compared with acquiring the plane without using the FP, regardless of sonographer seniority (95% CI <4% versus <6% for intra- and <7% versus <8% for interobserver reproducibility respectively) (table 1: AC data reported).

Conclusions: Fetal biometry reproducibility is higher with the use of FP for plane acquisition regardless of sonographer experience. We propose this method to be used for clinical practice and training.

VP34.02: Table 1. Intra- and interobserver reproducibility for AC. Values are expressed as a percentage in order to account for changes in fetal size with advancing gestation

		Mean difference, mm (%)	±95% Confidence interval, mm (%)
Abdominal circumference			
Junior	Intraobserver no FP	-1.22 (-0.40)	13.48 (5.14)
	Intraobserver FP	0.08 (-0.01)	8.21 (3.29)
Senior	Intraobserver no FP	0.63 (0.28)	15.04 (5.52)
	Intraobserver FP	-0.04 (-0.06)	7.24 (2.80)
Junior vs senior	Interobserver no FP	0.09 (0.05)	20.36 (7.67)
	Interobserver FP	0.29 (0.08)	17.43 (6.59)

VP34.03

Using artificial intelligence to identify fetal anatomy for biometry: image selection and efficiency

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Objectives: Standard fetal anatomic imaging planes are required to acquire biometric measurements necessary to estimate fetal weight (EFW). We evaluated a novel investigational artificial intelligence (AI) software to assess its ability to automate image selection of the fetal head, abdomen and femur during obstetric ultrasound. Comparisons of manual and AI acquisition were completed to determine clinical acceptability of images as well as an evaluation of workflow efficiency.

Methods: We conducted a prospective cohort study. 80 patients with a normal fetus were enrolled between 18 and 24 weeks of gestation. Images of the standard fetal anatomic planes of the head, abdomen and femur for biometric measurement were acquired in real-time manually and with AI on a Philips EPIQ Elite system. The primary outcome evaluated the clinical acceptability of the manual and AI acquired images as judged by an expert reviewer (MR). Secondary outcomes evaluated workflow efficiency including the average time, number of keystrokes and screen touches required for the fetal biometry exam.

Results: AI-detected images of the head, abdomen and femur were found to be clinically acceptable in 92%, 96% and 98% of exams, respectively. Further, the proportion of clinical acceptability were similar for AI and manual methods with differences of 4%, 2%, and 1%, respectively for the head, abdomen and femur. With the use of AI, the average number of keystrokes decreased by 14.6 ($p<0.0001$) and the number of screen touches decreased by 1.8 ($p<0.0001$). Over all 80 patients, the average duration of the AI exam was 14.8 seconds longer compared to manual acquisition ($p=0.0001$). A software modification, enabling additional user interaction for difficult cases, resulted in comparable exam times (82.4s AI vs. 82.5s manual) for the final 39 patients.

Conclusions: AI detection of standard fetal biometric imaging planes is comparable to manual acquisition during mid-trimester obstetric ultrasounds and demonstrated significant improvements in workflow efficiency.

VP34.05

Ultrasound ergonomics: scanning techniques leading to work-related musculoskeletal disorders

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Objectives:

1. To identify the scanning techniques leading to discomfort/pain amongst postgraduate students and qualified radiographers;
2. To explore the area of the body affected by discomfort/pain while performing ultrasound scanning;
3. To determine the scanning techniques that impede the participants from ergonomic ultrasound scanning and potentially leading to the development of WRMSDs;
4. To investigate the participants' suggestions for further education in ultrasound ergonomics.

Methods: Prior to conducting the research process ethical approval and permission were obtained. A mixed-methods approach using quantitative and qualitative methods was considered appropriate through the use of a self-designed questionnaire. Prior to data collection, the tool was tested for validity and reliability. Statistical tests were used to analyse the quantitative data while content analysis was used for the qualitative element.

Results: The results obtained showed that the respondents (72%, N = 25) do scan in discomfort/pain. The wrist was the area of the body most affected while performing ultrasound scanning. The workload and the number of unnecessary patient requests impeded the participants from carrying out ergonomic scanning. The lack of ergonomic equipment such as the scanning table and the scanning of obese patients were also observed as impeding from performing ergonomic ultrasound scanning techniques. The study found that the distraction from telephone and mobile phones did affect the participants from using ergonomic scanning techniques.

Conclusions: The study concluded that despite scanning in discomfort/pain the participants did not report their discomfort/pain to the health and safety officer of their department. The respondents also felt the need for ultrasound ergonomic awareness in their departments and therefore improvements in ultrasound equipment would aid the sonographers to perform good ergonomic scanning leading to the prevention of WRMSDs. The study also concluded the need for further education in ultrasound ergonomics through workshops and clinical training.

VP34.06

Optimisation criterion for pulsatile timing: observation in the human fetus

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Objectives: Pulsatile cardiac action is an energy consuming process. During pulse wave (PW) travel to the periphery, reflection back to the LV occurs. The concept of wave condition number, WCN, provides evidence that energy consumption of cardiac action is minimised

when time of return Tr to LV takes a certain percentage of the cardiac cycle T. Our objective was to assess WCN and reflection timing Tr/T in the human fetus.

Methods: Based on the WCN relation: $WCN = HR \times L/PWV$, energy consumption of pulsatile LV action is optimised for WCN ≈ 0.1 (HR: heart rate, L: effective aortic length, PWV: aortic PW velocity; *Pahlevan* 2014, 2020). Rearranging with $Tr = 2L/PWV$ (figure) yield $Tr/T = 0.2$ as optimal reflection timing.

To obtain Tr in the fetus by Doppler, hemodynamic modelling is required (figure): PWs arrive twice at cerebral circulation: 1st as a primary wave and 2nd after reflection and return. A systolic shoulder (S) in MCA Doppler (MCA-S) represents this 2nd impulse and delay $\triangle t$ corresponds to Tr (*Mills* 1970).

Results: Tr data of IUGR fetuses with MCA-S were obtained by this method (*Gonser* 2018): $Tr = 96 \pm 15$ms (GA 31 ± 3w). $T = 423$ms (FHR 140bpm) yield $Tr/T = 96ms/423ms = 0.23$, showing good agreement with optimal reflection timing of 20%, as suggested by the WCN.

Conclusions: In spite of circulatory stress, IUGR fetuses maintain nearly optimal pulsatile timing, probably due to the priority of minimal energy consumption. Thus appearance of MCA-S is not an artifact, but a sign of nearly optimal timed PW reflection.

Supporting information can be found in the online version of this abstract

VP34.07

Competency-based assessment of obstetric Doppler training outcome in an ISUOG-accredited program in Nigeria

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Objectives: The ratio of trained personnel in fetal assessment to obstetric population is suboptimal in developing countries. This study aims to assess the improvement in fetal Doppler skills of participants at an ISUOG-accredited advanced obstetric ultrasound workshop, using four fetal vessels.

Methods: During the 5-day program at Benin, Nigeria between 17–21 June 2019, 17 out of 55 participants were randomly selected for pre- and post-workshop assessment of competence on fetal middle cerebral artery (MCA), umbilical artery (UA), uterine artery (UtA) and ductus venosus (DV) Doppler. Pre-assessment scoring standardisation on vessel acquisition, Doppler-gate and angle-orientation, sonogram quality and Image optimisation was done for four accredited trainers that conducted the assessment. Possible overall score ranged between 4–16, with 12 as cut-off for proficiency. Scores were compared with paired t-test while determinants of outcome were assessed with regression analysis. $p < 0.05$ was taken as statistically significant.

Results: There was significant improvement in the mean post-workshop scores compared with the initial assessment for the UA (12.1 ± 1.8 vs. 4.7 ± 1.6; $p < 0.001$), UtA (9.5 ± 1.0 vs. 4.1 ± 0.1; $p < 0.001$) and MCA (9.0 ± 0.7 vs. 4.47 ± 0.2; $p < 0.001$) but not with DV (4.2 ± 0.2 vs. 4.1 ± 0.1; $p = .543$). None of the participants demonstrated competence pre-training, while 12 (70.65%), 6 (35.3%) and 4 (23.5%) of them achieved competence post-training for UA, UtA and MCA Dopplers respectively. There was none for DV. Previous practical training on obstetric ultrasound ($p = 0.02$) was the only significant predictor of competence.

Conclusions: Although there was significant improvement among the participants for UA, UtA and MCA Doppler post-assessment, training to competence within five days only appeared feasible with the umbilical artery Doppler. Continuous training is advised to achieve a critical mass of personnel needed to improve obstetric care in Nigeria.

VP34.08

Long-term evaluation of retention of acquired ultrasound theoretical knowledge and skills following an intensive ISUOG ultrasound course in the Sultanate of Oman

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Objectives: Current practice in the theoretical knowledge and practical skills in the field of gynecological and obstetrical ultrasound is of paramount importance. Outreach programs aim to provide essential skills in countries where ultrasound is infrequently practice; however, participants ifrequently encounter knowledge and skills retention difficulties, after completion of the program. The purpose of the present study is to present data on long-term retention of knowledge and skills following the completion of a structured program of obstetrical and gynecological ultrasound offered by ISUOG.

Methods: The study was based on data retrieved following the completion of an intensive ultrasound course carried out by ISUOG Outreach and which took place in Oman. Retention of theoretical knowledge and practical skills were assessed at 5 and 14 months following the completion of the initial course.

Results: During the second week, we noted a decline in the theoretical knowledge and practical skills, which was attributed to the limited use of ultrasound in clinical practice of trainees. Taking this limitation in mind, a structured electronic communication using instant messaging educational media was formed in order to help increase trainees' confidence and knowledge as well as their practical skills. Following this, a significant improvement in theoretical and practical skills was observed, with the exception of the achievement of competence in retrieving and analysing difficult sonographic planes/images, such as abdominal circumference or the 4-chamber view of the heart.

Conclusions: Intensive outreach ultrasound training programs aim to offer condensed knowledge and skills to trainees. However, their retention on a long term basis is difficult to achieve. Close monitoring of trainees and follow-up courses are essential to help boost knowledge, confidence, and skills so that trainees may effectively improve their clinical services.

VP34.09

Abstract withdrawn