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MEASUREMENT OF NON-CONTACT UTERINE FUNDUS IN SECOND AND THIRD TRIMESTER OF PREGNANCY USING MACHINE LEARNING

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ABSTRACT:
Regular pregnancy checkups provide good data points for pregnant women. The information obtained is expected to have an impact on the health of the baby from the womb to the baby is born. Fetal monitoring and examination has evolved significantly in terms of the use of technology as a tool for control and examination. The advancement of data technology causes changes in the order of life, including behavior and habits, one of which is the role of technology, which is increasingly vital in its initial nature as a tool for human life, including in the field of health. One of the things that can be integrated with technology is pregnancy monitoring for pregnant women, especially measuring symphysis-fundus height. Professionals must have accurate predictive methods for making diagnoses during prenatal care, so that they can detect them as early as possible. This can be helped by detecting the size of the symphysis-fundus height using digital imagery. This study took data from 98 respondents with a distribution of 4 data collection points. Of the 98 data, there were 10 invalid data because manual measurements failed to be performed. This study took data from 98 respondents with a distribution of 4 data collection points. This study is the best accuracy in Banjaran midwives, with a success rate of 93%. Further research with a larger sample of pregnant women is needed for machine learning to have adequate trials to become data-driven maternal health. The implication of this finding is that machine learning has not been able to predict gestational age

with precision, so it must be given more samples so that machine learning can continue to be trained in predicting and calculating after the end of the second and third trimesters.
Keywords: Symphysis-fundal Height, Digitalization, Measurement, Machine Learning

INTRODUCTION

Currently, antenatal care has carried out symphysis-fundal height (SFH) measurements at routine visits of pregnant women to screen for abnormalities in fetal growth, but the results are varied (Pugh et al., 2018). The sensitivity of the SFH measurement to detect SGA (small for gestational age) has a sensitivity of 17%–93% (Griffin et al., 2015). This shows that the measurement method used is not standardized due to the different variations in inspection and the local SFH charts used. For example, SFH is measured every week from 14 weeks of gestation using a tape measure that is rotated so that the number is not visible during measurement; besides that, the position of the mother during measurement can also affect the results.

The National Antenatal Care Coverage in 2019 reached 88.54%, which shows good access to antenatal care services in Indonesia. In terms of the availability of health facilities, until December 2019, there were 10,134 health centers (Suebu et al., 2022). Access to health centers or midwives is 60.8%, and access to clinics, doctors' practices, or independent midwives' practices is 62.6%, with difficult access (Halilintar & Sjaaf, 2019). The highest proportion of birth attendants were midwives at 62.7% and obstetricians at 28.9%. This data provides information that primary care facilities are the most widely used health services in the community, including antenatal care examinations, while ultrasound facilities in primary care areas are not yet available (Yigzaw et al., 2019).

Based on the analysis and ANC coverage data, efforts need to be made to measure fundus uteri-symphysis height as an accurate method, using a standardized tool, that is easy to use in the field so as to obtain accurate data for diagnosis and intervention (Mbuagbaw et al., 2015). In 2021, research was carried out by Yulinda, et al regarding a review of the theory and design of a digital image-based SFH measurement tool in pregnancy. Furthermore, this research aims to create a digital image-based SFH measurement tool in machine learning that can be used as a standardized and simple SFH measurement tool (Saunders & Cornish, n.d.). In an effort to provide quality antenatal care examinations. Currently fundus uteri height measurements are performed with intra- and inter-operator variations that cause data variations. A measuring device that will be a fundus uteri height gauge will be made using digital images that take images at the

top of the uterus and the lower border, namely the upper edge of the symphysis. It is hoped that using digital image-based measuring tools and machine learning designed can be obtained with precise measurements.

RESEARCH METHODS

The research design uses Research and Development, starting with a study of antenatal care examination procedures, especially the determination of fundal height and gestational age in an effort to determine the diagnosis of intrauterine fetus. The study concluded that there were inter- and intra-carrier differences in determining fundal uterine height with abdominal palpation, leading to differences in diagnosis.

Machine Learning (ML) is part of Artificial Intelligence (AI) which is an important part of system automation, both physical and robotic to increase the productivity of data management and the importance of diagnosis. This ML integration in Laptop that supports machine learning process in real time. The stages of building ML are as follows: Based on the purpose of this study that researchers will make a non-contact fundus uteri measuring instrument in pregnancy. The initial data that must be collected is the height of the uterine fundus according to the period of pregnancy using a measuring tape through examination by a midwife according to obstetric care standards. In addition, the initial data sought is a photo of the abdomen of pregnant women according to the period of pregnancy (Handayani et al., 2023).

Furthermore, these two initial data will be processed based on unstructured data. 1). Data Collection, include a. Structured data: Start Symfisis Pubis Umbilical Procecus Xypoideus distance in pregnant women, b. Next: Age of respondents, Last Mentrual Periode, height, weight, basal metabolisme index, pubic to Umbilicus Symphysis Size. 2) Data Pre Processing: The process to ensure all data is filled in properly. Cleaning data, so that the data is ready to be processed. Abdominal photo processing: color, width, formating pictures. 3). Developing Model, Use Supervised data. Image processing or fundus uteri image is carried out by: 1) Online: mother takes photos using Kamera. and 4). Performance Model.

RESULTS AND DISCUSSION

This study created a tool to measure the fundus of the uterus based on imagery to facilitate and perform early detection of the size of the Fundus Symphysis-Height which is important for pregnant women. Pprocesses using machine learning SFH measurement system in detail can be used by pregnant women and health workers. From the user side, pregnant women can access the patient's medical record history. From a healthcare staff's perspective, it can process SFH detection.

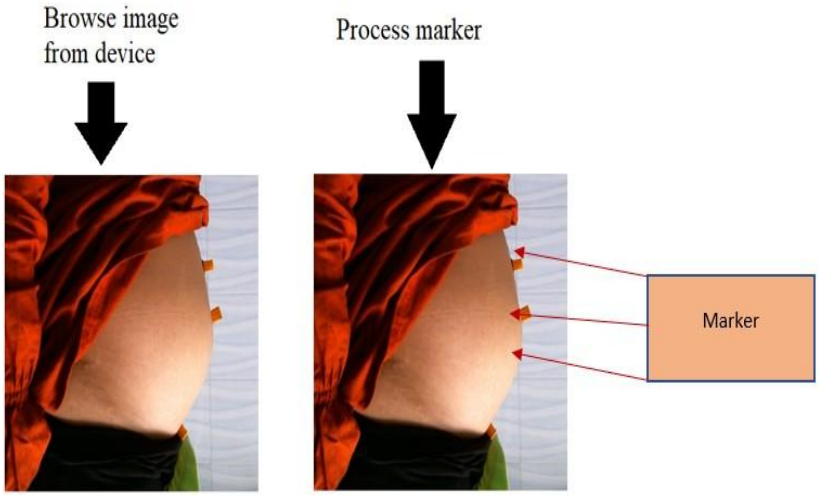

Figure 1. Marker Point

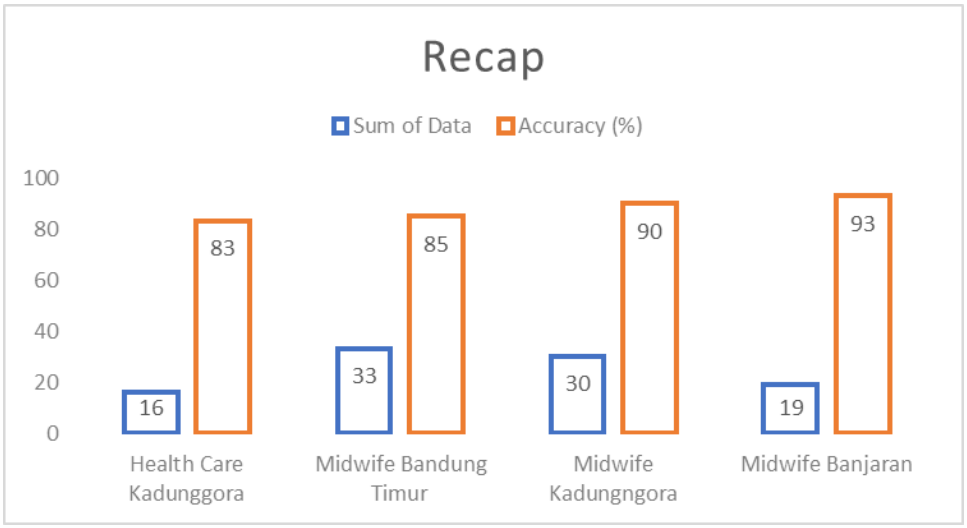

Figure 2. Recap Accuracy

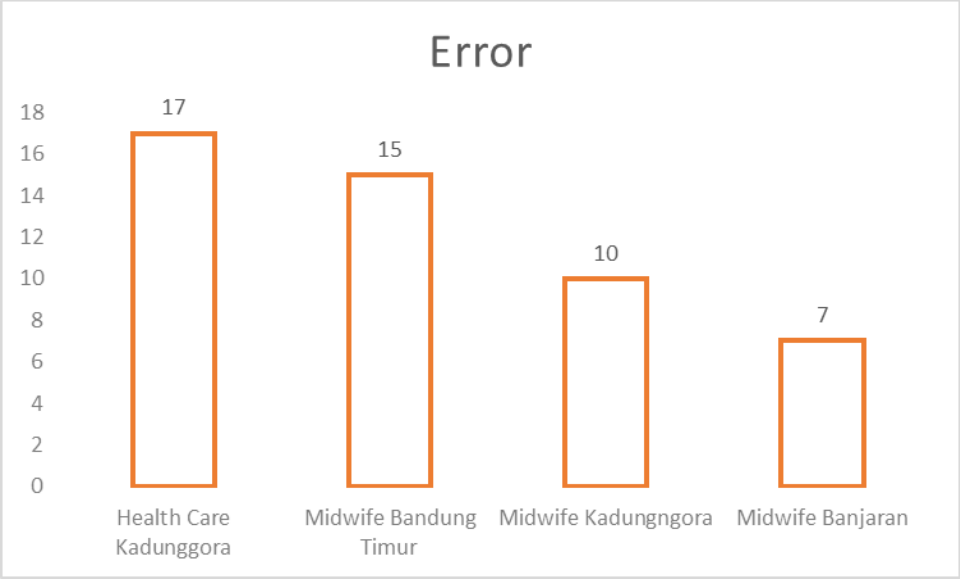

Figure 3. Recap Error

SFH-related correlation analysis has also been investigated by Aghadiati by linking it with nutritional intake and socioeconomic influence on birth weight. The conclusion of this study is that there is a relationship between energy intake, both from adequate protein, and the birth of the baby's weight, but factors related to education and economic status of the mother do not necessarily affect birth weight (Aghadiati, 2019).

In determining fetal weight, it can be simulated with a simple formula written by Fathia Rizki by comparing the simulation results with the actual measurement results. The final result of this study was a significant difference value of 0.054, with the conclusion that there was no difference in calculating fetal weight estimation using a simple formula with manual measurements (Rizki, 2019). Similar measurements have also been made by Maisarah by comparing the estimated calculations with the real results of SFH measurements. The final result of the study conducted by sampling at the Sidomulyo Health Center in Pekanbaru City is that there is no difference in the average birth weight with the formula applied in the simulation process using the Kruskal-Wallispada test approach (Maisarah, Yanti, 2021). Measurements using formulations have also been tested by Dian Kusumaningtyas by applying the Johnson Tousach formula and Dare formula to objects at Soewondo Kendal Hospital as many as 176 research samples. The results of this study show that Johnson Tousach formula has a better accuracy rate than the Dare formula, with the results obtained close to the actual birth weight of the baby (Dian Kusumaningtyas, 2021).

A further reference to measuring gestational age with high SFH volume estimation was made by Anne C C Lee the final results of this study showed that it was impossible to predict GA with a high degree of accuracy before birth using anthropogenic maternal measurements (Lee et al., 2020). The implementation of

ANC visits at the Cirebon City health center is intended for prenatal examinations during pregnancy to prevent pregnancy complications, with the result that pregnant women still have to carry out ANC examinations in the early stages of pregnancy (Nurmala Sari, Ani Nurhaeni, 2021).

Breakthroughs related to the evaluation of the fetus in the womb are carried out by ultrasound examination at least three months after metroplasty to be able to provide case assistance and next steps (Casadio et al., 2021). Research from Kanna Jayaprakasan shows that congenital uterine abnormalities are asymptomatic and some are not detected intentionally, so 3D ultrasound is carried out as a variation of obstetric examination (Jayaprakasan and Ojha, 2022). The research reference from Febi Puji Utami examined the suitability of TFU, measuring tapes, and LMP digitization tools to determine gestational age with the final result of the study being that TFU digitization tools can be used to determine gestational age in second trimester and third trimester pregnant women without having to look at LMP (Utami et al., 2019).

The dataset used to measure SFH is the result of direct photos or in the form of manually uploaded images, some samples of this study are shown in Table 1.

In addition, the COVID-19 pandemic has severely impacted the mental health of pregnant women, and factors unrelated to pregnancy seem to drive pregnancy-specific anxiety changes (Moyer et al., 2020). Regarding SFH, it was also found that there was no correlation between fundus findings and age or patient parity (Jitendra and Punam, 2020). With regard to fundal height, another reference study mentions using ultrasound-based measurements to accurately re-estimate GA after 20 weeks (Alice Self, Lama Daher, Michael Schlussel, Nia Roberts, Christos Ioannou, 2022). The process flow uses machine learning, the detailed SFH measurement system can be used by pregnant women and health workers.

From the user side, pregnant women can access the patient's medical record history. From a healthcare staff's perspective, it can process SFH detection using the flowchart in part 2. The use of machine learning systems for pregnant women uses two modes, namely manual mode and real-time mode which requires access to the database owned. Manual measurement is by uploading files to a website or detection system, while in real time is by directly capturing the object to be measured. The details of the differences between the two modes are as follows.

In both modes contained in the measurement of the SFH's images, it provides an alternative, namely manually by uploading files to an existing website to generate information. While the real-time mode is to capture images directly and will be detected related to the results of uterine fundus measurements. The following is the process of the marker stages carried out in image upload mode.

The recapitulation results for each location are the locations with the most data, namely East Bandung midwives with 33 data, but there are 10 invalid data in this location. The results with the best accuracy were shown by Banjaran midwives at 93% and the highest error rate was obtained at the Kadungora Health Center with an error rate of 17%. This can be helped by detecting the size of the symphysis-fundus height using digital images. Accuracy was assessed from images taken and the first day of menstruation calculated with machine learning.

CONCLUSION

This study resulted in the final conclusion that the application of digital image-based technology can be an alternative step to make measurements and detection more easily to be able to identify related fundal height of the uterus in pregnancy. The results obtained from this study have relatively high accuracy with a relatively low error rate and can be used as a tool to measure fundus uterine height. The highest accuracy results were obtained at Banjaran midwives with accuracy values of up to 93% and the largest error values were obtained at the Kadungora Health Center with error values of up to 17%.

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