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The Role of Balanced Nutrition Knowledge in Influencing Nutritional Status and Health Risks: A Literature Review

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ABSTRACT

Balanced nutrition is a key factor in maintaining health and preventing various nutrition-related diseases. An imbalance between nutrient intake and requirements can lead to malnutrition, either in the form of undernutrition or overnutrition. This condition contributes to an increased risk of non-communicable diseases such as obesity, diabetes, and hypertension. Good nutritional knowledge plays a crucial role in shaping healthy eating patterns and maintaining optimal nutritional status. Additionally, various factors such as dietary reference intake, nutrient absorption physiology, and intake control also influence an individual's nutritional balance. Physical activity also plays an important role in maintaining energy balance and body weight, thereby helping to prevent malnutrition and health disorders.This article reviews various aspects of balanced nutrition, including fundamental concepts, factors influencing nutritional status, health risks associated with nutritional imbalances, and the role of physical activity in maintaining nutritional balance. A deeper understanding of these aspects is expected to raise awareness of the importance of balanced nutrition in daily life.

Keywords : balanced nutrition, nutritional status, malnutrition, physical activity

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INTRODUCTION

Balanced nutrition is a key factor in maintaining health and preventing various nutrition-related diseases. An imbalance between nutrient intake and requirements can lead to health disorders, both in the form of undernutrition and overnutrition. Malnutrition, which includes micronutrient deficiencies, obesity, and other metabolic diseases, remains a global challenge with widespread impacts on quality of life and public well-being[1]. WHO data in 2022 indicates that 390 million adults are underweight, while 2.5 billion are overweight, with 890 million suffering from obesity. In Indonesia, the 2023 Indonesian Health Survey (SKI) reported that only 54.4% of the population had a normal body weight, while 14.4% were overweight, 23.4% were obese, and 7.8% were underweight[2].

Good nutritional knowledge plays a crucial role in shaping healthy eating patterns and maintaining optimal nutritional status. Individuals with a strong understanding of balanced nutrition are more likely to choose foods that meet their body's needs, thereby reducing the risk of metabolic disorders[3]. Additionally, other factors such as dietary reference intake, physiological processes of nutrient absorption, and intake control mechanisms also contribute to determining an individual's nutritional balance. Various social factors, including eating habits, access to nutritious food, and economic conditions, also influence an individual's nutritional status. Long-term nutritional imbalances can increase the risk of non-communicable diseases such as obesity, diabetes, and hypertension[4].

In addition to diet, physical activity plays an important role in maintaining energy balance and body weight. Doing physical activity regularly can help control body weight, increase metabolism, and prevent various non-communicable diseases such as diabetes mellitus and hypertension[5]. Therefore, a deep understanding of the relationship between balanced nutrition, nutritional status, and the factors that influence it is very necessary to improve the quality of life and prevent the negative impacts of malnutrition.

DISCUSSION

Balanced Nutrition

Balanced nutrition is a concept that emphasizes the importance of nutrient intake that aligns with the body's needs to support growth, development, and optimal health maintenance. A diet structured based on a balance between the types and amounts of nutrients according to the body's requirements helps ensure its optimal function, making it a key aspect of adopting a balanced nutritional lifestyle. This approach includes maintaining a balance between energy intake and expenditure, as well as ensuring the adequacy of various nutrients, including macronutrients and micronutrients, to sustain health and prevent diseases caused by nutritional imbalances[1].

According to the Indonesian Ministry of Health[5], balanced nutrition refers to a daily food arrangement that contains nutrients in the types and amounts that are appropriate for the body's

needs.This is achieved by following the principles of a diverse diet, engaging in physical activity, practicing clean living habits, and regularly monitoring body weight to maintain a healthy weight, prevent nutritional issues, and support the body's immune system. There are several things that need to be understood to learn about balanced nutrition, including the four pillars of balanced nutrition as follows: (1) Consuming a variety of foods. Consuming a balanced menu involves more than just one type of food. (2) Practicing a clean and healthy lifestyle to avoid diseases such as infections caused by germs, bacteria, or viruses. (3) Engaging in physical activity. Excessive nutrient intake must be balanced with physical activity to avoid increasing the risk of obesity, heart disease, and other serious illnesses. (4) Maintaining an ideal body weight. Body weight must be regularly monitored to avoid underweight or even obesity, which can lead to various health issues[6]. By applying these principles, individuals can ensure that their daily nutritional needs are met in terms of both quantity and quality, thus preventing health problems caused by nutrient deficiencies or excesses.

The level of nutritional knowledge greatly influences a person's attitude and behavior in making food choices. Nutrition knowledge reflects an individual's awareness of the concept of healthy food, a diet that suits individual needs, and its impact on body functions and psychological conditions. Individuals with a good understanding of nutrition tend to be more selective in consuming food, considering the balance between the quality and quantity of intake. Adequate nutrition knowledge also plays a role in determining which foods should be consumed regularly, limited, or avoided to prevent nutrient deficiencies or excesses that could negatively affect health[7].

One aspect studied in nutrition science is the balanced nutrition guidelines. According to the Indonesian Ministry of Health[5], these guidelines form the foundation for selecting and consuming food and beverages that meet the body’s needs proportionally. The balanced nutrition guidelines maintain a balance of nutrients in the body to avoid problems related to both deficiencies and excesses. The principle of food diversity in these guidelines encourages the variation of nutrient-rich foods, ensuring the body receives a complete nutritional intake. Physical activity is also a key element in maintaining nutritional balance. Consuming a variety of foods is a key pillar of the balanced nutrition guidelines. The body requires various nutrients from food, including carbohydrates, proteins, fats, vitamins, and minerals. Vegetables and fruits are highly recommended, with a portion of 400–600 grams per day. Additionally, the consumption of sugar, salt, and fats should be limited to 50 grams, 2000 mg, and 67 grams per day, respectively, to prevent the risk of non-communicable diseases such as diabetes and hypertension.

In addition to diet, clean living behavior is also an important factor in maintaining nutritional health. Infections caused by unsanitary environments can affect an individual's nutritional status. Therefore, habits such as washing hands with soap, covering food to avoid contamination, and wearing footwear to prevent parasitic infections are highly recommended. Adequate physical activity is also necessary to maintain energy balance and prevent obesity. Exercising for at least 30 minutes per day,

3–5 times a week, can boost the body's metabolism and reduce the risk of chronic diseases. The last pillar of the balanced nutrition guidelines is the regular monitoring of body weight. Maintaining weight within the normal body mass index (BMI) range is essential to prevent various health issues caused by both nutrient excesses and deficiencies. These guidelines can be applied to all age groups, including adolescents and adults, with adjustments for individual nutritional needs and lifestyles[1,5].

Nutritional Adequacy Rates at Different Ages

According to the Nutritional Adequacy Rate (Table 1), each age group has different nutritional requirements based on their stage of development and metabolic activity.

Table 1. Nutritional adequacy rate

Age group	Energy (kcal/day)	Protein (g/day)	Fat (g/day)	Carbohydrates (g/day)	Fiber (g/day)	Water (ml/day)
Children						
1-3 years	1350	20	45	215	19	1150
4-6 years	1400	25	50	220	19	1450
7-9 years	1650	40	55	250	23	1650
Male						
10 - 18 years	2000-2650	50-75	65-85	300-400	28-37	1850-2300
19 - 29 years	2650	65	75	430	37	2500
30 - 49 years	2550	65	70	415	36	2500
≥ 50 years	1600-2150	65	45-60	235-340	22-30	1600-2500
Female						
10 - 18 years	1900-2100	55-65	65-70	280-300	27-29	1850-2150
19 - 29 years	2250	60	65	360	32	2350
30 - 49 years	2150	60	60	340	30	2350
≥ 50 years	400-1800	58-60	40-50	200-280	20-25	1400-2350

Source: WHO, 2022[4]

For individuals aged 19–29 years, energy needs range from 2,250 to 2,650 kcal per day, with a protein intake of approximately 60–65 grams, fat intake of 65–75 grams, and carbohydrate intake of 360–430 grams. Moreover, consuming sufficient fiber and water is essential for supporting digestive health and maintaining a healthy metabolism.

For children, energy and nutrient requirements are lower than those of adults but remain essential for optimal growth and development. Children aged 1–3 years require approximately 1,350 kcal per day, with 20 grams of protein and around 45 grams of fat. As age increases, energy needs rise; for example, children aged 4–6 years require 1,400 kcal with 25 grams of protein per day. Children aged 7–9 years need 1,650 kcal with 40 grams of protein per day, while adolescents (10–18 years) require between 2,000 and 2,650 kcal with 50 and 75 grams protein per day, depending on gender and physical activity levels.

For young adults (30–49 years), energy requirements slightly decrease compared to the 19–29 age group due to a slowing metabolism. Males in this age range require around 2,550 kcal, while females need approximately 2,150 kcal per day. Protein intake remains important, with a

recommendation of around 60–65 grams per day, along with balanced fat and carbohydrate consumption to maintain metabolic health[5].

Meanwhile, in the elderly population (≥50 years), energy requirements further decline due to reduced muscle mass and lower physical activity.The average daily energy requirement is 2,150 kcal for men aged 50–64 years and approximately 1,800 kcal for women in the same age group. For those over 65 years, the figures decrease even further, with men requiring approximately 1,800 kcal and women around 1,550 kcal. Adequate protein intake remains crucial to prevent muscle loss (sarcopenia), with a recommended intake of 58–60 grams per day. Furthermore, consuming fiber, vitamin D, and calcium is essential for maintaining bone health and lowering the risk of osteoporosis and other degenerative diseases. Thus, meeting nutritional adequacy levels according to age is essential for maintaining health and preventing various chronic diseases in the future. A balanced diet that includes sufficient macronutrients and micronutrients can help individuals at every age achieve optimal quality of life[1,5].

Physiology of Nutrient Absorption

Nutrient absorption is a complex process that occurs throughout the digestive tract, primarily in the small intestine. This stage begins with mechanical and chemical digestion in the mouth, stomach, and small intestine before nutrients can enter the bloodstream or lymphatic system. Macronutrients like carbohydrates, proteins, and fats need to be broken down into simpler forms to aid absorption. Carbohydrates are converted into monosaccharides, such as glucose and fructose, with the help of amylase and other specific enzymes. Proteins are broken down into amino acids by the action of pepsin in the stomach and proteases in the small intestine. Meanwhile, fat absorption plays a crucial rolefor maintaining energy balance and supporting various vital physiological functions. The digestion process begins in the stomach, where gastric lipase starts breaking down triglycerides. However, the majority of fat digestion occurs in the small intestine with the help of pancreatic enzymes and bile salts[8].

After nutrients are broken down, absorption takes place through various mechanisms, including passive diffusion, facilitated diffusion, active transport, and endocytosis. Glucose and amino acids are mainly absorbed through sodium-dependent active transport, whereas fructose is absorbed via facilitated diffusion. Emulsified fats form micelles that pass through the intestinal epithelial cell membrane via passive diffusion and are then reassembled into chylomicrons before entering the lymphatic system. In addition to macronutrients, micronutrients such as vitamins and minerals also have specific absorption mechanisms. Water-soluble vitamins, such as vitamin C and B-complex vitamins, are absorbed through passive diffusion or active transport, whereas fat-soluble vitamins (A, D, E, and K) combine with fats in chylomicrons to enter the lymphatic system[9].

The small intestine, particularly the duodenum and jejunum, is the primary site of nutrient absorption due to its large surface area, which is enhanced by the presence of villi and microvilli. This

structural adaptation increases the absorptive surface area, enabling efficient nutrient absorption. Factors such as intestinal pH, enzyme availability, and nutrient interactions also influence absorption efficiency. For example, iron is more easily absorbed in an acidic environment, whereas calcium requires vitamin D for optimal absorption. Vitamin D plays a well-recognized role in calcium homeostasis, contributing to bone health by enhancing calcium absorption in the intestine, reducing calcium loss through urine, and mobilizing calcium stored in bones. However, vitamin D receptors are widely distributed throughout the human body, and vitamin D itself has various non-calcemic functions that enhance its absorption[10]. Additionally, digestive disorders such as lactose malabsorption (LM), celiac disease (CD), non-celiac gluten sensitivity (NCGS), and irritable bowel syndrome (IBS) can impair this process and lead to nutrient deficiencies[11].

Once absorbed, nutrients are transported to the liver via the portal vein for further processing. The liver plays a crucial role in metabolism and nutrient distribution throughout the body according to physiological needs. Glucose can be stored as glycogen, amino acids can be used for protein synthesis or converted into energy, while fats can be transformed into lipoproteins for transport to other tissues. Thus, nutrient absorption is a critical stage in meeting energy needs and supporting overall metabolic functions[12].

Physiology of food intake control

An individual's food intake is controlled by a complex physiological mechanism that involves interactions between the central nervous system, hormones, as well as environmental and psychological factors. The hypothalamus serves as the primary center for energy balance regulation and appetite control. It receives signals from various organs, including the gastrointestinal tract, adipose tissue, and pancreas, which convey information about the body's energy status. Two primary groups of neurons in the hypothalamic arcuate nucleus (ARC), pro-opiomelanocortin (POMC)-expressing neurons and neuropeptide Y/agouti-related peptide (NPY/AgRP) neurons, function antagonistically to regulate appetite[13]. Peripheral signals such as leptin and insulin play a crucial role in controlling food intake. Leptin, produced by adipose tissue, acts as a satiety signal by inhibiting NPY/AgRP neurons and stimulating POMC neurons to suppress appetite. In contrast, ghrelin, secreted by the stomach before meals, acts as a hunger signal by stimulating NPY/AgRP neurons, thereby increasing food intake[14].

In addition to hormonal regulation, neurotransmitters and dopaminergic pathways in the brain also affect eating behavior. Dopamine is crucial in controlling motivation and the reward system associated with food consumption. Eating foods high in sugar and fat can stimulate dopamine release in brain regions like the nucleus accumbens, producing pleasurable feelings and possibly leading to overeating or food addiction. This process plays a role in the development of obesity and eating disorders, such as binge eating disorder[15].

Nutritional status (definition, measurement, and classification)

Nutritional status refers to an individual's physiological condition, which is influenced by the balance between nutrient intake, the body's requirements, and its ability to digest, absorb, and utilize nutrients[16]. This balance is crucial to support various biological functions, including growth, development, metabolism, and the immune system. If nutrient intake meets the body's needs, an individual can maintain optimal nutritional status and good health. On the other hand, a mismatch between intake and nutritional needs can result in nutritional disorders that adversely affect overall physical condition and health. The determination of an individual's nutritional status is conducted through a nutritional assessment that includes various evaluation methods. This assessment consists of several main approaches, namely anthropometric measurement, biochemical analysis, dietary intake assessment, clinical health examination, and physical activity evaluation.

Anthropometric measurements involve parameters such as body weight, height, waist circumference, and upper arm circumference. Meanwhile, biochemical analysis includes examinations of hemoglobin levels, vitamin A, blood sugar, and cholesterol in the body. In addition, dietary intake is assessed using a food frequency questionnaire or a 24-hour dietary recall method. Clinical examinations include blood pressure measurement and an individual's medical history. Physical activity is also an important factor in nutritional assessment, which can be measured through physical activity recall, heart rate monitoring, and the use of devices such as accelerometers. One of the most frequently used methods in assessing nutritional status is anthropometric measurement, particularly through the calculation of Body Mass Index (BMI). BMI is determined based on the ratio of body weight to the square of an individual’s height and serves as a general indicator of nutritional status. Linear growth and body tissue mass can be evaluated using this method, as linear growth reflects an increase in bone length, while tissue mass growth represents changes in muscle and body fat. Tissue mass is associated with body circumference and weight, providing insight into an individual’s nutritional condition[17].

According to the Indonesian Ministry of Health[5], adult nutritional status is classified based on Body Mass Index (BMI) values. The BMI categories include underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-26.9 kg/m²), and obesity (≥27.0 kg/m²).Although BMI is a simple and easily applicable method, it has limitations as it cannot specifically identify body fat distribution. To assess central obesity, waist circumference measurement is required. Men are classified as having central obesity if their waist circumference is ≥90 cm, while for women, the threshold is ≥80 cm.

Anthropometric methods offer several advantages, such as their simplicity, low cost, and safety for application in various populations. However, these methods also have certain limitations, including their inability to detect specific nutrient deficiencies an individual may experience. Additionally, the accuracy of anthropometric results largely depends on the examiner's skill in using measurement tools and following proper procedures. Therefore, a comprehensive nutritional assessment requires a combination of multiple methods to obtain a more accurate representation of an individual's nutritional status[18].

Factors Influencing Nutritional Knowledge and Its Relationship with Nutritional Status

Balanced nutrition knowledge plays a crucial role in determining an individual's nutritional status and overall public health. Globally, various studies have examined the relationship between balanced nutrition knowledge and nutritional status, yielding diverse results. Several factors influence an individual's nutritional knowledge, including education, mass media, social support, and gender. These factors contribute to shaping an individual's understanding and awareness of nutrition and healthy eating habits. Education is a primary factor affecting nutritional knowledge levels. Individuals with higher education levels have greater access to information sources such as books, seminars, and other educational media. Research also suggests that women generally possess better nutritional knowledge than men, as they tend to be more proactive in seeking information about healthy eating patterns[7].

Numerous studies have highlighted the relationship between nutritional knowledge and nutritional status. For instance, a study found a significant correlation between nutritional knowledge and adolescent nutritional status, with a p-value of 0.003[19]. Similarly, reported that increased nutritional knowledge was associated with better nutritional status in adolescents [20]. However, not all studies have shown consistent results. A study by Angesti and Manikam[21] found no significant relationship between nutritional knowledge and the nutritional status of final-year university students, with a p-value of 0.619. This suggests that while nutritional knowledge is important, other factors such as eating habits, physical activity, and environmental influences also play a role in determining an individual's nutritional status. Hence, a holistic approach is required to improve public nutritional status.

Although nutritional knowledge is closely related to nutritional status, research indicates that understanding nutrition does not always translate into the adoption of healthy eating behaviors. Many individuals with good nutritional knowledge still consume unhealthy foods and beverages, such as sugary drinks and ultra-processed foods. One study emphasized the importance of effective methods for assessing food literacy, which includes understanding nutrient composition, food labeling, and the ability to apply healthy eating patterns. The validated food literacy scale can be used to evaluate and enhance public understanding of nutrition[22]. Therefore, raising awareness and implementing effective nutrition education is essential to encourage healthier eating behaviors and improve public nutritional status.

Health risks due to nutritional imbalance

Overnutrition, especially when it leads to obesity, raises the risk of several non-communicable chronic diseases, including type 2 diabetes, hypertension, cardiovascular diseases, and cancer. Insulin resistance caused by the accumulation of free fatty acids can lead to glucose metabolism disorders and elevated blood sugar levels, resulting in diabetes. Additionally, obesity activates the renin-angiotensin-aldosterone system (RAAS), increasing blood pressure and leading to hypertension. One of the risk factors for hypertension is hypercholesterolemia, which contributes to atherosclerosis, increasing

peripheral resistance and blood pressure[23]. In the long term, excess fat can also impair heart function due to mitochondrial dysfunction in cardiomyocytes, further contributing to atherosclerosis, a major factor in cardiovascular diseases. Moreover, obesity is linked to increased pro-inflammatory cytokines and oxidative stress, which can trigger DNA mutations and elevate the risk of cancer in various organs[4].

On the other hand, undernutrition can lead to metabolic disorders, weakened immune function, muscle loss, digestive issues, and delayed wound healing. Deficiencies in essential nutrients, such as protein, zinc, and vitamin A, impair immune response and increase infection risk. Inadequate protein intake also hinders muscle synthesis, causing sarcopenia and reducing physical strength. Digestive system disorders can result from intestinal villi atrophy and microbiota imbalance, leading to nutrient malabsorption. Additionally, deficiencies in vitamin C, vitamin A, and protein hinder collagen synthesis and tissue regeneration, slowing wound healing and increasing infection and complication risks[7].

Malnutrition

Malnutrition is a condition that occurs due to an imbalance between nutrient intake and the body's needs, which can manifest as nutrient deficiency or excess. According to the European Society for Clinical Nutrition and Metabolism (ESPEN), malnutrition or undernutrition is defined as "a condition resulting from inadequate intake or absorption of nutrients, leading to changes in body composition (loss of fat-free mass) and body cell mass, which in turn causes declined physical and mental function and worsens clinical outcomes of diseases"[24]. Malnutrition can result from various factors, including poor socioeconomic conditions, chronic illnesses, digestive disorders, or prolonged inflammation that raises the body's metabolic demands[25].

Aside from undernutrition, malnutrition also includes overnutrition, which occurs when energy intake exceeds the body's needs, potentially leading to obesity and various metabolic complications. Obesity is closely linked to an increased risk of chronic diseases such as type 2 diabetes mellitus, hypertension, and cardiovascular diseases[4]. Therefore, malnutrition does not only involve nutrient deficiencies but also nutritional imbalances that negatively impact health. Early detection and appropriate intervention are crucial in preventing and improving an individual's nutritional status.

Physiology of malnutrition: between obesity and undernutrition

Obesity occurs due to an energy imbalance, where energy intake exceeds energy expenditure. Energy derived from carbohydrates, proteins, and fats that is not utilized will be stored as triglycerides and glycogen in adipose tissue. Each adipocyte (fat cell) has a maximum storage capacity of approximately 1.2 mg of triglycerides. If this storage capacity is exceeded, the body will stimulate the formation of new adipocytes as additional storage sites. Fat has a high energy density (9 kcal per gram), making it an efficient energy storage source, but it is more difficult to access and metabolize compared to energy from carbohydrates or proteins. As a result, individuals who experience chronic energy

surplus are at risk of progressive weight gain leading to obesity[7].

There are two types of obesity: android obesity and gynoid obesity. Android obesity, also known as central obesity, is characterized by fat accumulation predominantly in the abdominal area and around internal organs (visceral fat). This type of obesity is associated with an increased risk of metabolic diseases, including insulin resistance, type 2 diabetes, hypertension, coronary heart disease, and stroke. Visceral fat is more metabolically active than subcutaneous fat and can secrete various inflammatory compounds and hormones that contribute to insulin resistance and metabolic dysfunction. Meanwhile, gynoid obesity is characterized by fat accumulation mainly in the hips and thighs. Although gynoid obesity poses a lower health risk compared to android obesity, it can still have negative health effects if not properly managed[4,5].

On the other hand, when energy intake is lower than the body's needs, the body starts utilizing stored energy in adipose tissue. This process is called lipolysis, where triglycerides in adipocytes are broken down into fatty acids and glycerol to be used as an energy source by various body tissues.In cases of prolonged energy deficits, adipocyte size decreases as fat stores are depleted. If this energy deficiency continues without adequate compensation through sufficient food intake, an individual may experience significant weight loss. Moreover, not only fat stores are reduced, but muscle mass may also shrink, especially if energy deficiency persists over the long term[4].

Malnutrition due to prolonged energy deficiency can have serious health impacts. Individuals suffering from malnutrition caused by energy deficiency often exhibit a weakened immune system, organ dysfunction, and an increased risk of infections and chronic diseases. Additionally, if essential nutrients such as proteins, vitamins, and minerals are also lacking, individuals may experience growth disorders, cognitive decline, and prolonged fatigue. Therefore, maintaining a balance between energy intake and expenditure is crucial to prevent various health problems related to malnutrition, whether due to excess or deficiency of nutrients[4].

The relationship between physical activity and nutritional metabolism balance

Physical activity is any bodily movement produced by skeletal muscles that increases energy expenditure above the basal (resting) level, including activities like house cleaning and gardening. On the other hand, exercise is a subset of physical activity, as it is a planned, structured, and systematic activity performed regularly to maintain or improve physical fitness. Common forms of exercise include aerobic exercise, resistance training, and flexibility exercises. Aerobic activities, such as running, jogging, and swimming, enhance cardiovascular health and promote calorie expenditure. Resistance training, such as weightlifting, increases muscular strength and supports bone density. Flexibility exercises, including yoga and Pilates, improve joint mobility and decrease the risk of injury[26].

Moreover, engaging in daily physical activity at a sufficient level can improve heart health, metabolism, physical and mental well-being, all of which play an important role in enhancing individual

well-being and quality of life[27]. In this case, physical activity is closely related to nutrient metabolism, as it influences the utilization of nutrients in skeletal muscles and adipose tissue, which helps boost metabolism and plays a vital role in managing obesity and type 2 diabetes[28]. Regular physical activity can enhance nutrient metabolism by increasing the body's ability to utilize nutrients optimally in maintaining health and managing metabolic disorders. Physical activity combined with healthy nutrition can result in optimal health[29].

A lack of physical activity can trigger an inflammatory cycle in the body, one of the consequences of which is obesity and fat accumulation[30]. Although obesity is associated with an increased risk of serious health problems, weight loss remains one of the most important reasons why overweight or obese individuals engage in exercise or physical activity. The fitness industry offers weight loss training programs targeting individuals based on their specific goals. Regular physical activity is linked to significant health benefits, including improvements in psychological, neurological, metabolic, cardiovascular, respiratory, and musculoskeletal conditions.

Despite the numerous benefits of physical activity (exercise), it is often ineffective in balancing weight, and some individuals lose less weight than expected based on measured energy expenditure[31]. Physical activity can enhance the production and balance of anti-inflammatory myokines, which play a significant role in metabolism. Physical activity should be tailored to individual health factors as a basis. A physical activity plan outlines the type, frequency, duration, and intensity of exercise[27]. Overweight or obesity is often described as an imbalance between energy consumed and energy expended through resting metabolism, spontaneous physical activity, and exercise as an individual effort to achieve recommended weight loss. The energy balance equation is described as energy intake = energy expenditure[32]. Food intake should be adjusted according to the energy expended[33].

Physical activity has generally been shown to regulate appetite. The appetite-suppressing effects become evident when individuals consistently engage in moderate- to high-intensity physical activity (exercise), leading to a shift toward healthier eating patterns. Appetite regulation is controlled by a complex hormonal system involving peptide YY, ghrelin, insulin, and glucagon. A combination of physical activity and diet is an optimal intervention for managing energy balance and body weight[32]. The amount of energy expended during exercise depends on the type, frequency, intensity, and duration of the activity[31]. Regular physical activity is essential for maintaining balanced nutritional status, as it influences dietary habits, nutrient intake, and energy requirements, ultimately supporting physical fitness, endurance, and overall health while reducing the risk of health disorders[34].

CONCLUSION

Balanced nutrition plays a crucial role in maintaining health and preventing various nutrition-related diseases. A review of the literature indicates that an imbalance between nutrient intake and the body's needs can lead to malnutrition, either in the form of undernutrition or overnutrition. This

condition significantly increases the risk of non-communicable diseases such as obesity, diabetes, and hypertension, which have become global health issues, including in Indonesia. Nutritional knowledge plays a key role in shaping healthy eating patterns. Individuals with a good understanding of the principles of balanced nutrition are more likely to make dietary choices that align with their body's needs, thereby reducing the risk of metabolic disorders. Furthermore, nutritional status and health outcomes are also influenced by various other factors, including dietary diversity, physical activity levels, and socioeconomic conditions. Consistent physical activity is crucial for maintaining energy balance and preventing obesity, as it enhances metabolism and supports overall well-being.

The physiological process of nutrient absorption is a complex aspect that plays a vital role in ensuring the body effectively utilizes consumed nutrients. Understanding this process can help individuals appreciate the importance of a balanced diet and recognize the potential consequences of nutritional imbalances on health. Ultimately, it is essential to raise awareness and a deeper understanding of balanced nutrition and its impact on health. This knowledge can empower individuals to make healthier choices, ultimately contributing to improved nutritional status and reduced health risks associated with malnutrition. By emphasizing a balanced diet and regular physical activity, individuals can enhance their quality of life and contribute to a healthier society as a whole.

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