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Comprehensive Review on BMI, TDEE, BMR, and Calories for Weight Management: Insights into Energy Expenditure and Nutrient Balance for Long-Term Well-Being

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Abstract
Body Mass Index (BMI) is a basic tool for assessing body mass based on height and weight, classifying individuals in BMI categories as underweight, normal, overweight, or obese. However, it has limitations as it overlooks muscle mass and fat distribution. Total Daily Energy Expenditure (TDEE) plays a crucial role in measuring the current maintenance calories, surplus calories for weight gain, and deficit calories for weight loss associated with Bansal Metabolic Rate (BMR) and Physical Activity Level (PAL). TDEE is related to 3 phases incline, stable, and decline according to age groups. Keeping these parameters, the current review focused on BMI, TDEE, BMR and calories. Calories are essential for understanding the energy the body stores and uses, making them a key factor for weight management. Macronutrients such as carbohydrates, proteins, and fats provide different amounts of energy, which can impact insulin levels and trigger cravings. Tools like BMI and BMR are useful, but focusing solely on counting calories is not enough for effective weight management. A sustainable approach includes understanding how the body processes different foods, choosing nutrient-rich options, regulating blood sugar, and staying physically active are discussed. This work reveals the long-term well-being for weight management via focused on BMI, TDEE, BMR and calories.
Keywords: *BMI, BMR-PAL, Calorie intake, Nutrients, Nutrition, TDEE.*

1. Introduction
The Body Mass Index (BMI) is simple Formula to describe weight distribution relative to height. Initially, 'Quetelet's Formula' aimed to define the 'Average Person' by calculating the ratio of weight in kilogram divided by the square of height in meters (kg/m^2)[1]. In the 20^{th} century, physiologist Ancel Keys popularized BMI as a tool for measuring obesity during his epidemiology studies on heart disease, as it was found to correlate with body fat and more user-friendly than other measurement [2]. Today, BMI remains one of the most common tools for categorizing individuals as underweight, normal weight, overweight, or obese, as it offers a cost effective and simple method for public health tracking [3]. The BMI has its limitations because it does not distinguish between Fat Mass (FM) and lean body mass. This can result in inaccuracies, especially among different populations and body types [4]. Despite these limitations, BMI is still widely used in obesity research and public health policies for monitoring global trends [5]. However, BMI doesn't account for the distribution of body fat, which can be a critical indicator of health risks. For example, central obesity, or excess fat around the belly, is a stronger predictor of metabolic diseases like cardiovascular disease and type 2 diabetes [6]. Total Daily Energy Expenditure (TDEE) is used alongside BMI to provide a more comprehensive assessment of health risks, as BMI alone does not account for fat distribution or body composition. By considering

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factors such as physical activity, TDEE helps determine the maintenance calories needed to maintain, gain, or lose weight over time. Less active individuals have lower TDEE, while adult males generally have higher TDEE than females due to testosterone's role in building muscle mass, whereas women typically have more adipose tissue. This makes TDEE a more precise tool for understanding calorie needs and health risks across different body types. To estimate Total Daily Energy Expenditure (TDEE), two key factors are used: Basal Metabolic Rate (BMR) and Physical Activity Level (PAL) [7]. The term "Basal Metabolism Rate" (BMR) was introduced by Magnus-Levy in the late 18th century and was later clarified as "Standard Metabolism" to avoid confusion with its lowest level of energy expenditure, primarily used for diagnosing thyroid conditions in the early 20th century. By the 1950s, BMR not only facilitated the diagnosis of thyroid issues but also extended its application to other diseases like diabetes and leukemia, eventually becoming essential for estimating Total Energy Expenditure (TEE) and Total Daily Energy Expenditure (TDEE) [8]. BMR represents the energy required for basic bodily functions, while PAL accounts for energy spent during physical activities. Additionally, the Thermic Effect of Food (TEF), which reflects the energy needed for digestion and metabolism, contributes minimally (up to 10%) to TDEE. Together, these components provide a clear understanding of how many calories are expended during both physical and mental tasks, with the formula.

TDEE = BMR × PAL

Calories are a measure of the energy stored in food and the energy expended by the body [9]. Foods high in sugar and starch can raise insulin and blood sugar levels, often leading to overeating and cravings [10]. Once food or drink is consumed, it is broken down to release energy, which the body uses for daily functions. Macronutrients like carbohydrates and proteins provide 4 calories per gram, while fats offer a higher energy density at 9 calories per gram [11]. Consuming fewer calories for short periods can slow metabolism and increase hunger, while the body's mechanisms for regulating food intake can become overwhelmed, leading to obesity. To maintain a healthy weight, it's crucial to understand how different foods fulfil energy needs and balance calorie intake effectively [12]. Calories provide energy, but the balance of macronutrients (carbohydrates, fats, proteins) and micronutrients (vitamins, minerals) ensures efficient bodily function and supports overall health. Macronutrients are needed in larger quantities, with carbohydrates serving as the main energy source and proteins aiding in muscle repair and growth. Fats store extra energy and provide essential vitamins like A, D, and E. Micronutrients, though required in smaller amounts, play vital roles in maintaining health, such as vitamins A, B, D, and K. There are two types of minerals: macro-minerals and microminerals. Macro-minerals, such as calcium, phosphorus, potassium, sodium, chloride, and magnesium, are required in larger amounts for essential bodily functions [13]. Alongside minerals, calorie intake is crucial, but the quality of nutrition is equally important for overall well-being. Nutrition quality is key; processed foods high in trans fats increase health risks, while nutrient-dense foods promote well-being [11].

2. Key Tools in Weight Management

2.1. BMI

The Table 1 summarizes key developments and events in the history of BMI, illustrating its evolution and significance in understanding body weight and health. BMI is a widely adopted method to estimate body fat using a simple Formula: *weight(kg)/height^2(m^2).* It classified individuals into categories such as overweight (BMI between 25 and 29.9kg/m^2) and Obese (BMI ≥ 30kg/m^2 and 34.9 kg/m^2) across various and ethnic bunches, groups. The approach assumes weight increases proportionally to the square of height, with its origin in data from Caucasian Population[14]. BMI also known as the Quetelet Index, is a measure that evaluates a people's weight relative to their height the BMI formula[5].

BMI = Height (Ft) / Weight(kgs)

BMI provides an estimate of whether an individual's falls into categories like underweight, normal weight, overweight weight, or obese which are

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linked to various health risks[15].

Table 1 Outlining the History of BMI

Year	Event/Development	Description
1796-1874	Introduction of the Quetelet Index [16]	Developed by Lambert Adolphe Francois Quetelet, this mathematical formula linked body size directly to height, becoming a relevant tool for identifying obesity.
1950s	Development of Normal Weight Table by Louis I. Dublin [15]	Created by the Vice President of Metropolitan Life Insurance, this table categorized clients into "small," "medium," and "large," but did not account for age.
1972	Derivation of Body Mass Index (BMI) [15]	Ancel Keys derived BMI from Quetelet's work, establishing the current formula based on height and weight.
1992	WHO Consultation declares obesity a global epidemic [17]	BMI plays a crucial role in highlighting the increasing rates of obesity, marked as a significant public health concern.
1962-2000	Prevalence of obesity among adults	A study tracking the increase in obesity levels among adults, revealing that both genders, especially women aged 55 to 64, experienced significant rises in obesity rates.

First, the equation for body weight about height was adjusted to take the following form:

$$\mathbf{Wt. = BMI \times Ht^2}$$

Thereafter, the equation and expanded it about a reference height Ht_0 as follows:

$$\mathbf{Wt. = BMI \times Ht^2_0 \times (\Delta\ Ht. / Ht_0)]^2}$$

Where

$$\mathbf{\Delta\ Ht. = Ht. - Ht_0}$$

and Ht. Is the individual's height. By using the technique of Taylor expansion in calculus and only keeping the terms linear in ΔHt, we observed the equation as a linear function,

$$\mathbf{Wt. \approx\ BMI \times Ht^2_0\ [1 + 2 \times (\Delta\ Ht. = Ht. - Ht_0)]}$$

If the percent error is small, then the estimate is relatively good. The linearity is close so the percent error is small or was determined by the neglected term in the Taylor series expansion.

$$\mathbf{(\Delta\ Ht. = Ht. - Ht_0)^2}$$

This error can be calculated directly. For example, if the reference height is in the middle of the 95% height range, the maximum percent error is 1.0%. Having the same reference height Ht0 that was used in previous IBW equations, we assigned Ht0 to be 5 ft (60.0 in or 1.52 m) in the US [16]. There are different classifications provided by different authors by calculating BMI. Here, key characteristics of all study participants, including BMI Classification are incorporated in Table 2. Table 2 presents the general characteristics of study participants, grouped according to their BMI classification. The analysis of participants (N) is extended by the BMI categories in several types, including Underweight, Normal weight, Overweight, Obesity, and two subcategories of obesity (Obesity2, Obesity3). the values are presented as mean ± standard deviation (sd), with additional data for minimum and maximum values with each group[17].

Table 2 Key Characteristics of All Study Participants, Including BMI Classification [17]

Group acc. To. BMI	N	x ± sd (min;max)	Age [Years]	Height [Cm]	Weight [Kg]	BMI [kg/(m2)]
Underweight	37	x ± sd	20.5 ± 2.3	166.6±5.1	48.7±3.3	17.5±0.7
		min; max	19; 30	156; 176	42.9;56.0	15.9; 18.4
Normal weight	199	x ± sd	21.1 ± 2.7	166.8±5.8	58.5±6.4	21.0±1.8
		min; max	18; 35	153; 180	46.0; 76.7	18.5;25.0
Overweight	24	x ± sd	23.1±4.6	164.9±5.9	72.3±6.9	26.5±1.3
		min; max	19; 34	155; 178	60.6; 89.4	25.1; 29.6
Obesity	7	x ± sd	22.6±3.1	164.3±2.1	87.2±5.4	32.3±1.8
		min; max	19; 27	161; 168	78.5; 95.0	30.3; 34.9
Obesity 2		x ± sd	25.8±4.2	162.5±3.9	92.4±6.7	35.4±2.3
		min; max	22;32	159;170	85.0;101.3	33.1; 37.9
Obesity 3		x ± sd	28.3±3.9	161.9±4.0	104.5±8.3	39.6±3.1
		min; max	25;35	158;172	92.0;115.0	35.5;44.0

2.2.TDEE

Weight management is closely associated with Total Daily Energy Expenditure (TDEE)[18], which represents the total number of calories the body burns in a 24-hour period. The Body Mass Index (BMI) helps define body composition, making TDEE essential for effective weight management. TDEE is influenced by both the Basal Metabolic Rate (BMR) and the Physical Activity Level (PAL), and it can be estimated using the formula TDEE =

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BMR × PAL. This calculation plays a significant role in achieving a balanced nutrient intake and maintaining overall health.

2.2.1 BMR

Basal Metabolic Rate (BMR) represents the number of calories the body requires for vital functions during rest, including nerve circulation, digestion, respiration, and temperature regulation. To accurately measure BMR, a person must be free from emotional stress, have fasted for 10 to 12 hours, be in a thermo-neutral environment (22-26°C), and be fully awake and lying down [8]. An alternative to BMR is the Resting Metabolic Rate (RMR), which can also be used for energy expenditure assessments. BMR is crucial for determining Total Daily Energy Expenditure (TDEE) and varies throughout the day, influenced by factors such as height, weight, age, and sex. Several predictive equations, including the Harris-Benedict equation (1919), Schofield equations (1985), and the Mifflin-St. Jeor equation (1990), are used to calculate BMR, with the latter being the most accurate and widely recommended for weight management. Newer equations, such as the Ravussin, Nachmani, and WHO equations [19], have also been developed to provide additional methods for estimating BMR. The Mifflin-St. Jeor method for calculating Basal Metabolic Rate (BMR) involves specific equations for males and females. For males, the BMR is calculated using the formula:

BMR = 9.99 × Weight (kg) + 6.25 × Height (cm) - 4.92 × Age (years) + 5

For females, the equation is:

BMR = 9.99 × Weight (kg) + 6.25 × Height (cm) - 4.92 × Age (years) - 161. ….[19]

While the terms Resting Metabolic Rate (RMR) and BMR are often used interchangeably, it is important to note that there is typically a difference of at least 10% between the two measurements, with BMR generally being lower than RMR [20].

2.2.2 PAL

The body movement invoked by the skeletal muscles that cause energy expenditure is a procedure defined in terms of `Physical Activity`. For athletes in some cases, physical activity is equal to BMR, and it is an essential part of TDEE. Exercise training in young adults to increase the Physical Activity [21]. Physical activities have their levels: Sedentary which contains the values 1- 1.2, Less Activity which contains the values 1.2 – 1.5, High Activity contains the values 1.6 – 1.8 and Intensive Activity contains the values above 1.9[22].

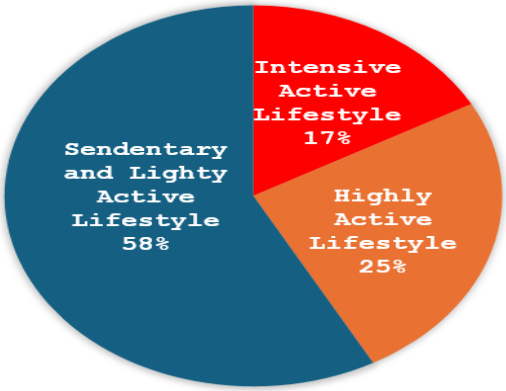

Figure 1 PAL Lifestyle

The Figure-1 illustrates the various Physical Activity Levels (PAL), categorizing them into sedentary, lightly active, highly active, and intensive active lifestyles. Sedentary activities include reading, watching television, and driving, while lightly active pursuits encompass casual walking, cooking, and yoga. The data indicates that approximately 58% of individuals lead sedentary or lightly active lifestyles, significantly higher than the 25% classified as highly active and the 17% identified as intensive active. The blue rectangular box represents sedentary and lightly active lifestyles, the orange box denotes highly active lifestyles, and the grey box reflects intensive active lifestyles [23]. The Figure-2 illustrates the average Physical Activity Level (PAL) across different Body Mass Index (BMI) categories, with the vertical axis indicating PAL values and the horizontal axis displaying various BMI classifications. Notably, all BMI categories align closely with an average PAL value of 1.75, indicating a highly physically active lifestyle. Furthermore, BMI categories such as overweight and obesity are not associated with lower PAL or low-intensity activities[21]. Suggesting that factors such as high caloric intake, genetic predispositions, and

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conditions like thyroid disorders contribute to higher BMI levels.

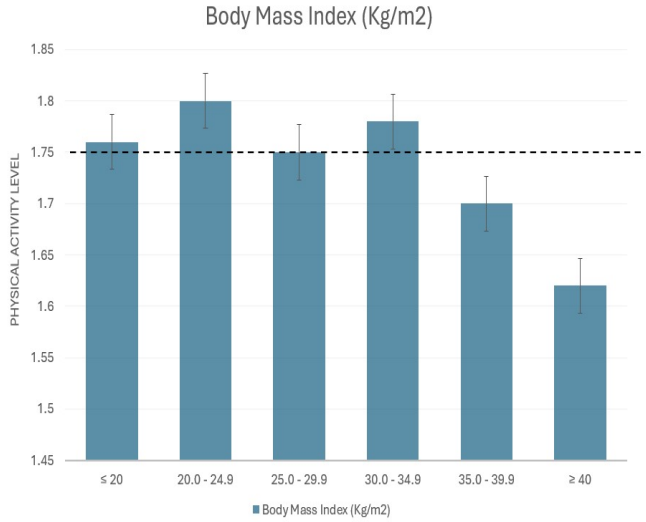

Figure 2 PAL Average in Different of Category, BMI of age 18 to 50 year

2.3.Calorie Intake

2.3.1 Calories Surplus and Deficit

Surplus: To gain weight you should eat more calories than your TDEE. Eating multiple meals throughout the day can assist in gaining weight. Prefer high-calorie food which also has good it's important to see the overall quality of your diet[11]. Consuming extra calories can lead to initial weight gain as the body uses them to build new tissue; however, this process does not continue indefinitely. Over time, the body's energy expenditure increases to accommodate the new tissue, resulting in weight gain stabilizing at approximately 2.7 kg (6 lbs.)[24] after prolonged excess calorie intake.

Deficits: Calorie intake plays a crucial role in weight management, as creating a calorie deficit—consuming fewer calories than the body expends—is essential for weight loss. However, overly restricting calories can slow metabolism and trigger hormonal changes that conserve energy, which may hinder weight loss efforts [11]. Meal replacements, including soups, shakes, bars, and pre-packaged meals, can effectively aid in managing calorie intake by substituting regular meals [25].

2.3.2 Calories Diet

Low-Calories Diet(LCD)-In LCD calories should be eaten between 1,000 and 1,500. It helps you for weight loss and eat less or fewer calories than you burn. Consuming low-carb and low-fat can be effective as long as you maintain a calorie deficit. Sticking to the diet requires effort in planning meals. Very-Low-Calorie Diet(VLCD)-The VLCD involves less than 800 calories per day and is not suggested for daily weight management. It can only be applied under specific situations and medical supervision [25] .

2.3.3 Exercise

Exercise is also important for energy expenditure. Individuals with high muscle mass burn calories more quickly and individuals who are not active and with less muscle mass burn calories relatively slower. Hence by building muscle, you can increase the number of calories your body uses, even when you're resting[11]. Consuming more calories and reducing physical activity can lead to an increase in body fat.

2.3.4 CHOICES Method for Calorie Control

The CHOICES Method simplifies calorie management by assigning 75 calories to each calorie choice. For a 1,500-calorie diet, this equals 20 choices per day. It emphasizes making intentional decisions about food, exercise, and time, staying accountable, and adapting habits to fit your lifestyle. This approach is particularly helpful for weight loss and managing type 2 diabetes [26]. Daily Calorie Distribution Example (Based on 1,500 Calories) includes multiple calorie options, with 4-5 choices for breakfast, 5 for lunch, 1-2 for an afternoon snack, 5-6 for dinner, and 2-3 for a bedtime snack.

2.3.5 Comparative Caloric Intake Analysis

The EAT-Lancet reference diet promotes human health and environmental sustainability with a mostly plant-based approach. It includes eight food groups, prioritizes fruits, vegetables, and plant-based proteins, and limits processed foods and red meat. Designed to provide 2,500 kcal per day, it aims to sustain 10 billion people by 2050 through sustainable food systems[27].

2.3.6 Practical Analysis

Author et. al. [28], did two experiments involving 139 individuals with obesity revealing insights into the effects of time-restricted eating versus daily calorie restriction on weight loss. In the first

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experiment, participants adhered to an 8:00 AM to 4:00 PM eating window while consuming restricted calories—1,500 to 1,800 calories per day for men and 1,200 to 1,500 calories for women. The second experiment allowed participants to consume the same caloric limits without time constraints. After 12 months, 118 participants completed the study, demonstrating that those in the time-restricted group lost an average of 8.0 kg, while the daily calorie-restricted group lost 6.3 kg. Notably, both groups exhibited comparable reductions in waist size, body fat, and BMI, suggesting that time restriction was not significantly more effective than daily calorie restriction for weight loss. These findings contribute to the understanding of dietary strategies for weight management in individuals with obesity.

2.3.7 Calories-Dense Vs Nutrition-Dense

Calories-dense foods are characterized by a high calorie count per serving but offer limited nutritional value, often containing excessive amounts of saturated fat, added sugars, and sodium. Examples of such foods include cakes, candies, sugary beverages, and fried foods. In contrast, nutrition-dense foods provide a wealth of essential nutrients, including vitamins, minerals, and fiber, while being lower in calories. Foods rich in nutrition encompass fruits, vegetables, whole grains, nuts, and seeds [11]. Prioritizing nutrition-dense options over calorie-dense choices is crucial for maintaining a balanced diet and overall health.

2.4. Nutrition

Previous sections highlight that Body Mass Index (BMI) is a useful indicator of body composition, serving as a key metric in weight management. Poor nutrition can contribute to both obesity and underweight conditions, primarily influenced by caloric intake. To prevent malnutrition and effectively manage weight, it is essential to strategically balance the calories consumed with those expended. This balance is crucial for achieving desired weight outcomes, whether the goal is to lose, gain, or maintain weight.

2.4.1 Nutrition Digestion and Absorption

When food is put inside our mouths, it starts as ingestion and is chewed with saliva containing an enzyme α-amylase that breaks down starch into simple sugars[29]. Then, in the stomach food gets together with gastric acids and some enzymes like pepsin to digest proteins. This mixture known as chyme passes on to the small intestine whereas the pancreas secretes enzymes for further digestion and bile helps emulsify fats out of the liver. The absorption of nutrients occurs through villi found in small intestines while remaining waste products go to the large intestines where they are absorbed for water; so that solid wastes can be excreted through the anus[30], [31].

2.4.2 The Impact of Nutrition on Daily Tasks, Long-Term Health, Cognitive and Physical Performance

The relationship between nutrition and diurnal tasks, both internal and physical, is well-established. Balanced diets rich in essential nutrients appreciatively impact mood, cognitive function, and physical performance. Diets that give sufficient vitamins, minerals, and macronutrients support optimal brain function and energy situations. For case, the MIND diet, a mix of the Mediterranean(plant-based eating plan) and DASH(Dietary Approaches to Stop Hypertension) diets, has been shown to decelerate cognitive decline and enhance brain health[32].

2.4.3 Positive Affect on Cognitive

Essential for brain development support are omega-3- 3 adipose acids, especially concentrated in fish oil painting makeup. These healthy fats have been proven to ameliorate memory and drop the chances of age-related decline in cognitive functioning. also, antioxidants similar to vitamins C and E can be set up in numerous fruits and vegetables that will protect the brain from oxidative stress, and damage in the brain cells. also, these antioxidants might also prop in the negativing dangerous free revolutionaries, therefore supporting cognitive performance. besides B vitamins similar as B6, B12, and folate. They're pivotal for producing neurotransmitters, which grease the proper functioning of brain cell communication; they also have an impact on the threat of depression and cognitive impairment[32].

2.4.4 Negative Affect on Cognitive

High sugar consumption may spark inflammation and oxidative stress that can stymie memory and

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cognitive functions. Trans fats, frequently set in reused foods, decelerate brain functions and have been linked to an advanced threat of depression. also, scarcities of some vital nutrients such as iron, iodine, or zinc lead to cognitive dysfunction, especially when the child is still developing. The main means of fostering long-term brain health is through maintaining a diet rich in essential nutrients[32]. Proper nutrition helps with long-term health like chronic disease prevention, bone density, and muscle mass, and reduced risk of osteoporosis and fractures also helps mental health issues in the long term. Healthy Weight management is based on nutrition. when someone wants weight loss it must be without malnutrition. In weight loss one of the factors is consuming fewer calories taking healthier nutrition that is essential for body functionality and avoiding highly processed food, and high-sugar drinks.

2.4.5 Daily Required Nutrition

Balanced nutrition plays an essential role in maintaining overall health and preventing malnutrition, particularly during weight management. Proper intake of key nutrients such as vitamins, minerals, proteins, and healthy fats is crucial for supporting vital bodily functions, including digestion, nutrient absorption, and cognitive performance. Furthermore, meeting daily nutritional needs tailored to an individual's specific metabolic requirements is critical for promoting sustained long-term health and well-being [33]. A well-balanced diet not only aids in achieving weight management goals but also ensures the body receives the essential nutrients needed for optimal functioning.

2.4.6 Technology

MyFitnessPal is a popular mobile app and website that helps users track their diet and exercise to achieve fitness goals, whether it be weight loss, muscle gain, or maintenance. It offers a comprehensive food diary with a vast database of foods, allowing users to log their daily intake of calories, macronutrients, and micronutrients. Additionally, MyFitnessPal integrates with various fitness apps and devices, allowing users to track their exercise and monitor calories burned. The app features personalised goal setting based on users' health metrics such as weight, height, and activity level. Its community forums provide support, tips, and motivation from other users.

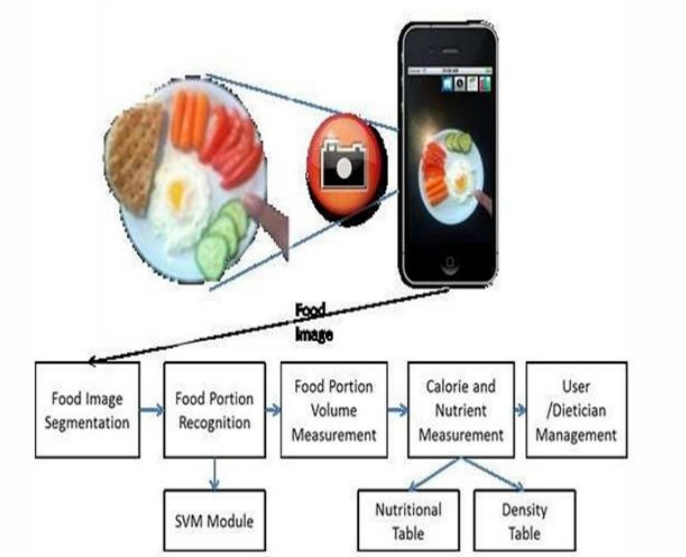

Figure 3 Measuring Calorie and Nutrition from Food Image [34]

MyFitnessPal's ease of use and detailed tracking make it a go-to resource for those looking to take control of their health and fitness journey [35]. The Figure-3 shows that the user captures image with a mobile devices, which are then pre-processed and segmented to identify food portions. The system uses SVM based Food Recognition to identify food types helps in determining the density and mass. the system can calculate the mass by having the type of food [34]. Consequently, the amount of calorie and nutrition of each food portion can be derived using nutritional tables, based on the following equation:

$$\text{Calorie in the photo} = \frac{\text{Calories from table x Mass in the photo}}{\text{Mass from table}}$$

Digital technologies have revolutionized the methods of data collection, analysis, and application in health interventions, significantly transforming the landscape of healthcare. Central to this transformation are mobile applications, which facilitate real-time data collection and feedback. With over 165,000 health apps available, platforms such as MyFitnessPal and Noom empower users to monitor their physical activity and receive insights

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on their progress [35]. These applications leverage user-generated data alongside smartphone sensors to deliver personalized suggestions. Notably, Noom incorporates psychological principles to foster behaviour change and support weight management, although the effectiveness of these apps can vary based on user engagement and the quality of their design. Wearable technologies have emerged as essential tools for health monitoring, tracking metrics such as heart rate, sleep patterns, and physical activity levels. Devices like the Apple Watch collect data through integrated sensors and offer features relevant to clinical nutrition, such as tracking calories burned and heart rate variability. The data collected from wearables can be seamlessly integrated with mobile health applications, providing a comprehensive view of an individual's health. This synergy enhances the ability to monitor and manage health conditions effectively [36]. Furthermore, the integration of artificial intelligence (AI) and machine learning has significantly advanced health technologies, particularly in improving the accuracy of dietary assessments and recommendations. AI tools analyze large datasets to predict outcomes like postprandial glycemic responses and to tailor nutritional plans based on individual health profiles. For example, AI algorithms can forecast blood glucose levels in response to dietary intake and other health metrics, enabling more personalized dietary recommendations. Additionally, deep learning models facilitate meal image recognition, enhancing the accuracy of dietary logging by identifying food items from photographs. This capability enables more precise nutritional assessments and interventions. Implementing these technologies involves a structured process, beginning with data collection through mobile apps and wearable devices that gather extensive information on dietary intake, physical activity, and biometric measurements. AI tools analyze this data to identify patterns and generate predictions, with machine learning models continuously refining their accuracy by training on large datasets. Based on this analysis, these systems provide personalized feedback and recommendations, including dietary advice, activity goals, and health tips. The integration of these technologies with healthcare systems allows for the sharing of information with healthcare providers, enabling more informed medical decisions and the tracking of patient progress. This holistic approach to data collection and analysis significantly enhances the effectiveness of nutritional interventions, ultimately improving health outcomes and demonstrating the transformative impact of digital technology in clinical nutrition [37].

Conclusion

BMI serves as a general measure for categorizing weight based on a person's height, offering a broad assessment of body weight. Getting assessment category of BMI of a person’s it is associated with weight management, for estimating which category of BMI person’s needed,Total Daily Energy Expenditure (TDEE) is essential to determine daily caloric requirements. TDEE is derived from Basal Metabolic Rate (BMR), which is the energy needed for vital functions, and Physical Activity Level (PAL), which adjusts TDEE according to activity levels. Effective weight management hinges on balancing caloric intake with these factors: consuming more calories than expended results in weight gain, while a caloric deficit leads to weight loss. Ensuring proper nutrition is vital, as it not only satisfies energy needs but also provides essential nutrients for overall health and metabolism. By understanding how these components interact, individuals can achieve effective and sustainable weight management.

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