Chapter 15

Healthy Aging: IADL and Functional Disability

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1 Introduction

Extension of healthy life expectancy is an important topic in Japanese healthy aging policy, which has already achieved extended life expectancy. In 2013, there was about a 9-year gap between life expectancy and healthy life expectancy among men, and a 13-year gap of them among women. Although the definition of healthy life expectancy is diverse, one definition is measured by a period that has not seen the onset of functional disability in public long-term care certification, or that has independence in instrumental activities of daily living (IADL; a higher-order functional capacity of older adults). About 18% of older adults were certified for long-term care/support needs, and the number was about 5.9 million people (as of 2014).

Many studies indicate that the ability to conduct IADL, the onset of functional disability, and death are intimately related to not only lifestyles and health behaviors, but also to socioeconomic situations. While several systematic reviews focusing on the daily functions of older adults exist [1–3], overseas findings are not necessarily applicable to Japan because of genetic, environmental, and cultural factors. There is thus a need to review findings on older adults in Japan. Longitudinal studies are needed when doing so because there is a bidirectional relationship between health and other variables (for example, the healthier one is, the harder it is to acquire income; the poorer one is, the easier it is to become unhealthy). As opposed to cross-sectional studies, which are based on synchronic data, longitudinal studies trace individuals. Furthermore, considering that there are few cases in which

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individuals incur functional disabilities or die when tracked for only a few years, it is preferable to conduct large-scale baseline surveys to acquire more robust data.

The number of studies based on large-scale epidemiological surveys in Japan has increased in recent years. The Japan Epidemiological Association website introduces 16 studies, each of which track over 10,000 people for longer than 5 years (as of April 2018). A search for articles based on longitudinal studies discussing the health and life functions of older adults in Japan¹ revealed 53 studies in Japanese and 212 in English. These were narrowed down to those covering 10,000 or more people, review papers and articles that discussed specific diseases and medical treatments were excluded, and hand-searching was added to give a set of 48 articles. This set was reduced to 34 articles after excluding those covering depressive symptoms, falls, and dementia outcomes, which are discussed in another chapter. This chapter provides an overview of the findings of these articles with large-scale longitudinal research on Japanese older adults that discussed factors relating to their IADL, functional disability levels, and mortality.

2 Overview of Large-Scale Longitudinal Studies

The outcomes covered by the articles were as follows: death (20 articles), functional disability (16 articles), and IADL (2 articles). The primary explanatory variables were classified as follows: mental health and psychological well-being [4, 5], health behaviors (e.g., smoking and obesity) [6–11], oral function/dental status [12–14], socioeconomic status (SES) [15–23], social participation [24–29], social network and social support [30–36], and others [37] (Table 15.1).

The Japan Gerontological Evaluation Study, from which approximately 80% of the articles are derived, is a research project that aims to create a scientific foundation for preventative policies that seek to create a healthy aging and long-living society (principal investigator: Katsunori Kondo, Professor, Chiba University). Since 2003, the self-administered postal survey has worked with municipalities to survey (through a questionnaire) tens of thousands of older individuals without certified functional disabilities. The response rate was 60–70% (there were approximately 13,000 responses in 2003, 40,000 in 2006, and over 100,000 from 2010 onward, see Fig. 15.1). The survey also included prospective cohort data that enabled understanding of the subsequent outcomes (e.g., death and functional disability level) based on information regarding public long-term care insurance records. At the same time, the survey is also notable for simultaneously collecting

¹For Japanese language journals, The National Diet Library Online Search and Request Service was used to search for the terms “高齢者AND コホート研究” (*kōreisha AND kōhōto kenkyū*; “elderly AND cohort study”) and “高齢者AND 縦断研究 AND 健康” (*kōreisha AND jūdan kenkyū AND kenkō*; “elderly AND longitudinal study AND health”). For English language journals, PubMed was used to search for “older Japanese AND cohort study” and “Japanese AND cohort study AND older.”

Table 15.1 Main results of associated factors with functional disability or mortality

Articles	Data	Explanatory variables	Outcome	Main results
Mental health and psychological well-being				
Nishi et al. [4] ^a	2003–2007 cohort (<i>n</i> = 14,668)	Self-rated health (SRH)	Mortality	Fair/poor self-rated health was a stronger predictor of mortality in both sexes (HR = 1.67, 95% CI: 1.35–2.07).
Wada et al. [5] ^a	2003–2007 cohort (<i>n</i> = 14,286)	GDS (short version)	Mortality and functional disability	Compared to older adults with nondepressive symptoms, depressive people were 1.26 times higher for functional disability, and 1.33 times higher for mortality than nondepressive.
Health behavior				
Iso et al. [6]	1989–1999 cohort (<i>n</i> = 94,683) including <65 years	Smoking cessation	Mortality	The multivariate relative risks for current smokers compared with never smokers were 1.41 (95% CI: 1.19–1.67) in older men, 1.69 (95% CI: 1.32–2.15) in older women for mortality from total cardiovascular disease.
Sakata et al. [7]	1963 to 1992–2008 cohort (<i>n</i> = 67,973) including <65 years	Smoking	Mortality	Current smokers compared with never smokers were 1.47 (95% CI: 1.41–1.52) among those born before 1920, 1.84 (95% CI: 1.74–1.96) among those born during 1920–1945 for all-cause mortality.
Tamakoshi et al. [8]	1988–2003 cohort (<i>n</i> = 26,747)	BMI	Mortality	The underweight group was associated with a statistically higher risk of all-cause mortality; 1.78-fold (95% CI: 1.45–2.20) and 2.55-fold (95% CI: 2.13–3.05) increase in mortality risk among severest thin men and women (BMI: <16.0), respectively.
Nakade et al. [9] ^a	2003–2007 cohort (<i>n</i> = 14,931)	BMI	Mortality	Among low income group, hazard ratios for mortality by all causes was 1.96 (95% CI: 1.02–3.73) for overweight.
Yamazaki et al. [10]	1999–2009 cohort (<i>n</i> = 13,280)	BMI	Mortality	Compared with normal-weight participants, overweight/obese participants tended to have lower hazard ratios; the multivariate hazard ratios were 0.86 (95% CI: 0.62–1.19) for obesity, 0.83 (95% CI: 0.73–0.94) for overweight, and 1.60 (95% CI: 1.40–1.82) for underweight.

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Table 15.1 (continued)

Articles	Data	Explanatory variables	Outcome	Main results
Tomata et al. [11]	2006–2011 cohort (<i>n</i> = 14,260)	Dietary pattern	Functional disability	Japanese pattern as one of three dietary patterns was associated with a lower risk of incident functional disability (HR = 0.77; 95% CI: 0.68–0.88). An animal food pattern and a high dairy pattern tended to have a higher risk of incident functional disability.
Oral function/dental status				
Hayasaka et al. [12]	2006–2010 cohort (<i>n</i> = 21,730)	Dental care	Mortality	Participants who practiced all three types of oral care (brushed teeth two or more times per day, had dental visits at least once a year, or used dentures) was 0.54 (95% CI: 0.45–0.64) times lower for mortality than participants who practiced none of the three.
Sato et al. [13] ^a	2010–2013 panel (<i>n</i> = 62,333)	Tooth loss	IADL	IPW models estimated the increment in TMIG-IC score (β = 0.170, 95% CI: 0.114–0.227) if edentulous participants gained 20 or more natural teeth.
Matsuyama et al. [14] ^a	2010–2013 cohort (<i>n</i> = 85,161)	Tooth loss	Functional disability	Among the participants aged ≥ 85 years old, those with ≥ 20 teeth had a longer life expectancy (men: +57 days; women: +15 days) and healthy life expectancy (men: +92 days; women: +70 days).
Socio-economic status				
Kondo N. et al. [15] ^a	2003–2007 cohort (<i>n</i> = 7673)	Relative income	Functional disability	The hazard ratio of incident physical/cognitive disability per one standard deviation increase in relative deprivation ranged from 1.13 (95% CI: 0.99–1.29) to 1.15 (95% CI: 1.01–1.31) in men.
Hirai et al. [16] ^a	2003–2006 cohort (<i>n</i> = 22,829)	Household income	Mortality and functional disability	Using governmental administrative data, comparing the lowest to the highest income level were 3.50 for men and 2.48 for women for mortality and 3.71 for men and 2.27 for women for loss of healthy life.

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Table 15.1 (continued)

Articles	Data	Explanatory variables	Outcome	Main results
Kondo K. et al. [17] ^a	2003–2007 cohort (<i>n</i> = 14,652)	Income and education	Mortality and functional disability	In men, significant health inequalities were observed between the highest income group and lowest one (HR: 1.55–1.75), and between the highest educational attainment group and lowest one (HR = 1.45–1.97).
Kondo N. et al. [18] ^a	2003–2007 cohort (<i>n</i> = 16,023)	Relative income	Mortality	1 SD unit increase in income deprivation relative to others was associated with increased death hazard in men (HR = 1.20, 95% CI: 1.06–1.36) and in women (HR = 1.17, 95% CI: 0.97–1.41).
Saito M. et al. [19] ^a	2003–2007 cohort (<i>n</i> = 13,310)	Poverty, social isolation, etc.	Mortality	Those with simultaneously relative poverty and social isolation and/or social inactivity were 1.29 times more likely to die prematurely than those who were not socially excluded.
Kondo N. et al. [20] ^a	2003–2007 cohort (<i>n</i> = 21,031)	Relative income	Cause-specific mortality	The HR for death from cardiovascular diseases per SD increase in relative deprivation was 1.50 (95% CI: 1.09–2.08) in men, whereas HRs for mortality by cancer and other diseases were close to the null value.
Tani et al. [21] ^a	2010–2013 cohort (<i>n</i> = 15,449)	Childhood SES	Mortality	Compared with men growing up in more advantaged childhood socioeconomic circumstances, the age-adjusted HR for men from low childhood SES backgrounds was 0.75 (95% CI: 0.56–1.00). This association was stronger among men aged 75 years or older.
Murayama et al. [22] ^a	2010–2013 panel (<i>n</i> = 11,601)	Childhood SES	IADL	Childhood SES was independently associated with functional decline in the older cohort. In the 75–79 years group, lower childhood SES was associated with functional decline.

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Table 15.1 (continued)

Articles	Data	Explanatory variables	Outcome	Main results
Inoue et al. [23] ^a	2003–2013 cohort (<i>n</i> = 12,290)	Month of birth	Mortality	Men born in December were more likely to die earlier (14%) while those born in January had lower mortality (10%). Time period when a birth is officially registered might be reflected in socioeconomic factors in early life.
Social participation				
Hirai et al. [24] ^a	2003–2006 cohort (<i>n</i> = 12,031)	Social participation, SES, etc.	Functional disability	In both sexes, frequency of going out, frequency of contact with friends, social participation were significantly related to onset of certification of long-term care insurance.
Ueshima et al. [25]	1999–2006 cohort (<i>n</i> = 10,385)	Physical activities	Mortality	Physical activity was associated with a reduced risk of all-cause and CVD mortality. The HRs among participants with 5 or more days of nonexercise physical activity per week and those with pre-existing disease were 0.38 (95% CI: 0.22–0.55) and 0.35 (95% CI: 0.24–0.52), respectively.
Kanamori et al. [26] ^a	2003–2007 cohort (<i>n</i> = 11,581)	Sports activity	Functional disability	Compared to the active participant group, the exercise alone group had HR of 1.29 (95% CI: 1.02–1.64) for incident functional disability. No significant difference was seen with the passive participant group.
Kanamori et al. [27] ^a	2003–2007 cohort (<i>n</i> = 12,951)	Social participation	Functional disability	Compared to nonparticipants, the HR was 0.83 (95% CI: 0.73–0.95) for participation in one, 0.72 (95% CI: 0.61–0.85) for in two, and 0.57 (95% CI: 0.46–0.70) for in three or more different types of organizations.
Ishikawa et al. [28] ^a	2003–2008 cohort (<i>n</i> = 14,286)	Social participation	Mortality	Relative to regular members, the IPTW-HR for all-cause mortality was 0.88 (95% CI: 0.79–0.99) for participants occupying leadership positions (e.g. president, manager, or having administrative roles).

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Table 15.1 (continued)

Articles	Data	Explanatory variables	Outcome	Main results
Ashida et al. [29] ^a	2003–2007 cohort (<i>n</i> = 12,991)	Social participation	Functional disability	Participants in sports (HR = 0.66, 95% CI: 0.51–0.85) or hobby group (HR = 0.69, 95% CI: 0.55–0.87), or who had a group facilitator role (HR = 0.82, 95% CI: 0.66–1.02) were less likely to be disabled.
Social network and social support				
Aida et al. [30] ^a	2003–2008 cohort (<i>n</i> = 14,668)	Social network	Mortality	Lower friendship network was significantly associated with higher all-cause mortality among men (HR = 1.30, 95% CI: 1.10–1.53) and women (HR = 1.81, 95% CI: 1.02–3.23).
Aida et al. [31] ^a	2003–2007 cohort (<i>n</i> = 14,589)	Community-level social capital	Functional disability	Women living in communities with higher mistrust had 1.68 (95% CI: 1.14–2.49) times higher OR of onset of disability, even after adjusting for covariates.
Saito M. et al. [32] ^a	2003–2007 cohort (<i>n</i> = 13,310)	Social isolation and satisfaction	Functional disability	The isolated older people were 1.34 (95% CI: 1.18–1.53) times more likely to develop functional disability. In men, satisfied isolation was associated with 1.27 (95% CI: 1.02–1.58) times higher risk of functional disability.
Saito M. et al. [33] ^a	2003–2013 cohort (<i>n</i> = 12,085)	Social network	Mortality and functional disability	The hazard ratios for functional disability and premature death increase in those with contact frequency of “less than once a month” were 1.37 (95% CI: 1.16–1.61) and 1.34 (95% CI: 1.16–1.55), respectively.
Tani et al. [34] ^a	2010–2013 cohort (<i>n</i> = 71,781)	Eating alone	Mortality	The HR were 1.48 (95% CI: 1.26–1.74) for men who ate alone yet lived with others. Among women, HR was 1.18 (95% CI: 0.97–1.43) who ate alone yet lived with others and 1.10 (95% CI: 0.93–1.29) who ate and lived alone.

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Table 15.1 (continued)

Articles	Data	Explanatory variables	Outcome	Main results
Saito T. et al. [35] ^a	2003–2013 cohort (<i>n</i> = 13,460)	Household	Functional disability	Men living only with nonspousal cohabitants and those living alone were more likely to develop disability. Social support exchange explained 24.4% and 15.8% of the excess risk of disability onset in those men.
Murata et al. [36] ^a	2003–2013 cohort (<i>n</i> = 14,088)	Social support	Functional disability	Social ties with co-residing family members, and those with friends or neighbors, independently protected functional health (HR = 0.81, 0.85) among men. Among women, ties with friend or neighbors had a stronger effect.
Others				
Tsuji et al. [37] ^a	2011–2015 cohort (<i>n</i> = 72,127)	Functional disability risk scale	Functional disability	A risk assessment scale of 0–55 developed from the Kihon Checklist's 10 items (included in the Needs Survey's essential items) is useful for predicting the incidence of Needed Support/ Long-Term Care certification.

^aFrom JAGES (AGES) longitudinal survey

panel data that individually compares cross-sectional data at certain intervals. Since 2010, the survey has expanded to cover more areas and has changed in name from AGES to JAGES (see website for details: <https://www.jages.net/>). In the 14 years from 2004 to 2017, the JAGES project has published 364 articles and books (267 in Japanese, 97 in English), including 55 papers based on longitudinal studies (including sub-projects).

3 Mental Health, Health Behavior, and Oral Functions

While subjective health indicators have been criticized as unreliable, large-scale Japanese longitudinal studies have found them to be important indicators for predicting future objective health. For example, regardless of age, chronic conditions, or disabilities at the baseline survey, both older men and women who stated that their health was poor had an approximately 1.7 higher risk of premature death compared to those who answered that their health was good [4]. Furthermore, individuals with depression were found to have a 1.26 higher risk of functional disability and a 1.33 times higher mortality risk [5].

Fig. 15.1 Overview of longitudinal survey in JAGES (AGES)

Regarding health behaviors, older male smokers were found to have 1.41 times the risk of death due to cardiovascular disease compared to nonsmokers. For women, the risk was 1.69 times higher [6]. In addition, smokers in the pre-1920 birth cohort had 1.47 times the risk of death [7]. Regarding body mass index (BMI), some large-scale cohort studies have consistently shown that Japanese older adults have approximately 1.6–2.6 times the risk of subsequent death if obese or underweight [8, 10]. Regarding food, Japanese dietary habits may reduce subsequent functional disability risk (HR = 0.77; 95% CI: 0.68–0.88) [11].

Oral health indicators such as bite strength and number of teeth are closely related to subsequent healthy aging. For example, it has been reported that people without teeth were more likely to experience a significant IADL decline compared to people with 20 or more remaining teeth; this influence was nearly equal to having a history of stroke [13]. The risk of death for older adults who brushed their teeth two or more times per day, visited the dentist at least once per year, or used dentures was reported as being 0.54 times those who performed none of these activities [12]. Furthermore, men aged 85 years or older with 20 or more remaining teeth had an estimated lifespan of 92 days longer than those who did not, while women with the same characteristics lived an average of 70 days longer [14].

Although it analyzed fewer than 10,000 subjects, another study reported that those with 19 or fewer remaining teeth had 1.21 times the risk of functional disability onset [38] and 1.83 times the risk of death because of cardiovascular or respiratory

disease [39]. In addition, young-old persons aged 65–74 with fewer than 20 remaining teeth were 1.78 times more likely to become housebound [40].

4 Differences in Health Risks Due to SES

It is a solid fact that poverty and social exclusion are one of the social determinants of health [41]. Research on Japanese older adults has found that low SES could be a health risk, and these trends are remarkable among men [41]. Older men with less education or income were found to have 1.6–2.0 times the risk of premature death [17]. The same trend was also found in objective income data from levy cost in public long-term care insurance [16]. It has been reported that income that is low in either absolute terms or when compared to others creates psychosocial stress and becomes a risk for functional disability [15], overall death [18], and cardiovascular disease death [20]. Furthermore, research indicates that economic poverty in both old age and childhood increases the overall risk of death during old age [21] in addition to causing declines in IADL [22]. In other words, the influence of SES on health extends throughout the course of people's lives, suggesting the effectiveness of countermeasures that begin at a young age. It is also clear that the destruction of one's house or job loss resulting from natural disaster (e.g., the Great East Japan Earthquake) is connected to worsening IADL [42].

5 Differences in Health Risks Due to Social Participation and Social Networks

Social participation is an important element of successful aging. According to activity theory in social gerontology, older individuals who actively participate in society maintain a sense of happiness due to steady social relationships and increased opportunities to receive positive feedback from others. One would therefore expect that social participation protects older adult health; this has in fact been confirmed by some large-scale cohort studies. People who hold positions and participate in social organizations (e.g., residents' associations) have significantly lower subsequent risks of functional disability [29] and death [28], and there is a lower risk of death and functional disability among older individuals who participate in sports or physical activities [25–27]. In addition, an intervention study in Taketoyo Town, Aichi Prefecture, indicated that those who participated in community salon activities had more positive health self-assessments 2 years later than those who did not [43]. Their risk of functional disability was 51% lower [44], while their risk of functional disability involving dementia was approximately 30% lower [45].

Large-scale longitudinal studies have also found that having a poor social network (i.e., social isolation) is also a health risk. It has been reported that isolated older individuals had 1.3–1.8 times the risk of functional disability [32]. Reports have also indicated that contact with others less than once per week was a functional onset disability risk and that less than once per month was a mortality risk [33]. In addition, eating alone while living with someone else increased the risk of death for both men and women [34]. It has also been found that those who belonged to an infrequently meeting sports club had lower functional disability risks than those who frequently played sports alone [23]. This suggests that connecting with others is an important element for health. Studies focusing on social support (i.e., the functional side of social networks) have found that men and women without social support had 1.25 and 1.08 times the risk of functional disability, respectively [36]. While individuals in single-person households were more likely to have functional disabilities, social support could possibly reduce these risks by 25% [35].

Although individual-level social participation and social relationships are important, community-level social participation (social capital) is also associated with health among older adults. There have been efforts to develop a health-related community-level social capital instrument (comprised of three factors: civic participation, social cohesion, and reciprocity) [46]. For example, it has been found that even after adjusting for individual attributes, older women living in communities in which there is a 1% higher prevalence of the view that people cannot generally be trusted were 1.68 times more likely to receive functional disability certification [31]. Such studies suggest the importance of developing age-friendly community/cities in addition to individual interventions in healthcare and social welfare.

6 Summary

The proper handling of population aging is a global health problem that must be addressed for sustainable development. While a diverse set of issues must be addressed, one of the most important is healthy aging. In 2017, the World Health Organization released “10 Priorities for a Decade of Action on Healthy Ageing” [47], which presents a collection of high-quality data regarding healthy aging as a priority and points out the need for analytical reviews of current data sources to identify where gaps exist in measuring healthy aging over the life course.

As demonstrated in this review, large-scale studies of the older adults in Japan have found that, in addition to lifestyle, health behaviors, and medical history, the following items were also related to the healthy aging: mental health and psychological well-being, oral function/dental status, the up-stream factors of social participation, social networks/social support, educational attainment, income, income disparities, SES throughout one’s life course, loss of living environment, and community-level social capital including civic participation, social cohesion, and reciprocity.

“Healthy Japan 21 (The Second Term)” [48], which established the basic policy for health promotion in Japan, discusses improving the quality of social environments as a way to increase healthy aging and decrease health disparities. The results of this review also suggest that along with approaches that focus on high-risk individuals, it is important to implement social policies that increase social capital, reduce socioeconomic disparities, construct environments that promote social participation and physical activity, and offer education to individuals from a young age (thus enabling anyone to develop their abilities without relying on household economic resources). However, with the exception of some, the articles considered in this review are observation studies, and there is a need to elucidate the mechanisms behind the discussed factors in addition to conducting intervention studies.

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