

Smart Way to Control Obesity using Telemedicine Method

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Abstract: Obesity demonstrates a weight more noteworthy than what is viewed as solid. It is an unending condition characterized by an abundance measure of muscle versus fat. Obesity is best characterized by utilizing the BMI. It is ascertained utilizing a man's tallness and weight. The Body Mass Index (BMI) breaks even with a man's weight in (kg) partitioned by their stature in m². A grown-up who has a BMI of 25-29.9 is viewed as overweight and a grown-up who has a BMI more than 30 is viewed as stout. A BMI of 18.5-24.9 is viewed as typical weight. This project uses behavioral treatment to induce a healthy eating/working habit which is an umbrella term for kinds of treatment that treat wellbeing issue. This type of treatment looks to distinguish and help change possibly pointless or undesirable practices prompting physical issues. It works on the possibility that all practices are found out and that undesirable practices can be changed. This project deals with taking real-time structural data relating to obesity from a patient, identifying his obesity and suggesting proper behavior patterns for him to counter the problem and make him healthy again. It consists of the following steps: obesity detection, quantification of severity and suggestion of behavior.

Key words: Obesity, telemedicine, Mifflin St. Jeor equation, smart band, possibly pointless, consists

INTRODUCTION

Obesity is a therapeutic illness in which overabundance muscle versus fat has collected to the degree that it might negatively affect wellbeing. It implies having excessively muscle versus fat. It is unique in relation to being overweight which implies weighing excessively. The weight may originate from muscle, bone, fat or potentially body water. The two terms imply that a man's weight is more noteworthy than what's viewed as solid for his or her stature. Weight occurs after some time when you eat a bigger number of calories than you utilize. The harmony between calories-in and calories-out varies for every individual. Components that may influence your weight incorporate your hereditary indulging eating high-fat nourishments and not being physically dynamic. Obesity builds your danger of diabetes, coronary illness, stroke, joint pain and a few tumors. In the event that you have stoutness, losing even 5-10% of your weight can defer these sicknesses (Harous *et al.*, 2017). Obesity is generally caused by a blend of intemperate sustenance admission, absence of physical movements or and hereditary powerlessness. A couple of cases are caused fundamentally by qualities, endocrine issue, prescriptions or psychological issue. Obesity is

for the most part avoidable through a blend of communal variations and individual decisions. Variations to eating routine and practicing are the principle medicines. Eating routine quality can be enhanced by decreasing the utilization of vitality thick nourishments, for example, those great in fat or sugars and by expanding the admission of nutritional fiber. Here, we have focused on avoiding obesity by using rigorous monitoring of lifestyle of a patient, tracking his food intake and recommending the same along with different exercises.

MATERIALS AND METHODS

Collecting pre-requisite data: Food database consisting of final stage (already cooked) food items (basically dishes) is taken from Kasturba Medical College (KMC) Manipal. The database contains food items their serving size their serving number and their calorie content. The food items are indigenous to India mainly as this application focuses mainly on India. The data acquired is splitted and further classified into vegetarian or non-vegetarian keeping in mind that India has the highest population of vegetarian people in the country (around 30%).



Fig. 1: Fitbit activity tracker

Food items are further classified whether they are likely to be eaten as breakfast, lunch or dinner. There might be items that are eaten multiple times during a day (for e.g., roti is eaten as breakfast, lunch or dinner). For that the data item is replicated in the table and again enlisted as falling in another category (Maranhao *et al.*, 2017).

Localised data acquisition: For calculating obesity, we are using BMI as a factor only. So, we need the weight and height of a person and the application provides for the same. When the user enters weight and height, it calculates the BMI and stores it in a table along with the date of that day (Fig. 1). For tracking the physical activities such as the distance travelled, calories burned, etc., we use the fitbit fitness smart band which allows users to download data for free use from its website. Using the motion patterns and its gyrometer and accelerometer, it calculates the distance travelled, the sedentary activities, sleep, etc. and finally, calculates the aggregate calories lost by a person during the whole day which is the only data that we need.

Transmission of data to localized server: Fitbit allows its users to download data from its website but unfortunately it does not allow third party applications to take its data. So, we have to manually download the data in excel format (.xls) and import it to our SQL database.

Suggestion of calories

Finding number of calories to be suggested: Weight increase/decrease in a person works on a simple fundamental. If number of calories consumed per day is more than the number of calories lost you gain weight eventually. Similarly, you lose weight eventually in the opposite case. So, after identifying the obesity of a person, if a person is overweight we suggest him to burn more calories than he eats in a single day and also

suggesting him to intake less calories than before per day. To calculate the calories expended per day by the person we can refer to the database but we use the Mifflin St. Jeor equation to determine the suggested calorie because of its acceptance and accuracy.

According to the Mifflin St. Jeor equation: For men:

$$\text{BMR} = 10 \times \text{weight}(\text{kg}) + 6.25 \times \text{height}(\text{cm}) - 5 \times \text{age}(\text{y}) + 5$$

For women: (1)

$$\text{BMR} = 10 \times \text{weight}(\text{kg}) + 6.25 \times \text{height}(\text{cm}) - 5 \times \text{age}(\text{y}) - 161$$

(2)

The value obtained from this equation is the estimated number of calories a person can consume in a day to maintain their body-weight assuming they remain at rest. Since, it is highly unlikely that a person stays at rest for the entire time of the day, this value is multiplied by an activity factor (generally 1.2-1.95) dependent on a person's typical levels of exercise in order to obtain a more realistic value for maintaining body-weight. Based on different activities, the multiplication factor can be assigned appropriately. This multiplication factor is determined by the calories burned by an individual. This data is taken from the activities table of the database. It is a known fact that being sedentary all day, one loses 1715 calories. The flowchart for determining the multiplication factor in Fig. 2.

Now that we know how much calories a person needs to maintain weight everyday we need to add or subtract to that amount in order to compensate for the overweightness or underweightness of the person Butgereit and Martinus (2016). But age of the person must also be taken care of as recommending lesser calories to an old person overweight person may result in less amount of blood glucose level further leading to other problems like weakness, fatigue, etc. So, based on the opinions of many experts, it was decided that 500 sec would be the value to be added or subtracted based on the patient. But if the person (under 45 years) was severely overweight, it was decided that he/she needs to cut down 700 sec/day from his/her BMR value to be healthy. The flowchart represents the algorithm for the recommendation of the person (Fig. 3). Note that for age >45 and BMI >30, BMR-500 sec are to be recommended. The value of 500 sec was also chosen because adding or subtracting this value leads a gain or loss of 1 pound weight of a person, respectively. This value was calculated and is based on a general study.

Suggestion of diet: After finding the number of calories required per day it is required to distribute it among three meals, breakfast, lunch and dinner. The required is

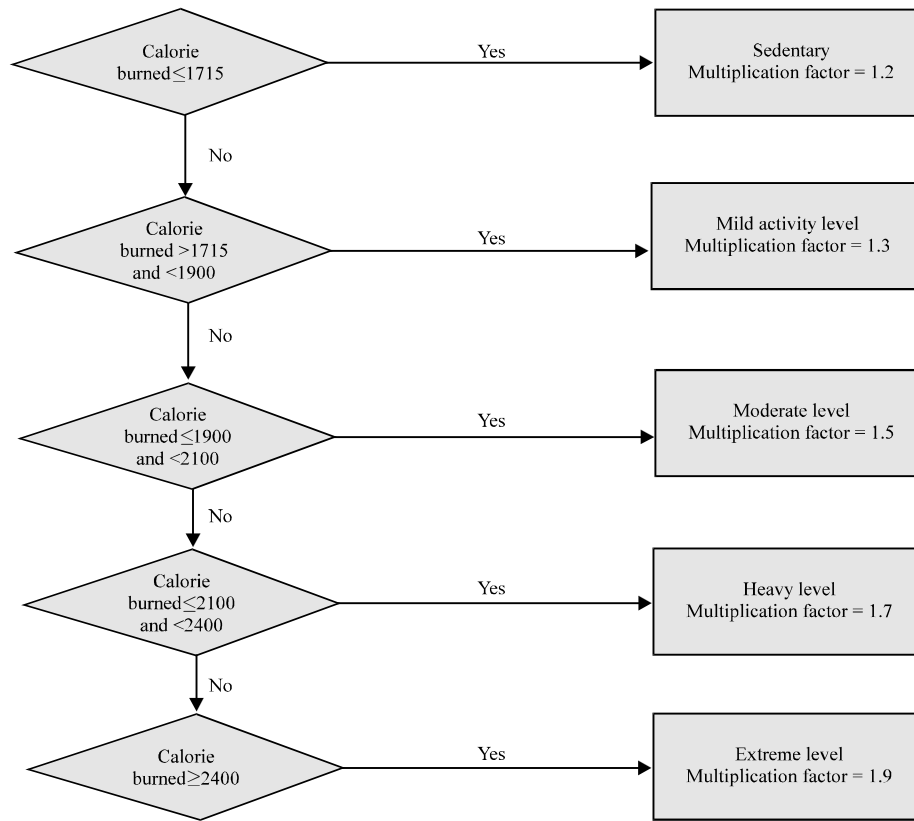


Fig. 2: Flowchart for multiplication factor

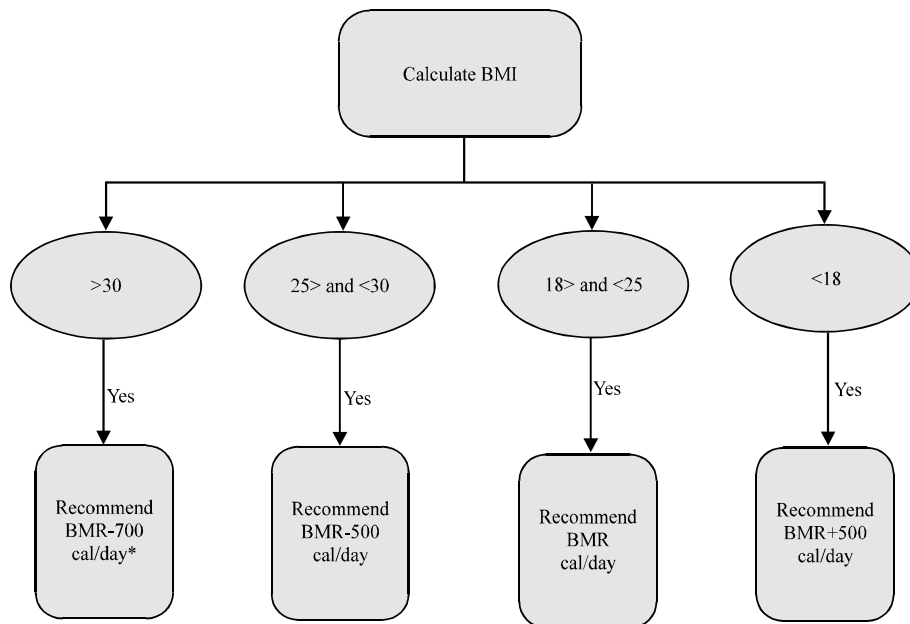


Fig. 3: Flowchart for recommendation (*Does not apply if age >45)

divided by three as equal importance is should be given to breakfast, lunch and dinner according to dieticians.

Now, we need to consider the number of food items to be recommended per meal. For now, it has been considered

that about 2-3 items be recommended in breakfast, atmost 4 items be recommended for lunch and again atmost 4 items be recommended for dinner. As mentioned earlier we have divided our food database table into different columns like items, calories, serving size, serving unit and time of consumption (Mifflin *et al.*, 1990; Breen and Matusitz, 2010). Depending on the time of the meal we have specific pool of items that go together. Like Idly and Sambhar go together pretty well. Hence, the required grouping of set of items is done and several different combinations are created. The algorithm that subsequently follows is:

- Suppose, we are recommending only two items for breakfast and the required s is K
- Now, let us assume x to be the/serving size of a food item to be recommended
- Let y be the/serving size of another food item to be recommended
- Let A and B be the weights of x and y, respectively, so that:

$$A*x+B*y = K \tag{3}$$

We have x and y available as the serving size of the two items. So, we need to find A and B, so that, Eq. 3 is closest to K. Bounds and limits should also be added to the range of A and B, so that, absurd values like 1 Idly and 2 Katoris of Sambhar don't get recommended (Acharibasam and Wynn, 2018).

We select a lower limit or minimum value and also a higher limit or maximum value of A or B depending on the food item and also select the step size or increment value of A and B (as 0.25 chapatis wouldn't make a lot of sense). We then take the minimum value of A and B and iterate through the nested loop with the selected step of incrementing for each item and calculate the expression:

$$A*x+B*y \tag{4}$$

Next, we need to find that out of all these steps which value of Eq. 4 is nearest to K or in other words which value of Eq. 4 has the least difference from K, thereby we find the least error from the required value. Hence, we need to find:

$$\text{Min}(|K-(A*x+B*y)|) \tag{5}$$

We note that the inner loops can have higher No. of iterations than the outer loops, so, we need to set the ranges and the step of incrementing accordingly. For meals containing 3 items we follow the same procedure and modify Eq. 6 as:

$$A*x+B*y+C*z = K \tag{6}$$

Here, z and C are serving size and its weight respectively. Similarly, for meals containing n items, the generic Eq. 7 becomes:

$$A1*a1+A2*a2+A3*a3+, \dots, + AN*aN = K \tag{7}$$

Where:

AN = Serving unit of Nth item

AN = Weight of the Nth item

Suggestion of exercise: From the data acquired by the fitbit band of ours, its analyzation led to some very interesting conclusions. Let, us look at the plot of the Distance covered vs. the calories burned by a person for 7 days (Fig. 4).

Let, us also look at the plot of the steps travelled vs. the caloriness burned by the same person for 7 days. We notice that the distance or the steps taken come directly proportional to the calories burned and vice versa approximately. From this we conclude that we can directly recommend the distance to be walked by the person each day for exercise (Fig. 5).

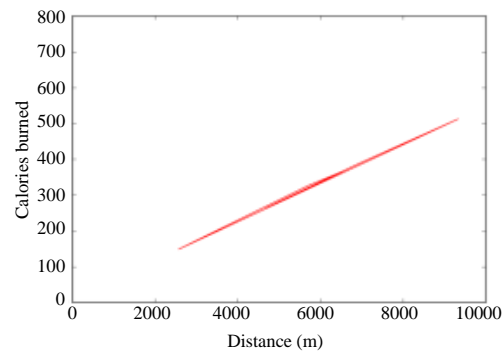


Fig. 4: Distance vs. calories

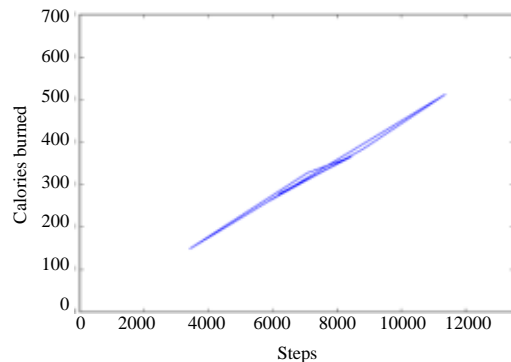


Fig. 5: Steps vs. calories burned

Generally a sedentary person loses 1800 kcal/day doing little work. Additionally, a person must also burn the calories equal to BMR to maintain body weight. So, we recommend an exercise equal to (BMR-1800) calories to be burned by exercise (Rintala *et al.*, 2013). Since, calories burned is directly proportional to the distance travelled, the slope of the graph is calculated and the value of the distance is recommended as:

$$x = (y-m)/c \tag{8}$$

Derived from the calories vs. distance graph of a straight line:

$$y = mx+c \tag{9}$$

RESULTS AND DISCUSSION

Application screenshots

Implementation results: To implement our application we took the help of one of our friends who is obese (Hsin *et al.*, 2009) (Fig. 6-10). We made him eat the items recommended by our app or atleast items having similar values and made him walk for the same approximate distance for about a week. The before and after weight values are as shown in Fig. 11 and 12. Clearly, his weight reduced by 0.3 kg or 300 g.

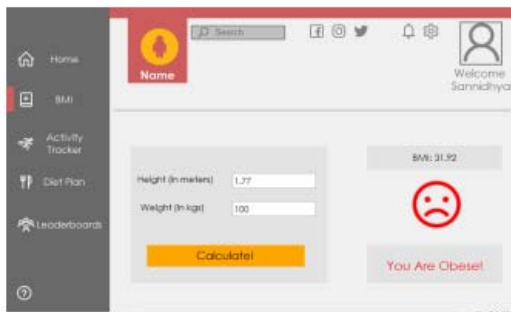


Fig. 6: Obesity calculation



Fig. 7: Calories progress chart



Fig. 8: Breakfast recommendations



Fig. 9: Lunch recommendations



Fig. 10: Dinner recommendations

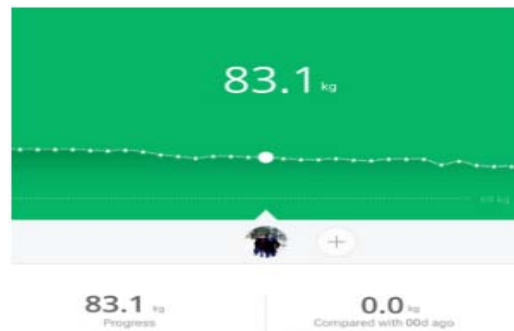


Fig. 11: Before implementation

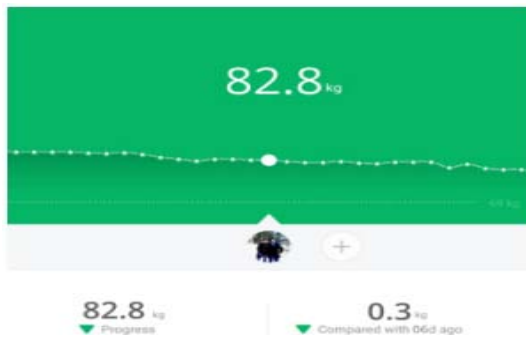


Fig. 12: After implementation

CONCLUSION

Let us analyze our implementation of the application. Based on the recommended diet plan and exercise, the person was supposed to lose 1 pound of weight in a week or 453 g. But according to, our results, he lost 300 g. So, the efficiency is:

$$\text{Efficiency} = (300/453) * 100 = 66.3\%$$

Hence, our app is not very accurate but still very effective in the long run as losing weight is a long, time-taking process. There are several bands available in the market which track your distance, steps, activity, sleep and but this project aims at suggesting diet and exercise, hence, a behavior to change the lifestyle of people to make them healthy in body, mind and spirit.

Hence in future, this can prevent or to a huge extent, reduce the role of a physical dietician to attend to the patients separately. Further, inducing machine learning in this project can also help determine the type of behavior shown by a patient in the future determined by his history of activities. This algorithm can be very robust and accurate compared to real time diet suggested by dieticians.

Further, the food database can be much bigger and contain foods from all around the globe. The food recommended would also likely be inclusive of the patient's eating history and his choices.

In addition to that a global forum or community can be set up for similar obese patients and dieticians as it helps in connecting similar people where they can discuss and identify their problems more and take counsel from the doctors. So, to conclude in future we may be having a digital dietician in our pockets having intelligence of its own.

SIGNIFICANCE STATEMENT

The study helps in finding an efficient method in controlling weight management in an optimized way.

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