# Mobile Application for Preparation of Nutritional and Healthy Food with Locally Available and Affordable Recipes

**Introduction**

Malnutrition refers to a pathological state in which children and adults are suffering from deficiency or excess of one or more nutrients leading to the point where the body can no longer perform proper body functions [1]. In developing countries, the deficiency states are common nutritional problems [2].

Severe acute malnutrition (wasting and/or nutritional edema) is defined globally as a very low weight for length/height (WFL/WFH) below – 3 z-scores of the median WHO growth standards, or less than 70% of the median National Center for Health Statistics standard or the presence of nutritional edema. In children aged 6–59 months, mid-upper arm circumference (MUAC) less than 11.5 cm is also indicative of severe acute malnutrition [10]. The UNICEF report says, one of the main causes of child mortality worldwide can be attributed to under nutrition, and is estimated to cause at least half of all child deaths.[3] According to the UNICEF-WHO-World Bank Joint Child Malnutrition Estimates of 2016, globally for children under 5 years, 155 million and 52 million children were stunted and wasted respectively. Moreover, 17 million children under 5 were severely wasted.[4] in which more than three-fourth of them are from South East Asia and sub-Saharan Africa with nearly half of under-five mortality attributable to malnutrition. [5–8,13] Malnourished survivors are usually left with mental developmental delay, poor school performance and reduced intellectual achievements [ 5, 9]. About 90% of children with disabilities worldwide do not attend school. Children with disabilities are at a 1.7 times greater risk of being subjected to some form of violence.[15] According to Child Rights International Network (CRIN) over 150 million children worldwide have a disability and 90% of the children with disabilities will not survive pass twenty years of age.[16] Optimal nutrition in infancy and early childhood is essential to meet the demands of rapid growth and development. Under-nutrition reduces immunological capacity to defend against diseases, and recurrent infections, in turn reduce and deprive the body from essential nutrients.

Studies show that malnutrition is a significant health problem for infants and young children in Eritrea. Though poverty is the underlining cause of malnutrition, inadequate food security, suboptimal infant caring practice and limited access to water and sanitation services, poor eating practices, lack of awareness on nutrition are also important causes of child malnutrition.

Lack of awareness in nutrition, balanced diet, nutrient content of different food groups, cooking and food preserving methods was mentioned in the local Focal Group Discussions that were conducted in Eritrea, as main factors affecting food and nutrition security. The biggest gaps in feeding practices are maternal, child feeding practices and hygiene.

Educating and mobilization of people to enhance nutrition and raise awareness in target populations is therefore an effective strategy to combat malnutrition. Even though the groceries are available in the market, people don’t know the effective and nutritional food and its preparation. This app is aimed to gap the lack of awareness by providing ways to fortified locally available foods, prepare or cook nutritious food and more as its stated in detailed in project goals and system features.

**Existing Systems**

According to our research on existing mobile applications on the market, we found different dietary applications. The issues we found in the applications were:

* There are rare applications that focus on nutrition for children on the age of 6 months to 5 years, which aim to tackle malnutrition.
* The applications don’t customize the food recipes based on your local groceries or affordability, especially to Eritrea or any other African country.
* They don’t customize the food based on your taste and state of malnutrition.
* The apps don’t have, nutrition status (malnutrition, obese or well nourished) monitoring system.

**Project Mission**

* To guide families to create the best nutritional diet that make a healthy (mentally and physically) and well-nourished children.
* To help every mother in Eritrea to prepare the best nutritional diet as much as possible with an affordable and available groceries.

**Project Goals**

* Help every mother in every location in Eritrea prepare the best nutritional food with affordable groceries available within its local market.
* Tackle malnutrition in the coming decade, in co-operation with other sectors such as ministries of health, agriculture and education and contribute to make well-nourished, strong, mentally and physically healthy youth that will build a healthy and strong nation.
* Improve the nutritional status, health, growth, development and the survival of infants and young children, through optimal feeding practices.

**System Features**

* **Offline database of food recipes**: The application is designed to provide a large offline database of food recipes that are identified to be nutritional and effective for a child growth. It includes the best ways to cook food without losing the content of the food content.
* **Malnutrition Calculator**: This feature helps families to know the health status of a child. It has an indicator that tells whether the child is in a state of well-nourished, malnutrition or overweight. Then based on that calculation, the application will also provide a healthy diet plan.
* **Personalized diet planner**: the application provides a personalized diet based on the age, location, likes, taste, culture and affordability of the person or family. This feature enables families to create a healthy diet plan with its groceries list and how to cook it.
* **Grocery list provider**: since the main goal of the application is to prepare the best nutritional food based on locally available foods, it will provide a grocery list based on what you have in your house-hold or what you can find in the market based on your location.
* **Diet Diary**: Diary is one of the most important features of the application. It registers the food intake and its effects. It helps the family and the developers to understand and monitor the effects of the food and its effects on the child growth. It will be accompanied by an easy-to-use artificial intelligence (AI) -especially computer vision - based journaling feature. This feature will also help the team to analyze and understand the taste, like, and the nutritional effect and can modify or update the recipes and way of cooking.
* **Notifications and reminders**: The application provides a scheduled reminder and notification to ensure proper implementation of individual’s diet plan.
* **Educational information and lessons of nutrition** for kids and families is also included in the application. This will increase the knowledge of families especially mothers about nutrition.
* **Customer support services:** The system will have an online or offline via SMS and call-based support system, where users can ask questions for the support team.

**General System Process Flow**

Our goal is to create an eco-system of diet and nutrition. The general participants in the system are: Users (kids and families), Ministry of Health, Nutritionists and Ministry of Agriculture.

**Users**: Families esp. mothers use the app to get awareness, recipes and way of cooking to feed their children. They will know the malnutrition state of the kid, feed the kid based on recommended food and schedule and monitor his growth status.

**Nutritionists**: will guide users what and when to eat. They will also provide the recipes and way of cooking.

**Health care professionals** help monitor the health status and can configure changes on the users diet and can inform the nutritionists and ministry of agriculture for any changes in recipes or preparation.

**Ministry of Agriculture** or farmers will provide the food to customers as requested. They can also improve nutritional quality of the food.

**Nutrition**



Prepare Recipes, Cooking, Analyze & Update recipes

**Health Care**



Monitor, Analyze & Report

**Agriculture**



Produce and Deliver Food

**Customers**



Learn, Cook, Eat & Observe

**Uniqueness and Advantages of the new system**

* This application is designed to provide recipes for the ages of 6 months to 5 years, which is the critical time for children to build their body and mind, where if they don’t get nutritional food at this time they are vulnerable to different diseases and malnutrition. This target of customers makes it to provide unique and important value to the community.
* The system will be equipped with large offline database of food recipes and way of cooking. The recipes will be affordable, locally available and nutritional. This makes it to be applicable for any user in any part of the country.
* The system is designed by group of people with different expertise. The system is designed by medical experts, computer programmers, food technology experts, data analysts, nutrition experts, AI and computer vision experts …etc.
* The application, has a great feature of provision of recipes out of one sample available at hand for cooking.
* The new application will be developed in Java and Flutter (new programming language that uses DART) programming languages, where the application will work in multiple platforms such as Android, IOS …etc.
* The system will create a food and nutrition community platform that integrates the community at its center and different ministries (Agriculture, Health, Nutrition, Education) with its pillars.

**Validity of the project**

The project will have a lean approach. Before our initial release, the team will make a pilot test for 6 to 12 months to check the nutrition effects (impact on growth), taste, practicality and acceptability. Based on that finding, the food recipes database will be updated and create its initial beta release.

**Expected outcomes**

* Improved food and nutrition attitudes, skills and feeding practices.
* To improve the nutritional status, health, growth and development and the survival of infants and young children, through optimal feeding practices.
* Improvement in dietary diversity rich in macronutrients and micronutrients in children.

**Research Team:**

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| Roles | Team |
| System design and development | Eng. Simon Okbagergis Manna, BSc. Computer Engineering |
| Idetification of nutritional value of local foods and recipe preparartion | Eden Tareke, PhD, Nutrition |
| Nahom Daniel, MD. |
| Salina Nigusse, BSc, Food Technology |
| Tsinat Berhane |
| Implementation Research | Mulugeta Russom, MSc., PhD Candidate, Pharmacoepidemiology and Pharmacovigilance |
| Nahom Daniel, MD. |

**Nutrition App Development Phases**

**Phase 1: Data Collection**

In the first phase of development, our team will conduct data collection in terms of zonal and local distribution of food and eating practices. This will involve active participation of the Ministry of Agriculture, Ministry of Marine Resources and National Women’s Association.

**Phase 2: Food Fortification and System Design**

In this phase, the existing eating habits and practices will be evaluated. Then, the best diet preparation and practices will be prepared. It will fortify the nutrition needed and recipes with active involvement of nutritionists and food technology experts. The Ministry of Health will finally assess validate the nutritional value and clinical feasibility of the system.

**Phase 3: Pilot App Trial**

Prior to official deployment, the impact of the Application will be tested using a blinded randomized controlled trial that will be conducted in different parts of the country. Exposed and unexposed children to the App will be enrolled (following baseline assessment) and strictly followed up for at least six months. All required information helpful for monitoring growth and clinical impact will be collected. The trial will also assess the feasibility, acceptability and challenges of the system.

**Phase 4: Mass App Distribution and implementation research**

At this stage, the system and recipes will be updated with the understanding gained in phase 3. This distribution will be made by the Ministry of Health and key partners. Media campaign will be conducted by the MoH and Ministry of Information. To assess the utilization, acceptability, feasibility and barriers to utilization, implementation research will be conducted by the research team and results will be disseminated to key stakeholders. Accordingly, the system will be continuously improved.

**Phase 5: Customer Usage and System Customization**

After the initial public release, the application has a dietary diary that registers daily intake and its effects on growth, nutrition, taste, likes …etc. The team will regularly, gather data about the customers. The Data Analysts and Machine learning engineers in the team will analyse the feedback on the usage and effects of the recipes. The main tools the team will use are: AI, machine learning and data science. Then, they will notify the nutrition, food technology and medical experts to update and improve the recipes and the ways of food preparation.

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