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# LIMITED OBSTETRIC ULTRASOUND BY GENERAL PRACTITIONERS VERSUS OBSTETRICS-GYNECOLOGY RESIDENTS IN MEDAN PRIMARY HEALTH CENTERS

**Jhon Hendrik Tambunan[1]*, Sarma N. Lumbanraja[1], Muhammad Rusda[1]**
[1]Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia
[1]jhonhendrik9914@gmail.com
*Corresponding Author

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**Abstract**

*Limited obstetric ultrasound (LOUS) is a non-invasive diagnostic modality that general practitioners at primary health care facilities can use to assess intrauterine pregnancy and fetal condition. However, the quality of this examination depends heavily on the examiner's competence, so it needs to be compared between general practitioners at primary health centers and clinicians who routinely work in hospitals. This study aimed to compare limited obstetric ultrasound results obtained by general practitioners and obstetrics-gynecology residents. This was a comparative observational study with a cross-sectional design. Examinations were first performed by general practitioners and then repeated by obstetrics-gynecology residents on the same patients. The parameters assessed were biparietal diameter, head circumference, abdominal circumference, femur length, maximum vertical pocket (MVP), fetal heart rate, estimated fetal weight, and gestational age, analyzed using the Mann-Whitney test ($p < 0.05$). A total of 458 pregnant women from 37 primary health centers were included. All general practitioners were able to detect intrauterine pregnancy and fetal presentation, but significant differences were found in all assessed parameters, with general practitioners' results generally lower than those of residents. Overall, 31.8% of general practitioners could not determine placental location and only 34.7% could measure MVP accurately. General practitioners tended to report lower biometric values, so gestational age was estimated as younger than the actual age, potentially leading to unnecessary referrals. These findings underscore the importance of additional training for general practitioners to improve the detection of obstetric abnormalities at primary health care facilities.*

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## INTRODUCTION

Ultrasonography (USG) is a non-invasive diagnostic modality that can confirm intrauterine pregnancy quickly and practically, so it can be performed as a bedside examination or diagnostic procedure (Herbst et al., 2023). As a non-invasive procedure, its use can be extended so that even general practitioners can use it clinically, known as limited obstetric ultrasound (LOUS). The main purpose of limited obstetric ultrasound is to assess the presence of intrauterine pregnancy, the number of fetuses, and gestational age based on fetal size parameters

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estimated by ultrasound (Abawollo et al., 2023; Kim et al., 2018). In addition, limited obstetric ultrasound can evaluate pregnancy quality from the first to the third trimester by assessing amniotic fluid volume and fetal biophysical parameters, such as biparietal diameter, head circumference (HC), abdominal circumference (AC), and others (Abawollo et al., 2023; Stolz et al., 2015). Limited obstetric ultrasound is also projected to detect congenital abnormalities or obstetric conditions that can affect fetal viability and maternal safety, such as abnormal placental location, ectopic pregnancy, multiple pregnancy, or non-pregnancy conditions such as hydatidiform mole (Greenwold et al., 2014; Swanson et al., 2014).

However, one of the main challenges of limited obstetric ultrasound as a diagnostic modality is that its quality is highly operator-dependent. In other words, examiners who are not proficient in ultrasound will produce suboptimal evaluations, and important findings that should be depicted by limited obstetric ultrasound may be inadvertently missed (Abramowicz, 2021; Tolsgaard et al., 2014). Quality improvement in primary health care facilities worldwide, including Indonesia, has reached a stage at which early diagnostic algorithms or protocols for obstetric abnormalities have become an essential need, one of which can be met by introducing limited obstetric ultrasound evaluation for clinicians or general practitioners at these facilities (Holmlund et al., 2017; Shah et al., 2015; Wanyonyi et al., 2017).

Nevertheless, there is a clear difference in the intensity of education and training in the use of obstetric ultrasound in clinical practice between general practitioners and obstetrics-gynecology residents. The researchers therefore considered it necessary to conduct a study assessing differences in interpretation between general practitioners at primary health centers (Puskesmas), who serve as front-line clinicians in primary health care, and physicians who have undergone further training or education in limited obstetric ultrasound. The research question of this study is: is there a significant difference between limited obstetric ultrasound results obtained by general practitioners and by obstetrics-gynecology residents? Accordingly, the main objective of this study was to compare limited obstetric ultrasound results obtained by general practitioners with those of obstetrics-gynecology residents who have received additional training and have a greater capacity to perform this examination in clinical practice.

## RESEARCH METHODS

### Study Design, Setting, and Subjects

This was a comparative observational study with a cross-sectional design conducted to compare the results and interpretation of limited obstetric ultrasound performed by general practitioners at primary health centers in Medan City, North Sumatra, Indonesia, with the findings described by obstetrics and gynecology residents of Universitas Sumatera Utara (USU) in first- to third-trimester pregnancies. The study population comprised pregnant women in the first to third trimester whose pregnancy had been confirmed by history taking, physical examination, or supporting examination (β-hCG levels measured with a standardized pregnancy test kit). Exclusion criteria were pregnant women with a history of delivering a fetus with congenital abnormalities or who were unwilling

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to have their limited obstetric ultrasound results documented; these subjects were not included in the final analysis.

### Variables and Study Procedure

The variables compared were limited obstetric ultrasound findings or markers that can be evaluated by both general practitioners and obstetrics and gynecology residents, namely biparietal diameter, head circumference (HC), abdominal circumference (AC), femur length (FL), maximum vertical pocket (MVP) reflecting amniotic fluid volume, estimated fetal weight (EFW), gestational age, and crown rump length (CRL). In addition, general practitioners' ability to identify intrauterine pregnancy, number of fetuses, fetal presentation, placental location, MVP, and fetal heart rate (FHR) was recorded descriptively.

The study began with recording the baseline characteristics of the subjects, followed by limited obstetric ultrasound examinations performed by general practitioners at each participating primary health center, accompanied by obstetrics and gynecology residents. The ultrasound examination was then repeated by the residents under the supervision of an obstetrics and gynecology specialist on the same patient. The residents and obstetric specialists participating in this study were the same individuals in every examination session.

### Data Analysis

Statistical analysis was performed using the Mann-Whitney test to compare the mean (standard deviation) of each examination parameter between general practitioners and residents, with $p < 0.05$ considered statistically significant (95% confidence interval). Categorical data on identification and measurement ability are presented as frequencies and percentages.

## RESULTS AND DISCUSSION

### Characteristics of the Study Subjects

This study involved 458 pregnant women from 37 primary health centers in Medan City, 370 (80.8%) of whom were in the second or third trimester at the time of limited obstetric ultrasound. The mean ages of pregnant women in the first-trimester and second/third-trimester groups were 26.98 ± 4.37 years and 28.83 ± 5.59 years, respectively. There were no meaningful differences in demographic characteristics between the two trimester groups, although in terms of clinical findings the second/third-trimester group had a relatively lower mean MVP and fetal heart rate than the first-trimester group (Table 1).

**Table 1.** Clinical and demographic characteristics of pregnant women

| Characteristics | First trimester (n = 88) | Second and third trimester (n = 370) |
|---|---|---|
| **Age (years)** | | |
| Mean ± SD | 26.98 ± 4.37 | 28.83 ± 5.59 |
| Median (min–max) | 26.5 (20–34) | 28 (16–48) |
| **Education level, n (%)** | | |
| Elementary school | 21 (23.9) | 10 (2.7) |
| Junior high school | 17 (19.3) | 36 (9.7) |
| Senior high school | 27 (30.7) | 241 (65.1) |
| University | 23 (26.1) | 83 (22.4) |
| **Parity status, n (%)** | | |

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| Characteristics | First trimester (n = 88) | Second and third trimester (n = 370) |
|---|---|---|
| Primiparous | 30 (34.1) | 166 (44.9) |
| Secundiparous | 19 (21.6) | 120 (32.4) |
| Multiparous | 18 (20.5) | 60 (16.2) |
| Grand multiparous | 21 (23.9) | 24 (6.5) |
| **Maximum vertical pocket (MVP)** | | |
| Mean ± SD | 6.05 ± 0.87 | 4.38 ± 1.01 |
| Median (min–max) | 6.24 (3.3–7.4) | 4.2 (2.5–7.68) |
| **Fetal heart rate (beats/minute)** | | |
| Mean ± SD | 161.22 ± 10.26 | 143.73 ± 8.01 |
| Median (min–max) | 164 (128–171) | 143 (126–168) |

SD: standard deviation; MVP: maximum vertical pocket.

## Performance of General Practitioners in Limited Obstetric Ultrasound

Table 2 shows that all general practitioners at the primary health centers involved in this study were able to detect intrauterine pregnancy, report the number of fetuses, and describe fetal presentation (in the second/third-trimester group). However, 31.8% of general practitioners were unable to determine placental location (in the second/third trimester), which is a crucial issue to address. Interestingly, all general practitioners were also able to measure fetal heart rate based on limited obstetric ultrasound findings, but only 34.7% were able to both identify and accurately measure MVP, while the rest could only identify it without measuring the parameter.

**Table 2.** Overview of general practitioners' performance in limited obstetric ultrasound

| Parameter | General practitioners, n (%) | | |
|---|---|---|---|
| | Identification (+) Measurement (+) | Identification (+) Measurement (–) | Identification (–) Measurement (–) |
| Intrauterine pregnancy | – | 458 (100.00) | 0 (0.0) |
| Number of fetuses | – | 458 (100.00) | 0 (0.0) |
| Fetal presentation (2nd/3rd trimester) | – | 370 (100.00) | 0 (0.0) |
| Placental location (2nd/3rd trimester) | – | 255 (68.92) | 115 (31.80) |
| MVP | 159 (34.72) | 299 (65.28) | 0 (0.0) |
| FHR | 458 (100.00) | 0 (0.0) | 0 (0.0) |

MVP: maximum vertical pocket; FHR: fetal heart rate.

## Comparison of Measurements by General Practitioners and Residents

Further analysis comparing limited obstetric ultrasound results in the first to third trimesters (Table 3) showed significant differences ($p < 0.05$) in all evaluated parameters. These findings show a consistent pattern: the measurements reported by general practitioners were consistently "smaller" than those described by obstetrics-gynecology residents. This trend was seen in measurements of biparietal diameter, head circumference, abdominal circumference, femur length, MVP, and CRL. These differences also affected gestational age estimates, with a considerable gap between the findings of general practitioners (median 21 [0–38] weeks) and obstetrics-gynecology residents (median 31 [16–38] weeks).

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**Table 3.** Comparison of limited obstetric ultrasound results in the first to third trimesters

| Parameter | General practitioners | Obstetrics and gynecology residents | p-value* |
|---|---|---|---|
| **Biparietal diameter (cm)** | | | |
| Mean ± SD | 73.95 ± 8.99 | 74.40 ± 14.82 | 0.001 |
| Median (min–max) | 73.6 (36–95) | 76.45 (33.1–98.50) | |
| **Head circumference (mm)** | | | |
| Mean ± SD | 245.64 ± 39.51 | 266.73 ± 55.10 | 0.001 |
| Median (min–max) | 244 (120–350) | 282.2 (122–383) | |
| **Abdominal circumference (mm)** | | | |
| Mean ± SD | 236.80 ± 61.73 | 252.09 ± 63.04 | 0.001 |
| Median (min–max) | 245.3 (74–378.9) | 264.9 (104–398.9) | |
| **Femur length (cm)** | | | |
| Mean ± SD | 28.11 ± 26.77 | 54.84 ± 13.24 | 0.001 |
| Median (min–max) | 34.6 (0–75.5) | 55.8 (18.10–88.75) | |
| **Maximum vertical pocket** | | | |
| Mean ± SD | 4.03 ± 1.288 | 4.38 ± 1.01 | 0.005 |
| Median (min–max) | 4.01 (0–7.58) | 4.3 (2.5–7.68) | |
| **Estimated fetal weight (grams)** | | | |
| Mean ± SD | 940.76 ± 1,086.54 | 1,703.48 ± 946.91 | 0.001 |
| Median (min–max) | 401 (0–3,940) | 1,696.5 (130–3,920) | |
| **Gestational age (weeks)** | | | |
| Mean ± SD | 16.87 ± 15.63 | 29.77 ± 5.8 | 0.001 |
| Median (min–max) | 21 (0–38) | 31 (16–38) | |
| **Crown rump length (CRL) (first trimester only)** | | | |
| Mean ± SD | 2.96 ± 1.57 | 3.99 ± 1.57 | 0.001 |
| Median (min–max) | 3.1 (0.11–6.4) | 4.07 (1.21–7.91) | |

*Mann-Whitney test.

## Discussion

This study set out to determine whether there is a significant difference between limited obstetric ultrasound results obtained by general practitioners and by obstetrics-gynecology residents. Obstetric ultrasound has been shown to detect risk factors for maternal and infant death, especially in resource-limited settings. However, because ultrasound is operator-dependent, standardization of the examination is crucial, including by comparing the adequacy of general practitioners' ability to perform this procedure with that of more highly trained clinicians.

This issue is reflected in the findings of this study, in which 31.8%, or almost one-third, of general practitioners in Medan City were unable to identify placental location. As a result, in clinical practice at primary health centers, many cases of abnormal placental location may go undetected. The importance of detecting placental abnormalities lies in their impact on the risk of maternal and infant death, as 4–8% of all cases may end in death (Alsammani & Nasralla, 2021; Berhan, 2014). Delay or failure in referring patients to better-equipped health facilities (for example, for termination of pregnancy by cesarean section) in the management of placental abnormalities greatly affects the quality of primary health center services as the first line of diagnosis for vital obstetric cases such as placental abnormalities (Anderson-Bagga & Sze, 2023).

Further analysis showed that 65.28% of general practitioners at primary

health centers could only identify MVP, which reflects amniotic fluid volume, but could not measure it accurately. Failure to identify amniotic fluid abnormalities, such as oligohydramnios, can lead to intrauterine growth restriction (IUGR), limb contractures or suboptimal development of limb soft tissue, delayed or incomplete lung maturation, and even intrauterine fetal death (IUFD). Oligohydramnios is diagnosed when the largest MVP is ≤2 cm (Keilman & Shanks, 2022; Shrem et al., 2016). On the other hand, this study found that general practitioners tended to estimate MVP at lower values, which indirectly increases the risk of patient referral even when the actual indications for referral are not met.

Other parameters that were also consistently underestimated indicate that examinations by general practitioners carry a higher risk of producing a diagnosis of growth failure or an erroneous gestational age estimate based on limited obstetric ultrasound. Ultimately, the concern is not only delayed diagnosis but also the potential increase in referrals of obstetric abnormalities that do not actually require further hospital management. This is reflected quantitatively in the much lower gestational age estimates from general practitioners (median 21 weeks) compared with obstetrics-gynecology residents (median 31 weeks), a difference of about 10 weeks. It should be remembered that gestational age estimation is based on the biophysical parameters mentioned above, so general practitioners who tend to underestimate these measurements will also produce lower gestational age estimates (Naidu & Fredlund, 2023; Skinner & Mount, 2023).

The strengths of this study lie in its paired comparison design on the same patients with fixed comparison examiners (residents and supervisor) in every session, and its broad coverage of 458 pregnant women from 37 primary health centers, which reflects the real conditions of obstetric ultrasound services at the primary care level. This study therefore encourages intensified training and education in limited obstetric ultrasound for clinicians or general practitioners working at primary health centers as the front line in detecting obstetric abnormalities. This effort is expected to produce "synchronization" of results between general practitioners and residents (or even obstetric specialists) in interpreting ultrasound findings, which in turn can significantly improve the quality of maternal health services in the future.

## CONCLUSION

There is a significant difference between the interpretation of limited obstetric ultrasound results by general practitioners and by obstetrics and gynecology residents. General practitioners were able to identify intrauterine pregnancy, number of fetuses, fetal presentation, and fetal heart rate, but almost one-third could not determine placental location and most could not measure MVP accurately. General practitioners also tended to report lower biometric values, raising concerns about an increase in unnecessary referrals from primary health care facilities such as primary health centers. Additional training in limited obstetric ultrasound for general practitioners is needed to improve the detection of obstetric abnormalities in primary care.

### Statement on the Use of Artificial Intelligence

AI was used in the preparation of this manuscript. The authors used artificial

intelligence tools solely to assist with language improvement, grammar checking, and editing for clarity and readability. The authors remain fully responsible for the accuracy, originality, integrity, and academic content of the manuscript. All AI-assisted content was reviewed and verified by the authors before submission.

## Conflicts of Interest

The authors declare no conflict of interest.

## Author Contributions

Conceptualization, J.H.T., S.N.L., and M.R.; methodology, J.H.T. and S.N.L.; data collection, J.H.T.; formal analysis, J.H.T.; writing—original draft preparation, J.H.T.; writing—review and editing, S.N.L. and M.R.; supervision, S.N.L. and M.R. All authors have read and approved the final version of the manuscript.

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