Decision Making Model for Choosing Normal Maternity or Cesarean Section with Machine Learning Approach

Rimin, Ermi Girsang, and Sri Lestari R. Nasution
Faculty of Medical, Universitas Prima Indonesia, Indonesia

Keywords: Choice of delivery, Normal delivery, cesarean section.

Abstract: Globally, the number of cesarean section has almost doubled, namely 12% in 2000 to 21% in 2015. While more than 50 developing countries have cesarean birth rates> 27%. Normal childbirth actually has many advantages over cesarean section, but data in various hospitals shows an increase in cesarean section rates. The purpose of this study was to identify the relationship of factors that influence mothers with the decision to choose normal delivery or cesarean section. An evaluation of 3,121 respondents with 118 samples was conducted. Statistical evaluation using univariate and bivariate analysis with chi-square test, and multivariate analysis with multiple logistic regression at 95% confidence level ($\alpha = 0.05$) was performed. Whereas the model of the relationship of the main factors in decision making in the selection of maternity scenarios was built using machine learning approach. Statistical evaluations indicate that there are only three variables (i.e., culture, lifestyle, and perception, $p \leq 0.009$) that have a relationship with the decision of the mother to choose normal delivery or cesarean section. The factor with the greatest relation is perception (Exp (B) / OR was 3.305).

1 INTRODUCTION

Delivery of cesarean section is becoming a trend now not only for mothers who have medical indications, but also those who do not experience medical indications (reasons for wanting to adjust the desired date and day). Another reason is that labor is fast, does not experience pain such as giving birth normally and can maintain a slim body appearance (Kasdu, 2015).

A systematic review published studies from the first year of records through August 2018 in PubMed, Scopus, and Web of Science showed that the reasons of maternal request for cesarean section were fear of childbirth, fear of labor pain, anxiety for fetal injury/death, pelvic floor and vaginal trauma, urinary incontinence, doctors suggestion, time of birth, experience of prior bad delivery, previous infertility, anxiety for gynecologic examination, anxiety for loss of control, anxiety for lack of support from the staff, fear of fecal, avoid long labor, emotional aspecs, body weight of the infant at birth and abnormal prenatal examination. The results of studies on demographic reasons of maternal request for cesarean section were advanced maternal age, occupation, parity, maternal obesity, education, family status, decreasing level of religiosity, number of living children, household income and age at marriage (Jenabi E et al, 2019)

Excessive and unnecessary use of cesarean section is growing as a major problem for women's health for which both developed as well as developing countries. There is no evidence to show any benefits either to mother or to infant when the procedure is not medically indicated (Panda et al., 2017).

Globally, infants born with cesarean section increased by 12% in 2000 to 21% in 2015 (Marleen, 2018). The high rate of cesarean delivery makes WHO set the average standard for cesarean delivery in a country around 5-15% per 1000 births in the world (Suryati, 2012). WHO also reviewed 110,000 births from nine countries in Asia during 2007-2008, showing that 27% of births were performed cesarean section. A similar survey conducted in Latin America found that 35% of pregnant women were born through cesarean section (Sihombing, 2017).

Around 23 million cesarean deliveries were performed globally in 2012. The international health care community previously considered the 10% and 15% levels to be ideal for cesarean section (Hamilton, 2018). More than 45 countries globally have cesarean birth rates <7.5%, while more than 50 developing

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countries have cesarean birth rates> 27% (Molina et al., 2015).

In 2017 in the United States, around 32% of women in the hospital were delivered by cesarean section (Hamilton, 2018). Primary cesarean delivery and repetition means that the mother giving birth at the first delivery in a cesarean section will do the same thing in the next delivery (Menacker, Declercq & Macdorman, 2016).

The incidence of cesarean section birth at the request of the mother and her contribution to the increase in cesarean section rate is not known with certainty, but it is estimated that around 2.5% of all deliveries in the United States are cesarean section at the request of the mother (Meredith, Birsner, & Flint, 2019). In a retrospective cohort study of 66,266 mothers giving birth in China, there were 24.7% of deliveries with cesarean section at the request of the mother (Liu, Landon, Cheng, & Chen, 2015).

It was found that the USA (84,5%) and Australia (77,3%) had the highest proportion of obstetricians who would perform a cesarean section on maternal request in uncomplicated pregnancies, while Spain (15%) and Canada (23%) had lowest proportion (Loke et al., 2019). Behind a maternal request for a planned cesarean section are various rationales and life experiences needing carefully targeted attention and health care (Eide et al, 2019). Women who requested a cesarean section had higher antepartum depression and anxiety levels (Olieman et al., 2017).

The study of cesarean section rate among doctors in S.V. Medical College, Tirupati indicates that the rapid socio-economic changes and the outlook towards medical intervention by the women, families and society are increasingly responsible for the current high incidence of cesarean section. For doctors point of view it is a defensive medicine to have a better outcome (Radha et al., 2015).

The number of cesarean section in Indonesia also continues to increase both in government hospitals and in private hospitals. According to the Indonesian Demographic and Health Survey Data (SDKI) in 1991-2007 there was an increase in cesarean section births, which was between 1.3% -6.8% (Ministry of Health Republic of Indonesia, 2018a). The results of the 2018 Riskesdas show that cesarean delivery rates were 9.8% of the total 49,603 births during 2014-2017, with the highest proportion in DKI Jakarta (19.9%) and the lowest in Southeast Sulawesi (3.3%) (Ministry of Health) RI, 2018b). The standard of caesarean delivery according to the Ministry of Health is 40% (Ayuningtyas, Oktarina, Misnaniarti, & Sutrisnawati, 2018).

One of the effects of cesarean section is pain and results in changes in tissue continuity due to abdominal surgery. According to Hillan in (Anggorowati & Sudiharjani, 2011) that 68% of post-sectio caesarean mothers have difficulty caring for infants, difficulty moving up and down from bed and arranging a comfortable position during breastfeeding due to pain, thereby delaying breastfeeding from the beginning of the baby (Batubara, 2008). Cesarean section is associated with an increased risk of uterine rupture, abnormal placentation, ectopic pregnancy, stillbirth, and preterm birth. (Sandall, 2018). After cesarean section there can be infection, bleeding, formation of blood clots in the legs, pelvic organs or lungs, injury to the intestine and / or bladder and reactions to drugs or anesthesia (Kasdu, 2015). The emergence of various postoperative complications after cesarean does not dampen the interest of the mother to give birth in a cesarean section, although there are no medical indications (Menacker et al., 2006).

The decision to choose a health service facility in a hospital are influenced by several factors / components (Figure 1). According to Kotler and Armstrong, the factors that influence the decision to choose service facilities are social factors, cultural factors, individual factors and psychological factors. Social factors consist of reference groups, family, role and status. Cultural factors include culture, sub-culture, social class. Individual factors include age, occupation, economic conditions, lifestyle, personality and self-concept. Psychological factors include motivation, perception, knowledge, beliefs and attitudes (Kotler & Armstrong, 2014; Turnip et al, 2020; Wijaya et al, 2019).

Based on interviews conducted in the initial survey of 10 mothers who gave birth, namely 5 normal births, and 5 cesarean delivery mothers, normal delivery mothers said that they wanted to feel a true mother can give birth to a normal baby, afraid of having cesarean delivery, costs cheaper, during pregnancy there are no significant problems or disorders of pregnancy so they want to give birth normally.

Mothers who choose cesarean delivery say fear of pain or fear of pain experienced by many mothers who give birth normally, want to give birth according to a beautiful date, want to give birth on a special day like according to their wedding date, in addition he also has a less pleasant experience on normal delivery before. There are also mothers whose reason because of a husband's request to give birth by cesarean section so that the shape of the vagina does not change after delivery, and the body shape of the mother can

be slim like before pregnancy. The medical doctor has actually explained to the mother who will give birth about the procedure and the negative effects of cesarean section delivery and the existence of a code of ethics about cesarean delivery if done without medical indications, but many mothers who still want to do it.

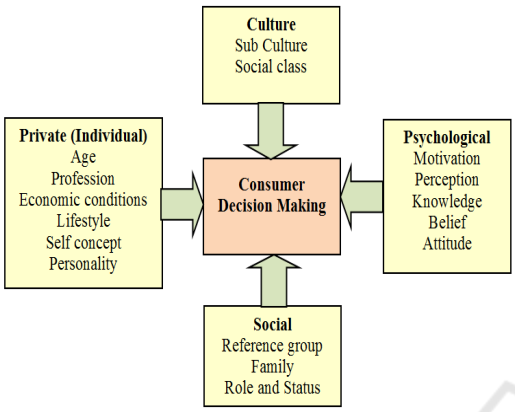


Figure 1: Theoretical Framework for Decision Making (Kotler & Armsrtong, 2014)

In this study, the decision making model for choosing normal maternity or cesarean section with fuzzy method is performed. The relationship between the factors that influenced the mother in deciding on a normal delivery or cesarean section in relation to the characteristics of the respondents was evaluated.

2 METHOD

This research was a quantitative analytic study with cross sectional research design. The study was conducted at the Stella Maris Hospital in Medan in November 2019. The number of deliveries (normal and cesarean section) from January 2019 - October 2019 was 3,121 deliveries (1,064 normal deliveries, 2,057 cesarean section divided into 403 cesarean section deliveries without medical indication and 1,654 cesarean section cesarean with medical indications). The research sample obtained by 118 respondents. Sampling technique by accidental sampling.

The conceptual framework of this study consists of independent and dependent variables. The independent variable consists of cultural factors consisting of Culture (values in the family); Social factors consist of reference groups, family support; Private (individual) factors consist of age, profession, lifestyle; Psychological factors consist of motivation and perception. The dependent variable is the decision to choose normal delivery or cesarean section. The full research conceptual framework can be seen in Figure 2.

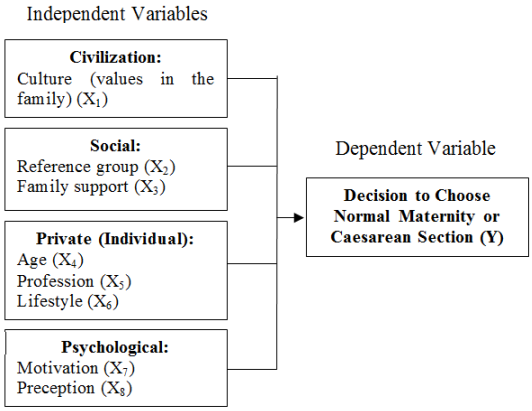


Figure 2: Research Scheme

The sample is a portion taken from the whole object studied and is considered to represent the entire population (Notoatmodjo, 2015). The sample of this study was a portion of the population whose size was taken using the Lemeshow formula as follows:

$$n = \frac{\left\{Z_{(1-\alpha/2)}\sqrt{Po(1-Po)} + Z_{(1-\beta)}\sqrt{Pa(1-Pa)}\right\}^2}{(Pa-Po)^2}$$

Where n is the sample size, $Z_{(1-\alpha/2)}$ is the standard deviation of the alpha for $\alpha = 0.05$ à $Z\alpha = 1.96$, $Z_{(1-\beta)}$ is the standard deviation of beta for $\beta = 0.10$ à $Z\beta = 1,282$, Po is the proportion of the prevalence of cesarean section without medical indication, Pa is the estimated maternal cesarean section without medical indication, Pa-Po is the proportion difference of 0.10.

Validity test is used to measure the validity of an instrument used (able to express what is measured). This test was conducted at Sarah Medan General Hospital as many as 30 women. The test conducted is to determine the correlation between the questions with the total construct score or variable. A construct is declared valid if there is a positive and significant correlation in the Pearson Product Moment test. The correlation value must be greater than 0.361 or the Corrected Indicator-Total Correlation value in SPSS output greater than 0.361 (Ghozali, 2015). Univariate data analysis, bivariate using chi-square and multivariate tests using multiple logistic regression tests with a confidence level of 95% ($\alpha = 0.05$).

Fuzzy Logic (Fuzzy Logic) or commonly also called Samar Logic is an appropriate way to map an input space into an output space based on the concept

of fuzzy sets. Among the inputs and outputs are black boxes. Inside the black box there is an unknown process, it can be approached with a linear system approach, econometrics, interpolation, expert systems or fuzzy logic. Fuzzy logic as the main component of soft computing builders, has proven to have excellent performance to solve problems that contain uncertainty (Kusumandari et al, 2018; Turnip et al, 2018). Its implementation is broad, both in the fields of engineering, psychology, social, and also in the economic field. This research is used to make decisions for Choosing Normal Maternity or Caesarean Section.

The Crisp set is defined by the items in that set. If a is a member of A, then the value associated with a is 1. However, if a is not a member of A, then the value associated with a is 0. Notation A = {x P (x)} indicates that A contains item x with P (x) is correct. If XA is a characteristic function of A and property P, then it can be said that P (x) is true, if and only if XA (x) = 1. To design a fuzzy system the following steps need to be carried out: (i) Define the functional and operational characteristics of the model. (ii) In this section, it is necessary to consider what characteristics the existing system has, and then formulate the characteristics of operations to be used in the fuzzy model. (iii) Decomposing the model variables into fuzzy sets. From the variables that have been formulated, fuzzy sets are formed without ignoring the domain. (iv) Making fuzzy rules. The rules on fuzzy show how a system operates. How to write rules in general are: If (X1 is A1). ... (Xa is An) Then Y is B where (.) is an operator (OR or AND), X is scalar and A is a linguistic variable. The block diagram of fuzzy interference system is shown in Figure 3.

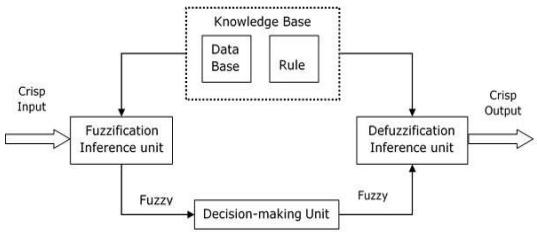


Figure 3: Block diagram of fuzzy interference system.

3 RESULTS AND DISCUSSIONS

Characteristics of respondents involved in data collection are the latest education and the number of births. The observations showed that the majority of respondents had an undergraduate education of 49 respondents (41.5%), the minority had a midle high school education of 1 respondent (0.8%). Based on the number of births, the majority of respondents gave birth to their first child as many as 59 respondents (50.0%), the minority gave birth to a fifth child of 1 respondent (0.8%).

Based on the results of bivariate analysis with the Chi-Square test obtained variables that have a significant relationship with the selection of normal maternity or cesarean section with a value <0.05 namely culture (p = 0.005), reference group (p = 0.008), family support (p = 0.003), lifestyle (p = 0.021), motivation (p = 0.003) and perception (p = 0.002). Whereas the unrelated variable because it has a value of p> 0.05 is age (p = 0.253), and occupation (p = 0.701).

Table 1: Relationship of each Independent and Dependent Variable (Normal and CS is C-Section).

Variables	Childbirth Method			*p-value*
	N	CS		
	f	f	F	
Age (years):				
20-35	63	41	104	0,253
> 35	6	8	14	
Profession:				
Working	44	29	73	0,701
Not Working	25	20	45	
Culture:				
Follow	44	18	62	0,005
Not Follow	25	31	56	
Reference group:				
Follow	39	15	54	0,008
Not Follow	30	34	64	
Family support:				
Support	63	34	97	0,003
Not Support	6	15	21	
Lifestyle:				
Lifestyle	13	19	32	0,021
Not Lifestyle	56	30	86	
Motivation:				
High	40	14	54	0,003
Low	29	35	64	
Perception:				
Good	56	26	82	0,002
Not Good	13	23	36	

Furthermore, multivariate analysis with multiple logistic regression tests showed that out of 8 research variables, there were 6 variable logistic regression candidates, p <0.25, namely culture, reference group, family support, lifestyle, motivation and perception. While the variables that were not included in the model candidate because it has a value of p> 0.25 were age and occupation. The results of multiple

logistic regression tests (Table 2) show that of the 6 variables tested about 3 variables related to the selection of normal maternity or cesarean section namely culture (values in the family), lifestyle and perception.

The most dominant variable related to the selection of normal childbirth or cesarean section is the perception variable with the value Exp (B) / OR = 3.305 meaning that mothers with good perceptions, have the opportunity to choose normal childbirth by 3.3 times higher than mothers with poor perception.

Table 2: Multiple Logistic Regression Test Results.

Variable	B	Sig.	Exp(B)	95%CI for Exp(B)
Culture	1,130	0,009	3,096	1,333-7,193
Lifestyle	1,260	0,009	1,284	1,110-6,732
Perception	1,195	0,008	3,305	1,359-8,037
Constant	-1,427	0,007		

3.1 Culture Factors

The results of this study indicate that there was a relationship between culture and the mother's decision to choose a normal delivery or cesareaen section. Mothers who follow the culture in the family which always give birth with normal delivery, have the opportunity to choose normal delivery by 3 times higher than mothers who do not follow the culture.

Culture is the result of human creativity form one generation to the next generation which greatly determines the behaviour of the members in their life as a society. Culture is complex which includes science, artistic beliefs, morals, customs, habits and norms that occurs in the society. According to Kotler, values in the family is included in the culture (Kotler, 2014).

The culture in the family influence a person to make a decision. Many groups can influence a person's behaviour especially in the family. A person's reference group consists of all groups that have direct (face-to-face) or indirect influence on a person's attitude or behaviour, especially in the famiy. Groups of direct influence on a person are called membership groups. This is a group in which a person participates and interacts (Tjiptono, 2014).

The results of this study indicate that culture is related to the mother's decision to choose normal or caesarean section. According to researchers' assumptions, this is because the habits that occur in the family will be carried out by other family members. Likewise in the case of childbirth, other family members will follow the culture in the family when they are about to give birth. Usually families who have normal childbirth habits, in choosing a birth, the respondent will also choose to have a normal birth. Likewise, families who have the habit of giving birth by caesarean section will also choose to give birth by caesarean section. This is also due to the type of delivery chosen after getting information from family or closest relatives, as well as suggestions from the family or relatives who suggest choosing childbirth that is usually done by the family. Culture in the family or relatives has a major influence on the decision of the mother to choose type of delivery, whether nomal or caesarean delivery, especially without medical indications.

3.2 Lifestyle Factors

The results of this study indicate that there was a relationship between lifestyle and the mother's decision to choose a normal delivery or cesarean section. Mothers who do not follow a lifestyle, have the opportunity to choose normal childbirth by 1.2 times higher than mothers who follow a lifestyle. Reasons that oftenly given by patients to deliver labor with cesarean section were not resistant to pain, worry about damage to the birth canal which is also a sexual organ and a factor of trust in dates and numbers.

The doctor's reason for fulfilling patient requests is generally to respect and pay attention to the patient's autonomy rights and the Medical Practice Law No. 29 of 2004 Article 52 paragraph d. (fear of being blamed if something bad happens to the mother and baby). Reasons that are not allowed are financial considerations (GoI, 2004).

To prevent the misuse of the cesarean section at the request of the patient or family by an Obstetrician and Gynecology specialist, the following signs should be made: The patient must submit a request to the doctor for cesarean section. Next the doctor must explain that at that time vaginal delivery is still possible and cesarean section is no better / safer than vaginal delivery. The signs as above must be stated clearly and clearly in the cesarean section request sheet at the request of the patient / family, which is incorporated in the informed consent sheet and permission for action (POGI, 2017).

Lifestyle is a lifestyle of someone in the world expressed in one's activities, interests and opinions (Kotler & Amstrong, 2014). Delivery of cesarean section has become a way of life, especially for young people. There was a trend of an increase in cesarean section in a number of hospitals, whereas the clinical risk for mothers giving birth was greater than the risk of vaginal delivery. But the perception of the community, especially young people, about cesarean section delivery is a fast and painless way of birth as

experienced in normal childbirth (Simanjuntak, 2012).

The results of this study indicate that lifestyle was related to the mother's decision to choose normal delivery or cesarean section. According to the researchers' assumptions, lifestyle is a personal factor (individual) of the mother herself, especially those who choose cesarean section without medical indications that assume cesarean section is a modern way to deal with the pain during childbirth. As for mothers who choose normal childbirth, assume that with normal childbirth, she will become a whole mother. As it is the case now, lifestyle returns to nature which means that everything in natural is more interesting and has great benefits for itself.

3.3 Perception Factors

The results of this study indicate that there was a relationship of perception with the decision of mothers to choose normal delivery or cesarean section. Mothers who have a good perception have a chance to choose normal delivery by 3.3 times higher than mothers with poor perception. Perception is the process that people go through in choosing, organizing and interpreting information to form a meaningful picture of the world. Someone which motivated is ready to act. How the person acts is influenced by their perception of the situation (Kotler & Armstrong, 2014).

The results of this study indicate that perception was related to the mother's decision to choose normal delivery or cesarean section. According to the researchers' assumptions, mothers who had the perception that childbirth was painful decided to choose cesarean section while mothers who had the perception that giving birth normally were a pleasure. Especially if he does not have a medical indication for cesarean delivery then he prefers to give birth normally. Normal delivery process is longer and painful, but now there are many therapeutic techniques that can be used to reduce pain during normal labor such as hypnobirthing, Entonox gas, ILA (Intrathecal Labor Analgesia) and others. Giving birth normally through a long process involves a mother's hard work and results in physical fatigue. However, many benefits are obtained by giving birth normally, such as being able to leave the hospital more quickly, avoiding the risks caused by surgery, the mother can directly interact with the baby, not too worried about the next pregnancy or childbirth and so forth. Cheap and painless normal delivery perceptions need to be explained to mothers since pregnancy, especially for young mothers so that more mothers give birth normally and take classes in hospitals such as pregnancy exercise, hypnobirthing, etc.

3.4 Machine Learning Approach

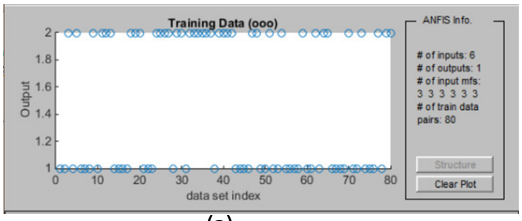
In the implementation phase, three processes were carried out, namely application testing, documentation, and analysis of test results. Application testing aims to see the results of applications that have been made whether running well or not. Tests conducted were black box testing (Turnip et al, 2018). This test was run to observe whether the program has successfully received input, processed, and produced the appropriate output without looking at the application source code.

In analyzing the problem, the first thing to do was to determine what parameters were used as input to the system. Second, observations made by the author indicate that what will be used as input reference was the calculation obtained from the evaluation variables in the form of culture, reference groups, family support, life style, motivation, and preception. Third, how the input values of these variables can be identified by ANFIS to produce an output so that the problem in predicting the decision for choosing normal maternity or cesarean section is resolved.

Decision making prediction application is an application that can predict maternity choices only by entering input variables as a result of measurement (Figure 4). Prediction of maternity choices can be done by taking the unique value of the maternity variable which will be converted into a certain value which is the identity of each decision and through a process of matching or matching training data. The database used was training data from maternity choices.

In the process of evaluating maternity choices preceded by taking the value of variables that have been determined by the Region of Interest. Furthermore, the value will be converted into a new value that is searched for the average value and will be used as input parameters in ANFIS.

The training of 80 training data uses six input membership function linear trimf output curves with 40 epochs (Figure 5), and a hybrid optimization method. After the training process was completed, the ANFIS Architecture is formed as Figure 6. Membership function and parameters formed from the training process are shown in Figure 7.



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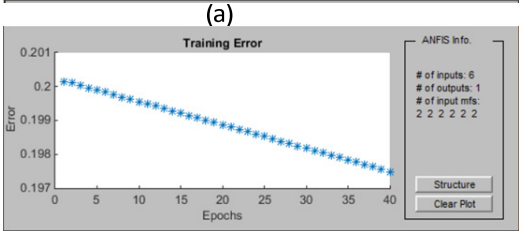
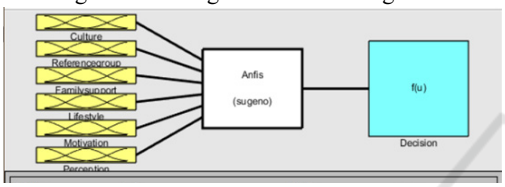


(b)

Figure 4: Trainig data and Training Error



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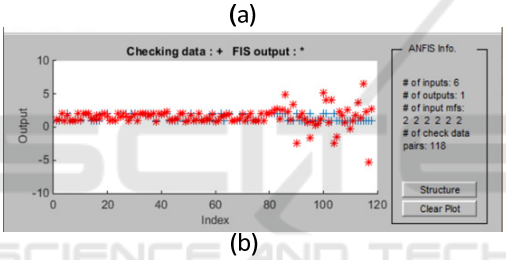

(b)

Figure 5: Membership function and FIS output.

In testing the prediction choice of maternity applications using the ANFIS method. The application can identify 111 correctly from a total of 118 input data. The overall success percentage was 94.24%. From 80 training data trained, all images were correctly identified. This shows the percentage of success identifying data that has been trained by 100%. Meanwhile, from 38 data that have not been trained or have not yet gone through the ANFIS training process there are 36 results that are correctly identified so that the percentage of success in identifying the data that has not been trained is 94.24%.

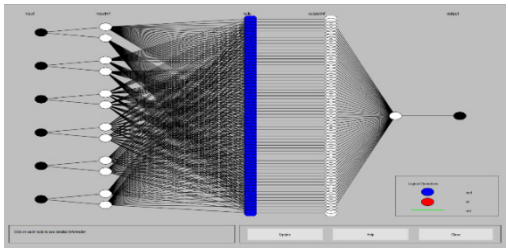

Figure 6. Adaptive neural network architecture.

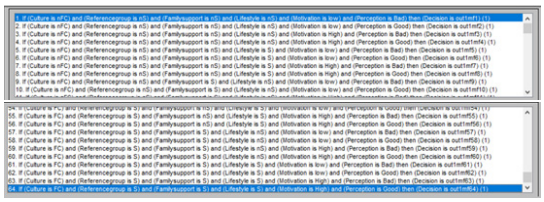

Figure 7: The applied rules for modeling.

4 CONCLUSIONS

There is a cultural relationship (values in the family), lifestyle and perception with the mother's decision to choose normal delivery or cesarean section. There is no relationship between the reference group, family support, age, occupation and motivation with the mother's decision to choose a normal delivery or cesarean section. The most dominant variable related to the mother's decision to choose a normal delivery or cesarean section in this study is the perception variable. Mothers who have good perception, have the opportunity to choose normal delivery by 3.3 times higher than mothers whose perceptions are not good.

Based on the results of the study concluded that to predict maternity choice decisions can be done using the Adaptive Neuro Fuzzy Inference System method as a matching tool with the values of variables that have been trained. From the results of testing of input data, this application has an overall success rate of 94.24%. With this application, maternity choice decisions can easily be predicted based on variable values that are set without having to retake data.

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