Paradigm Change to Future Health Enhancement through Comprehending the Concept of Obesity Disease in Japan

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Abstract

The prevalence of obesity is rapidly increasing worldwide. Obesity greatly increases health care costs because of associated complications. Illnesses related to obesity include impaired glucose tolerance, hypertension, and cardiovascular disease. Obesity also increases the risk of developing type II diabetes. Mild obesity, as well as severe obesity, may result in development of obesity associated diseases, where a person suffers from health problems that are caused by or related to obesity. Obesity disease is differentiated from obesity, which is not accompanied by health problems that represent risk factors for various diseases. Development of obesity disease needs to be prevented or mitigated through a reduction in weight. For individuals who are obese, awareness of the concept of obesity disease could help in selecting appropriate treatment. The Japan Society for the Study of Obesity recommends that researchers and physicians fully comprehend the concepts of obesity and obesity disease. Treatment paradigms and therapeutic focuses are constantly changing, and this knowledge needs to be disseminated to individuals with obesity, regardless of whether they have health problems. This review discusses the concepts of obesity and obesity disease. The role of adipose tissue in metabolic complications due to obesity, as well as prevention and treatment of metabolic complications are also discussed with respect to improving health. The main aim of this review is to assist reader to determine the level of risk associated with obesity disease and obesity-related complications.

Keywords: Obese with health problems; Type II diabetes; Metabolic complications; Body mass index; Nagoya Declaration 2015; Adipocytes

Introduction

The term obesity implies excessive body fat for an individual’s build [1,2]. The term body mass index (BMI) is used for assessment of the presence of overweight and obese individuals [3-5]. Obesity is a more extreme problem than overweight. BMI itself does not denote individuals who are overweight and obese. According to the World Health Organization (WHO) criteria for obesity, individuals who have a BMI of 25 to less than 30 kg/m² are pre-obese, and individuals who have a BMI of 30 kg/m² or greater are obese [1,2].

Table 1 shows the BMIs that correspond to individuals who are underweight compared with those that correspond to individuals who are morbidly obese. Without just applying WHO criteria, according to the Japan Society for the Study of Obesity, a BMI of greater than 25 kg/m² classifies the corresponding individual as obese [3]. Not only severe obesity, but also mild obesity, may easily result in development of obesity disease among the Japanese population [6-8]. The prevalence of obesity continues to markedly increase worldwide [9,10]. Recent data regarding the prevalence of obesity in Japan are listed in Table 2 [3,11].

In this report, the author provides an up-to-date and concise review of the concept of obesity and obesity disease, with the aim of guiding the reader through the Nagoya Declaration 2015 (Figure 1), where the concept of obesity disease has been globally proposed [12]. Prevention and control of obesity-related complications are also discussed with respect to enhancing future health.

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Table 1: Body mass index (BMI) for pre-obesity and obesity (BMI>25 kg/m²).

| WHO criteria | Body mass index (BMI) (kg/m²) | Japan criteria |
|--------------|------------------------------|----------------|
| Underweight  | Less than 18.5               | Underweight    |
| Normal range | 18.5 to 24.9                 | Normal weight  |
| Pre-obese    | 25.0 to 29.9                 | Obese (level 1) |
| Obese class 1| 30.0 to 34.9                 | Obese (level 2) |
| Obese class 2| 35.0 to 39.9                 | Obese (level 3) |
| Obese class 3| 40.0 and greater             | Obese (level 4) |

Role of adipose tissue in metabolic complications due to obesity

Obesity is the leading cause of insulin resistance and a major contributing factor to metabolic complications [13,14]. Enlargement of fat cells and an increase in the number of fat cells are associated with obesity. Fat cells are present in adipose tissue distributed throughout the body. Adipose tissue is constructed from fat cells storing lipid droplets, interstitial tissue where fat progenitor cells exist, and the vascular system. Furthermore, adipose tissue comprises at least two types of fat cells, brown and white adipocytes, which have different morphology, distribution, and function [15]. Brown adipocytes perform oxidation of fatty acids derived from triglycerides within cells,
as well as function as energy consumption cells. White adipocytes store redundant energy as triglycerides.

| Age (years) | Obesity prevalence (% of population) |
|------------|-------------------------------------|
|            | Men       | Women     |
| 20-29      | 0.218     | 0.107     |
| 30-39      | 0.254     | 0.133     |
| 40-49      | 0.349     | 0.148     |
| 50-59      | 0.311     | 0.219     |
| 60-69      | 0.287     | 0.215     |
| ≥ 70       | 0.276     | 0.271     |

**Table 2**: The prevalence of obesity in Japan. Data were modified from the National Health and Nutrition Survey 2015 by the Ministry of Health, Labour and Welfare [3, 11].

In addition to the function mentioned above, white adipocytes also function as endocrine cells and secrete signal molecules called adipocytokines. These adipocytokines include leptin, tumor necrosis factor, free fatty acids, and plasminogen activator inhibitor. An enlarged fat cell secretes adipocytokines after large quantities are produced, affecting signal transduction of insulin in the skeletal muscle and liver, which further result in the induction of insulin resistance. This situation occurs because of obesity-induced insulin resistance. Additionally, adipose tissue is not only an energy reservoir, but also a secretory endocrine organ that can produce cytokines, hormones, and proteins that affect cells and tissues throughout the body [16,17].

**Figure 2**: Photomicrographs of rat white preadipocytes (A) and adipocytes (B). White preadipocytes were isolated from the visceral fat of rats and cultured and passaged twice. With regard to morphology, most preadipocytes were fibroblast-like cells. Confluent cells were cultured in a differentiation medium.

Adipose tissue was once considered to be an inactive storage depot, but it shows a lot of metabolic activity. Fat is continuously being stored in and released from the adipose tissue. Insulin is responsible not only for moving glucose into muscle cells, but also for promoting glucose uptake by fat cells. Once glucose enters a fat cell, it can be converted to glycogen or fatty acids, which together form triglycerides. Therefore, fat cells affect the levels of triglycerides and free fatty acids, which partly explains why central obesity is a marker of impaired glucose tolerance and a risk factor for obesity-related disorders.

We previously found that thiamine (vitamin B₁) treatment decreases not only body weight but also visceral fat mass and adipocytes size in obesity-related diabetic rats. Absorption of food-derived thiamine, dietary supplements and medicines might be important in preventing and controlling obesity-related metabolic complications.
Obesity accompanied by health problems and medical economic impact

Obesity and metabolic syndrome significantly contribute to health care costs through their associated complications [21]. Some obesity-related illnesses are as follows: (1) type II diabetes, impaired glucose tolerance [22-27], (2) dyslipidemia [28,29], (3) hypertension [30,31], (4) gout [32,33], (5) cardiovascular disease [34-38], (6) cerebral brain infarction [39-41], (7) non-alcoholic fatty liver disease [42-45], (8) menstrual disorder and infertility [46-48], (9) sleep apnea [49-51], (10) degenerative joint disease [52,53], (11) obesity-related chronic kidney disease [54,55], (12) cancer [56-59].

The global epidemic of obesity is also heralding an epidemic of type II diabetes, which is in turn escalating health care costs related to the burden of complications [21]. Obesity is linked with type II diabetes in terms of increasing the risk of developing this condition and its associated morbidity [21]. The annual cost of diabetes worldwide is $825 billion [60,61]. Furthermore, the medical cost soars when the individual is also pre-diabetic. Intensive management of diabetes from the time of diagnosis yields a reduction in the risk of metabolic complications. Changes in therapeutic lifestyle need to be advocated starting to diet and exercise, considering obese individuals on a case-by-case basis is important from a medicoeconomic viewpoint (i.e., based on those who require a preventive intervention and those who should be medically treated). For individuals with obesity, making the concept of obesity disease widely available would contribute to prevention of the development of obesity disease. A healthy diet, regular physical activity, and maintenance of healthy body weight can prevent or delay the onset of obesity-related complications.

Closing Notes

The main aim of this review is to help readers determine the level of risk associated with obesity disease. Obesity affects every organ system in the body and may be the paradigm for obesity disease. The question can be asked whether obesity is a risk factor or a disease. Considering all of the types of obesity as equal is not scientifically appropriate. With regard to weight loss through improvements in lifestyle, such as starting to diet and exercise, considering obese individuals on a case-by-case basis is important from a medicoeconomic viewpoint (i.e., based on those who require a preventive intervention and those who should be medically treated). For individuals with obesity, making the concept of obesity disease widely available would contribute to selection of appropriate treatment. The prevalence of obesity disease is increasing worldwide. The Japan Society for the Study of Obesity recommends that doctors and researchers should fully understand the concepts of obesity and obesity disease. Because treatment paradigms and therapeutic focuses keep changing and evolving, this knowledge needs to be shared with individuals who are obese with or without health problems.

The true and scientific route to our future health enhancement is not only pharmaceutical medicine, but also preventive medicine against obesity disease and metabolic complications. A healthy diet, regular physical activity, and maintenance of healthy body weight can prevent or delay the onset of obesity-related complications.

Conflict of Interest

The author declares that there is no conflict of interest.

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