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Application of Decision Support System and Business Intelligence Model for Identification and Determination of Stunting

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Abstract
It is imperative to identify stunting in toddlers at an earlier stage in order to facilitate further treatment related to the health of toddlers, with the ultimate goal of improving the health status of toddlers. Stunting problems are not only related to health problems. The purpose of this study is to design and build DSS intelligence applications for the purpose of identifying stunting and determining stunting status in toddlers using Promethee models. It is anticipated that the DSS application will facilitate the early detection of stunting in toddlers and assist the Lhokseumawe City Health Office in determining the status of stunting in toddlers. The research methodology comprises a series of stages, commencing with a literature review and data collection, followed by the identification of the requirements for DSS applications, the design of the DSS application, the coding of the DSS application and the testing of the DSS applications. In this study, 27 test data (alternatives) were selected, each of which met six criteria. These criteria were age, weight, height, head circumference, speech style and behaviour. The results of the DSS system testing indicated that eight toddlers were identified as stunted, with net flow values between 0.54691588785047 and 0.65308411214953. Conversely, 19 children under five were classified as non-stunted, with net flow values below 0.5.
Keywords: *Intelligence Application; DSS; Stunting; Promethee*

Abstrak
Identifikasi stunting lebih awal bagi balita diperlukan untuk memudahkan penanganan lebih lanjut terkait kesehatan balita sebagai salah satu upaya untuk meningkatkan derajat kesehatan balita. Permasalahan yang diteliti adalah bagaimana mengidentifikasi stunting dan penetapan status stunting pada balita dengan pendekatan Sistem Komputer Decision Support System (DSS) menggunakan metode Preference Ranking Organization Method for Enrichment Evaluation (Promethee). Tujuan Penelitian adalah untuk melakukan perancangan dan membangun Aplikasi Intelligence DSS dalam identifikasi stunting dan penetapan status stunting pada balita dengan model Promethee. Aplikasi DSS tersebut diharapkan dapat membantu masyarakat dalam mendeteksi secara dini stunting pada balita dan membantu pihak Dinas Kesehatan Kota Lhokseumawe dalam penetapan status stunting pada balita. Tahapan metode penelitian dimulai dari studi literature dan pengumpulan data, melakukan analisis terhadap kebutuhan aplikasi DSS, melakukan desain aplikasi DSS, melakukan koding aplikasi DSS dan melakukan pengujian aplikasi DSS. Pada penelitian ini terdapat 27 data uji (alternatif) telah diseleksi yang memiliki 6 kriteria yaitu dari kriteria umur, berat badan, tinggi badan, lingkar kepala, gaya bicara dan tingkah laku. Hasil pengujian sistem DSS menunjukkan terdapat 8 balita yang dinyatakan status stunting dengan perolehan nilai Net Flow antara 0.54691588785047 sampai 0.65308411214953 dan sejumlah 19 balita dinyatakan bebas stunting dengan nilai Net Flow dibawah 0.5.
Kata Kunci: *Aplikasi Intelligence; DSS; Stunting; Promethee*

1. Introduction

Stunting is the main cause that inhibits the growth of toddlers, usually caused by poor nutrition so it has quite dangerous impacts such as inhibiting growth, the body's immune system quickly decreases so that the risk of disease is more likely to occur and the impact caused by stunting is that when the toddler grows it has Physical and body weight are not the same compared to other normal toddlers [1].

Stunting in toddlers is a global nutritional issue. Based on the 2010 UNICEF report, there are 79 billion stunted children under the age of 5 in the Asia Pacific region. Data from 2017 shows that 55% of stunted toddlers in the world come from the Asian continent and 39% come from the African continent. In Asia, the region with the highest prevalence (57.8%) of stunted toddlers is in South Asia and the lowest

prevalence (0.9%) is in Central Asia. The prevalence of stunting in Southeast Asia in 2012 included Laos (48%), Cambodia (40%), and Indonesia (36%). The prevalence of stunted toddlers in Indonesia has remained quite high over the last decade, averaging 36.4% in 2005-2020. In 2020, the prevalence of stunting and severe stunting in Indonesia decreased to 30.8%, but Aceh province became the third highest stunted province nationally [2], [3]–[7].

Early identification of stunting for toddlers is necessary to facilitate further treatment regarding toddlers' health as an effort to improve the health status of toddlers. The problem of stunting is not only related to health problems. The complexity of the stunting problem and the large number of stakeholders in nutrition interventions require handling from all related fields in an integrated manner. Therefore, an Intelligence Decision Support System (DSS) application is needed to facilitate early identification of stunting in toddlers and assist the relevant agencies/Health in making decisions regarding determining stunting status in toddlers in the regions. The research objectives are: (1) Developing an Intelligence DSS application in early identification of stunting and determining stunting status in toddlers using the Promethee model and (2) The DSS application is expected to help the community in early detection of stunting in toddlers and the Lhokseumawe City Health Service in determining stunting status in toddlers.

Intelligence Decision Support System (DSS) is a computer-based interactive decision support system that can be used to assist decision makers by utilizing data and models to solve unstructured problems [8],[9]–[11]. Model Preference Ranking Organization Method for Enrichment Evaluation (Promethee). In the Promethee model there are six criteria preference functions. Even though they are not absolute, these forms are good enough for several cases of capabilities that can be carried out by promethee, including completing comparisons in several decision makers which are defined as their own scale of measurement without limitations, setting priorities and preferences for all criteria and focusing on value, without think about the calculation method. The function of the difference in criterion values between alternatives H(d) is applied as a good example for areas that are not the same, this has a relationship with the preference function P [12],[13], [14].

2. Material and Methods

Data collection technique by inputting data into the DSS application for determining stunting. The data source used comes from the Lhokseumawe City Health Service. The method used in carrying out this research is [15],[16] :

a. Collecting data

Alternative data is toddler data consisting of 27 toddlers, while the criteria data used are: age, weight, height, head circumference, speaking style and behavior.

b. Perform data analysis

System requirements analysis is determining the overall system architecture, determining the data size and amount of data.

d. Designing the DSS Application

System design includes: determining the basics of data structures/formation and selection of DBMS, system architecture, algorithm selection, user interface design, application model design, ERD design, relational database/database design, data flow design, DSS application input design, design process and design of DSS application output.

e. Coding the application, namely transforming the design that has been created into a programming language using PhP version 7.0.0, MySQL DBMS software version 6.0.

f. Test the Study Program Selection DSS application before use. System testing includes: error debugging (black box and white box), data input into the application, form testing, system validation testing, system security testing, system performance with actual data testing. In summary, the stages of the research method can be seen in **Figure 1**.

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Figure 1. Research Method

Stunting Determination DSS Architectural Scheme

The DSS architecture for determining stunting in toddlers is as shown in **Figure 2**.

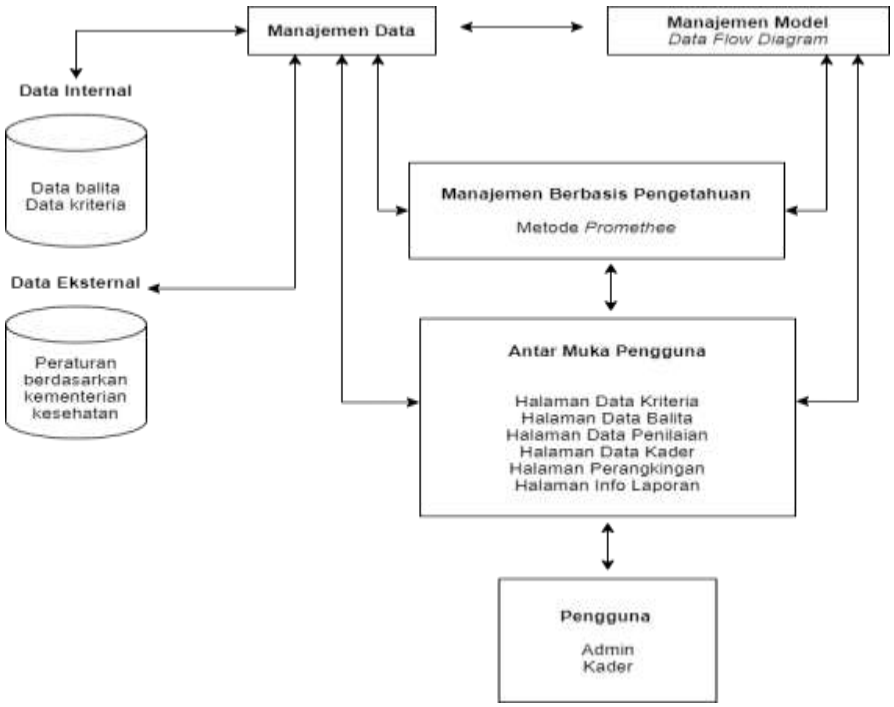

Figure 2. DSS architecture for determining stunting

Relational Database Schema (RDBMS)

Physical relational database scheme design used to store data/manage user data, toddler/alternative data, criteria data and assessment data in the Decision Support System (DSS) Application and Business Intelligence Model for Identification and Determination of Stunting Status in Toddlers which consists of a user table, toddler tables, assessment tables and category tables. The relational database schema is as shown in **Figure 3**.

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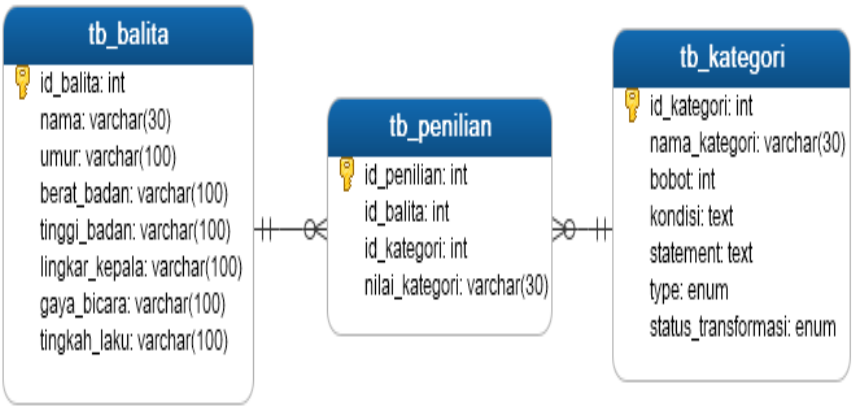

Figure 3. Relational table schematic

Context Diagram and DFD Schemes

The context of the Decision Support System (DSS) Application system diagram and Business Intelligence Model for Identification and Determination of Stunting Status in Toddlers is in **Figures 4** and **5**.

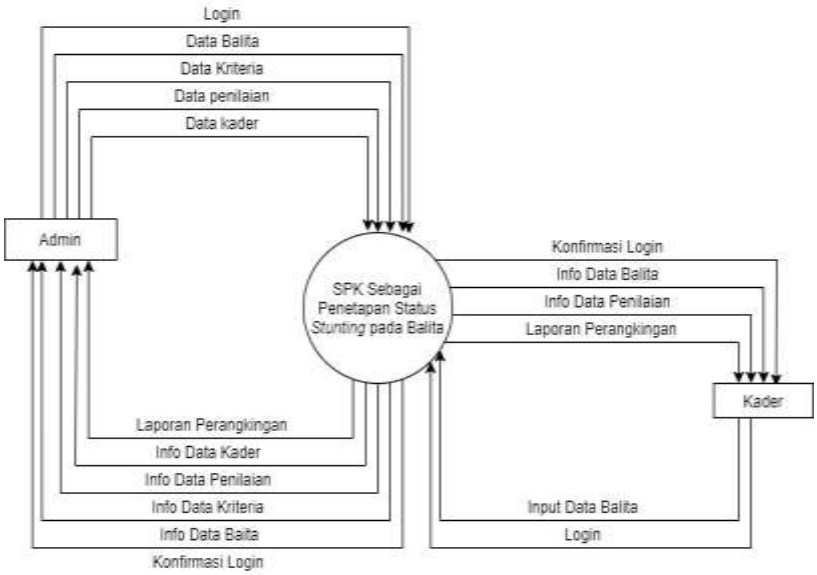

Figure 4. DSS Context Diagram for Determining Stunting

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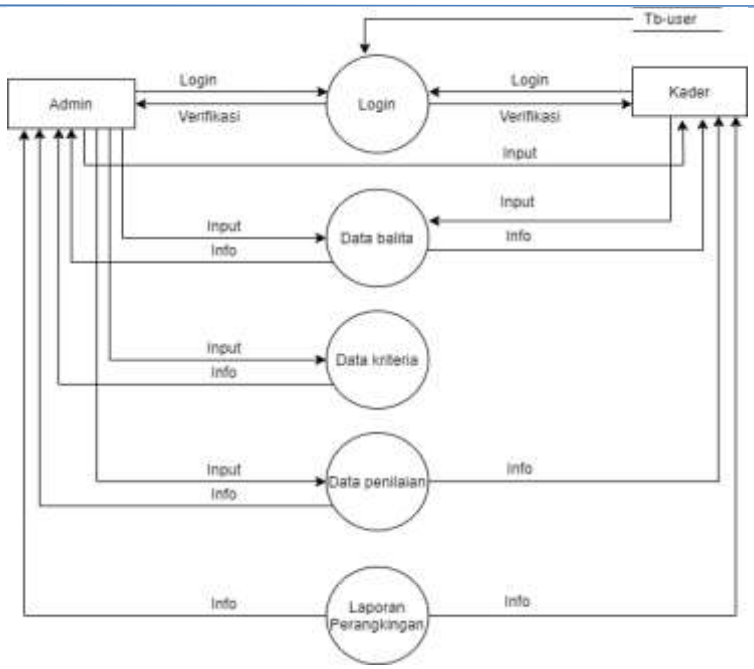

Figure 5. DFD level 0 DSS Stunting Determination

3. Results and Discussion

Display of the application page for the Decision Support System (DSS) Application and Business Intelligence Model for Identification and Determination of Stunting Status using the PROMETHEE model. The DSS system produces a decision report recommended by the DSS application regarding determining stunting status in toddlers.

Admin Main Menu Page Display

The admin main page is the initial display seen by the admin after successfully logging in. On this main page the admin has full access rights to manage and control this page. The admin page has a home menu, criteria data menu, toddler data menu, assessment data menu, menu cadre data, ranking menu and report info menu. The main admin page displays as shown in **Figure 6**.

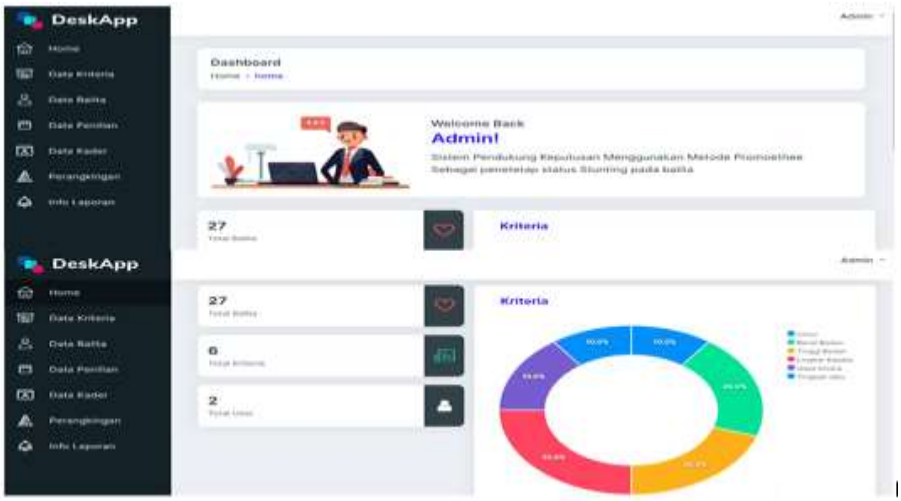

Figure 6. Admin Main Menu Display

Page Views Promethee Analysis and Calculations

Calculating the preference index using the function of the usual criterion H(d) or (Usual Criterion) in equation (4), the calculation results of the DSS application for determining stunting are as shown in **Figure 7**.

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C100	C101	C102	C103	C104	C105	C106	C107	C108	TOTAL
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.087476635514019
0.83	0.00	0.83	0.67	0.67	0.33	0.50	0.50	0.83	0.634766355140191
0.17	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.17	0.137570894579
0.83	0.17	0.83	0.50	0.67	0.50	0.50	0.50	0.67	0.514391223364491
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.025046728971963
0.33	0.00	0.83	0.33	0.17	0.00	0.17	0.00	0.33	0.287102803738321
0.67	0.00	0.67	0.67	0.50	0.33	0.33	0.50	0.67	0.499813084112151
0.83	0.00	0.83	0.67	0.50	0.33	0.50	0.50	0.83	0.56112149532711
0.17	0.00	0.67	0.33	0.00	0.00	0.00	0.00	0.00	0.182242990654211
0.83	0.17	0.83	0.67	0.67	0.50	0.50	0.50	0.83	0.554766355140191
0.67	0.17	0.67	0.67	0.50	0.50	0.33	0.67	0.67	0.531214953271031
0.83	0.17	0.83	0.67	0.67	0.33	0.50	0.67	0.83	0.610467289719631
0.17	0.00	0.67	0.33	0.17	0.00	0.00	0.00	0.17	0.212710280373831
0.17	0.00	0.17	0.00	0.17	0.00	0.17	0.00	0.17	0.088971962616822
0.17	0.00	0.33	0.33	0.17	0.00	0.00	0.00	0.33	0.211588785046731
0.33	0.00	0.83	0.33	0.17	0.00	0.17	0.00	0.17	0.286728971962621
0.67	0.00	0.67	0.50	0.50	0.33	0.17	0.33	0.50	0.394018691588791
0.17	0.00	0.33	0.17	0.17	0.00	0.17	0.00	0.17	0.162990654205611
0.17	0.00	0.50	0.50	0.00	0.00	0.00	0.17	0.33	0.273177570093461
0.83	0.00	0.83	0.67	0.83	0.50	0.50	0.50	0.83	0.684859813084111
0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.124859813084111
0.33	0.00	0.50	0.00	0.17	0.00	0.17	0.00	0.17	0.268411214953271

Figure 7. Display Preference Indeks

Next is to calculate the Net Flow Value for each alternative to get the Net Flow result, namely Leaving Flow - Entering FLow = Net Flow. The results of calculating the Net Flow value are the final value for determining stunting or normal status. If the Net Flow value is above 0.5 then the status is declared Stunting and if it is below 0.5 the toddler's status is Normal (Not Stunting) as shown in **Figure 8**.

F. Perhitungan Net FLow

Tabel di bawah ini merupakan perhitungan manual dari Net Flow yang mana persamaan untuk hasil Net FLow adalah Leaving Flow - Entering FLow = netFlow sebagai berikut:

No	Alternatif	Leaving Flow	Entering FLow	Net FLow	Status Balita
1	C20	0.6948598130841	0.0617757009457	0.6330841121495	Stunting
2	C47	0.6948598130841	0.0617757009457	0.6330841121495	Stunting
3	C74	0.6948598130841	0.0617757009457	0.6330841121495	Stunting
4	C101	0.6948598130841	0.0617757009457	0.6330841121495	Stunting
5	C2	0.6247665514019	0.0785046728972	0.5462158878505	Stunting
6	C29	0.6247665514019	0.0785046728972	0.5462158878505	Stunting
7	C56	0.6247665514019	0.0785046728972	0.5462158878505	Stunting
8	C83	0.6247665514019	0.0785046728972	0.5462158878505	Stunting
9	C12	0.6104672897196	0.1121495327102	0.4983177570093	Tidak Stunting
10	C39	0.6104672897196	0.1121495327102	0.4983177570093	Tidak Stunting
11	C66	0.6104672897196	0.1121495327102	0.4983177570093	Tidak Stunting
12	C93	0.6104672897196	0.1121495327102	0.4983177570093	Tidak Stunting
13	C4	0.5543925233644	0.1571962616822	0.4171962616822	Tidak Stunting
14	C31	0.5543925233644	0.1571962616822	0.4171962616822	Tidak Stunting
15	C58	0.5543925233644	0.1571962616822	0.4171962616822	Tidak Stunting
16	C85	0.5543925233644	0.1571962616822	0.4171962616822	Tidak Stunting
17	C10	0.5247665514019	0.1495327102803	0.4823364485981	Tidak Stunting

Figure 8. Showing Net Flow Values and System Recommendations

In this study, 27 test data (alternatives) were selected which had 6 criteria, namely age, weight, height, head circumference, speaking style and behavior. The results of system testing using black box and white box testing for all buttons on the system run well according to their function and according to user needs, the application of the promethee method in the system is used in the ranking process for determining stunting status in toddlers, in manual calculations and calculations from the system it shows The results of the determination are the same for toddlers who are infected with stunting. Based on system testing, it showed that there were 8 toddlers who were declared stunting status with Net Flow values between 0.54691588785047 to 0.65308411214953 and 19 toddlers were declared free of stunting with Net Flow values below 0.5.

Application testing has also been carried out involving 29 users/respondents of the DSS Application for Determining Stunting Status for Toddlers as shown in the graph in Figure 9. The test results show that the accuracy of the DSS Application for Determining Stunting Status reached 93.5%. So the DSS application can help health officers/village midwives/posyandu in determining the stunting status of toddlers and follow-up health measures and can educate the public regarding stunting, especially in Lhokseumawe City.

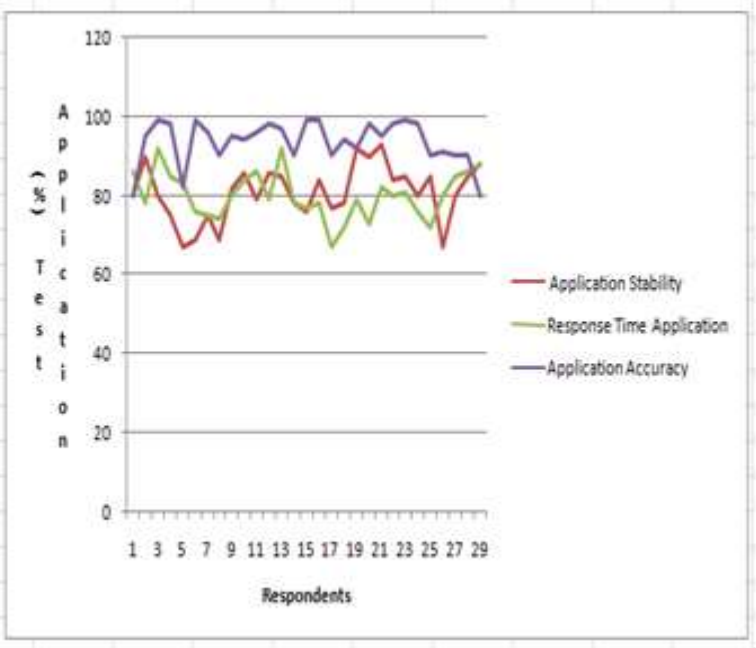

Figure 9. Accuracy of the Stunting Determination DSS system

4. Conclusion

The DSS application for determining stunting can help health workers/village midwives/posyandu in determining the stunting status of toddlers and follow-up health measures and can educate the public regarding stunting, especially in Lhokseumawe City. Testing of the DSS application for determining stunting has been carried out to ensure the application functions properly.

The results of application testing involving 29 users (respondents) showed that the application accuracy reached 93.5%. Even though the DSS application for determining Stunting has been created and has been tested, it also has weaknesses. However, the calculation results of the Stunting Determination DSS application using the Promethee model provide information in the form of recommendations issued by the DSS system accurately.

5. Acknowledgment

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