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NUTRANT ANDROID APPLICATION DEVELOPMENT FOR INDIVIDUAL NUTRITIONAL ASSESSMENT: AN ADDIE MODEL APPROACH

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ABSTRACT

To enhance both community and clinical nutrition reporting, it is crucial for nutritionists to stay informed about technological advancements that improve the understanding of nutritional needs and the assessment of individual nutritional status, thereby supporting effective monitoring of dietary intake. This research focuses on the development and evaluation of NutrAnt, an Android-based application designed for individual nutrition assessment. Conducted in Banda Aceh City and Aceh Besar between April and July 2025, the study involved 53 nutritionists and experts selected purposively. The Research and Development (R&D) method was applied using the ADDIE framework (Analysis, Design, Development, Implementation, Evaluation). The app underwent black-box and usability testing, with the analysis carried out through three stages: data reduction, data display, and conclusion drawing. To assess user satisfaction, the Technology Acceptance Model (TAM) was employed. Findings revealed that the app's functionality was highly rated, with satisfaction scores of 85.5% from Health Office nutritionists and 90.0% from the nutritionist team. NutrAnt demonstrated its effectiveness in improving nutritionists' ability to evaluate patients' nutritional needs across both community and clinical settings. In conclusion, the development of NutrAnt confirmed its usability and functionality for personalized nutrition assessment. Featuring four modules, the app offers an efficient tool to support nutritionists in providing accurate nutrition services. Future developments should explore expanding the app's features and adapting it for broader use, marking a significant step forward in advancing digital tools for nutrition assessment and reporting.

Kata Kunci:

Penilaian Gizi;
Aplikasi Mobile;
Promosi Kesehatan;
Catatan Diet;
Nutrisionis

ABSTRAK

Ahli gizi harus mengikuti perkembangan teknologi guna meningkatkan informasi terkait kebutuhan gizi dan penilaian status gizi individu, yang mendukung pelaporan gizi masyarakat dan klinis secara efisien. Hal ini dapat mempermudah penilaian gizi dan pemantauan asupan gizi. Penelitian bertujuan untuk mengembangkan dan mengevaluasi fungsionalitas serta kemudahan penggunaan aplikasi penilaian gizi berbasis Android, NutrAnt, untuk penilaian gizi individu. Penelitian ini menggunakan model Riset dan Pengembangan (R&D) yang dilaksanakan di Kota Banda Aceh dan Aceh Besar pada periode April - Juli 2025. Subjek penelitian melibatkan 53 ahli gizi dan tenaga ahli gizi yang dipilih secara purposif. Metode yang digunakan adalah model ADDIE (Analysis, Design, Development, Implementation, Evaluation). Pengujian aplikasi dilakukan dengan uji blackbox dan uji kegunaan. Hasil penelitian menunjukkan bahwa aplikasi ini memiliki penilaian fungsionalitas yang tinggi, dengan skor kepuasan sebesar 85,5% dari ahli gizi Dinas Kesehatan dan 90,0% dari tim ahli gizi. NutrAnt terbukti menjadi alat yang sangat berguna, yang secara signifikan meningkatkan kemampuan ahli gizi dalam menilai kebutuhan gizi pasien, baik di masyarakat maupun di klinik. Pengembangan selanjutnya sebaiknya mempertimbangkan perluasan fungsionalitas aplikasi dan penyesuaiannya untuk pengguna yang lebih luas. Inovasi ini menawarkan kemajuan praktis dalam alat digital untuk penilaian gizi, dengan dampak yang menjanjikan untuk perbaikan perawatan gizi dan pelaporan yang lebih baik.

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INTRODUCTION

Advancements in the healthcare industry are significantly dependent on efficient health management, which necessitates the provision of timely, precise, and relevant health data customized to meet the requirements of various health programs. The need for health information encompasses a broad spectrum of data from different health sectors, with a particular emphasis on nutritional data and associated fields (Grover et al., 2019; Rahimi et al., 2018). The global objectives for 2030 focus on eradicating all types of malnutrition, with particular attention to achieving the 2025 international benchmarks for reducing

stunting and wasting among children under five years old (Arndt et al., 2024). In Indonesia, there are notable differences in nutritional status among provinces, underscoring persistent nutritional inequalities that demand immediate action. The nation continues to face the dual burden of both overnutrition and malnutrition (Neupane et al., 2024; Rahman, 2024).

The National Medium-Term Development Plan (Indonesian: *Rencana Pembangunan Jangka Menengah Nasional* or RPJMN) for Health 2020–2024 has shifted its focus toward the prevention and control of non-communicable diseases (NCDs) such as obesity and diabetes, replacing the earlier emphasis on child malnutrition targets such as reducing stunting and wasting (Machfutra et al., 2025; Saraswati & Suri, 2023). In Indonesia, the incidence of diabetes has risen markedly over the past decade, establishing it as a major public health concern. Family-based interventions, previously demonstrated to be effective in enhancing child nutrition, are now being reconsidered in the context of adult health, particularly for the prevention of obesity and diabetes. Evidence indicates that family involvement is crucial in facilitating lifestyle changes and improving health outcomes among adults at risk of developing NCDs (Feng et al. 2023; Henes et al. 2025).

The integration of contemporary technology—encompassing mobile health (mHealth) applications, web-based platforms, and telehealth—has gained increasing significance in the early detection, monitoring, and education of individuals at risk for obesity and diabetes (Wang et al., 2020). These digital health tools not only expand access to healthcare services but also promote the adoption of healthier behaviors, even in contexts with limited face-to-face interactions (Kim, 2025). Active family engagement is crucial for effectively monitoring the growth and nutritional status of this vulnerable demographic. Furthermore, the utilization of modern technology, such as web-based applications and smartphones, can enhance the early detection of growth-related issues. Smartphones have become essential tools in promoting health services and facilitating health education (Yang et al., 2019).

The beneficial impact of family involvement in nutritional monitoring is underscored, as engaging families can substantially augment the ability of nutrition professionals to address nutritional challenges. The understanding of precise nutritional requirements and the assessment of nutritional status can be facilitated through applications such as NutrAnt, which aims to mitigate nutritional issues by providing actionable insights for users (Al Rahmad et al., 2024; Liu et al., 2023). Studies have demonstrated that the implementation of Android-based nutritional assessment applications has improved understanding of dietary habits and enhanced nutritional knowledge among diverse populations (Ardiansyah & Avianto, 2024; Conrad et al., 2020; Ocay et al., 2017).

Despite the global proliferation of nutrition applications, existing tools frequently fall short of addressing the unique challenges faced by Indonesian nutritionists. Critical gaps include the lack of integration with the Indonesian Food Composition Table (*Tabel Komposisi Pangan Indonesia*—TKPI) as the standard reference (Kemenkes RI, 2020), limited offline functionality unsuitable for remote areas, and the absence of culturally specific food composition databases. These shortcomings undermine the effectiveness of current manual and digital nutritional assessment methods used in Indonesia. This study addresses these challenges by developing NutrAnt, an Android-based application designed explicitly to align with Indonesia's nutritional context and healthcare system needs (Al Rahmad et al., 2024; Liu et al., 2023).

NutrAnt simplifies individual nutritional assessments by providing tools for accurate data collection, real-time analysis, and reporting tailored to local dietary patterns and requirements. Its intuitive interface allows healthcare workers to use the application without extensive technical training, including in settings with limited internet connectivity. This study focuses on the design and development of the NutrAnt prototype, highlighting objectives such as assessing user needs, interface design, functional development, and prototype testing.

METHOD

Type of Research

This study employed a Research and Development (R&D) design using the ADDIE model approach, which encompasses five stages: Analysis, Design, Development, Implementation, and Evaluation in the development of the NutrAnt application.

Table 1. Summary of ADDIE Phases, Purposes, Activities, and Outputs in the Development of the NutrAnt Application

Phase	Why (Purpose)	What Was Done (Process)	Output/Iteration (Results/Impact)
Analysis	Identify nutritional needs and problems	Literature review, interviews, FGDs, and user needs observation	List of requirements/features, key problems, foundation for app design
Design	Develop solutions based on user needs	Workflow mapping, database structuring, UI/UX wireframing, design validation	System blueprint, mockups, official database structure
Development	Application realization according to design and needs	Coding (Java/Kotlin, Android SDK, SQLite), internal testing, debugging	Functional app prototype, bug/feature documentation
Implementation	Field testing and usability evaluation of the application	Field trials, System Usability Scale (SUS) testing, daily use observation	Usability feedback, error logs, SUS results
Evaluation	Assess effectiveness and improvement	Statistical and thematic analysis, reliability assessment, iterative revisions	Evaluation reports, revision recommendations, system updates, new development cycle

Place and Time of Research

The research was conducted in the working areas of the Health Offices of Banda Aceh City and Aceh Besar District, which served as the testing sites for the application. These areas were selected because recent surveillance reports indicate an increasing prevalence of obesity and changes in eating behavior. For example, Banda Aceh and Aceh Besar districts have experienced a rise in adult obesity from 18% in 2020 to 23% in 2024 (Aceh Provincial Health Profile, 2024). This trend parallels a documented increase in fast-food consumption and the number of fast-food outlets, which doubled between 2020 and 2024. Furthermore, recent surveys show that 47% of adolescents in these regions now consume Western-style fast food at least once weekly, compared to only 21% in 2020. These data highlight the growing challenges of unhealthy dietary patterns and related non-communicable disease risks in both districts. The study was carried out from April to July 2025.

Sample

The study involved 53 nutritionists working in the operational areas of the Banda Aceh City and Aceh Besar District Health Offices. The sample size (n = 53) was determined based on usability testing literature, which suggests that testing with 20–50 users can effectively identify most usability issues and provide reliable feedback for application development (Andersen et al., 2023). Given the specialized nature of the target users, the chosen sample size was deemed sufficient to assess the NutrAnt application's usability and functionality in a real-world context.

Participants were selected through purposive sampling to ensure they met specific criteria relevant to the study objectives. The recruitment process entailed inviting nutritionists employed at the designated health offices who voluntarily agreed to participate in all phases of the study and confirmed their ability to use Android devices. Inclusion criteria: Nutritionists employed at Banda Aceh City or Aceh Besar District Health Office, with a minimum of one year of professional experience, willingness to engage in all study phases, and competence in using Android devices to access the NutrAnt application.

Exclusion criteria: Difficulty or inability to use Android devices, and unwillingness to fully comply with study protocols. This structured selection approach ensured that participants were appropriately skilled and motivated for the usability evaluation, thereby enhancing the reliability of the findings.

Data Collection

Data collection in this study was carried out in several stages following the ADDIE model framework:

1. Literature review. A comprehensive review of the scientific literature was conducted to identify standards for nutritional assessment, requirements of nutrition information systems, and similar applications previously developed. This served as the foundation for designing the features of the NutrAnt application.
2. Interviews and Focus Group Discussions (FGDs). In-depth interviews and FGDs were conducted with nutritionists, dietitians, and health experts to identify user needs, challenges in current nutritional assessment practices, and relevant suggestions for the application.
3. Application evaluation questionnaire. The evaluation of the application's functionality, accuracy, suitability, and reliability was carried out using the System Usability Scale (SUS), a widely recognized international tool for measuring the usability and appropriateness of technology-based applications. The questionnaire was completed by two groups of assessors: nutritionists at primary health centers and district health offices, as well as a panel of nutrition experts.
4. Observation of application use. A limited field trial was conducted to directly observe user experiences in operating the NutrAnt application, including ease of access, operational speed, and accuracy of the output results.

Additionally, the NutrAnt application is available free of charge and can be downloaded via Google Play Store, allowing broader user access and facilitating direct feedback for future developments.

NutrAnt App Development Procedure

The development of the NutrAnt application adhered to the ADDIE model, encompassing five sequential stages: Analysis, Design, Development, Implementation, and Evaluation. During the analysis phase, user needs were identified through interviews and observational studies involving nutrition staff, focusing on nutritional status evaluation, nutrient intake tracking, and overall ease of use. The design phase included crafting system workflows, database architecture, and a user-friendly interface with simple navigation. In the development stage, the application was coded for the Android platform, followed by rigorous internal testing to ensure compliance with design specifications. The implementation phase involved field testing using black-box and usability testing methods with nutritionists as end-users. Finally, the evaluation phase was continuous, involving routine system maintenance, bug fixes, and feature enhancements guided by user feedback. These stages collectively aimed to improve the accuracy and efficiency of individual nutritional assessments through NutrAnt.

Technically, NutrAnt was developed using Android SDK version 33 and programmed primarily in Kotlin, employing SQLite as its local database to enable offline data storage and access. The app's installation package size is approximately 18 MB, designed to operate on Android devices running OS version 8.0 (Oreo) and above, thereby accommodating a wide range of smartphones commonly used by health professionals in Indonesia.

Implementation encompassed field testing using black-box and usability testing involving nutritionists as end-users. The evaluation stage was continuous, with routine system maintenance, bug fixes, and feature updates driven by user feedback. Iterative improvements addressed UI enhancements, offline functionality, data validation, performance optimization, and reporting features, ensuring the app's alignment with practical needs and enhancing its effectiveness for individual nutritional assessments.

Data Analysis, Processing and Ethical Considerations

Data analysis was performed descriptively based on expert reviews and feedback in accordance with R&D procedures. Qualitative analysis involved data reduction, data presentation, and conclusion drawing, whereas quantitative analysis was used to evaluate the application's quality in terms of functional adequacy, performance efficiency, ease of use, and reliability. This study was approved by the Health Research Ethics Committee (HREC) of Poltekkes Kemenkes Aceh in 2024 (approval number: DP.04.03/12.7/157/2024).

RESULT

Subject Characteristics

The research was conducted within the operational areas of the Aceh Besar District and Banda Aceh City Health Offices, encompassing all public health centers (Puskesmas) as the unit of analysis. A total of 53 respondents participated, including nutrition staff at Puskesmas (nutritionists and dietitians), nutrition experts, and representatives from the Health Office.

Table 2. Frequency Distribution of Respondent Characteristics (n=53)

Characteristic	Category	N	%
Age	25–30 years	10	37.5
	31–40 years	32	62.5
	41–50 years	11	20.8
Gender	Male	9	20.8
	Female	44	79.2
Education	Nutritionist Diploma	14	29.2
	Clinical Nutrition Diploma	21	41.7
	Bachelor's Degree in Nutrition/Health	11	20.8
	Master's Degree in Nutrition/Health	7	8.3
Nutrition Training	Yes	41	83.3
	No	12	16.7

Table 2 summarizes the demographic and professional characteristics of the 53 nutritionist respondents. Most participants were female (79.2%) and belonged to the productive age group of 31–40 years (62.5%). A substantial portion held a Clinical Nutrition Diploma (41.7%), and the majority had completed nutrition training (83.3%). These characteristics suggest that the respondents were experienced nutrition professionals actively involved in nutrition service delivery, supporting their competence to critically evaluate the NutrAnt application and provide substantive usability feedback.

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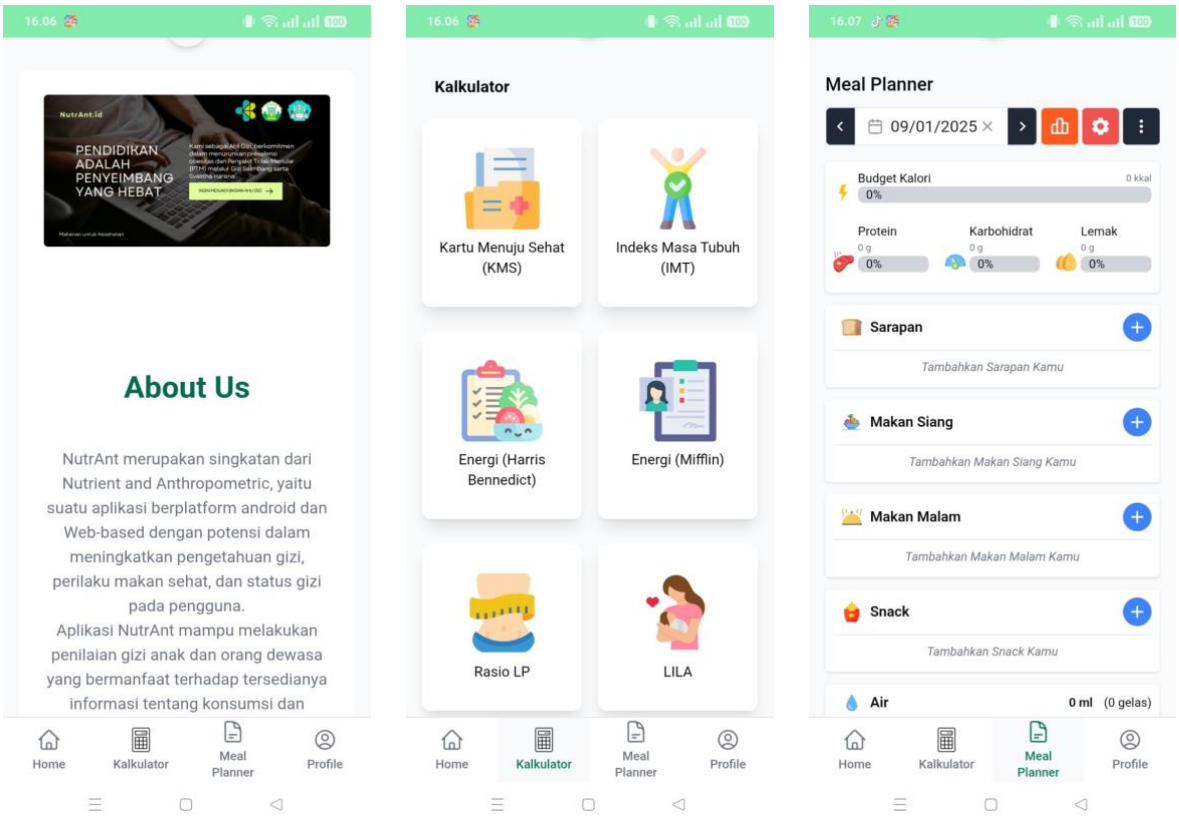
Modules in the NutrAnt Application

The NutrAnt application was developed by the research team conducting this study. Although the application has not yet been registered for patent protection, a patent application is planned for submission in 2026. Details regarding the development team are included in the manuscript to acknowledge their contributions. The NutrAnt application comprises four primary modules, each designed to help nutritionists perform individual nutrition assessments with greater efficiency and precision. The modules are as follows:

1. About Us Module. This section introduces users to the Android-based NutrAnt application, describing its objectives, functionalities, and advantages in evaluating dietary intake and calculating energy and nutrient requirements. This feature aims to enhance users' comprehension, confidence, and acceptance of the new technology.
2. Calculator Module. As the core component of the NutrAnt application, this module offers various calculators, including those for Body Mass Index (BMI), Healthy Menu Card tracking, energy and nutrient needs using the Harris-Benedict and Mifflin equations, and anthropometric measurements. It enables nutritionists to perform calculations quickly and accurately, reducing the risk of manual errors.
3. Meal Planner Module. This module records food and beverage consumption over the past 24 hours, using the *Indonesian Food Composition Table* (*Tabel Komposisi Pangan Indonesia*, TKPI) as the standard reference (Kemenkes RI, 2020). The 24-hour Food Recall method, widely recognized in nutrition research and clinical practice as valid and practical, is used to assess nutrient intake. Through this module, users can automatically calculate their intake of energy, protein, fat, carbohydrates, and essential micronutrients. The data generated provide a quantitative picture of daily intake and form the basis for identifying nutritional imbalances or potential deficiencies. Furthermore, this module serves as a tool for individual diet planning and evaluating the effectiveness of nutritional interventions. By presenting accurate and standardized information, it supports nutritionists in making data-driven, precise, and efficient decisions to improve nutritional status at both individual and group levels.

4. Profile Module. This module stores the subject's personal information, including relevant health history, to support personalized nutritional recommendations. It also facilitates the monitoring of changes in nutritional status over time.

These four modules offer a comprehensive approach to assist nutritionists in providing nutritional guidance for the prevention and management of adult obesity. This strategy includes education, calculation of nutritional needs, monitoring of food intake, and storage of individual data. Consequently, the NutrAnt application provides four main benefits: 1) It improves efficiency and accuracy by minimizing manual errors and accelerating the nutrition assessment process; 2) It offers user-friendly navigation through a clear and informative interface; 3) It enables data integration, supporting long-term monitoring and personalized advice; and 4) It strengthens nutrition initiatives at both individual and community levels.



(a) Menu Home (b) Menu Calculator (c) Menu Meal Planner

Figure 1. NutrAnt Application Display

Quality of the NutrAnt Application

The study's findings revealed that the NutrAnt application has been successfully developed and is now accessible to nutrition professionals. The evaluation of its functional feasibility highlighted some variations among respondents, with nutritionists from health offices and practitioners providing different assessments. Nevertheless, the expert team gave more favorable evaluations, particularly regarding the application's functionality, accuracy, suitability, and reliability. Specifically, the functional feasibility assessment conducted by nutritionists at the health offices and primary health care (PHC) centers received a score of 85.5%, while the expert team gave higher scores across several aspects, averaging 90.0%.

Table 3. Functional Appropriateness Assessment of the NutrAnt Application

Evaluator Group	Assessed Aspects	Suitability Score (%)
Nutrition officers at the health office and community nutrition workers	Functional appropriateness	82.5
Primary health care (PHC) nutritionists	Functional appropriateness	85.5
Nutrition expert team	Functional appropriateness, accuracy, suitability, and reliability	90.0

This study produced the NutrAnt application as an innovative tool with significant potential to enhance nutritional understanding, promote healthy eating behaviors, and assist in monitoring growth among both toddlers and adults in Banda Aceh City and Aceh Besar. Despite minor variations in evaluations among assessment groups, the expert team provided higher appreciation for the application's overall performance and potential impact.

DISCUSSION

Development of the NutrAnt Application

The NutrAnt app incorporates four primary modules designed to assist nutritionists in evaluating individual nutritional needs with increased precision and efficiency. These modules comprise an introductory section, a calculator, a meal planning tool, and a profile feature. Together, they support nutrition and health initiatives at both individual and community levels. The introductory module presents the app, detailing its core objectives and functions for evaluating consumption and calculating energy and nutrient requirements. It also plays a crucial role in building user confidence and promoting the acceptance of emerging technologies. As emphasized by Navidad et al. (2021), early education about the advantages and applications of health technologies substantially increases their adoption and effectiveness. Consequently, this module functions as both an educational resource and a promotional instrument for the application. For instance, the educational component includes interactive tutorials that guide users on conducting precise individual nutritional assessments and interpreting nutritional status results in accordance with established dietary reference standards.

Furthermore, the application promotes its use through notifications and in-app messages that encourage regular self-monitoring of nutrient intake and provide guidance on healthy eating behaviors. These features enhance user engagement while simultaneously reinforcing nutritional knowledge and awareness. The calculator module serves as a central feature of NutrAnt, offering a range of tools for assessing nutritional requirements, such as a Body Mass Index (BMI) calculator, a Healthy Menu Card monitor, energy and nutrient calculations using the Harris-Benedict and Mifflin equations, and anthropometric data. Research indicates that digital tools in nutrition assessments help minimize manual errors and enhance efficiency in task execution (Burgess et al. 2020; Paglialonga et al. 2023). This feature enables nutritionists to conduct assessments with greater speed, accuracy, and relevance for both individual and group evaluations.

The Meal Planner component plays a vital role in tracking and evaluating food and beverage intake over the last 24 hours. It references the Indonesian Food Composition Table (*Tabel Komposisi Pangan Indonesia*—TKPI), ensuring consistency with national guidelines. The 24-hour Food Recall method has been widely recognized as an effective tool for assessing nutritional intake (Thompson et al., 2018). This functionality allows dietitians to accurately determine the consumption of energy, proteins, carbohydrates, fats, and micronutrients, while also supporting the development of personalized daily or weekly meal plans (Carvalho et al., 2021).

The integration of both the Calculator and Meal Planner features represents a key strength of the app. Essential information, such as daily energy needs, body mass index (BMI), and anthropometric data obtained from the Calculator, forms the basis for meal planning in the Meal Planner module. As a result, the evaluation process and dietary planning become more organized and individualized. The final module, Profile, stores users' personal and health information, forming the foundation for providing more customized nutritional advice. Studies have demonstrated that personalized nutritional guidance improves adherence and leads to better long-term health outcomes (Chueh et al., 2024; Sjöblom et al., 2025). This

module also allows users to track nutritional status over time, offering a more comprehensive picture of individual nutritional health.

Compared to other international digital nutrition assessment tools, NutrAnt uniquely addresses local contextual challenges. Specifically, it integrates the TKPI database, supports offline functionality necessary for remote Indonesian regions with limited internet connectivity, and conforms to nutritional standards and dietary habits relevant to the Indonesian population. However, limitations remain, including the need to expand nutritional evaluation parameters, enhance interoperability with other health data systems, and develop cross-platform compatibility beyond Android devices. Practical challenges encountered during design and implementation included user onboarding difficulties due to varying levels of digital literacy among nutritionists and occasional technical issues related to device heterogeneity. Addressing these challenges required iterative user training, interface simplification, and robust offline capabilities to ensure accessibility. These reflections underscore the importance of tailoring digital health tools to user contexts for successful adoption and sustained use.

Benefits of the NutrAnt Application

The NutrAnt application, developed for nutritionists, offers several advantages, including increased efficiency, precision, user-friendliness, data integration, and support for nutrition initiatives. In terms of efficiency, the application reduces manual errors and saves time that would otherwise be spent on traditional calculations and record-keeping. Research suggests that digital tools in nutrition assessments enhance accuracy and expedite the workflow of healthcare professionals (Paglialonga et al., 2023; Ye et al., 2019). Its intuitive interface ensures usability for nutritionists with varying levels of technological expertise (Tan et al., 2020). Another key advantage is data integration, as the Profile module facilitates the storage of individual data that can be easily accessed for long-term monitoring. This integration is essential for generating more accurate and personalized nutrition advice (Middleton et al., 2019).

Furthermore, the application can assist in implementing nutrition programs within health offices or public health centers, particularly in community-based interventions. Recent studies emphasize that digital health applications can enhance the effectiveness of public health initiatives (Salas-Groves et al., 2023; Seid et al., 2024).

Feasibility of the NutrAnt Application

The findings of this study indicate that the NutrAnt application has been successfully developed and is now operational for use by nutrition professionals in Banda Aceh City. The evaluation of its functional feasibility yielded varied results among different evaluator groups. Field nutritionists assigned it an average score of 85.5%, whereas the expert team rated it higher at 90%, particularly regarding functionality, accuracy, suitability, and reliability. These discrepancies may be attributed to differences in understanding and experience among evaluator groups. Expert teams, with their broader academic and technical backgrounds, are more likely to appreciate the application's potential. This observation aligns with the findings of Navidad et al. (2021), who emphasized the importance of early education in improving comprehension and acceptance of new health technologies.

Despite the positive outcomes, the NutrAnt application still presents certain limitations. Its current features are basic—such as calculating nutritional needs and tracking daily consumption—and do not yet incorporate additional health parameters or integration with digital medical devices. Moreover, the application has only undergone black-box and usability testing, which are insufficient to assess performance under varied usage conditions (Fink et al., 2020; Grover et al., 2019). At present, the application is designed exclusively for Android, limiting accessibility for iOS users and thereby restricting broader adoption potential.

Furthermore, the NutrAnt application represents a significant innovation in supporting digital nutrition assessments. However, to enhance its usability and reach, further developments are necessary, such as expanding device compatibility, incorporating additional health parameters, and strengthening field evaluation methods. This study also acknowledges several limitations, including its scope—limited to nutrition personnel in Banda Aceh City—making it difficult to generalize the results to a wider population. Additionally, the functional feasibility assessment relied on respondents' perceptions, which may introduce subjective bias. The study also did not assess the long-term impact of the application on nutritional practices or behavioral changes among users.

CONCLUSION

The NutrAnt application demonstrates notable strengths as a comprehensive tool for nutrition professionals by integrating educational support, precise nutrient calculation, consumption tracking, and personalized data management into a single platform. Collectively, these features enhance both the efficiency and accuracy of nutritional assessments. With continued development focusing on expanding evaluation capabilities, improving data integration, and enhancing cross-platform functionality, NutrAnt holds strong potential to become an essential resource for nutritionists in clinical practice as well as in public health settings.

Future development of the NutrAnt application should emphasize long-term sustainability through the establishment of stable funding mechanisms, active engagement of key stakeholders, and strategic planning for a phased national rollout. Expanding cross-platform compatibility and strengthening maintenance infrastructure will help ensure broader accessibility and sustained system performance. Furthermore, extended trials are essential to evaluate the app's reliability and effectiveness in routine practice. Future research should also examine user behavior changes and assess the impact of NutrAnt on patient health outcomes, thereby providing stronger evidence to support its integration into national nutrition and health programs in Indonesia.

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