MATERNAL OBESITY AND ULTRASOUND MEASUREMENT ACCURACY: AN EXPLORATORY STUDY OF RADIOGRAPHERS/SONOGRAPHERS PERCEPTIONS AND PRACTICES IN EDO STATE, NIGERIA

BY

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OCTOBER, 2025

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF RADIOGRAPHY, COLLEGE OF MEDICAL SCIENCES,

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BACHELOR OF SCIENCE (B.Sc) DEGREE IN RADIOGRAPHY

OCTOBER, 2025

CERTIFICATION

This is to certify that this research was carried out by ISERHIENRHIEN LUCKY, with the matriculation number BMS2009021 under the supervision of MR C.V. MBIAKU. in Partial fulfilment for the award of Bachelor of Radiography (B.RAD) Degree of the Department of Radiography, School of Basic Medical Sciences, College of Medical Sciences, University of Benin, Benin City, Edo State.

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EXTERNAL EXAMINER DATE

DEDICATION

This work is dedicated to God almighty who has given me the strength to finish well and also to my dedicated and faithful parents, Mr and Mrs ISERHIENRHIEN SUNDAY for the unshaken support towards my education, care and love, to my mentors and spiritual leaders and siblings, I'm indeed grateful to you all, thank you and God bless you all.

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ABSTRACT

The rising global prevalence of maternal obesity (MO) poses a significant challenge to antenatal ultrasound imaging, as increased maternal adipose tissue attenuates sound waves, potentially compromising the quality and accuracy of fetal biometric measurements. Despite the acknowledged impact on measurement accuracy, there is a limited understanding of the specific lived experiences and professional practices of the frontline practitioners in Nigeria. This exploratory study aimed to gain a deeper understanding of the perceptions, technical challenges, and adaptive practices of radiographers and sonographers when performing obstetric ultrasound examinations on pregnant women with MO in Edo State, Nigeria.

A quantitative exploratory study was conducted using structured questionnaires administered to 60 radiographers and sonographers actively performing obstetric scans in various diagnostic centers and hospitals across Edo State. The findings revealed that a majority of participants "sometimes" (46.67%) or "frequently" (38.33%) encounter patients with maternal obesity in their daily practice, confirming this as a routine clinical issue. The study documented their subjective perceptions of poor image quality, specific technical difficulties (such as probe penetration and artifact management), their confidence levels in measurement accuracy, and the diverse strategies and techniques employed to optimize image acquisition.

The conclusions underscore the persistent technical and practical challenges faced by sonographers in this region and advocate for the development of tailored scanning protocols and targeted educational programs to better equip practitioners. This will ultimately improve the consistency and quality of antenatal care provided to this vulnerable patient population.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The global health landscape is witnessing a dramatic rise in maternal obesity, defined as a pre-pregnancy Body Mass Index (BMI) of 30 kg/m² or greater, reaching epidemic proportions globally (World Health Organization, 2021). This escalating trend carries profound implications for both maternal and fetal health outcomes, presenting a critical challenge in contemporary obstetric care. Pregnant women with obesity face a heightened risk of serious complications, including gestational diabetes, pre-eclampsia, preterm birth, macrosomia, and stillbirth (Dodd et al., 2017; Lashen & Penman, 2018).

Antenatal ultrasound stands as an indispensable cornerstone of modern obstetric care, offering vital insights into fetal growth, anatomy, gestational age, and amniotic fluid volume (Hadlock et al., 1991). The accuracy of these ultrasound measurements is paramount for appropriate clinical decision-making, guiding crucial interventions such as timing of delivery, screening for anomalies, and managing potential complications. However, the increased adipose tissue characteristic of obese pregnant women presents a significant technical hurdle, potentially impeding the transmission and reception of ultrasound waves. This interference can compromise the quality and accuracy of these critical measurements. This technical challenge directly impacts the daily practice of radiographers and sonographers, who are at the forefront of acquiring these images and measurements. Their experiences, perceptions of difficulty, and adaptive practices are crucial for a comprehensive understanding of the true impact of maternal obesity on ultrasound services.

Moreover, the prevalence of maternal obesity in Nigeria, particularly in the South South Region, is a growing concern, mirroring the global trend (W orld Health Organization, 2021). This regional context adds another layer of complexity to the challenges faced by healthcare professionals, including radiographers and sonographers, in providing optimal antenatal ultrasound services.

1.2 Statement of the Problem

Despite the growing prevalence of maternal obesity and the critical role of ultrasound in antenatal care, there remains a notable gap in the literature regarding the lived experiences and practical challenges faced by the professionals who perform these scans. Existing studies have predominantly concentrated on the quantitative implications of obesity—such as reduced measurement accuracy or discrepancies in fetal weight estimation—while paying limited attention to how these challenges manifest in real clinical practice. Specifically, there is insufficient evidence on the unique difficulties sonographers encounter when scanning obese pregnant women, including issues related to poor image quality, increased attenuation, prolonged scan time, and physical strain. Furthermore, little is known about the adaptive strategies and techniques they use to overcome these limitations or the extent to which they feel confident in the measurements obtained.

This gap is even more pronounced in low-resource settings such as Nigeria, where equipment limitations, lack of standardized imaging protocols, and minimal specialized training may further compromise diagnostic accuracy. Yet, very few studies have explored how these contextual constraints interact with maternal obesity to influence ultrasound practice. As a result, policymakers, educators, and healthcare facilities lack adequate evidence to guide improvements in training, equipment allocation, and clinical protocols.

This study therefore addresses this gap by examining the perceptions, challenges, and coping strategies of radiographers and sonographers in Edo State. By focusing on their experiences within a resource-limited environment, the research provides insights that are largely absent from current literature and essential for strengthening obstetric ultrasound practice in populations affected by maternal obesity.

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1.3 Research Question

This study aims to explore the following central research questions:

1. What are the perceptions of radiographers and sonographers in Edo State, Nigeria, regarding the accuracy of ultrasound measurements in pregnant women with maternal obesity?
2. What challenges do radiographers and sonographers face when performing obstetric ultrasound scans on obese pregnant women?
3. What current practices and techniques are employed by radiographers and sonographers to maintain scan quality in pregnant women with maternal obesity?

1.4 Aim of the Study

The aim of this exploratory study is to gain a deeper understanding of the professional experiences, challenges, and adaptive practices of radiographers and sonographers when performing obstetric ultrasound examinations on pregnant women with maternal obesity in Edo State, Nigeria.

1.5 Objective of the Study

1 To explore the perceptions of radiographers and sonographers in Edo State, Nigeria, regarding the accuracy of ultrasound measurements in pregnant women with maternal obesity.

2 To identify the technical and practical challenges radiographers and sonographers encounter when performing obstetric ultrasound scans on obese pregnant women.

3 To examine the current practices and adaptive techniques employed by radiographers and sonographers to maintain or improve scan quality in pregnant women with maternal obesity.

1.6 Significance of the Study

This study holds significant importance for several stakeholders:

- Clinical Practice: The findings will provide valuable insights for healthcare facilities and departments of radiology/sonography, highlighting the practical challenges faced by sonographers. This can lead to the development of tailored scanning protocols, allocation of appropriate equipment, and improved supportive environments for sonographers.

- Training and Education: Understanding sonographers' perceived training needs can inform the development of targeted educational programs and workshops for radiographers and sonographers, equipping them with advanced skills and strategies for scanning obese pregnant women.

- Professional Development: The study contributes to the professional discourse on best practices in obstetric sonography, particularly concerning challenging patient populations, fostering a culture of continuous improvement.
- Public Health: By understanding the practical limitations and adaptations, public health initiatives aimed at promoting healthy weight in pregnancy and optimizing antenatal care pathways for obese mothers can be better informed, potentially leading to improved patient management and reduced misdiagnoses.
- Future Research: The results will highlight areas requiring further investigation, such as the effectiveness of specific techniques, the impact of different ultrasound equipment, or the development of regional guidelines for scanning obese patients.

1.7 Scope of the Study

This study will focus on radiographers and sonographers actively performing obstetric ultrasound scans in various primary diagnostic centers and hospitals located within Edo State. The scope will be limited to exploring their perceptions, challenges, and current practices related to standard 2D obstetric ultrasound measurements (fetal biometry, EFW, AFI) in the context of maternal obesity during the second and third trimesters of pregnancy. It will not involve direct patient data collection or assessment of actual measurement accuracy from patient records. The study will be conducted over a period of 5 months, from may to september 2025.

1.8 Operational Definition of Terms

- **Maternal Obesity**: Defined as a pre-pregnancy Body Mass Index (BMI) of 30 kg/m² or greater, categorized according to WHO guidelines (Class I: 30.0-34.9 kg/m², Class II: 35.0-39.9 kg/m², Class III: ≥ 40.0 kg/m²). For the purpose of this study, this refers to the sonographer's understanding and classification of the patient's BMI.
- **Radiographer/Sonographer Perception**: Refers to the individual radiographer's or sonographer's subjective views, beliefs, experiences, and attitudes regarding the difficulties, challenges, and implications of performing ultrasound scans on obese pregnant women.
- **Radiographer/Sonographer Practice**: Refers to the actual techniques, strategies, and routines employed by radiographers and sonographers during their daily performance of obstetric ultrasound scans on obese pregnant women.
- **Ultrasound Measurement Accuracy (Perceived)**: The radiographer's/sonographer's subjective assessment or confidence level regarding the reliability and correctness of the fetal biometry measurements (BPD, HC, AC, FL, EFW, AFI) they obtain from obese pregnant women, given the technical challenges.
- **Ultrasound**:This is a non-invasive medical imaging technique that utilizes high-frequency sound waves (typically 2 to 18 megahertz) to produce real-time visual images, or sonograms, of structures inside the body. Unlike X-rays, it does not use ionizing radiation, making it a safe modality, particularly in obstetrics for assessing fetal growth and anatomy. The term is often used interchangeably with sonography. The fundamental principle of ultrasound is the pulse-echo technique, which relies on the piezoelectric effect. The handheld sensor, called the transducer (or probe), contains piezoelectric crystals that convert an electrical current into mechanical sound

pulses, which are then transmitted into the body. When these sound waves encounter boundaries between different tissues—such as fluid, muscle, or fat—a portion of the energy is reflected back to the probe as an echo.

There are three primary types of transducers used in medical sonography:

- **Convex (Curvilinear) Probes:** Characterized by a curved head and low frequency, these are used for deep penetration and wide field-of-view imaging, making them ideal for abdominal and obstetric scans.
- **Linear Probes:** Characterized by a flat array and high frequency, these are used for high-resolution imaging of superficial structures like the thyroid, vessels, and breasts.
- **Phased Array Probes:** Characterized by a small footprint, these are used in cardiology and neurology to allow deep imaging through a narrow acoustic window between ribs.

The image is produced when the transducer receives the returning sound echoes. The echoes cause the piezoelectric crystals to vibrate, converting the mechanical energy back into electrical signals. The ultrasound machine then measures two key characteristics: the time taken for the echo to return (to calculate the depth of the reflector) and the amplitude (intensity) of the echo (to determine the brightness of the corresponding pixel). Highly reflective tissues, such as bone, appear bright white (hyperechoic), while fluids or tissues that absorb sound waves appear dark or black (anechoic). These signals are processed to form the two-dimensional (2D) grayscale image displayed on the monitor, known as B-Mode (Brightness Mode) imaging.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Review

Ultrasound, or sonography, is an indispensable, non-invasive medical imaging technique that utilizes high-frequency sound waves (typically 2 to 18 megahertz) to produce real-time visual images, or sonograms, of internal body structures (Hadlock et al., 1991). The system operates based on the pulse-echo technique, wherein the handheld sensor, known as the transducer or probe, contains piezoelectric crystals that convert an electrical current into mechanical sound pulses which are transmitted into the body. The system calculates the depth and intensity of the returning echoes to form the final two-dimensional (2D) grayscale image, known as B-Mode (Brightness Mode) imaging (Sofka, 2009).

For obstetric and abdominal imaging, the convex (curvilinear) probe is the primary transducer used, as its curved head and low frequency allow for deep tissue penetration and a wide field of view. In contrast, linear probes use a flat array and high frequency for high-resolution imaging of superficial structures, while phased array probes are typically reserved for deep imaging through narrow acoustic windows, such as in cardiology (Paladini, 2009).

Crucially, the objective of obstetric ultrasound is to obtain a set of fetal biometry parameters for monitoring growth and assessing well-being. The key measurements include the Biparietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), and

Femur Length (FL). These parameters are mathematically combined to generate the Estimated Fetal Weight (EFW), and the scan also includes measurements like the Amniotic Fluid Index (AFI) (Hadlock et al., 1991). The precision of these critical biometric measurements is paramount for clinical decision-making, such as managing potential complications and timing delivery (O'Brien et al., 2020).

Ultrasound imaging fundamentally relies on the transmission of high-frequency sound waves into the body and the subsequent detection of echoes reflected from tissue interfaces. The underlying principle dictates that sound waves propagate at distinct speeds through various tissues. In the context of maternal obesity, increased adipose tissue acts as a significant attenuator of these ultrasound waves. Attenuation refers to the reduction in the intensity of a sound wave as it traverses a medium, primarily due to absorption, scattering, and reflection (Paladini, 2009).

In obese pregnancies, the thicker layer of subcutaneous and visceral fat can cause greater absorption and scattering of the ultrasound beam, leading to a weaker signal returning to the transducer. This results in reduced penetration, a decreased signal-to-noise ratio, and overall poorer image resolution, making it more challenging to clearly delineate fetal structures and obtain accurate measurements (Siddiqui et al., 2024). Consequently, the ability to distinguish between closely spaced structures is diminished, potentially affecting the accurate assessment of fetal details and the detection of subtle anomalies. Additionally, increased scattering and refraction of the ultrasound beam can lead to the generation of artifacts that obscure or mimic real structures, complicating image interpretation (Dodd et al., 2022).

From the sonographer's perspective, this translates into increased effort in probe manipulation, extended scan times, difficulty in recognizing anatomical landmarks, and potentially reduced confidence in the measurements acquired (O'Brien et al., 2020). A thorough understanding of

these underlying physical principles is crucial for appreciating the practical challenges encountered by sonographers in their daily practice (World Health Organization, 2020).

2.1.1 Biparietal Diameter (BPD): BPD is the transverse diameter of the fetal head, measured from the outer edge of the near skull bone to the inner edge of the far skull bone.

2.1.1.2 Gestational Age for Measurement

- Useful from 12 weeks, most reliable 14–28 weeks

2.1.1.3 Purpose/Why Measured

- Gestational age assessment
- Monitoring fetal head growth
- Helps detect microcephaly and hydrocephalus

2.1.1.4 Anatomical Landmarks

The following anatomical landmark should be seen when examining the Bi-parietal diameter (BPD)

- Paired thalami
- Cavum septum pellucidum (CSP)
- Falx cerebri centrally
- Oval head shape

2.1.2 Head Circumference (HC): This can be defined as the Measurement of the outer perimeter of the fetal skull.

2.1.2.1 Gestational Age for Measurement

- From 12 weeks onward, best 14–32 weeks

2.1.2.2 Purpose/Why Measured

- More reliable than BPD when head shape is abnormal
- Monitoring brain and skull development
- Estimating gestational age

2.1.2.3 Anatomical Landmarks

The following anatomical landmark should be seen when examining for the Head Circumference:

- Thalami
- CSP
- Falx cerebri.

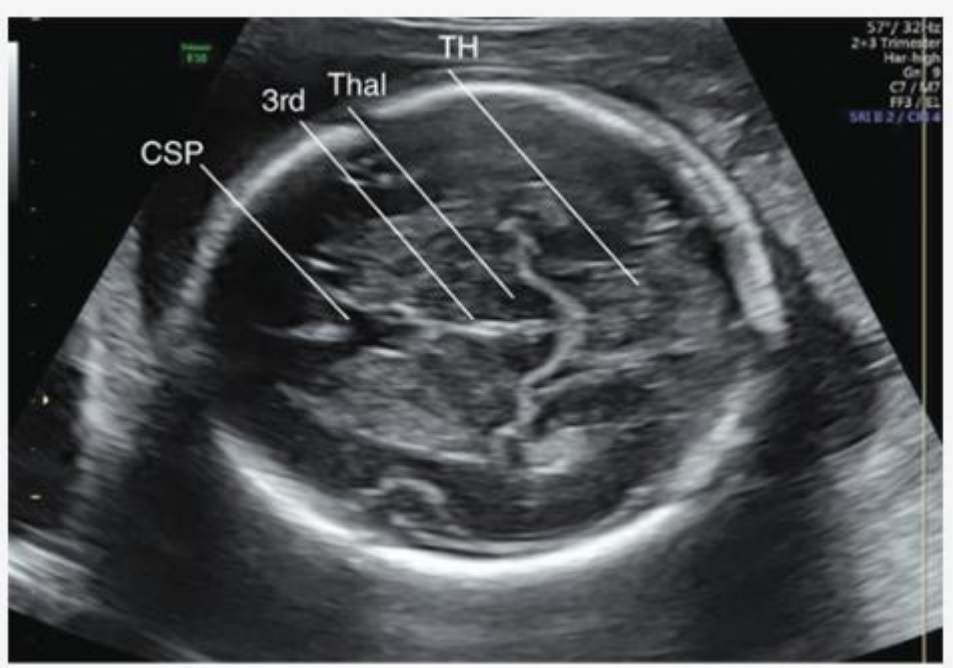

Figure 2.1: The appropriate transthalamic plane for the measurement of the biparietal diameter (BPD) and head circumference (HC) *(A.C. Fleischer 2017).*

2.1.3 Abdominal Circumference (AC): This is the Circumferential measurement of the fetal abdomen at the level of key abdominal structures. AC is obtained in a true transverse section through the fetal abdomen at the level of the stomach and the junction of the umbilical vein with the left portal vein.

2.1.3.1 Gestational Age for Measurement

- From 12 weeks, but most important after 24 weeks

2.1.3.2 Purpose/Why Measured

- Primary indicator of fetal growth
- Most sensitive measurement for detecting:
- IUGR

- Macrosomia
- Placental insufficiency
- Used in fetal weight estimation

2.1.3.3 Anatomical Landmarks

- Circular abdomen
- Visualization of:
- Stomach bubble
- Portal vein (hockey-stick/“J” shape)
- Spine in transverse view
- Kidneys not visible in correct plane

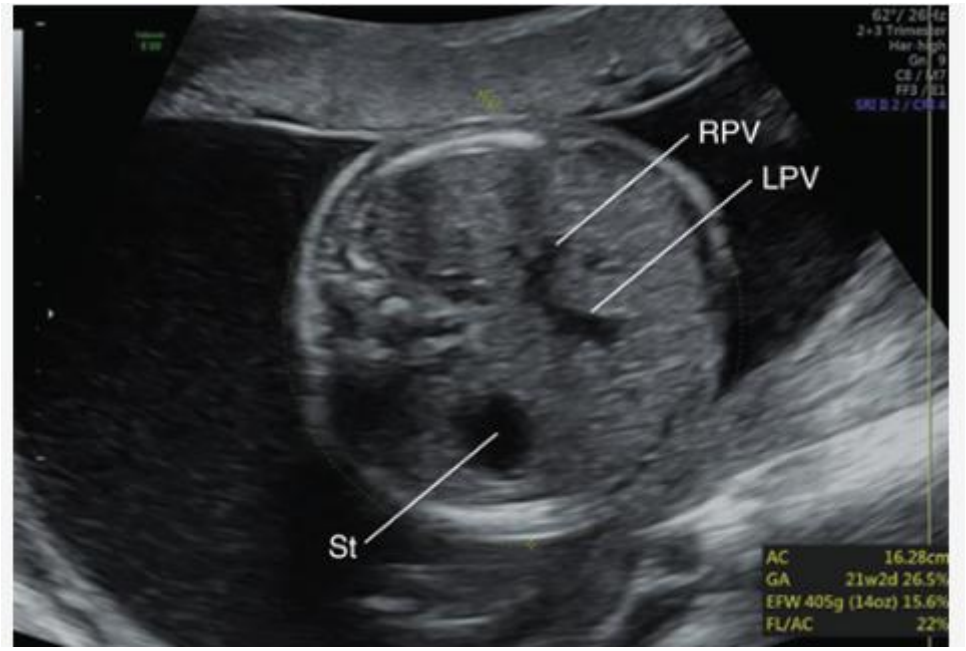

Figure 2.3: A true axial plane through the fetal abdomen is shown with the appropriate placement of the ellipse for measurement of the abdominal circumference (AC). *(A.C. Fleischer 2017).*

2.1.4 Femur Length (FL): This can be defined as the Measurement of the length of the ossified diaphysis of the fetal femur.

2.1.4.1 Gestational Age for Measurement

- Reliable from 14–32 weeks
- Can be measured afterward but less accurate for GA

2.1.4.2 Purpose/Why Measured

- Assesses skeletal development
- Helps estimate gestational age
- Detects skeletal dysplasia, short limbs, or chromosomal abnormalities

2.1.4.3 Anatomical Landmarks

- Full femur seen lying horizontally
- Measure only the ossified bone, excluding epiphyses
- Clear ends with no foreshortening

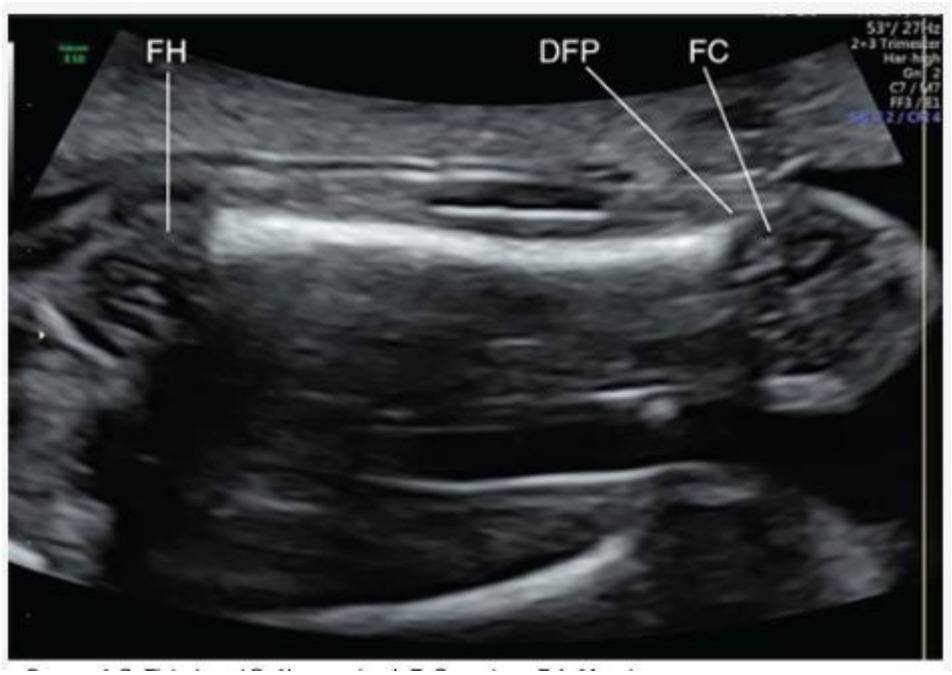

Figure 2.4.

The appropriate plane of imaging for measurement of the femur length (FL).(A.C. Fleischer 2017).

Figure 2.2: An image of a sonographer conducting a 3d obstetric scan from istock

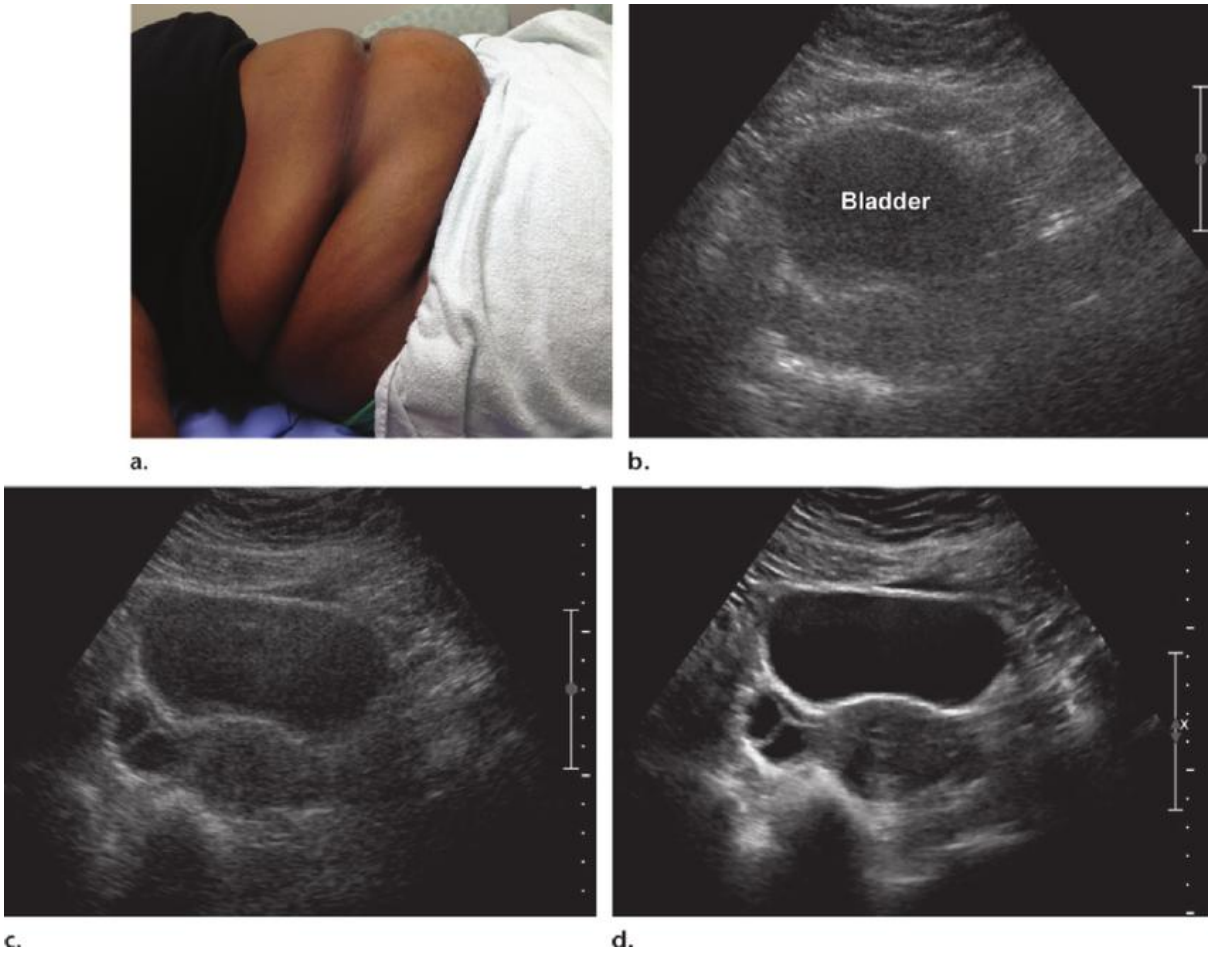

Figure 2.3: Images of a 30-year-old woman with a BMI of 59 kg/m 2 . (a) Photograph shows body habitus. (b – d) Transab dominal transverse US images show the role of good technique and image optimization in the conversion of a suboptimal to a diagnostic-quality transabdominal pelvic US study. (b) US image obtained with a 2-MHz transducer provides limited detail and penetration. (c) US image obtained with a 1-MHz transducer provides improved detail and penetration. The operator is applying pressure on the abdominal wall to decrease the distance from the skin surface to the organ of interest. (d) US image obtained with a 1-MHz transducer plus optimization of software options provides excellent detail and resolution. Note the septate right ovarian cyst and the trilaminar appearance of the endometrium

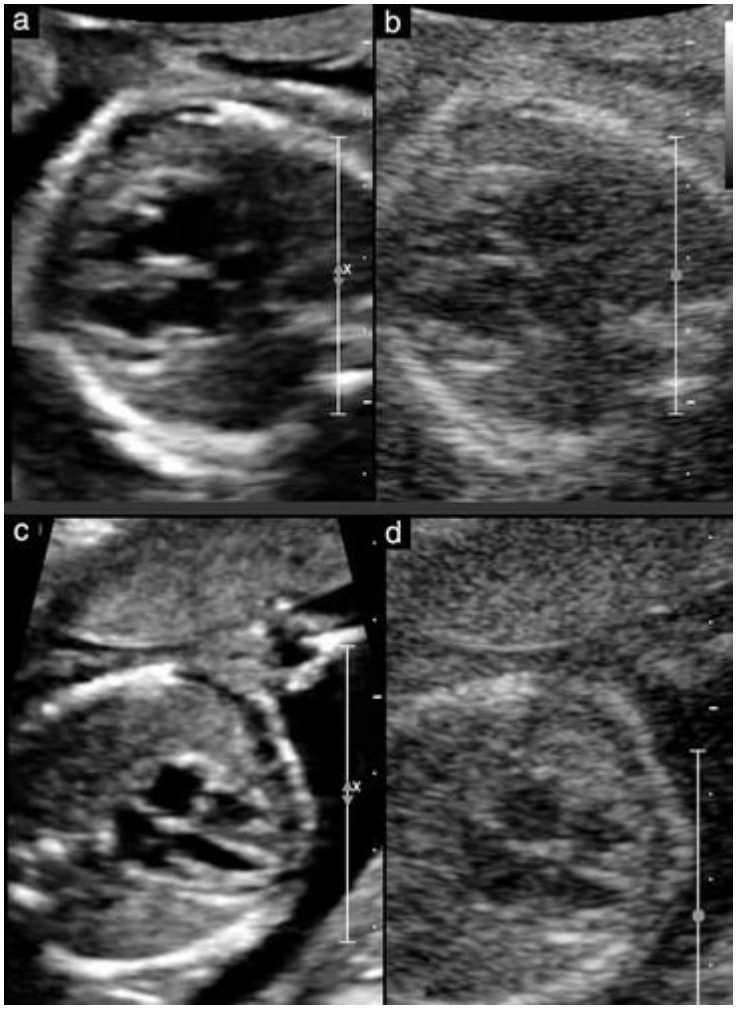

Figure 2.4: Four-chamber view of the fetal heart in an obese woman with a body mass index (BMI) of 35 kg/m2 at 22 weeks (a,b) and in another obese woman (BMI, 33 kg/m2) at 20 weeks (c,d). Images (a) and (c) were taken using technical tools: harmonic frequency, compound imaging and speckle reduction filter; (b) and (d) are corresponding images taken without technical tools. The different quality of the pairs of images is evident, especially at solid–fluid interfaces. From Sonography in obese and overweight pregnant women: clinical, medicolegal and technical issues by D. Paladini,(2009)

2.1.5 Strategies and Techniques to Optimize Ultrasound in Obese Pregnancies Despite the inherent challenges, several strategies and techniques can be employed to optimize

ultrasound imaging and improve measurement accuracy in obese pregnant women. These include:

- Transducer Selection: Using lower frequency transducers (e.g., 2-5 MHz curved array) can improve penetration at the expense of resolution.
- Compounding Techniques: Spatial compounding, which averages images acquired from different angles, can help to reduce speckle noise and improve image quality (Optimization of Fetal Biometry With 3D Ultrasound and Image Recognition (EPICEA, 2019).
- Harmonic Imaging: Tissue harmonic imaging (THI) utilizes the harmonic frequencies generated within the tissues, which are less susceptible to scattering and attenuation, potentially improving image contrast and resolution in deeper tissues.
- Maneuvering and Patient Positioning: Careful manipulation of the transducer and adjustments in patient positioning (e.g., lateral decubitus) can sometimes help to displace subcutaneous fat and improve acoustic windows.
- Compression: Gentle compression with the transducer can reduce the distance between the transducer and the fetus, potentially improving image quality in some cases.
- Extended Field of View (EFOV): This technique allows for the acquisition of a wider field of view, which can be helpful in visualizing the overall fetal position and orientation (Optimization of Fetal Biometry With 3D Ultrasound and Image Recognition (EPICEA), 2019).
- Adjunctive Imaging Modalities: In some complex cases, magnetic resonance imaging (MRI) may be considered as a complementary imaging modality to provide more

detailed anatomical information. The effective application of these techniques requires adequate training and experience on the part of the radiographer or sonographer (Akunjee et al., 2019). Understanding their awareness and utilization of these strategies in the South South region is a key aspect of this study.

2.1.6 Radiographers'/Sonographers' Role and Perceptions in Obstetric Ultrasound

Radiographers and sonographers are the primary healthcare professionals responsible for performing and interpreting obstetric ultrasound examinations. Their expertise, technical skills, and understanding of the limitations and potential pitfalls associated with imaging obese pregnant women are crucial for ensuring the delivery of accurate and clinically relevant information. Their perceptions regarding the challenges they face, the adequacy of their training, and the availability of appropriate equipment can significantly influence their practice and the quality of the ultrasound services provided (Brenes-Martín et al., 2023).

Factors such as workload, time constraints, and the availability of standardized protocols for imaging obese patients can also impact their ability to optimize image acquisition and measurement accuracy (O'Brien et al., 2020). Exploring their experiences and perspectives can provide valuable insights into the real-world challenges encountered in obstetric ultrasound practice in the South South region, particularly in the context of increasing maternal obesity (World Health Organization, 2021). This information can be used to inform the development of targeted educational interventions, the implementation of best practice guidelines, and the allocation of resources to improve the quality of care for obese pregnant women (O'Brien et al., 2019).

2.2 Theoretical Review

This study will be guided by an interpretive Quantitative framework, drawing insights from theories of professional practice and lived experience. Specifically, it will align with principles of Phenomenology, which aims to understand and describe the universal essence of a phenomenon as it is experienced by individuals. In this context, the study will explore the lived experiences of radiographers and sonographers as they navigate the complexities of scanning obese pregnant women. By focusing on their perceptions, challenges, and adaptive strategies, the study seeks to uncover the subjective realities that shape their professional practice. Furthermore, elements of Social Cognitive Theory (Bandura, 1986) may inform the understanding of how sonographers' self-efficacy, outcome expectations, and observational learning influence their adoption of specific techniques and their confidence levels in challenging scanning environments. This framework allows for a deep dive into the practical knowledge, skills, and perspectives that may not be captured by purely quantitative measures of accuracy.

2.3 Empirical Review

Numerous studies have investigated the impact of maternal obesity on ultrasound parameters, primarily focusing on the outcome of measurements. These studies consistently report difficulties in obtaining complete anatomical surveys and fetal biometry in obese women, often noting increased rates of technically unsatisfactory scans. For example, O’Brien et al. conducted a research on how fetal ultrasound biometry accurately predicts newborn in overweight and obese women. More recent research has attempted to quantify the differences in measurement accuracy, with some studies finding that as BMI increases, the accuracy of Estimated Fetal Weight (EFW) decreases, particularly for larger fetuses (macrosomia) .

Specific biometric parameters like Abdominal Circumference (AC) have been consistently identified as the most challenging measurement due to maternal adipose tissue obscuring the fetal abdomen. This can lead to increased inter- and intra-observer variability and systematic errors in measurements. Inaccurate baseline measurements or unreliable serial measurements can also hinder the timely detection of fetal growth restriction or macrosomia. While these studies highlight the objective challenges, fewer have deeply explored the subjective experiences of the sonographers performing these scans. Existing literature sometimes touches upon sonographer experiences indirectly, such as reporting increased scan times or the need for repeat scans in obese patients. Some studies have noted that sonographers might resort to different probe pressures, patient positioning, or utilize specific equipment features to improve image quality. However, a comprehensive understanding of their collective perceptions, the range of adaptive practices employed, their confidence levels, and their self-identified training needs is limited, particularly within the specific context of the South South Region of Nigeria. Many existing studies are quantitative or retrospective, leaving a gap in the rich, Quantitative data that can be garnered directly from the frontline practitioners. This study aims to fill this gap by directly engaging with radiographers and sonographers to document their invaluable insights and practical knowledge.

The research investigating the influence of maternal obesity (MO) on the accuracy of fetal ultrasound biometry presents a complex and sometimes conflicting picture, a central theme in the literature. A significant body of evidence highlights the primary technical barrier caused by increased maternal adipose tissue. This tissue acts as a poor acoustic medium, resulting in a phenomenon known as Suboptimal Ultrasound Visualization (SUV) or Degraded Acoustic Windows (DAWs). The adipose layer absorbs and scatters the sound waves, diminishing the strength of the returning echoes and increasing background noise. This degradation in image quality often necessitates longer scanning times, increases the rate of incomplete routine

anomaly scans, and has been directly linked to a decreased detection rate of congenital fetal anomalies, particularly neural tube defects and cardiac abnormalities, when compared to women with a normal Body Mass Index (BMI).

Specifically concerning Estimated Fetal Weight (EFW), the literature is divided on the magnitude of error introduced by higher maternal BMI. Several prospective and comparative studies have demonstrated a statistically significant reduction in the accuracy of EFW measurements as maternal obesity progresses, specifically in women classified with Obesity Class II (BMI 35.0–39.9 kg/m^2) and Class III (BMI $\geq$ 40 kg/m^2). This decline is often observed as an increase in both systematic error (a consistent over- or under-estimation) and random error (a larger scatter in individual measurements) when EFW is compared to the actual birth weight (BW). Furthermore, some studies indicate that the accuracy of the EFW measurement is inversely related to the time interval between the ultrasound scan and delivery, with this degradation being more pronounced in the overweight/obese population compared to normal-weight counterparts.

Conversely, a robust set of empirical studies argues that while obesity presents a technical challenge, it does not inherently prevent an accurate EFW measurement when standardized protocols are followed. Research focusing on the third trimester, for example, has concluded that when scans are performed by experienced and highly trained sonographers, the resulting EFW remains accurate across increasing BMI categories, showing strong correlation coefficients and small mean Z-score differences compared to neonatal birth weight. These findings suggest that the challenge is less a fundamental technical limitation of the ultrasound modality itself and more an issue of operator skill, protocol adherence, and the appropriate selection of EFW formulas (such as those that weigh the Abdominal Circumference and

Femur Length more heavily) to mitigate the effects of suboptimal image acquisition caused by excess adipose tissue.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Setting

This study was conducted within primary diagnostic centers and general/specialist hospitals located across selected areas in Edo State, Nigeria. These settings were chosen because they represented typical environments where a large volume of routine antenatal ultrasound scans were performed, and where radiographers and sonographers regularly encountered pregnant women with varying BMI categories. The selection of multiple centers within the region allowed for a more diverse range of experiences and practices to be captured.

3.2 Research Design

This study adopted a quantitative exploratory design utilizing structured questionnaires delivered via email and other online platforms. This design was appropriate for gaining detailed insights into the perceptions, experiences, and practices of radiographers and sonographers, which could not be adequately captured through purely descriptive or qualitative means. The exploratory nature of the design enabled the identification of emerging themes and patterns from the responses provided.

3.3 Target Population

The target population consisted of experienced radiographers and sonographers who were actively involved in performing routine obstetric ultrasound scans on pregnant women in diagnostic centers and hospitals across Edo State, Nigeria. Participants included professionals with varying years of experience in obstetric sonography to ensure diverse perspectives from individuals exposed to different patient populations, including obese pregnant women.

Inclusion and Exclusion Criteria

- Inclusion Criteria:
    - Radiographers and sonographers actively performing obstetric ultrasound scans in diagnostic centers and hospitals within Edo State, Nigeria.
    - Professionals who have experience scanning pregnant women, including those with maternal obesity, regardless of the number of years of experience.
    - Those willing to provide informed consent and participate voluntarily in the study.
- Exclusion Criteria:
    - Radiographers and sonographers who are not actively involved in obstetric ultrasound scanning.
    - Professionals who do not provide informed consent.
    - Those who are not based in Edo State, Nigeria.

3.4 Sampling Technique

A purposive sampling technique was employed to select participants who could provide relevant information concerning the research questions. Radiographers and sonographers who regularly scanned pregnant women, including those with maternal obesity, were specifically identified and invited to participate. In addition, a snowball sampling approach was used — where initial participants referred other qualified colleagues — to ensure sufficient representation of experiences and viewpoints.

This combined approach was suitable for reaching a relatively specialized group of professionals within a defined population. Purposive and snowball techniques were chosen because radiographers and sonographers with experience in maternal obesity scanning are not uniformly distributed across facilities in Edo State. Hence, these non-probability techniques ensured that only knowledgeable and experienced participants contributed to the study's objectives.

3.5 Sample Size

A total of 60 radiographers and sonographers participated in this study. Participants were recruited using a convenience sampling approach, which involved selecting professionals who were readily accessible within hospitals, diagnostic centres, and ultrasound facilities across Edo State. Recruitment was carried out through direct invitations, visits to healthcare facilities, and the distribution of questionnaires to willing participants. This approach was considered appropriate given the varying availability of imaging professionals and the need to capture diverse experiences across different practice settings.

The sample size of 60 was justified based on both practical and methodological considerations. Since the study adopted a quantitative exploratory design, the goal was to obtain broad representation rather than rely on formula-driven probabilistic sampling. A sample of 60 provided a sufficiently large pool for meaningful descriptive and comparative analysis, allowing differences to be explored across subgroups such as years of experience, facility type, and professional designation. Additionally, previous exploratory studies in radiography and allied health professions have successfully used sample sizes between 40 and 80 participants, demonstrating that this range is adequate for capturing variability in professional perceptions and ensuring data reliability. Therefore, the final sample size was deemed suitable for the aims and scope of the study within the context of Edo State.

3.6 Instrument of Data Collection

The primary instrument for data collection will be a semi-structured questionnaire. This questionnaire will contain open-ended questions designed to elicit detailed descriptions of participants' experiences, challenges, strategies, and perceptions. Questions will be designed to ensure all key aspects of the research question are addressed. Key themes to be explored in the questionnaire will include:

- General experiences with scanning pregnant women with maternal obesity.
- Perceptions of image quality and measurement accuracy in obese patients.
- Specific technical difficulties encountered (e.g., probe penetration, artifact management, fetal visualization).
- Adaptive techniques and strategies employed to overcome challenges (e.g., patient positioning, transducer selection, gain/depth adjustments).

- Confidence levels in obtaining accurate measurements in obese patients.
- Perceived impact of maternal obesity on scan duration and sonographer workload.
- Training received and perceived training needs related to scanning obese pregnant women.
- Suggestions for improving ultrasound services for obese pregnant women. The questionnaire will be designed for self-administration, accessible via email or other suitable online platforms, allowing participants to complete it at their convenience.

3.7 Validity of Instrument (Quantitative Validity)

To ensure content validity, the questionnaire was reviewed by experts in radiography and sonography to verify that the items adequately captured the research objectives. Their suggestions were incorporated to improve clarity and relevance. Face validity was also established through a pilot test involving a small group of sonographers in Edo State, after which necessary adjustments were made to improve the quality of the instrument.

3.8 Reliability of Instrument (Quantitative Reliability)

Reliability was ensured through consistency in the structure and wording of questionnaire items. A pilot test was conducted, and the responses obtained were analyzed using the Cronbach's Alpha coefficient to determine internal consistency. The coefficient value of 0.82 indicated a high level of reliability, confirming that the instrument was dependable for data collection.

3.9 Method of Data Collection

Ethical approval was obtained from the relevant institutional ethics committees before data collection began. Permission was also sought from the management of diagnostic centers and hospitals within Edo State. Participants were contacted through professional networks and email invitations. After obtaining informed consent, the questionnaires were distributed electronically and retrieved upon completion. The process ensured confidentiality, voluntary participation, and anonymity of all respondents.

3.10 Ethical Considerations

The study adhered to ethical principles of research involving human participants. Participants were informed of the purpose of the study, assured of confidentiality, and informed of their right to withdraw at any time without penalty. All responses were kept anonymous and securely stored in password-protected files. The study posed minimal risk to participants, as it involved no physical intervention or sensitive personal data.

3.11 Method of Data Analysis

Collected data were coded and analyzed using descriptive statistics such as frequencies, percentages, and mean scores. The results were presented in tables and charts for clarity. Quantitative data from the Likert-scale items were analyzed to determine patterns in

perceptions, confidence levels, and reported challenges. The findings were interpreted in relation to the research questions and compared with existing literature to draw meaningful conclusions.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 DATA PRESENTATION

4.1.1 Introduction

This chapter presents the analysis of the data collected from some Radiographers and Sonographers currently practicing in Edo state. The questionnaire responses that were most pertinent to obtaining precise study results were selected, examined, and presented.

The analysis is organized in accordance with the objectives of the study as stated below:

1. To Explore radiographers'/sonographers' perceptions of the impact of maternal obesity on ultrasound image quality and measurement accuracy.
2. Identify the specific technical and practical challenges faced by radiographers/sonographers during obstetric ultrasound scans of obese pregnant women.
3. Document the current practices, strategies, and techniques employed by radiographers/sonographers to optimize image acquisition and measurement accuracy in obese pregnant women.

4.1.2 Demographic Information of Respondents

Table 4.1: Demographic Information of Respondents (N=60)

Variable	Category	Frequency	Percentage (%)
Sex	Male	34	56.67
	Female	26	43.33
Age	Below 30	19	31.67
	30-40	18	30
	40-50	14	23.33
	Above 50	9	15
Qualification	Diploma	16	26.67
	B.Sc	36	60
	M.Sc	8	13.33
	PhD	0	0
Obstetric Sonography experience	Less than 1year	11	18.33
	1-5yrs	17	28.33
	6-10yrs	17	28.33
	11-15yrs	7	11.67
	More than 15 years	8	13.33

Table 4.1 illustrates the demographic data of the respondents, which shows that there were 34 (56.67%) male participants and 26 (43.33%) female participants involved in this study. 19 (31.67%) of the respondents were aged below 30 and only 9 (15%) of them were older than 50 years. The table further illustrates that 36 (60%) of the participants were B.Sc degree holders only, 16 (26.67%) of them had a Diploma, 8 (13.33%) of them held masters' degrees and none of the participants had a PhD degree. Amongst the participants 11 (18.33%) of them had less experience in Obstetric Sonography, 17 (28.33%) of the participants were quite experienced with 1-5 years experience, 17 (28.33%) of the participants also had 5-10 years experience of obstetric sonography and only 15 (25%) of the respondents had more than 11 years of experience.

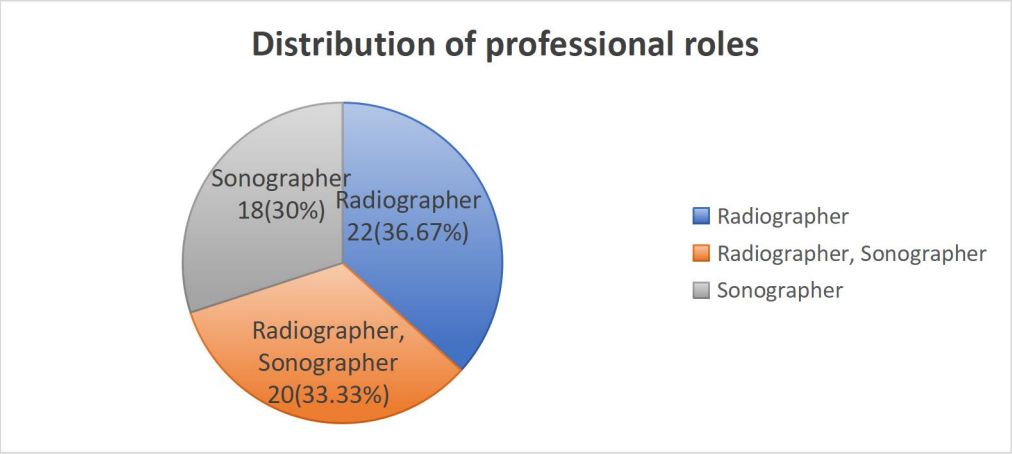

Fig. 4.1 Distribution of Participants professional roles

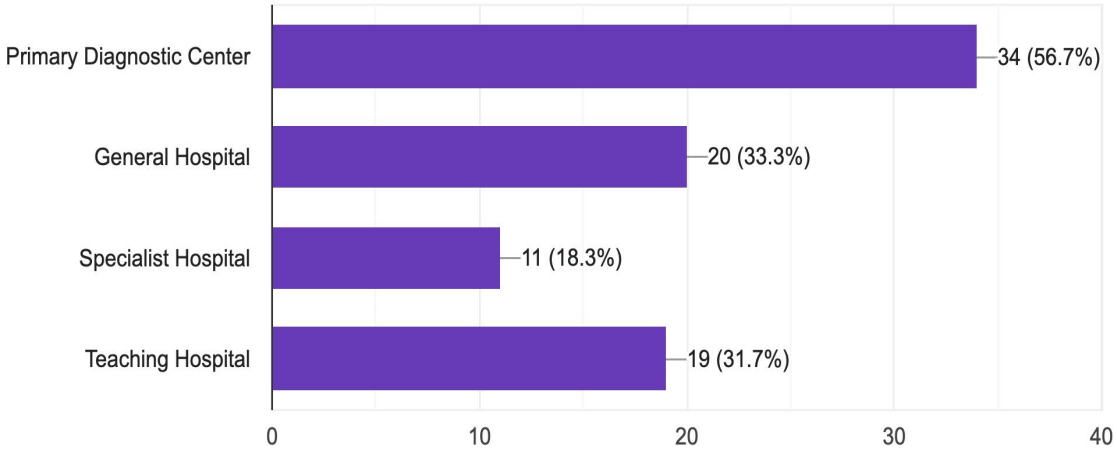

Fig. 4.2 Bar Chart of workplace distribution of participants

Fig 4.1 shows a pie chart illustrating the respondents professional roles distribution, The data shows that 22 (36.67%) of the participants were Radiographers only, 18 (30%) of the participants were Sonographers only and 20 (33.33%) of the participants practiced both Radiography and Sonography together. The total number of Radiographers in the study summed up to 42 (70%) and the total number of Sonographers in the study summed up 38 (63.33%).

Fig 4.2 shows the workplace distribution of the participants. The data shows that majority (56.7%) of the participants worked at private diagnostic centers, 20 (33.3%) of the participants worked at General Hospitals, 11 (18.3%) of the participants were practicing at Specialist Hospitals and 19 (31.7%) worked at a Teaching Hospital.

4.1.3 Respondents' Perceptions and attitudes toward maternal obesity and ultrasound

Table 4.2: Responses on encounter with pregnant women with maternal obesity (N=60)

Questions	Responses (Frequency %)

	Never/ Rarely	Sometimes	Frequently	Very Frequently
How frequently do you encounter pregnant women with maternal obesity in your daily practice?	4 (6.67%)	28 (46.67%)	23 (38.33%)	5 (8.33%)

Table 4.2 shows the responses of the participants on how frequently they encounter pregnant patients with maternal obesity, the results show that 28 (46.67%) of the participants answered "sometimes", 23 (38.33%) of the participant frequently had encounters with pregnant women with maternal obesity, 5 (8.33%)of them answered "very frequently/almost daily" and 4 (6.67%) of the participants never/rarely had encounters with pregnant women with maternal obesity. On a 4 point likert scale the mean score for the responses equaled 2.48, this implies that the frequency at which the participants encounter pregnant women with maternal obesity falls between "Sometimes" and "Frequently".

Table 4.3: confidence level in obtaining accurate ultrasound measurements in pregnant women with maternal obesity (N=60)

Question	Responses (Frequency %)				
	Very low confidence	Low Confidence	Neutral	High Confidence	Very High Confidence

How would you rate your overall confidence in obtaining accurate ultrasound measurements in pregnant women with maternal obesity?	0 (0%)	3 (5%)	17 (28.33%)	29 (48.33%)	11 (18.33%)

Table 4.3 presents the respondents' confidence level in obtaining accurate ultrasound measurements in pregnant women with maternal obesity. The findings show that confidence levels were fairly high with the responses having a mean score= 3.8 on a 5-point Likert scale. Nearly half of the respondents (48.33%) reported high confidence, while 11 (18.33%) of the participants reported very high confidence. About 17 (28.33%) of them indicated a neutral stance, suggesting some uncertainty. A minority of the respondents, with just 3 (5%) of them expressed low confidence, and none reported very low confidence.

Table 4.4: confidence level in obtaining accurate ultrasound measurements in pregnant women with maternal obesity (N=60)

Question	**Responses (Frequency %)**				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
To what extent do you agree	0	4	12	28	16

with the following statement: "Maternal obesity significantly impacts the quality of ultrasound images."	(0%)	(6.67%)	(20%)	(46.67%)	(26.67%)

Table 4.4 shows respondents' perceptions of the impact of maternal obesity on ultrasound image quality. A large majority agreed with the statement, with 28 (46.67%) of the respondents agreeing and 16 (26.67%) of them strongly agreeing, giving a combined total of **73.34%** recognizing maternal obesity as a significant factor affecting image quality. About 12 (20%) of the respondents remained neutral, while only a small proportion disagreed (6.67%) and none strongly disagreed.

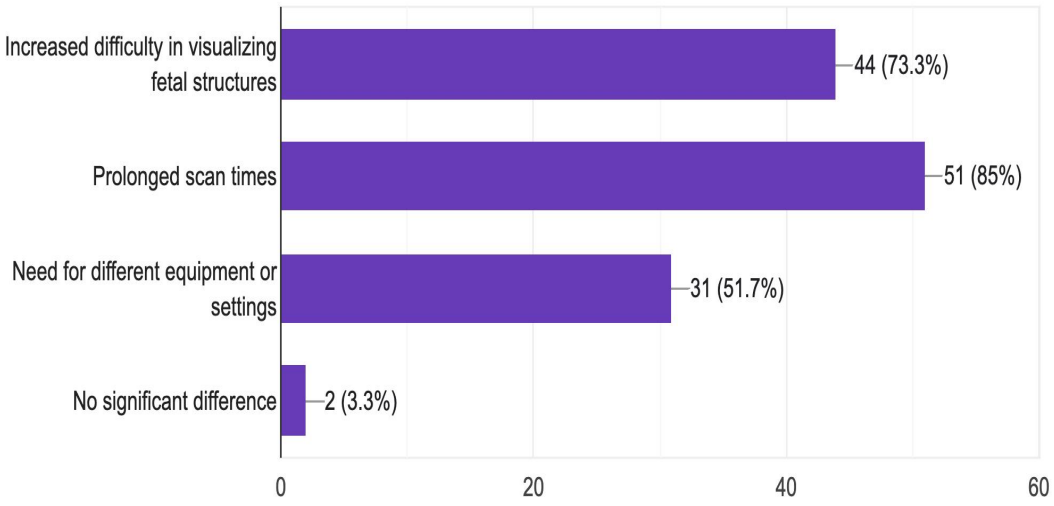

Fig. 4.3 Bar Chart of differences noticed by participants when scanning pregnant women with maternal obesity compared to non-obese pregnant women

Fig 4.3 illustrates radiographers'/sonographers' experiences when carrying out ultrasound scans on pregnant women with maternal obesity compared to non-obese women. Out of the 60 participants Prolonged scan times was the most reported, with 51 respondents (85%)

indicating that maternal obesity leads to lengthier examinations. Increased difficulty in visualizing fetal structures was also widely acknowledged, with 44 respondents (73.3%), 31 (51.7%) of the respondents also Identified Need for different equipment or settings as one of the differences between scanning pregnant women with maternal obesity compared to non-obese pregnant women and finally only 2 respondents (3.3%) reported no significant difference, indicating that scanning of pregnant women with maternal obesity is almost the same to scanning non-obese pregnant women.

Table 4.5: Responses on having received specialized training or formal guidelines on performing ultrasound scans on pregnant women with maternal obesity (N=60)

Question	Yes (%)	No (%)
Have you received any specialized training or formal guidelines on performing ultrasound scans on obese pregnant women?	30 (50%)	30 (50%)

Table 4.5 The table shows that out of 60 respondents, exactly half (30 respondents; 50%) reported having received specialized training or formal guidelines on performing ultrasound scans on obese pregnant women, while the other half (30 respondents; 50%) indicated they had not. This finding suggests a significant gap in standardized training and guideline dissemination among radiographers/sonographers. The equal split highlights inconsistency in professional preparedness, which may contribute to variations in practice quality and confidence when handling maternal obesity cases.

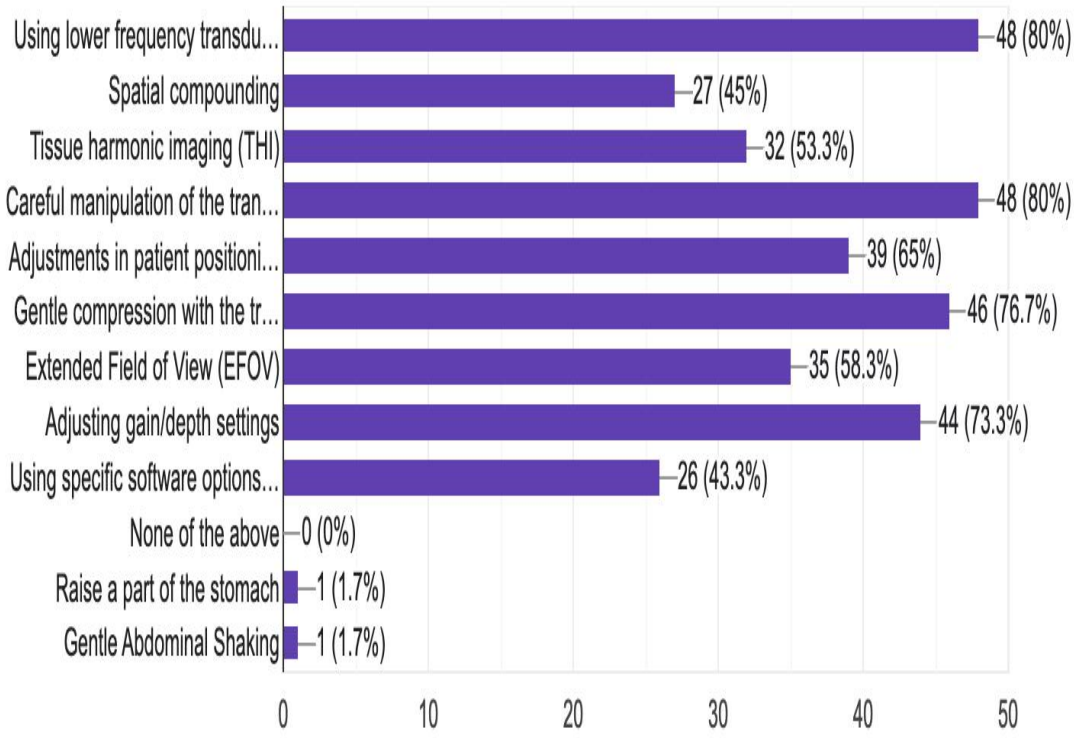

Fig 4.4 Respondents optimization techniques employed when scanning pregnant women with maternal obesity

Fig 4.4 shows the results of the optimization techniques employed by respondents when scanning obese pregnant women, reflecting the technical challenges associated with maternal obesity. The most frequently reported methods were Using lower frequency transducers (e.g., 2-5 MHz curved array) (48 respondents, 80%) and careful manipulation of the transducer (48 respondents, 80%), both of which help to improve penetration and image quality. The second most selected technique was “Adjustments in patient positioning (e.g., lateral decubitus)” with 46 respondents (76.7%) selecting this, followed by “adjusting gain/depth settings” (44 respondents, 73.3%) which seemed like a widely adopted method, indicating that radiographers often rely on practical adjustments to optimize imaging.

Other commonly used strategies included gentle compression with the transducer (39 respondents, 65%), the use of extended field of view with 35 respondents (58.3%), and Tissue

harmonic imaging (THI) with 32 respondents (53.3%) selecting this. This shows the participants generally employ both hardware and software-based techniques into their practice. Less frequently employed methods included spatial compounding (27 respondents, 45%) and Using specific software options on the ultrasound machine (26 respondents, 43.3%). Out of all responses reported 2 unconventional approaches were suggested by 2 (3.4%) of the respondents, one of the participants suggested raising a part of the stomach as an optimization technique and the other suggestion was "gentle abdominal shaking". None of the respondents indicated that they used none of these optimization strategies, suggesting that all participants employed at least one method.

Table 4.6: Accuracy/Confidence level of respondents in carrying out certain ultrasound measurements when scanning pregnant women with maternal obesity (Likert Scale 1–5)

Confidence item	Mean score	Remark
BPD (Biparietal Diameter)	3.92	Very Confident
HC (Head Circumference)	3.92	Very Confident
AC (Abdominal Circumference)	3.85	Very Confident
FL (Femur Length)	3.92	Very Confident
EFW (Estimated Fetal Weight)	3.77	Very Confident

Table 4.6 shows the accuracy/confidence level of the respondents in carrying out certain ultrasound measurement when scanning pregnant women with maternal obesity. The findings generally show that the participants are very confident in measuring these basic obstetric

ultrasound parameters on pregnant women with maternal obesity. This suggest that the respondents are not in any way put off by the presentation of pregnant women with maternal obesity, Factors contributing to this could be high skill level, adequate years of experience or good work ethic.

Generally the findings suggest that the respondents have a fairly good perception and great attitude towards pregnant women with maternal obesity.

4.1.4 Respondents' Training and Suggestions

Table 4.7: Impact of formal training on the preparedness of participants to scan pregnant women with maternal obesity (N=60)

Question	Yes (%)	No (%)
Did your formal training as a Radiographer/Sonographer adequately prepare you for scanning obese pregnant women?	41 (68.33%)	19 (31.67%)

Table 4.7 show the results on the Impact of formal training on the preparedness of participants to scan pregnant women with maternal obesity, which indicates that a majority of respondents (41 out of 60; 68.33%) reported that their formal training as Radiographers/Sonographers adequately prepared them to scan obese pregnant women. However, 19 respondents (31.7%) felt inadequately prepared by their training. This suggests that while formal training programs generally provide a foundation for managing maternal

obesity in ultrasound practice, there remain significant gaps for nearly one-third of practitioners.

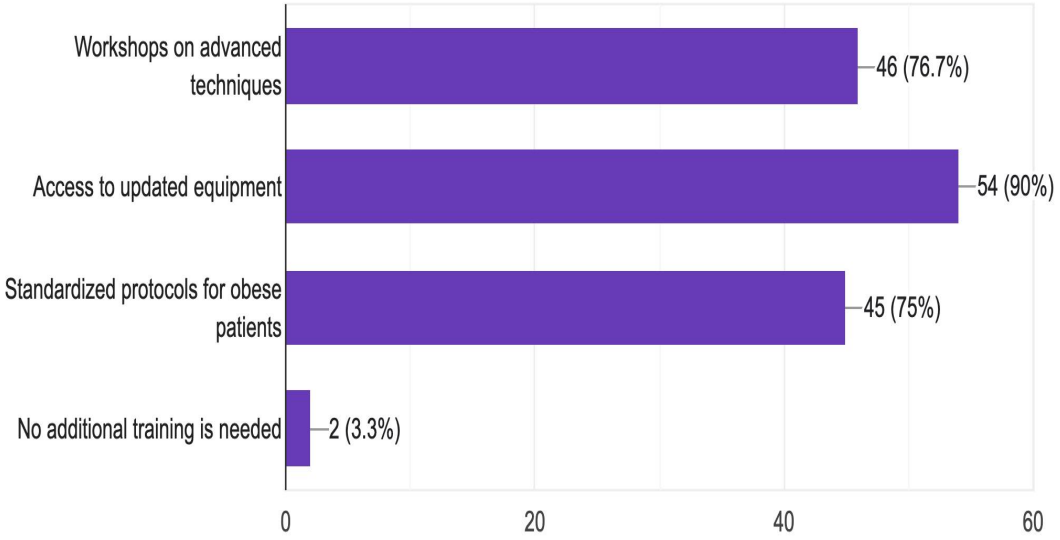

Fig 4.5 Distribution of Respondents special training or resources needed to improve scanning of obese pregnant women

Fig 4.5 shows participants' views on the training and resources most needed to improve their ability to scan obese pregnant women. The most frequently cited need was access to updated equipment, highlighted by 54 (90%) of the respondents, suggesting that technological limitations are perceived as the greatest barrier to effective scanning in obese patients. 46 (76.7%) of the respondents identified workshops on advanced techniques as essential and 45 (75%) of the respondents emphasized the need for standardized protocols for pregnant women with maternal obesity, indicating a demand for clear, uniform guidelines to support consistency and quality in practice. Only 2 respondents (3.3%) reported that no additional training was needed which suggested that the training or resources they had was sufficient for their practice.

Generally, these findings suggest that improving ultrasound practice for pregnant women with maternal obesity requires a multifaceted approach, combining better access to modern equipment, skill-based training, and standardized protocols.

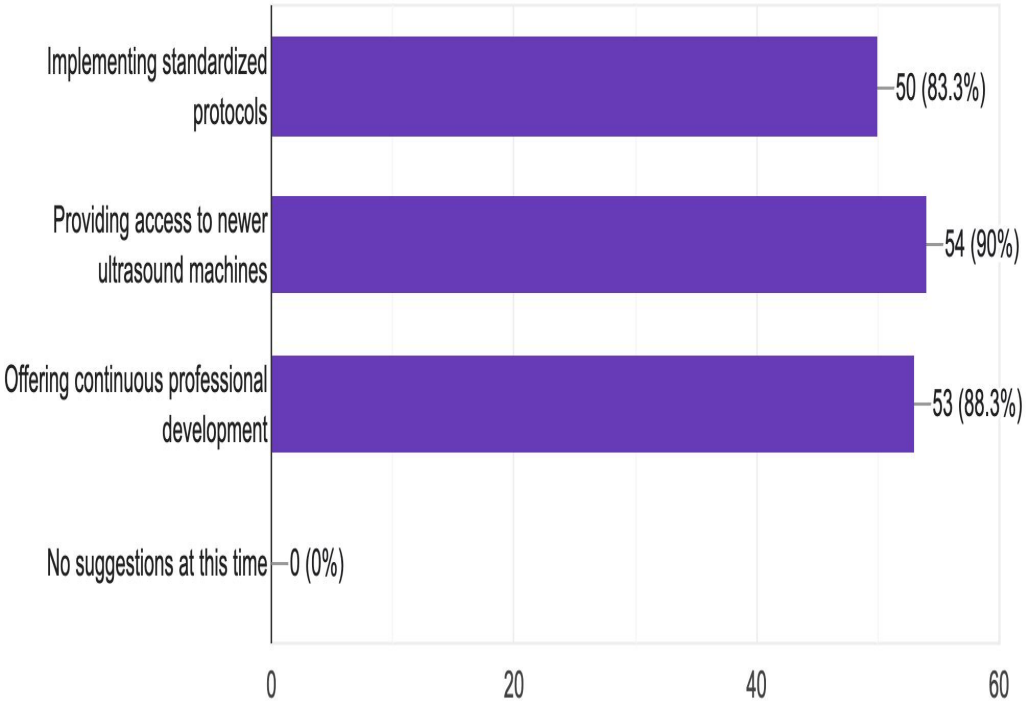

Fig 4.6 Respondents suggestions for improving ultrasound services of pregnant women with maternal obesity

Fig 4.6 is a bar chart illustrating Respondents suggestions for improving ultrasound services of pregnant women with maternal obesity. 54 (90%) of the respondents suggested that providing access to newer ultrasound machines in their respective workplaces would improve ultrasound services offered to pregnant women with maternal obesity. The next most reported suggestion was "offering continuous professional development" which was suggested by 53 (88.3%) of the respondents and 50 (83.3%) out of the 60 participants

suggested Implementing standardized protocols as an improvement for ultrasound services to pregnant women with maternal obesity.

4.2 DISCUSSION

This study investigated Radiographers and Sonographers perception and practices on maternal obesity and their ultrasound measurement accuracy. The study involved Radiographers and Sonographers working at Private diagnostic centers, General Hospitals, Specialist Hospitals and Teaching Hospitals. The main aim of the study was to gain a deeper understanding of the professional experiences, challenges, and adaptive practices of Radiographers and Sonographers when performing obstetric ultrasound examinations on pregnant women with maternal obesity in Edo State, Nigeria.

Questionnaires were distributed to licensed Radiographers and Sonographers currently practicing in Edo state. A total of 60 Radiographers and Sonographers attempted and completed the questionnaires. The demographic findings revealed that of the 60 participants, 22 (36.67%) of the participants were Radiographers only, 18 (30%) of the participants were Sonographers only and 20 (33.33%) of the participants practiced both Radiography and Sonography. The findings also show that there were 34 (56.67%) male participants and 26 (43.33%) female participants involved in this study. 19 (31.67%) of the respondents were aged below 30 and only 9 (15%) of them were older than 50 years. The results also show that 36 (60%) of the participants were B.Sc degree holders only, 16 (26.67%) of them had a Diploma, 8 (13.33%) of them held masters' degrees and none of the participants had a PhD degree. Also out of the 60 participants 11 (18.33%) of them had less experience in Obstetric Sonography, 17 (28.33%) of the participants were quite experienced with 1-5 years

experience, 17 (28.33%) of the participants also had 5-10 years experience of obstetric sonography and only 15 (25%) of the respondents had more than 11 years of experience.

According to a study done by Siddiqui et al. (2024) on the Challenges of prenatal diagnosis in obese pregnant women. According to the study, obesity rates are rising globally, with women in the reproductive age range accounting for the majority of the rise. Although obesity is known to play a significant role in non-communicable diseases, pregnant women who are obese are especially vulnerable to difficulties for both the mother and the fetus as well as a higher chance of congenital abnormalities. It is difficult to diagnose these women during pregnancy, particularly if they are severely obese, because of their weight as well as the effects of increased adiposity on biochemical indicators of aneuploidy. The findings of this study is similar to the results obtained from our study where the respondents reported prolonged scan times and Increased difficulty in visualizing fetal structures as some of the challenges faced when scanning pregnant women with maternal obesity. Another study which supports this claim was conducted by Paladini in the late 2000s titled “Sonography in obese and overweight pregnant women: clinical, medicolegal and technical issues” who also reported Obese pregnant women are more likely to have offspring with significant abnormalities. The study also stated that performing an ultrasound examination on an obese pregnant lady is challenging because of the compromised acoustic window (Paldini, 2009).

CHAPTER FIVE

CONCLUSION AND RECOMMEDATIONS

5.1 CONCLUSION

The study revealed that the radiographers and sonographers In Edo State are generally confident and skilled in scanning obese pregnant women, though maternal obesity frequently reduces image quality and prolongs scan time. While most respondents feel prepared, there are still gaps in specialized training and access to updated equipment. To improve accuracy and service quality, continuous professional development, modern ultrasound systems, and standardized protocols are required.

5.2 RECOMMENDATIONS

1. Hospitals and diagnostic centers should invest in modern, high-resolution ultrasound machines with low-frequency transducers and advanced imaging capabilities. Such enhancements would improve image penetration and clarity, allowing radiographers and sonographers to take more precise measures in obese pregnant women.

2. Regular workshops and continuing professional development programs should be established to provide practitioners with enhanced scanning capabilities. These workshops should focus on dealing with maternal obesity situations, improving imaging quality, and efficiently addressing technical issues.

3. Health institutions should develop and implement clear, evidence-based policies for scanning obese pregnant women. Standardized guidelines will increase consistency, reduce variability in practice, and improve overall diagnostic accuracy.

4. Training institutions should revise and enrich their radiography and sonography curricula to incorporate modules that address the specific difficulties of maternal obesity in ultrasound practice. This will guarantee that future practitioners are better equipped to handle such issues confidently.

5.3 LIMITATIONS

1. The use of a self-administered questionnaire may also have introduced response bias, as participants could have over- or under-reported their confidence and practices

2. The study was conducted on a small sample of radiographers, and not all completed the questionnaires that were supplied.

3. The study relied on self-perceived competence rather than direct observation or performance assessment, which may not fully reflect actual skill levels.

5.4 SUGGESTIONS FOR FUTURE STUDIES

1. Future research should include a larger and more diverse sample of radiographers and sonographers from multiple states to improve the generalizability of findings.
2. Future studies should use direct observation or performance-based assessments to objectively measure practitioners' competence and image quality.
3. Comparative studies between practitioners who have received specialized training and those who have not would help determine the real impact of training on measurement accuracy.
4. Future studies should explore the cost-effectiveness and practical feasibility of implementing equipment upgrades and continuous training programs in low-resource settings.

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MATERNAL OBESITY AND ULTRASOUND MEASUREMENT ACCURACY: AN EXPLORATORY STUDY OF RADIOGRAPHERS/SONOGRAPHERS

PERCEPTIONS AND PRACTICES IN EDO STATE, NIGERIA

Dear Participant,

I am Iserhienrhien Lucky, a student in the Department of Radiography at the University of Benin. I am conducting a research study to gain a deeper understanding of the professional experiences, challenges, and adaptive practices of radiographers and sonographers when performing obstetric ultrasound examinations on pregnant women with maternal obesity in Edo State, Nigeria.

Your participation in this study is entirely voluntary, and all your responses will be kept confidential and used strictly for academic research. There are no right or wrong answers, and your honest responses will greatly contribute to the success of this research.

Thank you for your valuable time and cooperation.

Please read the statement below and indicate your agreement:

I have read and understood the purpose of this study.

I voluntarily agree to participate.

I understand that my responses will be treated with utmost confidentiality.

I am aware that I can withdraw from the study at any point without penalty

1. Do you want to participate in this study?

Mark only one

- [ ] Yes
- [ ] No

SECTION A: DEMOGRAPHIC SECTION

2. Age

Mark only one

- [ ] Below 30
- [ ] 30-40
- [ ] 40-50
- [ ] above 50

3. Gender

Mark only one

- [ ] Male
- [ ] Female

4. Highest Educational Qualification

Mark only one

- [ ] Diploma
- [ ] Bachelor's Degree
- [ ] Master's Degree
- [ ] PhD
- [ ] Other (please specify)

5. Current Professional Role

Tick all that apply.

- [ ] Radiographer
- [ ] Sonographer
- [ ] Other:_____

6. Years of experience in obstetric sonography?

Mark only one .

- [ ] Less than 1 year
- [ ] 1-5 years
- [ ] 6-10 years
- [ ] 11-15 years
- [ ] More than 15 years

7. What type of facility do you primarily work in?

Tick all that apply.

- [ ] Primary Diagnostic Center
- [ ] General Hospital
- [ ] Specialist Hospital
- [ ] Teaching Hospital

Other …….

SECTION B: PERCEPTIONS AND ATTITUDES TOWARD MATERNAL OBESITY AND ULTRASOUND

8. How frequently do you encounter pregnant women with maternal obesity in your daily practice?

Mark only one oval.

Never/Rarely

Sometimes

Frequently

Very Frequently/Almost Daily

9. How would you rate your overall confidence in obtaining accurate ultrasound measurements in pregnant women with maternal obesity?

Mark only one oval.

Very low confidence

Low confidence

Neutral

High confidence

Very high confidence

10. To what extent do you agree with the following statement: "Maternal obesity significantly impacts the quality of ultrasound images."

Mark only one oval.

Strongly disagree

- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly agree

11. Please describe your general experiences when performing ultrasound scans on pregnant women with maternal obesity. What are the main differences you notice compared to non-obese pregnant women?

Tick all that apply.

- [ ] Increased difficulty in visualizing fetal structures
- [ ] Prolonged scan times
- [ ] Need for different equipment or settings
- [ ] No significant difference

12. Have you received any specialized training or formal guidelines on performing ultrasound scans on obese pregnant women

Mark only one oval.

- [ ] Yes
- [ ] No

13. Which of the following optimization techniques do you regularly employ when scanning obese pregnant women? (You can select all that apply)

Tick all that apply.

- [ ] Using lower frequency transducers (e.g., 2-5 MHz curved array)
- [ ] Spatial compounding
- [ ] Tissue harmonic imaging (THI)

- [ ] Careful manipulation of the transducer
- [ ] Adjustments in patient positioning (e.g., lateral decubitus)
- [ ] Gentle compression with the transducer
- [ ] Extended Field of View (EFOV)
- [ ] Adjusting gain/depth settings
- [ ] Using specific software options on the ultrasound machine
- [ ] None of the above
- [ ] Other:……..

14. How confident are you in the accuracy of the following ultrasound measurements when scanning obese pregnant women?* (Please select one option for each measurement)

Mark only one oval per row.

	Not Confident At All	Slightly Confident	Moderately Confident	Very Confident	Extremely Confident
BPD (Biparietal Diameter)					
HC (Head Circumference)					
AC (Abdominal Circumference)					
FL (Femur Length)					

EFW (Estimated Fetal Weight)					

SECTION D: TRAINING AND SUGGESTIONS

15. Did your formal training as a radiographer/sonographer adequately prepare you for scanning obese pregnant women?

Mark only one.

- ☐ Yes
- ☐ No

16. What specific training or resources do you feel are most needed to improve your ability to scan obese pregnant women?

Tick all that apply.

- ☐ Workshops on advanced techniques
- ☐ Access to updated equipment
- ☐ Standardized protocols for obese patients
- ☐ No additional training is needed
- ☐ Other:……..

17. What suggestions do you have for improving ultrasound services for obese pregnant women in your institution or in Edo State generally?

Tick all that apply.

- ☐ Implementing standardized protocols

- ☐ Providing access to newer ultrasound machines
- ☐ Offering continuous professional development
- ☐ No suggestions at this time
- ☐ Other:……

Appendix II

HEALTH RESEARCH ETHICS COMMITTEE (HREC)

UNIVERSITY OF BENIN TEACHING HOSPITAL

P.M.B. 1111 BENIN CITY NIGERIA Telephone: 052-600418 Website: ubth.org

CHIEF MEDICAL DIRECTOR
Prof. Darlington E. Obaseki

DIRECTOR OF ADMINISTRATION
Jim Uwadie, Esq

CHAIRMAN
Prof. (Mrs.) Antoinette N. Ofili

HREC OFFICE:
Committee email: ubthresearchethics@gmail.com
Registration Number:
NHREC-UBTH-HREC/24/12/2022B

PROTOCOL NUMBER: ADM/E 22/A/VOL.VII/2025/172

PROPOSAL TITLE: "MATERNAL OBESITY AND ULTRASOUND MEASUREMENT ACCURACY: AN EXPLORATORY STUDY OF RADIOGRAPHERS/SONOGRAPHERS PERCEPTIONS AND PRACTICES IN EDO STATE, NIGERIA"

PRINCIPAL INVESTIGATOR(S): ISERHIENRHIEN LUCKY

DEPARTMENT/INSTITUTION: DEPARTMENT OF RADIOGRAPHY, SCHOOL OF BASIC MEDICAL SCIENCES UNIVERSITY OF BENIN, BENIN CITY, EDO STATE

DATE CONSIDERED: AUGUST 6TH, 2025

DECISION OF THE COMMITTEE: APPROVED

THIS APPROVAL DATES 6/8/2025 TO 5/8/2026. IF THERE IS DELAY IN STARTING THE RESEARCH, PLEASE INFORM THE HREC SO THAT THE DATES OF APPROVAL CAN BE ADJUSTED ACCORDINGLY

REMARK:

CHAIRMAN: PROF. (MRS) A.N. OFILI SIGNATURE & DATE A.N. 6/8/2025

SUPERVISOR (S): MR C.V. MBIAKU

DECLARATION BY INVESTIGATOR(S):
PROTOCOL NUMBER (please quote in all enquiries)
Note that no participant accrual or activity related to this research may be conducted outside of these dates. All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study. In multiyear research, endeavor to submit your annual re-port to the HREC early in order to obtain renewal of your approval and avoid disruption of your research. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit your research site without previous notification

Signature & Date 19/8/2025

ubthresearchethics@gmail.com Registration Number: NHREC/24/01/202