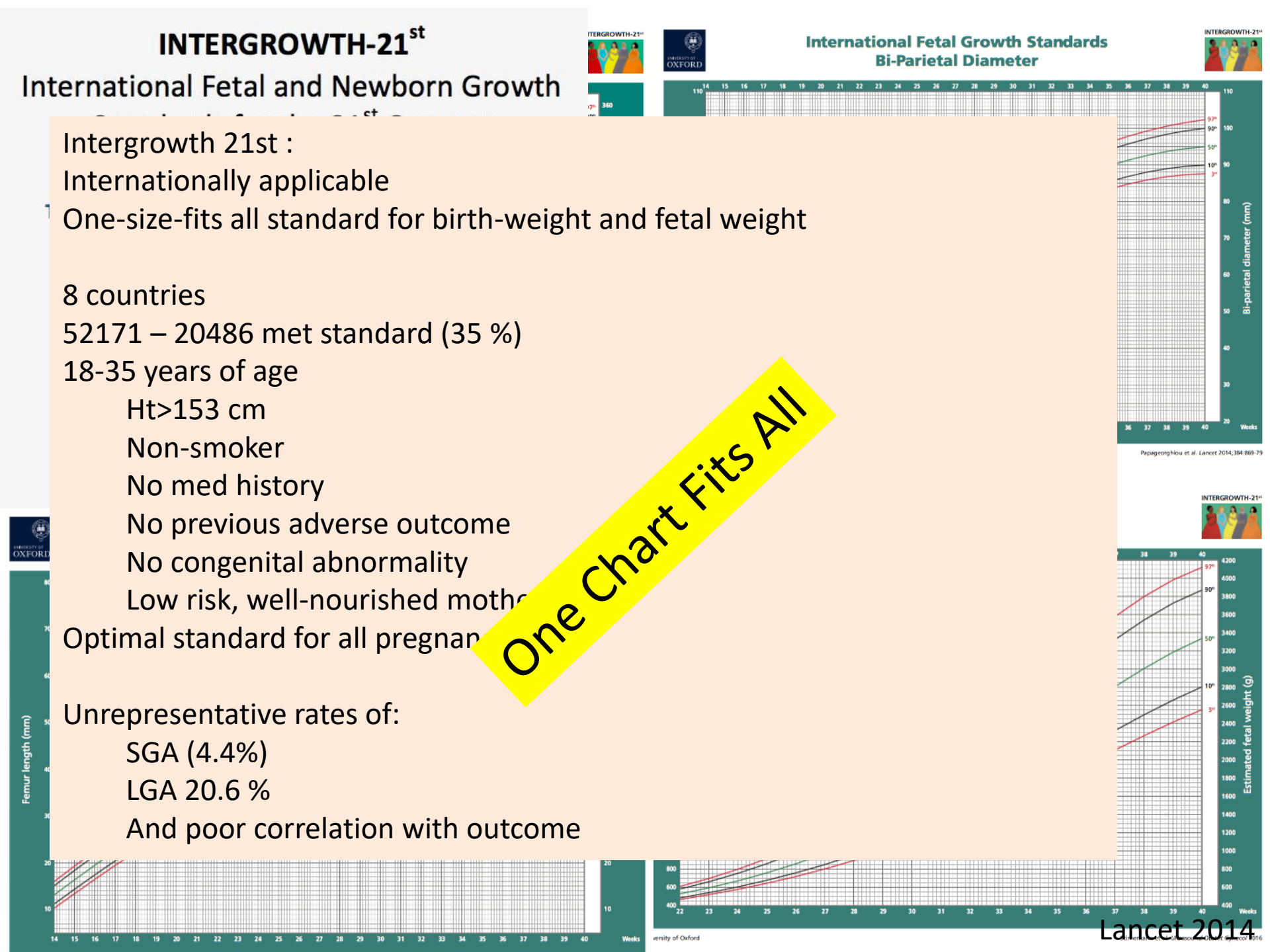
Median gestational age at birth was 3… 3.3kg, - significant differences among country

Quantile regression that made poss… monstrate a number of features of fetal growth that were not well appreciated or un…

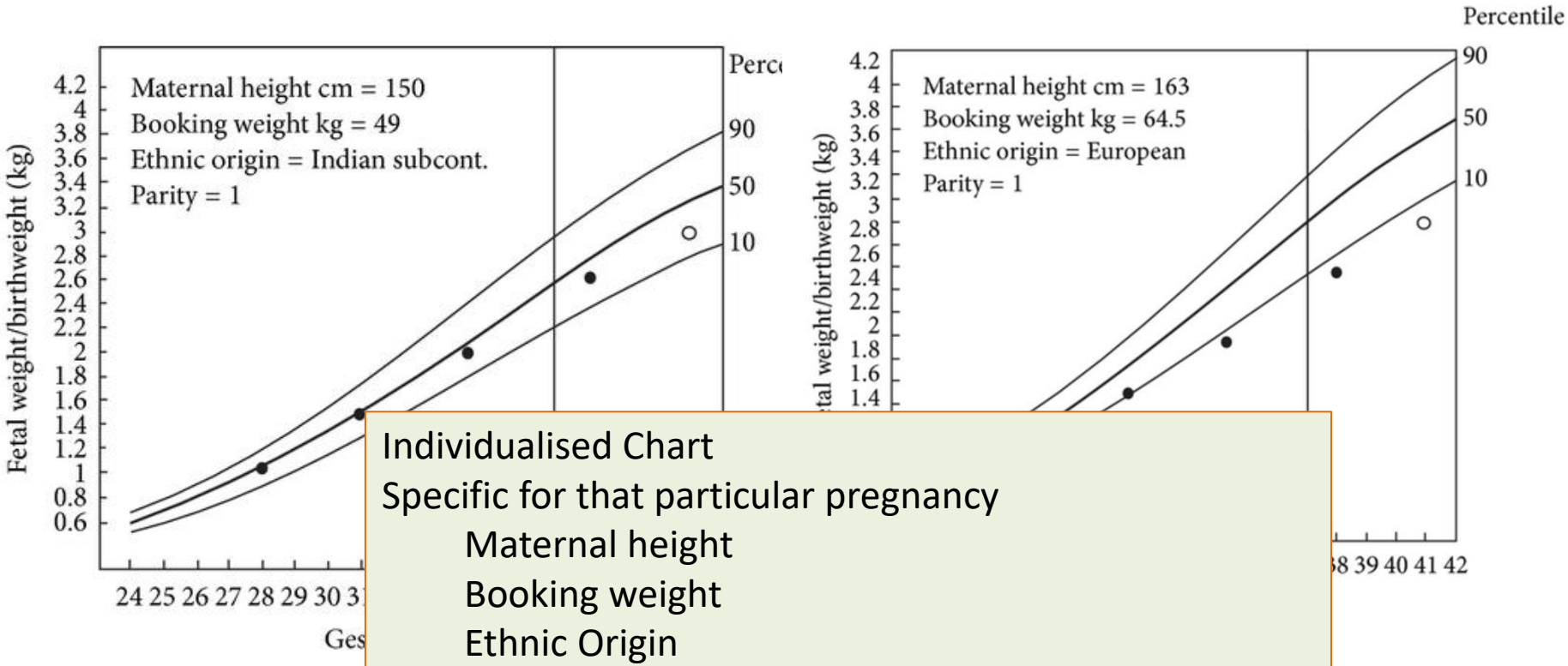
Asymmetric distribution of EFW,

Early second trimester, wider among fetuses <50th

Third trimester reversed


INTERGROWTH-21st
International Fetal and Newborn Growth
International Fetal Growth Standards
Bi-Parietal Diameter
Bi-parietal diameter (mm)
Weeks
Papageorghiou et al. Lancet 2014;384:869-79
Femur length (mm)
Estimated fetal weight (g)
Intergrowth 21st :
Internationally applicable
One-size-fits all standard for birth-weight and fetal weight
8 countries
52171 – 20486 met standard (35 %)
18-35 years of age
Ht>153 cm
Non-smoker
No med history
No previous adverse outcome
No congenital abnormality
Low risk, well-nourished mothe
Optimal standard for all pregnan
One Chart Fits All
Unrepresentative rates of:
SGA (4.4%)
LGA 20.6 %
And poor correlation with outcome
Lancet 2014

CUSTOMISED GROWTH CHART



Individualised Chart

Specific for that particular pregnancy

- Maternal height
- Booking weight
- Ethnic Origin
- Parity

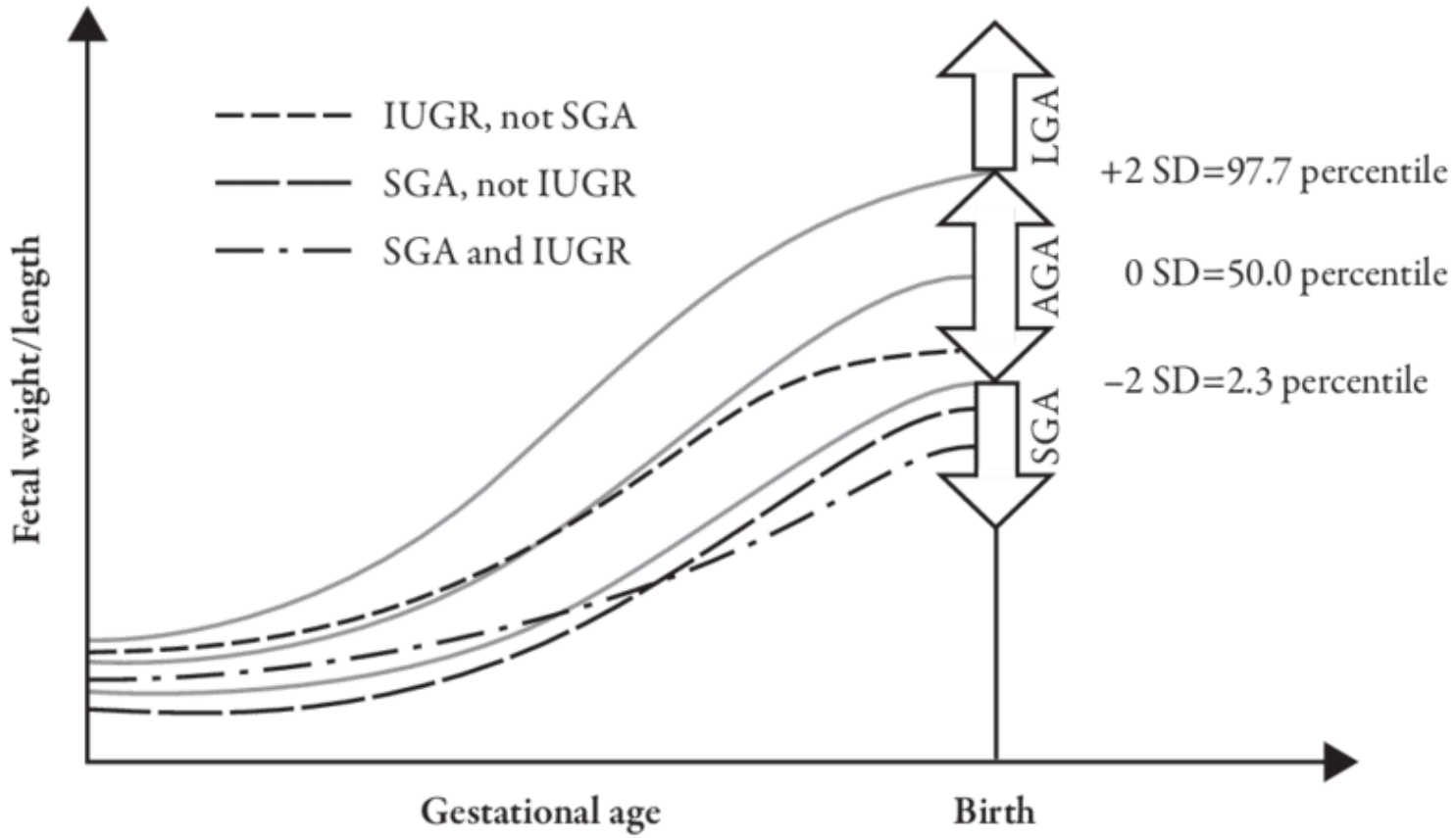
TABLE

Estimated fetal weight from relevant studies presented with 10th and 90th percentiles for selected gestational stages

Variable	Gestational week 20	24	28	32	36
10th Percentile of estimated fetal weight (g)					
United States: white[a]	289	583	1045	1686	2432
Democratic Republic of Congo[b]	288	576	1023	1624	2310
World Health Organization[c]	286	576	1026	1635	2352
United States: black[a]	286	559	985	1579	2264
Norway[d]	283	610	1102	1730	2411
United States: Hispanic[a]	279	555	987	1595	2298
United States: Asian[a]	275	546	978	1574	2262
Intergrowth-21st[e]		602	951	1473	2144
90th Percentile of estimated fetal weight (g)					
Norway[d]	408	833	1472	2304	3230
United States: white[a]	381	771	1391	2276	3368
World Health Organization[c]	380	765	1368	2187	3153
United States: Hispanic[a]	379	755	1353	2209	3245
United States: black[a]	376	742	1317	2135	3115
United States: Asian[a]	373	737	1318	2129	3111
Democratic Republic of Congo[b]	345	700	1277	2083	3032
Intergrowth-21st[e]		751	1276	2089	3089

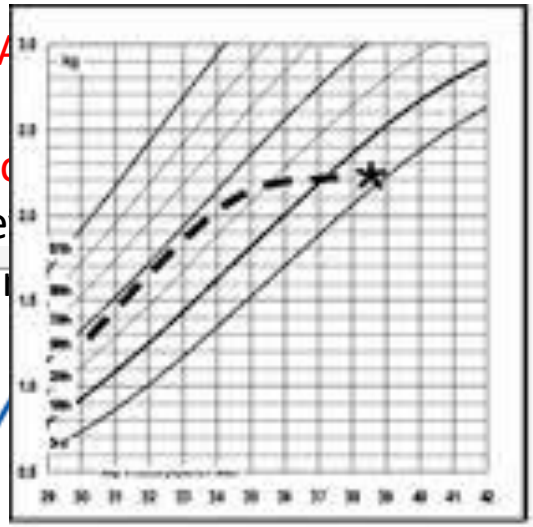
[a] Buck Louis et al[19]; [b] Landis et al[59]; [c] Kiserud et al[16]; [d] Johnsen et al[29]; [e] Stirnemann et al.[18] The World Health Organization study, the National Institute of Child Health and Human Development study from United States, the Intergrowth-21st study, a study from the Democratic Republic of Congo, and another from Norway are listed according to descending values at 20 weeks but are not formally compared or ranked. Modified from Kiserud T, Piaggio G, Carroli G, et al. The World Health Organization fetal growth charts: a multinational longitudinal study of ultrasound biometric measurements and estimated fetal weight. PLoS Med 2017;14:e1002220. With permission.

Kiserud. WHO fetal growth charts. Am J Obstet Gynecol 2018.

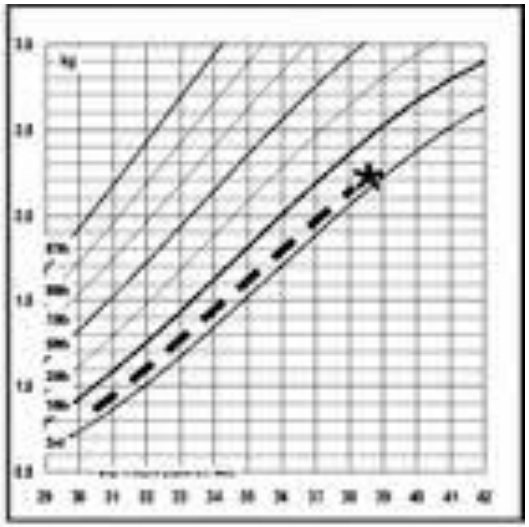

IUGR, not SGA
SGA, not IUGR
SGA and IUGR
LGA
AGA
SGA
+2 SD=97.7 percentile
0 SD=50.0 percentile
−2 SD=2.3 percentile
Fetal weight/length
Gestational age
Birth

IUGR or FGR is defined prenatally by the following:

EFW <p10 based on BPD,HC,AC,FL (A
EFW <p3 (extreme case) WHO
EFW >2SD below mean (<p2.5) (Euro
or Umbilical artery Doppler > p95 (e
or Cerebro-placental ratio > p95 (co



SGA newborn with IUGR



SGA newborn without IUGR

Pattern of fetal growth ★ Neonatal weight

Abritrarily <10th percentile =
SGA (post-natal definition)

Figueras & Gratacos, Fetal Diagnosis and Therapy 2014

Table 2 Ultrasound growth velocities (20–32 weeks, in mm/week) in the optimal appropriate-for-gestational- age (oAGA) and suboptimal appropriate-for-gestational-age group (sAGA)

	Optimal AGA (oAGA) group (n = 365) Bwp50–80	Suboptimal AGA (sAGA) group (*n* = 569) Bwp10–50	P
Abdominal circumference velocity	11.23 ± 1.00(8.19–14.28)	10.72 ± 1.00(7.70–14.00)	<.0001
Head circumference velocity	10.68 ± 0.77 (8.54–13.51)	10.50 ± 0.80 (6.79–12.67)	0.001
Biparietal diameter velocity	3.08 ± 0.27(2.31–3.99)	3.01 ± 0.28(1.96–3.85)	<.0001
Femur length velocity	2.50 ± 0.22(1.89–3.01)	2.47 ± 0.21(1.54–3.08)	0.014

Data are expressed as mean ± standard deviation (min-max)

Table 3 Neonatal outcomes in the optimal appropriate-for-gestational-age (oAGA) and suboptimal appropriate-for-gestational-age (sAGA) group

	Optimal AGA (oAGA) group (*n* = 365) Bwp50–80	Suboptimal AGA (sAGA) group (*n* = 569) Bwp10–50	P
Composite adverse neonatal outcome	25 (6.8%)	37 (6.5%)	*P* = 0.919
Hypoglycemia	23 (6.3%)	52 (9.1%)	*P* = 0.139
NICU stay (yes/no)	26 (7.1%)	35 (6.2%)	*P* = 0.588
Hospital stay (yes/no)	145 (39.7%)	226 (39.7%)	*P* = 0.998
Metabolic acidosis	14 (5.2%)	29 (6.5%)	*P* = 0.520
APGAR 5 min < =5	5 (1.4%)	6 (1.1%)	*P* = 0.759
APGAR 5 min < =3	0 (0%)	2 (0.6%)	*P* = 0.523

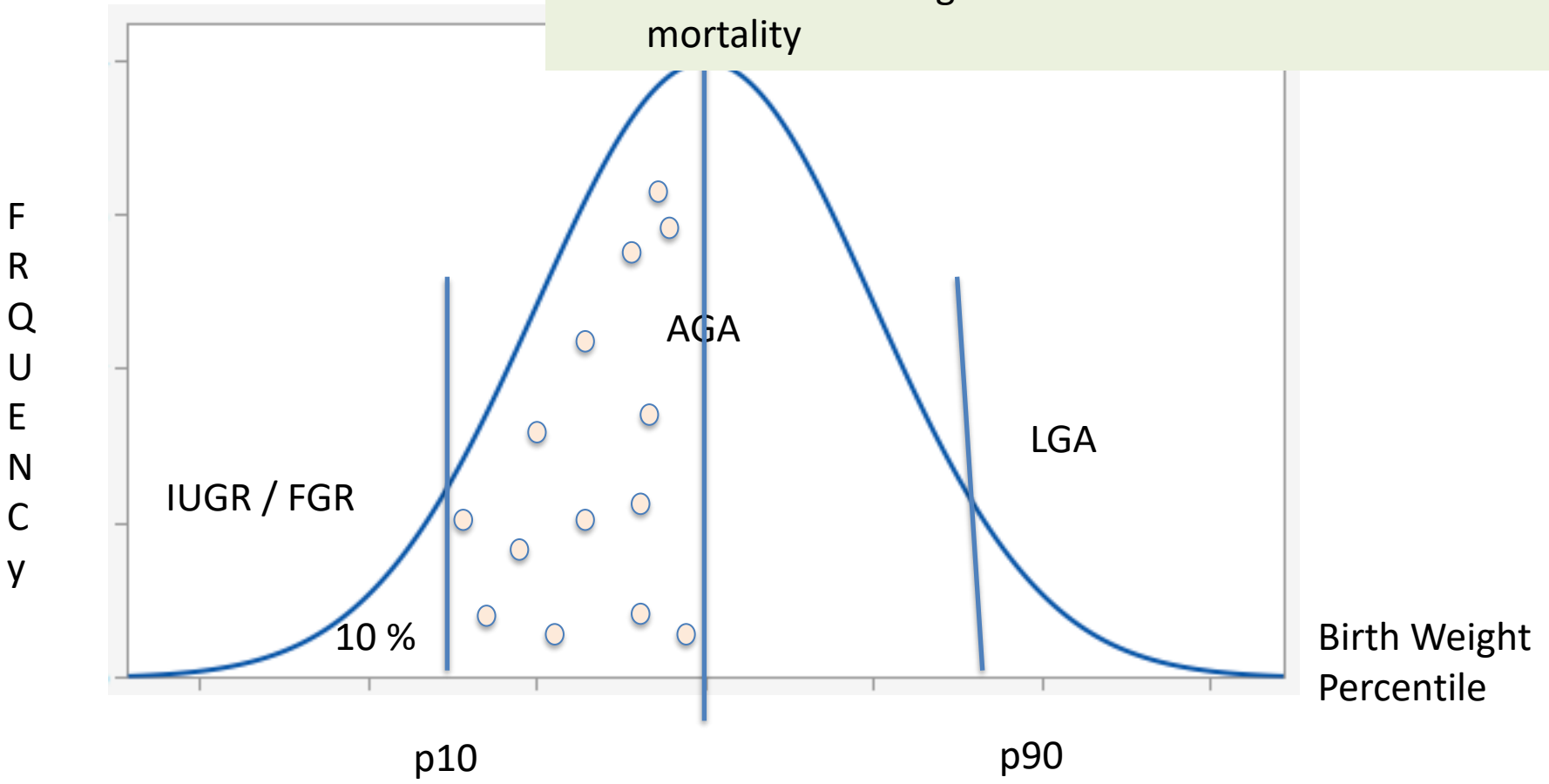
Data are expressed as *n* (%). Composite adverse neonatal outcome: asphyxia, sepsis, respiratory distress syndrome and transient tachypnoea of the newborn. NICU, neonatal intensive care unit. Metabolic acidosis, blood pH < 7.0 and base deficit > 12 mmol/L

Hendrix et al, BMC,Pregnancy and Childbirth 2019

LGA :
a birth weight ≥ p90 at given gestational age

Macrosomia growth beyond a specific weight, 4,000 gram or 4,500 grams regardless of gestational age

- Grade 1 : > 4000 gm : increased risk of labor and newborn complications
- Grade 2 : > 4500 gm : increased risk of neonatal morbidity
- Grade 3 : > 5000 gm : increased risk of infant mortality



Hendrix et al, BMC,Pregnancy and Childbirth 2019

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EFW <p3 (extreme case) WHO
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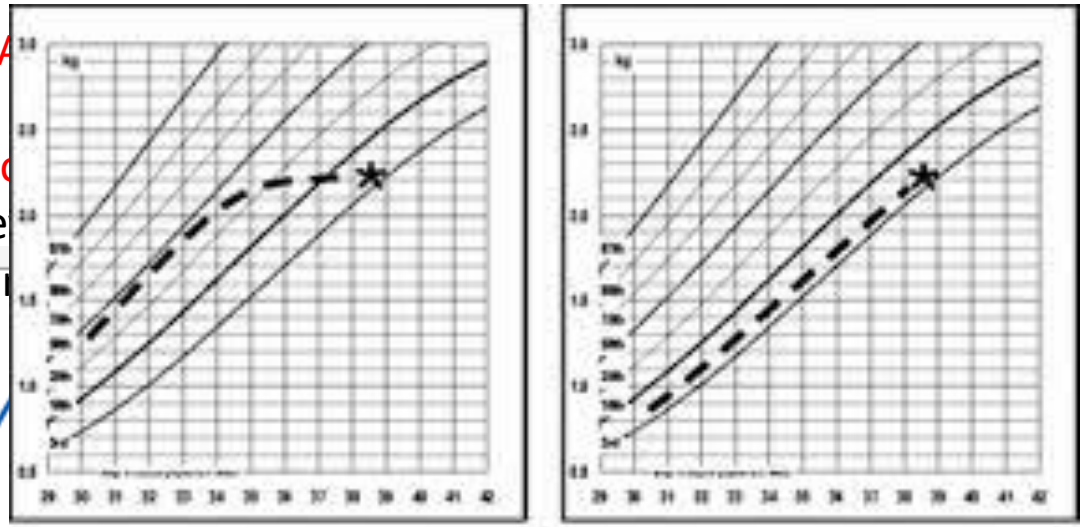
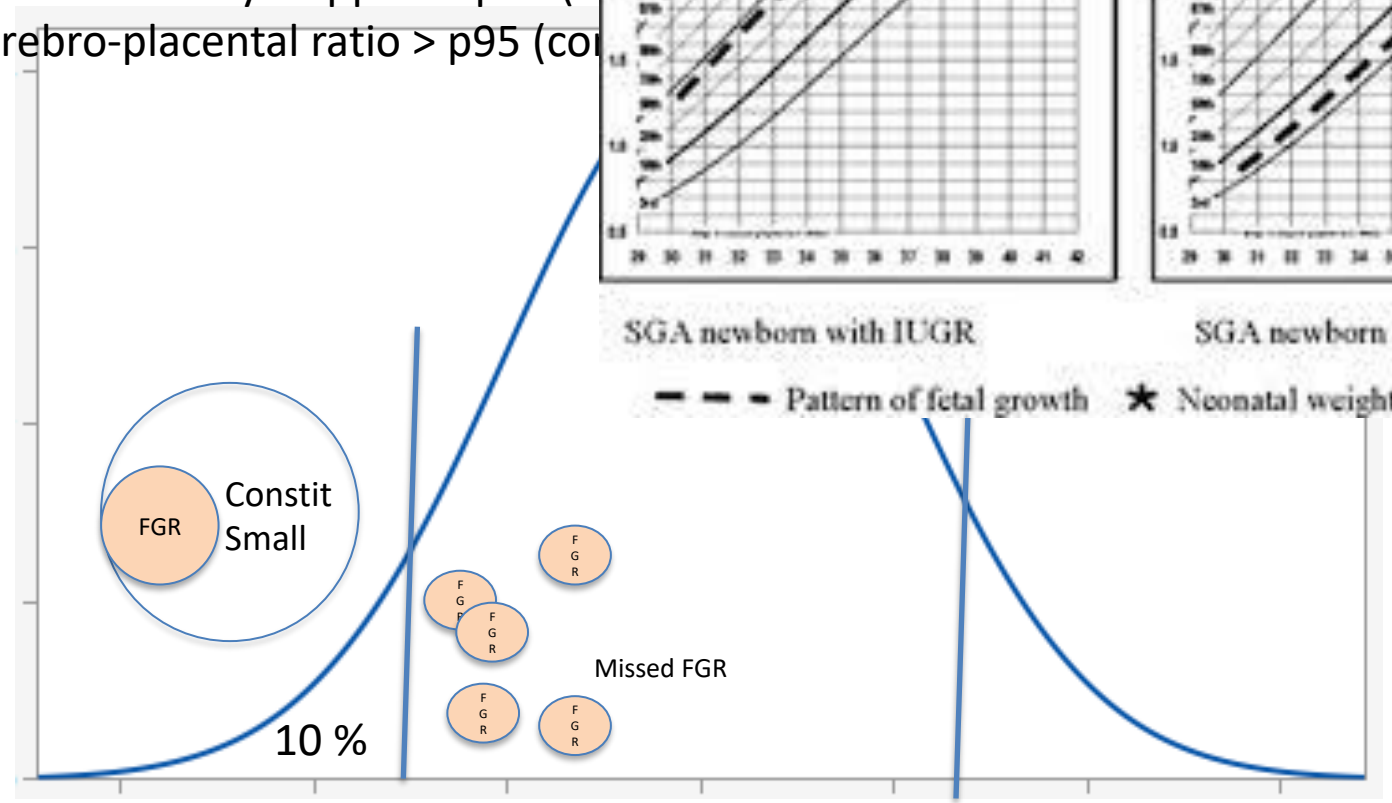
or Umbilical artery Doppler > p95 (e
or Cerebro-placental ratio > p95 (co



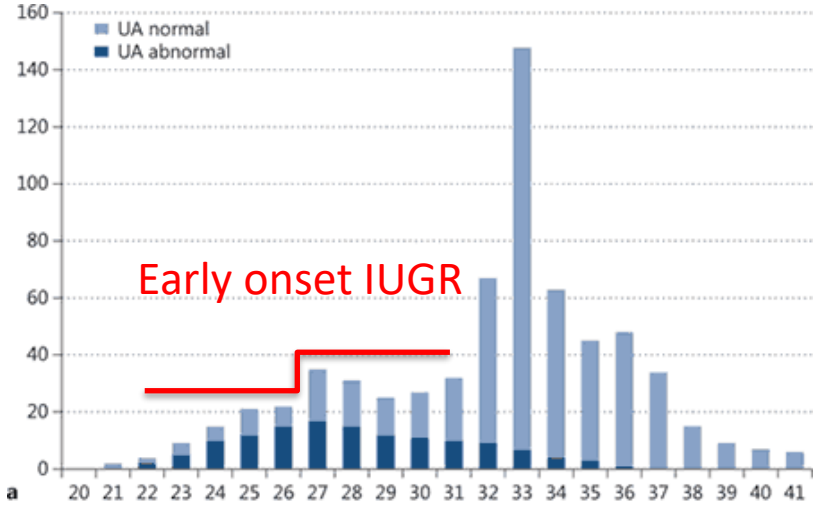


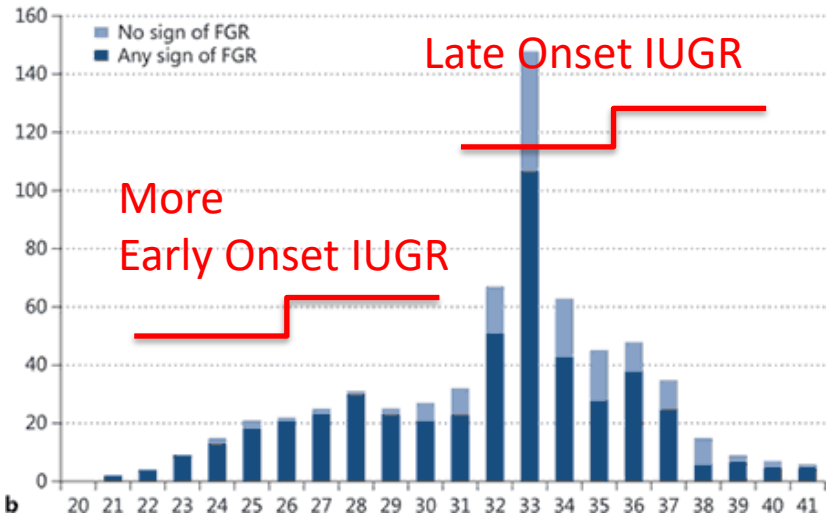
Abritrarily <10th percentile =
SGA (post-natal definition)

Figueras & Gratacos, Fetal Diagnosis and Therapy 2014

IUGR/FGR: Prenatal Definition

Proportion of SGA Fetuses (n: 656) Diagnosed to be IUGR

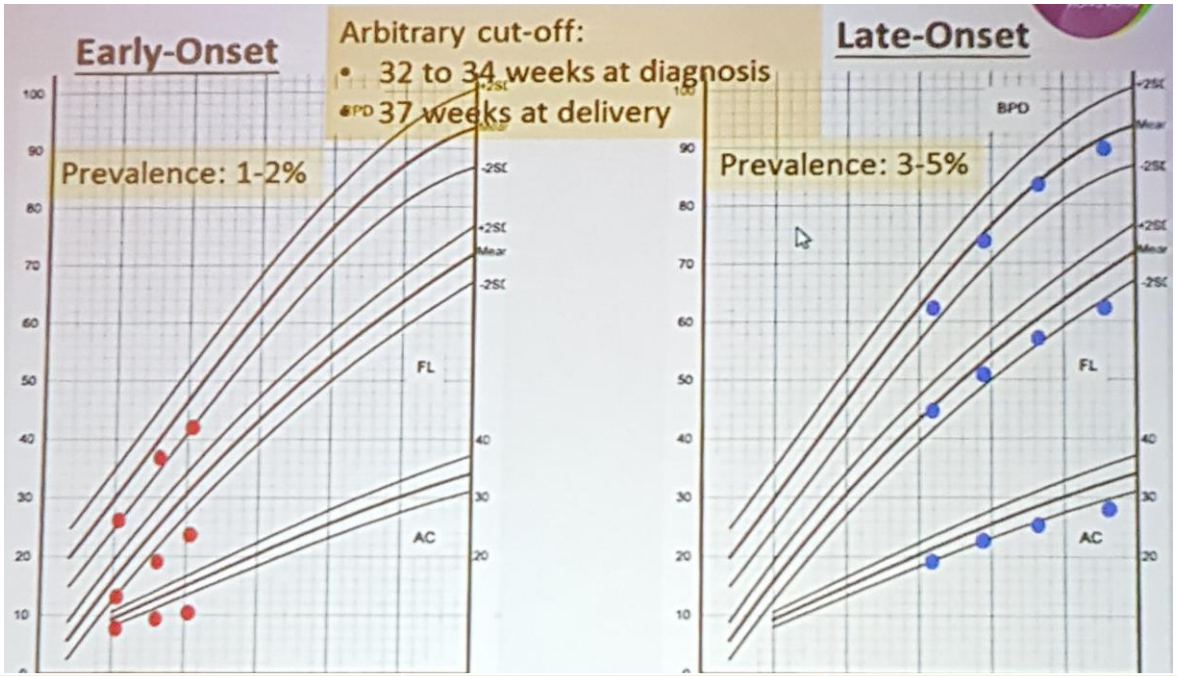




Defined by :
Umbilical artery Doppler >p95 alone

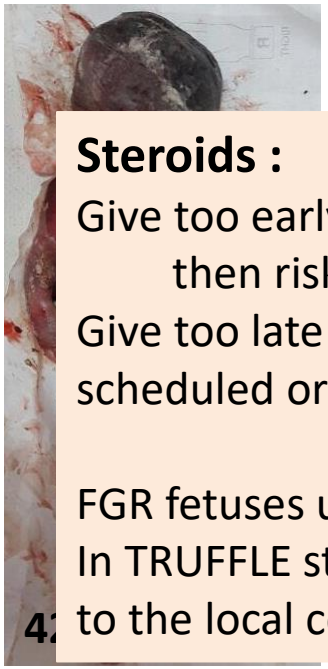
Defined by any of the following:
Umbilical artery Dopper >p95
EFW <p3
Cerebroplacental ratio (CPR) >p95

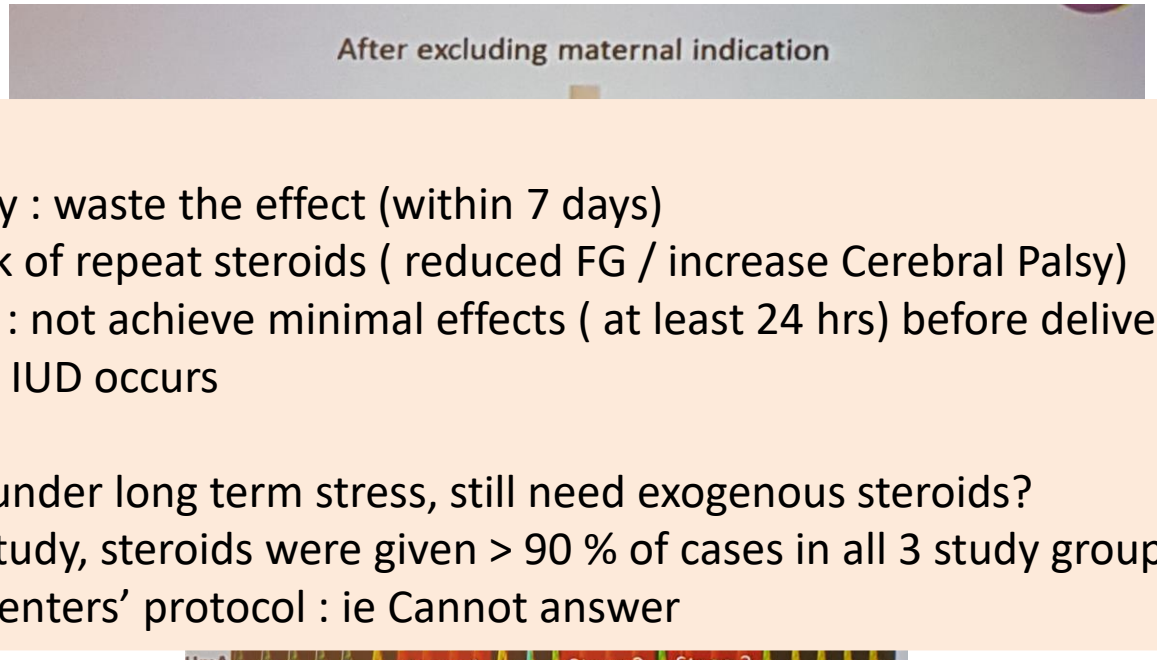
Early-onset vs Late-onset

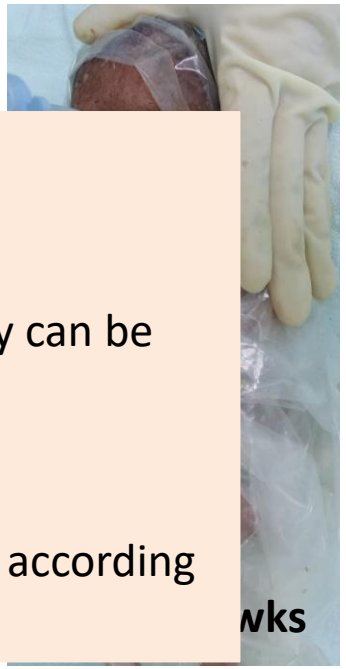


Early-Onset IUGR	vs	Late-Onset IUGR
1-2 %	Prevalence	3-5 %
More severe abn Um A	Doppler	Less severe UmA
High tolerance	Tolerance to hypoxia	Less tolerance
Management	Problem	Diagnosis
High	Mortality and Prematurity	Lower

Early-onset IUGR







Steroids :

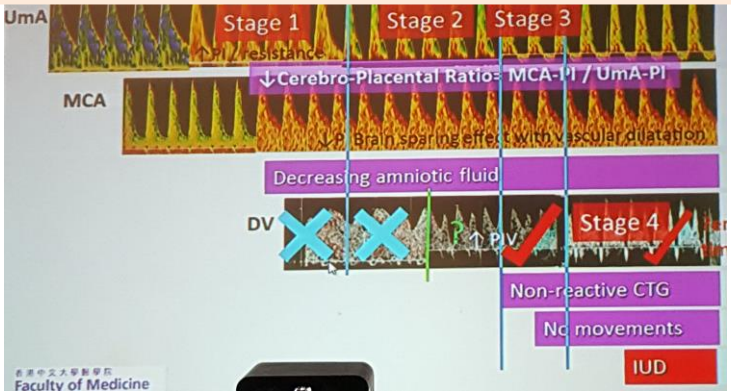
Give too early : waste the effect (within 7 days)

then risk of repeat steroids (reduced FG / increase Cerebral Palsy)

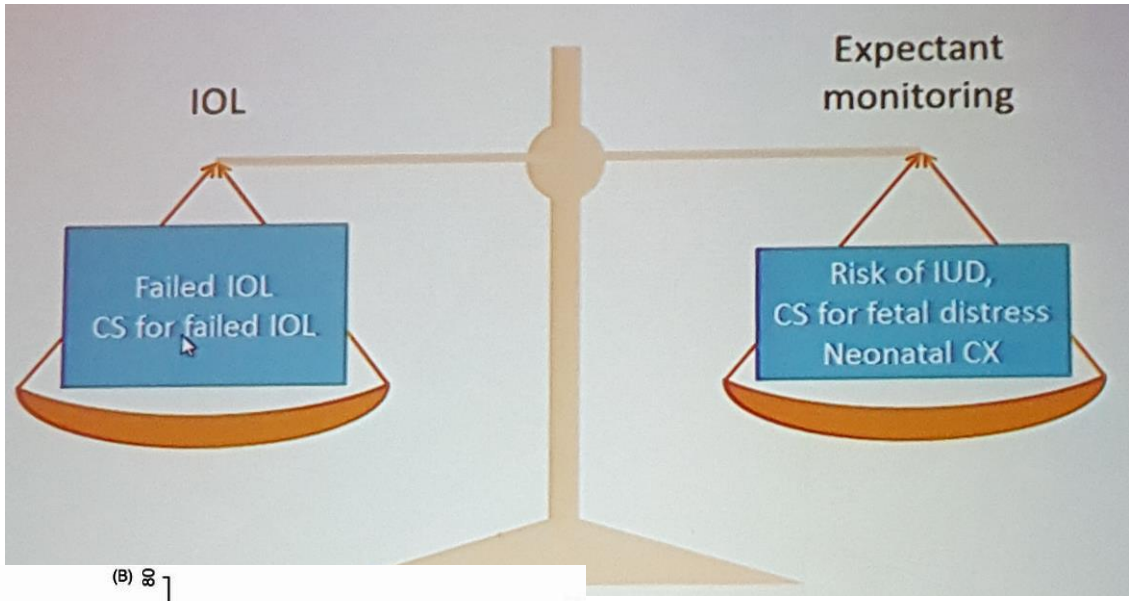
Give too late : not achieve minimal effects (at least 24 hrs) before delivery can be scheduled or IUD occurs

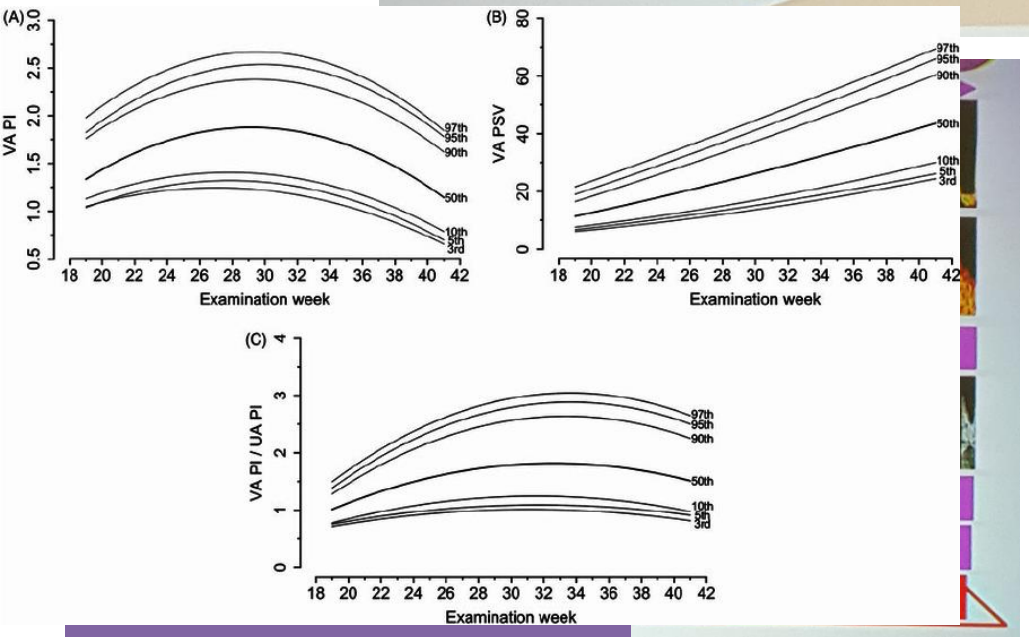
FGR fetuses under long term stress, still need exogenous steroids?

In TRUFFLE study, steroids were given > 90 % of cases in all 3 study group, according to the local centers' protocol : ie Cannot answer



Late-Onset IUGR





Delivery based on : MCA Doppler
Cerebro : Placenta Ratio CPR < 1 poor perinatal outcome
Delivery at 37 weeks with increase UA-PI
Delivery at 37-38 normal UA-PI but with abnormal MCA
IOL but increase rates of EmCS

Turan et al Ultrasound Obstet Gynecol 2008
De-Vore, Am J. Obstet Gynecol, 2015

TAKE HOME MESSAGE

- Perinatal and Stillbirth - still high as late detection of fetal growth abnormalities
- Accurate Dating is emphasized
- Appropriate Ultrasound Biometry Measurement
- The Right Growth Chart
  - Time to use Customised growth chart!
  - At least WHO growth chart
- Management of IUGR
  - Early-onset (Fetal Doppler) vs Late-onset IUGR (CPRatio <1)

Thank You