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BMI: One of the Health Screening Tools

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Abstract:
Body Mass Index (BMI) is a widely used health screening tool for assessing an individual's body weight in relation to height. It serves as a simple, cost-effective, and non-invasive method to categorize individuals as underweight, normal weight, overweight, or obese. BMI plays an important role in the early identification of potential lifestyle disorders, including obesity, diabetes mellitus, hypertension, and cardiovascular diseases. Although it does not directly measure body fat composition, BMI remains a practical preliminary indicator for evaluating nutritional status and associated health risks at both individual and community levels.

Keywords: BMI, Health screening tool

Body Mass Index (BMI) is a widely accepted and cost-effective screening tool used to assess an individual's body weight in relation to height. It provides an indirect estimation of body fat and helps classify individuals into categories such as underweight, normal weight, overweight, and obesity. Although BMI does not directly measure body fat percentage, it serves as a practical and reliable indicator for identifying potential health risks associated with abnormal body weight in both clinical and public health settings.

Lambert Adolphe Jacques Quetelet, a Belgian-born sociologist, astronomer, and mathematician, is responsible for developing the Body Mass Index. In the mid-19th century, Quetelet was searching for a way to relate an individual's height to their ideal weight as a tool for studying populations.

Body Mass Index (BMI) serves as an important screening tool for identifying potential weight-related health risks, including cardiovascular diseases, diabetes, and malnutrition. While it is simple and widely used, BMI does not directly measure body fat percentage and therefore may not always provide an accurate representation of an individual's body fatness. For a more comprehensive health assessment, healthcare professionals often combine BMI with additional parameters such as waist circumference, blood pressure, and other clinical evaluations to ensure a more precise evaluation of overall health status.

Diagnosing weight types with BMI

In general, the following BMI ranges (in kg/m2) classify different weight types:

Underweight: Less than 18.5
Optimum range: 18.5 to 24.9
Overweight: 25 to 29.9
Class I obesity: 30 to 34.9
Class II obesity: 35 to 39.9
Class III obesity: More than 40

Significance of Body Mass Index (BMI) as a Health Screening Tool

Body Mass Index (BMI) is a widely utilized, cost-effective anthropometric index that assesses body weight relative to height and categorizes individuals into underweight, normal weight, overweight, and obese classifications. Owing to its simplicity, reproducibility, and non-invasive nature, BMI has become a standard screening measure in clinical practice and epidemiological research.

Numerous studies have demonstrated a significant association between abnormal BMI values and increased risk of chronic non-communicable diseases, including type 2 diabetes mellitus, cardiovascular diseases, hypertension, dyslipidaemia, and certain malignancies. Elevated BMI is particularly linked with metabolic syndrome and increased morbidity and mortality rates, while low BMI may indicate malnutrition, compromised immunity, and other underlying health concerns.

In addition to risk stratification, BMI serves as an effective tool for population-level surveillance, health policy planning, and monitoring trends in obesity and undernutrition. However, despite its widespread application, BMI does not directly measure body fat distribution or composition and may not accurately reflect adiposity in certain populations, such as athletes, the elderly, or individuals with high muscle mass. Therefore, for comprehensive clinical evaluation, BMI should be interpreted alongside other parameters such as waist circumference, waist-to-hip ratio, body composition analysis, and relevant biochemical investigations.

Overall, BMI remains a valuable preliminary screening instrument that supports early identification of weight-related health risks and facilitates preventive and therapeutic interventions in both individual and public health contexts.

Organ Systems Involved

An elevated Body Mass Index (BMI) has significant implications across multiple organ systems. Increased BMI is strongly associated with the development of hypertension, hyperlipidaemia, and type 2 diabetes mellitus—well-established risk factors for coronary heart disease.

The cardiovascular system is particularly affected, as excess adiposity contributes to increased cardiac workload, endothelial dysfunction, and atherosclerosis. The endocrine and metabolic systems are also involved, with obesity-related insulin resistance playing a central role in the pathogenesis of type 2 diabetes and metabolic syndrome. Additionally, altered lipid metabolism leads to dyslipidaemia, further increasing cardiovascular risk.

Beyond these, elevated BMI may impact the respiratory system (e.g., obstructive sleep apnea), musculoskeletal system (e.g., osteoarthritis due to increased joint stress), and hepatobiliary system (e.g., non-alcoholic fatty liver disease). Thus, increased BMI is not limited to a single organ system but exerts widespread systemic effects, contributing significantly to overall morbidity and mortality.

Respiratory System Involvement

An increased Body Mass Index (BMI) has significant effects on the respiratory system. It is most commonly associated with **Obesity Hypoventilation Syndrome (OHS)**, a condition characterized by chronic hypoventilation in individuals with obesity. Elevated intra-abdominal pressure and excess body weight restrict diaphragmatic excursion and reduce chest wall compliance, thereby impairing normal lung expansion. This mechanical limitation results in decreased tidal volume and alveolar ventilation, predisposing individuals to hypoxemia and hypercapnia.

Patients with OHS often experience dyspnea and adopt rapid, shallow breathing patterns, which may increase the risk of alveolar collapse and atelectasis. Reduced lung volumes—particularly functional residual capacity and expiratory reserve volume—further compromise effective gas exchange.

Increased BMI is also strongly associated with **Obstructive Sleep Apnea (OSA)**, a disorder characterized by recurrent upper airway obstruction during sleep. Excess adipose tissue around the neck and upper airway contributes to airway narrowing and collapsibility. OSA may result in excessive daytime sleepiness, impaired cognitive function, pulmonary hypertension, and cardiac arrhythmias. If left untreated, it significantly increases the risk of cardiovascular morbidity.

Thus, elevated BMI exerts both mechanical and metabolic effects on the respiratory system, contributing to substantial respiratory and cardiopulmonary complications.

Gastrointestinal System Involvement

An increased Body Mass Index (BMI) is significantly associated with various gastrointestinal (GI) disorders. Elevated BMI has been linked to a higher incidence of gallbladder disease, particularly cholelithiasis, due to alterations in cholesterol metabolism and bile composition. Obesity is also recognized as an important risk factor for colorectal malignancy, with increased adiposity contributing to chronic inflammation, insulin resistance, and hormonal imbalances that may promote carcinogenesis.

Furthermore, excess body fat, especially central (abdominal) adiposity, increases intra-abdominal pressure. This pressure exerts force on the lower oesophageal (cardiac) sphincter, reducing its tone and facilitating the retrograde movement of gastric contents into the oesophagus. As a result, individuals with elevated BMI are at increased risk of developing **gastroesophageal reflux disease (GERD)**. Chronic GERD may lead to complications such as esophagitis, Barrett's oesophagus, and, in severe cases, oesophageal adenocarcinoma.

Thus, increased BMI contributes to both structural and metabolic disturbances within the gastrointestinal system, significantly elevating the risk of both benign and malignant GI conditions.

An increase in BMI has also been linked to the development of liver disease. Fatty deposition within the liver, known as non-alcoholic steatohepatitis (NASH), is one of the leading causes of liver failure in the United States. Fat accumulation within the liver causes inflammation, injury, and scarring.

Obese individuals typically have increased adipose tissue hypertrophy, leading to endocrine dysregulation and insulin resistance. Insulin resistance increases triglycerides, serum glucose, and blood pressure, increasing the risk of cardiovascular disease and type 2 diabetes mellitus. Excess adipose tissue leads to insulin resistance by releasing excess free fatty acids.

Integumentary System Involvement

An overweight or obese BMI may also affect the integumentary system. The increase in adipose tissue increases inflammation within the dermis, a risk factor for developing immune-mediated hidradenitis suppurativa. This increased pro-inflammatory state seen in obesity has also been linked with the development of psoriasis. On the other end of the spectrum, a lower than normal BMI may cause dry, thickened dermis, less exfoliation, and fine hair growth, known as lanugo.

Genitourinary System Involvement

Elevated Body Mass Index (BMI) exerts substantial effects on the genitourinary system. Clinical evidence indicates that acutely ill patients with obesity are at a higher risk of developing acute kidney injury (AKI),

a complication associated with increased short- and long-term mortality. The pathophysiology is multifactorial and includes altered renal hemodynamic, increased inflammatory mediators, oxidative stress, and heightened susceptibility to nephrotoxic insults.

Furthermore, excess body weight demonstrates a linear relationship with the risk of chronic kidney disease (CKD) and progression to end-stage renal disease (ESRD). Obesity contributes to glomerular hyperfiltration, increased intraglomerular pressure, and structural renal changes that predispose individuals to progressive renal dysfunction. A distinct entity known as obesity-related glomerulopathy (ORG) has been described, characterized by proteinuria and glomerulomegaly. The incidence of ORG has been rising, particularly in regions such as the United States, paralleling the increasing prevalence of obesity.

In addition, obesity is associated with a higher prevalence of nephrolithiasis, particularly uric acid stones, due to alterations in urinary pH, increased uric acid excretion, and metabolic abnormalities. Female urinary incontinence is also strongly correlated with elevated BMI, likely resulting from increased intra-abdominal pressure and pelvic floor stress.

Collectively, these findings underscore the significant impact of elevated BMI on renal structure and function, as well as broader genitourinary health outcomes.

Reproductive System Involvement (Female)

An increased BMI has been directly related to decreased reproductive function. The current literature has demonstrated that women with a BMI >30 kg/m^2 have a higher incidence of anovulation/subfertility. Obesity has also been shown to strongly influence reproductive cancers, including neoplasms of the breast, prostate, endometrial lining, and ovaries.

Significant reproductive issues are common among young women with an obese BMI. In obesity, there is an increased peripheral aromatization of androgen to oestrogens. Via negative feedback, this increase in oestrogen leads to a decrease in gonadotropin-releasing hormone (GnRH), which leads to irregular or anovulatory cycles. Research has also found that obese women are three to four times more likely to experience menstrual dysfunction than those with a normal BMI.

Reproductive System Involvement (Male)

Obesity has been increasingly recognized as a contributing factor to male reproductive dysfunction. Excess adipose tissue promotes the production of pro-inflammatory cytokines and reactive oxygen species (ROS), resulting in oxidative stress. This oxidative environment can impair spermatogenesis and lead to sperm DNA fragmentation, thereby reducing sperm quality and fertility potential.

Additionally, obesity is associated with endocrine alterations, including reduced testosterone levels and increased aromatization of androgens to estrogens within adipose tissue. These hormonal imbalances may further disrupt the hypothalamic–pituitary–gonadal (HPG) axis, adversely affecting sperm production and function.

Emerging evidence also suggests that sperm from obese men may exhibit altered epigenetic modifications, including changes in DNA methylation and histone patterns. Such epigenetic alterations, along with changes in the endocrine composition of seminal fluid, may influence early embryonic and foetal development, potentially contributing to adverse metabolic outcomes in offspring.

Thus, obesity not only affects male fertility at the level of sperm quality and hormonal regulation but may also have transgenerational implications through epigenetic mechanisms.

In individuals identified by screening as at risk of malnutrition, the diagnosis of malnutrition should be based on either a low BMI (<18.5 kg/m(2)), or on the combined finding of weight loss together with either reduced BMI (age-specific) or a low FFMI using sex-specific cut-offs.

Survey Findings on BMI Distribution

A recent electronic survey was conducted among 230 participants, who were asked to calculate and report their Body Mass Index (BMI). The study population included both male and female respondents across a wide age range, from 11 to 80 years.

Based on BMI classification criteria, 40 participants (BMI < 18.5 kg/m²) were categorized as underweight, indicating possible malnutrition. In contrast, 50 participants (BMI ≥ 25 kg/m²) were classified as overweight. The remaining participants fell within the normal BMI range.

Age-wise analysis revealed notable trends. The highest prevalence of overweight individuals was observed in the 41–50 years age group. Conversely, the underweight category was most prominent among individuals aged 11–20 years. An interesting observation was that the 21–30 years age group demonstrated the second-highest proportion in both underweight and overweight categories. This suggests that individuals in this age bracket are more likely to deviate from the ideal BMI range, either toward undernutrition or excess weight, rather than maintaining a normal BMI.

These findings highlight age-related variations in BMI distribution and underscore the need for targeted nutritional awareness and lifestyle interventions, particularly among adolescents, young adults, and middle-aged populations.

TABLE 1 different age group people taking part in the survey.

AGE GROUP	NUMBER OF PEOPLE
11 yrs- 20 yrs	102
21-30	41
31- 40	28
41-50	41
51-60	12
61-70	3
71-80	3
total	230

Table 2 shows number of people having normal/underweight/ overweight BMI.

BMI	NUMBER OF PEOPLE
NORMAL	90
UNDER WEIGHT	50
OVERWIGHT	40
TOTAL	230

Table 3 shows number of people of different age group whose BMI indicates overweight.

over weight	
AGE GROUP	NUMBER OF PEOPLE
11 yrs -20 yrs	11
21- 30	3
31-40	7
41-50	15
51-60	1
61-70	1
71-80	2
total	40

Table 4 shows number of people and their age group whose BMI indicates they are underweight.

UNDER WEIGHT	
AGE GROUP	**NO OF SAMPLE**
11 yrs- 20 yrs	40
21-30	9
31-40	1
41-50	0
51-60	0
61-70	0
71-80	0
total	50

Conclusion and Future Recommendations

The present survey was conducted to obtain a preliminary assessment of the health status of individuals across different age groups using Body Mass Index (BMI) as a screening indicator. Although BMI provides a useful overview of weight distribution, it alone is insufficient to determine comprehensive health status. Therefore, additional screening investigations are required to accurately evaluate the overall health of participants and to identify the underlying causes of their current BMI status.

It is essential to further explore the factors contributing to overweight and underweight conditions. These may include dietary habits, physical activity levels, socioeconomic status, psychological factors, and genetic predisposition. Unhealthy eating patterns, increased consumption of processed foods, sedentary lifestyles, and irregular daily routines are probable contributors to abnormal BMI values. The growing prevalence of lifestyle-related disorders in recent years further emphasizes the importance of early identification and preventive strategies.

Comprehensive health education, nutritional counselling, and lifestyle modification programs should be implemented to promote optimal BMI and reduce the risk of long-term health complications.

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