



IMPLEMENTATION MODEL FORWARD CHAINING FOR DETECTION EARLY TODDLER MALNUTRITION AGE 0-59 MONTH

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ABSTRACT

This study focuses on the problem of malnutrition in toddlers in Indonesia, who experience multiple nutritional challenges. Toddler age is a critical period in growth and development, but a lack of nutritional intake can lead to long-term health problems. To overcome this problem, the study proposed the development of an Expert System for Poor Nutrition in Toddlers using the Laravel Framework-based Forward Chaining method. This system will assist health workers in diagnosing malnutrition in toddlers by utilizing anthropometric information such as Body Weight According to Body Length or Height children aged 0-60 months. With variables such as gender, age, weight, and length/height, this system can generate a z-score to determine the nutritional status of toddlers.

Keywords : Gizi buruk balita, forward chaining, laravel.

ABSTRAK

Penelitian ini berfokus pada masalah malnutrisi pada balita di Indonesia, yang mengalami tantangan gizi ganda. Usia balita merupakan periode kritis dalam pertumbuhan dan perkembangan, tetapi kurangnya asupan gizi dapat menyebabkan masalah kesehatan jangka panjang. Untuk mengatasi masalah ini, penelitian Implementasi Model Forward Chaining untuk Deteksi Dini Malnutrisi Balita Umur 0-59 Bulan. Sistem ini akan membantu tenaga kesehatan dalam mendiagnosa malnutrisi pada balita dengan memanfaatkan informasi antropometri berdasarkan indikator Berat Badan Menurut Panjang Badan atau Tinggi Badan (BB/PB atau BB/TB) anak usia 0-60 bulan. Dengan variabel seperti jenis kelamin, usia, berat badan, dan panjang/tinggi badan, sistem ini dapat menghasilkan z-score untuk menentukan ada tidaknya masalah malnutrisi balita.

Kata kunci: Gizi buruk balita, forward chaining, laravel.

INTRODUCTION

Malnutrition, as defined by the World Health Organization (WHO), is a condition where there is an imbalance between the supply of nutrients and energy and the body's requirements needed for growth, maintenance, and proper functioning. (Triawanti, Didik Dwi Sanyoto, 2017) . Protein Energy Malnutrition (PEM) is a condition characterized by inadequate intake of energy and protein in daily food consumption, leading to the failure to meet the Recommended Dietary Allowance (RDA) for nutritional needs. (Fitrianingsih1 et al., 2021) . Protein Energy Malnutrition can be described as a nutritional disorder characterized by a range of pathological conditions resulting from a deficiency of both energy and protein in varying proportions. (Damayanti, Didit, Pritasari, 2017) . There are four forms of malnutrition, namely 1) Under nutrition means deficiency relative and absolute food consumption for a certain period, 2). Specific deficiency which is defined as a lack of certain nutrients, 3). Over nutrition means excess food consumption for a certain period and 4). Meaningful imbalance because of disproportion substance nutrition (WHO, 2024) (Mulfianda2, 2019) .

Even though there are four malnutrition, the government is currently still prioritizing them on toddler nutrition problems, namely malnutrition, malnutrition and stunting. Status assessment toddler nutrition is based on the 2005 WHO standards as outlined in the Ministerial Regulation Health Number 2 of 2020 concerning Child Anthropometric Standards. these regulations determines the measurement of nutritional status of toddlers using three indices, namely Weight Body according to Age (WW/U), Body Length or Height according to Age (BW/U or TB/U), and Body Weight according to Body Length or Height (BB/BW or BB/TB) (Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2020 concerning Child Anthropometric Standards, 2020) .

Based on results data surveillance nutrition year 2020 on activity monitoring growth, status nutrition toddler with measurement index BB/TB found as much as 1.1% toddler nutrition bad And 4.3% malnourished toddlers. Nutritional status of toddlers with measurement PB/U or TB/U index is found as many as 3.0% of toddlers are very short and as many as 8.5% of toddlers are short. Nutritional status of toddlers with measurement index BB/U found as much as 1.4% toddler with heavy body very not enough And as much 6.7% toddler with heavy body not enough (Indonesian Ministry of Health, 2021) .

Whereas status nutrition toddler in Pringsewu Regency, Lampung Province, in 2021, the weight of under five was recorded less (underweight) by 6.4%, toddlers short (stunted) by 6.6% and toddlers wasting was 3.8%. One of the community health centers in the Pringsewu Regency area which was recorded as having a more or less high nutritional under-five presentation in the district that is Banyumas Community Health Center that is toddler with heavy body less than that 8.4% (BB/U), short toddler as big as 8.5% (TB/U) And skinny toddler as big as 3.4% (BB/TB) (Health Service, 2021) .

Growth toddler important Also For noticed. Growth interpreted as changes in body cells occur in two forms, namely increase in size cell And or increase amount cell shown with exists increase size physique, Good in form heavy body, tall body or appearance physique. Growth during the toddler years starts from the fetus in the womb until around age five year. On period toddler Which need get attention is growth brain tissue that has been growing since in the womb and continues until around age 2 year, furthermore decrease its growth And Already will finished growth brain on around age 8 year (Holil M. Par'i, Sugeng Wiyono, 2017) .

On moment This, detection early For know determination malnutrition And status growth is still underway in a way manually by health workers in a way calculate results z - score or look at the table standard anthropometric assessment nutritional status child. So that need time to determine a child's malnutrition and status the probability of error rate growth is high Because less thorough power health. Therefore by going through study This, will made a system taking possible decisions help power health as well as family or the community to determine malnutrition and growth status of toddlers aged 0-59 month through system expert. An expert system is a computer-based system that uses knowledge, facts and reasoning techniques to solve problems that usually can only be solved by an expert. (Wiyandra, Y., & Yenila, 2018) (Kusrini, 2008) .

Based on background behind as reviewed above , research detection early malnutrition and growth status will use system expert forward chaining method proceed). Method forward chaining a process tracing Which started with displays data set or convincing fact going to conclusion end (Rofil M. Nur, 2022) . With use draft in on , so make it A solution For finish problem malnutrition And status growth with using a forward model chaining.

MET HOD

Research steps have a crucial role in ensuring that research runs according to the stated targets. The following is a description of the research stages which can be arranged in the following outline :

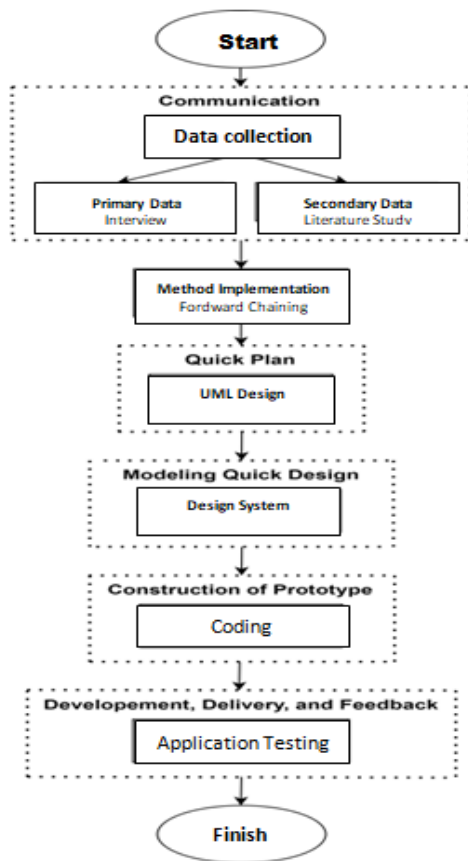


Figure 1 Research stages

A. Communications

At the Communication stage, researchers carried out data acquisition using two approaches, namely literature study and toddler data information. 1). Literature Study; The literature study process was carried out with the aim of collecting information related to the topic of malnutrition in toddlers as well as methods that are relevant in this research. References taken come from various sources, such as journals, books and internet resources. 2). toddler data information

B. Implementation of the Forward Chaining Method

After completing the data collection stage in Communication, the next step or trace forward is the implementation of the Forward Chaining method (Dwiny Meidelfi, Salman Alfarissy, Afrizal Fauzi, 2021) . This method is used to analyze data that has been obtained from the Communication stage. In the context of diagnosing toddler malnutrition, the anthropometric approach using Body Weight According to Body Length or Height (BB/PB or BB/TB) requires four variables, namely gender, age, body weight, and body length/height. With these data, the research produces z-score values that are relevant in the diagnosis process (REPUBLIC & 2020, 2020) .

Table 1
Gender Variable

No.	Code	Gender
1	LK	Man

2	PR	Woman
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Table 2

Index Variables

No.	Code	Index
1	BB	Heavy Body
2	PB/TB	Long or Tall Body

Based on the variables that have been explained, the application of the forward chaining method includes setting rules that link gender, age, body length/height, and body weight with a threshold (z-score), as shown in table III .

Table 3

Z-Score Variable

Index	Nutritional Status Category	Threshold (Z-Score)
Heavy Body According to Long Body or Tall Body (BB/PB or BB/TB) of the child aged 0-60 months	Nutrition bad (severely wasted)	< -3 SD
	Nutrition less (wasted)	-3 SD to < -2 SD
	Nutrition good (normal)	-2 SD sd +1 SD
	Berisiko gizi lebih (possible risk of overweight)	> + 1 SD sd + 2 SD
	Gizi lebih (overweight)	> +2 SD sd +3 SD
	Obesitas (obese)	> +3 SD

Tabel 4

Variabel Z-Score

No	Rule
1	IF LK AND US1 AND PB AND BB THEN Z-SCORE
2	IF PR AND US1 AND PB AND BB THEN Z-SCORE
3	IF LK AND US2 AND TB AND BB THEN Z-SCORE
4	IF PR AND US2 AND TB AND BB THEN Z-SCORE

After these rules are determined for each variable, a decision tree is formed which is the core of the expert system for diagnosing malnutrition in toddlers, as depicted in Figure 2.

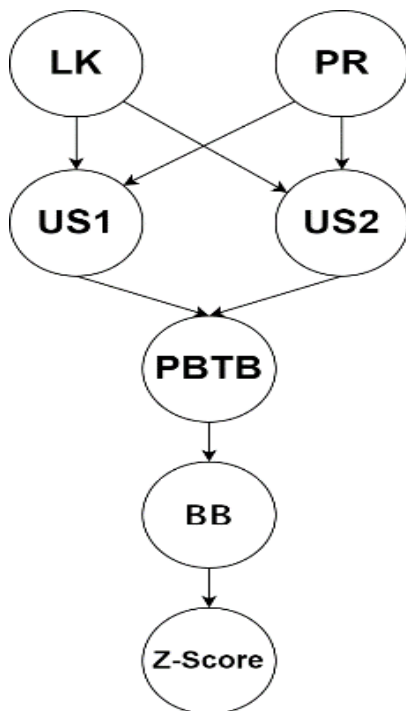


Figure 2. Decision tree

It is important to note that the weight standards used refer to the provisions regulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2020 concerning Child Anthropometric Standards (Minister of Health of the Republic of Indonesia, 2020) .

Table 5

Standard Body Weight according to Body Length (BB/PB) of Children
Boys Aged 0-24 Months

Body Length (cm)	Heavy Body (Kg)						
	-3 elementary school	-2 elementary school	-1 elementary school	Median	+1 SD	+2 SD	+3 elementary school
45	1.9	2	2,2	2,4	2.7	3	3.3
45.5	1.9	2.1	2,3	2.5	2.8	3.1	3,4
46	2	2,2	2,4	2.6	2.9	3.1	3.5
46.5	2.1	2,3	2.5	2.7	3	3,2	3.6

Table 6

Standard Body Weight according to Body Length (BB/PB) for Girls Aged 0-24 Months

Long Body (cm)	Heavy Body (Kg)						
	-3 elementary school	-2 elementary school	-1 elementary school	Median	+1 SD	+2 SD	+3 SD
45	1.9	2.1	2,3	2.5	2.7	3	3.3
45.5	2	2.1	2,3	2.5	2.8	3.1	3,4
46	2	2.2	2.4	2.6	2.9	3.2	3.5
46.5	2.1	2,3	2.5	2.7	3	3.3	3.6

Table 7

Standard Weight according to Height (WW/TB) of Children
Males Aged 24-60 Months

Tall Body (cm)	Heavy Body (Kg)						
	-3 elementary school	-2 elementary school	-1 elementary school	Median	+1 SD	+2 SD	+3 SD
65	5.9	6.3	6.9	7.4	8.1	8.8	9.6
65.5	6	6.4	7	7.6	8.2	8.9	9.8
66	6.1	6.5	7.1	7.7	8.3	9.1	9.9
66.5	6.1	6.6	7.2	7.8	8.5	9.2	10.1

Table 8

Standard Body Weight according to Height (WW/TB)
Girls aged 24-60 months

Tall Body (cm)	Heavy Body (Kg)						
	-3 elementary school	-2 elementary school	-1 elementary school	Median	+1 SD	+2 SD	+3 SD
65	5,6	6,1	6,6	7,2	7,9	8,7	9,7
65,5	5,7	6,2	6,7	7,4	8,1	8,9	9,8
66	5,8	6,3	6,8	7,5	8,2	9	10
66,5	5,8	6,4	6,9	7,6	8,3	9.1	10.1

C. Quick Plan

At the Quick Plan stage the researcher carried out system design using use case diagrams and class diagrams for draft databases.

The following is a use case design:

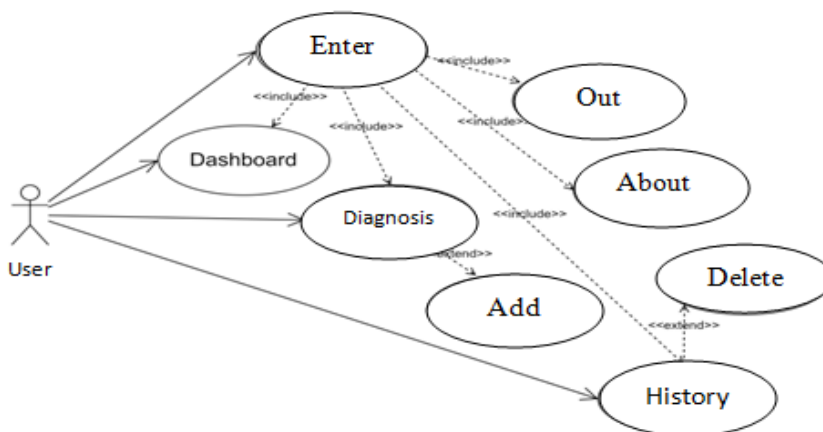


Figure 3 . Use cases

The class diagram is as follows :

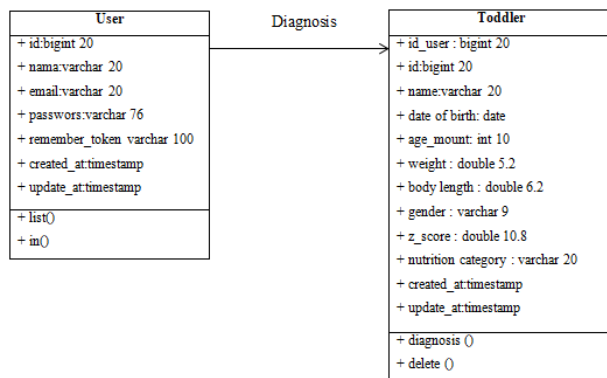


Figure 4. Class diagrams

D. Modeling Quick Design

At the Quick Design Modeling stage, researchers designed the interface using mock-ups .

a. Design page registration user

The mock-up shows a registration form with a circular profile icon placeholder at the top. Below it are four input fields labeled "Name", "Email", "Password", and "Confirmations". At the bottom are two buttons: "Enter" and "List".

Figure . 5 User Registration Plan

b. Dashboard page design



Figure 6. Dashboard Menu Design

c. Diagnostics page design .

Figure . 7 Diagnostic Menu Design

E. Construction Of Prototype

At the Construction of Prototype stage the researcher will carry out coding based on the design that was created in the previous stage. In the process, researchers used the Laravel Framework. Program code for calculating z-score in determining nutritional status:

```

1. if (
2. ($jk == $rule['jk'] && $categoryAge == $rule['age'] && $bodylength == $rule['body'])
   && $rule['type'] = 'pb' ||
3. ($jk == $rule['jk'] && $categoryAge == $rule['age'] && $bodylength == $rule['body'])
   && $rule['type'] = 'tb'
4. ) {
5. if ($bodyweight > $rule['0']) {
6. $zScore = ($bodyweight - $rule['0']) / (($rule['1'] - $rule['0']));
7. } elseif ($beratBadan < $rule['0']) {
8. $zScore = ($beratBadan - $rule['0']) / ($rule['0'] - ($rule['-1']));
9. }
10. $found = true;
11. break;
12. }
13. }
14. if (!$found) {
15. $zScore = 0;
16. }
17. return $zScore;

```

F. Deployment, Delivery and Feedback

At the Deployment, Delivery and Feedback stage, researchers will test the program that has been created to test the functionality of the system created using Black Box Testing .

Table 9

Blackbox Testing

No	Functionality	Order And Input	Results	Status
1	Registration account user	Do registration	System direct user to Dashboard	Success

page				
2	Enter account user	Enter email and password with Correct	System direct user to Dashboard page	Success
		Enter email and password with Wrong	System displays announcement on the login menu	Success
3	Dashboards	Visit Dashboard page	Displaying Dashboard page	Success
4	Diagnosis	Do diagnosis	Displaying results diagnosis	Success
5	History	See And Delete History Diagnosis	History diagnosis come on stage And can deleted	Success
6	About	Visit page About	Displaying page About	Success
7	Go out account user	Click the exit menu	System direct to page enter	Success
		Visit Dashboard page	System direct to page enter	Success

RESULTS AND DISCUSSION

Implementation of malnutrition on adopted toddler Forward Chaining method with basic Laravel framework has tested successfully . Following This is results implementation :

1. There is page where to register user must own account For access application .

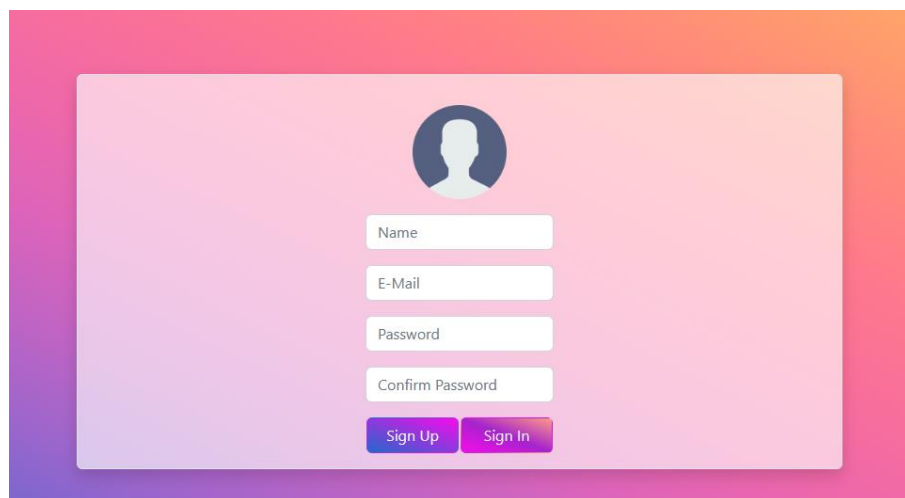


Figure 8. Page registration

2. There is dashboard page that displays statistics about number of diagnoses by status.

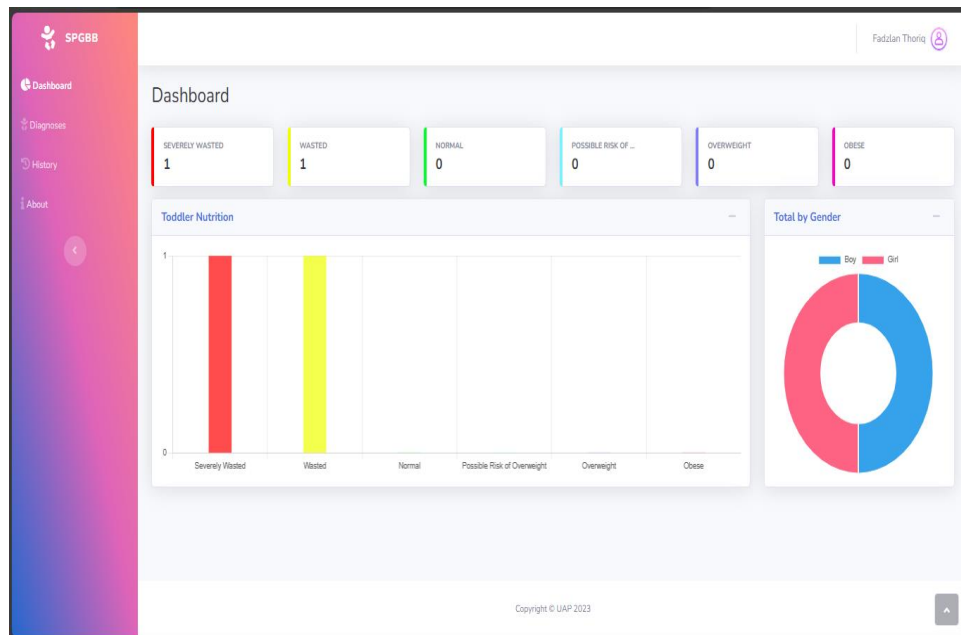


Figure 9. Page dashboards

3. There is possible diagnosis page user For carry out a nutritional diagnosis bad on toddler with fill in required form .

The form contains the following fields:

- Name: Eve
- Birth Date: 05/01/2023
- Month of Age: 8
- Weight (kg): 2
- Lenght or Height (cm): 45
- Gender: ☒ Girl
- Conversion: ☐ Lenght or Height

Diagnoses button

Summary of Diagnosis: The diagnosis results will appear here ...

Figure 10. Page diagnosis

CONCLUSIONS AND SUGGESTIONS

CONCLUSIONS

From the results of this research, it can be concluded that the application of an expert system to diagnose malnutrition in toddlers using the forward chaining method can be integrated into the Laravel framework. An anthropometric approach using the ratio of Body Weight to Body Length or Height (BB/BW or BB/TB) in children aged 0-60 months is used as a method for diagnosing malnutrition. To carry out this diagnosis, variables such as gender, age, weight, length/height are needed. From this data, a z-score value is generated, and if the z-score is less than -3 SD, then malnutrition is considered to occur.

However, this study has several shortcomings that are worth noting:

1. Toddler growth charts are not included as additional visual information that can make understanding easier .
2. Focus only on the Weight by Length or Height index as a diagnostic method, so that other variations of the method are not considered .

SUGGESTIONS

Based on research that has been done about expert system malnutrition in toddlers use m method Forward Chaining based on the Laravel framework , researcher recommend some suggestions for development study in the future coming that is exists chart growth toddler on application .

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