Obesity, obesity–related diseases and application of animal model in obesity research An overview

Byung-Sung Park† · N. K. Singh* · A. M. M. T Reza*

Department of Animal Biotechnology, College of Animal Life Sciences, Kangwon National University, Republic of Korea
(Received December 8, 2013 : Revised January 3, 2014 : Accepted January 3, 2014)

Abstract: The multi-origin of obesity and its associated diseases made it's a complex area of biomedical science research and severe health disorder. From the 1970s to onwards this health problem turned to an epidemic without having any report of declining yet and it created a red alert to the health sector. Meanwhile, many animal models have been developed to study the lethal effect of obesity. In consequence, many drugs, therapies and strategies have already been adopted based on the findings of those animal models. However, many complicated things based on molecular and generic mechanism has not been clarified to the date. Thus, it is important to develop a need based animal model for the better understanding and strategic planning to eliminate/avoid the obesity disorder. Therefore, the present review would unveil the pros and cons of presently established animal models for obesity research. In addition, it would indicate the required turning direction for further obesity and obesity based disease research.

Keywords: Obesity, obesity–related diseases, animal models of obesity research.

1. Introduction

Obesity is a major health disorder in the present age. Having body mass index (BMI) more than 30 kg/m² is termed as obesity [1]. Research and investigation to explore the mechanism of obesity is one of the top priority areas of biomedical science research. Scientist are struggling to have a suitable solution to the obesity and diseases related to obesity such as hypertension, type 2 diabetes, sleep apnea, certain form of cancers, cardiovascular diseases, liver diseases including liver cirrhosis, premature death, cardiac arrest, infertility, polycystic ovary, respiratory dysfunction, lumbago, muscle weakness and many other diseases [2–3]. Moreover, the severity of obesity is not a single cause: several reasons of obesity have already been established and severe obesity might be the result of any single cause or the cumulative effect of more than one reasons. Defective genetic makeup followed by lack of leptin signaling, β–cells dysfunctions of pancreas and insulin resistance are proven causes of obesity and obesity–derived diseases: all these functions are not controlled by a single gene, it is controlled by more than one genes inherited through ancestors [4]. Beside this, over eating, in particular having food...
contained high animal fat and insufficient physical activity and exercise are also prominent causes of obesity, which is known as diet-induced obesity [5]. There are some other environmental and ambient factors severely affect the mechanism of obesity; these factors include lack of sleep and stressed condition, endocrine disruptions, little fluctuation of ambient temperature, decreased rate of smoking (as smoking directly affects appetite), consumption of medicines that enhance the metabolic activity, pregnancy at the later part of life (cause susceptibility to obesity in children), natural selection for higher body mass index (BMI) and assortative mating [6]. All of the findings related to the obesity are discovered through the animal study that is the animal model of obesity research contributed to point out the reasons behind obesity and also directed towards the strategic planning should be taken to avoid/eliminate the epidemic outbreak of obesity and its associated diseases. Meanwhile, many drugs and therapeutic treatment for human diseases have already been developed using various animal models. [7–12]. Though, different animal model of obesity research has been developed targeting specific research goals, but, neither all expected outcomes have been fulfilled nor the obesity epidemic has been eliminated yet. Therefore, the present review has been done to accumulate the established animal models of obesity research with the successful outcome of that model, to overview the trends of obesity outbreak and obesity research and finally to make interference over the future research directions related to obesity associated diseases and animal models development to enhance obesity research.

2. Current and future trends of obesity epidemic

There was no evidence of severe obesity problem before 1970s, the sudden prevalence of obesity since 1970s without any evidence of decreasing made it a hot concern in biomedical researches [13–14]. The National Health and Nutrition Examination Survey (NHANES) conducted on 2007–2008, showed 50% and 100% increase of obesity compare to 1988–1994 and 1976–1980 respectively [13]. The rapid increase in obesity trend resulted excess weight gain, poor health status, susceptible to complex diseases and increase cost of medicine and treatment. The estimated currency loss due to obesity is around 9% (over $147 billion/year) of total medical cost [15]. Recent studies forecasted that obesity prevalence would be increased by 33% with 130% increase in severity of obesity prevalence by 2030 [16]. If the projected future trends showed of obesity rates come true. If the powerful influences of environments (physical, social and economic environments that favor obesity) become more and more consolidated by the next two decades. That would further hinder the efforts of healthcare cost containment [16].

3. Animal model of human diseases and its classification

The idea of using animal model for the investigation of human diseases developed from need of conducting research as having donor human for experimental purposes is not possible and it creates ethical issues. Therefore, animal models for human diseases are being used since long back. The term animal model refers to the non–human living organism used for the research and investigation of human diseases. Animal models for human diseases enhance better understanding of particular human disease and to test the accuracy of newly developed drugs without having the risk of harming human being [17–18]. Establishment of animal model needs to select