DIGITALIZATION SYMPHYSIS-FUNDAL HEIGHT MEASUREMENT OF NON-CONTACT FOR SECOND AND THIRD TRIMESTER USING MACHINE LEARNING

Yulinda, Subandi, Susetyo Bagas Bhaskoro, Teguh Budi Prijanto, Epti Yorita

1 Politeknik Kesehatan Kemenkes Bandung, Universitas Pendidikan Indonesia
2,4 Politeknik Kesehatan, Kemenkes Bandung
3 Politeknik Manufacture Bandung
5 Politeknik Kesehatan, Kemenkes Bengkulu

Email: yulinda@staff.poltekkesbandung.ac.id, yulinda.plg@upi.edu, bandibmc@gmail.com, bagas@ae.polman-bandung.ac.id, teguhbudip@staff.poltekkesbandung.ac.id, eptiyorita74@g.mail.com

ABSTRACT:
Regular pregnancy checks 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 until the baby is born. Fetal monitoring and examination have developed significantly regarding the use of technology as a tool for control and analysis. In harmony with digitalization being promoted by the government through digital-based health services. On the other hand, apart from causing things to change the order of life, including behavior and habits, one of the things is the role of technology, which is increasingly vital in its initial nature as a tool for human life, including in the health sector. One of the things that can be integrated with technology is pregnancy monitoring for pregnant women, especially measuring the symphysis-fundal height. Professionals should have an accurate prediction method for making diagnoses during prenatal care so they can detect them as early as possible. This can be assisted by seeing the size of the symphysis-fundal height using digital images. This study took data from 98 respondents with a distribution of 4 data collection points. Of the 98 data, there were ten invalid data because manual measurements failed to take place. This study took data from 98 respondents with a distribution of 4 data collection points. This study has the best accuracy at the Banjaran midwife location, with a success rate of 93%. Further research is needed with a larger sample of pregnant women so that machine learning has an adequate trial to become a data-based maternal health. These findings...
imply that machine learning has not been able to predict gestational age with precision, so more samples must be given 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. Still, 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. 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 most 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. In contrast, 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 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 straightforward SFH measurement tool (Saunders & Cornish, n.d.) 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
uteros and the lower border, namely the upper edge of the symphysis. 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 determining fundal height and gestational age, to diagnose an intrauterine fetus. The study concluded that there were inter- and intra-carrier differences in determining fundal uterine size with abdominal palpation, leading to differences in diagnosis.

Machine Learning (ML) is part of Artificial Intelligence (AI), which is an integral part of system automation, both physical and robotic, to increase the productivity of data management and the importance of diagnosis. This ML integration in the Laptop supports the machine learning process in real-time. The stages of building ML are as follows: Based on the purpose of this study, researchers will make a non-contact fundus uterus 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 Menstrual Period, height, weight, basal metabolism index, pubic to Umbilicus Symphysis Size. 2) Data Pre-Processing: Ensure all data is filled in correctly. Cleaning data so that the data is ready to be processed. Abdominal photo processing: color, width, formatting pictures. 3) Developing a 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 research creates a tool for measuring the uterine fundus based on imagery to facilitate and make early detection related to the measurement of the Symphysis-Fundal Height, which is essential for pregnant women. The flow in this study is divided into four parts, each part of which is connected with details shown in the below figure.
Based on the figure, the process flow using machine learning and the SFH measurement system in detail can be used by pregnant women and health workers. From the user side, pregnant women can access the history of the patient's medical record. From the health staff perspective, it can process the SFH detection using the flowchart in section 2. Using a machine learning system for pregnant women uses two modes, namely manual mode and real-time mode, which require access to the database they have. Manual measurement is by uploading files to the website or detection system, while in real-time, it is by directly capturing the object to be measured. The details of the differences between the two modes are as follows.
Digitalization Symphysis-Fundal Height Measurement of Non-Contact for Second and Third Trimester Using Machine Learning

Figure 2. Manual Mode

Figure 3. Marker Point
Aghadiati has also studied correlation analysis related to the SFH by linking it to nutritional intake and socioeconomic influences on birth weight. The conclusion from this study is that there is a relationship between energy intake, both from adequate protein and birth weight, but factors related to the mother's education and economic status do not necessarily affect birth weight (Aghadiati, 2019).

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

The following reference to measuring gestational age with a high estimation of SFH volume was made by Anne C C Lee. The final results of this study show that it is 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 aimed at prenatal checks during pregnancy to prevent pregnancy complications, with the result that pregnant women should still 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 with an ultrasound examination at least three months after metroplasty to provide case assistance and the next steps (Casadio et al., 2021). Research from Kanna Jayaprakasan showed that congenital uterine abnormalities were asymptomatic, and some were not detected on purpose, so a 3D ultrasound was performed as a variation in obstetric examinations (Jayaprakasan and Ojha, 2022). The research reference from Febi Puji Utami examined the suitability of the TFU, measuring tape, and LMP digitization tools to determine gestational age, with the final result of the study being that the TFU digitization tool can be used to determine gestational age in trimester II and third-trimester pregnant women without having to look at the LMP (Utami et al., 2019).

The dataset used for measuring the SFH results from direct photos or images uploaded manually. Several samples regarding this study are shown in Table 1.48. In addition, the COVID-19 pandemic has profoundly impacted the mental health of pregnant women, and factors unrelated to pregnancy appear to be driving changes in pregnancy-specific anxiety (Moyer et al., 2020). Regarding the SFH, it was also found that there was no correlation between fundus findings and the patient's age or parity (Jitendra and Punam, 2020).
Regarding fundal height, other reference studies mention using ultrasound-based measurements to accurately estimate GA after 20 weeks (Alice Self, Lama Daher, Michael Schlussel, Nia Roberts, Christos Ioannou, 2022). The process flow using machine learning and the SFH measurement system in detail can be used by pregnant women and health workers.

From the user side, pregnant women can access the history of the patient’s medical record. From the health staff perspective, it can process the SFH detection using the flowchart in section 2. Using a machine learning system for pregnant women uses two modes, namely manual mode and real-time mode, which require access to the database they have. Manual measurement is by uploading files to the website or detection system, while in real-time, it 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, manually uploading files to an existing website to generate information. At the same time, the real-time mode captures 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 results of the recapitulation for each location are the locations with the most data, namely East Bandung midwives, with 33 data, but there are ten invalid data at this location. The Banjaran midwife showed the results with the best accuracy at 93%, and the highest error rate was obtained at the Kadungora Health Center with an error rate of 17%. This can be assisted by detecting the size of the symphysis-fundal height using digital images. Accuracy is judged by the photos taken and the first day of menstruation calculated by machine learning.

**CONCLUSION**

This research resulted in the conclusion that the application of digital image-based technology can be an alternative step to make measurements and detections more easily to be able to identify the height of the uterine fundus. The results obtained from this study have relatively high accuracy with a relatively low error rate and can be used as a tool for measuring the height of the uterine fundus. The highest accuracy results were obtained at the Banjaran midwife with an accuracy value of up to 93%, and the most significant error value was received at the Kadungora Health Center with an error value of up to 17%.

**BIBLIOGRAFI**

Griffin, M., Seed, P. T., Webster, L., Myers, J., Mackillop, L., Simpson, N., Anumba, D., Khalil, A., Denbow, M., & Sau, A. (2015). Diagnostic Accuracy Of Placental Growth Factor And Ultrasound Parameters To Predict The Small-For-Gestational-Age Infant In Women Presenting With Reduced Symphysis–Fundus Height. *Ultrasound In Obstetrics*
Digitalization Symphysis-Fundal Height Measurement of Non-Contact for Second and Third Trimester Using Machine Learning

& Gynecology, 46(2), 182–190.


Saunders, N. J., & Cornish, P. (N.D.). *CONFLICT LANDSCAPES.*


Griffin, M., Seed, P. T., Webster, L., Myers, J., Mackillop, L., Simpson, N., Anumba, D., Khalil, A., Denbow, M., & Sau, A. (2015). Diagnostic Accuracy Of Placental Growth Factor And Ultrasound Parameters To Predict The
Small-For-Gestational-Age Infant In Women Presenting With Reduced Symphysis–Fundus Height. *Ultrasound In Obstetrics & Gynecology*, 46(2), 182–190.


