# Possibilities of a Body–Region Separately Weighing System in Healthcare

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## INTRODUCTION

In this chapter, a newly developed system for regional weight measurement of the human body; "body-region separately weighing system" (BRSW-system); was shown to be potentially applicable for self-measurement of regional weights of own body to use the measurement data for personalized health management.

The BRSW-system is the world's first regional body weight measuring system devised by Kurata, and patented in Japan (JP Patent No.4290704, 2009), US (US Patent No.8540649, 2013), EU (EP Patent No.1985978, 2014), and other countries; however, it is not commercially available currently.

## BACKGROUND

The human body consists of the following six main regions: the head, the upper extremities, the torso and the lower extremities. Each of these body regions has its own functions and consists of its own set of tissues, such as connective tissue and muscle tissue, needed to perform those functions. As the weight of the tissues forming the various body regions differ from one region to another, the weights of the body regions themselves also differ.

From a kinesiological perspective, the two hands, two lower extremities, trunk and head participate in various movements and thus can be broadly regarded as components of the musculoskeletal system. Knowing the weight (or the mass, to be exact) of each body region is very important when scientifically assessing the mechanical role of each body region during movement and their contribution to postural control. Studies that measured the weights of body regions, however, have all been based on data from

cadavers in which the weight of each body region was measured after it was dismembered from the body (Dempster & Gaughran, 1967; Mozumdar & Roy, 2004), and no reports on the weighing of body segments on living bodies could be found. Thus, while the current way of measuring body weight throughout the world is to stand on a scale to determine whole body weight, the weights of and weighing methods of one's separate body regions, which is more important information as far as body movements in everyday life are concerned, are at present largely unknown.

Meanwhile, the rate of aging is accelerating in Japan,, as shown in Table 1, and according to the Ministry of Internal Affairs and Communications, the number of people aged 65 years or older is 32.96 million as of September 2014, accounting for an unprecedented 25.9% of the total population, with one in eight people now aged 75 years or older.

The average life expectancy of a Japanese person is long; 79.55 years for men and 86.30 for women as of 2010 according to the Ministry of Health, Labour and Welfare. However, healthy life expectancy is estimated to be 70.42 years for men and 73.62 years for women. Healthy life expectancy is the period in which an individual lives without health problems, so men have approximately nine years of life with health problems and women have approximately 12 years. The reasons behind reduced independence, being bedridden, or the need for assistance or long-term care are musculoskeletal disorders (23%), cerebrovascular disorders (22%), cognitive impairment (15%), debility (14%), and other problems (26%) (Ministry of Health, Labour and Welfare, 2012), thereby revealing the importance of health of the musculoskeletal system. Maintaining a healthy musculoskeletal system therefore greatly contributes to prolonging healthy life expectancy.

The musculoskeletal system is composed of the bones, joints, muscles, nerves, etc., in the body regions such as the upper and lower extremities that are necessary in order to freely move the body. The various parts of the musculoskeletal system all work together, so if any one of them deteriorates, the entire body will not move well. Reduced locomotive function of the body due to musculoskeletal impairment is called "locomotive syndrome" (LS), which may lead to an increased risk for requiring long-term care if it progresses. In other words, LS is a condition in which one or several of the various musculoskeletal tissues such as muscles, bone, joints, cartilage and intervertebral discs are impaired, thereby disrupting gait or other activities of daily living, and is a concept that was proposed by the Japanese Orthopaedic Association in 2007 following projections for Japan's future with its aging society.

Simple methods of managing health are therefore needed at the individual level in order to extend healthy life expectancy and maintain health until individuals reach the average life expectancy. Moreover, a simple method of quantitatively assessing muscles is required, although a method has yet to be established.

*Table 1. Changes in the elderly population in Japan*

| Year | Total Population | Aged People (Over 65 Years of Age) | Percentage of Aged People (%) |
|------|------------------|-------------------------------------|-------------------------------|
| 1970 | 103,720,000 | 7,330,000 | 7.1 |
| 1980 | 117,060,000 | 10,650,000 | 9.1 |
| 1990 | 123,610,000 | 14,930,000 | 12.1 |
| 2000 | 126,930,000 | 22,040,000 | 17.4 |
| 2010 | 128,060,000 | 29,480,000 | 23.0 |
| 2020 | 124,100,000 | 36,120,000 | 29.1 |
| 2030 | 116,620,000 | 36,850,000 | 31.6 |

Data source: Bureau of Statistics, Ministry of Internal Affairs and Communications, 2014.

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