

## Chapter 7

# Nutrition for a 100 Year Life



**Abstract** The elderly loses or decline in various physical abilities, suffer from multiple chronic diseases, and have a higher risk of dying. However, even under these circumstances, they can lead independent daily lives and live happily by utilizing their remaining physical and mental functions. Furthermore, even if a person becomes ill and has a disability, it is still possible to be a healthy elderly person. and extending healthy life expectancy means increasing the number of such elderly people.

Energy-restricted diets for adults were effective in preventing obesity and metabolic syndrome, but not for children or the elderly. Energy restriction decreases bone density and increases the risk of sarcopenia and frailty. It is necessary to change gears in the life stage.

**Keywords** Healthy life expectancy · Energy-restricted diets · Sarcopenia · Frailty · Weakness · Nutrition Care Stations

### 7.1 What Is the Extension of Healthy Life Expectancy?

Throughout history, people have wished for health and longevity. This desire is especially strong among the powerful and the rich, and there are many stories from various countries about the search for food and medicine that will would grant health. Immortality, health and longevity. However, unfortunately, no one has yet fulfilled this wish. As long as human beings are living beings, the decline of physiological functions and the end of life due to aging are inevitable realities that come to all of us. In a sense, the search for food and medicine that will give us immortality is a challenge to our fate as living beings, and there is no solution yet. On the other hand our health has improved compared to 100 years ago, and we are able to live an incredibly long life. In other words, immortality is a pipe dream, but there is a good chance that we can extend our healthy longevity, our so-called healthy life expectancy, by improving our health, preventing diseases and advancing medical care.

In 2016, Professors Lynda Gratton and Andrew Scott of the London Business School shocked the world with the publication of “LIFE SHIFT: 100-year life - living and working in an age of longevity - (Toyo Keizai Inc.)”. In developed countries, one out of every two people born in 2007 will live to be 103 years old, or will have a “100 year life”, and Gratton and Scott advocated life planning based on the premise of living for 100 years. The average in Japan is expected to continue to rise, with half of children born in 2007 expected to live to age 107, maintaining the world’s longest life expectancy. In September 2017, the Japanese government launched the Council on the 100-Year Life Era, chaired by Prime Minister Abe, to discuss economic and social systems in a super-longevity society.

### ***7.1.1 The Challenges of a 100 Year Life***

Now, in this super-aged society, can we live a healthy and happy life? What should our pensions, health, medical care, welfare, nutrition and diet be like?

The WHO has released an innovative report on ageing societies, the World Report on Ageing and Health 2015. What is innovative about this report is that it does not convey a sense of doom and gloom about aging societies, as is commonly the case. The report states that “the elderly are not dependents”, “the aging of society will lead to an increase in health care costs, but not as high as expected”, “look to the future, not the past”, “consider spending on the elderly as an investment, not a burdened” [not a burden] “the cost burden of medical care and nursing care for the elderly is overemphasized, and social contributions are underestimated”, “investment should be made in policies that support the elderly as well as efforts to reduce costs”.

### ***7.1.2 New Perspectives on Health***

It is true that the elderly lose or decline in various physical abilities, suffer from multiple chronic diseases, and have a higher risk of dying. However, even under these circumstances, they can lead independent daily lives and live happily if they prevent and treat diseases that are more likely to occur as they age and are able to utilize their remaining physical and mental functions. Furthermore, even if a person becomes ill and has a disability, it is still possible to be a healthy elderly person, and extending healthy life expectancy means increasing the number of such elderly people.

There is another important aspect to the issue. It is health in the context of “extending healthy life expectancy” for the elderly, which is based on a different view of health than that of “health promotion”, which aims to prevent the onset of disease. In other words, just as no one would call a Paralympic athlete who has lost a limb unhealthy, it is advocated that even if a person has cancer, diabetes, heart

disease, kidney disease, etc., he or she should be an energetic elderly person who can do housework, hold a job, and engage in hobbies and volunteer activities. In short, we should aim for a society with a long life expectancy, where both the sick and the disabled can live independently and happily.

## **7.2 Physiological Changes and Nutrition in the Elderly**

With aging, the functions of the whole body decline and the ability to adapt physically, mentally, and to the environment decreases. The changes vary from organ to organ, from person to person and from environment to environment. The physical changes include loss of height, atrophic changes in the intervertebral discs, flattening of the vertebrae, folding of the spine and lower limbs, weight loss, dryness of the skin, and loss of teeth. In terms of motor functions, movements become slow and unstable, and muscular strength and endurance decline. The decrease in muscle mass, which is a component of the body, and the decrease in water storage due to emaciation cause dehydration, and the decrease in bone mass makes the body prone to osteoporosis.

With aging, most organs atrophy, and physiological functions decline overall. However, differences occur among different organs. For example, cardiac output, which is a circulatory function, declines, while narrowing of the lumen of blood vessels and increase in resistance of peripheral blood vessels occur, as well as atrophy and loss of elasticity of the lungs. Among digestive functions, dryness of the oral cavity, decreased secretion of saliva, gastric juice/bile, and pancreatic juice, decreased masticatory function, decreased swallowing reflex, decreased contractility of peristalsis in the esophagus, and further decreased peristalsis in the intestines all occur, resulting in an overall decrease in the digestive and absorption functions.

In addition, decreases in the number of tongue papillae and unguent buds and in taste cell function cause a reduction in the sense of taste, and changes in taste are also observed due to changes in the sense of temperature and erosion pressure of the tongue and oral mucosa. In terms of hematopoietic functions, impairments in red blood cells, hematocrit level, hemoglobin level, serum iron, and iron-binding capacity occur.

As for mental functions, verbal ability, reasoning, and insight are relatively preserved, but nonverbal abilities such as intelligence efficiency, learning efficiency, memorization and recall decline.

### ***7.2.1 Causes of Malnutrition in the Elderly***

In the midst of these physiological changes, the elderly are more likely to suffer from malnutrition. The reason for this is that overall dietary intake declines in old age due to changes in taste, loss of teeth, and decreases in masticatory strength and saliva volume, in motor functions of chewing and swallowing, and in saliva due to

increases in medication and in digestive enzyme activity (Table 7.1). This is also related to a change in the content of the diet from meat dishes to lighter dishes such as seafood and vegetables, and a decrease in the intake of fats and oils, meat, milk and dairy products, and eggs. This leads to a lack of energy intake, protein, fat, vitamins and minerals.

Reduced food intake tends to result in weight loss, especially lean body mass (LBM), as well as in loss of muscle strength and of intercellular water. As muscle strength and physical activity decline, a appetite weakens, and at the same time, muscle mass is lost, causing a lowering of basal metabolism, leading to a negative spiral in which the amount of energy consumed decreases. Ultimately, low nutrition results in lessened vitality, increased fatigue, and a lower quality of life (QOL). Such undernutrition in the elderly increases the risk of developing deficiency diseases such as emaciation, energy and protein deficiency, sarcopenia, iron deficiency anemia, and osteoporosis due to calcium deficiency.

In addition, even if such nutritional deficiencies do not develop, the deficient state will lead to the development of various complaints.

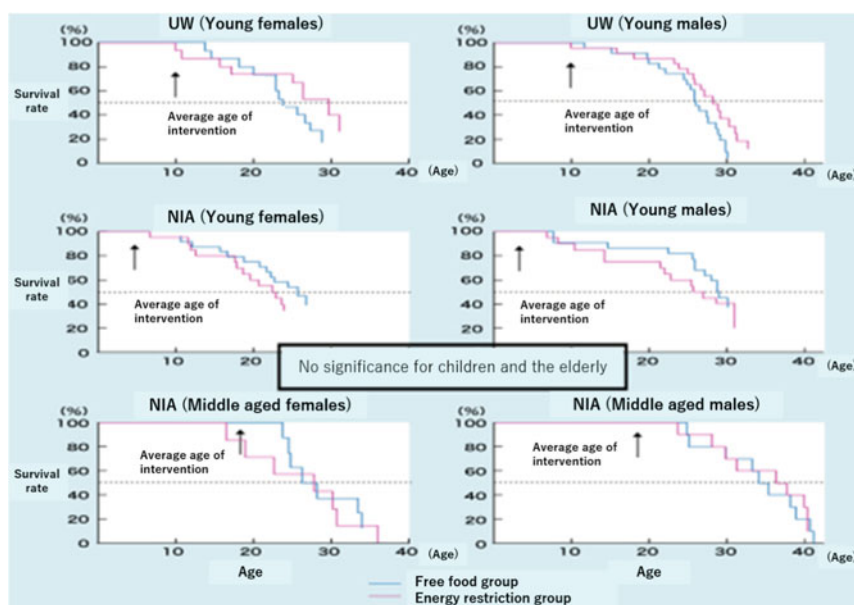
### 7.3 The Risk of Eating in Moderation for Elderly People

Many Japanese people believe that a moderate eating diet is effective for good health and longevity. Is this really true?

In nutritional terms, a moderate eating diet implies an “energy-restricted meal”. In 2009, the University of Wisconsin (UW) in the U.S. announced the longevity effects of an energy-restricted diet on rhesus macaques, after raising them for many years (Fig. 7.1). Both males and females lived longer when maintained on an energy-restricted diet. This result led many researchers to believe that a moderate eating diet is a healthy diet for longevity. However, in 2012, the National Institute on Aging (NIA) in the U.S. reported that an energy-restricted diet was not effective in reducing mortality and extending life span in rhesus monkeys in an experiment similar to that conducted at UW. Why did they get different results from nearly identical experiments? The two groups argued constantly for 5 years. But, deciding not to continue the controversy any longer, the two groups came to the same table, examined the causes in detail, and published a jointly-authored report in 2017.

**Table 7.1** Factors causing decrease in food intake

<b>1</b>	<b>Aging</b>	Loss of appetite, loss of sense of smell and taste
<b>2</b>	<b>Diseases</b>	Mastication and swallowing disorders, digestive disorders, inflammation and cancer, metabolic disorders, side effects of drugs
<b>3</b>	<b>Psychiatric and psychological</b>	Cognitive dysfunction, depression, fear of aspiration and choking
<b>4</b>	<b>Society</b>	Living alone, lack of care, loneliness, poverty
<b>5</b>	<b>Others</b>	Incompatible eating patterns, excessive reaction to obesity and lifestyle-related diseases, faulty nutrition and diet knowledge



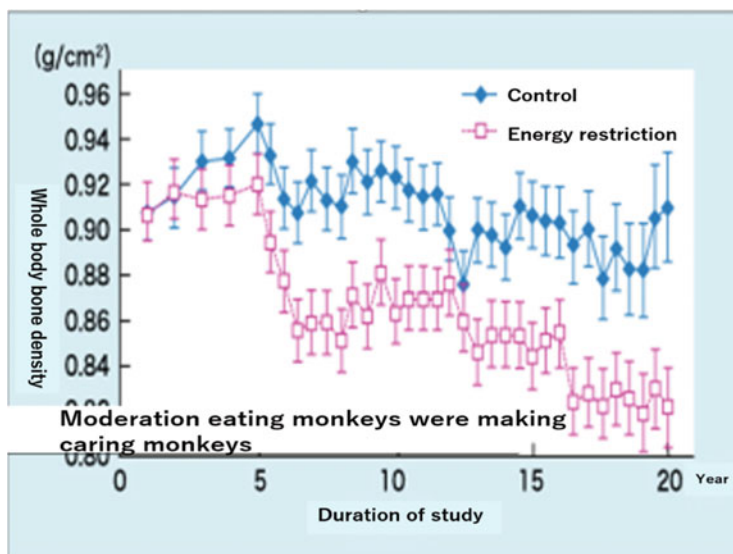
UV study: Survival rates were high for both males and females in young age group 7-15 years (21-30 years in humans).

NIA study: Males have no difference at young ages 1-5 years (human ages 3-15 years), females have lower survival rates. No difference between males and females at 16-23 years (48-69 years in humans).

**Fig. 7.1** Benefits of an energy-restricted diet

### 7.3.1 Pitfalls of Energy Restriction Research

The reason for the different results was simple. It was the difference in age at the start of the energy-restricted diet intervention. That is, the UW study included monkeys aged 7-15 years (21-45 in human years), while the NIA study included monkeys aged 1-5 years (3-15) and 16-23 years (48-69), respectively. In other words, energy-restricted diets for adults were effective in preventing obesity and metabolic syndrome in middle-aged and older adults and were associated with longer life, but not for children or the elderly. In addition, the monkeys that responded well to the energy-restricted diet showed a decrease in bone density, indicating that they had an increased risk of osteoporosis despite their longevity. In the end, a moderate eating diet in the elderly does not lead to longevity, and energy restriction decreases bone density and increases the risk of requiring nursing care (Fig. 7.2).



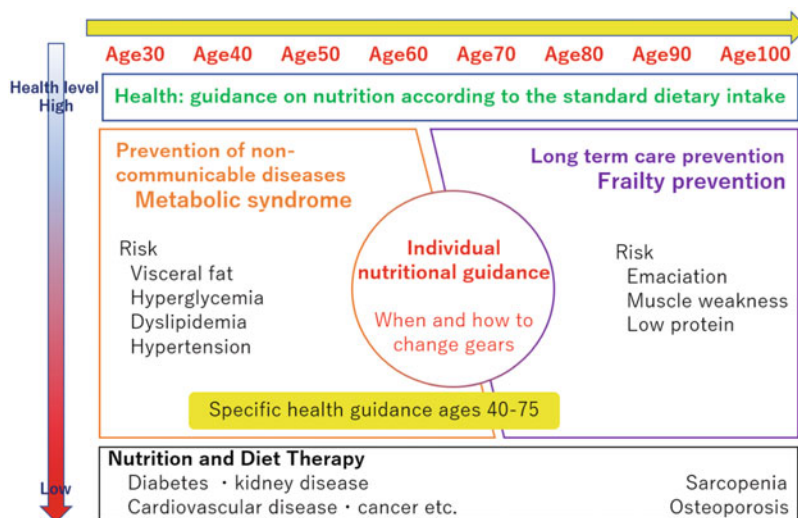
**Fig. 7.2** Loss of bone density due to long-term energy restriction. (UW Study (Age (Dordor) 34:1133–1143, 2012))

## 7.4 Sarcopenia and Frailty

Sarcopenia and frailty are attracting attention as conditions that can lead to the need for nursing care and reduce life expectancy. Sarcopenia refers to the decline in skeletal muscle mass due to aging, with a secondary decline in muscle strength and aerobic capacity. Loss of muscle mass is an essential factor, and sarcopenia is diagnosed if either muscle strength or physical ability deteriorates. On the other hand, “frailty,” which is translated into Japanese as “weakness”, not only refers to a decline in muscle mass and function, but also includes mental frailty, which leads to cognitive loss and depression, and social frailty, in turn leading to withdrawal and decreased communication with others. In other words, while sarcopenia is a disease in which the main symptom is a decrease in muscle mass in all age groups, frailty is a syndrome in which the functions of the entire body decline with aging.

### 7.4.1 Causes of Sarcopenia and Frailty

A common factor that triggers this condition is undernutrition, which is a lack of energy and protein. Undernutrition leads to an increase in fatigue, as well as decreases in vitality, walking speed due to muscle weakness, and activity, which increase the risk of both sarcopenia and frailty, and increase the risk of nursing care.



**Fig. 7.3** Shifting from metabolic syndrome prevention to frailty prevention

In recent years, frailty has received particular attention as we face an aging society. A study has been published that observed men in Scandinavia for a long period of time from the 1970s to 2007. When long-term changes in BMI and the onset of frailty were examined in four groups, there was no relationship between the normal weight-unchanged group, the consistently overweight group, and the weight gain group, but there was a significant increase in the onset of frailty in the weight loss group.

What is important in preventing frailty is prevention of emaciation and muscle loss due to lack of energy and protein, which ultimately means eating well. On the other hand, in order to prevent lifestyle-related diseases, which are non-communicable chronic diseases, it is important for middle-aged and older people to take active measures against metabolic syndrome and control their weight by eating an adequate amount of food. In other words, in order to prevent age-related frailty, it is necessary to eat well and not lose weight, and when one reaches a certain age, it is necessary to change gears (Fig.7.3).

#### 7.4.2 How to Become an Independent Elderly Person

Akihiko Kitamura et al. of the Tokyo Metropolitan Institute of Health and Longevity Sciences observed the incidence of loss of independence, need for long-term care, and death from frailty and metabolic syndrome categories as outcomes in subjects aged 65 years or older who received medical examinations (Table 7.2). The results showed that the more advanced the frailty, the higher the incidence of any of the outcomes. The incidence of loss of independence over a 7-year period was about

**Table 7.2** Incidence of self-loss, long-term care needs and death by frailty category (7 years)

		Frailty category		
		Non-frailty	Pre-frailty	Frailty
Male	<Average age>	<69.5>	<71.1>	<74.8>
	Loss of self	22.8	42.9(1.9)	110.4 (4.9)
	Long-term care required (Including support required)	10.7	24.4(2.3)	77.3(7.2)
	Long-term care required (level 2 or more)	5.0	11.1(2.2)	42.8(8.6)
	All deaths	29.5	53.6(1.8)	124.7 (6.1)
	Deaths from cardiovascular disease	2.9	9.3(3.2)	38.4 (13.3)
Female	<Average age>	<68.7>	<70.9>	<75.7>
	Loss of self	13.6	32.9(2.4)	90.8(6.7)
	Long-term care required (including support required)	11.9	26.7(2.3)	77.4(6.5)
	Long-term care required (2 or more)	5.9	8.8(1.5)	32.0(5.4)
	All deaths	5.3	20.9(0.3)	58.1 (11.0)
	Deaths from cardiovascular disease	1.8	6.2(3.5)	20.3 (11.3)

twice as high in the pre-frailty group and about five times as high in the frail group as in the non-frailty group for men, and about 2.5 times as high in the pre-frailty group and about 6.5 times as high in the frail group for women. The age-adjusted hazard ratios for the outcomes were higher in the pre-frailty group than in the post-frailty group, and the risk ratios were three to four times higher in both groups, indicating that it is more effective to detect and address frailty early in old age.

On the other hand, when we look at the metabolic syndrome category, the incidence of outcomes in the metabolic syndrome group and the non-metabolic syndrome group was not related to any of the items, and it was understood that metabolic syndrome measures had no effect. In other words, at the age of 65 years or older, those with a BMI of 25 or higher should continue to lose weight by eating a moderate diet, but the aging of patients with chronic diseases will require new measures.

For all outcomes, the frailty group was significantly higher than the “non- frailty group”. Loss of self was five times higher. Loss of self is the first Certification of Needed Long-Term Care or death before Certification.

New problems are beginning to arise for elderly people who already have chronic diseases. For example, elderly diabetic patients are more likely than non-diabetic patients to suffer from sarcopenia, cognitive decline, ADL decline, falls, bone fractures, and other geriatric syndromes and frailty. A hemoglobin A1c of 8.0% or



higher is associated with various complications of diabetes, while a hemoglobin A1c of less than 7.0% is associated with bone fractures, falls, and frailty. Add different Countries are considering setting higher hemoglobin A1c targets in elderly diabetics than in the general diabetic population.

**7.4.3 Response to the Individualization of Nutrition and Diet Therapy**

Against this background, in September 2019, The Japan Diabetes Society published its Diabetes Care Guidelines 2019. While the method of calculating total daily energy intake is body weight (kg) × energy coefficient (Kcal/kg), as in the past, in the Guidelines body weight was changed from standard weight to target weight, and the energy coefficient was made flexible, taking into account not only the physical activity level but also the pathological level. In other words, the entire diet therapy should be individualized, and at the same time, it should be tailored to the individual pathological and nutritional conditions of elderly patients, especially those at high risk of obesity, underweight, malnutrition and frailty. Specifically, the guideline for the target weight (kg) should be set individually within the range of height (m)<sup>2</sup> × 22 for those under 65 years old and height (m)<sup>2</sup> × 22–25 for those 65 years old and over; especially for late-stage elderly patients aged 75 years old and over, it should be determined based on the current weight and assessment of frailty, ADL decline, concomitant diseases, body composition, shortening of height, eating status and metabolic status. The decision should be made as appropriate based on the preceding factors. The amount of physical activity is also expressed as a coefficient and is chosen from the following three levels (Table 7.3).

With the ageing of the population, diet therapy has become more individualized and methods of nutritional management more complex. Nutritional status, therapies, medications, genetic make-up, nutritional support methods, as well as community and family environment, relationships, learning ability and financial situation, must all be considered to determine the most appropriate nutritional and dietary treatment for the individual. To achieve this, it is necessary to create a place where people can get advice from a dietitian in close proximity where they live, and The Japan Dietetic

**Table 7.3** Energy coefficients (Kcal/kg)\*<sup>1</sup> by physical activity level and disease state

1. Light exertion (mostly static activity in a seated position): 25–30
2. Normal exertion (mostly sedentary, but includes commuting, housework, and light exercise): 30–35
3. Heavy exertion (heavy work, active exercise habit): 35~
A coefficient larger than the physical activity level can be set for frailty prevention in the elderly, and a coefficient smaller than the physical activity level can be set for weight loss in the obese. In either case, if there is a discrepancy between the target weight and the current weight, the coefficient should be set flexibly with reference to the above

Association launched the “Nutrition Care Stations Certification System” in 2018 (Heisei 30). The Nutrition Care Station offers a wide range of services, including nutritional dietary counseling, specific health guidance, and seminars and workshops for local residents as well as municipalities, health insurance associations, private companies, and medical institutions.

Also, in hospitals, registered dietitians have been becoming to taken a role in promoting nutritional management in intensive care units for early recovery of patients.

## **7.5 Nutritional Dietary Care for the Elderly at Home**

In the elderly, diseases become more complex, and at the same time, the decline in physical and mental functions affects their lives. Therefore, it is necessary both to improve nutrition to enhance the intrinsic functional capacity of the individual and to improve their environment to enable an independent diet. Low nutritional status causes weight loss as well as physiological changes such as decreased body temperature and pulse rate, decreased physical strength, edema, and decreased vision and hearing. Furthermore, it is noteworthy that mental changes in the elderly, such as lower concentration and attention, depression, irritability, lethargy, and hysteria, occur. In other words, low nutrition causes a decline in mental and physical functions, regardless of the disease. Nutritional management is necessary to maintain and improve the QOL of the elderly as well as to treat diseases. In order to do this, a nutritional assessment must be conducted to evaluate and determine the nutritional status of the subject, a nutritional care plan must be developed based on this assessment, and dietary therapy and nutritional supplementation must be monitored and reevaluated. This will help to maintain and improve the physical and mental functions of the elderly and extend their healthy life expectancy.

Human beings always wish to be healthy and live a normal life. However, in order to maintain a healthy life expectancy while feeling a sense of well-being, people often wish to live in their own homes as long as possible and wish to have nutritional management at home.

### ***7.5.1 Key Points on Improving Nutrition for the Elderly at Home***

The following are the key points to improve nutrition for the elderly at home:

- ① Hyponutrition in the elderly is seen as a generalized malnutrition, so certain nutrients and foods are not the solution; we need to make sure that the elderly are not deficient in all nutrients. Energy and protein, of course, but also vitamins and minerals lacking. In the case of a decrease in food intake, it is necessary to know

why the person is unable to eat, and to improve these factors to the extent possible. Specifically, it is important to use vinegar, spices, and highly palatable foods and preparations that increase appetite in moderation, as well as to control the temperature of food, the atmosphere of the table and room, and smells. Furthermore, it is important to eat together as much as possible and not to talk about unpleasant topics during meals. In addition, if chewing and swallowing are difficult, it is also a good idea to use special-purpose foods like thick liquid foods and foods that are easy to chew and swallow.

- ② Human relations with the subject, family members, housemates, and people in the community surrounding the home are important; it is also necessary to understand the relationship and characteristics of the community, as well as the environmental conditions that support meals at home, such as convenience stores, supermarkets, food stores, and even restaurants and cafeterias.
- ③ The capacity and support of the target population themselves, their families and communities for knowledge of and skills in nutrition management also need to be investigated as part of the support system. Once these are ascertained, a plan of care is constructed based on the results of the assessment of the subject as to how the actual diet and enteral/intravenous nutrition will be implemented.

In the elderly, even gender, age, and health and disease status are the same, we should realize in mind that there is no standardized diet or diet therapy. It is necessary for physicians, registered dietitians, nurses, pharmacists, public health nurses, physiotherapists, occupational therapists, and others to work together to create and implement individualized and comprehensive nutritional management methods that take into account the degree of illness, diversity, and risk of health problems, as well as lifestyle and medications, of individual subjects.

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