原　著

An analysis of the relation between social interaction and healthy life among the community-dwelling elderly in Japan

日本の地域高齢者における社会関係性と健康的な生活との関連構造

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Abstract

Objectives: The purpose of this cohort study was to investigate age- and gender-related differences in the structural relationship between social interaction and healthy life among urban elderly Japanese people aged 65-84. Methods: 7,904 elderly residents of Tama City were followed up for six years by using questionnaires and registers obtained from city hall. Both bivariate correlation and structural equation modeling were utilized in the analysis. Results: "Healthy life 2004" was positively and strongly associated with "social interaction 2001", "healthy lifestyle 2004" and "physical function 2004". Moreover, besides direct effects, social interaction also demonstrated indirect effects by means of healthy lifestyle and physical function. The maintenance of physical function was determined to be particularly vital among older elderly and females, and the effects of a healthy lifestyle were much more pronounced in males than in females. The older elderly were found to be more influenced by social interaction levels than the younger elderly group. Conclusions: Healthy people should have the ability to supervise others and to manage themselves, even at an advanced age. If changes are made in potential risk factors, early prevention may be possible before functional disability, thus reducing the risk of mortality.

抄　録

目　的：本研究の目的は、日本の都市部に住む 65-84 歳の高齢者における社会的関連性と健康的な生活の関係について、性・年齢別の違いを明らかにすることである。

方　法：多摩市の 7,904 人の高齢者について 6 年間追跡調査し、相関関係と構造方程式モデリングで分析した。

結　果：主観的健康感と生存日数と関連する「健康的な生活 2004」(「」潜在変数を示す)は、「社会的関連性 2001」、「健康的なライフスタイル 2004」と「身体的な機能 2004」との関連構造が明らかになった。「健康的な生活 2004」は、「社会的関連性 2001」を基盤とする「健康的なライフスタイル」からの直接的な影響の他に、「身体的な機能」を経由する間接的な効果が示された。「身体的な機能」から「健康的な生活 2004」への効果は、前期よりも後期高齢者で、男性よりも女性で強く関連していた。

結　論：高齢者の健康長寿のためには、本人の健康を管理する能力がなければならない。もし制御要因を維持させるという早めの予防活動は、機能低下を予防し、生存を維持させることにつながる可能性がある。

Key words: social interaction; healthy lifestyle; physical function; healthy life; structural equation modeling.
キーワード: 社会的関連性; 健康的なライフスタイル; 身体的な機能; 健康的な生活; 構造方程式モデリング

1. Introduction

The final goal of "Health Japan 21"[1], which provides l0-year national objectives for improving the health of all Japanese people since 2000, was to increase quality and years of healthy life. Increasing healthy lifespan means more than just living longer – it also means having fewer unhealthy years. With a rapidly aging population in Japan, achieving a longer and healthier life becomes increasingly significant.

An extensive amount of literature has shown that self-rated health (SRH) accurately reflects the health status of older adults, including in Japan[2]. In this study, a healthy life was defined as being able to live longer with good SRH.

Healthy People 2010, proposed a systematic approach to promote health on a national level[3]. In summary, healthy life could be influenced by hereditary factors, the health-care system, environmental factors, personal interactions, and healthy lifestyles. Of these factors, the easiest for people to control to live a healthy life were personal interactions and healthy lifestyles. However, the elderly in general are distinguished from other adult demographics by increased levels of physical functional decline[4, 5], and this is of note because of the associated increase in dependence, which is used in examining long-term care degrees in Japan, and because of its relation with mortality[6].

Social interaction plays an important part in the daily life and well-being of elderly people. The association between social interaction and lower mortality has been well observed in many western countries[7, 8, 9, 10, 11]. However, Yasuda et al. recognized that such relations only observed in the ≥75 years age group who lived in northeast Baltimore, maybe due to functional decline with age[12]. Besides the direct effects[13], social interaction also affected mortality indirectly by its effects on a healthy lifestyle[14, 15] and on one's physical functionality[16, 17, 18]. Furthermore, social interaction may serve different functions for men and women[19].

After the economic crisis, the interpersonal relationship crisis has emerged in recent years. Thus, the importance of social interaction has been re-evaluated in Japan, especially for the elderly people [20]. The strength of the influence of having social contact and participation on mortality and longevity were also found in direct and indirect ways through lifestyle[21] and functional status[22], respectively. Murata et al. suggested group membership was significantly related to lower mortality among the old-old men (aged 75 and over) but not among women in rural areas[23]. After adjustment for lifestyle[24] and physical function[25], the associations between social interaction and mortality still existed. However, the covariant relationship, the underlying mechanism and the process in which social interactions affect a healthy life are still not well understood.

In addition, social isolation and disengagement, which formed in the absence of social interaction and participation, were associated with a higher risk of reporting one's health as being fair or poor[26]. Tomás, Gutiérrez, Sancho and Galiana maintained social relations had a positive impact on SRH for the young old, but these relations disappeared for the oldest old[27].

Identifying related factors of health and mortality among the elderly is important not only for their caregivers, but also for the whole country. Japanese females have the highest life expectancy of 85.90 years at birth in the world, which is 6.46 years longer than males[28]. In Japan, the traditional view of gender roles is that men should work outside while women stay at home being a housewife: the differences in lifestyle are rather obvious. If age and gender differences are taken into consideration, it is useful to inspect the related factors of healthy life, because the impact of predictors may vary between subgroups on the basis of gender and age, which few studies have analyzed.

Accordingly, this cohort study aims to: 1) investigate the structural relationship between social interaction, healthy lifestyle, physical function, and healthy life among community-dwelling men and women aged 65 to 84 in Japan over a six-year period; 2) determine age- and gender-related differences.

2. Methods

2.1 Study subjects and data collection

Tama City is a new city located in the western suburbs of Metropolitan Tokyo, developed in the late 1960s. With young adults got older and older in forty years, the elderly population had raised obviously. The life expectancy of Tama (80.3 years for men, 86.5 years for women) is a little bit higher than Tokyo (79.4 years for men, 85.7 years for women), and the long-term care needs in Tama are the lowest in Tokyo[29]. This baseline survey enrolled all individuals, aged 65 and over, living in Tama in September, 2001. 13,195 individuals answered and mailed back the questionnaire, giving a response rate of 80.2%. A follow-up survey was conducted in September 2004 by using the same questionnaire, and 8,558 responded again. Of the 4,637 non-respondents, 505 had moved, 914 had passed away and 3,218 did not respond for other reasons. There was no statistical significance in age and gender differences between participants and non-participants. Those aged 85 and over in 2001 were excluded in order to minimize deviation, due to their instability of data[30]. Finally, the analyzed sample was 7,904, aged 65-84, who responded to the first and second questionnaires. Dates of death were obtained from registers at the municipal hall, including all deaths occurring between 1 September 2004 and 31 August 2007. In order to facilitate comparisons, two subsamples were described by age: 'younger elderly' (65-74 years) and 'older elderly' (75-84 years). All the participants were provided with informed consent forms, and all agreed.

2.2 Measurements

Healthy life

People who lived a healthy life should have longevity in quantity and health in quality. In this study, it was measured by survival time and the current self-rated health. A single question, 'How do you rate your state of health?' was asked in 2004, with a 4-point Likert scale response: 1 = Very Poor; 2 = Poor, 3 = Good; and 4 = Excellent. Survival time was calculated as the number of days from 1 September 2004 to either the date of death or the end of the follow-up survey, whichever was earlier. Continued living and perception of oneself in good health indicated a healthy life.

Social interaction

Two levels, social contact and social participation, were used to evaluate social interaction. Regarding social contact, participants were required to describe the frequency of contact with their neighbors and friends. The responses were categorized as: no contact at all; once a month; 3-4 times a week; and every day. As for social participation, leisure activity and volunteering asking: 'Did you take part in leisure activities in your area?' with 1 = No, 2 = Yes, and 'Were you involved with volunteering in your area?' with 1 = Regularly; 2 = Occasionally; and 3 = Not at all.

Healthy lifestyle

Healthy lifestyle was assessed with a healthy dietary score and a healthy practice score. According to Japanese surveys about dietary and lifestyle habits by Hoshi[31], eight healthy dietary habits were selected as follows: having meat and fish one to four times per week; having bean products and salt-cured food more than five times per week; having milk, dairy products, fruits and vegetables every day; and having fried food three to six times per week. Each item was assigned one point, and a person's healthy dietary score was calculated as the sum total, with a minimum of 0 points and a maximum of 8 points. A higher score indicated a healthier dietary pattern.

Similarly, a person's healthy practice score was defined to be the sum of the points assigned to six factors, each with a point range of 0-6, those being: having breakfast every day; moderate alcohol consumption everyday (with a different pattern of binge drinking); having never smoked cigarettes; no more than nine hours of sleep every night; doing physical activities no less than once a month; and having a BMI of more than 21. A higher score represented a more favorable health-promoting practice pattern.

Physical function

Two indicators were used to measure physical function in 2004: basic activities of daily living (BADL) and instrumental activities of daily living (IADL). BADL was based on three items: toileting, bathing, and going outside, which derived from the Barthel Index of Activities of Daily Living[32]. Individuals could gain one point if they could conduct themselves without assistance, and no points were assigned to those who needed help. The BADL score was calculated with three items, ranging in value from 0 to 3. A higher score indicated better basic living competence. The IADL score was determined by summing the points assigned to the following activities: purchasing daily goods; preparing daily meals; making transactions at the bank; managing one's pension and insurance; and reading newspapers and books[33]. The scores varied between 0 and 5 points, with higher scores indicating less dependence.

2.3 Hypothesis

In this study, the hypothesis were: 1) physical function had direct impacts on healthy life; social interaction and healthy lifestyle demonstrated not only direct impacts on healthy life of the elderly, but also indirect effects by the means of physical function; 2) the underlying structural relationships varied among age and gender (Fig. 1).

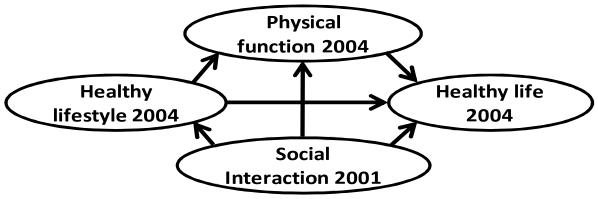

Fig 1. Hypothesis of healthy life among the community-dwelling elderly in Japan.
[There are four latent variables. Arrows demonstrates significant relationships and directions between variables.]

2.4 Statistical analysis

Two levels of analyses were performed. First, bivariate analysis was applied to examine associations between the independent variables and healthy life, using SPSS 19.0 for Windows. Second, multivariate structural equation modeling was performed to explain healthy life simultaneously regarding all the independent variables, using Amos 17.0 for Windows. Statistical comparisons across subgroups by the multi-group analyses were supposed to examine the commonplaces and disparate points among the research population. The goodness-of-fit was determined by Normalized Fit Index (NFI), Incremental Fit Index (IFI), Root Mean Square Error of Approximation (RMSEA), and chi-square (CMIN). When NFI and IFI values were above 0.9, and RMSEA was less than 0.05, the model was considered to be an adequate one.

3. Results

3.1 Bivariate relationships

All the potential predictors were significantly and positively related to healthy life, indicating that an increase in the value of independent variables could lead to a longer and healthier life. But when the associations were presented in four age and gender subgroups, some exceptions of no statistical significance appeared between survival time and contact with neighbors and friends, leisure activity, as well as in volunteering (Table 1).

Table 1. Pearson correlation coefficients among independent variables and healthy life by age and gender

Predictors	Survival time				Self-rated health			
	Male		Female		Male		Female	
	65-74	75-84	65-74	75-84	65-74	75-84	65-74	75-84
Contact with neighbors and friends 01	0.050**	0.128**	0.018	0.049	0.174**	0.251**	0.165**	0.228**
Leisure activity 01	0.033	0.132**	0.053**	0.066*	0.206**	0.250**	0.221**	0.260**
Volunteering 01	0.031	0.077*	0.004	0.049	0.123**	0.147**	0.146**	0.155**
Healthy dietary score 04	0.083**	0.123**	0.071**	0.122**	0.129**	0.120**	0.116**	0.154**
Healthy practice score 04	0.185**	0.202**	0.063**	0.148**	0.280**	0.293**	0.207**	0.239**
BADL score 04	0.189**	0.280**	0.138**	0.237**	0.361**	0.448**	0.379**	0.485**
IADL score 04	0.192**	0.250**	0.173**	0.202**	0.354**	0.385**	0.360**	0.451**

*. Correlation is significant at the 0.05 level (2-tailed)

**. Correlation is significant at the 0.01 level (2-tailed)

01: indicates year 2001

04: indicates year 2004

3.2 Structural analysis

For the SEM, four latent variables were applied: social interaction 2001; healthy lifestyle 2004; physical function 2004; and healthy life 2004 (Fig. 2, 3). All the coefficients were significant under the regression co-variation (P<0.001). NFI was 0.984, IFI was 0.990, and RMSEA was 0.011, which showed the model fitted the observed data very well. Healthy life 2004 was determined by social interaction 2001, healthy lifestyle 2004, and physical function 2004. For older males, 84% of healthy life could be explained by social interaction, healthy lifestyle and physical function (R2=0.84), 57% for younger males, 63% for younger females and 93% for older females. The

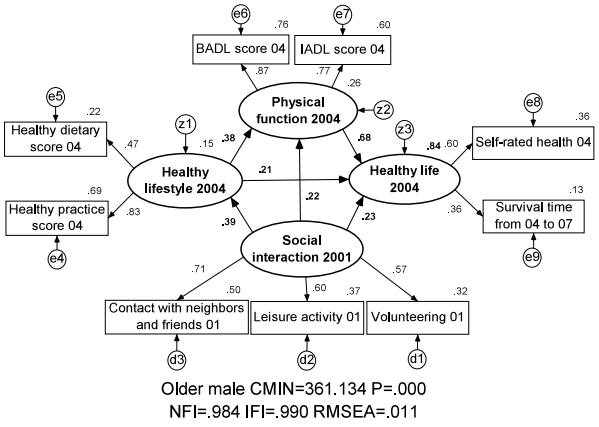

Fig 2. Structural equation modeling of social interaction and healthy life among older males.
[There are one latent exogenous variables (social interaction 2001), three latent endogenous variables (healthy lifestyle 2004, physical function 2004, and healthy life 2004) and 12 unobserved exogenous residual error variables (d1- d3, e4- e9, z1- z3). The models fitted the data reasonably well. The Normalized Fit Index (NFI) and Incremental Fit Index (IFI) exceeded the recommended value of 0.9, whereas the Root Mean Square Error of Approximation (RMSEA) was 0.011<0.05.]

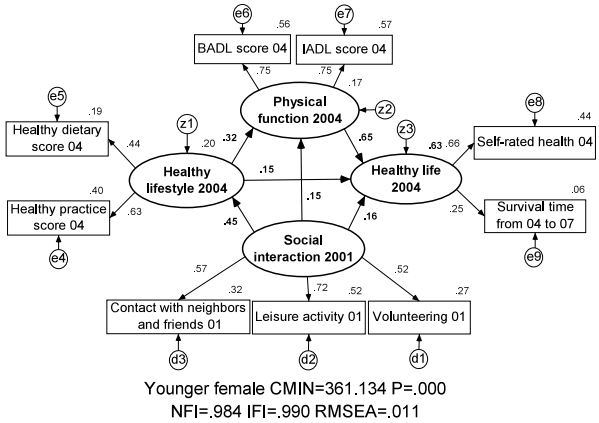

Fig 3. Structural equation modeling of social interaction and healthy life among younger females

Table 2. Standardized direct and indirect effects by age and gender

		Male			Female		
		65-74	75-84	Total[a]	65-74	75-84	Total[a]
Standardized direct effects	Social interactions→Healthy lifestyles	0.36	0.39	0.36	0.45	0.41	0.45
	Social interactions→ Physical functions	0.15	0.22	0.17	0.15	0.25	0.18
	Healthy lifestyles→ Physical functions	0.38	0.38	0.40	0.32	0.41	0.40
	Social interactions→Healthy life	0.14	0.23	0.16	0.16	0.17	0.17
	Healthy lifestyles→Healthy life	0.30	0.21	0.29	0.15	0.13	0.15
	Physical functions→Healthy life	0.51	0.68	0.58	0.65	0.80	0.72
Standardized indirect effects	Social interactions→→Healthylife	0.26	0.33	0.29	0.26	0.39	0.33
	Healthy lifestyles→→Healthylife	0.19	0.26	0.23	0.21	0.33	0.29
Standardized total effects	Social interactions→→→Healthylife	0.39	0.56	0.45	0.42	0.56	0.50
	Healthy lifestyles→→→Healthylife	0.49	0.47	0.52	0.36	0.46	0.44
	Physical functions→→→Healthylife	0.51	0.68	0.58	0.65	0.80	0.72

Total [a]:indicates the effects by gender (male & female)

→: direct effect

→→: indirect effect

→→→: total effect

model also showed social interaction 2001, healthy lifestyle 2004 and physical function 2004 were positively and strongly related to healthy life 2004. In addition, whether structural relationships were direct or indirect were revealed: physical function 2004 had a direct impact on healthy life in the same year; healthy lifestyle 2004 had not only a direct effect on healthy life 2004, but also affected healthy life indirectly via physical function 2004; Social interaction 2001 not only exerted direct effects on healthy life of the elderly, but also demonstrated an indirect effect by the means of both healthy lifestyle and physical function in 2004.

On the basis of age and gender, four elderly groups were compared with each other. The standard direct and indirect effects of social interactions, healthy lifestyles and physical functions on healthy life by age and gender were shown in Table 2. With respect to direct effects, physical function exerted much more influence on healthy life among older elderly people (0.68 for males and 0.80 for females) and females (0.72). The direct effects of social interaction on healthy life were more significant in older elderly (0.22 & 0.25) than younger elderly (0.15 & 0.15). Similar to direct effects, the indirect (0.33 & 0.39) and total effects (0.56 & 0.56) of social interaction on healthy life were also more pronounced in older groups. Concerning healthy lifestyles, both the direct and total effects on healthy life were greater among males than females. In decreasing order, the standard regression coefficients of direct effects were 0.30 for younger males, 0.21 for older males, 0.15 for younger females, and 0.13 for older females.

4. Discussion

Based on this large-scale cohort study of community-dwelling elderly in Japan, healthy life in 2004 was well explained by social interaction in 2001, healthy lifestyle in 2004 and physical function in 2004. In conjunction with other related factors of healthy life, physical function exerted much more influence in accordance with the standard coefficient of total

effects. In Nakazawa et al., an inverse relationship was established between physical function levels and mortality in institutionalized elderly adults of Japan6). In the present study, after adjusting for age, gender, social interaction, and lifestyles, less physical limitation still could obviously decrease mortality risk among urban non-institutionalized elderly people of Japan. As noted by Manton, higher mortality often occurs in disabled individuals[34].

Additionally, physical function in 2004 directly affected healthy life in the same year, whereas social interaction in 2001 and healthy lifestyle in 2004 exerted not only direct effects on healthy life in 2004, but also indirect impacts via physical function in 2004. This indicated that social interaction was the basis of the structure: high levels of interaction with society could provide elderly people with access to information about health and health-care services, and chances to go outdoors into the life-space, thus leading to a more favorable healthy lifestyle, protecting against declining physical functionality, and resulting in a healthy life. This finding confirmed 'Activity Theory' raised by Robert J. Havighurst in the early 1960s, which outlined that successful aging occurs when the elderly maintain social interaction actively. Successful aging consist of not only health, but also good relationships with society. Therefore, people with high levels of interaction may live longer, but this may not be directly due to positive interaction but due to protective health behaviors and functional maintenance. The findings were consistent with the conclusions found in Liu et al.[35]. They suggested that socio-demographic factors (age, gender and education), social relationships and health behaviors associated with active life expectancy among elderly Japanese persons between 1987 and 1990. In spite of different indicators and survey periods, similar conclusions were acquired among Japanese elderly people. However, their sample was limited, just 1,671, over three years, and failed to examine the co-variation and the extent to which social interactions may protect against death, failed to compare the age- and gender-related differences as well. In this study, four subgroups were compared with each other on the basis of age and gender to determine the similarity and dissimilarity. Allowing for education which has related to disability and mortality, the consideration of the effects of socio-economic factors on healthy life are required in future studies.

Social interaction served different functions for men and women, younger elderly and older elderly. With regard to standard total effect of physical function on healthy life, it was much greater in older elderly groups than younger elderly groups, and greater in females than males. In the view of Sauvaget, Tsuji, Aonuma and Hisamichi, men suffered disability at a younger age and died earlier, while women experienced a slow progress and longer duration in a disabled state in Japan due to longer life expectancy[36]. That is why maintenance of physical function is of capital importance for older elderly and females.

Regardless of standard direct, indirect or total effects, social interaction had the biggest impact on healthy life in older elderly groups. According to the 'Disengagement Theory' raised by Blaine Cumming and William E. Henry in 1961, with an increase in age, older adults may break away from society due to a decline in ability and the loss of social roles: they do not have to deal with heavy housework or take care of grandchildren, leaving them with much more leisure time. Consequently, the older an individual gets, the lonelier they would feel[37]. This was why the effects were particularly noticeable in the older elderly subgroup: they required more social contact than the younger subgroup, to increase their social interaction level and help them build new social roles for themselves. Furthermore, social participations provided elderly people much more chance going out. To some extent, it can promote their physical exercises.

5. Conclusions

This study investigated the relationships between social interaction, healthy lifestyle, physical function and healthy life in Japanese community-dwelling elderly over a six-year period. Among these factors,

social interaction was found to be the core: besides direct effects, it also demonstrated indirect effects by means of healthy lifestyle and physical function, and indicated that high levels of social interaction may lead to a more favorable lifestyle and improved physical function, resulting in a healthy life. In other words, social interaction may reduce the risk of becoming disabled or dead. In fact, people who interact with society actively can live longer, because indirect effects of healthy lifestyle other than direct effects of social interaction. Functional limitation confers additional risk for death. Thus, death was considered as a logical extension of limited physical function. In summary, healthy people should have the ability to supervise others (active engagement in society) and to manage themselves (high functioning), even at an advanced age. What's more, gender or age had only indirect effects. The maintenance of physical function was determined to be particularly vital among older elderly and females, and the effects of a healthy lifestyle were much more pronounced in males than in females. The older elderly were found to be more influenced by social interaction levels than the younger elderly group. Health will be not perceived as something which should be protected, but rather as something which could be produced, by active interactions and appropriate lifestyles. Accordingly, if changes are made in potential risk factors, early prevention may be possible before functional disability, thus reducing the risk of mortality and the burden of caregivers.

Several distinguishing features of this study were: 1) a long period and large-scale follow-up survey provided a unique opportunity to explicate the structure between social interaction and healthy life among urban Japanese elderly; 2) it was found that changes in social interaction and lifestyle that lead to a healthy life are feasible through individual efforts; 3) the results may be popularized to urban general populations aged 65-84 due to the non-specific research population. Future study is needed to better understand among those aged 85 and over. As a next step, the influence of socio-economic factors, such as education and income, which would result in health disparity among the survey sample, also should be considered and analyzed.

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