Mobile Application to Track Nutritional Intake- a Smart Step towards Nutritional Security through m-Health

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Abstract—*Millions of people in India are affected by malnutrition. Overweight, obesity, hypertension and diabetes are widely prevalent in the population. At the same time, people are suffering from micronutrient deficiencies. This dual burden of malnutrition poses serious health risks. There are many means of nutritional education. However, in today's fast paced technology driven world, it becomes imperative that we make use of the technology to educate people about their nutritional requirements. Thus, we have developed a mobile application called 'Health Buddy' which tracks nutritional intake of the users. In the first phase, the app was developed in which a large number of cooked foods and their Energy, protein, fat, fibre, iron, calcium, sodium and potassium contents were enlisted. Also, calorie distribution of a meal is shown in form of a calorie plate. 'Traffic light' approach is used in which green, amber and red colours indicate the adequacy of the diet with reference to recommended daily allowances (RDA). In the second phase, fifty female college students were selected and their dietary intake and nutritional awareness were surveyed through questionnaire followed by installation of the app in their phones. They were assessed again after a month. Results showed small but significant improvement in their nutritional intake vis a vis increased fruit intake, amount of exercise and overall nutritional awareness. Thus this app can help people do a quick check of their nutrient intake on day to day basis. It stands apart because it calculates iron, calcium, fibre, sodium and potassium intake whereas other similar apps only indicate daily calorie intake of the user. The app can be further improved to include daily health updates, pedometer to track exercise in real time, suggestions in terms of calorie intake to reduce or gain weight.*

1. INTRODUCTION

Nutritional security is a major aspect that, if addressed it can result in a strong and functional population. Nutritional deficiencies cause weakness, stunted growth, various disorders and also death when prolonged. Such statistics reflects the global image of the country, as nutrition deficiency leads to less productivity, more illness and lower rate of development of the nation as a whole. Hence a healthy and stable population is not only desired but also vital to attain a certain amount of progress. This important issue needs immediate attention as soon it will be considered as a major cause of concern. The current lifestyle of the youth promotes insufficient nutrient intake thereby easily making way for nutritional problems to set in. For around 20% of the planet's population, lack of food and malnutrition are the main impediments to healthy eating [1]. Hence promoting healthy eating habits is a good way to start battling this problem. Nutritional recovery, particularly takes time, hence a step taken now can save our future.

2. M-HEALTH

In today's world, globalization and mobile technology have played a pivotal role in shaping our lifestyle. It provides worldwide communication, and has led to a highly interactive society. It provides a great source of information sharing, as newer studies and findings can be shared with a large crowd. In spite of various benefits technology provides us; one can't ignore the adverse effects it has had on our lifestyles. Working for long hours at one place, eating high fat and high sugar processed foods, spending most of our time watching movies, playing video games and on social sites has given rise to various health issues which includes obesity, diabetes, high blood pressure, cancer, stress etc.

Additionally, people hardly get the time to think about their health or visiting a dietician or a nutritionist for planning diet charts and tracking their nutritional intake. Mobile technology which is accessible to a large population can be used to enhance nutritional awareness by tracking and self assessing their daily meal intake and exercise.

3. MALNUTRITION IN INDIA

Today, the world's population is facing a superfluous burden of nutritional crisis that includes under nutrition, overweight and micro-nutritional deficiency, especially in the developing countries. With the rising tech savvy population it is becoming convenient for us to enable the users to maintain, not only their meal intake but more specifically nutrient intake and this android application, Health Buddy targets to strive against such global nutritional challenges. Some of them include:

3.1. Obesity

Obesity continues to increase at an alarming rate globally affecting men, women and children alike. Today it is estimated that there are **more than 300 million** obese people worldwide [6]. WHO considers BMI 23 or more for Indian population is associated with an **increased risk of Diabetes mellitus and cardiovascular diseases**. Also, according to WHO, waist to hip ratio of more than 0.85 in women and 0.9 in men indicates increased risk of diseases because of the pattern of **fat distribution.**

The National Family Health Survey-3 (NFHS-3) reported that in India, obesity (BMI ≥ 25) was more prevalent in the urban areas and in higher socioeconomic groups compared to the rural areas, especially among women (men- urban: 15.9 vs. rural: 5.6%; Women). In the three states studied, the percentage of women who were obese (BMI≥ 25) was highest in Tamil Nadu (24.4%), followed by Maharashtra (18.1%) and Jharkhand (5.9%) and a similar order was reported among men in the three states with 19.8, 15.9 and 5.3 per cent being obese respectively [3].

3.2. Under nutrition

It is one of the world's most serious, but least addressed problems, yet it is almost **entirely preventable**. In Uttar Pradesh, India's densest state by population most children under the age of 5 are stunted due to under nutrition. A National Family Health Survey reveals that 23% of children in Tamil Nadu are underweight, while 25% of Chennai children show moderately stunted growth. Madhya Pradesh has India's highest number of undernourished children - 74.1% of them under 6 suffer from anaemia, and 60% have to deal with under nutrition. At 56.5%, Jharkhand has India's second highest number of undernourished children, followed by Bihar, at 55.9%. [4]

3.3. Hidden Hunger

Also known as **micronutrient deficiencies,** Hidden hunger afflict **more than 2 billion individuals**, or one in three people, globally (FAO 2013). Even if an individual is feeling full, lack of proper nutrients can result in hidden hunger therefore **poor diet** is a common source of hidden hunger [5]. Its effects can be devastating, leading to mental impairment, poor health, low productivity, and even death.

3.3.1. Iron Deficiency: Iron deficiency anaemia (IDA) is the most common micronutrient disorder in the world. IDA is currently estimated to affect more than **500 million people**, also touching about 43 percent of women of reproducible age in less developed countries [6]. The overall iron requirements increase from a preadolescent level of approximately 0.7-0.9 mg Fe/d to as much as 2.2 mg Fe/d (NCBI) or perhaps more in heavily menstruating young women [7].

3.3.2. Calcium Deficiency: It is one of the incredibly common deficiencies in the world. Sufficient calcium is needed for bones to grow to a **maximum density by age 20-30** and maintain their density as one gets older. Serious bone diseases, **osteoporosis and osteomalacia**, can result from insufficient calcium intake throughout the lifetime [8]. During Pregnancy, mother requires sufficient calcium reserves for foetal skeletal development; this necessitates the intake of calcium rich diet during adolescence in order to prevent such bone disorders [9].

3.4. Fibre Deficiency

Approximately **97% of population is fibre deficient** worldwide. Adequate dietary fibre is essential for GI health and reduction of a number of chronic diseases including heart disease, certain cancers and diabetes [11]. Importance of fibre in diet can be well interpreted by **the increase in the RDA** from 35 g/day (earlier) to 40 g/day by ICMR.

3.5. Excess Sodium Intake

In most people, the kidney problems are increasing with the excess sodium in the bloodstream. **Shifting trend towards processed food** tends to increase our sodium levels in the bloodstream unknowingly. As sodium accumulates, the body holds onto water to dilute the sodium increasing the volume of blood in the bloodstream leading to **high blood pressure, heart attack, and stroke**. It can also lead to heart failure [10].

4. HEALTH BUDDY

Health Buddy is an android-based mobile application, which aims at tracking nutritional intake of young college students. It provides the users a friendly, easy and a customized interface to keep track of their daily nutritional intake.

It equips the user with an easy to use mobile application to manage one's health on a daily basis in an interactive manner. Application presents graphical representations of overall nutrient intake via meal, this feature enable the users to keep an account of their meal intake. It also takes into consideration dietary fiber, iron, sodium and potassium, which other similar applications do not, thus becoming a unique feature of our application. All these nutrients have found great importance nowadays due to increasing health concerns. Users can select their meal from the menu that is provided by the app as the first step to calculate the nutritional value of their diet (see figure 1). There is also a provision of reviewing and editing the selected food list in case of any item selected by

mistake (see figure 2). This app will track the calorie intake of user and display in the form of calorie plate along with ideal **calorie plate** (see figure 3) hence permitting the users to establish a fair comparison of their intake with the ideal one.
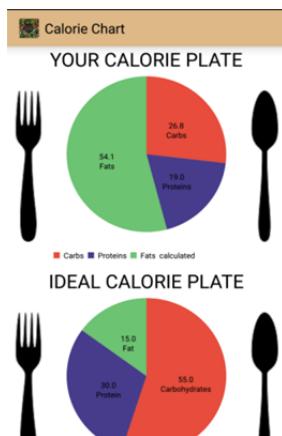
Figure 1

Figure 2

Figure 3

Figure 4

Along with the statistical representation of the result red, amber and green marks are shown according to their severity in nutritional aspect & as per daily intake of particular nutrient in accordance with the RDA, this feature is named as '**Traffic Light Approach'** which enables the representation of results in a more striking manner (**see fig 4)**. 'Red' represents too high or too low, 'yellow' depicts moderate consumption and 'green' shows adequate and healthy status of intake. Additionally, food facts and myths are also displayed to make people aware and breaking the stereotypical opinions about certain foods covering how it is beneficial and the health remedies associated with some foods. It also provides tips for gaining or losing weight via good and healthy eating habits and exercise.

5. METHODOLOGY

In the first phase, a manual as well as online survey using Google forms was conducted to tap the nutritional habits of target population and get the required data. Nutritional information of various food items was collected and tabulated so that it can be coded in the android application. With the aid of all supplementary information a user friendly android application was developed.

In the second phase, fifty female college students were selected and their dietary intake and nutritional awareness were surveyed through questionnaire followed by installation of the app in their mobile phones. The effectiveness of application was projected by conducting a post survey and then comparing results to that of pre survey. Results showed small but significant improvement in their nutritional intake vis a vis increased fruit intake, amount of exercise and overall nutritional awareness. Thus, this application enabled the users to keep a check on their nutrient intake daily basis.

6. INTERPRETATION

In order to analyze the effectiveness of this application, a pre-survey (before the use of app) and post survey (after the use of app) was conducted for the sample population and conclusion were determined statistically. Total number of students surveyed was 50. Significant changes were observed after the use of app in sample population.
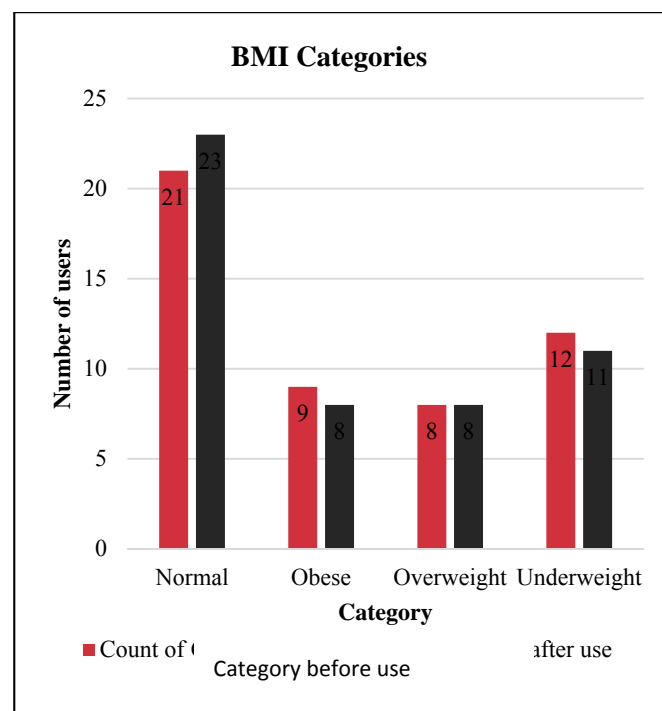
Figure 5- The classification of Body Mass Index of users in kg/m³

- Height and weight of sample population was recorded in both pre-survey and post-survey and it is observed that the application did make commendable (though small) success in increasing the number of students with 'Normal' BMI by 2% (see figure. 5). This shows that

continuous use of the application can indeed improve the BMI (and thus the overall health) of a student.

- Also, a significant number of students exercise daily more frequently now. 72% of the population tried and changed their eating habits after using app. 54% of the population incorporated exercise in their schedule after using app.

- A whopping 33.3% increase in the weekly consumption of fruits was witnessed after the use of Health Buddy (see figure 6). Further, it was satisfying to note that the number of students who included fruits in their breakfast increased by nearly 7%.

- The study assessed how many times a week, students miss or take their breakfast and what they generally have for this meal. Survey shows (see figure 7) that after using the application, the number of students who improved the number of days they had **breakfast, increased drastically (4.5%).**

- Participants were asked to rate their physical activity before and after using the mobile application. In the post app-deployment survey they were also asked how frequently they exercise per week. The results collected suggest that **40% of the total students increased the amount of time they exercised** and for 44% of them the time remained a constant before and after the use of the app

- The application has majorly succeeded in making students realize the significance of Calcium, Iron, and Fibre. As a result, **73% of sample population increased their consumption** (see figure 8).

- Also, survey shows that **32% students reduced their intake of carbonated and caffeinated** drinks like coffee and cold-drinks (see figure 9). Even with a very small period of use HEALTH BUDDY has shown positive effect on users eating habits. It can be easily predicted that long term of this app would have commendable effects of the users' health.

- 76% of population found our app easy to use.

In addition, in our busy lives, we hardly get the time to think about our health or visiting a dietician or a nutritionist for planning diet charts and tracking our nutritional intake. Hence, health buddy can be seen as a perfect solution to this problem as it provides an easy way to track our nutrient consumption on a daily basis with a just a few clicks on our smart phones.
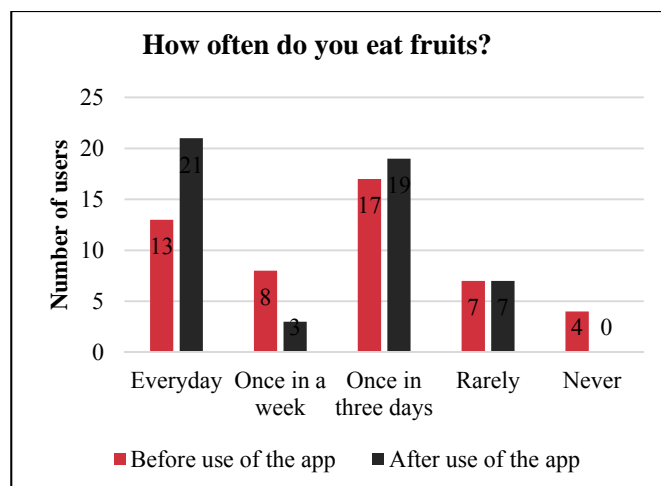

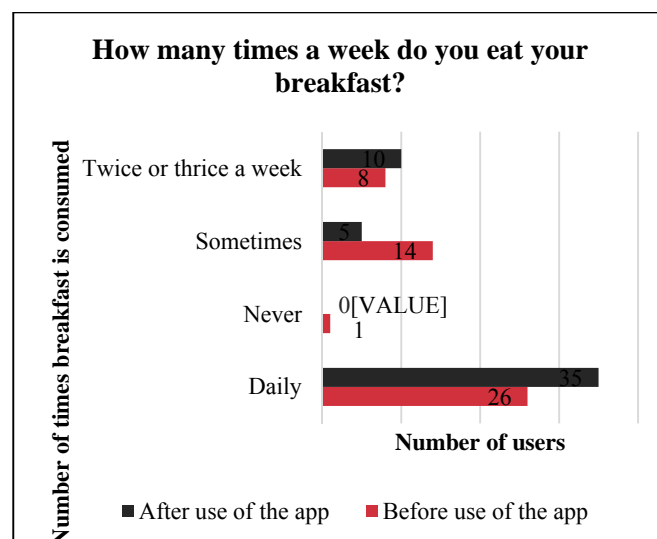**Figure 6: Pattern of fruit consumption by the users of Health Buddy**

Figure 7- Pattern of breakfast consumption by the users of Health Buddy
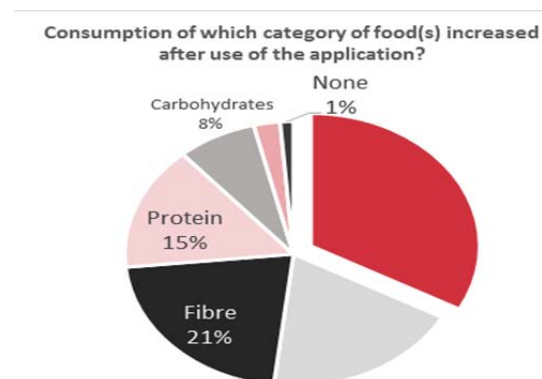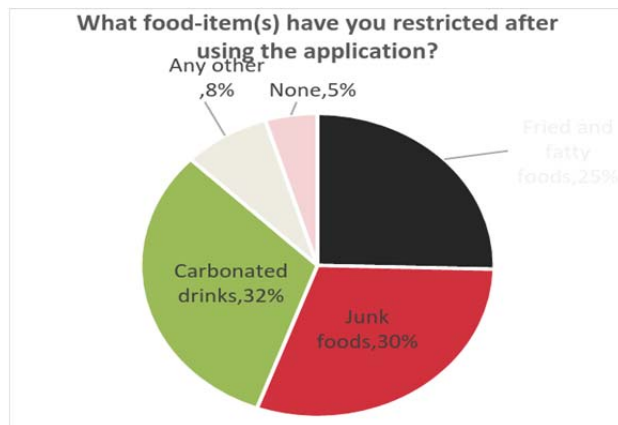

Figure 8- Increase in the consumption of different categories of foods by the users

Figure 9: Improvement in dietary choices of the users after the use of app

7.   FUTURE GOALS/ASPECTS

Health buddy can bring about a needful and positive change in the aspects of health and nutrition. With increasing use of smart phones and technology, it can successfully combat health related issues. The app currently focuses on young college going students. However, it can be expanded further by targeting different age groups. As in the corporate world, people don't have enough time to focus on their health; "Health Buddy" can be a successful means of tackling this issue. Also, with emerging technology, app can include various short exercise videos which will be helpful in knowing how exactly exercises have to be performed and how effective will it be in improving their health and leading a healthy lifestyle.

Apart from it, app can have 'Ask the Doc' segment, where the user can enter his/her query from his user profile regarding health which will be answered by the consultant.

Future prospects of the app can be made even brighter by adding pedometer and notification feature for health updates.

Thus, Health Buddy can be a revolution in this field and can successfully change the growing concern of health issues and ignorance of health.

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