Decision support system for handling intervention on toddlers stunting cases in Indonesia using the certainty factor method

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Abstract. Stunting is a condition of failure to thrive in children under five caused by lack of nutritional intake for a long time and the occurrence of repeated infections. The causative factor is influenced by inadequate parenting, especially in the first 1,000 days of life. This study applies a decision support system with an expert system as an intervention for handling stunting by providing solutions using the Certainty Factor method. This expert system is implemented using the PHP programming language, and the use of expert systems will be easier when implemented into web-based applications. The test results are acceleration in reducing the number of stunting cases, thus providing the right percentage and solution in handling and increasing supervision of government efforts to combat stunting. Stunting intervention research can see the results of the percentage value of sensitive and specific interventions for pregnant women, nursing mothers, and adolescent girls. Testing uses black-box validation and accuracy. The validation results are in the form of 100%, which shows the system functionality can run well and according to the list of requirements. The accuracy result is 83% which shows that the expert system can function quite well according to the Certainty Factor method.

1. Introduction

Stunting is a condition of failure to thrive in children under five years of age due to lack of nutrition for a long time and recurring infections. Both Reviews These factors are influenced by inadequate parenting, especially at 1,000 HPK (First Day of Life). Stunting prevalence of data collected by the World Health Organization (WHO), Indonesia is included in the third country with the highest prevalence in the Southeast Asia / South-East Asia Regional (SEAR) region. The average prevalence of Stunting under five in Indonesia in 2005-2017 was 36.4% [1].

Womb in 2018, using the Certainty Factor method, has been used in the prevention and identification of pest diseases so that the percentage of uncertainty in pest diseases is well Diagnosed [2]. Likewise, conducted by Indawati in 2018 in previous studies, research has been Carried out using the Certainty Factor method for the diagnosis of web-based dermatitis [3].

The research seeks to provide alternative solutions with the Decision Support System and the Certainty Factor method in the case handling Stunting intervention. In this case, it can Facilitate the distribution of the Certainty Factor method to provide results in the form of a percentage value of
confidence, and the solution that will be provided for handling the Stunting case is expected to reduce the number of Stunting cases in Indonesia, especially areas prioritized in areas with high rates of Stunting cases for correct decision making. A decision support system was made to determine the intervention handling cases of Stunting toddlers by providing certainty using the Certainty Factor method.

2. Research method

Stunting is a condition of failure to thrive in children under five years of age due to lack of nutritional intake in a long time and recurring infections. One of the main causes of Stunting is the poverty factor that can not provide good nutrition to children. In 2014, there were an estimated 159 million stunted children, almost all children living in low-income countries [4]. Efforts to reduce Stunting interventions are done through two items, namely specific nutrition interventions and nutrition-sensitive interventions. Specific nutrition interventions are activities that directly address the occurrence of stunting, such as food intake, infection, maternal nutritional status, infectious diseases, and environmental health.

The expert system is a system that is trying to adopt human knowledge into a computer designed for modeling the ability to solve problems like an expert [5]. The processing performed by an expert system is knowledge processing and not processing the data on conventional computer systems. Knowledge is both practical and theoretical understanding of an object or a particular domain. Some models of representativeness of knowledge that matters are:

a. Semantic Networks, semantic Network is a knowledge representation technique that is used to update proportionate.

b. Frame, frame a collection of slots that contain attributes to describe knowledge.

c. Rule Production, production will write the rules in the form of if-then

d. Predicate Logic, besides predicate logic used to determine the truth or falsity of a statement, it can also be used to present a statement about a particular object.

![Figure 1. Traditional definition a computer program](image)

2.1. Certainty factor method

Certainty Factor Model introduced by Shortliffe and Buchanan as a method for knowledge representation and manipulation of uncertain on rule-based expert system MYCIN and then incorporated, in a slightly modified form, in a rule-based expert system shell prototype EMYCIN [6]. Certainty Factor (h, e) merely a numerical measure between -1 and +1, defined in terms of the size of belief and disbelief. Negative certainty factors that hypothesis h is not confirmed by evidence e. A positive certainty factors suggest that the hypothesis h is confirmed by evidence e. Certainty factor equal to zero means that the evidence e does not affect confidence in the hypothesis h. Result, with every production rules if e then h is now associated with the certainty factor CF (h, e); This also can be described as a directed graph, as shown below:

$$e \xrightarrow{CF(h, e)} h$$
Certainty Factor introduced the concept of confidence, and uncertainty are then formulated in the basic formula. The basic formula as follows:

\[ CF(H, E) = MB(H, E) - MD(H, E) \]  

Basic Formulas explanation as following:
- \( CF(H, E) \): Certainty Factor in hypothesis H by the fact E.
- \( MB(H, E) \): A measure of confidence in hypothesis H, if evidence E (between 0 and 1).
- \( MD(H, E) \): Size H distrust of the evidence, if granted Evidence E (between 0 and 1).
- \( H \): Hypothesis or conclusion resulting
- \( E \): Evidence (events or facts).

The basic form of a rule Certainty Factor formula IF E THEN H is as shown by the following equation:

\[ CF(H, E) = CF(H, e) \cdot CF(E, E) \]  

\[ CF_{combine}(H, E) = CF(H, E) \cdot CF(E, E) \]  

\[ CF_{percentage} = CF_{combine} \cdot 100\% \]

Certainty Factor explanation Basic Formulas If E then H
- \( CF(H, E) \): Certainty Factor evidence e influenced by evidence e.
- \( CF(E, E) \): Certainty Factor hypothesis assuming evidence known with certainty, that is when the CF (E, e) = 1.
- \( CF(H, e) \): Certainty Factor hypothesis yang influenced by evidence e.

Value Certainty Factor No 2, namely: Value Certainty Factor rules whose value is attached to a rule / specific rule and the value given by experts.

Certainty factor value given by the user to represent the degree of certainty/belief or premise for instance symptoms, conditions, characteristics experienced by the user. The following interpretation of Certainty Factor values in table 1.

| No. | Term certainty               | CF   |
|-----|------------------------------|------|
| 1.  | definitely not               | -1.0 |
| 2.  | Almost certainly not         | -0.8 |
| 3.  | Unlikely                     | -0.6 |
| 4.  | Probably not                 | -0.4 |
| 5.  | Do not know / not sure       | -0.2 - 0.2 |
| 6.  | Maybe                        | 0.4  |
| 7.  | Most likely                  | 0.6  |
| 8.  | almost certainly             | 0.8  |
| 9.  | Certainly                    | 1.0  |

3. Results and analysis

Results from this study are a decision support system for determining the value of the percentage of certainty Stunting intervention. The system is designed with the method of Certainty Factor to give a confidence percentage value. Performance of the process of implementation of the method of Certainty Factor will generate value and user certainty experts whose function is to generate the initial calculations on the method of Certainty Factor. This system framework was adapted to the analysis and design. Table 2 shows the system framework.
Table 2. Intervention System Framework Toddler Case Handling Stunting

| feedback | Process | Output |
|----------|---------|--------|
| a. Stunting data. b. Stunting Intervention Data Handling. | Stunting case of grouping data in the form of: a. Data Pregnancy b. Data Breastfeeding c. Data Young Women. | The results of the confidence percentage value interventions Stunting handling. The method of calculation by Certainty Factor. |

3.1. Knowledge representation

Respresenti knowledge of knowledge base rule rule-based case management intervention stunting infants using certainty factor. The following table on representation in pregnant women, nursing mothers and young women.

Table 3. Knowledge representation of knowledge base pregnancy

| Code | Prefelensi | I1.Sensitif | I2.Spesifik |
|------|------------|-------------|-------------|
| H1   | Monitoring Growth in Pregnancy | v           |             |
| H2   | Medical check-up | v           |             |
| H3   | Using KB (Family Planning) | v           |             |
| H4   | Cash Help Poor Families | v           |             |
| H5   | have latrines | v           |             |
| H6   | Water Everyday | v           |             |
| H7   | knowledge Stunting | v           |             |
| H8   | using BPJS | v           |             |
| H9   | Consumption of Animal Protein | v           |             |
| H10  | Food Supplement (PMT) | v           |             |
| H11  | Consumption Tablet Add Blood | v           |             |
| H12  | Check Pregnancy | v           |             |
3.2. Calculation method of certainty factor in pregnancy
The result of the uncertainty in calculating the value certainty factor method. The calculation by this method requires the value of experts and also users and people in accordance with what is required of researchers. Sensitive Interventions Maternal who are in the certainty factor calculation method.

| Table 6. Value Assurance User |
|-------------------------------|-----------------|
| No.                           | Preference                  | Score |
| 1.                            | Monitoring Growth in Pregnancy | 0.6   |
| 2.                            | Medical check-up            | 0.6   |
| 3.                            | Using KB (Family Planning)  | 0.8   |
| 4.                            | Cash Help Poor Families     | 0.6   |
5. using BPJS 0.6
6. Water Everyday 0.8
7. knowledge Stunting 0.6
8. have latrines 1.0

| No. | Preference                     | Score |
|-----|--------------------------------|-------|
| 1.  | Monitoring Growth in Pregnancy | 1.0   |
| 2.  | Medical check-up               | 1.0   |
| 3.  | Using KB (Family Planning)     | 0.6   |
| 4.  | Cash Help Poor Families        | 0.6   |
| 5.  | using BPJS                     | 0.6   |
| 6.  | Water Everyday                 | 1.0   |
| 7.  | knowledge Stunting             | 0.8   |
| 8.  | have latrines                  | 1.0   |

Table 7. Value Assurance Specialist

Results Percentage values on the sensitive interventions in pregnancy are 1 * 100% = 1. Here are the results of the uncertainty value Specific Intervention On Pregnant Women who are in a certainty factor calculation method.

| No. | Preference                      | Score |
|-----|--------------------------------|-------|
| 1.  | Consumption of Animal Protein   | 0.6   |
| 2.  | Food Supplement (PMT)           | 0.8   |
| 3.  | Consumption Tablet Add Blood    | 0.8   |
| 4.  | Check Pregnancy                 | 0.8   |
| 5.  | Consumption of food Iron And Folic Acid | 0.8 |
| 6.  | 3x daily food needs             | 0.6   |

Table 8. Value assurance user

Results The percentage of the value of the specific interventions in the form of pregnant women 0.9996 * 100% = 99.92%. Here are the results of Sensitive Interventions uncertainty value In Nursing Mothers who are in the certainty factor calculation method.

| No. | Preference                      | Score |
|-----|--------------------------------|-------|
| 1.  | Consumption of Animal Protein   | 0.8   |
| 2.  | Food Supplement (PMT)           | 1.0   |
| 3.  | Consumption Tablet Add Blood    | 1.0   |
| 4.  | Check Pregnancy                 | 0.8   |
| 5.  | Consumption of food Iron And Folic Acid | 1.0 |
| 6.  | 3x daily food needs             | 1.0   |

Table 9. Value assurance specialist
Table 10. Value assurance user

| No. | Preference                        | Score |
|-----|-----------------------------------|-------|
| 1.  | Medical check-up                  | 0.8   |
| 2.  | Using KB (Family Planning)        | 1.0   |
| 3.  | Cash Help Poor Families           | 0.8   |
| 4.  | using BPJS                        | 0.8   |
| 5.  | Water Everyday                    | 0.8   |
| 6.  | knowledge Stunting                | 0.8   |
| 7.  | have latrines                     | 1.0   |

Table 11. Value assurance specialist

| No. | Preference                        | Score |
|-----|-----------------------------------|-------|
| 1.  | Medical check-up                  | 1.0   |
| 2.  | Using KB (Family Planning)        | 0.6   |
| 3.  | Cash Help Poor Families           | 0.6   |
| 4.  | using BPJS                        | 0.6   |
| 5.  | Water Everyday                    | 1.0   |
| 6.  | knowledge Stunting                | 1.0   |
| 7.  | have latrines                     | 1.0   |

Results Percentage values on the sensitive interventions in nursing mothers in the form of $1 * 100\% = 1$. Here are the results of the uncertainty value Specific Intervention In Nursing Mothers who are in the certainty factor calculation method.

Table 12. Value assurance user

| No. | Preference                                      | Score |
|-----|-------------------------------------------------|-------|
| 1.  | Consumption of Animal Protein                   | 0.6   |
| 2.  | Consumption Tablet Add Blood                    | 0.8   |
| 3.  | Examine children in health centers              | 0.8   |
| 4.  | 3x daily food needs                             | 0.6   |
| 5.  | Monitoring Growth in Toddlers                   | 0.8   |
| 6.  | Exclusive breastfeeding                          | 1.0   |

Table 13. Value assurance specialist

| No. | Preference                                      | Score |
|-----|-------------------------------------------------|-------|
| 1.  | Consumption of Animal Protein                   | 0.8   |
| 2.  | Consumption Tablet Add Blood                    | 1.0   |
| 3.  | Examine children in health centers              | 0.8   |
| 4.  | 3x daily food needs                             | 1.0   |
| 5.  | Monitoring Growth in Toddlers                   | 1.0   |
| 6.  | Exclusive breastfeeding                          | 1.0   |

Results The percentage of the value of the specific interventions in nursing mothers in the form of $1 * 100\% = 1$

Here are the results of Sensitive Interventions uncertainty value In Young Women who are in a certainty factor calculation method.
Table 14. Value assurance user

| No. | Preference                           | Score |
|-----|--------------------------------------|-------|
| 1.  | Medical check-up                     | 0.6   |
| 2.  | Drug consumption Worms               | 0.4   |
| 3.  | Cash Help Poor Families              | 0.4   |
| 4.  | using BPJS                           | 0.8   |
| 5.  | Water Everyday                       | 0.8   |
| 6.  | knowledge Stunting                   | 0.6   |
| 7.  | have latrines                        | 1.0   |

Table 15. Value assurance specialist

| No. | Preference                           | Score |
|-----|--------------------------------------|-------|
| 1.  | Medical check-up                     | 1.0   |
| 2.  | Drug consumption Worms               | 0.8   |
| 3.  | Cash Help Poor Families              | 0.6   |
| 4.  | using BPJS                           | 0.6   |
| 5.  | Water Everyday                       | 1.0   |
| 6.  | knowledge Stunting                   | 0.8   |
| 7.  | have latrines                        | 1.0   |

Results

The percentage of the value of the intervention be sensitive to the Young Women

\[ 1 \times 100\% = 1 \]

Here are the results of the uncertainty value Specific Intervention In Young Women who are in a certainty factor calculation method.

Table 16. Value assurance user

| No. | Preference                           | Score |
|-----|--------------------------------------|-------|
| 1.  | Consumption of Animal Protein        | 0.4   |
| 2.  | Health Check                         | 0.6   |
| 3.  | Consumption Tablet Add Blood         | 0.8   |
| 4.  | Sexual and reproductive health education and nutrition | 0.8 |
| 5.  | Food needs 3x a day                  | 0.8   |

Table 17. Value assurance specialist

| No. | Preference                           | Score |
|-----|--------------------------------------|-------|
| 1.  | Consumption of Animal Protein        | 0.8   |
| 2.  | Health Check                         | 0.6   |
| 3.  | Consumption Tablet Add Blood         | 1.0   |
| 4.  | Sexual and reproductive health education and nutrition | 1.0 |
| 5.  | Food needs 3x a day                  | 1.0   |

Results

The percentage of the value of the specific interventions in the Young Women in the form of

\[ 0.996 \times 100\% = 99.7\% \]

3.3. Accuracy Testing

Accuracy testing is carried out to determine the performance of the expert system to provide the results of identifying conclusions from the value of stunting interventions.
### Table 18. Accuracy testing

| No | Complaints in Suffering | User Answer | System Diagnostic Results | Expert Diagnosis Results | Comparison Result Accuracy |
|----|--------------------------|-------------|----------------------------|--------------------------|----------------------------|
| 1. | Pregnancy Growth Monitoring. | Often | Intervention for Sensitive Pregnant Women with 100% certainty value results | Intervention for sensitive pregnant women with definite value results if the value is 100% | 1 |
|    | medical check-up | Often | | | |
|    | Using Family Planning | Very | | | |
|    | Cash Assistance for Poor Families. | Often | | | |
|    | Has a latrine. | Yes | | | |
|    | Daily Clean Water. | Very | | | |
|    | Stunting knowledge. | Often | | | |
|    | Using BPJS. | Often | | | |
| 2. | Medical check-up. | Very Often | Breastfeeding Mother Sensitive Interventions with the result of 100% certainty value | Breastfeeding Mother Sensitive Interventions with the result of an exact value if the result of the value is 100% | 1 |
|    | Using Family Planning | Yes | | | |
|    | Cash Assistance for Poor Families. | Very Often | | | |
|    | Has a latrine | Yes | | | |
|    | Daily Clean Water. | Very Often | | | |
|    | Stunting knowledge. | Very | | | |
|    | Using BPJS. | Very Often | | | |
| 3. | Medical check-up. | Often Rarely | Young Women Sensitive Interventions with the result of 100% certainty value | Young Women Sensitive Intervention with definite value results if the value is 100% | 1 |
|    | Cash Assistance for Poor Families. | | | | |
|    | Has a latrine | Yes | | | |
|    | Daily Clean Water. | Very | | | |
|    | Stunting knowledge | Very | | | |
|    | Using BPJS. | Very | | | |
|    | Consumption of worm medicine. | Rarely | | | |
| 4. | Consumption of Animal Protein. | Often | Pregnant Mother Specific Interventions with the result of a certain value | Pregnant Mother Specific Interventions with the result of an exact value if | 1 |
|    | Supplementary Food (PMT) | Very Often | | | |
|    | Consumption of Blood Supplement Tablets. | Very | | | |
Results of the accuracy test on the results of the system intervention values and experts, it can be concluded that the accuracy of the expert system using the Certainty Factor method based on six data for stunting preference diagnosis that has been tested has a fairly good success rate according to the expert's diagnosis, which is 83%. Accuracy value = 5/6 x 100% = 83%

4. Conclusion

In this paper, we describe a methodology to provide confidence percentage value by using the certainty factor. The researcher seeks to provide an alternative solution with Decision Support Systems and methods Certainty Factor in handling cases of intervention Stunting. In this case, the use of methods to facilitate the distribution of Certainty Factor to deliver results in the form of a percentage value and the confidence that solutions will be provided for the handling of cases Stunting. Results using a black box for the Stunting Intervention System application, the conclusion is that the stunting intervention system application program produces a value of 100%, which is valid or appropriate and using the results of the accuracy test on the stunting expert who has been tested has a fairly good success rate according to the expert's diagnosis, which is equal to 83%

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