

Calorie Restriction in the Elderly People

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Excessive calorie intake and subsequent obesity is associated with multiple chronic diseases, including type 2 diabetes mellitus, hypertension, dyslipidemia, coronary heart disease, stroke, and some types of cancers such as colon cancer, endometrial cancer, and breast cancer (1). Moreover, obesity is an independent risk factor for the disability and premature mortality.

However, management of the food intake is much neglected by physicians. Furthermore, it is one of the difficult challenges to effectively motivate patients to change their eating behavior for the maintenance or promotion of health. Among the major barriers to counseling patients, physicians' inadequate confidence and lack of knowledge with regards to the optimal food intake is believed to be the main reason for suboptimal recommendation of life style modification in the daily practice.

It has been well established that calorie restriction, defined as a reduction in calorie intake below usual ad libitum intake without malnutrition, slows aging and increases maximum life span in various animal models from yeasts to non-human primates (2). Data from epidemiologic studies also suggest that calorie restriction can have beneficial effects on the factors involved in the pathogenesis of age-associated chronic disease and life expectancy in humans.

Residents of Okinawa in Japan are famous for their longevity, high numbers of centenarians, and accompanying low risk of age-associated diseases. Much of the longevity advantage in Okinawa is believed to be related to a healthy lifestyle, particularly the traditional diet, which is low in calories yet nutritional-dense (3). In addition, the participant of biosphere 2 experienced a forced decrease in calorie intake for 18 months because of an unanticipated decrease in food availability. During the period, the participants consumed a low-calorie (1,750-2,100 kcal/d) nutrient-dense diet, which resulted in a marked reduction of cardiometabolic risk factors such as blood glucose level, lipid profile, and blood pressure (4).

In addition, data from the Calorie Restriction Society who are practicing calorie restriction showed many of the same alterations in metabolic profile and organ function previously reported in calorie restriction rodents, such as low percentage of body

fat, low blood pressures, markedly reduction in plasma cholesterol, increased insulin sensitivity, low plasma concentrations of inflammatory markers, low levels of circulating growth factors, low serum concentrations of T3, and improvement of left ventricular diastolic dysfunction (5, 6). Furthermore, calorie restriction may reverse age-related autonomic decline and improve memory in the elderly people (7, 8).

Although, it has not been fully established yet, it is believed that changes in nutrient-sensing signaling pathways such as target of rapamycin (TOR), insulin/IGF1, FOXO are responsible for the beneficial effects of calorie restriction in the animal models (2). However, it remains unclear whether the signaling pathways are also having similar impacts on human.

There are several issues to be solved before the widespread use of calorie restriction in the elderly people. First, it is not clear whether the association between obesity and adverse outcome is also applicable to the elderly people. The relative risk associated with greater body mass index declined with age (9). In addition, several epidemiologic data showed that overweight is related to the better outcome in the elderly people. Moreover, excessive weight loss in the elderly people is associated with poor clinical outcomes. Accordingly, further studies are required to investigate the association between obesity and clinical outcome in the elderly people.

Second, previous studies reported that excessive calorie restriction more than 45% reduction in calorie intake had serious deleterious effects, including anemia, muscle wasting, neurologic deficits, lower extremity edema, weakness, dizziness, lethargy, irritability, and depression (10). Furthermore, calorie restriction was associated with reduced bone mass as well as lower extremity muscle mass and strength in the elderly people (11). Accordingly, it is uncertain whether calorie restriction has also beneficial effects on the elderly people as the younger counterparts. In addition, the timing and amount of calorie restriction, which have the maximal benefit in human health, has not been fully understood yet. All of these questions should be solved before the widespread recommendation of calorie restriction in the elderly population.

Even though calorie restriction may have some beneficial effects on longevity and age-associated diseases, it is unlikely that such calorie restriction will be widely adopted because of the difficulty in maintaining long-term calorie restriction in modern society. As a result, there has been an increased interest in developing pharmacological agents that act as calorie restriction mimetics. Such agents could provide the beneficial effects of calorie restriction without change of dietary intake (10). Accordingly, calorie restriction mimetics should be considered as an effective alternative for the maintenance of health in the elderly people.

Optimal calorie intake is an important component for the maintenance of health in the elderly people. Insufficient or excessive energy intakes represent different forms of nutritional problem that lead to unfavorable changes in body composition, organ dysfunction, metabolic derangement, and premature mortality.

The precise calorie intake needed for optimal health and function likely varies for each individual, depending on genetic background, age, energy expenditure, comorbidity, and diet composition. Moreover, the optimal calorie intake needed to slow the aging process is not known. However, the available data support the concept that calorie restriction with adequate and balanced nutrient intake in humans causes many of the same metabolic adaptations and reduction of multiple chronic disease risk factors that occur in calorie restricted animal models, even when restriction is started in midlife.

However, there was scanty data supporting the beneficial effect of calorie restriction in the elderly people. Furthermore, some concerns with regards to calorie restriction should be considered before the widespread recommendation of calorie restriction for the health of the elderly people. Accordingly, we need further studies regarding the optimal food intake and the effect of calorie restriction for the promotion of health in the elderly people.

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