RABERTA : The Application of Low Fetal Weight Probability Detector as a Solution for Recording and Intervention in the Golden Period

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新生児の推定15～20％は低体重（2500グラム以下）で生まれてくるという。そこで筆者らは、女性が妊娠中に、わが子が低体重で生まれてくる可能性を簡単に予測できるコンピュータ・プログラムRABERTAを開発した。

Abstract

Low Fetal Weight (LFW) or Small Gestational Age (SGA) can cause low birth weight and contribute to neonatal mortality and morbidity. This application innovation is named RABERTA which was created to facilitate intervention in monitoring the condition of mothers who are included in the golden period by calculating the probability of SGA. This innovation was created with the Java programming language through NetBeans IDE 6.8 with an expert system based on a research model of BBJR risk prediction with a sample size of 752 samples of pregnant women by cross sectional in 25 health services purposively in Palembang City, Indonesia. LFW prediction model after confounding and interaction control, there are 5 LFW significant variables, namely abortion history, hypertension, gestational distance <23 months, BMI before pregnancy is thin, and weight gain is not optimal. The quality of the prediction model is powerful (AUC = 0.951) so it is accurate to be used as a prediction of LFW. The implementation of the widespread use of RABERTA can be done by advocating for stake holders such as the Health Office and easily applied to computers based on Windows 7, 8 and 10.

Keywords low fetal weight, neonatal mortality, golden period, maternal health

Introduction

Low birth weight fetus is known as Small Gestational Age (SGA) or Low Fetal Weight (LFW). The term SGA or small gestational age (KMK) is also often equated with fetal growth restriction or intrauterine growth restriction (IUGR). SGA or LFW is a fetus with an estimated fetal weight or fetal abdominal circumference when ultrasound examination is less than the 10th percentile, which means the fetus weighs less than 90% of all fetuses in the same gestational age (POGI, 2016).

Low fetal weight or Small Gestational Age (SGA) can have an impact on several conditions. SGA conditions can result in low birth weight (LBW). It is estimated that 15-20% of all births worldwide are LBW. Improving human quality should start as early as possible since the fetus is still in the womb. So far, the intervention is still focused on babies who have been born so that the intervention on infant mortality can be said to be too late. Prevention of infant mortality is carried out early on by preventing the occurrence of LBW at the stage the baby is still in the womb (Ernawati, Kartono, & Puspitasri, 2011). Fetal period is included in the period of the first 1000 days of life. This period is often referred to as the golden period or window of opportunities, during which a very fast growth and development process occurs and does not occur in other age groups. Appropriate intervention during this period will have an impact on the better quality of human resources (Kemenkes RI, 2012).

The incidence of low fetal weight has an impact on several adverse health conditions. Therefore, recording, reporting and intervention as early as possible need to

be done to avoid these losses. The current problem is that there is no record of the prevalence of Intrauterine Growth Restriction (IUGR) in Indonesia.

The government, the Health Service, and research institutions only publish the incidence of Low Birth Weight (LBW), without classifying gestational age and supporting diagnoses. Not all low birth weight babies are categorized as IUGR, because some premature babies even though their birth weight is <2500gr, their growth is in accordance with their gestational age. Meanwhile, IUGR is the inability of the fetus to achieve normal growth, both in preterm, athermic, and postterm conditions (Nuraini, 2017).

Methodology

This innovation stage starts from planning and several stages of research and application design stages.

a) User Research

The research stage is carried out in 4 stages: 1) analysis of risk factors that most influence fetal weight; 2) confounding analysis and interaction test; 3) making a fetal weight prediction model; 4) the last, calculation of the probability of fetal weight.

1) Risk factor analysis
   1. Examination of 752 pregnant women
   2. The variable measured is a variable that based on previous research has a lot to do with the incidence of LBW. The variables are maternal age, mother's education, mother's occupation, maternal height, maternal BMI before pregnancy, maternal weight gain, parity, history of abortion, pregnancy interval, hypertension, and smoking status
   3. From these variables, a partial statistical test was performed. From the statistical test results at 5% alpha, 7 variables become risk factors, namely: BMI before pregnancy; Age; Weight gain; parity; Abortion history; Pregnancy Distance; and hypertension

2) Confounding analysis and interaction test
   1. After obtaining 7 variables, the next analysis is the confounding test. From the confounding analysis that has been done, it is obtained 2 confounding variables in this study. Confounding variables affect changes by >10% in exp B other variables. The variables are age and parity. The next stage is to test the interaction on each variable
   2. The significance value for all interaction variables is P-value > 0.05. This means that there is no interaction between these variables, so all interaction variables are excluded from the model. Thus, it is concluded from this research that there is no interaction variable.

3) Making a Fetal Weight Prediction Model
   From the results of the confounding and interaction tests and from the results of multivariate analysis using logistic regression, there were 5 variables that affected the incidence of low fetal weight. The variables are:
   1. The most dominant risk factors for low fetal weight were the history of abortion with a P-value of 0.005; 95% CI of = 2.00-52.56.
   2. The other risk factors are hypertension with a P-value of 0.012; 95% CI of = 1.65–57.99. Next, gestational interval <23 months with a P-value of 0.001; 95% CI of = 2.63–33.86.
   3. The variable BMI before pregnancy being underweight was a risk factor as well with a P-value of 0.026; 95% CI of = 1.25–30.14.
   4. The last risk factor is an increase in body weight P-value 0.016; 95% CI of = 1.32 - 16.4.

b) Application program design

The stages of designing the RABERTA application start from making a programming language with Java, then end with application testing

Results

a. App View

In Indonesian, RABERTA stands for *ramalan optimal berat janinku* (optimal prediction of my fetal weight). This innovation answers questions from health workers and mothers regarding optimal or not the weight of the

fetus they are carrying easily and accurately. The desktop version of RABERTA is a calculator that is optimized for use with Windows 7, 8, and 10. The scenario for how to use it is as follows :

1. Install the application into the Computer
2. Once installed, open the application
3. Enter data such as name and age

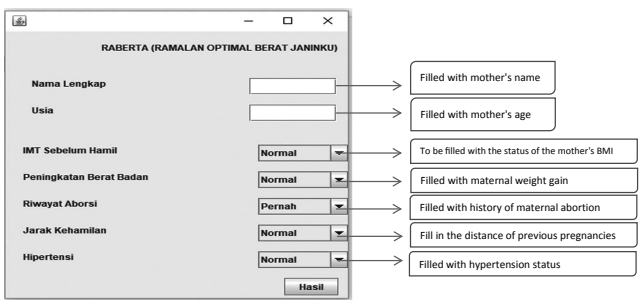

Figure 1. Application Form

4. Enter data on risk factors, namely BMI before pregnancy, weight gain, history of abortion, pregnancy interval and hypertension according to the respondent's condition.
5. Click "Results"
6. The results will appear in the form of a pop up menu as shown in the image below.

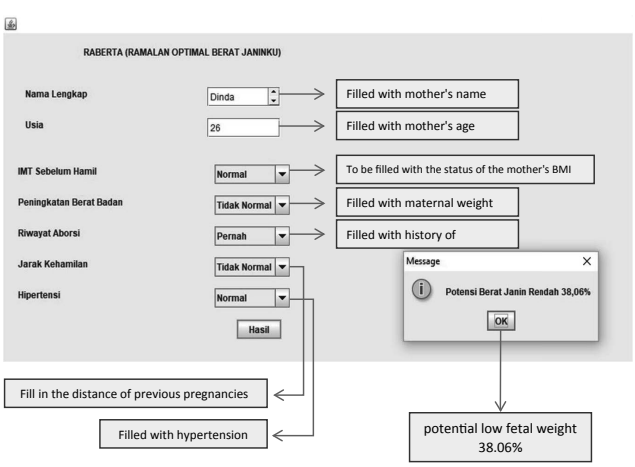

Figure 2. Application Results Page

b. Fetal Weight Probability Calculation

After obtaining a fit logistic regression model equation, the probability of the binary logistic regression model equation is as follows:

With $P(x) = 1/ (1 + e^{-y})$

y = Fit Model

e = Natural number; 2.718

Description:

a. Weight gain: optimal = 0; not optimal =1
b. Hypertension: no hypertension = 0; hypertension = 1
c. Pregnancy interval: >23 months = 0; < 23 months = 1
d. BMI before pregnancy: normal = 0; skinny =1
e. Abortion history : no abortion = 0; ever had an abortion = 1

The value of the quality of this equation can be seen from the results of the Receiver Operating Curve (ROC).

Table 1. ROC Calibration Value

Area	Std. Error	95% *Confidence Interval*	
		Min	Mak
0.951	0.018	0.917	0.986

Based on the results of the Area Under Curve (AUC) assessment, it is known that the AUC value is 0.951 or 95% with a range of 92% - 99%. Statistical interpretation as an equation discrimination parameter can be seen in the following table:

Table 2. Interpretation of ROC Calibration Values

AUC Value	Interpretation
>50%-60%	Very weak
>60%-70%	Weak
>70%-80%	Medium
>80%-90%	Strong
>90%-100%	Very strong

Based on the discrimination parameter, the AUC value is 95%, which means that statistically the quality of the equation model for the incidence of low fetal weight in this study is very strong (> 90%-100%).

c. Application testing

The trial of this RABERTA application used 164 samples. The sample formula uses the minimum sample size formula for validity testing. The calculation formula is as follows

$$n = \left\{\frac{Z \propto + Z\beta}{0{,}5 \ln[(1+r)(1-r)]}\right\}^2 + 3$$

With α = 99%; β = 99%; r = 0,4; drop out 20%

Thus n = 164 samples

Based on the test results obtained :

$$\text{Validity} = \frac{\text{The Number of Test Results That Are True}}{\text{The number of samples}} \times 100\%$$

$$= \frac{137}{164} \times 100\%$$

$$= 83{,}53\%$$

Discussion

Fetal period is included in the first 1000 days of life which is commonly referred to as the golden period. This period is a very important time because at this time a very fast growth and development process occurs and is not experienced by other age groups. For now, data collection related to BBJR has not been carried out. So far, the recording and reporting carried out by the government, the Health Service and research institutions is only limited to data collection of LBW. It is important to note that interventions for LBW problems can also prevent the occurrence of LBW. With the problem of BBJR resolved, neonatal health problems can be resolved earlier.

Therefore, the right intervention during this period of pregnancy will have a good impact on the quality of human resources in the future. Interventions are especially carried out for pregnant women who have a risk of stunted fetal growth, in this case referred to as low fetal weight (LBW). This is done to prevent the occurrence of health problems for babies, both when they are still in the womb and when they are born, such as Small Gestational Age (SGA), LBW and others. This intervention can be carried out if pregnant women have a high percentage of the probability of having LBW. Therefore, a breakthrough is needed to detect this percentage of opportunity.

This breakthrough can be realized by creating a software that is able to calculate the percentage probability of a mother having a fetus with low birth weight. This device will facilitate the data collection process for pregnant women who have a high risk. Thus, based on the results of the data collection, interventions can be carried out quickly and accurately.

This RABERTA application has received a good validity score. In the future, RABERTA will continue with web-based and android-based versions. If both versions have been implemented, this version will be directly connected to the surveillance system of the health office. If it is connected, the fetal weight surveillance system is expected to be optimal and capture many underweight fetuses. Thus, many fetuses will be intervened, and reduce the number of LBW (low birth weight babies).

The advantages of this desktop version application: 1. The main display application is very simple; 2. Easy to use; 3. Light application size; 4. RAM used is light; 5. High validity. Another advantage can be distributed to public health centers and private clinics as a solution if the internet network is problematic or public health centers or private clinics do not have internet access. Spread the application by inserting it into a CD-R to be installed on each PC in the Public Health Center and delivery clinic. Public Health Center and Delivery Clinics can use this application every time the patient visits pregnancy (K1 to K4).

The disadvantages of this application are : 1. If the application is closed, history data will be lost; 2. Absence of data backup; 3. There is no undo and redo menu.

Conclusion

RABERTA (*ramalan optimal berat janinku*, or optimal prediction of my fetal weight) is created as a solution for recording and intervention in the fetal golden period. The application can be used easily, quickly and accurately. Suggestions that can be given to the Health Office can use this application and disseminate this

application to the Health Service and the community to be used to detect the low fetal weight probability. For further research, the development of applications that can be used on Android, the development of more nutritional sensitivity and obesity calculation formulas, the development of application history storage, the development of application data backup and the development of undo and redo menus.

Suggestions

This RABERTA application requires collaboration with various parties in order to maintain its sustainability. Including the following :

1. Commitment of the Department of Health. The Health Office needs commitment and supervision so that this application can continue to be used by public health centers and private clinics.
2. Private Clinic. Cooperation of the willingness of private clinics is required to install this RABERTA application.
3. BKKBN of North Sumatra province. In this case, the role of the BKKBN is needed to socialize the RABERTA Application in every event. BKKBN can also offer help installing this application to the public
4. Cooperation with various universities to empower students as agents to maintain the sustainability of the RABERTA application. In this case, the university is also a center for research studies to evaluate the effectiveness of RABERTA.
5. Cooperation from investors is needed for financial assistance. If it has received support from investors, then this application will expand cooperation to the IT research center, so that this RABERTA can continue its development to the WEB Based and Android Based versions. Thus, the benefits of the RABERTA Application will be felt more and more throughout the archipelago

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