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From manual to digital: Transforming hospital nutrition with Nutrihas-Pro application

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ABSTRACT

Background: Hospital malnutrition is a serious issue, often caused by inadequate food intake and underlying diseases. In Makassar, malnutrition in hospitals is 28.1%, higher than provincial and national levels. This can lead to more extended hospital stays, higher costs, and increased risks of complications. To improve care, the Nutrihas-Pro app was developed to help plan patient meals more efficiently. Automatically calculating an individual's energy requirements saves time and reduces errors, leading to better patient outcomes.;

Methods: The study uses an **experimental design with repeated measures** to compare two methods (manual vs. app) in Accuracy in Calculating Total Energy Requirements and Efficiency in Time for Composing Patient Food Composition. The research was conducted over four weeks at Dr. Wahidin Sudirohusodo Hospital, Makassar. A sample of 30 participants (Residents from the Clinical Nutrition Specialist Program) were selected based on **purposive sampling**. In stage 1, each sample was given 2 cases of malnutrition patients to perform according to the manual calculation procedure; 2 weeks later, the same participants performed the same cases by application.

Results: The study revealed a significant difference in time efficiency between the Nutrihas-Pro app and the manual method (89.53 ± 17.52 seconds vs. 297.5 ± 39.08 seconds, **p<0.001**). However, both methods showed similar accuracy in calculating energy requirements, with no statistically significant difference in results (**p=0.096**), demonstrating that the Nutrihas-Pro app is both faster and equally accurate.

Conclusions: The Nutrihas-Pro App reduced the time required for meal planning by more than **60-70%**, making it a valuable tool for clinical nutritionists, especially in time-constrained environments.

KEYWORDS

Food composition, malnutrition, energy requirements, nutritional medical therapy, nutrition software.

INTRODUCTION

Malnutrition in hospitals is a serious health problem, especially in hospitalized patients. This condition is caused by several factors, such as inadequate food intake and increased catabolism due to underlying diseases, such as metabolic infections and malignancies[1]. Based on research in Makassar, the prevalence of malnutrition in hospitals is relatively high, reaching 28.1%, which exceeds the provincial and national averages. This malnutrition condition can affect patients' clinical outcomes, prolong hospitalization, increase treatment costs, and increase the risk of morbidity and mortality[2,3]. Therefore, proper meal planning is critical in ensuring patients' nutritional requirements are met during hospitalization to support recovery and improve health outcomes.

Manually compiling food composition poses significant challenges due to the complex process of relating foods described in compositional datasets to those reported in dietary assessment tools. This task is often time-consuming and relies heavily on individual judgment[4]. Manual extraction of Food Composition Knowledge from the scientific literature is a laborious process involving copying elements one by one to create a Food Composition Table[5]. The classification and description of foods required to link food composition data with consumption data is done manually. This leads to insufficient integration between these data sets and requires substantial time and expertise[6].

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Digitalization in the healthcare sector, including technology-based applications, can help plan and calculate patient meal composition[7]. The Nutrihas-Pro application, developed by the nutrition department of Hasanuddin University's Faculty of Medicine, aims to improve the efficiency of nutritional medical therapy planning for hospitalized patients. The app automatically calculates patients' energy and nutrient requirements based on anthropometric data and clinical conditions, reducing the potential for human error and speeding up the planning process. In addition, studies have shown that using apps saves time composing meal compositions compared to manual methods, which were often time-consuming and prone to errors[4,8]. Implementing this technology is expected to improve the quality of healthcare services and support more effective patient nutrition management[9].

The study concludes that the Nutrihas-Pro application significantly improves the efficiency of calculating patients' energy requirements and composing meal plans compared to the manual method. While both methods produce similar results in terms of accuracy, Nutrihas-Pro drastically reduces the time required for these tasks, making it a valuable tool for clinical nutritionists. This enhanced efficiency, especially in time-sensitive hospital settings, supports using digital solutions like Nutrihas-Pro to optimize medical nutrition therapy and improve patient care outcomes.

MATERIALS AND METHODS

Study design

The study design used in this research is an *Experimental* design with a *Repeated Measures* approach. This design involves testing the same group of participants under different conditions—in this case, comparing the manual method versus the Nutrihas-Pro application for calculating energy requirements and preparing meal plans for hospitalized patients. The repeated measures design allows for direct comparisons between the two methods by having the same respondents perform the task twice, reducing variability due to individual differences.

The study was conducted over four weeks in June 2023 at Dr. Wahidin Sudirohusodo Hospital in Makassar. In the first week (stage 1), each participant was given 2 cases of malnutrition patients and manually calculated the energy requirements and meal compositions of patients. After resting during the second week, they used the Nutrihas-Pro application to perform the same tasks in the third week (stage 2). By measuring performance under both conditions, the researchers could assess differences in accuracy and efficiency between the two methods. The fourth week was dedicated to analyzing the collected data.

Instruments and tools

Several instruments and tools were used to measure the effectiveness of the manual method versus the Nutrihas-Pro application for calculating energy requirements and preparing meal plans. The primary tools included inpatient data from Dr. Wahidin Sudirohusodo Hospital, which provided the clinical information needed for each participant to perform their calculations. This data was used for manual and application-based methods to ensure consistency in the evaluation process.

For the manual calculation phase, the researchers provided participants with calculators and food composition tables, which were essential for manually determining energy requirements and macronutrient breakdowns. Stopwatches tracked each participant's time to complete the tasks, ensuring precise efficiency measurement. The time requirements for each respondent to calculate energy requirements and prepare meal compositions was an important outcome variable in the study.

During the application phase, participants used laptops to access the Nutrihas-Pro web-based application. The app provided an automated platform for calculating energy requirements and planning meal compositions, allowing participants to input patient data and receive results instantly. This setup allowed for direct comparisons between the manual and app-based methods regarding time efficiency and accuracy. Office stationery was also used for note-taking and data logging during the process.Top of Form

Nutrihas-Pro

Nutrihas-Pro is a web-based application designed to assist clinical nutrition specialists in planning nutritional medical therapy for hospitalized patients. The software was developed using hundreds of algorithms to streamline the time-consuming process of calculating food intake, dietary requirements, and therapy planning.

The program is built on robust technical foundations, utilizing HTML, PHP, CSS, and JavaScript, with a client-server architecture based on a MySQL relational database. The software integrates formulas and algorithms to calculate daily energy and fluid requirements, macronutrient and micronutrient needs, and specific nutritional therapies based on the patient's condition. It also features a comprehensive food database, including information on foods available at hospitals, their macronutrient and micronutrient composition, and compatibility with clinical conditions.

In terms of functionality, Nutrihas-Pro offers several modules, including a user interface for easy interaction, a security module for data protection, and a business logic module for implementing nutritional therapy planning. A significant feature is its reporting module, which produces detailed reports on patient data, including anthropometric measurements, laboratory values, and therapy plans.

Participants

The participants in this study were clinical nutrition residents from the Specialist Medical Education Program at

Hasanuddin University, Makassar, Indonesia. A total of 30 respondents were selected through purposive sampling based on specific inclusion and exclusion criteria to ensure they met the study requirements. The study involved two phases, with the respondents testing 60 patient samples. In the first phase, each respondent manually tested two patient samples. After a two-week interval, the same respondents re-evaluated the same patient samples using an application-based method. This comparative approach assesses the application's effectiveness in improving the testing process's accuracy and efficiency.

The inclusion criteria required participants to be at their intermediate or expert level, and they also had to participate in the socialization and training sessions for the Nutrihas-Pro application. Exclusion criteria included residents assigned to the Intensive Care Unit (ICU) or those unable to attend the research activities.

This selection process ensured that the participants had sufficient knowledge of both the manual methods and the newly introduced Nutrihas-Pro application, enabling them to provide meaningful comparisons between the two approaches. The sample consisted of a balanced mix of participant's experience levels, with half categorized as intermediate and half as expert.

During the study, each respondent was required to calculate energy requirements and prepare meal compositions for patients using the manual method and the Nutrihas-Pro app. Their performance was measured in terms of accuracy and the time taken to complete the tasks, with their results providing insights into the effectiveness and efficiency of using the application in clinical settings.

Ethical and approval

Before the study began, we obtained ethical clearance from the Medical Ethics Commission at the Faculty of Medicine, Hasanuddin University, which ensured that research ethics standards conducted the study. With approval number No. 776/UN4-6.4-5.31/PP36/2023, this study was eligible to be carried out by maintaining the confidentiality of respondent data, safety, and comfort of participants.

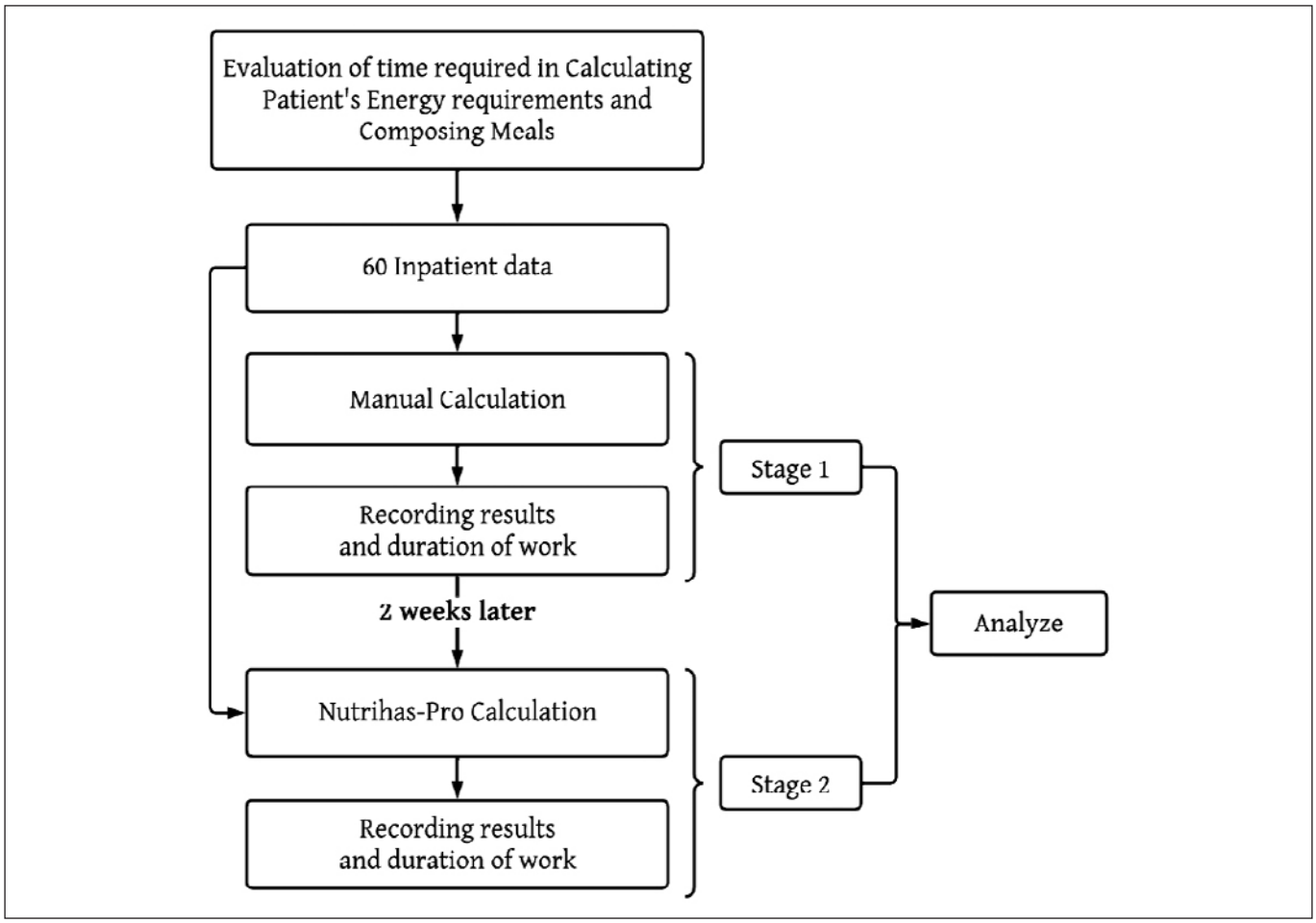

Figure 1. Flowchart of this study

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Macintosh (version 29.0.0.0 (241), IBM Corp, Armonk, NY, USA, 2022). Descriptive statistics are presented as a number, percentage, mean ± standard deviation (SD), or median with corresponding 95% confidence intervals (CI). Differences between groups were analyzed using the advanced *t-test* (parametric), Mann-Whitney U-test (nonparametric), Wilcoxon, and ANOVA tests. Tests with a calculated two-sided *p-value* ≤0.05 were considered significant.

RESULTS

Participant Characteristics

The characteristics of respondents were carefully documented to provide a clear understanding of the sample composition. The research involved 30 participants, primarily female (83%) and aged between 35 and 40 (63.3%). The distribution of respondents was balanced in terms of professional level, with 50% categorized as intermediate and 50% as advanced participants (table 1). These respondent characteristics are integral to this study as they ensure that the sample accurately reflects the intended population, thereby contributing to the reliability and validity of the research outcomes.

This study uses 60 case data of malnutrition patients hospitalized at Wahidin Sudirohusodo Hospital, then randomly selected 2 cases each per participant to test the calculation. The patient cases tested were dominated by men (60%), with SGA score C (severe malnutrition) at 70% and SGA score B (moderate malnutrition) at 30%. The patient's nutritional pathway dominated the oral path (61.7%), but there were also nutritional pathways via combination (16.7%), enteral (15%), and parenteral (6.7%) (table 2).

In the analysis of patients' energy and macronutrient requirements, no significant differences were found between the manual and app methods, with all p values showing results above the recognized threshold (table 3). In contrast,

Table 1. Characteristic of participants

characteristic		n	%
Age	35–40y	19	63.3
	> 40y	11	36.7
Gender	Male	5	16.7
	Female	25	83.3
Level	Intermediate	15	50.0
	advance	15	50.0

Table 2. Characteristics of patients tested

Characteristic		n	%
SGA	B	18	30.0
	C	42	70.0
Age	48 (17-60 y.o)		
Sex	Male	36	60.0
	Female	24	40.0
Nutrient Pathway	Oral	37	61.7
	Enteral	9	15.0
	Parental	4	6.7
	Combination	10	16.7

Table 3. Comparison of Calculation of Energy requirements, Protein requirement, carbohydrates, and fats in manual method calculations and application method calculations

	Manual			Nutrihas-Pro			p
	Mean	SD	Median	Mean	SD	Median	
Energy (kcal)	1764.17	239.90	1800.00	1753.33	227.34	1800.00	0.096
Protein (gram)	63.08	12.85	64.25	63.00	12.83	64.00	0.216
carbohydrate (gram)	219.41	27.28	218.75	218.75	27.95	218.75	0.477
Fat (gram)	69.48	13.2	68.00	69.44	13.20	68.00	0.148

Pair(t) test.

the difference in time taken to compose the patient's diet was significant, with the app drastically speeding up the process (table 4). These findings indicate that while the accuracy in nutrient requirement calculation did not differ between the two methods, the app offered a significant advantage in time efficiency of meal composition.

The results showed no statistically significant difference between the manual method and the app in calculating energy requirements at the Intermediate level, with p values showing consistency across both methods (table 5). However, in the analysis of food composition time, there was a significant difference between the two methods at the Intermediate and Advanced levels, with the app showing higher time efficiency (table 6). These findings indicate that apps can be helpful in simplifying the food composition process, increasing efficiency, and reducing the potential for human error in daily practice.

Table 7 compares meal composition time between manual and app-based methods for various patient nutrition pathways. The analysis showed that each path, including oral, enteral, parenteral, and combined, showed a statistically significant difference in time with a p-value of 0.001. This finding indicates that using apps in the food composition process consistently speeds up the time taken compared to the manual method, highlighting the efficiency of technology in improving patient nutrition services[10].

DISCUSSION

The use of manual calculations and applications each has advantages and disadvantages. Manual calculations offer a deeper understanding of basic concepts, enhance critical thinking skills, and do not require technology, making them flexible for various situations. However, this process is time-consuming, prone to human error, and less efficient for processing large amounts of data. Manual calculations are suitable for deep understanding and situations that do not require speed or automation[11].

Table 4. Comparison of food composition preparation time using the manual method compared to using the App method (in seconds)

	Manual			Nutrihas-Pro			p
	Mean	SD	Median	Mean	SD	Median	
Preparation time (seconds)	297.05	39.08	291.50	89.53	17.52	89.50	<0.001*

Wilcoxon test.

Table 5. Comparison of Energy Requirement Calculation in manual method calculation and application method calculation based on participant level (Kcal unit)

	Manual			Nutrihas-Pro			p
	Mean	SD	Median	Mean	SD	Median	
Intermediate level	1758.33	241.70	1700.00	1766.67	258.20	1700.00	0.262
Advanced level	1616.67	204.12	1650.00	1616.67	204.12	1650.00	0.623

Pair(t) test.

Table 6. Comparison of food composition preparation time using the manual method compared to using the Application method based on participant level (in seconds)

	Manual			Nutrihas-Pro			p
	Mean	SD	Median	Mean	SD	Median	
Intermediate level	327.50	22.31	329.50	97.67	6.41	97.50	<0.001*
Advanced level	270.17	18.24	277.00	93.50	23.70	100.50	<0.001*

Wilcoxon test.

Table 7. Comparison of meal composition time using the manual method compared to using the App method based on the patient's nutritional path (in seconds)

Nutrient Pathway	Manual			Nutrihas-Pro			p
	Mean	SD	Median	Mean	SD	Median	
Oral	291.8	36.1	283	87.1	18.6	87	0.001*
Enteral	311.8	38.6	341	87.7	14.1	89	0.001*
Parenteral	242	31.2	293	70	19.7	108	0.001*
Combination	236	49.8	323	72	15.3	94	0.001*

Pair(t) test.

On the other hand, apps offer high speed, accuracy, and efficiency in processing extensive data, with automation capabilities and visualization of results that make analysis easier. Apps make integration with other systems easier but are technology-dependent, cost money, and potentially face technical risks like bugs. App users may not understand the calculation process deeply because they focus on the result. Apps are more suitable for business and professional needs that require high efficiency and accuracy[12].

This study compares the accuracy and efficiency of manual and application methods in calculating Total Energy Requirements. Based on the study's results, manual calculations using the standard formula and automatic application calculation showed no significant difference in the result (p=0.096). This proves that both methods are valid for energy calculations so that users can choose either method depending on preference or need. However, although the results produced are almost the same, there is a notable difference in time efficiency. Manual calculations take an average of two minutes for a data set, while the app only takes about 10 seconds, providing a huge advantage, especially in scenarios with extensive data or limited time.

In terms of efficiency and practicality, the app is superior. Its fast, practical use and ability to reduce the potential for human error in the calculation process make it a more effective tool, especially for complex data analysis in the field. By speeding up the calculation process and ensuring accuracy on par with manual methods, the app provides a more efficient solution for professionals who need energy analysis in various scenarios. Therefore, it is recommended that this app be adopted as a more efficient and practical alternative to manual methods[13].

This is consistent with using mobile applications as food diaries. This can efficiently reduce the time required to report dietary patterns, with completion durations of no more than three minutes per meal[14]. This efficacy is crucial for users who may feel compelled to maintain a comprehensive food diary using pen and paper, frequently leading to inaccurate or incomplete records[15]. Furthermore, the systematic review conducted by Thornton et al. underscores that smartphone applications optimize the accuracy of dietary pattern assessment by automating the calculation of energy and nutrient intake[16].

This study evaluates the efficacy of manual calculations vs an application in assembling inpatient meal compositions, specifically to meet nutritional requirements, including calories, protein, carbs, and fat. The findings indicated that the application significantly enhanced efficiency, decreasing preparation time by 60-70% while maintaining the precision of nutritional calculations. The application provides seamless customization, enabling dietitians to concentrate more on clinical assessment and patient consultation. Although the manual method remains precise, the application demonstrated enhanced ease and adaptability in response to fluctuating patient health situations. The application is endorsed as an efficient support tool in clinical practice for the expedited and accurate formulation of diet plans, accessible to users with diverse degrees of specialist clinical nutrition[17].

The research demonstrated that the application of the app considerably expedited the preparation of food composition in comparison to the manual method, as shown by both Intermediate and Advanced study participants. The time required by Intermediate participants decreased from an average of 327.50 seconds with the manual method to 97.67 seconds with the app, while Advanced participants decreased from 270.17 seconds to 93.50 seconds. The app's effectiveness was evident in the extremely low p-value (<0.001), demonstrating that it enhanced time efficiency for all participants, irrespective of their proficiency level. These results indicate that app technology can be a highly efficient and beneficial instrument for all users, regardless of their level of independence or proficiency[18,19].

Nutrihas-Pro's ability to compose meals for patients based on nutritional pathways significantly improves efficiency compared to manual methods. With optimized algorithms, the app can calculate nutritional requirements more quickly and accurately, thereby reducing the workload of healthcare workers and enabling a faster response to patient needs. Statistical analysis showed improved efficiency in all nutrition pathways (oral, enteral, parenteral, and combined) with a p-value of 0.001. The integration of this application is expected to improve the quality of health care through accelerated time and accuracy in the preparation of patient nutrition[20].

This study has limitations, including variability of patient data, limitations of the application in handling complex medical conditions, and dependence on the quality of data input. In addition, the study did not include local food variations or special medical diets and faced non-technical challenges such as resistance to technology and limited infrastructure. Although the app is effective in the short term, further research is needed for long-term evaluation and wider applicability.

CONCLUSIONS AND RECOMMENDATIONS

The application's performance in determining patients' energy requirements and dietary composition was more precise and expeditious than the manual approach. While the manual method necessitates using tools such as calculators and food tables, which result in a lengthier processing time, the application utilizes algorithms with lower error rates to automatically process the data. The app's efficacy significantly enhances patient nutrition management, particularly in time-constrained clinical settings.

It is recommended that this application be used as the primary tool in calculating energy requirements and composing patient diets, especially in hospitals or clinics with many patients. However, adequate training for health workers on using the app is essential to avoid data input errors. In addition, although the app is more efficient, it is important to understand the manual method as a basic science foundation in certain cases requiring in-depth analysis or when the app is unavailable.

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