DESIGN OF THE SI-NANING MOBILE APP AS A DIGITAL INTERVENTION FOR ANEMIA AND STUNTING PREVENTION

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Article Info	ABSTRACT
	Stunting is a problem that needs special attention because of its high prevalence in Indonesia. Anemia in pregnant women is one of the factors that causes stunting. Based on preliminary studies, in Tanjungpinang City, there has been no digitization of Health Education about the prevention of anemia and stunting. This research aims to design and build an Android application called "Si-NaNing as an information medium for anemia and stunting prevention. The research methods used include information content planning, data and software needs used as well as application system development using the Rapid Application Development (RAD) method. The results of the development of the Si-Naning application will provide convenience in providing health education related to anemia and stunting, and can be used to improve the knowledge, attitude, motivation, and independence of pregnant women in the prevention of anemia and stunting. *This is an open access article under the CC BY-SA license.*

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1. INTRODUCTION

The prevalence of stunting among children under five in Indonesia from 2005 to 2017 was 36.4%. The occurrence of stunting (short stature) remains a major nutritional problem faced by the country. The Ministry of Health of the Republic of Indonesia reported that 45,000 children under five in the Riau Islands Province suffered from malnutrition and undernutrition throughout 2018. This number represents 13% of the total 350,000 children under five in the province. Stunting cases in the Riau Islands reached 24% of total live births in 2018. Factors influencing stunting include the nutritional status of mothers during pregnancy [1]. One of the key nutritional issues among pregnant women is anemia. The iron supplementation program (TTD) is expected to reduce the incidence of anemia during pregnancy, thereby lowering the risk of stunting. However, the results remain unsatisfactory, as the prevalence rate is still high. Low adherence to iron supplementation among pregnant women is one of the contributing factors. Maternal health behaviors are influenced by knowledge and enabling factors, including the availability of facilities and health services [2] . Therefore, it is essential to provide education to pregnant women on preventing anemia, consuming iron tablets, and eating iron-rich foods along with vitamin C to enhance iron absorption. Misunderstanding and low levels of knowledge negatively impact maternal behavior, particularly health behaviors and dietary practices during pregnancy, which indirectly increase the risk of stunting [3].

Currently, applications and social media are accessed not only through desktop browsers but also through tablets and smartphones [4] . In addition to serving as communication tools, smartphones offer various features accessible across all social classes—from higher-income to lower-income groups. A survey on smartphone ownership in Indonesia indicated that more than one smartphone is owned by 48.3% of the upper class, 23.1% of the upper-middle class, 9.2% of the middle class, and 3.7% of the lower class [5]. Applications related to stunting and anemia among pregnant women are widely available in the App Store; however, none provide reminders for iron tablet (TTD)

510

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consumption or include an interactive group for consultations on stunting and anemia. Health workers and community cadres typically deliver information on anemia in pregnancy using leaflets and educational modules, and these modules have been proven effective in increasing the knowledge and attitudes of pregnant women [6] .

The consequences of stunting include impaired physical growth, metabolic disorders, impaired brain development, and reduced intelligence. Therefore, stunting is a problem that requires serious attention. Based on a preliminary study conducted on January 7, 2021, at community health centers (Puskesmas) and independent midwifery practices in Tanjungpinang involving 20 respondents, it was found that 100% of respondents owned smartphones with internet access. All respondents had never received information regarding stunting, anemia, or iron supplementation (TTD), and none had a reminder feature for TTD consumption from any application. The purpose of this study is to develop an Android-based application for pregnant women. The application is designed to improve service delivery by providing education and evaluating users' knowledge related to anemia and stunting.

2. RESEARCH METHOD

The research method used in the design of the Si-NaNing application for pregnant women includes a planning stage in which the information to be delivered, the required data, and the software needed to build the application are determined. During this planning stage, data collection was also carried out through literature reviews based on books and related articles, as well as interviews with individuals who possess relevant knowledge about the topic. Once the desired inputs and outputs of the application were identified, the process continued with the application design phase. This phase included designing the application structure, database design, and user interface design, all of which were adjusted to suit the intended users.

The development of this system employed the **Rapid Application Development (RAD)** method, which consists of the following steps [7]:

1. **Requirement Planning**
   Data collection related to problems experienced by pregnant women in detecting anemia and stunting. Observations were conducted through interviews with a pregnant woman in the working area of Batu X Community Health Center (Puskesmas).
2. **Design System**
   In this stage, developers and users collaboratively identify the goals of the system and the required information. Activities carried out include creating system models related to the prevention of anemia and stunting in island areas.
3. **Implementation**
   The final stage involves developing a system that can operate on Android devices, which will be used by two types of users: midwives and pregnant women.
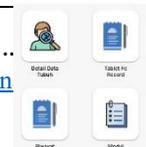
3. RESULTS AND ANALYSIS

Review, followed by problem identification through a Focus Group Discussion (FGD) with midwives working in the Batu X Community Health Center area. Once the problems were identified and a potential solution was formulated, a prototype of the application was designed. This study resulted in the development of an application named Si-NaNing. The application was designed to be utilized by pregnant women to empower themselves by enhancing their knowledge, attitudes, and motivation in preventing anemia and stunting. It provides interactive education and practical guidance on actions that should be taken to reduce the risk of anemia and stunting. The development process involved several stages, including needs analysis, user interface design, implementation, and testing.

During the needs analysis phase, the features identified included body data input, early detection assessments, personal registration records, educational materials on anemia and stunting, reading modules, anemia and stunting screening, and a live group discussion feature. The user interface design focused on ensuring easy access to information and intuitive navigation for users with varying levels of knowledge. The planning, analysis, and design stages preceded the implementation stage. The implementation phase demonstrates the processes used to develop the application flow, along with system analysis and design.

The implementation of the Android-based Si-NaNing application and several visualization examples of the interface are presented in the following table :
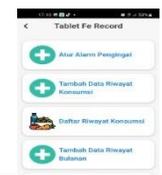
Tabel 1

No	Description	Content	Results
1.	Log in	Login Page Username and Password	

2.	Main menu	On the main feature page there are: Body Details, Food Consumption History, Nutritional Status, Stunting Education, Stunting Risk, Body Mass Index, Educational Videos, Fe Record Tablets, Modules, Notes, Anemia Education, Anemia RiskQiizz and Live Chat	
3.	Detailed body data	On this page, you can fill in the data regarding the name of the pregnant woman, the name of the pregnant woman's husband, height, weight, hemoglobin level and upper arm circumference.	
3	Food Consumption History	On this page you can fill in alarm settings, add data on consumption history, fe tablets and a list of monthly fe tablet consumption history.	
4	Nutritional status	On this page, you can fill in data on hemoglobin levels and upper arm circumference data and can show anemia status and Chronic Energy Deficiency status.	
5	Stunting Education	This page contains stunting education about the definition of stunting, causes of stunting, risk factors for stunting, ways to prevent stunting and the impacts of stunting.	
6.	Risk of Stunting	On this page you can see the risk of stunting based on the available data and can show the stunting risk certificate (at risk or not at risk).	
7.	Body Mass Index	On this page, you can see your Body Mass Index status. You can also update your height and weight data.	

512

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9.	Tablet Fe Record	On this page there is a list of daily and monthly consumption history as well as a certificate of compliance with Fe tablet consumption based on consumption history data.	
11	Anemia Education	This page provides education about anemia, namely the definition of anemia, iron tablets, side effects of iron tablets, iron tablet administration programs and how to prevent anemia.	
12	Risk of Anemia	On this page, you can see the risk of anemia in pregnant women and there is a feature to update hemoglobin data and there is a feature for anemia risk certificates (anemia / no anemia).	
13	Quizz	Quizzes are available about stunting and anemia.	
14	Live Chat	Live chat connected with researchers	
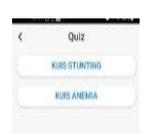
The selection of colors, submenu design, text combinations, and the alignment between colors and background were carefully considered in the design of the Si-NaNing application. The user guide provided in the application is clear and appropriate. In addition, the app's attractive and colorful design increases users' interest—particularly among pregnant women—in reading information related to the prevention of anemia and stunting. To make the content more appealing, each submenu is presented with a distinct design and bright color scheme. According to [8], colors can evoke emotions such as joy, sadness, enthusiasm, or motivation.

The educational materials in this application were obtained from literature reviews, data collection related to eclampsia emergencies, and previous studies. The materials include definitions, causes, impacts, and preventive measures for anemia and stunting. These topics were selected to ensure that pregnant women and their husbands understand that anemia and stunting are influenced by multiple factors and to provide them with the knowledge needed for prevention, along with other relevant information [9]. The login page contains instructions for accessing the application using personal identity data such as an email address, similar to many other applications that require personal data for login purposes [10]. A computer system must meet several security aspects to ensure that data remain protected from unauthorized access, preventing insertion or deletion of data (external manipulation without the knowledge of authorized users). One of these aspects is Confidentiality, which refers to efforts to protect information from those who are not authorized to access it [11].

The main feature page includes: Body Details, Dietary Intake History, Nutritional Status, Stunting Education, Stunting Risk, Body Mass Index, Educational Videos, Iron Tablet Record, Modules, Notes, Anemia Education, Anemia Risk Quiz, and Live Chat. These menus are designed according to the needs of pregnant women related to anemia and stunting prevention [12]–[14]. The stunting and anemia education pages contain various information such as the definition of stunting, its causes, risk factors, prevention methods, and impacts; the definition of anemia; iron

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supplementation; side effects of iron tablets; iron tablet supplementation programs; and anemia prevention strategies. This structure is similar to other applications that provide comprehensive information needed by users for anemia and stunting prevention [15], [16]

The Stunting and Anemia Risk pages display risk levels based on the available data and include digital certificates indicating whether the user is at risk or not. The Anemia Risk page allows users to update their hemoglobin data and also provides anemia risk certificates (anemic or non-anemic). These pages serve to confirm the user's risk status for stunting and anemia and align with the interfaces of other applications, which also require specific data as the basis for determining diagnoses or risk factors [16]–[18]. The Nutritional Status page allows users to input hemoglobin levels and mid-upper arm circumference (MUAC) to determine anemia status and Chronic Energy Deficiency (CED). In general, all nutrients must be increased during pregnancy. However, deficiencies in protein energy and minerals such as iron and calcium are commonly found among pregnant women [17]. Iron deficiency during pregnancy can lead to anemia, which subsequently affects the nutritional status of the infant.

The application also provides daily and monthly dietary intake history and a certificate of compliance with iron tablet consumption based on recorded intake. This feature was included because previous studies show that adherence to iron supplementation significantly influences anemia status in pregnant women [19]. Health information should be delivered creatively and innovatively to prevent user fatigue and ensure that health messages are well received and easily remembered. Health education in the digital era is considered more efficient when delivered online. Digital applications and websites can serve as effective and efficient platforms for improving knowledge among target groups in stunting prevention programs [20]. The Si-NaNing application is expected to serve as an innovative and creative digital tool for pregnant women in preventing anemia and stunting.

4. CONCLUSION

The Si-NaNing application is a maternal health app developed in the form of a prototype that can be operated on Android smartphones. This application helps pregnant women prevent anemia and stunting.

5. ACKNOWLEDGEMENTS

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